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Understanding the Process of Innovation Adoption in 12 NHS trusts – technology selection, procurement and implementation to help reduce HCAIs

Report Commissioned by the Department of Health

Centre for Infection Prevention and Management, Imperial College London

20 September 2010

Executive summary

Introduction

This study was commissioned by the Department of Health (DH) and looks at 12 trusts, recipients of the 'DH Health Care Associated Infection (HCAI) Technology Innovation Award for outstanding contributions to fighting infections 2009' (HCAI Technology Innovation Award). The award sum was £150,000 for each Strategic Health Authority (SHA) regions. The award was split equally amongst three trusts in one of the SHA region. Hence nine trusts received £150,000 each, and three received £50,000 each in February 2009. The trusts were given free reign to use the award to procure technologies that could help reduce HCAIs. The trusts were nominated by each SHA on the basis of having excelled in either turnaround or "best in class" concerning infection prevention performance in the fiscal year 2008/9.

The award was given as part of the DH's HCAI Technology Innovation Programme which aims to speed up the development and adoption of new technologies that could help combat HCAIs, particularly MRSA and *C. difficile.* The Programme was launched in January 2008, is being run by the Department of Health in collaboration with the NHS[1] and comprises several work-streams including: Smart Ideas, Showcase Hospitals, Design Bugs Out, Smart Solutions, Product Surgeries[2]

Whilst a number of technologies exist to address HCAIs and a number of programmes are in place to facilitate innovation adoption, overall, the NHS has been a slow adopter of innovative technology. This award provided an invaluable opportunity to add to learning about the adoption of technologies in the area of Infection Prevention and Control (IPC).

Study objectives

The aims of this study are to understand the impact of differing organisational capacity and contextual circumstances on technology selection, the subsequent procurement and implementation of the technologies.

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[1] HCAI Technology Innovation Programme was formally acknowledged in the DH HCAI strategy for 2008 - "Clean Safe Care" – chapter 6: *http://www.clean-safe-care.nhs.uk/ArticleFiles/Files/CleanSafeCare_ReducingInfectionsAndSavingLives_Strategy.pdf*
[2] http://www.clean-safe-care.nhs.uk/ArticleFiles/Innovations/HCAI_TechnologyProgrammeOverview.pdf

The   study of each trust covered three distinct phases of technology adoption:

(a) decision making: focusing on aspects such as how the decision to spend the award monies has been reached, who was involved and what factors affected the choice of technology;

(b) procurement: focusing on issues such as the ease and process of procurement;

(c) adoption: focusing on implementation issues and measures of 'success'.

The scope of this study does not include technology impact evaluation on trust HCAIs.

Methods

We employed a case study research design with each trust and technology as units of analysis. The sample as described above was predefined with one attribute in common as recipients of the HCAI award. We followed the processes of decision making, procurement and implementation, up to August 2010 for each technology and then carried out a cross case analysis to illicit learning from these processes. The research methods were qualitative, with primary data collection using a semi-structured interview schedule. Interviews were face to face at two or more data collection points. Telephone interviews and electronic interviews were used to gather data on progress between field visits. Secondary data sources, including trust and DH reports and other sources of performance data such as the Health Protection Agency (HPA), Monitor and Care Quality Commission were used to understand the context. We conducted over 100 interviews across the 12 trusts from July 2009 to August 2010, with clinical and non-clinical managers, members of trusts' executive boards, health professionals including nurses, doctors (within IPC and general ward staff involved in the implementation of the selected technologies), clinical biochemists, clinical microbiologists, and staff from domestic services, estates and facilities departments.

The data was analysed using an integrated approach[3]. Such an approach employs both an *"inductive or ground-up"* development of codes as well as a *"deductive organising framework as a start-up list"* (Bradley et al, 2007: 1762). As a conceptual organising analytic device we employed the conceptual framework for the adoption of complex health innovations previously employed to understand multi-level innovation adoption[4]. This approach focuses on contextual

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[3] Bradley et al, (2007) Qualitative Data Analysis for Health Services Research: Developing Taxonomy, Themes, and Theory. Health Services Research 2007 August; 42(4): 1758–1772

[4] Atun, R.A. Kyratsis,I., Jelic,G., Rados-Malicbegovic, D & Gurol-Urganci, I. (2007) Diffusion of complex health innovations - implementation of primary health care reforms in Bosnia and Herzegovina, Health Policy and Planning

factors; (1) attributes of the innovation (2) attributes of the adopter, (3) the communication of these attributes through various media, and (4) the role of individuals, teams, professional groups and organisations in the adoption process. At the same time a more "ground-up" coding was also applied, enabling themes under the above four broad conceptual domains to emerge as well as independent themes.

Figure 1: A Conceptual Framework for the Adoption of Complex Health Innovations
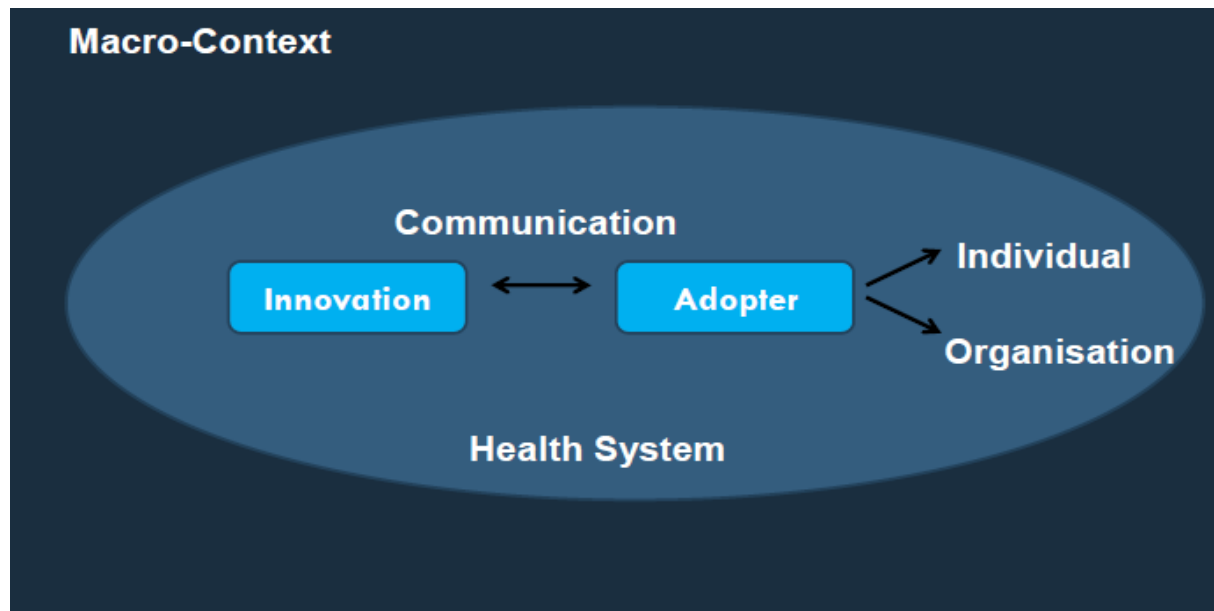
Findings

1   Technologies selected and IPC priority areas

1.1.1   Across the 12 trusts a total of 38 technology selections were made of 34 different technologies. The majority of trusts (nine) selected three or more individual technologies. Two trusts used the award to procure one technology. The selected technologies spanned the full range of IPC priority areas, with technologies to address environmental hygiene being most common.

1.1.2. Of the 38 technology selections 15 selections of products with a 'Rapid Review Panel Recommendation 1' (RRP 1) at the time of the award, were made[5][6].

Ten trusts had previously adopted one or more RRP 1 products with two trusts having implemented all six RRP 1 products

Figure 2 Selected technologies by IPC priority area
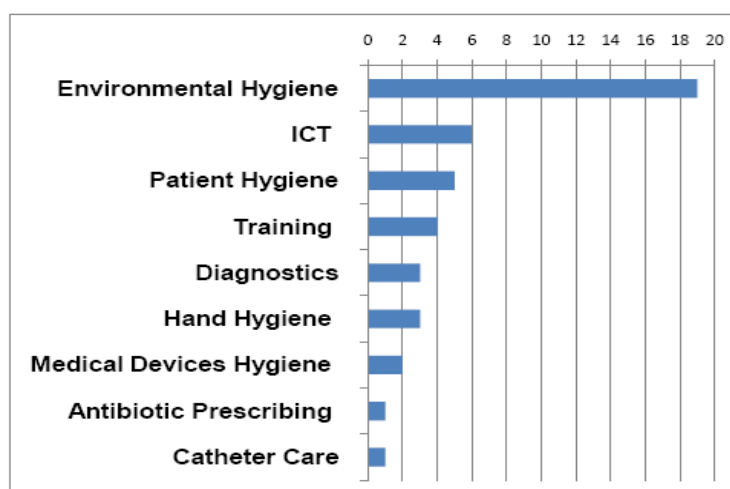
2   Key considerations in technology selection

Whilst we present here separately the themes which emerged under the broad categories of our framework, interactions between the dimensions have consequences for adoption success.

2.1   Attributes of the technology

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[5] The Rapid Review Panel (RRP) is an independent arms-length review panel convened in 2004 by the Health Protection Agency (HPA) at the request of the DH. The panel provides a prompt assessment of new and novel equipment, materials and other products or protocols that may be of value to the NHS in improving hospital infection control and reducing HCAIs. www.clean-safe-care.nhs.uk

[6] An RRP 1 rating is defined as a product for which 'Basic research and development, validation and recent in use evaluations have shown benefits that should be available to NHS bodies to include as appropriate in their cleaning, hygiene or infection control.

RRP 1 products as at February 2009: Bard BARDEX® I.C silver alloy catheter; 3M Clean-Trace™ ATP Hygiene Monitoring system; BIOQUELL Hydrogen Peroxide Vapour (HPV) Decontamination System; Enturia Ltd ChloraPrep; ConvaTec Flexi-Seal® Faecal Management System (FMS); Zassi™ Bowel Management System®

2.1.1 Innovativeness: Innovativeness was considered a combination of the 'hardware' and 'software' associated with the technology. Some trusts used simple technology 'hardware' (material tool) with new 'software' (processes and practices) and viewed the **concept** to be the innovation rather than the technology 'hardware' in isolation.

"I'm not quite sure how they'll [DH] take it because it's not exactly high tech...it's not...what someone would call innovative. It depends in which way you look; I look upon it as being innovative. A lot of people out there might not, but I think it's the whole, it has to be sold on the whole concept, with the whole package" [Trust 1; Urinary Catheter Packs].

Within this, technologies were considered according to their newness to the NHS sphere. Few trusts aimed for 'radical' or 'cutting edge' technologies in the NHS context, with the majority of selected technologies being new for their individual trusts. This perhaps reflects the abundance of new technologies in the realm of HCAIs which have been expedited through the various DH HCAI Technology Innovation Programme workstreams.

Each of the adoption studies needs to be taken within the context of recent technology adoption within each trust. There is variation in innovation history of trusts which influenced how newness of the technologies was approached by trusts.

2.1.2 Cost: Cost considerations made in selecting technologies were around the short –term and long-term costs. High running costs were the main financial considerations as the award was one off. Trusts used three main strategies to maximise this funding opportunity: (a) by selecting high cost technologies that would have been unfeasible without the award; (b) by procuring technologies with low on-costs for sustainable solutions; (c) by selecting a number of different technologies to allow local trial within the trust to inform future procurement decisions. Whilst business cases were made for some of the technologies, demonstrating short-term cost-effectiveness was a challenge for some technologies:

"Well, when you talk about cost, we talk about different levels of cost... if you take a price

*per test [PCR Norovirus] it's more expensive [to do it in-house]; but if it reduces your closed bed days, your ward closures by 48 hours, then there's no comparison because however much that costs,…**overall** it will reduce the cost but it'll cost more for the department* [Trust 2; Microbiologist]

2.1.3. Effectiveness: Evidence of effectiveness of technologies was considered for each of the 38 technology selections. However the sources of evidence and definitions of effectiveness varied. The main sources of evidence used were peer reviewed literature, technologies in use in other trusts, professional networks, supplier information, the Rapid Review Panel rating of technologies, and central DH's HCAI Technology Innovation Programme initiatives. The fact that a product had received an RRP 1 from the HPA was deemed by some trusts to constitute 'evidence' of effectiveness. Others looked for findings from the Showcase Hospital evaluations, and others felt both recommendation and evaluations to be inadequate evidence. On definition of effectiveness, this ranged from local opinion including patient perceptions, ease of use by staff, to controlled trials data. Many trusts noted that for these technologies, no particular technology could be solely or directly attributable to reducing HCAIs. Impact was attributable to ongoing multifaceted approaches. Four trusts viewed this funding opportunity to specifically develop methodologies to evaluate the technology interventions. Nine trusts intended to write up findings for wider dissemination. One trust appointed a research nurse to manage the implementation and evaluation process.

2.1.4 Types and sources of knowledge: On wider knowledge sought in making decisions we mapped to three types of knowledge required to make effective innovation adoption decisions[7] [8] [9]; awareness knowledge, principles / theory knowledge, and 'how to' knowledge. Overall the 'how to' knowledge was given less priority when compared to the other types of knowledge and this had implications for implementation. Practical issues such as requirements for dedicated fixed power supplies for technologies and hidden costs for replacement parts became apparent after procurement in those cases where

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[7] Rogers, E (2003) Diffusion of Innovations 5th Edition, Free Press
[8] Glasby, J. and Beresford, P. (2006) Who knows best? Evidence-based practice and the service user contribution, Critical Social Policy, 26(1), 268-284
[9] Walshe, K., (2009), "Pseudoinnovation: the development and spread of healthcare quality improvement methodologies." International Journal for Quality in Health Care, 21(3): 153

'how to' knowledge had not been adequately sought.

2.2 Attributes of the adopter & context

2.2.1 Trust size: The trust size and the size of the core IPC team had a greater impact on the *process* adopted by the trust in making the technology selection decision rather than the technology type. For example, none of the larger trusts (with sizeable IPC teams) consulted with staff outside of the core IPC team to generate ideas for consideration. Conversely, smaller in size trusts with small IPC teams relied more so on the cooperation of directorate/ward staff for generation of ideas and technology implementation.

2.2.2 PFI sites: PFI status was seen as a barrier by two of the trusts. Specifically, Hydrogen Peroxide Vapour Decontamination System was discounted by one trust as this would have implications for PFI contracts requiring expensive adjustments. The same technology was discounted by another trust because the PFI provider had raised concerns of the technology causing damage to buildings in the long term. However, other PFI sites in our sample had adopted the technology previously. These trusts attributed the relationship with the contactors being conducive to joint working and raising quality. In addition, with the exception of one trust, PFI status did not impact on decision making when the technology was procured as a fully managed service, which implied minimal training or involvement of the PFI personnel. Other options needed to be considered by one trust for hand signage, due to PFI considerations.

2.2.3 Ability to evaluate: Across the cases, but particularly in the teaching trusts, the 'ability to evaluate' the technology impacted on technology selection. Three teaching / university affiliated trusts had interpreted the purpose of the award to be specifically for evaluating technologies. The potential for evaluation may be considered as an attribute of the technology or of the adopting context. Difficulty to evaluate was a barrier to adoption in some cases.

2.2.4 **Pro-innovation culture:** Across the trusts there were a range of trust-wide programmes to encourage innovation across disciplines. The extent to which IPC teams were engaged with these wider activities varied. Whilst this pro-innovation culture was largely a positive influence, there were instances of disjointed efforts. Cross-departmental collaboration is essential, especially if innovations are to be rolled out trust-wide. For example in Trust 10, the Intensive Care Unit team already had invested in a Faecal Management System, however the IPC team selected another similar system with essentially the same functionality as were unaware of this previous procurement.. ; This gives rise to duplication of training, inconsistencies and issues of compatibility for staff and patients. Pro-innovation was consistent with a non-blaming open and honest culture. For example, in Trusts 5 and 11 support staff were confidently able to monitor all staff for 'bare below the elbows', whilst in other trusts nurses did not feel able to raise this issue with doctors.

2.2.5 **Professional groups and evidence:** By considering the interplay between technologies and adopters across various professional and functional groups within the trusts we identified that the same technologies had been defined and interpreted differently by dissimilar categories of adopters. The perceived benefits and weaknesses of the technologies reviewed by the trusts, as well as the 'evidence' supporting them and the sources and type of evidence sought varied across adopter categories. For instance, clinical microbiologists and clinical matrons or infection control nurses looked at the same technologies differently and made dissimilar judgments about the value of specific technologies, or valued dissimilar sources and types of evidence. Professional training, experience and role, as well as personal interests of adopters all shaped technology selection decisions across the trusts studied.

2.2.6 **Leadership roles:** Differing views of leadership roles and professional training of decision makers also influenced selections made. For example in Trust 1 and Trust 10, though of similar professional training, the Directors of Infection Prevention and Control (DIPCs) adopted very different leadership roles in the decision making process. In Trust 1, the DIPC was clear about differentiating her role as a manager from her professional training as a microbiologist. In Trust 10, the DIPC felt that this management role was

only possible as a medical microbiologist.

"I'm a microbiologist by background but, and this is something that I learnt right at the beginning when I took on this post, when you actually become a clinical manager or a clinical leader you have to drop your knowledge of your own...because that professional background starts interfering... I think that is important for clinicians who become either leaders or managers of any sort, that they really have to let the expert professionals guide and say, this is what we need to do, and the role of the manager or leader is just to facilitate"
(Trust1)

"We do get a lot of brochures through the post, and they do send them to the wrong people as far as they get to the Chief Exec and get to the Chief Nurse, and they just all look wonderful, and I think it's a real, real problem for trusts that perhaps have a DIPC who's not a microbiologist, [to have the expert knowledge to judge for the validity of technology effectiveness claims / evidence]"
(Trust 10)

2.3 The communication process

2.3.1 **Communication:** The approach, methods and actors involved in communication during the decision making and implementation processes was important. For example, a 'champion' for an individual technology emerged in the majority of cases and facilitated the implementation phase. Communication approach varied from 'top down' cascade of information to 'peer mediated', "grassroots spread" of new technology information among users through 'word of mouth and trial and error learning'. The latter approaches heightened feelings of ownership by users and led to swift and efficient technology implementation, particularly evident in the adoption of hygiene monitoring and Ultra Violet light technologies by housekeepers in Trust 11. Communication forms varied from formal presentations by manufacturers to informal expert opinion sought by various stakeholders during decision making and implementation. Trust internal communication

of the process was seen as an opportunity to raise the profile of IPC. Communicating effectively the rationale for technology selection, (including results of any evaluations) and the implementation strategy to key people, who are involved in or can influence implementation, facilitated staff engagement. The use of existing trust forums for such communication efforts streamlined information flow across the trust. Informing patients and the public about adopting innovative technologies was deemed a useful tool for raising the profile of trusts and facilitating patient involvement, but was lacking in the majority of cases. For example, Trust 7 did not invest in patient communication activities and in retrospect realised that patients 'took the new technologies for granted' and did not appreciate the extra effort and resources invested by the trust. In contrast, Trust 11 invested significantly in patient communication when introducing the individual patient MRSA decolonisation packs. This resulted in high patient involvement, and better informed patients and as reported by staff, less patients blaming the hospital for catching MRSA .

3   Learning from the decision making process

3.1   Who was involved?   The approach to decision making varied in terms of who was involved within and outside of the core IPC team. Decisions were either highly exclusive to the core IPC team or inclusive of the wider trust. IPC leadership approach, and size of trust were strong factors in which process was adopted. Support by senior management in the trust, at the point of decision making facilitated implementation by mobilising resources and providing increased legitimacy to the initiatives. Early involvement of the intended technology users in the decision making process helped to obtain user 'buy-in'. Early engagement of frontline clinical staff and technology users in decision making also led to feedback to suppliers. For example, in Trust 8 feedback from consultants resulted in appropriate procurement of computer devices consistent with working practices as well as compliant with infection prevention guidelines. In addition, the presence of an IPC matron in the core decision making team facilitated communication and ensured high levels of cooperation by ward matrons with significant positive implications for implementation. An example of excluding relevant stakeholders is hotel services personnel being excluded in the design and testing of the ATP Hygiene Monitoring system, which would have potentially saved time and effort for training during

the trust-wide roll out of the technology.

3.2 **When was the technology first considered?** For some trusts preparatory work for technologies considered before the award informed decision making whilst others viewed the award as a starting point. We identified technologies predetermined before the award and those emergent after the award notification.

Extremes in approaches had definite strategic or cultural reasons underpinning the approach. For example one trust with a highly 'predetermined' and 'exclusive' approach was guided by an identified IPC priority area. The trust with the most inclusive approach to decision making reflected the trust's culture and leadership style.

4   Learning from the procurement process

4.1 **Procurement frameworks or direct to supplier:** For the trusts which used the NHS Supply Chain (all when the product was available) or other national procurement frameworks; procurement was described as smooth and efficient. For the remainder of products all technologies were procured direct from the supplier and knowledge of regional procurement frameworks was weak.

4.2 **Involvement of trust procurement teams:** Procurement Action Groups or similar models were found in the majority of the trusts. However involvement of the procurement team varied, from up front and early involvement to delayed involvement. Consistently, where procurement links were made late, the process was protracted as important considerations had been overlooked. Late involvement was due to inexperience of IPC individuals in procuring products, or the perception that the procurement team would act as a barrier to adoption. This is another example of insufficient attention to 'how to' knowledge.

Those trusts facing particularly hard financial constraints involved procurement earliest, and viewed this expertise as a facilitator to innovative practice.

5   Enablers and barriers to implementation

5.1   Capacity: Consistently the biggest barrier encountered during implementation was lack of staff capacity within IPC and also trust-wide in intended implementation wards / units. Many trusts commented on the short notice of the award having an impact on decision making. For example where decision making and procurement were not completed until early winter, the window for implementation of certain technologies was missed due to winter pressures compounded by flu outbreak. Implementation therefore was delayed until late spring / summer in these trusts. Adopting and implementing innovative technologies was an additional task on top of routine operations which stretched the trust innovation co-ordinator; the impact was higher on trusts with small IPC teams.

5.2   'How to' knowledge: The second significant barrier, above any structural or cultural barriers to implementation which emerged was insufficient attention to the 'how to knowledge'. Where detailed implementation plans had been formulated addressing this area and had been discussed with the supplier, managers in implementing units and technology users within the trust, implementation followed smoothly. None of the trusts reported resistance by staff and this may be attributable to consistency of the decision making processes with organisational culture.

5.3   The regulatory framework: In the context of the project the regulatory framework within the specified area (HCAI) was a strong enabler for the adoption of innovative technology, as HCAIs are high on the agenda both trust-wide and nationally. However, there were conflicts with other regulations / national performance targets for the trusts which raised barriers to technology adoption and implementation. For example admitting patients within four hours in A&E created tension with the need to test for MRSA.

5.4   Implementation plans: Optimum implementation occurred when relevant involvement of actors and consideration of implementation at the point of decision making was made,

coupled with well structured and managed implementation plans. Early engagement of frontline clinical staff and technology users in decision making led to technology modification and adaptation to fit the local context at implementation stage. Early engagement and regular steering of the process by a core group of managers, responsible for the service areas, facilitated the implementation process. Cross departmental team working, champions and endorsement from senior management were evident to varying degrees across the trusts, but all helped implementation.

5.5 **Learning through training:** Training was in some cases underestimated particularly where the technology was viewed as incremental (versus radical) and / or 'simple' and 'focal' (versus complex and multifaceted). For example, in Trust 7 introduction of single use patient admittance packs would have been smoother with better induction and training of staff. In addition training intentions were sometimes not realised due to staff capacity constraints, for example pressures on ITU staff in Trust 1 meant that training was delayed. Learning from previous technology adoption particularly in conducting evaluations was a valuable resource for IPC teams.

5.6 **Technology – adopter interface:** Technologies which consist of many components or processes involving a high number of diverse stakeholders appeared to be more complex and demanding during implementation. For example, the aim to diversify users involved in diagnostics to widen access to MRSA testing failed. In Trust 2, ward based, matron-led diagnostics was aborted due to incompatibility with roles and workload. The trust reverted to technology adoption in the microbiology laboratory.

5.7 **Technology – strategy fit:** Fit of the technology with the IPC strategy of the trust allowed for sustainable investment in the particular technology. The trust anticipated the benefits of the technology to be amplified over time as the technology evolves. This approach was taken to allow for synergies with other technology investments made by the trust and create complementarities. One such example is Trust 3 investing in a trust-wide IT surveillance system. The aim here was to monitor HCAI trends and hotspots to areas and teams, thus identifying future IPC 'technology needs'. Fit with wider trust

strategy was demonstrated in Trust 6, with use of the trust-wide Information Management platform, and development of a module specific to IPC consistent with the prevailing system.

5.8 **Enabling Technologies:** Pre-existing or co-adopted technologies facilitate implementation of new technologies by resolving issues of structural compatibility. For example, the introduction of the Patient Group Direction protocol facilitated the trust-wide standardisation and subsequent implementation of individual patient MRSA packs in Trust 11. The adoption of a universal adapter prior to the introduction of the disposable BP cuffs and SpO2 sensors in Trust 7 provided for structural compatibility irrespective of the type and brand of monitors and enabled the rolling out of the disposable packs to all trust wards. In Trust 6 wireless technology created an enabling environment for portable laptops for real-time data capture and monitoring.

6. Key Learning

In summary our key learning for stakeholders in the innovation landscape in addressing HCAIs, which are generalisable to innovation adoption across the NHS, are as follows:

6.1   For trusts

- Early involvement of the trust procurement team is essential to ensure effective and sustainable innovation decisions.
- Coordinating activities across in-house innovation programmes can promote locally relevant learning and avoid duplication. Organisational learning will be important to inform future adoption decisions.
- Encouragement and support for staff to visit other NHS Trusts and attend specialised conferences / workshops is important. In conjunction with staff participation in professional forums/networks exposure to innovation dissemination events encourages knowledge exploration and exploitation of such knowledge by trusts.
- Dedicated funding and time for training is important.

6.2   For IPC

- Understanding the 'how to' knowledge through appropriate channels requires as much investment as is currently given to the 'principles / theory knowledge'. Identifying appropriate individuals to obtain this knowledge is critical.
- IPC is evolving from a highly technical service to one that requires a more strategic and general management approach. This also needs to be reflected in how adoption decisions are made, who is involved, and implications for implementation need to be considered early on.

6.3   For industry/suppliers

- Providing 'how to' knowledge alongside principle / theory knowledge appropriate to staff who will be using the technologies is important to successful adoption. This includes appraising the adopting environment for structural compatibility.
- Work with national and trust procurement to create sustainable solutions.

6.4   Future research

- Longitudinal research of technology adoption in NHS trusts will build on and complement previous work such as the Showcase Hospitals work stream. Such studies will provide learning beyond the trialling and short-term implementation of technologies, focussing on technology routinisation and sustainability.
- Effective procurement models and processes are central to the technology adoption process. However this process requires deeper exploration and understanding.
- Use of theory based analysis is important to provide meaningful and generalisable learning of innovation adoption.

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1. INTRODUCTION

1.1 Background to the Project

Infection control is one of the biggest challenges facing the NHS today. In England 8.19% of all patients within the NHS acquire an infection (Smyth et al, 2008). The reporting of MRSA blood stream infection and C. *difficile* are mandatory and there are national and local targets for reduction. New technologies and products have the potential to make a real difference in reducing levels of Health Care Associated Infections (HCAIs). Despite the significant health and financial impact and the availability of 'evidence based' technologies and interventions, such innovations are not always adopted. A prime example of the 'evidence-practice gap'. Although a number of programmes are in place to facilitate innovation adoption, the NHS has been a slow adopter of innovative technology. In addition to identifying those products which work best, as the Department of Health (DH) is doing through its HCAI Technology Innovation Programme, there is also a need to ensure that once identified, effective new methods and technologies are adopted and disseminated widely across the NHS.

In healthcare organisations adoption of innovations into daily practice and their diffusion do not occur readily, or in a linear manner, even when benefits are backed by robust evidence. This may be due to a variety of contextual, health system, organisational and professional factors. Understanding these factors is key for organisational success in addressing complex challenges, such as infection prevention and control, but it is also essential for improving the dissemination of effective new technologies in all areas of healthcare.

Initiatives informed by simplistic situational analysis may experience resistance, as the most important causes of resistance to the uptake and assimilation of innovations are overlooked. This research aims to address this knowledge gap.

1.2 Project Overview – Research Setting

This study was commissioned by the DH and looks at 12 trusts, recipients of the 'DH Health Care Associated Infection (HCAI) Technology Innovation Award for outstanding contributions to fighting infections 2009' (HCAI Technology Innovation Award). The award sum was £150,000 for each Strategic Health Authority (SHA) region. The award was split equally amongst three

trusts in one of the SHA regions. Hence nine trusts received £150,000 each, and three received £50,000 each in February 2009. The trusts were given free reign to use the award to procure technologies that could help reduce HCAIs. The trusts were nominated by each SHA on the basis of having excelled in either turnaround or "best in class" concerning infection prevention performance in the fiscal year 2008/9.

The award was given as part of the DH's HCAI Technology Innovation Programme which aims to speed up the development and adoption of new technologies that could help combat HCAIs, particularly MRSA and *C. difficile.* The Programme was launched in January 2008, is being run by the DH in collaboration with the NHS[10] and comprises several work-streams including: Smart Ideas, Showcase Hospitals, Design Bugs Out, Smart Solutions, Product Surgeries[11]

1.3 Aims and Objectives of the Research

The aims of this study are to understand the impact of differing organisational capacity and contextual circumstances on technology selection, the subsequent procurement and implementation of the technologies.

The study of each trust covered three distinct phases of technology adoption:
  (a) decision making: focusing on aspects such as how the decision to spend the award monies has been reached, who was involved and what factors affected the choice of technology;
  (b) procurement: focusing on issues such as the ease and process of procurement;
  (c) adoption: focusing on implementation issues and measures of 'success'.

The scope of this study does not include technology impact evaluation on trust HCAIs.

1.4 Layout of the report

This report is organised into 17 chapters. After the introduction, we present the research

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[10] HCAI Technology Innovation Programme was formally acknowledged in the DH HCAI strategy for 2008 - "Clean Safe Care" – chapter 6: *http://www.clean-safe-care.nhs.uk/ArticleFiles/Files/CleanSafeCare_ReducingInfectionsAndSavingLives_Strategy.pdf*
[11] http://www.clean-safe-care.nhs.uk/ArticleFiles/Innovations/HCAI_TechnologyProgrammeOverview.pdf

methodology. Chapter 3 provides an overview of the technologies selected by the 12 trusts. The individual case studies for each of the trusts follow from Chapters 4 to 15. Within the individual cases we present some contextual information for the trust, and then look at each of the selected technologies in turn. In Chapter 16 we synthesise main findings of the cross case analysis. We conclude this report with implications in Chapter 17. The appendices include additional information regarding methodology. In keeping with consent for this research, the trusts are not named.

2. METHODS

We employed a case study research design with each trust and technology as units of analysis. The sample of trusts was predefined with one attribute in common as recipients of the HCAI award. We followed the processes of decision making, procurement and implementation, up to August 2010 for each technology and then carried out a cross case analysis to illicit learning from these processes. The research methods were qualitative, with primary data collection using a semi-structured interview schedule.

Our overarching framework to study the processes is illustrated in **Figure 3** and discussed in section 2.1.4 below.

Figure 3: A Conceptual Framework for the Adoption of Complex Health Innovations
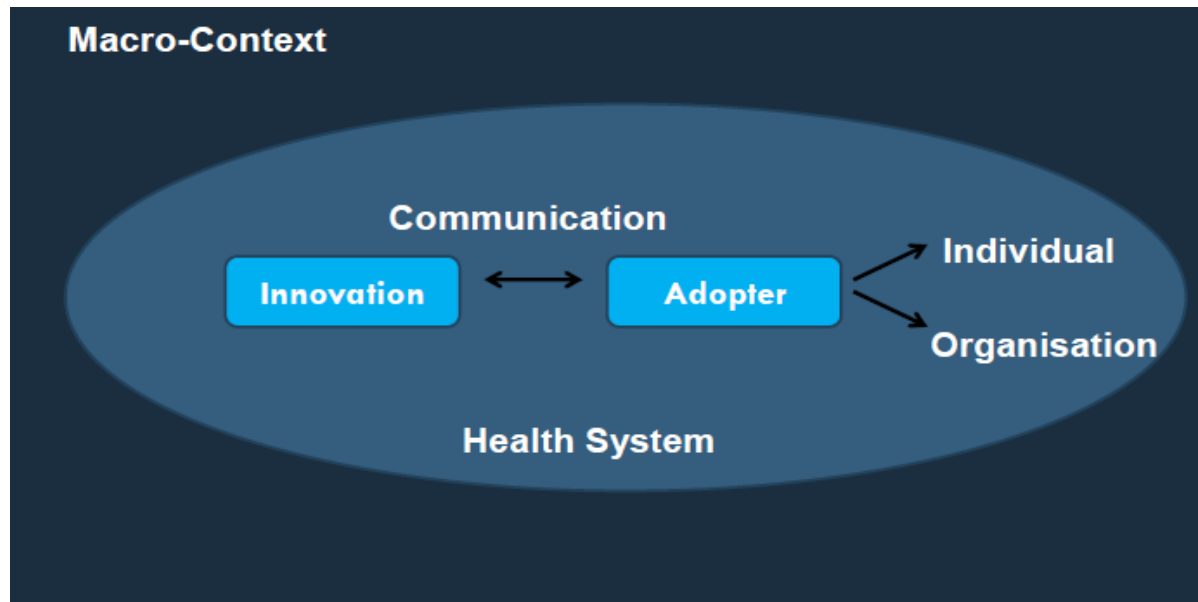
2.1 Data Generation Collection

2.1.1 Data Sources

We used trust annual reports, websites and newsletters as secondary data sources. In addition we accessed government regulatory and monitoring frameworks including Health Protection Agency, Care Quality Commission, and Monitor.

2.1.2 Primary Data Sample

Access to the trusts was via the DH in the first instance through an introductory letter. The internal trust project lead and IPC teams then facilitated access to those involved in the decision making, procurement and implementation of the selected technologies. Interviews were face to face at two or more data collection points. Telephone interviews and electronic interviews were used to gather data on progress between field visits. We conducted over 100 interviews across the 12 trusts from July 2009 to August 2010. Our sample included clinical and non-clinical managers, members of trusts' executive boards, health professionals including nurses, doctors (within IPC and general ward staff involved in the implementation of the selected technologies),

clinical biochemists, clinical microbiologists, and staff from domestic services, estates and facilities departments.

2.1.3 Data Collection and Management

Our primary data was generated through face to face interviews, email progress reports and telephone interviews. This data was gathered at the beginning, middle and end of the project. Field work commenced in May 2009 and was concluded August 2010. Data collection and field interviews were conducted by two members of the research team, namely Dr Yiannis Kyratsis and Dr Raheelah Ahmad. Face to face interviews were conducted at trust sites, and were audio recorded. Two respondents declined consent to record the interview and the researchers took hand notes.

A semi-structured interview schedule was used for the field visit interviews (Appendix 1 Interview topic guide), with more structured questions in follow up interviews. This allowed emergent themes to be compared across the trusts. All interviews were transcribed and stored with a unique identifier maintaining confidentiality of research respondents.

2.1.4 Data Analysis

The data was analysed using an integrated approach[12]. Such an approach employs both an *"inductive or ground-up"* development of codes as well as a *"deductive organising framework as a start-up list"* (Bradley et al, 2007: 1762). As a conceptual organising analytic device we employed the conceptual framework for the adoption of complex health innovations previously employed to understand multi-level innovation adoption[13]. This approach focuses on: (1) contextual factors, (2) attributes of the innovation, (3) attributes of the adopter, (4) the communication process, and (5) the role of individuals, teams, professional groups and organisations in the adoption process. At the same time a more "ground-up" coding was also applied, enabling themes under the above four broad conceptual domains to emerge as well as independent themes. Transcripts were coded using qualitative data analysis software, Nvivo 8.

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[12] Bradley et al, (2007) Qualitative Data Analysis for Health Services Research: Developing Taxonomy, Themes, and Theory. Health Services Research 2007 August; 42(4): 1758–1772

[13] Atun, R.A. Kyratsis,I., Jelic,G., Rados-Malicbegovic, D & Gurol-Urganci, I. (2007) Diffusion of complex health innovations - implementation of primary health care reforms in Bosnia and Herzegovina, Health Policy and Planning (22), 28-39

3 FINDINGS - OVERVIEW OF THE TECHNOLOGIES

We present here the technologies selected across the 12 trusts. In total 38 technology selections were made with 34 different technologies. We reflect on broad technology selection decisions, as we have grouped together technologies perceived by trusts as comprising one selection. In this taxonomy we have also excluded some specific technologies which were considered by trusts as not representing a 'core technology selection', for example, a fax machine. The breakdown of technology selections per trust is summarised in Table 1.
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Two trusts made one technology selection, while the majority of trusts made three or more. Trust 2 made the maximum technology choices with six technologies. Trusts 8, 11 and 12 selected technologies using an overall budget of £50,000 (the award was split equally amongst three trusts in one of the SHAs), while the remaining nine trusts used a £150,000 budget.

Table 1: Technology Selections per Trust

Trust (Award Funding)	Number of Technology Selections
Trust 1 (£150,000)	1
Trust 2 (£150,000)	6
Trust 3 (£150,000)	1
Trust 4 (£150,000)	3
Trust 5 (£150,000)	3
Trust 6 (£150,000)	2
Trust 7 (£150,000)	4 broad selections (5 specific technologies)
Trust 8 (£50,000)	3 broad selections (5 specific technologies)
Trust 9 (£150,000)	3
Trust 10 (£150,000)	4
Trust 11 (£50,000)	3 broad selections (4 specific technologies)
Trust 12 (£50,000)	5
Total:	**38 broad selections** (42 specific technologies)

In Table 2, we provide a brief description of the 34 different technologies selected, the Infection Prevention and Control (IPC) priority area which each technology seeks to address and the trusts which selected each of these technologies.

The IPC priority areas used to group the technologies have been constructed from various

sources[14] [15] and our own conceptualisation. Some technologies do not fit neatly into one category; however, we provide a broad mapping of areas of investment. For example, the ATP Hygiene Monitoring System may be grouped under 'environmental hygiene' (as an audit tool to monitor environmental cleanliness) and 'training' (as a training aid tool to educate staff and/or the public).

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[14] Weston, D., (2008), Infection Prevention and Control: Theory and Practice for Healthcare Professionals, Wiley-Blackwell
[15] Pratt, R.J., Pellowe, C.M., Wilson, J.A., Loveday, H.P., Harper, P.J., Jones, S.R.L.J., McDougall C., Wilcox, M.H., (2007) epic2: National Evidence-Based Guidelines for Preventing Healthcare-Associated Infections in NHS Hospitals in England, Journal of Hospital Infection (2007) 65S, S1–S64

Table 2: Technologies Overview

Technology description	IPC priority area	Selected
ATP Hygiene Monitoring System **Brand / supplier:** *SystemSURE Plus^{TM}* **/** *Hygiena^{TM}* ATP hygiene monitoring is based on the measurement of Adenosine Triphosphate (ATP), the energy molecule in all living cells. In addition to micro-organisms, the system detects organic residues left on surfaces after cleaning and/or sanitation. The system comprises a handheld luminometer and swabs. It works through collection and quantification of ATP remaining in organic residues post cleaning. The result is given in RLU (relative light units). The product received an RRP Recommendation 1 by HPA (December 2009).	**Environmental hygiene / Training**	**Trust 2** **Trust 10** (selection made prior to award; technology used by trust for comparative evaluation in the scope of this project)
ATP Hygiene Monitoring System **Brand / supplier:** *CleanTrace^{TM} / 3M^{TM}* ATP hygiene monitoring is based on the measurement of Adenosine Triphosphate (ATP), the energy molecule in all living cells. In addition to micro-organisms, the system detects organic residues left on surfaces after cleaning and/or sanitation. The system comprises a handheld luminometer and swabs. It works through collection and quantification of ATP remaining in organic residues post cleaning. The result is given in RLU (relative light units). The product received an RRP Recommendation 1 by HPA (8th January 2008).	**Environmental hygiene / Training**	**Trust 4** **Trust 9** **Trust 10** **Trust 11** **Trust 12**
ATP Hygiene Monitoring System **Brand / supplier:** *Genie / Health Edge Consumables Ltd* ATP hygiene monitoring is based on the measurement of Adenosine Triphosphate (ATP), the energy molecule in all living cells. In addition to micro-organisms, the system detects organic residues left on surfaces	**Environmental hygiene / Training**	**Trust 5**

after cleaning and/or sanitation. The system comprises a handheld luminometer and swabs. It works through collection and quantification of ATP remaining in organic residues post cleaning. The result is given in RLU (relative light units).

Comprehensive (All in one) Care Foley Catheter Tray **Brand / supplier:** *BARD*[®] The technology comprises a sealed aseptic pack containing a LUBRI-SIL[®] Hydrogel coated all silicone pre-connected Foley Catheter and additional equipment required for the complete procedure[16]. The packs do not contain silver coated catheters also manufactured by BARD, which have achieved an RRP 1[17].	**Catheter care (Urinary catheter)**	**Trust 1**
Bladeless Fans **Brand / supplier:** *Dyson* Fans with no blades to enhance safety and ease of cleaning.	**Environmental hygiene**	**Trust 2**
Endoscopy sinks **Brand / supplier:** *Ecolab®* (detergent),*Neocare[TM]* (sinks) Custom built sinks for cleaning endoscopy equipment. The three main features of the sinks are: temperature gauge, chemical dosing measure, height adjustable.	**Medical Devices Hygiene**	**Trust 2**

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[16] chambered urinemeter, bed bag and leg bag. The other contents of the pack are:
1 x waterproof surface protection blanket
1 x patient protection fenestrated underpad
1 x STATLOCK® Foley Stabilisation Device
2 pairs of gloves, cleansing solution, cleansing gauze swabs
1 x syringe of urethral lubricant, apron, refuse bag
1 x prefilled 10mL syringe of sterile water and 1 x empty 10mL syringe
[17] The technology given a RRP 1 includes a silver coated catheter

PCR testing – Norovirus **Brand / supplier:** *SmartCycler® / Becton and Dickinson* Molecular platform and PCR machine for Norovirus	**Diagnostics**	**Trust 2**
PCR testing – MRSA **Brand / supplier:** *GeneXpert® System / Cepheid* Real-time PCR testing molecular platform for MRSA providing test results from prepared biological samples in 30-40 minutes	**Diagnostics**	**Trust 2**
Hand Signage (Talking) **Brand / supplier:** *Hand Signage / Pipa HealthCare* Talking and flashing Hand Signage placed outside wards and clinical areas with the aim to promote hand hygiene	**Hand hygiene**	**Trust 2**
Hand Signage Posters **Brand / supplier:** *Local Supplier*	**Hand hygiene**	**Trust 7**
Non-chlorine based disinfectant **Brand / supplier:** *CLEANKILL DIFFICIL-S® / Clinimax*	**Environmental Hygiene**	**Trust 10**
Faecal management system **Brand / supplier***: Zassi (ActiFlo) Bowel Management System / Hollister* The product is designed for the diversion of faecal matter for patients requiring stool management, to provide access for colonic irrigation and to administer enema/medications. It has demonstrated effectiveness in	**Environmental Hygiene / Patient Hygiene**	**Trust 10**

containing faeces and preventing faecal contamination of the environment. The product received an RRP Recommendation 1 by HPA (September 2007)

Infection control IT surveillance system Brand / supplier: *ICNet® / ICNet International*	**Information Management and Communication**	**Trust 3**

Individual Patients MRSA Decolonisation Pack Brand / supplier: *In-house product pack*	**Patient Hygiene**	**Trust 11**

The MRSA decolonisation pack for use by individual patients comprises the following: (a) Patient information leaflet re pre-operative screening; (b) Instructions to MRSA positive patients for skin decolonisation regime; (c) Patient Group Direction (PGD) for the supply of MRSA decolonisation medication; (d) Pre-labelled aqueous Chlorhexidine 4% skin cleanser (Hibiscrub) in containers for individual patient use; (e) Mupriocin 2% nasal ointment (Bactroban) for individual patient use.

Antiseptic Body Cleaning Washcloths 2% Chlorhexidine Gluconate Brand / supplier: *Sage®*	**Patient Hygiene**	**Trust 11** **Trust 10**

The product is a rinse and alcohol free antiseptic body cleansing washcloths with 2% Chlorhexidine gluconate. Based upon the evidence supplied to the HPA Rapid Review Panel concerning intensive care patients the product has demonstrated a reduction in skin colonisation with nosocomial pathogens leading to a reduction in surgical site infections and infection transmissions. The product received an RRP Recommendation 1 by HPA (14 April 2008)

Hydrogen Peroxide Vapour (HPV) Decontamination System Brand / supplier: *Sterinis® / Gloster Sante Europe*	**Environmental and Medical Devices Hygiene**	**Trust 12**

The hydrogen peroxide vapour (HPV) disinfection system disinfects hospital areas and equipment which can be sealed off during the decontamination process.

Hydrogen Peroxide Vapour (HPV) Decontamination System
Brand / supplier: *Bioquell®*

The hydrogen peroxide vapour (HPV) disinfection system disinfects hospital areas and equipment which can be sealed off during the decontamination process. *Bioquell's* hydrogen peroxide vapour (HPV) disinfection system was awarded Rapid Review Panel (RRP) Recommendation 1 by HPA (26 October 2007).

| | Environmental and Medical Devices Hygiene | **Trust 7** **Trust 9** |

Hydrogen Peroxide Vapour (HPV) Decontamination System with Silver (Ag+)
Brand / supplier: *BioGienie® / Hygienics^{TM}*

The hydrogen peroxide vapour (HPV) disinfection system disinfects hospital areas and equipment which can be sealed off during the decontamination process. The product uses Sterusil Biocidal Disinfectant H_2O_2 5% with silver (Ag+cation 50ppm)

| | Environmental and Medical Devices Hygiene | **Trust 6** |

Non Chlorine-based Cleansing / Disinfectant
Brand / supplier: *Virusolve+® / Cairn Technology*

Virusolve+ RTU Ready to use spray disinfectant
Virusolve+ *Concentrate* Cleansing & Disinfection Solution
Virusolve+ Impregnated disinfectant wipes

| | Environmental Hygiene | **Trust 12** |

Hand Inspection Ultra Violet (UV) light inspection kit
Brand / supplier: *DaRo UV Systems*

| | Hand Hygiene / Training | **Trust 12** |

Hand Inspection Cabinets using UV light & Glow and Show cream training aid units		
Hand Inspection Ultra Violet (UV) light **Brand / supplier**: *UV Light Technology*	**Hand Hygiene / Training**	**Trust 11**
Ozone Sanitizer Machines **Brand / supplier**: *OTEX / JLA* The OTEX medical sanitiser machine produces the naturally occurring gas ozone, which fills the room to be treated contributing to infection control and removing odours. The sanitiser is fitted with a UVC light	**Environmental Hygiene**	**Trust 9**
Electronic Data Management System for the Evaluation of Cleaning Schedule **Brand / supplier**: *Maximiser® / Expolink*	**Environmental Hygiene /** **Information Management and** **Communication**	**Trust 7**
Single Use Patient Admittance Packs: **Disposable Blood Pressure Cuffs & Pulse Oximeter Probes** **Brand / supplier:** Designed in-house: *FlexiPort™ / Welch Allyn* (BP Cuffs) & Masimo Set / LNOP® (SpO2 sensors)	**Patient Hygiene/ Medical** **Devices Hygiene**	**Trust 7**
Chlorhexidine Gluconate (CHG) Dressing (disk) to prevent Catheter-Related Blood Stream Infections (CRBSI) **Brand / supplier:** *Biopatch® /Johnson & Johnson* *Biopatch®* Disk is a dressing for use in reducing CRBSI. It is designed to continually release CHG over 7 days, providing 360º protection around the catheter	**Catheter care (venous catheters)** **/ patient hygiene**	**Trust 4**

Ultra Violet (UV) Air Sterilisation Units **Brand / supplier:** *Medixair / GE Healthcare*	**Environmental hygiene**	**Trust 4**
Microbiology testing: mass spectrometry analysis machine **Brand / supplier:** *MALDI TOF / AB SCIEX*	**Diagnostics**	**Trust 5**
Infection Manager Software System **Brand / supplier:** *VitalPAC / The Learning Clinic* The *VitalPAC* software records, stores, and analyses vital signs data, enabling clinicians to monitor the condition of their patients in real time – The *VitalPAC* Infection Manager System is specifically designed for Infection Prevention and Control.	**Information Management and Communication**	**Trust 6**
Portable PC Tablets **Brand / supplier:** *ThinkPad® X- 200 / Lenovo*	**Information Management and Communication**	**Trust 8**
Portable PC Tablets **Brand / supplier:** *Toughbook CF-H1 / Panasonic* Alcohol resistant, hospital specification PC tablet	**Information Management and Communication**	**Trust 6**
Ultrasonic Cleaning tanks **Brand / supplier:** *MediSonic™*	**Medical Devices Hygiene**	**Trust 5**
Smart flat infection control PC Keyboards (for all portable computer carts and PACS machines)	**Environmental Hygiene**	**Trust 8**

Brand / supplier: *Medigenic® / Esterline Advanced Input Systems*

The Medigenic keyboard has a flat design and smooth surfaces to be quickly and easily wiped clean with ordinary hospital disinfectants. It also includes the Medigenic Alert System: an indicator which flashes / bleeps when cleaning is required to help monitor and promote good infection control practices

Digital Camera (as training aid for Infection Control) **Brand /supplier:** *DSC-W210 / Sony*	**Training**	**Trust 12**
Digital Count Up Posters/Boards (showing MRSA / CDI free days for each ward) **Brand / supplier:** *Local Supplier*	**Hand Hygiene**	**Trust 8**

4. Case study – Trust 1

4.1 Context

4.1.1 General Context

Trust 1 is an Acute and specialist trust and is affiliated with a university. The trust is one of the largest in the country, employing over four and half thousand full time staff and serves a population of approximately 750,000 people from a wide range of backgrounds across a wide area. The trust delivers its services from two district general hospitals, one of which is managed under a PFI contract[18]; both sites operate an A&E department in addition to providing acute services consisting of all the major specialties of large district general hospitals. During 2009/10 the trust as a whole dealt with 571,075 booked outpatient appointments, 187,058 attendances at A&E and a total of 128,535 inpatient admissions and reported a financial turnover of just under £400 million. The trust also reports a history of success in innovation and was named 'Innovative Trust of the Year' in 2009 for submitting the highest number of ideas to NHS Innovations in London[19].

4.1.2 Trust Performance

The trust was the only one to receive a double 'weak' rating for both quality of services and financial management in the Care Quality Commission's performance ratings for 2008/09[20].

Table 3 The Care Quality Commission Assessment

	2005/06	2006/07	2007/08	2008/09

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[18] One of the sites is managed by Catalyst Healthcare – a consortium that includes Bovis Lend Lease, Sodexho Investment Services and Uberior Infrastructure Investments, the contract runs for 36 years (Source: Trust Website, News 2007)
[19] Trust Annual Report and Accounts 2009-10
[20] Care Quality Commission, October 2009

| Quality of services | Fair | Fair | Fair | Weak |
| Quality of financial management | Weak | Weak | Weak | Weak |

The results for the most recent Patient Environment Action Team Assessments (PEAT, 2010) are outlined in the Table 4 below[21], showing improvements on the previous year for food, privacy and dignity at hospital A from 'Acceptable' to 'Good'.

Table 4 PEAT inspection results

	Environment Score	Food Score	Privacy & Dignity
Hospital A	Good	Good	Good
Hospital B	Good	Excellent	Good

4.1.3 Infection Prevention and Control Context

The Infection Prevention and Control team under the Director of Infection Prevention & Control, consists of the Infection Control Doctor (ICD) and the Head of Infection Prevention and Control; responsible for 3 infection control nurses (including 1 senior infection control nurse) 2 administrative co-ordinators, and 1 Infection Prevention and Control Facilitator. The team is supported by microbiological services, with advice available on a 24 hours basis. The nursing team was fully established at the end of August 2008 and the budget allocation for infection control activities was £383,931 for 2008/09[22].

4.1.3.1 Trust performance on mandatory HCAI indicators

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[21] Patient Environment Action Team (PEAT) Assessment 2010, National Patient Safety Agency
[22] Infection Prevention and Control Annual Report, April 2008 – March 2009

Table 5 Trust performance on HCAI indicators[23]

	2007/08	2008/09	2009/10
MRSA *bacteraemia*	40 (target, Max no of cases 46)	47 (target, Max no of cases 40)	28 (target, Max no of cases 39)
Clostridium difficile	218 (target, Max no of cases: 597)	126 (target, Max no of cases: 219)	80 (Target, max no of cases: 145)

4.1.3.2 Previous trust IPC interventions

In 2007/08 the trust implemented the Infection Prevention & Control Action Plan. The trust focussed on increasing education and training of all staff through acquisition of the "Infection Control Passport" and increased practical training for junior doctors. The Passport was primarily designed to deal with infection prevention & control with an emphasis on issues related to the isolation of C. *difficile* positive patients. By 2009, 732 staff members had been trained of which, 620 have been assessed.

Recent IPC technologies have centred around high impact interventions. Business cases prepared by the IPC team for standardisation of intravenous peripheral and central line packs have been accepted and implemented as follows:

- Off the shelf peripheral packs including single use tourniquets - July 2007
- Custom-made central venous catheter packs - July 2008
- Custom-made peripheral packs - September 2008

Following a number of arterial line bacteraemias it was agreed that arterial packs would be introduced in the trust. In addition the trust introduced ChloraPrep for all line insertions and was involved in trials for 3 types of single use tourniquets (Saint /VYGON and Tounastrip). For environmental cleaning the trust has 24 steam cleaning machines for the wards. Communication products include 10 talking cones with a flashing light purchased for use during ward closures due to outbreaks; recorded messages are triggered as the infrared beam is broken. The IPC team was also involved in developing 60 peripheral access trolleys. The trust has used ATP monitoring since 2009, using the Hygiena system sure plus.

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[23] Trust Annual Report

Looking specifically at RRP 1 technologies, the trust has used ChloraPrep (Enturia Ltd) since Jan 2007; Flexi-Seal Faecal Management System (ConvaTec) since 2007; and since 2006 hires the Hydrogen Peroxide Vapour System (BIOQUELL) as required.

4.2.1 HCAI Technology Innovation Award: Trust IPC Areas of priority and technologies selected

Who was involved and how?

Primarily the IPC team was involved in the decision making process as a follow on from a trust-wide audit described below. Wider involvement was sought through formation of a project team to implement the plan including clinical governance, urology specialists, procurement, finance, turnaround, and human resources.

Options outside of prevention of catheter associated UTIs were not sought given the background of recent investment in IPC interventions.

Initial options considered

During 2008, the trust undertook an estimate of catheter associated UTIs, as well as an audit of staff knowledge and skills, and completeness of documentation. This audit report, "Urinary Catheters and the Knowledge / Skills of Staff who Care for Patients with Indwelling Urinary Catheters" was conducted by the IPC team and was presented at the Clinical Governance Trust audit meeting in July 2008 and to the Trust Board in August 2008. The audit report was awarded first prize in the Trust's clinical audit competition and outlined the following recommendations:

- Urgent review of training for staff in the insertion and management of urinary catheters to be undertaken
- Foundation Year 1 (FY1's) doctors to be given training on induction to Trust on the insertion and care of urinary catheters
- FYI clinical passport to be developed
- Urinary catheter care bundle to be developed in line with High Impact Intervention 6 of saving lives
- Review product use in catheter care re-audit in one year
- Business case for a trust continence nurse

Addressing the above recommendations an operational plan to reduce the incidence of Catheter Associated Urinary Tract Infections (CAUTI's) was developed with implementation planned for 2009/10. A business case for two continence advisors was submitted and agreed in January 2009. The IPC team aimed to have staff in post by September 2009. Upon receipt of the DH HCAI Technology Innovation Award in February 2009, the trust decided to use these funds to implement the above plan to help reduce CAUTIs.

The trust made initial enquiries to DH to clarify scope of the funding. For example if the award could be used to fund two clinical nurse specialists for incontinence.

What was finally selected?

The trust was advised by DH that the funding was for technologies and hence the trust put all the funding to procure the technology component of the care bundle. The product is the Comprehensive Care Foley Tray – all in one. The supplier is BARD®. The product was seen as one component of the urinary continence care bundle and strategy to improve outcomes and to reduce waste. The trust agreed to fund the nurse specialist to sustain the changes and to lead on the other recommendations from the audit. Until such an appointment the IPC team would take this role.

Table 6 Technology, priority area and progress (August 2010)

Technology	IPC priority area	Brand/supplier	Procured	Implementation
Urinary catheter care bundle	Catheter associated UTIs	*BARD®*	Yes	Yes

The selection of the technology, from time of award took 6 weeks. As described, the IPC priority area had already been identified and the selection was immediate.

4.2.2   Urinary Catheter Pack - technology selection, procurement and implementation

Decision Making Process

The audit report described above helped the trust to identify areas for improvement in the care of patients with indwelling urinary catheters. The decision to use the award towards implementation of this care bundle and procure urinary catheter packs for improving urinary catheter care was approved by the Trust Board and Clinical Governance Committee.

The aims of introducing the packs were threefold, as follows:

Asepsis: to provide all items in one pack that is easy to open

Standardise: to provide standardisation of urinary catheter types

Aid decision making to catheterise: to introduce another decision making point to assess if catheterisation is necessary

The project team included the Urology Nurse Specialist to ensure that the packs would comply with all relevant guidelines of best practice [24] [25]: Essentially the idea emerged from previous technologies adopted by the trust for high impact interventions and specifically through cross learning from another trust. This was the project lead's (IPC matron) previous place of employment. This connection provided a strong professional link and was used to elicit local evidence to help build the business case for Trust 1. The IPC matron worked with her project team to set aims and write a robust business case. Due to the financial constraints faced by the trust a strong business case needed to be made *"we had Rose from turnaround... very heavily involved to begin with"* [matron].

The considerations at the decision making stage were therefore the dual benefits of improved IPC outcomes with a cost neutral business case. Cost savings projected by the 'Trust-Wide Audit of Urinary Catheters and the knowledge /skills of staff who care for patients with indwelling Urinary catheters' are set out in .Box 1.

Box 1 Areas for potential cost savings (*source: Trust Audit, 2008)

Action	Projected saving
Reduce inappropriate use of products: 50% of the patients with urinary catheters insitu had urine meters attached for drainage which has an added cost implication to the trust.	**Cost to Trust :** Over a 12 month period £9,000 versus £737.00 if correct urine bag enforced within trust.

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[24] The Urological Society
[25] The Continence Society

Reduce number of CAUTIs: Through training and catheter packs. The number of estimated CAUTI's in the trust each year is 2,507	Cost to trust: These would incur additional stay costs of £1,573,794 additional nursing costs of £1,352,351 other additional costs of £992,295. Total cost of CAUTI is therefore £3,918,441 (Based on a model developed by the York Health Economic Consortium)
Appoint continence nurses: Use some of savings to reinvest in two continence nurses band 7, £96,000, to sustain changes.	

Whilst the decision making process was formal in terms of constructing a project team and inclusive of various intelligence within the trust, the process can be described as being fairly exclusive to the IPC team, steered by a local 'champion'; the IPC matron. Previous experience of technology adoption helped formulate the concept:

"We knew what we wanted because we'd previously done it, we had done it with the peripheral, IV peripheral packs, we'd done it with central line packs, arterial line packs and what we wanted was a company who would give us an all in one package so that we didn't have to go for bits here, bits there" [DIPC]

The DIPC described her own role as a facilitator of the process and how she made a concerted effort not to influence the decision making using her professional background as a clinical microbiologist:

"I'm a microbiologist by background but in this project, ...something that I learnt right at the beginning, when I took on this post, is when you actually become a clinical manager or a clinical leader you actually have to drop your knowledge off your own ... because you start interfering... I think that is quite an important one for clinicians who become either leaders or managers of any sort, is that they really have to let the professionals guide and say, this is what we need to do, and the role of the manager or leader is just to facilitate" [DIPC]

The trust procurement structure includes procurement activity groups (PAGs) and is segmented by wards, theatres, and critical care. The PAGs meet every two months and review any product put forward by staff. The PAGs then find out the range of companies supplying the product,

invite them for presentations and may ask companies to supply the product for a trial period. In this case there was, at the time, only one company with the required product. Hence the decision making was dominated by the business case. The anticipated benefits of the technology and perceived innovativeness are summarised in boxes 2 and 3.

Box 2 Anticipated benefit of technology

Perceived Relative Advantage
Will help address over-use of catheterisation
Intervention will be cost-neutral
Time saving
Asepsis
Fits with care bundle to improve indwelling catheter care
Potential to reduce lengths of stay

Box 3 Perceived innovativeness

Perceived Innovativeness
Need identified and packs to fit overall CAUTI work plan
No other companies currently producing - so leading product
All products in one pack: '*one stop shop*'
Pre connected catheters

The selected technology was not the RRP 1 product – the silver coated catheters. The RRP 1 product was significantly more expensive than the standard package. The project lead, the IPC matron had wanted the RRP 1 product but was not supported by the trust's R&D committee.

"They [R & D committee] actually asked BARD and said, would you be willing to do more studies? And they said, categorically no and as soon as they said that then the R & D said, well if they're not willing to go back and relook at some things and they're going to stand by the evidence from sort of X number of years ago which actually does say, when it was peer reviewed every peer review does actually say needs further work or should have more trials" [matron].

The project lead accepted that this 'enhanced' technology maybe re-considered later as follows:

If we reach a plateau [in reducing CAUTIs] that's the time I then have to relook and say, OK we've got so far, we've got the knowledge and skills in place, we've got the right equipment, everyone is doing everything right, we've got the acute PCT seamless service and everything is working out there. Why have we still got a problem and we cannot reduce it any further? That's

the time I would go back to the board and say, OK we've done everything now, now it's time to approach it in a different way and this would be the time to put the silver coated in to see if it actually does reduce it that step further, that's my rational behind it" [Matron].

The project lead described the *whole concept* to be the 'technology'. Potential impact on practice was deemed to be a key benefit:

"So they [professional] *stand back and actually think well actually do I need that? Do I really need to make that final step and put that catheter in the patient because it's very much, it's very different opening a thin catheter to taking something like that off the shelf and opening it"* [Matron] .

Procurement Process

The procurement team were involved early on in the decision making process. The packs were procured through the NHS Supply Chain. As described earlier a business case had been approved by the trust, and with the product available through NHS Supply Chain, procurement was described as smooth and efficient.

The PAGs, as for all technologies, had been involved early in the process. As the range of suppliers was limited to one, input was concentrated on securing comprehensive after sales care including onsite training. The process was described by the IPC team to have been enhanced by the ethos of the procurement lead for the project:

"we've got somebody who is also quite an innovator in there and who is as passionate about getting procurement right" [Matron].

Further the procurement process was described as similar to the process followed for other products. The IPC team also described an ongoing good working relationship with the trust's procurement team.

Implementation Process

Implementation was trust-wide through a rolling programme and was facilitated by the company representative and involved 'replacement' of packs on all but the 'guardian' wards along with

training. The guardian wards included Urology wards and Obstetric wards and theatre which use specialist products. Training was key, as found in the trust's audit, some extremes were revealed with staff who had not received any up-dates to training on catheter insertion for up to 30 years.

The team had learnt from previous technology implementation that a one step plan had been difficult to manage. Hence a phased introduction was used to allow for learning and time for any potential problems to be identified. The packs were introduced first to those areas identified for greatest volume of catheterisation; namely Accident & Emergency, and the acute assessment area in the medical wards.

"Once we've embedded it in there [A&E] and the knowledge and the skills are embedded in there we then move it on to the surgical wards...so that we're basically doing, by staging the implementation, we are allowing people to get used to the product, we're allowing people who are doing the educating to take small chunks and that's what I've said by having the company living here practically permanently for the next heavens only knows how long. And it is a massive, massive undertaking to do what we're doing", [Matron].

The guardian wards, which were to retain different catheter types were stocked with the catheters being replaced on other wards, to avoid any wastage.

A detailed implementation plan was drawn up and an agreement made with the company to have a representative dedicated to the project. The training was conducted in two main phases: July 09 – Sept 09 and Sept 09 – Oct 09. During this time BARD® conducted 98 training sessions attended by 401 nursing staff in total. Registrar training followed. The FY 1 doctors where trained on urinary catheterisation and how to correctly use the Foley Tray when undertaking the procedure. The company was asked to delay training in ITU's at both hospitals due to work pressures on staff.

All wards and departments where provided with a Foley Tray Folder, which contained all relevant clinical evidence and the BARD representatives direct contact number.

The packs were replaced in all the wards (expect for guardian wards) and the IPC Matron, BARD representative and member of staff in stores were points of contact for staff with queries

or problems.

The initial response to the packs was reported as positive by the matron and the company representative. Later, the matron reported a number of queries about the packs which were easily resolved through guidance from the matron or the company representative. There was mixed reaction from some doctors who were not accustomed to the preassembled catheters. In some cases doctors had disconnected the catheter before insertion thinking it was a mistake.

"Even within the pack there's innovations that the trust isn't used to, so the pack itself is an innovation and on top of that the product within it, the pre connected catheter is totally new to most people within the trust...when we first showed it to them looked at it and went, oh that's a bit unwieldy we can't,... we're not going to be able to do that...they were trying to figure out how to sort of, put it under my arm, round my neck? So there's a lot of education on that side to be done", [matron].

One nurse had reported trouble opening the packs which had risked cross contamination. His initial views were that "*they were a waste of money*" [nurse]. However subsequent experience was very positive and he attributed initial problems to a 'faulty batch'. The matron however attributed this to packs being opened from the incorrect end.

One of the most common queries was around the use of the term 'female' and 'male' catheters. The packs were supplied with standard catheters in two sizes (12 or 14) and female catheters were removed from all but guardian wards. This was to address an alert from MHRA whereby female catheters had been inserted into males. The protocol for the female catheters was implemented as follows:

Catheters being inserted for a short period (a couple of days or a week) – use standard catheters.

Patient is female and is to be discharged home with a permanent or a long term indwelling catheter – request and use a female catheter.

This new protocol caused the largest number of queries but was the optimum time to implement with the new packs. Hence there were positive synergies in standardising practice with the

implementation of the packs. Similarly a protocol was implemented for anyone requesting a larger sized catheter, whereby a urology referral was set as a pre-requisite.

The implementation of the packs was intended to be supported by the documentation, training and the appointment of nurse specialists as part of the care bundle. Whilst the training for use of the packs is well implemented, the trust has experienced delays in the other two areas. Two attempts at appointing a continence nurse have failed and a decision has now been made to make the appointments through the division of medicine under the matron for elderly medicine rather than IPC. The continence nurses are expected to work very closely with the IPC team. The second delay is the one page catheter care plan to be included in the medical notes which is waiting to be signed off by the trust.

These delays were not deemed to have directly impacted on implementation of the packs but may have an impact on the complete care bundle. As the project lead reflected, this appointment before implementation would have been ideal:

"It [the delay] has impacted on the actual ongoing knowledge and skills because some of the knowledge and skill factors, we need the continence nurses in to get that education programme rolling...dealing with somebody who's got continence problems rather than throwing a catheter into them is very much in the remit of continence nurses. And that's why it's very much a joined up approach", [Matron].

4.2.3 Trust Evaluation of the Technology

On process, the staggered implementation process was considered to have been successful coupled with the training.

On outcomes, the key performance indicators agreed by the trust to evaluate the project are under four main areas: knowledge and skills, documentation, catheterisation rates and catheterisation infection rates.

Specific measurable indicators include:
- o   Reduction in use of urinary/continence care products
- o   Reduction in spend on urinary/continence products

- Reduction in Bacteraemia urinary rates set at a target of 20% reduction year on year
- Reduction in use of antibiotics

An initial audit had been carried out by the IPC team. The target to achieve a 20% reduction in bacteraemia urinary rates has been achieved for year 1; a reduction from 66 to 53 in year 2009/10. The target has now been adjusted to 42 for 2010/11.

Currently there is no aggregate information on reduced spending or on the other parameters. However, immediate savings have been made, for example limiting use of hourly urine bags, with ordinary catheter bags (a price difference of 10p compared to £7 per bag).

4.2.4 Discussion

The overall process for this project has been led by a passionate 'champion' for the whole concept rather than the technology in isolation. The technology itself was viewed as simple and compatible with the hospital structurally and culturally. The respondents pride themselves as innovators and this was qualified by the respondents by the number of applications made by the trust through NHS innovations. In addition the work done in implementing new technologies in IPC.

The respondents also recognised leadership and visibility of the DIPCs. There has been a change of DIPC through the life of this project, but support for the project has been consistent.

Previous experience both within the trust (regarding IV packs) and outside the trust (project lead's previous place of employment) helped the project team through decision making, procurement and implementation.

4.2.4.1.   The decision making process

The process of decision making for technology selection was exclusive to the IPC team, with the decision communicated to the wider trust. The rationale for this highly exclusive approach reflects where the trust was in terms of its IPC strategy and the area of priority identified; urinary catheter care. This exclusive approach to the decision making process was explained by the project lead:

"...in fairness because it was linked to healthcare associated infections we just said to the team well just go on work on something, now had it been £150K on innovation we might have had to do a different thing to be fair to the rest of the trust" [matron].

The technology selection decision was initially informal and confined to the IPC team. The primary decision was therefore exclusive to the IPC team. A project team was subsequently formed to approve the selection decision and included representatives from the following groups: (a) clinical governance, (b) urology specialists, (c) procurement, (d) finance, (e) financing turnaround, (f) human resources. A more formal format was required to present to the Trust Board and clinical governance committee.

The resulting technology selection was therefore predetermined and was part of a care bundle to improve urinary catheter care. We define here, predetermined, those technologies which had been selected before the award, typically whereby the trust awaited a funding opportunity. Emergent describes those technologies which were considered after initiation of the project. Trust 1 used all funds for one technology and the decision is described as predetermined and exclusive to the IPC team. As described earlier, members outside of the IPC team were not involved in generating ideas for use of the award. When compared to other trusts in the sample, Trust 1 took a highly exclusive approach to decision making.

Overall, a key focus of the business case was showing cost savings in future years, hence reinforcing the sustainability of the technology.

4.2.4.2   Evidence

The project team used a wide range of sources to get information in three broad areas. We map to three types of knowledge required to make effective decisions (Rogers, 2003; Glasby & Walshe, 2006) as follows.

Knowledge awareness: to find out what is available in terms of the range of technologies specific to IPC.

Principles or theory knowledge: why and how a technology works in terms of the underlying scientific principles or theory.

How to knowledge: how to put the technology in to use, including all aspects of implementation

Overall, there was consistency in the efforts by each of those involved in the decision making to look for the three types of knowledge about the technology and IPC priority area.

Table 7 Type and sources of knowledge used in decision making

Awareness knowledge	Principles /theory knowledge	How to knowledge
Professional networks – link with trust where project lead previously employed Rapid Review Panel (RRP 1)/ Showcase Hospitals evaluation reports Trust Staff Trust's Procurement Action Groups	Professional networks Peer review journals Supplier Trust R&D	Supplier Other trust Showcase Hospitals evaluation reports Previous experience of other technologies (success/failure)

(Adapted from Rogers, 2003; Glasby & Beresford, 2006)

Trust 1 used links with another trust as described above, and used this professional network for 'awareness' and 'how to' knowledge. The 'principle/theory' knowledge was informed by extant peer review and policy literature as well as formal professional networks such as the Infection Control Nurses Association. We saw, specifically how the trust's R&D committee had challenged evidence on 'principles/theory' knowledge which directly impacted the decision of silver coated catheters versus standard catheters.

Similar sources of evidence were sought by the different professionals involved in the project, there were differences in what constituted 'evidence'. For example measures of length of stay, economic analysis, governance issues took differing priority for different stakeholders.

The collective evidence was included in the resource pack for each ward including all 'how to' guidelines on using the technology as part of the care bundle. The intention is also to update with clinical papers and supporting guidelines.

4.2.4.3 Procurement

The procurement team were involved early on in the decision making process. As described earlier a business case had been approved by the trust, and with the product available through NHS Supply Chain, procurement was described as smooth and efficient.

Further the procurement process was described as similar to the process followed for other products. The IPC team also described an ongoing good working relationship with the trust's procurement team. This was considered important due to the trust's financial constraints.

4.2.4.4　　　Context

The large size of the trust was not a consideration at the selection stage, but did have an impact on the implementation process. A well managed and staggered implementation plan was required. This also required a high level of after sales service from the company, which was negotiated during procurement.

According to the respondents being a financially constrained trust has acted as a driver for innovative activity. Getting the business case right, involving procurement early and working together were key components for any initiative to be considered by the trust board. These considerations are reflected in the HCAI award project as described.

Culturally, as mentioned earlier, the respondents prided themselves on being part of an innovative organisation. The project lead, since receiving the HCAI award, had been invited to join the trust's innovations steering group. The group is headed by the director of clinical governance and has been running for a year. This initiative was seen as a real opportunity to encourage ideas from frontline staff for clinical and non-clinical innovations:

"...people are sometimes scared to come forward , I think they're scared of being made to look foolish but to me the more simple, the simpler an idea is, sometimes the better it can be, but also the wackier something is, it can actually work. And even if somebody else has thought about it, it could be that that initial idea could then be taken and extended. So it's, and people, I think, get so bogged down in their day to day work, ...and they don't push it forward" [Matron].

Another cultural shift deemed important by the respondents was 'visible leadership', with executive members seen on wards talking face to face with staff. Other forms of communication include an intranet blog.

4.2.4.5 Implementation

Overall, to date implementation of the technology has progressed according to plan. Few barriers to implementation were noted. The phased approach in a large trust was as a result of direct learning from previous technology adoption which had been introduced in one step. Implementation has involved training and replacement with the new packs as described. In terms of the care bundle, according to the project lead appointing the continence nurses first or at least in tandem with the packs would have been optimal implementation. In addition there has been delay in getting the care plan approved and in use.

Other areas to make savings have been identified. By control through stores, ordering can be monitored. For example, an overuse of underpads has been noted whereby pads are being used as continence aids for people to sit on, and under peoples feet instead of the intended purpose: in patients with a broken arm, broken leg or an oozing wound.

Table 8 Barriers and facilitators to implementation

Perceived barriers to implementation	Perceived enablers/facilitators to implementation
- Enhanced implementation would have been achieved with continence nurse in place - High volume of work in ITU with limited time for training	- Onsite support from company representative - Detailed implementation plan - Dedicated lead - Learning from previous technology adoption - Learning from another trust - Phased introduction to allow for learning and time for any potential

	problems to be identified

Next steps identified by the project team include extending learning, followed by embedding the knowledge and skills of catheter care widely through the rolling programme of theory sessions. Practice models from the clinical skills laboratory have already been taken to wards and left for a few days to allow for opportunistic learning.

Across trusts there are plans to use standard discharge packs. There is scope to reduce waste resulting from wards giving supplies to patients to take home with them. By linking the trust's (to be appointed) continence nurses with the PCT continence nurses the aim is to standardise products across the health economy.

5. Case study – Trust 2

5.1 Context

5.1.1 General Context

Trust 2, was awarded foundation status in 2008. The trust delivers its services from two main sites: a modern £100 million pound district general hospital built and managed under a PFI scheme[26]; and a purpose-built community hospital in addition to a smaller community hospital. The trust provides services to 340,000 people across a wide area, employs over 3000 staff and has an annual turnover of around £156 million.

Trust 2 has approximately 600 beds (a third of which are single en suite rooms) and provides a range of services from emergency care, surgery, diagnostics, and out-patient and day case services. In addition, attached to this site is a 128 bed state-of-the art facility for elective surgery patients and a 20 bed private patient unit. During 2009-10 the number of patients seen, treated or admitted by the trust numbered: 94,587 new outpatients; 152,627 appointments; 28,053 day cases; 39,202 emergency inpatients; 7,004 elective inpatients; and, 66,262 A&E attendances.

The trust is comprised of four directorates: Women's and Children's; Diagnostics and Outpatients; Planned Care; Unscheduled Care. The Infection Prevention and Control Team is headed by the Associate Director of Clinical Quality.

5.1.2 Trust Performance

The Care Quality Commission (CQC) rated the trust as 'good' for both the quality of services and for the quality of financial management in the NHS performance ratings for 2007/08. In addition, Table 9 shows The CQC's assessment of return against trust declarations for 2007/08.

Following an unannounced inspection on 7th October 2009 by the CQC, inspectors reported no breaches to regulation to protect patients, workers and others from the risks of acquiring a healthcareassociated infection. Specifically, regards the area which had previously been

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[26] Built and managed in partnership with Carillion for a period of up to 27 years

identified for improvement, findings were as follows:

"the trust had improved on the use of effective arrangements for appropriate decontamination of instruments and other equipment, and these are detailed in appropriate policies" [27]

There were no concerns or requirements for further improvement for the remaining 14 measures. The quality of services and of financial management was rated 'good'.

However, on another measure, the Monitor governance risk rating declined from 'green' (in quarter 4, 2008/09) to 'amber' (quarter 1, 2009/10). This was due to risk of MRSA breech.

Table 9: The Care Quality Commission Assessment

	2005/06	2006/07	2007/08	2008/09
Quality of services	Good	Fair	Good	Good
Quality of financial management	Weak	Good	Good	Good

Trust 2 is inspected annually by the nationally co-ordinated Patient Environment Action Team (PEAT). The trust was rated as 'excellent' for the quality of the environment, including cleanliness and quality of patient meals (Table 10).

Table 10 PEAT inspection results

	Environment Score	Food Score	Privacy & Dignity
Trust 2	Excellent	Excellent	Excellent

5.1.3 Infection Prevention and Control Context

Patient safety priorities have been to reduce the numbers of hospital acquired MRSA and C. *difficile* infections and to reduce drug errors, patient falls and associated fractures. In addition, zero tolerance of any blood transfusion errors and incorrect clinical procedures has been

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[27] Inspection report on the prevention and control of infections, CQC
www.healthdirectory.cqc.org.uk/ accessed 18.06.2010

agreed[28].The trust has achieved reduction in hospital acquired infections both in numbers and rates. Strategies to achieve these targets include:

- o Monitoring of and changes to antibiotic prescribing protocols
- o implementation of infection control risk assessments on all patients admitted to hospital
- o phased introduction of MRSA screening of all patients admitted to hospital for both elective and emergency admissions.

5.1.3.1 Trust performance on mandatory HCAI indicators

The targets for reducing MRSA and C. *difficile* commenced in 2003 and 2008 respectively. In 2008/09 the trust achieved a reduction in annual MRSA infections from 10 to 6 which is 4 below the trajectory set by the DH. The annual C. *difficile* infections reduced from 221 to 75, significantly below the trajectory set by the DHof 220.

Table 11 Trust performance on HCAI indicators

	2007/08	2008/09	2008/09
	Actual number	Target	Actual number
MRSA hospital acquired	12	10	6
Clostridium difficile	221	220	75

(Source: Trust Annual Plan May 2009)

5.1.3.2 Previous trust IPC interventions

Under quality and safety, IPC was given 'top priority' in 2008/2009, specifically to reduce the rates of HCAIs. The trust's screening policy for MRSA is as follows:

All elective admissions to be screened for MRSA, either at the time of admission or, for those attending pre-admission clinics, before admission. MRSA screening for Day Surgery patients was implemented on 1st April 2009. The following groups are not routinely screened (as per DH Operational Guidance): day case ophthalmology, day case dental, day case endoscopy, children/paediatrics unless already in a high risk group, maternity/obstetrics except for elective

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[28] Trust Report & Accounts, 1.12.08-31.03.09

caesareans and any high risk cases. The compliance results show above 90% compliance since April 2009, peaking in October at 97%.

The trust states that one of their top safety priorities is to reduce the number of MRSA Bacteraemias and C. *difficile* infections and consequently report an 80% drop in these infections since 2005. This reduction has been credited to 'rigorous monitoring of antibiotic regimes and by the implementation of infection control risk assessments and MRSA screening on all patients admitted to hospital'.

The following interventions have been included in the strategy for IPC as set out in the trust's annual plan: policy formation, training, clinical guidelines, governance, organisational structure, IPC team formation. The trust launched the 'HIT' (Hit Infection Together) campaign to engage staff and patients to bring down infection rates[29].

It is useful here, to place the current award and technology adoption process in the context of the trust's technology adoption on IPC over the last few years, as well as the wider cultural context of technology adoption across disciplines. Regards IPC, at first interview (July 2009) the trust had not previously adopted any of the RRP 1 technologies. The hospital had accepted (approximately a year prior) a free trial period for the 1-2 hour PCR testing machine. The machine had been based in the laboratory. On the basis of a pre-post analysis, this technology was put forward by the directorate of planned care and is discussed later.

To stimulate creativity, a trust-wide competition was hosted in 2008/09. Following the format of the 'Dragon's Den'[30] internal innovation awards across the trust were given to interventions aimed at improving patient satisfaction, quality or efficiency.

5.2.1 HCAI Technology Innovation Award: Trust IPC Areas of priority and technologies selected

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[29] Trust annual plan, May 2009
[30] Include brief explanation of this

Who was involved and how?

Overall, the first phase of the technology selection process as described by the respondents was an inclusive process in that the four directorates were all contacted in the first instance to generate ideas. Namely, Women's and Children's; Diagnostics and Outpatients; Planned Care; Unscheduled Care. Within each directorate the senior nurses, managers and senior consultants were contacted by email with information of the award. Bids were then 'filtered' by the executive board, and final decisions were made by the Associate Director of Clinical Quality and the Medical Director. This second phase of the decision making process was described by all respondents as centralised. The process described above was repeated through several iterations until all monies were allocated. Final decisions were overall accepted:

"We sit centrally, we're not within a clinical directorate and we've got absolutely no bias at all, we don't manage clinical areas,... and I'm the operational lead so together we've worked on it...I think that's worked well. And [Medical Director] is very, very credible, probably the most, , one of the most credible people in the trust. So if, when he's made a decision I will say, [Medical Director] and I…that's it then" [Associate director of clinical quality]

There was only one documented objection to the process whereby one of the refused bids remained unhappy with the decision. The reason for the refusal was that there were already dedicated trust-wide funds for this proposal (electronic prescribing).

Initial options considered

Over 300 initial options were generated through the trust-wide consultation and ranged across IPC priority areas, with some more 'loosely' linked to IPC.

What was finally selected?

The final selection of technologies along with the priority area are summarised below. The technologies cover a broad range of IPC priority areas; environmental hygiene, hand hygiene, decontamination of medical devices & equipment, diagnostics and information communication and technology (ICT). The resulting adoption decisions reflect a multifaceted approach to IPC as well as the inclusive and open process of selection which was adopted by the trust, described next.

The trust selected six technologies, addressing five IPC priority areas. Thus far, four of the technologies have been procured and implemented. Two are undergoing pre-tests before procurement. An additional technology has been broadly identified but a supplier has not yet been selected (IT System to support Day Surgery MRSA Screening).

Table 12 Technology, priority area and progress (August 2010)

Technology	IPC priority area	Brand/supplier	Procured	Implementation
Endoscopy sinks	Decontamination of medical devises/equipment	Ecolab & Neocare	Yes	Yes
Hand signage	Hand hygiene	Pipa Hand Signage	Yes	Yes - pilot and roll out
PCR – Norovirus	Diagnostics	Becton and Dickinson, BD. *Launch*,	Yes	Yes
1-2 hour PCR – MRSA	Diagnostics	Cepheid, and GeneXpert.	Yes	Yes - pilot
Bladeless fans	Environmental hygiene	Dyson	No	Pre-test
ATP hygiene monitoring system	Environmental hygiene	Hygiena	No	Pre-test
IT System to support Day Surgery MRSA Screening	ICT	Not yet selected *(June 2010)*	No	No

We look at the decision making process in more detail for each of the four technologies adopted by the trust. We then look at the three technologies being trialled before being procured.

5.2.2 Individual technology selection, procurement and implementation

The adopted technologies ranged from those identified prior to the award to those which were considered in later iterations of the bidding process.

5.2.2.1.   Endoscopy sinks

Decision Making Process

The proposal for endoscopy sinks was led by the clinical innovation coordinator for the trust. She was project lead for the development of the endoscopy unit at the trust and in the process of upgrading the unit for accreditation[31]. A bid by the endoscopy unit project for easy clean flooring was rejected by the HCAI award project leads. The bid for endoscopy sinks responded to the patient safety element for accreditation of the unit and hence monies were requested from the award for the decontamination process of endoscopes. The new custom built sinks were to replace 'kitchen sinks'. The three main features of the sinks are: temperature gauge, chemical dosing measure, height adjustable. The last of these features responded to improved health and safety and ergonomics. Benefits and potential impact as detailed in the bid are set out in Box 4. The total cost of the sinks was met by the HCAI award.

Box 4 Endoscopy project team- anticipated benefit of customised endoscopy sinks

Benefit/impact
January 2009 : The endoscopy decontamination assessment highlighted areas of non-conformance for JAG accreditation. We were therefore unable to comply with the requirement as follows :   There is a double sink for the washing and rinsing of endoscopic equipment within the decontamination area which is sufficient to meet required capacity and throughput. Sinks should be: 1. Of adequate size to ensure manual cleaning is carried out effectively   2. Positioned to minimise the risk of occupational injury   The action following the report was that this be considered in the redesign of the endoscopy decontamination area.   July 2009: Preliminary investigation conducted by Ecolab looked at the current practice of chemical dosing to static sinks. This highlighted a number of risks to product and traceability.   Ergonomic assessment of fixed height sinks was conducted independently by the Health and Safety Department. This highlighted a number of posture concerns which increases the risk of work related upper limb disorders for staff using fixed height sinks with prolonged static posture. Recommendations from this report were height adjustable sinks are the preferred

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[31] Joint Advisory Group (JAG) accreditation: A visit includes an assessment of the environment, decontamination facilities and processes. To pass a unit must provide evidence of high standards in the following domains: clinical quality; quality of the patient experience; training; workforce; waiting times for all procedures must be <9 weeks; Surveillance lists must be up to date; environment, decontamination facilities and processes.

method for reducing risks associated with prolonged static posture

(Source: Trust bids for HCAI funds)

Thus this decision was based on a number of priorities which this technology could address. The relative advantage of this technology addressed patient and work force safety, and was closely based on guidelines which form the JAG accreditation. Hence the regulatory framework acted as an *enabler* to the innovation adoption process in this case. Regards evidence the endoscopy project lead and team used a combination of sources for this. For awareness knowledge of the products and for acting as a bridge between the endoscopy project team and the HCAI award project team, the decontamination lead contributed. The endoscopy project team had sought information from a number of sources about the range of technologies available including the on-line resource 'inside hospitals'[32]. Regarding evidence of efficacy of technologies literature review and updates are used opportunistically.

Procurement Process

Procurement was through NHS Supply Chain for Ecolab (who supply the chemical/detergents) and worked with the supplier of the sinks – Neocare. Neocare were not available through NHS Supply Chain and the project lead, with advice from the trust's procurement team, went direct to the supplier. The project lead was unaware if the supplier was included in a regional framework. A formal quote was requested. The procurement process was described as smooth. The decision to procure was made in July 2009, order made in August 2009, the company was ready to supply in September 2009. However the trust delayed fitting of the sinks to comply with the project plans of the endoscopy unit. The sinks were constructed in the factory and wheeled in and installed in November 2009.

Implementation Process

Response from the nurse auxiliaries who spend all day on rotation, cleaning and drying the equipment has been positive. They demonstrated the foot controlled height adjuster and viewed this as extremely important in improving productivity. Other factors such as situating the sinks facing a window also contributed to better ergonomics. The temperature and chemical dosing

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[32] www.inside-hospitals.co.uk

meant that there was consistency and that staff felt confident of the cleaning process.

The endoscopy unit has achieved JAG accreditation and the new technology was essential to this achievement.

5.2.2.2.   Hand hygiene signage

Decision making process

The trust had previously identified hand hygiene as an area of low compliance, prior to announcement of the award, and had been looking for some time at different signage formats. In terms of behaviours, respondents identified doctors as the most resistant to change. For example one IPC nurse reported that in spite of a trust-wide 'bare below the elbows campaign' doctors persist in wearing watches. Audits of hand cleansing opportunities versus hand cleansing had revealed low levels of hand cleansing across the board. When looking at possible interventions, there are some limitations due to PFI trust buildings. For example, floor signage was not permitted in PFI buildings, and the alternative of mats posed a trip hazard. The need for signage systems was raised at PEAT inspections and also anecdotally by staff that had seen such systems in other facilities.

The signage comes in two formats, with the aim of reminding public and staff to cleanse hands. First, the 'Pipas', a wall mounted device with a red signal reminding to cleanse hands. Second, the 'Daves', a wall mounted device which plays a pre-recorded and customised message. The units are placed next to hand gelling units. The devices may be activated by movement or set on a timed message activation schedule. The outgoing message may be customised. The timing of the messages can be modified – where this causes 'annoyance' to say reception staff – this may be set at a longer time interval. The voice message may also be switched off which is the practice at night. The units without voice messaging but a brighter LED were included to benefit a particular patient group*: " ...especially for elderly people and those visually impaired wouldn't know where the voice was coming from...so didn't want to frighten our patients"* (IPC nurse).

The initiative for the idea came almost in tandem with the receipt of the award. So there was an identified need before the monies came through. As mentioned, floor mats were perceived a trip

hazard as well as causing problems during floor cleaning and stickers were not allowed in a PFI building. The IPC team were not aware of any products to fit with their needs until the marketing material for the free standing/wall mounted units arrived. The trust was targeted with marketing material. The selected company (Pipa signage) began work in the retail industry (queue calling at supermarkets and post-offices) and then developed the devices in response to the demand for effective tools for hand hygiene. The company presented to the IPC team and then again to a wider audience: invitees to this second meeting included members of the infection control link nurse network, matrons, executive board. At this meeting different clinical areas were recruited to try out the units.

Prior to procurement, evidence of effectiveness had not been sought from other trusts with this technology in use.

Procurement process

The local procurement team were involved once the bid was approved. No other providers were approached for this particular type of signage. Other providers had previously been considered for other types of signage. The process of procurement was described as straightforward for the initial purchase, direct from supplier.

A business plan has been written up and further units procured. The further purchase of these units has taken longer as the local procurement team had expected that quotes from another company should have been sought. The distribution of these additional units will be on demand from wards and areas requesting the units. For example the Deputy Director of Nursing has asked for one to be put on a certain ward because of numerous outbreaks. Also plans include sharing and rotation of the units so that staff do not become desensitised. Pre-audits have been conducted, but these additional units have not yet been implemented.

Implementation process

The project lead for this bid, IPC Nurse, had requested a 3 year project duration, as a one year investment was viewed insufficient for providing evidence of effectiveness. With a one year bid approved, the team opted for a phased roll out with ongoing evaluation. The attributes of the system which appealed were that there was flexibility in where they could be placed, timing, and

messages.

Particular areas in the hospital had been identified as high risk/low compliance. For example, the project lead had identified one ward as a problem area as this is a thoroughfare for a number of assessment units. Hand cleansing compliance was lowest here prior to the intervention. [The researcher had walked through this area and had not noticed the unit]. In terms of information, education and communication activities, internally, ward managers had been notified trust-wide via email.The launch of the units had attracted local press coverage[33]. Documentary analysis revealed regular coverage in the local press of HCAIs progress and critical events. There has been some positive feedback from the public (patients and visitors). The senior IPC nurse felt that the trust is very open to public feedback and responsive; *"the public will say if they are unhappy"* [Senior IPC nurse].

The main impediment to implementation was the period of sick leave for the lead on this bid coinciding with installation of the units (IPC nurse broke her ankle). An implementation plan with precise positioning had not been confirmed. The installation had to go ahead in her absence and she was unhappy with the positioning of some of the machines. For example, a number of units have the sign and actual dispenser on different walls. However, following evaluation the position of the devices was retained. In addition, a free standing unit is being customised to place in the thoroughfare ward which does not have a facing wall where the unit can be noticed.

Audits of effectiveness of the units have been completed in trust ward/areas where the units are located. This, together with feedback from staff and patients has been positive,

 "in fact we've had a lot of good feedback from outside as well as inside the trust... talking to other trusts that have got various talking devices, staff have been known to try and plug the hole to stop the sounds... the fact that the system does shut down out of hours, so that it doesn't disturb people is probably why people aren't trying to find the hole to stop the sound" [IPC nurse].

Both features of the units *plus* the method of implementation was attributed for the success of the units, *"but also we did consult with people, we didn't just say, oh we're going to put one there"* [Senior IPC nurse].

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[33] Units and Senior IPCN featured in local newspaper The Swindon Advertiser 14.08.09

5.2.2.3. PCR – Norovirus

Decision making process

The bid for the PCR- Norovirus technology was prepared by the trust's laboratory team. The aim was to expand the molecular testing service within the Microbiology Department and provide services related to both Infection Control and Sexual Health. Previous to the award, the department had identified this method of diagnostics, a molecular platform, specifically a *SmartCycler*, but was too costly. For infection control, testing for Norovirus was not available on-site, requiring samples to be sent to another trust. The main relative advantage of the new technology would be to enable faecal samples to be tested on site within 2-3 hrs in place of sending to Bristol for testing which takes 2-3 days. This is especially beneficial for identifying cases of Norovirus. The PCR machine was purchased in November 2009 and after parallel testing (to validate the new machine) with the current external supplier for Norovirus testing the laboratory is now using the system for testing hospital patients in an outbreak situation.

An important resource used by the laboratory team for information and evidence concerning the range of technologies and diagnostic methods is The South West Laboratory Managers Network. In addition, systematic literature reviews are carried out, particularly for larger projects/investments such as this.

Box 5 Anticipated benefit of technology

Perceived Relative Advantage
Enable faecal samples to be tested on site
Faster turnaround time: within 2-3 hrs compared to 2-3 days

Procurement process

The technology was procured through the NHS Supply Chain and the process was described as efficient and smooth.

"because it was bought with the framework, excellent" (Microbiology Manager)

Implementation process

The technology has been in use since November 2009 and was used in parallel to the existing system to validate the machine.

Since implementation, the IPC team has been positive about this technology and identified a number of benefits compared to the previous service. Whilst faster results may not *change* the decision to close a ward, significant benefits were reported including aiding executives make confident decisions and in putting appropriate cleaning processes into place.

"It's just nicer to give them that hard evidence; yes this is what we've got... rather than waiting four days, five days before you get to know that yes you have got Norovirus when the ward's already about to reopen" [Senior IPC nurse].

These benefits were also important for patient care, and communication with patients:

"So it's really good and it's just nice to be able to tell the patients what's wrong with them as well rather than we think it's this, it's probably this, you can say, yes you have got Norovirus. Which is not very nice, but it's nice to know straight away what you're dealing with" (IPC Nurse).

Use of this technology is approximately 25% more expensive than testing off-site. Longer term cost effectiveness may be demonstrable through shorter ward closures, stopping admissions to the ward earlier and initiating appropriate hygiene measures quicker.

5.2.2.4. PCR – MRSA testing machine

Decision making process

This bid was prepared by the directorate of planned care and was supported by the unscheduled care directorate to help achieve and maintain the four hour emergency department target.

Table 13 Proposal for PCR MRSA testing machine – anticipated benefits

The Benefit to staff - Patient will be placed on the most appropriate ward and therefore

nurses, medical staff and other allied health professionals will have easy access to them rather than having to visit outlying wards. This provides increased job satisfaction, efficient use of time and resources and the highest standards of care. Teams on non Orthopaedic wards would have more appropriate speciality patients under their care. There would be reduced pressure on the emergency department and site managers.

Benefits to Patients - Will be able to be admitted to the most appropriate ward with access to nurses, medical staff and other allied health professionals who are specialists in caring for them. This delivers the highest standards of care and patient safety. Orthopaedic patients admitted to the unitwill benefit from the increased protection from MRSA that the ward can offer. Surgery would be performed promptly and at the optimum time with less on the day cancellations due to lack of bed availability.

The hospital had previously been supplied with a pro-bono machine for a 'pilot' just over a year ago. This had been a ward based machine. The pre and post effects were evaluated and staff had felt that this was a beneficial investment. Hence when the award monies were announced, the IPC team put forward this bid, headed by the microbiology services manager. Decision making was described as 'very central' by the matron.

Procurement process

The technology was procured through the NHS Supply Chainand the process was described as smooth.

Implementation process

Implementation for the technology was delayed. The discussion around where the machine should be based has taken some months to resolve. Advantages and limitations for two competing options (either ward based or laboratory based) have been discussed. Ward staff feltl that there is lack of capacity on wards and that quality of testing may vary given the high turnaround of staff. The laboratory staff felt that for full benefit of the technology to be realised, the 'real time' aspect as described in the original bid needed to be maintained. A pilot is underway to gather data on needs assessment. The decision of where to place the machine

delayed implementation therefore.

"There was a lot of pressure to get the MRSA machine in at the beginning of the year and that was from the Chief Executive right the way down, because we wanted to, we had a bed crisis and we wanted to be able to move patients around, primarily onto … wards so you need to know they're MRSA negative. But ultimately the decision came, I suppose it came down to, it comes down to the laboratory manager of what bit of kit we get, as long as we've got agreement " [Microbiology Manager].

The machine is based in the laboratory. So far the technology has been used to identify patients who haven't been screened pre-admission. Results are available within two hours, as they are treated with priority and processed straight away. The demand for this service is expected to decline as screening of patients reaches desired targets:

"But now that we're screening a lot more I think we're up to about 96% for electives and 90, over 90% for emergencies. So over time it will, we'll be much less reliant on the PCRs because they'll screen more patients on admission or pre-admission. So hopefully, because obviously it is an expensive process, PCR, compared to the normal process. (Lead IPC Nurse).

5.2.2.5.   Bladeless fans

The suggestion for this technology came late in the project, as there were funds available. Previously standard fans had been removed from wards as they were difficult to clean and had presented as a reservoir for bacteria. The idea for the fans came from trust staff who had seen the product in other trusts.

The trial period for the bladeless Dyson fans has commenced. The fans have been in situ for a trial period and have been sent back to Dyson to see how much dust has gathered inside the fan. The expectation of the bladeless fans is that they will gather less dust than conventional fans and will be easier to clean.

Initial microbiology testing by the trust has shown that no harmful organisms were present. In addition the feedback from staff has been positive, and the lead IPC nurse felt that this would

make a difference in levels of hygiene:

"*And our biggest thing was that, yes they can be cleaned so easily by the staff and that's a big bugbear with that type of fan, that staff don't, and some of them they can be quite easily unclipped and staff just don't do it. So if they've got a unit that's really easy to clean it will get done. And it's also their pride in this new equipment as well.*" (Lead IPC nurse)

Next steps are to look at results from the company who are also looking at the amount of dust gathered within the fans.

5.2.2.6.   ATP hygiene monitoring system

This bid was prepared by the IPC team in later iterations of the consultation process as funds remained unspent. The aim was to investigate and develop additional methods to validate cleaning standards for trust equipment by trust staff. The ability to provide 'measurable' results for cleaning practices which could be fed back to staff was perceived to be more effective than current methods of observation.

The trial of the technology is being used currently on "walk around" to look at the standards of cleaning of certain equipment. The cleaning standards of nursing and the PFI contractors are monitored in this way.

Two products were considered and knowledge of the RRP ratings for the products did inform the initial consideration. However decision making was based on a critique of the two systems in terms of functionality and sustainability (Box 6).

Box 6 Considerations made for two ATP products

Hire versus purchase
Pre-calibrated versus self-calibration
Robustness of system if vial leaks
Indicator figures and interpretation
User friendly – simple versus complex
Ease of use and presentation of the accompanying software

The IPC team also reflected on the RRP recommendation process as valuable as the NHS context was considered unique. The fact that a product has been through the process was considered important. However, the temporal dimension to decision making was also noted:

"I know I talked to a few people and they'd gone with 3M™ because it was the first one that got through the rapid review, but they said on reflection, if they were going again they would look at the other company as well." [IPC nurse].

Overall the selected product – the Hygiena system was perceived to be more user friendly and this was reported as a unanimous decision by the IPC team.

5.2.2.7.   ICT system

The aim of a customised and integrated software for MRSA screening is to help monitor and achieve the DH MRSA screening of all Day Surgery patients (from April 2009). The project lead is a matron in planned care.

The anticipated benefits to staff are ease of access to the patient process data. Currently a stand alone IT database is used for recording day surgery, patient details and care. This causes duplication of work and an inability to capture all patient episodes of care. The proposed system would also allow for monitoring of compliance against DH targets and auditing of clinical practice and processes.

The need for the system was articulated by the senior manager:

"There's all the infection control stuff and the follow up.   There's no specific pathway for

monitoring a patient's status for MRSA and pre-admission clinics, especially elective orthopaedics is really crucial. So at the moment they go in, they'll look at one system, they'll look at this, they'll look at that." [Assistant Director for Quality].

The project lead (matron) for this technology is currently exploring ways forward with a number of suppliers and looking at 'off the shelf' solutions.

5.2.3 Trust evaluation of the technology

The trust has communicated some evaluation for those technologies thus far implemented (hand hygiene signage).

For the hand hygiene signage, fifteen minute observation audits of behaviour[34] (opportunities to cleanse hands versus observed cleansing of hands) have been completed pre and post intervention. The audits are based on direct observation by the ward clerk or IP nurse monitoring all hand cleaning opportunities versus observed hand cleansing. The audits have been used during the implementation phase with a phased roll out. These audits were carried out pre-implementation and hand cleansing was low in these particular areas. Hence there are pre and post results available.

Results were fed back and interpretation of the results were made by the IPC and ward/area staff. The flashing hands did not have such an effect in theatres or the thoroughfare ward partly due to the layout of the department and lack of appropriate 'facing' walls. Overall talking units achieved a better result but not significantly so.

Table 14 Hand hygiene audits

	Hand hygiene compliance rates on entrance to hospital area	
Hospital area	Pre-intervention results	Post-intervention results
Thoroughfare pre-admission clinic	5.5%	17.5%
Eye clinic	29%	43%
Theatres	10%	17%
Elective orthopaedics -	32%	45%

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[34] Fifteen minute Lewisham Hand Hygiene audits

ICU	46%	Not done
AAU	33%	43%
Delivery	29%	48%

Further pipa hand hygiene signage units have been purchased on the basis of these results.

For the bladeless fans, two are on loan from Dyson for a trial period. The trust is working with Dyson to trial the fans. The evaluation aims to answer the following questions:

Are the fans easier to clean? Will the fans therefore be cleaned to a better standard (compared to standard fans)? Do the fans harbour micro-organisms inside? Does dust gather inside the fans?

Early indications shows that less dust is gathered, no harmful micro-organisms have been found, and that staff are more likely to clean the fans more thoroughly. Depending on additional results, fans will be procured.

5.2.4 Discussion

5.2.4.1.   The decision making process

The process of decision making for technology selection was highly inclusive, reaching trust-wide to encourage bids. The rationale for this highly inclusive approach reflects the trusts approach to IPC, as explained by the project lead:

"It was driven by the organisation, and we had the money and everybody's so involved in it [IPC] or played their part, that we invited suggestions from the organisation to say, we've got this money. It's got to be spent on innovation technology, what are your suggestions, and they came up with all their packages..." (Associate Director for Clinical Quality).

Further, including as many stakeholders in the decision process was considered necessary for effective implementation:

"It's no good saying, infection control thinks it's great, go and use it. And they say, no it's not practical to use for this reason that reason" (Senior IPC nurse).

The decision making processes were formal, requiring written bids in a template format including: Purpose; Capital Cost; Benefits/Impact; Trust Lead. After review by the project team, final decisions were taken by the Medical Director and the Associate Director of Clinical Quality. The trust's hospital committee was kept informed of decisions, and progress on spend.

The approach described and the response from across the trust provides some insights to the trusts' culture and type of leadership. The medical director for example was described as 'one of the most credible people in the trust' hence his involvement was important.

The resulting technology selections were thus a combination of predetermined and emergent decisions. We define here, predetermined, those technologies which had been selected before the award and the trust was awaiting a funding opportunity. Emergent describes those technologies which were considered after initiation of the project. Further, these decisions as described earlier were inclusive of trust staff rather than exclusive to the IPC team. When compared to other trusts in the sample, Trust 2 took the most inclusive approach to decision making, that is, including the widest number of stakeholders outside of the IPC team. In addition the technologies selected were more emergent than predetermined.

The technology selection in Trust 2 can also be described as 'demand pull' . This means that the priority area was identified and relevant technologies were sought.

5.2.4.2 Evidence

A wide range of sources were used by the different professional groups to get information in three broad areas (Table 15).

Table 15 Type and sources of knowledge used in decision making

Awareness knowledge	*Principles /theory* knowledge	*How to* knowledge
Professional networks	Professional networks	Suppliers
Rapid Review Panel (RRP 1)	Peer review journals	Other Trusts
Trust Staff	Suppliers	Showcase evaluation reports
Supplier marketing		Previous experience (success/failure)

Showcase Hospitals conferences		

(Adapted from Rogers, 2003; Glasby & Beresford, 2006)

Overall, there was consistency in the efforts by each of those involved in the decision making to look for *principles / theory* knowledge. For some of the technologies there was less emphasis placed on the *how to* knowledge at the point of decision to adopt which later delayed implementation, for example the PCR MRSA testing which was intended to be ward based. However good cross–departmental working resulted in adaptation to implementation. However the phased approach adopted by this trust meant that learning from the process was quickly utilised in further decision making for the remaining technologies.

5.2.4.3 Procurement

For those technologies procured through the NHS Supply Chain, the process was described as smooth.

The IPC team has gone through a process of learning in working with the procurement team. The need to involve procurement staff early was not previously recognised by some of the team. For example smaller investments made through direct purchase from one supplier were not replicable when further procurement decisions were made – the initial cost of hand hygiene units was £5,000 but further units have taken total costs up to £10,000 which means formal competitive quotes should have been gathered from more than one supplier.

Other project leads had more experience of the procurement process. The clinical innovation coordinator for example is part of a newly formed resource in the trust; a clinical product review group and investigated the procurement side early on.

Management described the importance of the trust's procurement team:
"*They'll look at any costings or reviews of products that you use in the trust to make sure you're getting value for money and good products. We're now meeting actually once a month with procurement and another matron where we look at products in the trust to make sure everybody's using the same, that we've got best value for money. That we're not cutting*

corners by quality just to save money that sort of thing. So they've got quite a big role.", [Associate Director for Clinical Quality].

5.2.4.4   Context

The trust as a PFI had some influence on the adoption decisions. For example type of hand hygiene signage for consideration was limited. Also previously, hydrogen peroxide had been discussed and the PFI contractors felt the procedure would take a long time, meaning a delay in rooms ready for use. For the purpose of this award they were contacted and invited to make bids and were kept updated of other bids.

The size of the trust, not being extensive and split between numerous sites, meant it was feasible to consult trust-wide. The highly inclusive approach taken by the project team resulted in investments in five IPC priority areas and engagement with various professional groups within the trust. When adopting a highly inclusive approach the method of selection needs to be transparent and final decisions were made by the medical director and associate director of clinical quality with the trust's management committee fully informed of decisions. Also with a highly inclusive approach, as highlighted by respondents there is a risk of losing momentum through a protracted procurement or implementation phase:

"...and there's that fine line between getting everybody on board, which is really, really important, but then not following up by giving them the product because... they will start to lose faith in you thinking they're never going to get it. And you don't want to waste their time in all the trials and the feedback for them never to see anything at the end of it. And yes it will happen, but it just feels that it's taking a very long time and a very hard road to get there." [IPC nurse]

Overall, the IPC team felt that the award and the process followed by the trust in technology adoption have raised the profile of IPC, with technology adoption which may not have otherwise happened. New technology adoption also had a benefit in terms of morale, for example, motivating staff to carry out better environmental cleaning, in the case of the bladeless fans:
"So if they've got a unit that's really easy to clean it will get done. And it's also their pride in this

new equipment as well" (IPC Nurse).

The respondents felt that the approach and resultant decisions were consistent with the organisational culture for example, as articulated by the microbiology manager, ongoing collaboration and discussions are important:

"because from the lab point of view you can provide one thing and is it what actually the ward or the infection control actually need, so there was a lot of stuff done around that." [Microbiology Manager].

5.2.4.5 Implementation

The implementation phase for the various technologies has been captured to varying degrees according to the cut off for this case study. Those technologies adopted in the later iterations of the bidding process have not yet been implemented. Overall the perceived enablers and barriers to implementation are summarised below (Table 16).

Table 16 Enablers and facilitators to implementation

Perceived barriers to implementation	Perceived enablers/facilitators to implementation
• Staff capacity due to staff sickness leave • Staff capacity on wards unable to support implementation of ward based MRSA testing	• Buy-in from trust staff as a result of an inclusive approach to the decision making process • Consultation with users regarding implementation • Technologies perceived to improve overall quality and safety of service, over and above IPC

The HCAI Technology Innovation award and process which followed has resulted in some wider

positive effects. Respondents felt that the importance of IPC has been reinforced, but also the importance of individual units and departments has also been recognised. For example raising the profile of the laboratory within the trust as an important element of quality and safety.

The extent of learning from this process will inevitably have implications for future adoption and also the process which the trust may adopt.

6. Case study – Trust 3

6.1 Context

6.1.1 General Context

Trust 3 is an acute and specialist trust, and is affiliated with a university. The trust has submitted a bid to become an NHS Foundation Trust in January 2010 and is in the process of conducting a public consultation. The trust is one of the largest teaching trusts in England, employing 12,000 staff and providing services for a diverse population of about one million residents from the immediate localities and to a further two to three million people from the nearby region. The trust delivers its services across three main hospital sites and has approximately 1963 inpatient beds and posted a total income of £652 thousand turnover for 2008/09. Services include: emergency services, general acute surgery and medicine, oncology, renal and urology, cardiac and children's services.

6.1.2 Trust Performance

Trust 3 was awarded a 'Good' rating for the quality of services by the Care Quality Commission in the latest annual health check for 2008/09; this is down from the 'Excellent' rating of the previous three consecutive years. However, the trust was awarded 'Good' for its use of resources, from the previous year's 'Fair' score[35].

Table 17 The Care Quality Commission Assessment

	2005/06	2006/07	2007/08	2008/09
Quality of services	Excellent	Excellent	Excellent	Good
Quality of financial management	Good	Good	Fair	Good

The latest (2010) Patient Environment Action Team (PEAT) assessments for Trust 3 are outlined in the table below[36], whereby the trust achieved an 'Excellent' score for Food and 'Good' for both Environment and Privacy & Dignity across all three of the trust's hospital sites.

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[35] Care and Quality Commission, October 2009
[36] Patient Environment Action Team (PEAT) Assessment 2010, National Patient Safety Agency

These scores reflect no change on the previous year.

Table 18 PEAT inspection results

	Environment Score	Food Score	Privacy & Dignity
Hospital A	Good	Excellent	Good
Hospital B	Good	Excellent	Good
Hospital C	Good	Excellent	Good

6.1.3 Infection Prevention and Control Context

In the trust's 2008/09 annual report the trust set out 10 clear priorities for the year to guide the way services and standards are developed. The trust's number one stated clinical priority was Infection prevention and control, with a targeted reduction of 10% in C. *difficile* and further reductions in MRSA infections[37].

6.1.3.1 Trust performance on mandatory HCAI indicators

Table 19 Trust performance on HCAI indicators (Source: HPA)

	2007/08	2008/09	2009/10
MRSA *bacteraemia*	43 cases reported	30 cases reported	19 cases reported
Clostridium difficile	437 cases reported	498 cases reported	498 cases reported

6.1.3.2 Previous trust IPC interventions

Collaboration with the local university's Professor of Clinical Nursing Research has led to a number of research projects in the area of HCAIs. One example is the development of a predictive tool for assessing the likelihood on admission to hospital of the development of C. *difficile* infection.   Regards technologies, the trust has adopted the following four RRP 1

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[37] Trust Annual Report 2008/09

technologies: Hydrogen peroxide; Silver coated Urinary Catheters, *ChloraPrep,*and Flexi-Seal. The trust has not implemented ATP hygiene monitoring, but has recently considered this technology. An ATP unit is on loan for teaching and demonstrations.

6.2.1 HCAI Technology Innovation Award: Trust IPC Areas of priority and technologies selected

Who was involved and how?

The IPC committee including consultant microbiologists, clinicians and IPC nurses discussed the award for generating ideas. Wider trust staff were not involved, but the decisions were communicated through to the trust board.

The business plan was approved in June 2009.

Based on the technology decision the project was led by the Lead IPC Nurse and the Senior IPC Nurse with extensive experience of surveillance.

Initial options considered

There were two suggestions considered; the computer surveillance systems (ICNet) and sliding doors to seal off individual bays.

The second suggestion though economical was not considered high priority and perhaps could be funded elsewhere and was not perceived as very innovative:

"This money was too valuable" (Lead IPC Nurse)
"We didn't think doors were very innovative" (Senior IPC Nurse)

As earlier described the trust had previously invested in fourof the RRP 1 products.

What was finally selected?

The trust decided to dedicate all funds to one technology, Infection control IT surveillance system (ICNet). The award monies covered installation and maintenance for 3 years.

Table 20 Technology, priority area and progress (August 2010)

Technology	IPC priority area	Brand/supplier	Procured	Implementation
Infection control IT surveillance system	Surveillance	ICNet	Yes	NO – (as at August 2010)

6.2.2 Technology selection, procurement and implementation

Decision Making Process

This technology had been considered prior to the award. One team member had begun a review of available systems and had identified two systems which met specifications devised by the trust IPC team. The first was Quality Compass; but this was considered cost prohibitive. The second, ICNet; this had a larger user base and was more affordable. The existing user base and potential to share information, benchmark and feedback information to DH was a key consideration in decision making. In addition the key attributes of the technology considered were ease of use and resilience.

After these considerations the potential to integrate with the trust system was explored as this was a complex issue. A visit to another trust with the system in use was made.

Table 21 Anticipated benefit of technology

Perceived Relative Advantage
Predictive ability
Saving IPC staff time
Allows monitoring and planning

Table 22 Perceived innovativeness

Perceived Innovativeness
Compatibility with existing systems
Predictive ability

The project lead was very clear about the decision to invest in the technology and the potential for targeting other interventions, and making cost savings.

"I'm very clear that we must have in this Trust, a robust surveillance system, because I absolutely fundamentally believe that a robust surveillance system will allow the Trust to direct its money most effectively on interventions that will support directly patient care and so for me, there was absolutely no question what we would spend this money on", [IPC Lead]

The three year investment is aimed at gathering data to build a robust business case:

"And then we want to be able to extract some meaningful data from it, that we can then convince the Trust to invest and to maintain the system and for it to be ongoing, and for us to then develop an ongoing surveillance program", [Senior IPC Nurse].

Procurement Process

The procurement process was described as a steep learning curve for the project lead due to the amount being invested in the one technology. The procurement negotiations were managed through the IT department at the trust. The procurement was made through a local framework. Once the procurement team were involved the process was smooth. As described by the IPC nurse, the process was new to the team:

"we've never spent this amount of money, we didn't include procurement or the finance department in those discussions, and so we didn't realise how complicated the process of spending this amount of money was. And I have to say, to be fair, they were really good, really supportive and once we talked to them, they directed us...there was the potential then that we may have to go out to tender for six, three or six months in the European Journal, which we hadn't even considered, because we didn't appreciate that was the process. So we thought that was going to be another huge stumbling block" ,[IPC nurse].

The procurement team provided support in writing the business case and was able to advise that a tender process was not in fact required as the IPC team had done the background

research to uniquely identify the ICNet system.

Implementation Process

The delay in implementation has been due to the internal upgrading of the trust's IT systems. The ICNET project was placed in a queue with a work plan but has been delayed by 10 months. Hence at the time of writing this report the trust has not implemented the technology. A partial implementation was considered to allow training to commence but this would require duplication of work at a later stage.

Once implemented the planned areas of surveillance include:
- o Surgical site infection
- o Ventilator associated pneumonia
- o Central line associated bacteraemia
- o Haemodialysis catheter related infection
- o Catheter associated urinary tract infections
- o Cannulae associated bacteraemia

6.2.3 Trust evaluation of the technology

Evaluation of the technology will be along the following dimensions;
- o Ease of use
- o Integration with current ICT systems
- o Impact on working practice
- o Savings to IPC staff time

Longer term evaluation will be on outcome measures to be defined once the system has been implemented.

6.2.4 Discussion

6.2.4.1.   The decision making process

The process of decision making for technology selection was exclusive to the IPC team, with decision communicated to the wider trust. The rationale for this highly exclusive approach reflects where the trust was in terms of its IPC strategy and the area of priority identified; surveillance. In addition as described in the introductory section, Trust 3 has implemented the majority of RRP 1 products to date. The preliminary work assessing competing solutions had been carried out prior to the HCAI Technology Innovation award announcement in February 2009.

We define here, predetermined, those technologies which had been selected before the award, typically whereby the trust awaited a funding opportunity. Emergent describes those technologies which were considered after initiation of the project. Trust 3 used all funds for one technology and the decision is described as predetermined and exclusive to the IPC team. As described earlier, members outside of the IPC team were not involved in generating ideas for use of the award.

6.2.4.2 Evidence

In terms of evidence this IPC priority area had been highlighted in the DH's commissioned project – the ASEPTIC[38] project. The recommendations from this report were used to inform the decision making and initial specification for potential systems to be considered. In addition experience from other users within the NHS was sought. During this exploratory work the IPC leads contacted long-standing as well as recent users of the system.

The project team used a wide range of sources to get information in three broad areas (Table 23). Knowledge awareness: to find out what is available in terms of the range of technologies specific to IPC. Principles or theory knowledge: why and how a technology works in terms of the underlying scientific principles or theory. How to knowledge: how to put the technology in to use,

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[38]Fearon & Parnell, 2003 ASEPTIC – A systems evaluation project for infection control
http://www.hpa.org.uk/web/HPAwebFile/HPAweb_C/1194947365304

including all aspects of implementation.

Overall, there was consistency in the efforts by each of those involved in the decision making to look for the three types of knowledge about the technology and IPC priority area.

However, this said, initially the project leads had not anticpated the level of complexity and potential issues of compatibility involved. Trust 3 used other trusts as sources of 'how to' knowledge, particularly for issues of integration with hospital information systems

Table 23 Type and sources of knowledge used in decision making

Awareness knowledge	*Principles /theory* knowledge	*How to* knowledge
Professional networks Rapid Review Panel (RRP 1) Supplier marketing Showcase evaluations	Professional networks Trust IM& T Peer review journals Supplier ASEPTIC report	Supplier Other Trusts –site visits Showcase conferences

(Adapted from Rogers, 2003; Glasby & Beresford, 2006)

6.2.4.3 Procurement

The IPC team had not anticipated the implications for the procurement process as a result of funds being used for one technology. As discussed above, earlier involvement of the procurement team would have made the process smoother and quicker.

6.2.4.4   Context

Culturally there was high consistency amongst the IPC team and belief in the targeted IPC area as most beneficial in terms of patient outcomes. The trust had previously adopted most of the technologies recommended by the RRP and considered themselves as leaders in innovation adoption.

Overall the trust prided themselves on a pro-innovation culture and demonstrated this through successful implementation of complex technologies previously.

6.2.4.5   Implementation

In spite of the delay in implementation the team expressed a highly optimistic view of the potential of the system. The trusts envisage implementation to commence in November 2010

7. Case study – Trust 4

7.1   Context

7.1.1 General Context

Trust 4 is an acute and specialist trust and is affiliated to a medical school and local universities. The trust is a regional teaching hospital, delivering services from two sites and a number of specialist units, including a newly re-opened children's hospital built under a PFI scheme. It employs around 6000 members of staff, has 850 beds and provides a full range of acute services to the local population and specialist tertiary services for the wider region. Tertiary services include neurosciences, paediatrics, cardiac, cancer, renal, infectious diseases and HIV care. In 2008/09, 516,000 patients came through the trust's doors, including around 45,000 elective inpatients and day cases, 54,000 non-elective inpatients, 136,000 A&E admissions and 406,000 outpatients[39]. The trust's income for 2008/09 was approximately £353 million[40].

The trust aims to achieve foundation trust status by the end of 2010.

7.1.2 Trust Performance

The trusts' performance was rated as 'Good' for both the quality of its services and financial management by the Care Quality Commission in the latest annual health check in 2008/09. This is compared to the 'Excellent' and 'Fair' scores received for quality of services and financial management respectively for the previous year. The trust was also ranked among the safest NHS organisations in the country by the Dr Forster Hospital Guide 2009 which measured trusts across 13 safety measures[41].

Table 1: The Care Quality Commission Assessment

	2005/06	2006/07	2007/08	2008/09
Quality of services	Fair	Fair	Excellent	Good
Quality of financial	Weak	Weak	Fair	Good

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[39] Trust website
[40] Trust Annual Report 2008/09
[41] Trust Quality Report 2010/11

management

The results for the most recent (2010) Patient Environment Action Team (PEAT) assessments for the trust's hospitals and sites are outlined in the table below[42].

Table 24 PEAT inspection results

	Environment Score	Food Score	Privacy & Dignity
Hospital A	Good	Good	Good
Hospital B	Excellent	Good	Excellent
Hospital C	Good	Excellent	Good

7.1.3 Infection Prevention and Control Context

The trust states that the prevention and control of infection is their number one priority[43]. The Infection Prevention and Control Team is comprised of qualified Infection Control Nurses (6, including 2 Senior Infection Control Nurses and 1 Nurse Consultant), audit and surgical site surveillance nurses and an Infection Control Doctor, a Consultant Microbiologist; reporting directly to the Chief Nurse. The team works with colleagues and other health-care professionals, patients and visitors, providing: specialist infection control advice; education to all healthcare workers; surveillance of infection rates; and audit practices central to care including the cleanliness of the hospital. In January and September 2009 the trust passed unannounced inspections by the Care Quality Commission. For 2010/10 the trust sets the aim of achieving no more than 8 MRSA bloodstream infections, and no more than 155 cases of C. *difficile* acquired in the trust's hospitals[44].

7.1.3.1 Trust performance on mandatory HCAI indicators

[42] Patient Environment Action Team (PEAT) Assessment 2010, National Patient Safety Agency
[43] Trust website
[44] Trust Priorities document 2010/2011

Table 25: Trust performance on HCAI indicators (*Source: Annual Report 2008/09 and Quality Report 2009/10)*

	2007/08	**2008/09**	**2009/10**
MRSA *bacteraemia*	66 cases	36 cases	24 cases (target, Max no of cases 36
Clostridium difficile	322 cases	184 cases	148 cases (target, max no of cases: 163)

7.1.3.2 Previous trust IPC interventions

In January 2008 a special ward opened as a cohorting ward for care of patients with C*. difficile*, taking all patients who test positive for C*. difficile* toxin and active diarrhoea. Based on available evidence, the initiative has been very successful, with audit data indicating that all the cause mortality for patients with severe C*. difficile* infection has fallen markedly since the ward's opening[45].

The trust also participates in the National Patient Safety Agency "clean*your*hands" campaign. In September 2008, the trust reviewed the placement, accessibility and suitability of alcohol hand gel. The trust reports full compliance by removing and relocating alcohol hand gel in some non-clinical areas. A review of the storage of the alcohol hand gel in clinical areas has also been implemented.

This teaching trust has also developed and launched (2008) a customised ICT package (Infection Control TeamTrack]. The software allows access to 'live' laboratory data on alert organisms and has so far alerted IPC to over 4000 notifications.

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[45] Trust Infection Prevention and Control Annual Report 2008/09 and Infection Prevention and Control Annual Programme for 2009/10

7.2.1 HCAI Technology Innovation Award: Trust IPC areas of priority and technologies selected

Who was involved and how?

The process began informally with the IPC team discussing the range of technologies already familiar with and scanning journals for new technologies. Later a more formal approach was adopted with identification of a project team to lead the decision making process. The team comprised: DIPC (medical director), medical microbiologist, nurse consultant at the time and the director of facilities. IPC team members discussed a range of technologies and attended a Clean Safe Care conference and exhibition in London (17.06.2009) to help find out about current technologies. The project team then invested time individually and collectively to gather information from manufactures and peer reviewed literature. A shortlist of technologies was compiled and manufacturers were invited in August 2009 to present to the project team. Final selections were made at the end of the day's presentations. The selection process therefore was completed within six months from the award.

Following on, the nurse consultant and her administrative assistant prepared the paperwork for the bids. The approved product representatives visited the trust in October and orders were placed.

Initial options considered

The shortlist considered further by the project team is included below . The selection decisions are set out for each.

Table 26: Technologies considered

Supplier/Technology	Outcome of decision making process
Hygiena – Rapid ATP Hygiene Testing	unsuccessful - the group preferred a similar product – Clean-Trace™
Vygon – IV TimestripPlus™	successful
3M™ – Clean-Trace™ Clinical Hygiene Monitoring System	successful
Sunlight – Air Disinfection Units	unsuccessful – the group preferred the UV system designed by Medixair
Proventec – Difficil-S	unsuccessful – the group felt that at this stage this was not the type of

	product to take forward and that it should be led trust-wide
Kirton – Commodes	unsuccessful – product still on the production line and the group felt that this should be led at ward level
Cepheid – Rapid PCR for MRSA screening	unsuccessful – cost prohibitive - £100K for 3 months supply. The group may review this again at a later date
Medixair – Air Sterilisation Units	successful

The Vygon – IV TimestripPlus™   was later discounted for procurement due to prior work at the trust with the intravenous nurses (Box 7). This demonstrates cross departmental collaboration which avoided an inappropriate technology selection decision.

Box 7: Discounted technology

Vygon – IV TimestripPlus™

Aim: Enhancing current practices around the removal of peripheral catheters at 72 hrs

- Proposal discussed with IV Team Lead revealed that the product has already been introduced in various places across the Trust on a pilot agreement between the IV team and the company. The IV lead is also working with the company on the development of a 96 hr timestrip.

Outcome:
- Consequently, this product will not form part of the project work.

- Group to look into reviewing an alternative IV product.

What was finally selected?

The trust selected three technologies. Two of these technologies aimed to address environmental hygiene; Medixair Air Sterilisation Units and 3M™ Clean-Trace™ hygiene monitoring system. One technology was selected to reduce catheter associated infections and patient hygiene; Biopatch (Chlorhexidine dressing) which was first considered at a later iteration of decision making.. In addition to these, the trust used funds to employ a research nurse for 6 months, to oversee the project, particularly implementation and evaluation. The nurse was

employed after the technologies had been procured, and hence she was not involved in the decision making process.

Table 27 Technology, priority area and progress (August 2010)

Technology	IPC priority area	Brand/supplier	Procured	Implementation
Medixair Air Sterilisation Units	Environmental hygiene	GE Healthcare	Yes	Yes
ATP hygiene monitoring system	Environmental hygiene	3M™	Yes	Yes
Biopatch (Chlorhexidine dressing)	Catheter care (renal catheters)	Johnson & Johnson	Yes	Yes

7.2.2 Technology selection, procurement and implementation

Whilst a project team led on the decision making process, formal structures such as regular meetings, minutes and work plans were not formalised. These processes were adopted after technology selection, once the research nurse had been appointed. The nurse was appointed specifically to manage the process as the trust was facing difficulties due to a number of staff capacity issues. During the life of the project, as well as a change in DIPC, change in the nurse consultant, the lead IPC nurse had been on long-term sick leave.

7.2.2.1 Ultra Violet (UV) Air Sterilisation Units - Medixair

Decision Making Process

Medixair was considered through the decision making process described above. Specifically consideration of evidence of effectiveness was made. There were mixed perceptions as to how effective the technology would be in reducing HCAIs.

"So my feeling about a lot of the technologies that we see, there is no evidence that they reduce infections. But some have evidence that they might have the potential to reduce infections by demonstrating that they kill bacteria or keep the environment clean etc." [Medical Microbiologist].

The product is a winner in the Smart Solutions work streams in the HCAI Technology Innovation programme, however this was not mentioned as a factor in the decision making process.

Procurement Process

The procurement team were involved at the point of compiling the business case for each of the technologies. The process was described as 'slow' as a number of queries were raised by the procurement team.

Procurement was direct from the supplier. Procurement frameworks were not explored. The process was described as efficient. Purchase orders were made as follows: for six units 19/11/2009, for further six units 25/11/2009. The units were delivered in December 2009.

Implementation Process

Twelve Medixair units were placed on the renal ward. The twelve units were in two bays each comprising six beds on the renal ward, with the highest risk patients. The units were placed, as advised by the company, one per bed space. The units were used as free standing, but could be wall mounted which staff preferred for stability of the product and creating more space.

Prior to installation, air samples for testing were taken. A similar process is planned for a respiratory ward at the other hospital site.

A number of issues came to light after procurement, at implementation stage. For example the delivery of the units was on a large pallet and took up a lot of space on the ward until assembly of the units. Upon assembly, the staff noticed screws were missing from the units which delayed assembly. Engineers were not on site to facilitate. This was offered for any future purchase of units. Whilst the units come with a year's supply of filters, each needs changing every 3 months.

This was not apparent at time of purchase. In addition, the unit comes with 4 UV bulbs in situ. These also require changing on a yearly basis. Again this was not apparent at time of purchase. Hence the staff uncovered a number of running costs associated with the technology not apparent at time of technology selection. These extra items need to be procured as a service pack from the supplier.

7.2.2.2 Hygiene Monitoring System - CleanTrace™ / 3M™ATP

Decision Making Process

Following company presentations as described earlier, at the trust in October 2009, further discussions took place with 3M™ early November to agree quantities.

Procurement Process

A purchase order was made on 25/11/2009. Procurement was through the NHS Supply Chain. There was some delay in signing the contract due to miscommunication between companies and agreeing delivery quantities. This was signed in February and the product was delivered within the month.

Implementation Process

Training of facilities staff commenced in March 2010. According to the medical microbiologist, with the aim of evaluating the technology, initial implementation was not managed effectively:

"...once it got out of there we lost control of it and because no nurse in our team was watching it, it's almost become embedded as the routine, not a research project, not an evaluation project. I've had to say to the staff, stop. Decide where Clean-Trace™ is to be used, leave it at that, decide how long you're going to let it run there for keeping an eye on the budget and then decide, we need to decide how we're going to evaluate it" [medical microbiologist].

A detailed implementation plan has been drawn up for the duration of one year (up to March 2011).Clean-Trace™ is being used in areas identified as high risk areas with high incidence of *Clostridium difficile* and MRSA. Weekly swabbing of areas, defined in a sample plan, are recorded on accompanying software. Specific sites and issues are highlighted; for example

cleaning technique or particular items such as bed tables/lockers which are contaminated.

7.2.2.3 Chlorhexidine Gluconate (CHG) Dressing (disk) - Biopatch®

Decision Making Process

The Biopatch (Chlorhexidine dressing) for central lines[46] was suggested by the intravenous nursing team. This suggestion came later in the project as there was capacity on the award monies. The idea had come from evidence in the literature:

"I think in some of the papers, or there was one particular paper which described it, well, which seemed, or appeared to show that there were reductions in vascular line related infections. So there was an influence there" [Medical Microbiologist].

Two types of dressing were considered initially. Biopatch dressing and 3M™ CHG dressings were evaluated on the renal dialysis ward in November 2009. Staff preferred the Biopatch dressing as it gave full coverage of haemocatheter insertion site and was easy to apply and remove.

Box 8 Anticipated benefit of technology

Perceived Relative Advantage
Will reduce catheter line associated infections

A decision was made with the IPC team to procure Biopatch for a 12 month trial project.

Procurement Process

The product was procured through the NHS Supply Chain and this process was described as 'straight forward'. A Purchase order was raised on 18.02.10 and the product was delivered early April 2010. Stocks were ordered and pulled down to wards on a monthly basis.

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[46] Chlorhexidine soaked pad that goes around the insertion site of central lines to prevent extra luminal line infection.

Implementation Process

Prior to the project the trust was not using a Chlorhexidine dressing on line insertion sites.

For this project, implementation was on the Renal wards. Guided by evidence that for renal patients, the highest risk of patients developing a bacteraemia occurs in the first 14 days following line insertion, a protocol was devised as follows:

- o   Biopatch would be placed under the clear dressing when all the renal lines inserted
- o   Biopatch removed and second Biopatch placed when the dressing was changed for the first time after 7 days
- o   No Biopatch dressing on the renal lines after this period

The project implementation will be for 12 months and no other interventions will be made regards IPC in the renal unit related to central venous lines. Implementation is on the dialysis ward only. Data is being gathered by the audit nurse on the dialysis ward for a period of 12 months. This commenced in April 2010 and therefore is due to complete in April 2011.

7.2.3 Trust evaluation of technologies

The trust viewed the main purpose of the award to 'evaluate' new technologies, which had a bearing on technologies considered. In addition, the project team felt that the size of the funds was insufficient to fully evaluate the impact of the technology on HCAI rates. The trust invested some of the funds to employ a research nurse for six months to manage implementation and evaluation.

Evaluation is ongoing, currently available results are included in summary here.

Box 9 Evaluation of Medixair air sterilisation unit (Source: Trust technologies report)

Method 1: Air sampling using Trypticase soy agar plates was performed for 5 days pre installation of the 12 units. This was done in the 2 bays containing the units, as well as 2 other x6 bedded bays for comparison. Air sampling was repeated a week after installation of the units for a further 5 days.

Results 1: The results show no clear advantage in the bays with/without units in place.

Method 2: Structured 8 item questionnaire completed by ward staff

Results 2:

- o Units were found to be completely noise free
- o Units were found to be difficult to clean around and created clutter.
- o Units require 24hour electrical supply, so become ineffective if switched off at any point.
- o The units did not seem to impede normal staff/patient routine.
- o The Ward Manager was happy for the trial but felt that the units would require wall mounting if long term.
- o Generally patients/visitors/staff were interested in the units and their prospective benefits.
- o One patient was distressed and suspicious of the units presence despite reassurance that it was purely a trial process.

Conclusion:

- • On dissemination of results - ward staff did not feel there was conclusive evidence demonstrating benefits of the product.
- • The grid on top of the unit had potential to become contaminated in an outbreak scenario and would be difficult to deep clean.

The ward manager on the Dialysis ward commented on the evidence base of the technology and Trust 4's experience so far:

"I mean the company sold it to us as the bees knees, there is a very, very small study with, involving literally one patient with inside rooms...and it reduces infection to nothing, and you know the germ count went down to nothing, and this and that. I mean nice study, but not quite convincing, but I thought well I'll keep an open mind, because we have high risk patients. And if it does help at, you know something that's given to me by the trust, and little cost of maintenance, compared to having to buy the things, yes, I would be in favour of, for the safety of patients. If I, if it doesn't convince me, if just the count has not reduced so much, then I think maybe the trust should invest the money into something else, that is actually proving, rather than being seen to do something, do something that actually works." (Ward Manager)

In light of the evaluation the trust decided not to progress with any future order of units, but will maintain the units for the year (2010/11) but unlikely to continue after that:

"The Medixair is the one where we've got furthest with the project and we've got a better idea about what it's like to use and, we've uncovered all sorts of complicated things about maintenance and additional hidden costs and all the rest of it. So, and a little bit of evidence that it doesn't affect C diff rates or environmental contamination rates, so that's where we've got more of a conclusion that this thing probably isn't worth pursuing further" [Medical Microbiologist].

For the ATP Clean-Trace system, as described above implementation was not managed as intended but an evaluation project plan has subsequently been drawn up. Early findings on process issues which can affect validity of any future evaluation are summarised below (Box 10).

Box 10 Clean-Trace ATP monitoring system (Source: Trust technologies report)

> o   Limitations of the system identified to inform future evaluation:
> o   Sampling techniques of operator(s) may vary. This should be minimised through appropriate initial training and refresher training
> o   Sample sites may not be completely comparable dependent upon differences in items procured, materials used in construction of equipment, specialist equipments.
> o   The sample obtained will only be a proportion of the surface of the site and therefore a contaminated area may be missed
> o   The data and results that are obtained should not be interpreted as a definitive level of environmental cleaning that has been achieved across each ward and department. The interpretation is merely a sample of a sampled site of equipment or the environment.
> o   All wards and departments must maintain consistency in the level of cleaning practises that are employed at all times. The production of positive data must not lead to complacency or a reduction in cleaning services or frequencies that are stipulated in the cleaning schedules of each ward / department.

The evaluation study for the Biopatch commenced in April and an audit nurse is collecting data as follows:

"An audit nurse up on renal unit who's gathering the data, all of our line infections, and so we'll be able to write up in April next year. Hopefully we'll see a reduction in our line infections. We have a little pocket of infections in renal, we have just a little difficulty because the patients go home and we don't have any control over what they're doing when they're at home" [Research Nurse].

7.2.4 Discussion

7.2.4.1 Decision making process

The process of decision making started as fairly exclusive to the IPC team in terms of generating ideas. Estates were involved in the decision making process and the DIPC is the medical director. Later, when decisions for use of remainder funds were being considered, a more inclusive approach arose. For example the use of the Biopatch was suggested by the intravenous nurses.

The selected technologies were discussed after announcement of the award; none were considered before the award. In addition the technology adoption process for Trust 4 can be described as technology push as opposed to demand pull. That is technologies were identified first and use and fit with strategic plans was considered second. A demand pull approach involves IPC priority area selection first, followed by scanning for relevant technologies.

The under spend of funds (almost 50%) of the award as at 31.07.10 was attributed to staff capacity issues earlier described. Plans for further technology adoption are in the area of diagnostics. This decision has been led by the medical microbiologist and a demand pull approach is being adopted:

"And it takes a while until you think about, well what are our problems, how can we use the money to help solve our problems? So I just took an executive decision to do what was worrying me and, I don't know if you know much about C diff, but there's nationally a real concern about what is the right test to do, and everybody's doing something different now. And they're all playing with new things, so I thought, well let's do some PCRs for C diff in parallel with our standard testing and see what we can do with it." [Medical Microbiologist].

This demonstrates application of learning through the life of the project. Previous technology adoption was characterised largely by technology push.

The trust reported that fragmented project management due to poor staff capacity had an

impact on the project with the project lead (nurse consultant) resigning one month into the project. The main aim of the award, as understood by Trust 4, was to evaluate technologies and hence had an effect on each of the phases of selection, procurement and implementation. For example no long term procurement decisions were made as each technology was 'on trial'. As the medical microbiologist explained:

"I've had to reiterate it again and again and again, how are we going to decide if we like Clean-Trace™ or not and nobody's thinking about it,...And because if you get in a panic about C diff the managers pick up on it and say, oh well we're using Clean-Trace, well we'll use Clean-Trace there as well, it might help solve the problem. And you just lose control of it completely, so I've really been firm about drawing a line under it" [Medical Microbiologist].

7.2.4.2 Evidence

The use of evidence in selecting the technologies had concentrated more on the principles/theory than the 'how to' knowledge. Culturally, there was a view that 'hard scientific evidence' was the driver for successful implementation:

"if there was really good significant data that there is a reduction or it does help to reduce, and if there was a case where you really believe that it does make a difference and it's proven, then I think the organisation would have to incorporate that into its daily, routine...it's just say all your key stakeholders within the organisation, and I think they they're all interested in reducing bacteraemias and infections in their particular areas. And I think there would be interest if there was proven, and I think people would reprioritise to fit this in" [Infection Prevention Nurse].

However there was acknowledgement that most of the 'evidence' was about the ability of the technology to reduce bacteria, without the establishment of causation that this also goes on to reduce HCAIs:

"So my feeling about a lot of the technologies that we see, there is no evidence that they reduce infections. But some have evidence that they might have the potential to reduce infections by demonstrating that they kill bacteria or keep the environment clean etc." [Medical Microbiologist].

Table 28 Type and sources of knowledge used in decision making

Awareness knowledge	*Principles /theory* knowledge	*How to* knowledge
Professional networks Peer review journals Previous experience of same/similar technology Showcase evaluations DH HCAI dissemination conferences	Peer review journals Supplier Expert advice Own research / evaluation	Previous experience of same/similar technology Supplier marketing

(Adapted from Rogers, 2003; Glasby & Beresford, 2006)

7.2.4.3 Procurement

The need for earlier involvement of the procurement team was cited as a learning point for future adoption decisions.

"*...they* [procurement] *should have been involved from the very early stages...maybe things would have gone a bit smoother, maybe it would have been a high profile thing for them. Because this whole technologies award is a really big deal for the trust, you have such a good thing to say, you've won an award because of your turnaround time of your infections. It's a great thing and I think that would have, I think with them if they'd appreciated that maybe that things possibly would have moved on a bit further, maybe communications between us would have been a bit more open and freer. So I think possibly if there was, if I could have the time over again I think that possibly to involve them in the early stages...they just supplied us with the plan and how much it would cost. I think maybe if they were involved maybe there could have been more negotiations, I don't know*. [Infection Control Nurse].

7.2.4.4 Context

The 'ability to evaluate' the technology impacted on technology selection and was indicative of the trust's approach to innovation adoption and IPC. The trust had interpreted the purpose of the award to be specifically for evaluating technologies. Low staff capacity impacted on implementation and on the project significantly. However the trust demonstrated within the life of the project learning by employing a research nurse to manage the process as well as a different approach to technology selection for the remainder of the funds.

7.2.4.5 Implementation

Overall barriers and facilitators to implementation are summarised below.

Table 29 Barriers and facilitators to implementation

Perceived barriers to implementation	Perceived enablers/facilitators to implementation
o Low staff Capacity due to staff turnover and sickness absence o Discontinuity of project lead o Late involvement of procurement team	• Appointment of a research nurse to lead implementation and evaluation of the project • Good working relationship with ward staff

8. Case study – Trust 5

8.1 Context

8.1.1 General Context

Trust 5 is one of the largest foundation trusts in the country and also one of the largest and busiest teaching hospitals. It is a major employer in the region with over 13,500 staff and plays a key role in the education and training of medical, nursing and dental students in partnership with a number of affiliated universities. The trust manages and delivers its services from five hospital sites, providing care to over 500,000 residents locally and a further 1.7 million people from the surrounding region. The trust has over 2200 beds across all sites, including a new hospital wing built as part of a PFI scheme. During the last year the trust has performed over 260,000 inpatient episodes and day cases and around 940,000 outpatient appointments. The hospital offers a full range of local hospital services as well as a number of specialist services. In particular, the trust is recognised internationally for its work in neurosciences, spinal injuries, cancer, transplantation, and orthopaedics. The trust's income from patient services for 2009/10 was £647.9 million[47].

The trust emphasises strong links with its academic partners, in terms of both teaching and research. In 2009/10 the trust was involved in 450 clinical research studies and has an annual research income in excess of £15 million; placing the trust amongst the largest research institutions in the United Kingdom.

8.1.2 Trust Performance

In 2008/09 the Care Quality Commission rated the trust's performance as 'Excellent' for the quality of financial management, maintaining this score for the fourth consecutive year, and 'Good' for the quality of its services.

Monitor, the independent regulator of NHS s, gave the trust a financial risk rating of 4 (rated 1-5, where 1 represents the highest risk and 5 the lowest) and a governance risk rating of green

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[47] Trust Annual Report 2009/10

(rated red, amber or green).

Table 30 The Care Quality Commission Assessment

	2005/06	2006/07	2007/08	2008/09
Quality of services	Good	Excellent	Excellent	Good
Quality of financial management	Excellent	Excellent	Excellent	Excellent

The most recent (2010) Patient Environment Action Team (PEAT) assessments for Trust 5 are outlined below[48]. All three hospital sites rated received 'Good' score for Environment, Food and Privacy and Dignity, maintaining the same scores on all three measures of the previous year.

	Environment Score	Food Score	Privacy & Dignity
Hospital A	Good	Good	Good
Hospital B	Good	Good	Good
Hospital C	Good	Good	Good

8.1.3 Infection Prevention and Control Context

The trust states it's number one priority is infection prevention and control and aims to achieve a year on year reduction in the number of cases of MRSA and C. *difficile* towards a zero rate of preventable infection. Over the last five years there has been an 83% reduction in the number of MRSA bacteraemias, which includes a 33% reduction in cases during 2009/10 compared to the previous year. While similarly, the 60% reduction in C. *difficile* includes a further 24% fall in the number of cases detected in 2009/10 compared to last year[49]. Following an unannounced inspection by the Care Quality Commission in February 2010, all of the trust's five hospital sites were given a clean bill of health, passing all 15 standards assessed.

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[48] Patient Environment Action Team (PEAT) Assessment 2010, National Patient Safety Agency
[49] Trust Annual Report 2009/10

8.1.3.1 Trust performance on mandatory HCAI indicators

Table 31 Trust performance on HCAI indicators (Source HPA)

	2007/08	2008/09	2009/10
MRSA *bacteraemia*	36 cases	25 cases	16 cases
Clostridium difficile	517 cases	267 cases	202 cases

8.1.3.2 Previous IPC interventions

To achieve the aim of a year on year reduction in the number of cases of MRSA and C. *difficile*, the trust introduced a number of initiatives during 2009/10, these included among others:

- Revising the trust's infection control accreditation scheme, expanding on areas of care that are regularly audited
- Ensuring commode cleanliness as a priority, with regular spot audits undertaken by the Infection Prevention and Control team
- Screening all patients admitted for a planned procedure for MRSA before they come into hospital (well ahead of the March 2010 deadline set by the DH for this requirement)
- Introducing an infection prevention and control e-learning package for staff to undertake education and training in a flexible and consistent manner
- Extending the Norovirus testing services to enable responsive management of any infections that occur

In addition to these, the trust has outlined further initiatives for 2010/11, including:

- Investigate the use of new technology in optimising cleaning schedules and protocols
- Collect data to include *Staphyloccocus aureus* and *E.coli* bacteraemia. Feedback of audit and infection rate data to wards and departments will be expanded and this information made more publically available
- Continue to work with colleagues in the primary care sector to optimise antibiotic prescribing practice in the community and care of patients with C. *difficile* and MRSA
- Review the feedback process of accreditation scheme audit results and investigate ways of expanding this to allow staff and patients greater access to their results
- Continue to undertake reviews of areas with C. *difficile* infections; this will include clinical

practice, antibiotic prescribing and environmental cleanliness audits

- Participate in a national multi-centre C. *difficile* vaccine study
- Introduce the World Health Organization safe surgery checklist to all operating theatres in the trust during 2010/11and monitor its use and effectiveness throughout the year

In December 2009, the trust invested in a robot to assist with the pharmacy service.

The trust has also trained and appointed Infection Control Assistants (ICAs). They have no formal nursing training and some were selected from the domestics personnel.

8.2.1 HCAI Technology Innovation Award: Trust IPC Areas of priority and technologies selected

Who was involved and how?

The IPC team meets monthly and includes the infection control nurses, infection control doctors, microbiologists, antibiotic pharmacist, management (chief nurse), and procurement specialist.

When the award notification was made, the chair of the group invited proposals with a one month timeline. Paperwork for the selected technologies was prepared by the senior IPC nurse and the medical microbiologist. Other trust staff were not consulted for idea generation. The team made a decision to select technologies which could be delivered with input confined to the IPC team as the time frame of the award was considered 'tight'.

Initial options considered

From an initial group of suggestions, four were considered and then three selected (Box 11).

The discounted technology was an ICT technology, VitalPAC (see Trust 6). The main reasons for discounting this option were 1. The technology would need to be implemented trust-wide and the large size of the trust was perceived a barrier to adoption. 2. Wireless environment currently not available in the trust 3.The technology was still in developmental stages 4. High ongoing costs

Whilst many benefits of the technology were identified the IT infrastructure was not mature enough to introduce a new trust-wide initiative:

"The problem is how do you make it work. Up until this year we had three different patient administration systems that didn't even talk to each other" (Deputy Chief Nurse).

Box 11 Technologies considered

1. Develop the electronic patient identification system, currently being rolled out to optimise blood transfusion management, for the purposes of logging insertion and on-going management of peripheral intravenous lines
2. Evaluation of ultrasonic cleaning tanks
3. Evaluation of rapid technology for identifying organisms within positive blood cultures
4. Evaluation of ATP technology to assess the thoroughness of environmental cleaning

Option 1 was ruled out as the technology was not advanced enough to progress in the coming year.

Options 2,3,4 were considered worthy of progressing assuming the costs could be funded either from the £150k award or from other Trust sources.

What was finally selected?

The three remaining technologies came within budget and were selected, procured and implemented.

Table 32 Technology, priority area and progress (31 July 2010)

Technology	IPC priority area	Brand/supplier	Procured	Implementation
Ultrasonic cleaning tanks	Medical devices hygiene	Medisonic	Yes	Yes after trial period
ATP hygiene monitoring system	Environmental hygiene	1.3M™ Clean-Trace™ 2.Health Edge	Yes – for trial and evaluation	
Microbiology testing	Diagnostics	MALDI-TOF	Yes	Yes

8.2.2 Individual technology selection, procurement and implementation

The key actors involved in the process for each of the technologies is as follows:

Evaluation of ultrasonic cleaning tanks - Infection Control Nurses and Assistants, Laboratory Clinical Scientist.

Evaluation of rapid technology for identifying organisms within positive blood cultures - Infection Control Doctors and Specialist Registrars in Microbiology

Evaluation of ATP technology to assess the thoroughness of environmental cleaning -

Lead Infection Control Nurse

8.2.2.1 Ultrasconic tanks

Decision Making Process

The idea for the technology first arose when members of the team had worked with a deep cleaning company. The tanks were demonstrated during training on-site. The wide scope of this cleaning method was considered highly innovative:

"part of that including the electrical equipment going through the tank and then being plugged straight back into the mains which as we were saying earlier goes against any kind of knowledge of physics that anybody has including estates...They just can't imagine how it would work and you can understand those reservations. I also felt the same because when you went to plug it in after it had been through the tank I expected the big bang and the lights to go out but it didn't, but, and so that was where we first became aware of that" [Senior IPC nurse].

The main relative advantage compared to current practice is the savings in time with enhanced cleaning. The large tanks could contain large items such as commodes and big bins, which currently are difficult to clean with high time investment.

On cost-effectiveness, this was anticpated but not clearly demonstrable:

"it'll be soft data like, well, if the ultrasonic tanks clean things better we'll get less complaints from patients because things will look less dirty even if they're not microbiologically clean or dirty. So we get less complaints so that makes everybody feel better but does that save you money? It might do. It might not." [Deputy Chief Nurse].

Box 12 Anticipated benefit of technology

Perceived Relative Advantage
Low ongoing costs
Beneficial across the trust
Efficiency and saving time of domestic services
Enhanced cleaning

Box 13 Perceived innovativeness

Perceived Innovativeness
Application of ultrasonics to tackle large items of equipment
Previously ultrasonics used for small and delicate items
Ability to clean electric equipment

Procurement Process

The IPC team followed the trust's policy for the introduction of new techniques and treatments; a ten step framework which ensures that all stakeholders affected by an innovation have considered structural, and financial implications. The order was made through the trust's supplies to ensure the following considerations have been adequately addressed: maintenance and monitoring, IT implications, decontamination equipment issues, biomedical engineering issues.

The technology was ordered direct from the supplier as was not available through the NHS Supply Chain. In addition these particular tanks were only available from one supplier.

Overall the procurement process was described as smooth and in total took approximately 6 weeks.

Implementation Process

The aims of the evaluation for the US tanks were as follows:

- o Efficacy of cleaning assessed by visual inspection
- o Efficacy of cleaning assessed by use of ATP bioluminescence testing
- o Microbiological safety of items following ultrasonic cleaning and drying with hot air; this will be assessed with microbiological sampling via contact plating pre- and post processing
- o Microbial loads within the tank water during processing; this will be assessed via serial sampling, filtering and culture of tank water
- o Determine the frequency with which water should be changed during processing i.e. length of time for use of water before emptying or numbers of items to be processed before emptying
- o Identify the practical procedures necessary to maintain electrical safety when operating the tank and when cleaning electrical items ultrasonically
- o Establish safe procedures for movement and handling of a) the tank and b) equipment during processing

Training was provided on-site by the supplier and was attended by matrons, nurses and estates.

In the initial trial the tanks were tested for bacteria levels in the water after cleaning. The expectation had been that water would not need to be replaced for up to three days. However the bacterial levels in the tanks after cleaning equipment meant that water needed to be replaced after each cleaning session. This is a long process as the tanks need to be emptied, refilled and water heated overnight.

This had implications for the IPC team, whereby additional work was needed. A thorough pre-evaluation before setting out an implementation plan was thus required:

"we're having to take a step back and say, right, and build up a whole sampling plan around using the tanks with baseline sampling of the water and sequential sampling of the water in the tank during use and logging how many bits of equipment we put through it and which bits they are and, do you know, to try and build up a profile of exactly what this thing, working with this thing means in practice, so... for a team like ours somebody within the team is now having to

take that piece of work on additionally" [Deputy Chief Nurse].

The experience of the team here is dissimilar to that reported by a Showcase Hospital. Trust 5 recalls that they commenced work *before* the Showcase Hospital and the tanks are being trialled differently in those settings, perhaps as a result of the feedback to supplier by Trust 5. The expectations at time of selecting the technology have not been met and hence the implementation plan has required modification:

"It was very definitely sold as a replacement for manual cleaning, and not just manual cleaning. It was, we embarked on that in the belief that using the tank would mean that when the equipment came out at the other end and was dried, it was safe to go on for use with the next patient." [Senior IPC nurse].

"... they sampled the surface of items of equipment after it had been through the process and had been dried, and we were still finding things like coliform organisms on the surface of kit. And we didn't feel comfortable that we could just put it through the tank and then put it back out into use for another patient. We felt that what we would have to do to make these pieces of equipment safe would be to then manually go over them with a disinfectant, which really negates, it doesn't" [Senior IPC nurse].

In addition there were problems with plugging the tanks into the electrical main and concerns were raised by estates. The tanks will need to be hardwired which means no manoeuvrability – the initial plan had been to take tanks around the hospital rather than shift dirty and bulky items around. The tanks are now being housed by estates in a storage area on the top floor of the hospital.

8.2.2.2 Evaluation of two Hygiene Monitoring System (ATP) - 3M™ Clean-Trace™ and Health Edge

Decision Making Process

The idea for the technology came from the RRP products list and Showcase Hospitals conferences attended by staff, as well as other trusts with the technology in use. This

technology had been considered before the award. The trust aimed to evaluate the process of cleaning and use the ATP to provide an 'objective' measure of levels of hygiene. In addition the trust aimed to evaluate two different ATP systems to understand relative advantages with a longer term view of procurement decision making. The two systems were, 3M™ Clean-Trace™ and Health Edge.

Box 14   Anticipated benefit of technology

Perceived Relative Advantage
Helps rationalise methods and products for environmental cleaning

Box 15 Perceived innovativeness

Perceived Innovativeness
Provides a more objective means of measuring standards of cleanliness
Ability to tailor it around different combinations of cleaning methods

The evaluation of the two products was to be conducted along the following dimensions:

- o   Hardware cost
- o   Ease of use,
- o   Performance,
- o   Customer service
- o   Value for money.

Procurement Process

Procurement for the two systems was smooth and efficient and was through the NHS Supply Chain.

Implementation Process

The implementation plan was in collaboration with Hotel Services and clinical teams and aimed to monitor and refine the following cleaning practices:

- Microfibre floor cleaning systems
- Manual cleaning with detergent
- Manual cleaning with detergent + chlorine combination product
- Steam cleaning
- Exploratory use of ultrasonic cleaning tank

The implementation process needed to be managed to ensure that relationship with estates was not compromised.

"But I think if we can maintain the emphasis on just looking at what methods are best rather than there being any suggestion that, you know, because staffing within domestic services is historically very difficult, isn't it?" [IP Nurse].

The two main clinical areas where the trust focussed were the neonatal unit and the imaging department.

The implementation thus far has been positive with changes in results:

"You've got upper and lower thresholds, the sorts of results that have exceeded the upper threshold or have been in the caution zone over time have got fewer, and all the results that are below the lower threshold have started to increase proportionally, so that's a positive sign. And with regard the, well, with both of those areas what they've found is that as a result of doing the ATP sampling, that's impacted quite directly on the cleaning practices and policies for those areas." (Senior IPC Nurse).

The comparison of the two systems has been through implementation of each of the systems at two different hospitals within the trust. The plan to swap systems across the hospitals did not get implemented in time.

Overall the ATP's value in providing 'evidence' to change behaviour was a consideration for future procurement:

"I think if ever they're [doctors] challenging things, which they always say where's the evidence for this, where's the evidence for that, it just gives you something else to say, look here it is" (Microbiologist).

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Next steps are to look at areas such as insides of mattresses and to get some benchmarks for standards of cleaning for these.

8.2.2.3 Microbiology testing: MALDI-TOF

Decision Making Process

This technology was considered for two main reasons, it's ability to contribute to lab based research work and the potential to enhance reporting turnaround times. Specifically perceived benefits are set out below (Box 16).

This specific technology, the MALDI BioTyper, has been introduced in the last few years and has been used mainly for research in the UK.

Box 16 Anticipated benefit of technology - MALDI-TOF

> **Perceived Relative Advantage**
> Speed of results with antibiotic susceptibility (4 hours)
> Improved accuracy
> Patients much more likely to get the right antibiotic first time
> Reducing use of broad spectrum antibiotics – hence antibiotic resistance
> Spreading workload throughout the day

Box 17 Perceived innovativeness - MALDI-TOF

> **Perceived Innovativeness**
> Speed of results
> Mass spectrometry using a laser technology

Whilst the technology enables speedy results and improved patient care, it is relatively more expensive compared to previous testing processes. However, with better patient outcomes costs-effectiveness was anticipated, if not yet demonstrable.

"That's where these technologies are. They're upfront investment from a different source for perceived savings downstream, but also for perceived quality benefits for the patients which in

themselves will achieve savings because it's this thing, isn't it, if you get it right first time then actually that's a lean way of thinking, that's a productive way of thinking" [Medical Microbiologist].

Procurement Process

The procurement was direct from the supplier. As there were no other identified suppliers with similar specifications, competitive quotes were not required.

Implementation Process

The impact of the technology has restructured the way the laboratory staff work, with a more steady workload throughout the day. However the potential impact on the IPC team needs to be considered and responded to appropriately.

... but it's making sure that the results are available in a time that other people who do need to deal with those results can do it because like Patty says they don't really want results coming in at six o'clock, you might as well not bother to get them till the next day because they're not going to deal with them. So that needs to be looked at" [IPC nurse].

The technology initial costs are high but running costs are lower when compared to traditional methods.

Only a few research laboratories in the country are using this technology with a bigger market in mainland Europe. The technology is perceived to be more accurate and with cheaper *ongoing* costs when compared to traditional PCR testing methods.

Training of staff and potential for the technology to become part of the mainstream work of the laboratory has commenced.

8.2.3 Trust evaluation of the technologies

The difficulty with evaluating effectiveness and cost-effectiveness was articulated by the IPC

team. With numerous interventions collectively contributing to a reduction in infection rates evaluating technologies was deemed a complex task. Decision making therefore was less systematic along this criteria:

"The patients' experience will be better, less people will get infections, your gut feeling is that's got to help financially therefore you take a chance... you wouldn't find the data, it's very difficult to prove the data so you can't say, well, actually we know by doing this we're going to get 6% less MRSA, that will save us X amount of money. That data will not be there"

For the microbiology testing the measures of success the trust is interested in are as follows:
- o How quickly you get the final result?
- o Have you saved cost of antibiotics? And which antibiotics?
- o Have we found out resistant bugs quicker than we would have known?

In addition cost savings in the longer term are anticipated through improved outcomes stated above coupled with low running costs compared to traditional methods. This is anticipated to offset the high initial costs. One of the possible negative consequences identified by the IPC team was overuse of the service, with the expectation of a quick result.

For the ultrasonic tanks there are issues of process including health and safety including the risk assessments around moving and handling electrical safety. The main evaluation concerns the provision of a service for cleaning difficult to clean items, and integrating into the service effectively. As described above the initial planned implementation needed to be modified. The evaluation will be shared as there is a disconnect between the experience of Trust 5 and a Showcase Hospital. This may be due to the difference in timing of implementation but also in that the Showcase Hospital is demonstrating a managed service.

"What I need to do still is provide the summary, which we need, we feel we need to share with DH, because if we've got findings coming out of the Showcase Hospitals that are saying different things" (Senior IPC Nurse)

Early on the IPC team found that their expectation of the tanks had not been met.

"It was very definitely sold as a replacement for manual cleaning...we embarked on that in the

belief that using the tank would mean that when the equipment came out at the other end and was dried, it was safe to go on for use with the next patient". (IPC nurse)

For the ATP, the relative advantages of one of the systems (3M™ Clean-Trace™) has helped the trust formulate a specification for a tender. The main relative advantage between the two systems was flexibility where 3M™ Clean-Trace™ has the facility of a web based server for uploading data. The robustness of the handheld systems however was considered better with Health Edge, with a number of replacements needed for the 3M™ product.

In addition the need to plan a schedule of sampling was important learning from the evaluation process so that results are meaningful and feed into trust cleaning policies and practices.

8.2.4 Discussion

8.2.4.1.   The decision making process

Overall the process of decision making was informal in that a specific project team was not constructed and approval from the Trust Board was not sought, though they were informed and kept up to date. The proposals originated from the IPC team but were discussed at meetings attended by the wider group on the IPC committee. Hence overall the process was fairly exclusive to the IPC team. The technologies, though known to some members of the team were really considered after announcement of the award and therefore can be described as emergent.

"People were aware we'd won the award if you like and the money because it went out at … team brief and it was briefed to senior nurses and otherwise so there was an opportunity for people to say, well, I've got an idea or a thought, but we didn't actually actively canvas" [Deputy Chief Nurse].

As the three technologies being considered came within budget a more formal decision making process was not perceived as necessary. Key considerations in technology selection were sustainability of the technologies and being able to implement effectively.

The one-off nature of funding and short notice of the funding was seen as not ideal. Further the

trust had perceived the award to be for evaluating a number of technologies, and this influenced their decision making. In addition, the trusts understanding of the purpose of the award had an impact on the decision making process and technologies being considered in the first place. The purpose of the award was perceived as trialling as many different technologies rather than investing in one technology.

"If you'd have said to us here's £150,000, use it to develop something for a longer term benefit we might have changed that. We might have said, OK, well, we are going to try and invest in the systems" [Deputy Chief Nurse].

There was no consultation with patient groups, but the patient representatives on the IPC committee were informed of selection decisions.

"But did we actively seek out their suggestions and actively seek out the support for them? Not in that way. We made them aware of the award, the fact that we're doing some work on it and what the likely outputs were meant to be" [Medical Microbiologist].

The selected technologies reflected the trust's approach to IPC as multifaceted, although not purposive:

"The whole bundle approach thing is what we'll all be encouraged in many ways to go for, so our infection control programme has an element of all those things... I don't think we actually probably sat down and thought, right, we'll do one from each of those groupings. [IPC nurse]

8.2.4.2 Evidence

The IPC team used a number of sources for evidence for each of the technologies including the RRP 1 products and Showcase Hospitals as discussed above. The IPC team acknowledged limitations in assessing technologies, due to their professional backgrounds.

" the technology bit comes in. We're microbiologists or infection control nurses, we're not engineers" [Medical Microbiologist].

One of the technologies considered early on was non-chlorine based cleaning, but it was discounted as there was insufficient evidence. The trust had considered evaluating the technology but precise regulation about cleaning agents had an impact on potential for innovation:

"we cannot evaluate this without you getting OK from the Healthcare Commission, from PEAT from NPSA because if they come and evaluate us, as they do on their spot visits, and they say, are you doing a chlorine based clean? And we go, no, we're doing this new product. They could say, fail" [Senior IPC nurse].

In addition there was a strong perception that evaluation of technologies should be managed centrally with guidance on robust methodology.

"you do feel quite responsible because if you turn round and say a project, we think this is the best thing since sliced bread you know that your colleagues are going to turn round and say, well, we'll have it then and you could actually end up with the whole of the NHS saying we want product X on very thin, you know, you'd really want to make sure you'd got it right. And I think one of the things that we're quite nervous about is actually you don't want to be involved in a study that's, that you know isn't that great" [Medical Microbiologist].

Table 33 Type and sources of knowledge used in decision making

Awareness knowledge	*Principles /theory* knowledge	*How to* knowledge
Professional networks	Professional networks	Suppliers
Rapid Review Panel (RRP 1)	Peer review journals	Other Trusts
Trust Staff	Suppliers	Showcase Hospitals
Supplier marketing		Previous experience (success/failure)
Showcase Hospitals		

(Adapted from Rogers, 2003; Glasby & Beresford, 2006)

Whilst the IPC team kept up to date of the Showcase Hospitals and RRP 1 technologies this was not a major consideration but helped in some of the decision making processes:

"like the ATP it's coupled with the fact that the rapid review panel had made a judgement about this particular technology and that although we're not privy to all the processes that inform that decision there will have been an assessment of evidence that has helped inform that". [IPC nurse].

8. 2.4.3   Procurement

As described above, the procurement structure within the trust was systematic. However involvement from the procurement team in the technology appraisal may have helped to critique the decision when only one supplier was available for the chosen technology.

8. 2.4.4   Context

The main contextual factor which impacted on the technology selection is the large size of trust. This precluded some initiatives. For example VitalPAC, the ICT system which would require trust-wide implementation.

The trust prides itself on performance and a testing ground for innovation, with visits from other trust being common.

"2,000 bedded hospital group so it's, in bed terms it's the second or first largest in the country depending on which sort of figures you may look at and it's the largest in England ...So in terms of the perception is that in that complexity of an organisation if [Trust 5] can achieve results that are good then what is it that you're doing that others could learn from?" [Deputy Chief Nurse].

8.2.4.5   Implementation

The modification to implementation for the Ultrasonic tanks was the main learning from this project, as the other two technologies were implemented closer to implementation plans. Overall in the decision making a number of factors related to implementation had impacted on the

decision making process.

Table 34 Barriers and facilitators to implementation

Perceived barriers to implementation	Perceived enablers/facilitators to implementation
o Large size of trust o Involving wider staff groups o Award timeline	o Confining technology selection to technologies that can be delivered by the IPC team

Next steps include tendering for a hygiene monitoring system and building a plan for hygiene monitoring and evaluation, specifically to inform which areas need enhanced cleaning for producing better patient outcomes.

For the microbiology testing (MALDI-TOF), longer term plans are to incorporate the service into daily practice, whereas currently the focus has been on research.

9. Case study – Trust 6

9.1 Context

9.1.1 General Context

Trust 6 is a large NHS trust providing a full range of acute, specialist and tertiary services to more than half a million people. It employs around 7,800 staff and has an annual turnover of approximately £430 million. The trust delivers its services across two main sites, including a newly re-developed £256 million state-of-the-art hospital, completed in 2009 as part of a PFI scheme[50]. This new hospital brings together services provided by a number of smaller hospitals and locations onto one site, which now accommodates about 1400 beds across new and existing parts of the hospital.

9.1.2 Trust Performance

The trust was rated 'Excellent' for quality of services by the Care Quality Commission's annual health check for 2008/09, maintaining the same score on the previous year[51]. The trust's use of resources and financial management was rated as 'Fair' (rated 'Good' in the previous year).

Table 35 The Care Quality Commission Assessment

	2005/06	2006/07	2007/08	2008/09
Quality of services	Good	Good	Excellent	Excellent
Quality of financial management	Good	Good	Good	Fair

The results for the most recent available Patient Environment Action Team Assessments (PEAT) are outlined in the table below[52], showing an improvement on the 'Acceptable' score of previous year for food at the newly re-developed hospital site. Against comparable measures,

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[50] Work completed in partnership with 'The Hospital Company', a consortium of Carillion plc and the Royal Bank of Scotland. The scheme includes facilities management and maintenance for both old and new parts for the next 31 years by Carillion.

[51] Care and Quality Commission, October 2009

[52] Patient Environment Action Team (PEAT) Assessment 2010, National Patient Safety Agency

scores for the other hospital sites remained the same for environment and food, with the exception of the 'Acceptable' score for environment at one of the hospital sites, from the 'Good' score of the previous year.

Table 36 PEAT inspection results

	Environment Score	Food Score	Privacy & Dignity
Hospital A (2010)	Acceptable	Good	Good
Hospital A (2009)	Acceptable	Acceptable	Good
Hospital B (2009)	Acceptable	Good	Acceptable
Hospital C (2009)	Acceptable	Good	Acceptable

9.1.3 Infection Prevention and Control Context

Over the last three years, the trust has achieved a reduction in both MRSA and C. *difficile* cases (by 80% and 50% respectively). Aiming to continue this success in reducing infection, the trust has invested in improving the cleanliness of its hospitals. The newly re-developed hospital site, formally opened in June 2009, was designed with infection prevention and control as a priority[53], with hundreds of clinical and other staff involved in the design, planning and implementation process. One third of beds in the newly built parts of the hospital are single en-suite rooms, with the remaining new rooms in four-bed rooms with en-suite shower facilities. Furthermore, all the new beds have 10% more space around the beds than the current standard, with other special design features including anti-microbial curtains and curved skirting boards. These additions were noted to be easier to clean and therefore help minimise the spread of infection.

The Infection Prevention and Control Team were recognised at the Oxoid Infection Control Team of the Year Awards for 2009. They were praised for their communication within the hospital and the wider community, with a 'bugbusters' campaign launched in 2008 that raised public awareness of good hand hygiene and infection control issues.

9.1.3.1 Trust performance on mandatory HCAI indicators

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[53] Trust website

Table 37 Trust performance on HCAI indicators (Source: annual report)

	2007/08	**2008/09**	**2009/10**
MRSA *bacteraemia*	44	23	19 (target, Max no of cases 22)
Clostridium difficile	293	184	115 (Target, max no of cases: 263)

9.1.3.2 Previous trust IPC interventions

In addition to the Infection Control Policy, the trust has a number of related strategies and policies, accessible on the trust website, these include:

- Antimicrobial Prescribing Policy and Strategy
- Diarrhoea and Vomiting Management Policy
- Hand Hygiene Policy
- Isolation Policy
- MRSA and other antibiotic resistant micro-organisms Management
- Linen Handling and Laundry Policy

In May 2009 the Care Quality Commission conducted an unannounced inspection of the main hospital site. The inspection found that the trust was fully compliant in eight out of the nine measured areas. Of the eight areas assessors were impressed by the trust's effective arrangements for the cleaning of wards and equipment and the facilities for the public to practice good cleanliness. In the ninth measure, dust was found on the curtains of one of the wards, whereby the trust put in place extra cleaning measures. In the follow-up unannounced inspection in August 2009 the trust was found fully compliant in all nine measured areas. Specific areas attracted praise, such as patient beds, trolleys, bedside furniture, stands, fixtures and fittings for being cleaned to a good standard[54].

Hospital cleanliness is emphasised as playing a vital part in Infection Control and Prevention across the trust, however, in addition a number of initiatives have been introduced to continue

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[54] Trust Quality Accounts 2009/10

the fight against infection[55]:

- Improved cleaning programmes

- Infection prevention and control staff working closely with primary care colleagues to make sure antibiotics are appropriately prescribed

- Improvements in the techniques used for inserting intravenous drips and close monitoring by the intravenous therapy team.

- Bare below the elbow – all clinical staff wear short sleeves with no wrist watch, bracelets or other jewellery apart from a plain wedding band

- Pioneering use of VitalPAC technology – a handheld computer system which records a patient's vital signs and MRSA screening

- Stop the Bugs – an award-winning public awareness campaign which raises the importance of good hand hygiene among staff and patients

- Review of all new cases of MRSA and *C. difficile* within 24 hours of identification

- Enhanced surveillance and management of all patients with infections. As a result the Infection Prevention and Control Team sees an estimated 75% more patients per day than the previous year

9.2.1 HCAI Technology Innovation Award:Trust IPC Areas of priority and technologies selected

Who was involved and how?

The decision making involved the IPC team and wider trust staff were not consulted for idea generation. Within the team decision was by consensus and the technologies selected had been previously discussed by the team, prior to the award. Hence decision making was fairly quick and reported as 'easy'.

Initial options considered

Previously the ICT surveillance system ICNet had been considered (see Trust 3). The main difference between ICNet and the technology under consideration, the VitalPAC IT system was

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[55] Trust Annual Reports 2009/10; and 2008/09

articulated as follows:

It's [VitalPAC] initiated from the patient, whereas ICNet is all initiated from the quality systems. It's not started at the patient's bedside, if you see what I mean. So it's based on results coming out of pathology whereas our system is going to be initiated at the patient's bedside. [Medical Microbiologist].

What was finally selected?

Trust 6 selected two technologies. One focussing on environmental hygiene, the other on data capture and monitoring through an integrated IT solution.

Table 38 Technology, priority area and progress (August 2010)

Technology	IPC priority area	Brand/supplier	Procured	Implementation
VitalPAC Infection Manager System	ICT	VitalPAC/The Learning Clinic	Yes	Yes
Hydrogen Peroxide and silver	Environmental hygiene	Hygenics	Yes	Yes

9.2.2 Individual technology selection, procurement and implementation

9.2.2.1 VitalPAC & Toughbooks

Decision Making Process

The decision to use the award to further develop the VitalPAC Infection Manager System was made almost immediately by the IPC team:

"There was one obvious contender in terms of innovation and technology which is adapting of

VitalPAC system which is a novel system for us, and it was just sitting there ready to be developed. And so this money was a perfect opportunity to develop our VitalPAC system, which is the electronic patient management system that we've got. So there was one obvious contender really, so it wasn't particularly difficult or controversial really", [DIPC].

The perceived innovativeness and potential for benefit had been previously considered. Following development of the VitalPAC with MRSA screening in 2007, adding the infection control module was considered as an incremental progression of the technology; already being rolled out trust-wide for vital sign recording and analysis. The additional functionality is included in Box 18. Compatibility of VitalPAC with the trust's system had previously been tested.

A time and motion study conducted by the IPC team showed that the Infection Control Nurses spent approximately 40% of their time doing administration and results type work. The automated, real-time system is expected to free up staff time to carry out more clinical work.

In addition laptops, specifically Panasonic Toughbooks were included to allow for real-time downloading and monitoring of data. The perceived relative advantage, for the Toughbooks compared to PCs and standard laptops, are included below.

Box 18 Anticipated benefit of VitalPAC Infection Manager System

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Perceived Relative Advantage
Real-time recording and analysis of patient vital signs **plus** laboratory results

Additional functionality to include:
Surgical site surveillance
Management of IV devices
Electronic High Impact Intervention care bundles
Antibiotic Management
Hand hygiene audit tool
Cleaning and environmental audits
Save IPC staff time

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Box 19 Perceived innovativeness of VitalPAC

Perceived innovativeness

Remote access to patient ward data
Patient centred system
First trust to pilot the module

Box 20 Anticipated benefit of Toughbooks

Perceived Relative Advantage

Flexibility
Resilient
Waterproof – can be wiped with alcohol wipes
Wireless connection

Procurement Process

The procurement was direct from the supplier for the VitalPAC and was described as smooth. The procurement was managed through the IPC department direct from the supplier. Procurement of the Toughbooks was via the trust IT department as part of a larger order which was the economical option.

Implementation Process

The implementation started with using test patients to identify and resolve any software bugs. Following this, live data is being introduced, which has highlighted additional areas for work.

For ease of use there has was a mixed response initially but quick progress was reported:

"Some people found the touch screen keyboard tricky and I think it's just down to individual preferences with people with technology some people find technology easier. But even people who were very reticent initially and were saying, no, over my dead body I'm not going to get used to using it, are now actually finding it not too bad. So it has been fairly easy",[Lead IPC Nurse].

9.2.2.2 Hydrogen Peroxide Vapour (HPV) Decontamination System with Silver (Ag+) - Hygienics™

Decision making process

The hydrogen peroxide had been previously considered but the trust had been prohibited due to costs. The decision was communicated to the facilities manager' being a PFI trust was not perceived as a barrier at the point of decision making.

Procurement Process

The procurement process was described as smooth. The technology was purchased direct from the supplier. The trust had explored a local procurement framework (Solent Supplies) but found that the direct from supplier option provided a better deal. The paper work was handled by the IPC data manager and two quotes were obtained, one from Bioquell and one from Hygenics. The difference was in procuring a managed service or buying the system. The more economical option was selected.

Implementation Process

The implementation process involved the IPC team carrying out the process of vapor cleaning. Facilities were not asked to carry out the procedure.

The IPC team has received training and carries out the process in pairs. The team has also reduced the turnaround time from four to three hours:

"...just trying to always make it quicker, being slicker in the way we do things. They've now just seen, they've seen these magnetic, have they ordered any? Not yet, they've seen these magnetic stuff, you can just put a magnetic shield over all the vents and the fire alarms so that means we're not even having to phone Carillion to get it switched off, so that will be another half hour off the system" [IP Consultant]

The team had previously tested Bioquell's machines and found them to be bulkier and also required a separate machine to dehumidify the environment.

9.2.3 Trust evaluation of the technologies

For VitalPAC close working with the supplier and IPC team in developing the system has meant that evaluation is an ongoing priority. From validity to user friendliness both the trust and supplier are interested in monitoring and improving the system.

For Hydrogen Peroxide the trust will be interested in the *C. difficile* rates in particular as an outcome measure. The trust aims to use the VitalPAC to alert for possible outbreaks and help inform implementation of the hydrogen peroxide.

9.2.4 Discussion

9.2.4.1. The decision making process

The adopted technologies had been identified prior to the award. The decision making was exclusive to the IPC team. This was reflected also in the implementation of the Hydrogen Peroxide Vapor. In addition the process was described as informal, with relevant staff being informed of progress:

"...but we have got the backing of the clinicians and the Medical Director for the way that we've progressed with this, and the clinicians, general nursing and medical staff out there respect our views and we haven't felt necessary to seek any formal process really for decision making", [Medical Microbiologist]

9.2.4.2 Evidence

The use of evidence such asDH's ASEPTIC project had helped inform earlier implementation of

VitalPAC. Further exploration of competing systems had been carried out with discussions with other trusts.

For the hydrogen peroxide, the RRP 1 rating helped inform the technology selection as did literature reviews.

Overall the three types of knowledge had been given similar levels of consideration. There was no fundamental difference in the sources of knowledge used by the different professional groups. Working with the supplier for the development of VitalPAC meant that the 'how to' knowledge was addressed as an ongoing priority. The trust hopes to build on the evidence base; with VitalPAC they are one of 12 trusts in the country using the system. However Trust 6 is the first to pilot Infection Prevention Control Manager. The trust had previously worked with The Learning Centre to pilot the module for IV cannulation which has now been rolled out in other trusts.

Table 39 Type and sources of knowledge used in decision making

Awareness knowledge	*Principles /theory* knowledge	*How to* knowledge
Professional networks/events (Performance Improvement Network) Rapid Review Panel (RRP 1) Trust Staff Supplier marketing Showcase Hospitals conferences	Professional networks Peer review journals Suppliers	Suppliers Other Trusts Showcase Hospitals evaluation reports Previous experience of success

(Adapted from Rogers, 2003; Glasby & Beresford, 2006)

In terms of awareness knowledge the Decontamination Lead commented on the stronger professional networks in London compared to the current locality.

9.2.4.3 Procurement

The procurement process was well examined by the IPC team and purposeful decisions to go direct to the supplier were made. According to the IPC team, better financial options were available through this route. This was consistent with methods of procurement for other technology procurement where local frameworks are compared to direct to supplier rates.

9.2.4.4 Context

The existing structures provided an enabling environment for technology adoption for VitalPAC. For example pre-existing wireless facilities and also the compatibility with the trust-wide IT system were contextual factors which had implications for all phases of the adoption process.

Trust in the IPC team was also cited by the medical microbiologist as a cultural factor which determined the process of decision making adopted by the trust – that is, highly exclusive to the IPC team.

9.2.4.5 Implementation

The main barriers and facilitators to implementation were cited as follows;

Table 40 Barriers and facilitators to implementation

Perceived barriers to implementation	Perceived enablers/facilitators to implementation
• Involving estates/facilities • Involving wider trust staff in technology selection	• Local champion for the technology • Good working relationship with supplier • Leadership from DIPC • Compatibility with existing IT infrastructure • Good IPC team working

10. Case study – Trust 7

10.1 Context

10.1.1 General Context

Trust 7 was awarded foundation status on 1st of August 2006. Part of the trust, the Department of Medicine for the Elderly ward, is under the PFI scheme. The trust has 599 beds and 27 contingency beds, 27 wards, (including 2 private wards) and over 3,400 staff..

The trust provides services to a population of approximately 350,000. The population served by the hospital is culturally diverse, and there are several areas of high social deprivation in the trust's catchment area.

A new four Divisional Business Unit structure has been introduced since April 2010 encompassing: Surgery; Medicine; Clinical Support Services and Women's and Children's Services.

Table 41: Trust 7 at a Glance

Trust type	Foundation Trust / part of it under PFI
Trust size	3,400 staff
Number of sites	1
Population coverage	350,000
Number of beds	626

10.1.2 Trust Performance

The trusts' performance was rated as "Excellent" for both the quality of its services and financial management by the Care Quality Commission in the latest annual health check in 2008/09. This is compared to the "Fair" and "Excellent" scores received for quality of services and financial management respectively for the previous year.

Table 42: The Care Quality Commission Assessment

	2005/06	2006/07	2007/08	2008/09
Quality of services	Good	Fair	Fair	Excellent
Quality of financial management	Good	Good	Excellent	Excellent

The most recent Financial Risk Rating from Monitor was 4 and the trust also received an Amber rating for Governance Risk.

Monitor Assessment

- **Financial risk rating: 4**
  (Rated: 1-5, where 1 represents the highest risk and 5 the lowest)

- **Governance risk rating: Amber**
  (Rated: red, amber or green)

The most recent PEAT Self Assessment was carried out on 12th of February 2010. Specific cleanliness, toilet and bathroom cleanliness, infection control, environment, access and external areas, food and food services, privacy and dignity came out with an average score of 4 out of 5 (4 = Good). Trust's self assessment scores have been submitted to the National Patient Safety Agency (NPSA) and the final calculated scores will then be used to support demonstrating compliance against the CQC regulations.

10.1.3   Infection Prevention and Control Context

The Infection Prevention and Control Team comprise an infection control clinical matron, an infection control nurse and a consultant microbiologist who acts as the DIPC.

In recent years, the trust has successfully reduced the number of MRSA bacteraemias by introducing state of the art practice in vascular access care. Further, education and training on IPC principles for all ward sisters has been introduced by the IPC team in 2008 and has been successfully rolled out trust-wide.

Lead the NHS in patient safety

Since its introduction in 2008/09 the trust's Transforming Patient Safety Strategy has seen steady progress in relation to the two year goal to save 600 lives and to avoid 3,000 patients being harmed over that period. Every Directorate has a clinical patient safety lead; there has been continuous investment across the organisation to ensure front line staff have the skills and capabilities to lead further improvements in patient safety, patient experience as well as efficient hospital processes. The trust has signed up to the *National Patient Safety First Campaign* making "the safety of patients everyone's highest priority". The trust achieved the National targets for C. *difficile* and MRSA.

10.1.3.1 Trust performance on mandatory HCAI indicators

The trust received 'Green' rating outcome from Monitor for both C. *difficile* and MRSA infections. In 2007 the trust achieved its lowest rates of C. *difficile* for 3 years and a record low in number of cases of hospital acquired C. *difficile* in 2009/10.

Table 43: Trust performance on HCAI indicators[56]

	2008	2009	2010 (Q1: Jan - March)
MRSA *bacteraemia*	7	10	1
Clostridium difficile	121	128	35

10.1.3.2 Trust infection prevention and control interventions

The management of Hospital Associated Infections (HAI) remains a key focus as part of the No Avoidable Infections Strategy (NAI) and is reviewed by the Care Quality Commission for compliance against the Hygiene Code. The NAI continues to adopt a directorate based approach with the Clinical Director and General Manager being responsible for delivery on infection control.

A number of practices have been sustained during 2009/10 including:

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[56] HPA Quarterly counts of Meticillin Resistant *Stapylococcus aureus* (MRSA) bacteraemia from April 2007 to March 2010- all reported cases
HPA Quarterly counts of *Clostridium difficile* (*C. difficile*) infection by acute Trust (patients aged 2 years and over) from April 2007 to March 2010

- Nurses and Doctors are audited for hand hygiene compliance twice a month. The results are monitored through Directorate performance management and reported to the Patient Safety Committee on a monthly basis.
- The roles and responsibilities of all staff are emphasised in relation to infection control to ensure that every member of staff is aware of their responsibility in relation to the NAI Strategy.

Rapid Improvement Programme in 2008

The DIPC, IPC matron and IPC nurse designed a training and education programme on IPC for all the ward sisters; the programme lasted one day per week for 16 weeks and all the ward sisters were released to go to this study day. The training programme started off with basic principles of infection control and then moved on to cover more specialist IPC topics. All issues covered came from the Hygiene Code. This proved to be very positive

10.2.1 HCAI Technology Innovation Award: Trust IPC Areas of Priority and Technologies Selected

The final selection of technologies along with the priority areas are summarised below Table 44. The technologies selected by the trust address the *overarching theme of **reducing the bio-burden*** in the hospital environment through a *combination of complementary modalities*. Specifically, the technologies focus on the IPC priority areas of environmental hygiene, patient hygiene, hand hygiene and information management and communication technology (IMCT).

Who was involved and how?

Overall, the technology selection process, as described by the respondents, was *inclusive* in that staff from outside the core infection prevention and control group were also involved. However, although there was communication with representatives from the different directorates / divisions, the latter were not all contacted in the first instance to generate ideas and an open bidding process among them did not take place. For one of the four selected technologies the idea came from the domestic services general manager rather than the core infection prevention and control team. Decision making and implementation were widely perceived by

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respondents as being collective. The decision making process in selecting technologies was led by the DIPC, was championed by the IPC matron and also involved a core group of senior hospital staff including clinical matrons, nursing staff, the general managers of estates and domestic services. There was involvement in the decision making process of senior management, namely the trust CEO and the Deputy CEO, who is also director of nursing and director of operations. The support provided by senior management facilitated technology implementation. The lack of an independent spending account for the infection prevention and control team impeded prompt procurement of the selected technologies.

Initial options considered

The technology selection process as described by respondents involved **three iterations** until all monies were finally allocated.

Initially, the DIPC and members of the trust's Executive Board came up with the option of investing the awarded monies in the prevention and control of catheter acquired urinary tract infections, part of the DH High Impact Interventions. This initial option was meant to build on trust's relevant previous experience.

Incorporating input from staff in the Department of Medicine for the Elderly (DME), the initial proposal was to use the award monies to appoint a continence adviser nurse. Following informal discussion with the DH the trust was advised that the DH did not consider paying for a nurses' salary being a "technology".

The second option considered by the trust was to create an 'archetypal infection ward', which would have incorporated a number of innovative infection prevention and control interventions. This ward was aimed to represent a role model to test the applicability of innovative IPC interventions in a busy ward setting.

"Our plan B, that's thoughts that we had, was to have the perfect infection control environment, where you put every innovation possible. So you have a brand new ward with good hand washing facilities and UV lamps, or whatever that you might want to put into that, and see if you could put a number of interventions on a busy ward and see if you could apply them effectively", [DIPC]

The above idea was deemed rather unstructured and vague for the scope of the project and was eventually dropped. The third and final option follows.

What was finally selected?

The trust made four technology selections, addressing four IPC priority areas (Table 44). The overall theme focused on reducing the bio-burden of HCAI. Thus far, three of the technologies have been procured and implemented. The final technology has been identified; however, delay in the commencement of refurbishment work across a number of wards which had been targeted for implementation has resulted in delaying the procurement and implementation of the particular technology.

Table 44: Technologies, Priority area and Progress (August 2010)

	Technology	IPC Priority Area	Brand / *Supplier*	Procured	Implemented
1	Hydrogen Peroxide Vapour (HPV) Decontamination System (fully managed service)	Environmental Hygiene	Bioquell	Yes	Yes
2	Single Use Patient Admittance Packs: Disposable Blood Pressure Cuffs & Pulse Oximeter Probes	Patient Hygiene	Packs created in-house Suppliers: FlexiPort™ BP Cuffs *Welch Allyn* *Masimo* Set LNOP® Single Patient Use Durable Adhesive Pulse Oximetry Sensors	Yes	Yes
3	Electronic Real Time Monitoring System for the Evaluation / Auditing of	Environmental Hygiene / Information Management and Communication	Maximiser® *Expolink*	Yes	Yes

		Hospital Cleaning			
4	Signage Posters	Hand Hygiene	Not Selected Yet	No	No

10.2.2 Individual technology selection, procurement and implementation

The adopted technologies ranged from those identified prior to the award to those which were considered in later iterations during the decision making process. In the following paragraphs the decision making, procurement and implementation processes for each of the technologies are discussed in detail.

10.2.2.1 *Bioquell®* Hydrogen Peroxide Vapour Decontamination System

Decision Making Process

The *idea* for the technology (*Bioquell* HPV) came from the Clean Safe Care HCAI Conference and Exhibition at Church House Westminster in London (June 17th 2009). The DIPC together with a team of nurses and matrons attended the conference. The DIPC was already aware of the technology at the time of the conference, while the majority of the matrons and nurses were not. It was widely reported by the respondents that the conference sensitised the IPC team to the *Bioquell* HPV technology and contributed to the development of a positive attitude. Although the DIPC and other staff were aware of the DH 'Showcase Hospital's Programme' (though not everyone involved in the decision making was aware of the programme), they did not contact or visit any such hospital or other NHS Trust which had already adopted the particular technology.

As already described, the overarching theme agreed by the IPC team to focus efforts on was towards reducing the bio-burden, and within this strategy, the selection of the *Bioquell* HPV technology focused on reducing C. *difficile* and Norovirus infections, especially in DME and medical wards.

The actual technology selection **decision making process** was *collective* and rather *inclusive* with involvement of staff outside the core infection prevention and control team (which

comprised the DIPC and two nurses); this process is neatly described by the infection control nurse in the excerpt below:

"Initially the infection control nurses, the team itself were given the responsibility to co-ordinate which [technology] will be the first priority. That was in the first few weeks of the programme. It was difficult at that time because we needed to factor for patient flow, bed management and co-ordinate activities with domestics. In the end after a few weeks of the start of the system we sat again, met with each other – there were also representatives from domestics and bed management - and we discussed how are we going to take this forward in a good system", [DIPC]

The proposal for the *Bioquell* HPV was led by the DIPC and the IPC matron; in addition, senior members of staff were also involved as reported by the DIPC in the following quote, which aligns with similar accounts provided by other staff:

"I have had involvement in the [decision making] process. There were other people involved as well, who included some of our matrons, our Deputy Chief Executive, discussions with our Chief Executive, in terms of what we're to do, with our Estates General Manager, our Domestic Services Manager", [DIPC]

The overall process was described by the respondents as *informal* since no project team was formed.

The IPC team collaborated with the trust's procurement department to identify the range of companies supplying the product. In this case there was at the time (as reported by the respondents), only one company supplying the technology (HPV decontamination system), namely *Bioquell* (the main competitor's product – *Sterinis* – was withdrawn from the market). The supplier of the technology was invited to initially present to the IPC team and then to a broader audience in the trust, which included ward sisters, clinical matrons, bed managers and managers / supervisors of domestic services. These meetings took place in the summer of 2009. Due to illness of the trust's Deputy Director in the summer of 2009 the final decision was postponed for a few months. The limited capacity of the core IPC team (three members of staff) and the lack of a dedicated person to project manage the process further contributed to delaying

technology selection. The final decision to invest in the *Bioquell* HPV was made in October 2009.

A number of factors influenced the final decision for HPV. Box 21 and Box 22 summarise the key perceived elements of innovativeness of the particular technology and its perceived relative advantage as reported by the respondents in our qualitative interviews.

Box 21: Perceived Innovativeness of *Bioquell* HPV Decontamination System

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Perceived Innovativeness

- Technology used in the trust for the first time representing a radical innovation in cleaning and decontamination
- 'High tech robot' providing enhanced reassurance and standardisation of cleaning procedures
- Potential of the technology to provide a standardised deep clean in areas that are inaccessible during routine cleaning
- Represents a novel "tool" or a "procedure" to promote collaboration among various departments and service groups for which co-operation was not always easy to achieve: IPC team, bed management, domestics, estates, ward sisters and managers, cleaners

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Box 22: Perceived Benefit of *Bioquell* HPV Decontamination System

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Perceived Relative Advantage

- The *Bioquell* HPV can be used to reach and properly clean otherwise inaccessible areas and difficult to clean equipment
- Offers reassurance for staff and patients, *"a physical activity taking place in addition to routine cleaning"*
- A standardised and thorough process that 'prevents cutting corners in cleaning'
- The *Bioquell* HPV as a fully managed service poses almost no risk to the trust: extra staff resources and training
- Effective for cleaning areas infected with microorganisms that cause gastrointestinal disorders, especially useful for preventing repeat cycles of infection in C. *difficile* and Norovirus outbreaks: there are convincing evidence from deployment of the service in

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other NHS Trusts
- Quicker turnaround times for domestics terminal cleaning (no need to change curtains etc)
- Monthly reports which create a track record of activity with precise numbers of deployment of the service
- *"Machines will do things as they are programmed to do it; human beings don't"* [Clinical Matron]
- Provides 'protected time' for cleaning personnel to do their job properly and under less time pressure

It is worth mentioning that the main benefit that was repeatedly stressed by all respondents was the reassurance the *Bioquell* HPV technology was perceived to provide for staff and patients. The following quote by the DIPC exemplifies this widely shared notion:

"Matrons and nurses and people were quite happy because they saw a physical activity happening which was restricted, for two hours or two and a half hours the room is sealed, it's properly gassed. There's a man standing there, there's a certificate that comes out at the end, so there's a lot of reassurance that comes out of the process", [DIPC]

Besides the aforementioned perceived benefits respondents also highlighted a number of perceived weaknesses of the HPV system delivered as a managed service. These are summarised in Box 23

Box 23: Perceived Weaknesses of *Bioquell* HPV Decontamination System

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Perceived Weaknesses

- The *Bioquell* HPV is hazardous to human health, therefore, *"an inherent problem with the system is that it can only be used in areas that can be emptied of patients and staff and sealed during the disinfection process for X amount of time",* [DIPC]
- The technology could not be used in large Nightingale style open wards (12 HPV machines were needed to disinfect a large Nightingale type of ward); the technology had also limited application in older 6-bedded wards which were difficult to seal off
- Very costly and difficult to justify its use to the finance department in a business case (£180,000 / year approximate estimated cost)
- Equipment and surfaces to be disinfected must be clear of soil prior to the application of the *Bioquell* HPV and therefore the *Bioquell* HPV system extends the duration of the cleaning with implications for bed occupancy and waiting times
- Need to co-ordinate a wide range of stakeholders and fine tune the activities of different service groups which is a time consuming and labour intensive process

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Regards evidence the project leads and team used a combination of sources for this. For awareness knowledge of the product the trust used information from the DH HCAI conference and exhibition and the Clean Safe Care website. They also approached the company at the exhibition to ask for additional information and evidence. The company also provided evidence (during the presentation to the trust) about its effectiveness and principle knowledge (what is the theory / mechanism behind the product). The trust took into account the fact that the technology had received an RRP 1, which provided the trust with extra reassurance and enhanced the legitimacy of the product in the eyes of the IPC team; staff from the trust also reviewed journal articles to verify relevant evidence. Networking with colleagues in other trusts (though that happened after the product had been procured for the six months trial and was primarily meant to inform any future trust decision for continuation of the service) was used to get additional information about practical issues and 'how to' knowledge. Additional evidence was gathered from reviewing the evaluation report of Bioquell HPV system (by the DH), based on evaluation

of the technology in Showcase Hospitals, as part of the HCAI Technology Innovation Programme.

Procurement Process

The trust procurement team were involved early on in the decision making process. Procurement was through a national procurement framework, namely Buying Solutions of the Office of Government Commerce (OGC).

The procurement process was described by the respondents as *protracted*. The decision to procure was made in October 2009 and the supplier was ready to provide the service in November 2009. However, the project lead, with advice from the trust's procurement team had to delay the procurement for a couple of months until the product became available through OGC Buying Solutions, which also reduced the initial asking price. The order was made in January 2010 and the company supplied the service on the 18th of January 2010. The delay in implementation was also partly contributed to the limited availability of the company to provide the managed service at the particular time. Typical costs for a managed service (two on-site Bioquell engineers, three HPV generators and consumables) are £15,000/month. The trust did not top up the award.

Implementation Process

A six month trial period of the Hydrogen Peroxide Vapour system as a fully managed service, with two on-site Bioquell engineers working Monday to Friday 09:00 – 17:00, three HPV generators and consumables, was implemented in January 2010. The HPV service was meant to complement routine cleaning. Since the focus was on reducing C. *difficile* and Norovirus infections, the implementation efforts were concentrated on the DME and the medical wards, as well as the side rooms on the surgical wards. A detailed and structured plan of deployment had been initially designed in collaboration with Bioquell's engineers.

The main issue during implementation was the availability of patient-free rooms for disinfection at the times when the Bioquell engineers were available. There was reported difficulty in matching availability of rooms with the hours of work of Bioquell staff, with rooms becoming available late in the day when patients were discharged, when Bioquell staff were finishing for

the day. High bed occupancy levels added to these difficulties, as well as the tension for bed managers between the four hour wait in A&E target and the extra two and half hours needed in cleaning a room with HPV. After the first month of deployment of the service it was also revealed that its use in 'clinical' or 'patient areas' was rather limited and most deployments were taking place in non-clinical areas such as toilets and bathrooms; this was again due to unavailability of rooms empty from patients

In February 2010 a first month review meeting took place with involvement of bed management, domestics, estates, ward managers, ward sisters, and Bioquell engineers. The meeting was co-ordinated by the DIPC and there was involvement of the deputy CEO. The first month experience was reviewed and it was decided that the trust should aim to make full use of the available service and emphasise more deployments in 'patient' areas. It was agreed that the domestic supervisors and bed managers would undertake a more active role and there should be co-ordination with ward staff and Bioquell engineers. Bed managers agreed to ensure maximum availability of rooms. Good communications between bed managers, domestic services, IPC team, facilities and estates department, representatives from the PFI scheme (DME ward), fire officers, occupational health, and the Bioquell engineers helped minimise disruption. The service was perceived by hospital staff as being very responsive and there was very good communication and collaboration with the supplier of the technology. The supplier also agreed to providing overlapping shifts for the engineers on site to address the issue of availability of the service when rooms were available late in the day. This meeting proved to be a catalyst in the successful implementation of the service in the trust. As illustrated in

Figure 4 the deployment of side rooms more than doubled during the period after the meeting (Q2), while there were also more deployments in bays and isolation rooms.

Figure 4: Deployments of HPV by Area
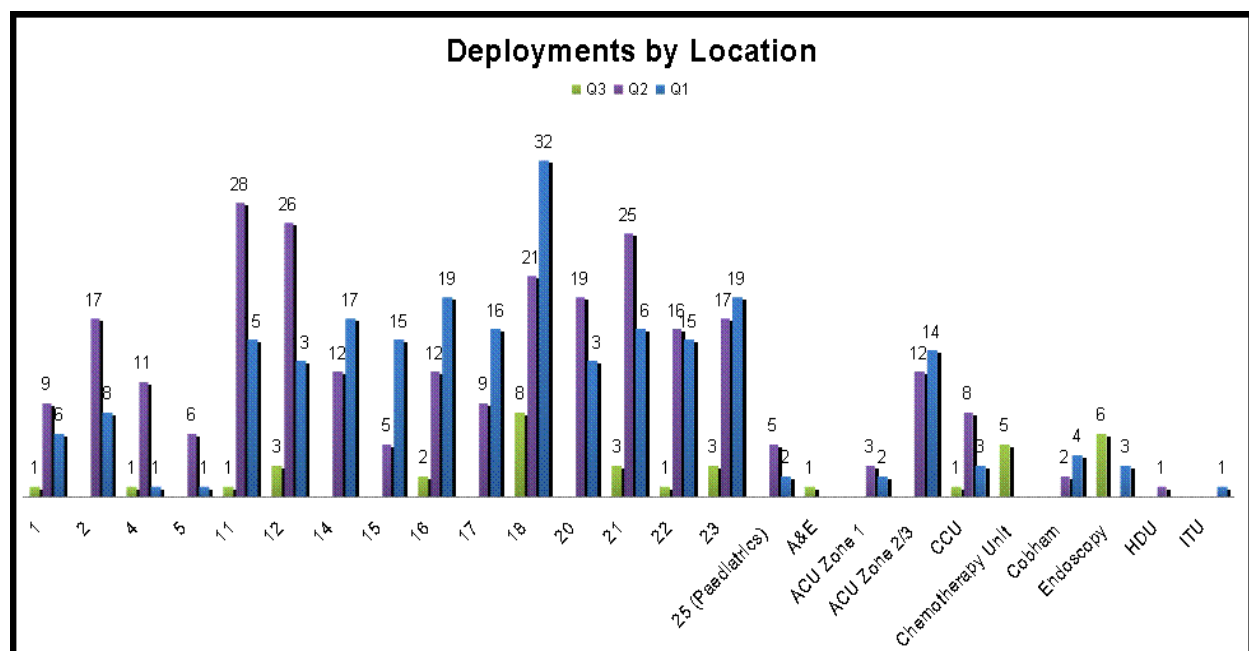
The importance of the meeting, which facilitated the engagement of and communication among various stakeholder groups in the trust, in catalysing implementation is illustrated in the account provided by a clinical matron:

"When we first started probably it was seen by others, and I mean in the clinical side, it was very much an infection control project. But that one meeting and the change in the structure of the

bed meeting in the morning changed everything. Domestic supervisor would turn up, because normally it is clinical people there, and she would say, we did so many rooms yesterday, what rooms do you want me to clean today? So it requires a lot of people talking to each other, isn't it?", [Clinical Matron]

It was vital to engage with bed managers in order to identify which rooms would be available for disinfection using HPV. As detailed above, 'buy-in' from key-personnel was also essential for optimal adoption and effective application. Relevant stakeholders in the trust were identified at the outset and kept informed throughout.

The successful and optimal implementation of the HPV system required a multi-disciplinary approach, with the cooperation of nurses, bed managers, infection control teams, facilities and estates management, cleaners and domestic supervisors, ward sisters and managers, and the manufacturer's team.

During the six month trial in the trust it was not possible for the IPC team to make a direct connection between the use of Bioquell and reduction in C. *difficile* rates and/or cost savings. During deployment of the service the trust was unable to close and empty entire wards due to bed pressures. The wards decontaminated consisted mainly of 4-bed and 6-bed bays; the Nightingale style open plan wards were not decontaminated. The wards were decontaminated sequentially from January 2010 onwards, each cycle taking two and half hours to complete.

The process was well received by ward staff and was seen as a positive intervention, which provided added reassurance to both patients and staff. Despite logistical considerations raised by bed managers, such as vacation of areas to be decontaminated, most clinical and domestic staff reported a positive attitude towards the technology. The clinical matrons appeared to be particularly satisfied. However, bearing in mind the cost implications of the service and the difficulty to make a direct connection between the use of Bioquell and reduction in C. *difficile* rates and/or cost savings it would be difficult to justify its continuation to the trust Board. A detailed review of the experience of the service and its future continuation is planned to take place in September 2010.

10.2.2.2 Single Use Patient Admittance Packs: Disposable Blood Pressure Cuffs (*Masimo®*) & Pulse Oximeter Probes (*Welch Allyn FlexiPort™*)

Decision Making Process

Technology in brief (in-house product pack)

The single use patient admittance pack contains in a plastic envelope the following: (a) a disposable Masimo® pulse rate and oxygen level sensor, (b) a Welch Allyn disposable FlexiPort™ Blood Pressure Cuff with a universal adapter which connects to a variety of monitors, (c) patient information leaflet, including a patient evaluation form. The packs are colour coded according to the size of the BP cuff (white/transparent for large and blue for medium size).

The *idea* for the particular technology pre-existed the receipt of the award. So there was an identified need before the monies came through and there was already relevant experience with similar products in the trust. Most traditional blood pressure cuffs are made from fabric and Velcro, which trap dirt and cannot be cleaned effectively without leaving the material damp. The many curves of the pulse oximeters also create problems of properly cleaning and disinfecting them. The poor cleaning of such materials encourages cross-patient contamination. The trust had identified this as an area where there was room for improving performance. It had been looking for some time at the use of reusable and disposable cuffs and disposable oxygen level sensors which had been implemented in ITU (approximately two years ago) and in paediatric wards (approximately one year ago).

Since 2008, the disposable cuffs and sensors have been used in the trust independently in the form of a trial; though these were not used in combination in the form of a pack. The products for these trials were provided free of cost by Welch Allyn (disposable BP cuffs) and Masimo (disposable SpO2 sensors). The idea of using the above two products in a pack came from the general manager of the clinical engineering department and was presented internally to a trust committee and won an award in 2008. With funding from the SHA the trial took place in some wards of the trust. This trial led to the use of the then newly introduced (2008) disposable BP cuffs by Welch Allyn fitted with a universal adapter to match the wide variety of different monitors across the various trust departments and service groups without the need for different

types of connectors or extra tubing. This idea had been implemented in a small scale across only two wards.

So, as soon as the monies from the award came through, the trust decided to roll out the innovative idea of the single patient use pack to all patients admitted in the Acute Care Unit. It was meant that these single use packs would follow patients throughout their journey in the hospital across the different wards they visit.

As with the case of the HPV system, the actual technology selection *decision making process* was *collective* and *inclusive* with involvement of staff outside the core infection prevention and control team and particularly the Clinical Engineering department. The same core group of people who had been involved in the decision making process for the HPV system also made the decision for the single use packs and the final decision was made in October 2009.

The proposal for the single patient admittance packs was led by the clinical engineering department. As with HPV, the overall process was described by the respondents as *informal* since no specific project team was formed.

The suppliers of the technologies (disposable BP cuffs and SpO2 sensors) were already supplying them to the trust. Each of the manufacturers were invited to initially present to the IPC team and then to a broader audience in the trust, which included ward sisters, clinical matrons, bed managers and managers/supervisors of domestic services. These meetings took place in the summer of 2009. Due to illness of the trust's deputy director for patient safety and infection control during the summer of 2009 the final decision was postponed for a few months. The limited capacity of the core IPC team (three members of staff) and the lack of a dedicated person to project manage the process further contributed to delaying technology selection. .

Box 24 and *Box 25* summarise the key perceived elements of innovativeness of the particular technology and its perceived relative advantage respectively as reported by the respondents in our qualitative interviews.

Box 24: Perceived Innovativeness of Single Patient Use Packs

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Perceived Innovativeness

- The combination of all disposable patient single use technologies in a pack was perceived to be innovative
- Having adopted a universal adapter for all trust monitors: *"Getting the connector sorted out enabled us to make the change and that was the most innovative element", [clinical engineering manager]*

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Box 25: **Perceived Benefit of Single Patient Use Packs**

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Perceived Relative Advantage

- Standardised universal adapter for the BP cuffs which clips on various types and brands of monitors without the need for extra tubing or special connectors
- Since the BP cuff is introduced at admission (as part of the pack) there is no need for a separate cuff in each ward which makes the use of such disposable products more cost-effective
- Both the cuffs and probes being disposable contribute to preventing patient cross contamination
- Being a standardised process across the trust rather than an isolated initiative in a few wards
- In combination with other innovations, which are aimed at reducing the bio-burden, provide enhanced reassurance to both staff and patients
- Colour coded packs to eliminate confusion regarding the size of the cuffs, which also makes it easy to distinguish disposable from reusable ones
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Besides the aforementioned perceived benefits respondents also highlighted a number of perceived weaknesses of the single patient use packs. These are summarised in Box 26

Box 26: Perceived Weaknesses of Single Patient Use Packs

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Perceived Weaknesses
- High cost and generate extra clinical waste (eco friendly?)

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- Patient information leaflet not adequate; there is need for better labelling of the packs to avoid staff unintentionally mixing up packs coming from different patients
- If the SpO2 sensor is taken off by the patient it may lose its adhesiveness and then becomes useless and needs to be replaced
- The pulse oximeter probes tend to wear out after 48 hours giving less accurate readings

Evidence of effectiveness had not been sought from other trusts. The main source of evidence used was trust's previous experience with the particular technologies, the evidence provided by the suppliers and most importantly, relevant peer reviewed papers published in academic journals, as the following quote illustrates:

"That's the whole reason behind us having this concept because even when staff clean such equipment this is not always adequate. There was a study done, not within the UK but in America, which is published in a peer reviewed journal, and 66% of the cuffs even after having been cleaned were not clean. And the same with the reusable SpO2 sensors; 75% - if I'm not wrong - of the sensors which according to nurses, they had been cleaned but when they scrutinised it, I mean they examined it under the scope, the contamination was still there. So that was basically the turning point for us to introducing this pack", [Clinical Engineering Manager]

Procurement Process

There is a price agreement in place between the trust and the companies who supply the products. When such agreements are in place, then various hospital departments just need to raise a Purchase Order to procure any of these products. For the particular project the IPC team provided the funding, and procurement was carried out by clinical engineering and involved negotiation directly with the suppliers, who offered the products with an extra 15-18% discount for the trial. The process of procurement was described by respondents as *straightforward*, although there was some unexpected delay, which was mainly due to a mistake in ordering slightly different products from the ones initially intended - instead of ordering medium and large size cuffs the order was placed for medium and large medium; since these are disposables there needed to be some negotiation with the companies to agree and swap them with the right

products. The plan was to have the 2000 single patient use packs available to be implemented at the same time with the HPV system (in January 2010). The mistake in ordering them led to a delay in implementation of two extra months (19th of April 2010). The trust did not top up the awarded amount.

Implementation Process

2000 packs (1,200 medium size and 800 large size BP cuffs) were created locally in the trust and one bank staff was hired for two weeks to complete the task. Implementation, with the intention of trialling them until the stock lasts, commenced on the 19th of April 2010 and about 250 packs / week were aimed to be given out to all adult patient admissions in ACU. The stock lasted until July 2010. The process is described by the DIPC in the following quote:

"What we did was we focused on ACU, which is an acute care unit. That's where everybody was, whoever required monitoring was given this pack and then they would travel to their ward with this pack. That was the idea you see. So the other wards had to know that people were going to come with these packs as well", [DIPC]

The technologies were already available in the trust and had been used independently by the ITU and paediatric wards for the last couple of years. The innovative element of the project during implementation was the intention to roll the packs out to a large part of the hospital. The **key facilitating factor** that had been repeatedly stressed by all respondents was the *structural compatibility* issue of having a universal adapter in place for the cuffs, which had already been trialled in the trust in 2008. The availability of the universal adapter enabled the rolling out of the packs to all types of wards irrespective of the type and brand of monitors they had in place. These issues are illustrated in the excerpt from the manager in clinical engineering.

"How to implement these in a ward or two is an issue. But to make a business case, to have these, plus change all the monitors or do something like that across a number of wards, is a humungous task to achieve. But once we managed to get those universal adapters … I think this gave us the opportunity, with this additional funding, to look at it on a larger scale. Because ITU is only seven patients, paediatrics is a handful of patients", [Clinical Engineering Manager]

However, a similar structural compatibility issue will need to be resolved for the SpO2 sensors if

these are to be fully scaled up throughout the hospital:

"One of the other biggest hurdles at the moment [to fully scale up] is the fact we've got two different SpO2 technologies in the trust at the moment. We're using Nellcor and we're using Masimo. The majority of them are Masimo but if we are to fully scale up the packs to the whole trust we might need to switch to one of the technologies", [Clinical Engineering Manager]

Since the intention was to standardise the use of the innovative packs and spread them across the hospital wards, *communication* became a key theme. Initial communication to ward staff was done via email and verbal instruction was given to staff who would administer the packs; patient and staff evaluation forms were given out during the trial period, too.

The initial response to the packs was reported as positive by the DIPC and clinical engineering. Later, the DIPC reported that he also noticed a rather mixed reaction from staff in the wards, with some nurses commenting about the packs being "a waste of money" and others raising a number of queries about the packs which were easily resolved through guidance from the IPC team. The issue of proper labelling of the packs also emerged during the trial period as illustrated in the excerpt:

"The nurse in charge [in the ward] was complaining to me. She said, see, they send these things with the patient notes and they don't label them properly and so I don't know which patient it belongs to. I said, but it's come with this patient's notes so it's this patient...though it made me think are these packs not properly labelled? are we mixing things up? I don't know. Maybe we can put a barcode with their pack when they're going out with patients", [DIPC]

In addition, it was retrospectively recognised by the IPC team that most patients that had been given the packs were not aware of the fact that "this was different from what they would have got otherwise". The DIPC felt that during the trial the innovative aspect of this initiative should have been emphasised more in patient communication.

Following the implementation of the trial, it became clear to the DIPC and clinical engineering representative that there was a need to educate both nursing staff and patients (the latter especially with the SpO2 sensors)

10.2.2.3 ICT Electronic Real Time Monitoring System for the Evaluation of Hospital Cleaning (*Expolink's Maximiser®*)

Decision Making Process

The *idea* for the technology came from the domestic services manager (DSM) through her professional network of DSMs and her hands on experience with a similar technology in her previous work in another NHS Trust. The domestic services manager has been advocating the concept for some time before the trust was presented with the award monies. Then, the idea was discussed in the Infection Control Committee meeting and was adopted by the trust as high priority for investment.

The *decision making process* for the particular technology was once again *collective* and *inclusive;* staff from the domestic services and the estates and facilities department took up the lead on this technology proposal. The technology was initially championed by the domestic services manager and later by the general manager for estates and facilities with high levels of involvement by the DIPC and the Deputy Director of Nursing. In addition, early in the decision making process a wide range of stakeholders were involved, including ward sisters and ward managers, IT, matrons, cleaning, domestic services supervisors. As with the rest of the technologies selected by the trust, the overall process was described by the respondents as *informal* since no specific project team was formed.

The rationale for the particular technology selection decision is illustrated in the following quote by the domestic services manager:

"It makes us more operational. We get to spend more time out on the floor rather than dealing with paperwork in an office trying to add up audits. So therefore my supervisors are able to spend more time on the ward areas rather than in office bases and trying to fill in paperwork", [Domestic Services Manager]

Box 27 and Box 28 summarise the key perceived elements of innovativeness of the particular technology and its perceived relative advantage as reported by the respondents.

Box 27: Perceived Innovativeness of E-Real Time Cleanliness Monitoring System (*Maximiser*)

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Perceived Innovativeness

- Real time paperless system from data collection to report distribution
- Readily available reports against the National Standards of Cleanliness, PEAT, waste management audit, CQC audit
- Central repository of information easily accessible and retrievable which allows sharing of cleaning information by various interested groups in the trust

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The main perceived benefits of the technology are also exemplified in the excerpt below:

"My supervisors do at least three to four audits a day now whereas previously they were doing two audits a day and on some occasions we weren't getting them, you know, they were kind of missing them out whereas now because they know that the computer's going to flash up if these areas haven't been covered and plus they know as well that it's very important that these audits are completed now. And again with the clinical staff they know, it's the same....it is an open book for everybody to see what's in it. And people are getting a lot more competitive now. Both clinical staff, and domestic staff are slightly more competitive because there's nothing secretive any more, it's all open", [Domestic Services Manager]

Box 28: Perceived Benefit of E-Real Time Cleanliness Monitoring System (*Maximiser*)

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Perceived Relative Advantage

- Paperless system from data collection to report distribution
- Proper documentation record and electronic audit tool
- Can be tailored to local needs: enables incorporation of site's structure; development of checklist against the National Standards of Cleanliness, PEAT, waste management audit, CQC audit
- Brings staff from different functional groups together to act as joined working teams
- PDAs include cameras to take pictures if necessary for auditing or training purposes
- Central repository of information on cleaning easily accessible and retrievable

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> which allows sharing of cleaning information by various interested groups in the trust
- Encourages healthy competition among wards
- Modern "21st Century service" *"it instilled a lot of pride to those staff using it"*, [DIPC]
- Promotes openness, transparency and accountability "cleaning results are in the public domain"
- Improves compliance

Two companies were identified and were invited to present to the trust. The IPC matron and the domestic services manager reviewed the two types of products that were available. Maximiser was chosen as being more "user friendly". In addition, Maximiser was an established, off the shelf product, in use by other NHS Trusts and provided the option for customisation to create complementary audit tools in addition to checklists against the National Standards of Cleanliness. The final technology selection decision was made in October 2009, eight months after the announcement of the award. The rationale for selecting the Maximiser product is summarised in the words of the DIPC:

"So really the Maximiser system comes in and it's a programme. You expand on that programme. The other company had to build the programme. We didn't want something to develop. We wanted something that had been in place and obviously been proven and tracked by other hospitals that had used it and found it helpful to them", [DIPC]

Evidence of effectiveness had been sought from other NHS Trusts that had previous experience with the particular technology and the evidence provided by the supplier.

Procurement Process

The procurement process was perceived by respondents as *protracted* since it took almost seven months to be completed. The frustration and delay faced by the IPC team in procuring the particular, and most of the rest of the technologies, was reported to be due to the lack of a separate spending account for infection control. Consequently, the IPC team was dependent on other trust departments to do the ordering of technologies and products for them. The complex communication arrangement that needed to be put in place was deemed responsible by the

DIPC for having created an organisational bottleneck which impacted on the procurement process. This is exemplified in the following quote:

"About five or six weeks were lost because we didn't know who had, who was sitting on the order form within the trust, which is very bad actually. That was around Christmas time, and once the thing was ordered I had loads of emails sending people around who's got it, who's doing the ordering, where is, you know… that kind of thing. The basic problem is that we as infection control people don't have a spending account", [DIPC]

The technology was procured through NHS Supply Chain. The estates and facilities department placed the order and then infection control was cross-charged. The trust procurement group was also involved early on in the process.

Implementation Process

Implementation of the technology started on the 17th of May 2010 and was trust-wide. The software package was tailored to the local needs of the trust. In the customisation process the trust structure was incorporated in the design of the produced checklists to replace generic templates; checklists were developed against the National Standards of Cleanliness, PEAT, waste management audit, CQC audit to also facilitate the trust with the reporting of the above. The Domestic Services Manager, the Deputy Director of Nursing, the IPC matron were directly involved in the customisation of the software in collaboration with the IT department and the engineers from the supplier company.

The trust IT department had been engaged in the decision making and had initially reviewed the technology. However, they failed, according to the DIPC, to identify when they undertook their scoping exercise the need for the trust to procure a server to support the implementation of the Maximiser software. This miscommunication between the IPC team and the IT delayed the implementation further.

Training for the nurses and the domestic supervisors using the PDAs and the software has been provided by the supplier and internally by the IT team. The implementation has been smooth and significant progress has been made in fully operationalising the new technology in a period of less than three months. The comment on the implementation of the Maximiser software by

the domestic services manager vividly illustrates the process:

"My crew were like, gosh, we'll never be able to use those.... at the beginning maybe slow because it took a bit of time to get used to it. Now supervisors are managing to do three to four audits on any one day ...I have to say they're fantastic with it and they totally have taken to them and they think it is brilliant. They think it is a very good tool… with some areas we're still having teething problems because we're changing bits and pieces to get it completely the way we want it, but give it another few weeks", [Domestic Services Manager]

10.2.2.4. Hand Hygiene Signage Posters

The DIPC commented on the progress made so far with respect to the fourth technology identified:

"we haven't done anything so far about the signage. And the reason being that the wards that we were focusing on are on a three year refurbishment programme and we were hoping that the refurbishment programme was going to start - when we were planning it, it was going to start in May this year. So we were thinking that there was no point in doing signage and then cutting the whole thing. So we were hoping that we would do it at the same time and make … hand wash stations and, you know, we collected some ideas with our estates department, but things haven't gone on as we predicted so those wards still haven't started with the refurbishment, so we haven't done that bit of the work", [DIPC]

Procurement Process

The technology has not been procured yet

Implementation Process

The technology has not been implemented yet

10.2.3 Evaluation of technologies

Overall, the criteria for success of the technologies, agreed by the trust (the core IPC team) are as follows: (a) user friendliness, (b) patient acceptance, and (c) reduction in infections.

In the case of the disposable patient packs the rationale is to *"break the chain of infection"*. Evaluation to date shows that the majority of nursing staff who had responded have found the technology useful. However the response rate has been poor. It was felt that the appointment of someone to project manage the whole process would have enabled a more systematic evaluation of the technologies and would have facilitated better planning of activities also ensuring timely feedback by users. The trust plans to gauge patient feedback next.

Box 29: Staff evaluation of patient disposable pack April-May 2010

Number of responses = 25

Number of wards = 6

No	QUESTION	YES	NO	No Response
1	Did you find the single patient use admittance packs easy to use?	72%	28%	
2	Did using the single patient use admittance pack save time compared to the time it would have taken to clean the cuff/sensor?	68%	32%	
3	Did you find the cuff easy to connect to the FlexiPort connector?	80%	16%	4%
4	Did the SpO2 sensor stay in place well?	16%	76%	8%
5	Was the SpO2 sensor easy to apply?	44%	52%	4%
6	Do you think the use of a single patient use admittance packs is a good idea?	80%	20%	
7	Did the patient think the use of a single use patient admittance pack was a good idea?	68%	32%	
8	Do you think the use of single use admittance packs will reduce the risk of cross-contamination in the hospital?	88%	12%	

Results of the staff evaluation show that staff found the packs easy to use, but the SpO2 sensor was described in the comments as not maintaining its "stickiness" when used more than once

resulting in poor pick up of O_2 saturations. The score on question 2 and 5 probably reflects the time spent trying to obtain a good contact with the sensor, using a standard sensor or opening another pack is described as a solution.

10.2.4   Discussion

10.2.4.1   The decision making process

The process of decision making for the technology selections was *inclusive* and *collective*. Ideas were generated both within and outside the core IPC team. Decision making was led by (a) the core infection prevention and control team, but also involved a wide variety of stakeholders and service groups, including: (b) domestic services supervisors and managers, (c) the general manager of estates and facilities, (d) the deputy director of nursing, (e) clinical matrons, (f) ward sisters, (g) the hospital's IT department and (h) members of trust's executive board.

Trust 7, when compared to other trusts in the sample, took one of the most inclusive approaches to decision making, that is including the one of the widest number of stakeholders outside of the IPC team. Engaging with a wide variety of stakeholders in the decision making process was considered necessary for effective implementation.

The decision making process for all technology selections was informal and no specific project team was formed. The trust's infection control committee were kept informed of decisions, and progress on spend.

Technology selections were a combination of pre-determined and emergent decisions. We define here, predetermined, those technologies which had been selected before the award and the trust was awaiting a funding opportunity. Emergent describes those technologies which were considered after initiation of the project.

The decision making process in selecting technologies was led by the DIPC, was championed by the IPC matron and also involved a core group of senior hospital staff including clinical matrons, the general manager of estates and domestic services. There was involvement of

senior management, namely the trust CEO and the Deputy CEO (who is also director of nursing and director of operations). The support provided by senior management further facilitated technology implementation. The lack of an independent spending account for the infection prevention and control team impeded prompt procurement of the selected technologies.

10.2.4.2 Evidence

The staff who were involved in technology selection decisions used a wide range of sources to get information about the technologies grouped in three broad areas (Table 45)

Table 45: Type and sources of knowledge used in decision making

Awareness knowledge[57]	Principles / theory knowledge[58]	How to knowledge[59]
Professional networks – link with trust where project lead previously employed [E-real time monitoring of cleanliness] Rapid Review Panel (RRP 1) / Showcase Hospitals [HPV] Trust Staff [E-real time monitoring of cleanliness & Disposable patient packs] Central DH activities – HCAI conference [HPV]	Professional networks [E-real time monitoring of cleanliness] Peer review journals [Disposable patient packs / HPV] Supplier [E-real time monitoring of cleanliness]	Supplier Other NHS Trusts Showcase Hospitals / DH Evaluation report of Bioquell HPV Previous experience with the same or similar technologies [Disposable patient packs]

(Adapted from Rogers, 2003; Glasby & Beresford, 2006)

Regards information about the technologies and relevant evidence trust members used links with other NHS Trusts and professional networks. For one of the technologies the idea came from a central DH event (HCAI conference in London).

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[57] to find out what is available in terms of the range of technologies specific to IPC

[58] why and how a technology works in terms of the underlying scientific principles or theory

[59] how to put the technology in to use, including all aspects of implementation

The information used by different professional groups and the assessments they made about technologies varied. For instance, the clinical microbiologist emphasised the principle/theory knowledge and the underlying science for the effectiveness of the technology, looking primarily in peer reviewed papers for such information. In contrast, the clinical matron would rather prefer to use more simple information about technology effectiveness and would discount very technical accounts as the following excerpt illustrates:

"You don't want such jargonistic information. You need to make it very simple, to say this is how it works. These are the benefits, blah, blah, blah, rather than going to such, you know, higher level of microbiology", [Clinical Matron]

An IPC nurse highlighted the importance of combining 'How to' and 'Principle/theory' knowledge:

"You need both evidence paper and the practicality of using the product. It's very important" [IPC nurse]

The domestic services manager prioritised professional and social networks, observing the technology in use in other settings or trialling it if possible to get the information she required about a particular technology

"For evidence or information about a technology, networking with other people that are using it would be my top choice. Obviously trial basis ourselves if necessary. I would obviously go and see it in use in other areas", [Domestic Services Manager]

10.2.4.3   Procurement

The procurement process was largely delegated by the IPC team to either other departments (i.e. clinical engineering) or the trust's procurement team. Purposeful decisions to go direct to the supplier or use national frameworks were made. For some of the technologies (disposable blood pressure cuffs and pulse oximeters) better financial options were available through direct procurement from the supplier. For other technologies better rates were available through national procurement frameworks (Bioquell HPV). Overall, the procurement process for the various technologies selected by the trust was perceived by respondents as *protracted*. This

was partly attributed to the lack of a separate spending account for infection control.

10.2.4.3 Context

The medium size of the trust and the small size of the IPC team had implications for both the technology selection and implementation processes. Due to its small size, the IPC team relied on the cooperation of directorate/ward staff for generation of ideas and technology implementation. This has been reflected in the inclusive approach followed by the trust in making technology selections.

The high bed occupancy rate and winter pressures compounded by flu outbreak increased the implementation challenges for certain technologies and particularly the HPV system.

The trust has been in a situation of organisational flux during the duration of the project: change of CEO, change of general manager in clinical engineering, high employee turnover, ongoing refurbishment programmes, deputy CEO being on extended sick leave. This organisational instability inevitably delayed the selection, procurement and implementation processes.

10.2.4.4 Implementation

One of the four technologies selected has not been implemented yet. The procurement and implementation processes for the remaining three technologies were perceived to be rather smooth, although lasted significantly longer than expected. The HPV system was implemented as a fully managed service for a six months period from January 2010 until July 2010. The single use patient admittance packs were implemented in April 2010 and the Maximiser software with the 8 PDAs in May 2010.

Box 30 Box 21and Box 31 summarise the main implementation barriers and facilitators as perceived by the respondents in Trust 7.

Box 30: Perceived Implementation Barriers

Perceived Barriers to technologies Implementation

- Lack of staff capacity of the IPC team (DIPC, two nurses and one administrator)
- The lack of an IPC spending account which led to protracted procurement and delayed implementation
- Technologies which consist of many components and involve a high number of diverse stakeholders appear to be more complex and demanding during implementation (Maximiser Vs Disposable BP cuffs & SpO2)
- Underestimating the need for training even in what appears to be simple tasks (Single use patient admittance packs)

Box 31: Perceived Implementation Enablers

Perceived Enablers/Facilitators to technologies Implementation

- Support by senior management in the trust facilitated implementation by mobilising staff and providing increased legitimacy to the initiatives
- Early involvement of the technology users in the decision making process helped to obtain users' buy-in and to feedback to customise the technology to better fit the local context
- Early engagement and regular steering of the process by a core group of managers who are responsible for the service areas in which implementation is to take place
- A non-blaming open and honest culture
- The presence of a matron in the IPC team has facilitated communication and ensured higher levels of cooperation by ward matrons with significant positive implications for implementation

A final review meeting is planned for late September 2010 for staff to reflect on their experience, systematically evaluate the technology selections and jointly decide upon the future investment in the technologies trialled by the trust. Carrying on with using the Maximiser software appears to be highly likely and expansion to also use the web based system is planned. There is positive experience with the trial of the single patient use admittance packs and the continuation of the initiative is very likely. The HPV system as a fully managed service due to high cost implications appears to be a less attractive technology option for further investment by the trust in the near future.

11. Case study – Trust 8

11.1 Context

11.1.1 General Context

Trust 8 is a University Hospital NHS Foundation Trust which was established on 1st August 2006. It is a medium size NHS Trust providing acute healthcare to a population of 330,000. The trust comprises two main teaching hospitals and is one of the largest employers locally with around 3,463 staff. It has a bed complement of 860 inpatient beds and 90 day-case beds. The trust is also a teaching hospital and a tertiary centre providing specialist services to a much wider population of around 1.5 million. The population served by the trust includes some of the most socially deprived communities in the country, with high levels of illness creating a high demand for hospital-based care.

The trust handles over 73,300 episodes of inpatient and day case care per annum, over 257,000 outpatient attendances (77,840 of which are new patients), and over 87,900 patients attend the Emergency Department. The trust's services were used to be managed through a Directorate system with 24 Clinical Directorates grouped within three main Divisions – Medicine & Emergency Care, Surgery, and Support Services. From 1st April 2007 a new structure regrouped a number of Directorates into Business Units with the aim of improving their functional interrelationships. The trust has an annual turnover of about £250 million a year.

Table 46: Trust 8 at a Glance

Trust type	Foundation Trust / University affiliation
Trust size	3,463 staff
Number of sites	2
Population coverage	330,000 (1.5 million for tertiary care)
Number of beds	950 (860 inpatient)
Patient turnover	73,300 inpatient, 257,000 outpatient, 87,900 emergencies
Financial turnover	£250 million / year

11.1.2 Trust Performance

The trusts' performance was rated as "Good" for the quality of its services and as "Excellent" for

financial management by the Care Quality Commission in the latest annual health check in 2008/09. This is compared to the "Fair" and "Excellent" scores received for quality of services and financial management respectively for the previous year.

Table 47: The Care Quality Commission Assessment[60]

	2005/06	2006/07	2007/08	2008/09
Quality of services	Fair	Good	Fair	Good
Quality of financial management	Good	Excellent	Excellent	Excellent

The results for the most recent (2010) Patient Environment Action Team (PEAT) assessments are outlined in Table 47 below[61] showing improvements on the previous year for privacy dignity from 'Good' to 'Excellent'.

Table 48: PEAT Inspection Results (2010)

	Environment Score	Food Score	Privacy & Dignity
Trust 8	Good	Excellent	Excellent

11.1.3   Infection Prevention and Control Context

The core Infection Prevention and Control Team (IPCT) is headed by the Director of Infection Prevention & Control, who is nurse by profession and she is also the Director of Nursing for the trust. The IPCT consists of the Infection Control Doctor (ICD) and the assistant director of Nursing for patient safety and infection control, who is responsible for 6 infection control nurses (including 2 infection prevention matrons) and 2 and half administrative co-ordinators, while there are link nurses for each ward.

11.1.3.1   Trust performance on mandatory HCAI indicators

Table 49: Trust performance on HCAI indicators

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[60] Care and Quality Commission, October 2009
[61] Patient Environment Action Team (PEAT) Assessment 2010, National Patient Safety Agency

	2007/08	**2008/09**	**2008/09**
MRSA hospital acquired	33 cases	28 cases (target, Max no of cases 24)	18 cases
Clostridium difficile	292 cases	340 cases (target, Max no of cases 201) **HPA: 448**	213 cases

Source: Trust Annual Reports and HPA website

11.1.3.2   Trust Infection Prevention and Control Interventions

In the past year the trust invested £2.2 million in infection prevention and control including the expansion of the infection Prevention and Control Team from 3 full time equivalent members of staff to over 7 full time equivalent members of staff[62]. A number of IPC initiatives have also been taken up, which are summarised below.

Initiatives in 2008/09:

• Introduction of an isolation ward (2nd March 2009)

• Establishment of daily infection prevention and control task force meetings

• Installation of new hand wash stations outside all wards (completed in the summer of 2009)

• Expansion of the Infection Prevention Control Team to include two new infection prevention matrons (took up post at the trust during 2009/10)

Initiatives in 2009/10[63]:

• The trust worked closely with the DH in developing an assessment framework for infection prevention and control (Q1 2009/10)

• Establishing a decant ward to support the trust deep cleaning programme

• Implementation of revised antibiotic prescribing guidelines offering alternatives to cephalosporin

• Recruiting additional microbiologists and antibiotic pharmacists

• Putting in place an enhanced educational programme for all health professional and ancillary staff.

Improving cleanliness and reducing hospital acquired infections[64]

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[62] Trust annual report p22

[63] Trust annual report and accounts 2008/09 p13

• All domestic staff in direct employment with the trust and integrated into ward teams

• A regular programme of deep cleaning has been introduced

• The trust introduced routine screening of all patients on admission for MRSA 12 months before the date required by the DH

11.2.1 HCAI Technology Innovation Award: Trust IPC Areas of Priority and Technologies Selected

Who was involved and how?

Primarily the IPC team was involved in the decision making process for all three technologies selected. The initial decisions for selecting types of technology were made at the weekly IPC operational meetings, in which the core IPC team was involved. These initial decisions were later discussed and communicated to a broader group of hospital stakeholders at the monthly IPC committee meeting. In the latter meeting the following stakeholders were involved: (a) the medical director, (b) the DIPC / director of nursing, (c) assistant director of nursing for patient safety and infection control, (d) microbiology, (e) domestic services, (f) estates, (g) matrons, (h) clinicians. At a later stage (i) IT were involved, too.

Initial options considered

Two first round technology options were considered by the trust. The initial option entailed investing the award money in procuring the *ICNet HCAI surveillance software*, with the aim of enabling the infection control team to have rapid access to microbiology results. However, the cost (it was estimated by the IPC and IT teams to be over £80,000) exceeded the available funding of £50,000 (Trust 8 was one of the three trusts in the region nominated by the respective SHA that shared the £150,000 award, with each trust having received a third of the overall amount).

A second option considered by the trust was to invest the money in procuring *Hand Hygiene Glow and Show kits* as training aids for Hand Inspection. This option aimed at allowing the link

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[64] Trust annual report and accounts 2008/09 p18

nurse in each ward to train and assess hand hygiene with staff in the directorates. However, as explained in the quote by a senior nurse below this technology was finally not prioritised by the trust:

"*Initially we did want to buy also, the glow and show hand gel so that we could check everyone's hand hygiene. However, because we had more carts than we expected to originally, we haven't been able to buy them as well. So originally the directorates were going to be bought one of them each, but they'll now have to buy their own, because we felt it was more important that we got all the carts with the Medigenic keyboards, and the tablets provided for the staff as well, and the count up boards for all",* [Assistant Director of Nursing for patient safety & infection control]

The two technology options above were not taken forward by the trust. The technologies finally selected are discussed next.

What was finally selected?

The trust made *three main technology selections*, addressing *three IPC priority areas* (Table 50). All selected technologies have been procured and implemented in clinical practice. Due to trust's poor performance in 2008 in combating C. *difficile* infection, the trust was on a *"huge drive around reducing C. difficile rates"* during the time when technology selection decisions were being made. In particular, emphasis was given to the procurement of flat, easy to clean keyboards to be used on the mobile medical carts in all clinical areas and this is where most of the award money was spent.

Table 50: Technologies, Priority area and Progress

	Technology	IPC Priority Area	Brand / *Supplier*	Procured	Implemented
1	Portable PC Tablets + wireless connection	Information Management & Communication Technology	*Lenovo* ThinkPad® X-200	Yes	Yes
	Fax Machine			Yes	Yes
2	Smart flat infection control PC Keyboards (for all portable computer carts	Environmental Hygiene	Medigenic® / *Esterline Advanced Input Systems*	Yes	Yes

	and PACS machines)				
	General PC Keyboard Skins/Covers (for all computers in a clinical setting)				
3	Digital Count Up Posters/Boards showing MRSA / CDI free days for each ward	Hand Hygiene	Local Supplier	Yes	Yes

11.2.2 Individual technology selection, procurement and implementation

11.2.2.1 *Lenovo ThinkPad® X- 200* Portable PC Tablets & Fax Machine

Decision Making Process

The *idea* for the technology (portable PC tablets) came internally from within the trust since PC tablets had been already in use by managers and matrons across several trust directorates. The close collaboration between members of the IPC team and the Assistant Director of Performance for the trust, who has been an advocate of investing in ICT technologies in the trust, provided further momentum to the idea.

The decision to invest some of the awarded monies into the particular technology was further supported by: (a) the availability of other "enabling technologies", such was the set up of an integrated clinical information system across the hospital and a hospital wide wireless network; (b) the strategic fit of the technology with the trust's choice of "going paper light" and investing in the development of ICT to improve service quality.

The technology selection *decision making process* for the portable PC tablets was *collective* and *inclusive to a certain extent,* with involvement of staff outside the core IPC team and particularly of the Assistant Director of Performance for the trust. Further, the IPC team linked up closely with the trust IT department who undertook the scoping exercise and ordering of the

PC tablets. A preliminary decision of investing in the PC tablets was made at the infection prevention and control committee meeting in May 2009 about two months after the award of the money. Though, the final decision was reached in September 2009, when the team finally concluded on the allocation of the award money among the different technology products considered.

The primary rationale for selecting the PC tablets was the significant potential it offers in time savings for the IPC team members enabling them to complete their audits faster and in a more reliable fashion.

"As IPC staff go on the wards to do the audits [the PC tablets] would save work and help in avoiding duplication of paperwork really. That was the main thing, because the IPC team do an awful lot of audits", [Assistant Director of Nursing for patient safety & infection control]

The overall decision making process was described by the respondents as *informal* since no specific project team was formed.

The decision was further shaped by two significant contextual influences: (a) the adoption by the trust of an updated IPC assurance framework, and (b) the strategic approach pursued by the trust of being proactive in IPC issues. The above two broad themes were linked through the trust's strategic choice of investing in developing a robust information and communication technology infrastructure in the trust. The overall strategic perspective and the fit of the particular technology selection decision with the trust's strategy in this particular area are summarised in the quote below

*"It's all got to fit together, so this has to fit in with our IT strategy. So the infection control innovations have got to be part of the wider strategic sort of perspective. And the wider strategic perspective is based on **information at the bedside**, **rapid access to information**, **those that need the information to be able to access it wherever they are**. The Infection Control Team need to capture data about care pathways, and to do that you need to have something you can record on site, so that's why we went for the tablets",* [Assistant Director of Performance]

The previous experience of the trust with the same technology and the use of computer tablets in clinical settings outside the immediate IPC realm greatly influenced the final decision.

According to informants' accounts, the following key factors were considered by the decision makers on the tablets: (a) technology's data capture functionality, (b) technology robustness, (c) technology fit with trust and IT strategy, (d) practicality (resistance to physical damage), (e) connectivity and real time information feed, (f) cost, (g) technology aesthetics and feel. The latter was the decisive factor according to the informants that led to the selection of Medigenic keyboards. Box 32 and Box 33 summarise the key perceived elements of innovativeness of the particular technology and its perceived relative advantage as reported by the respondents in our qualitative interviews.

Box 32: Perceived Innovativeness of *Lenovo ThinkPad® X- 200* Portable PC Tablets

Perceived Innovativeness

- The opportunity it provides the IPC team with to capture data at the bedside in real time, to report and share information rapidly
- "The product isn't particularly innovative; it is a vehicle that enables the use of very innovative framework data capture tools; the real innovation is the process which this technology supports: the use of real time matron's checklist, IPC information that feeds into other things and that's really innovative"

Box 33: Perceived Benefit of *Lenovo ThinkPad® X- 200* Portable PC Tablets

Perceived Relative Advantage

- Saves time for IPC staff by using it in audits and taking electronic notes during meetings
- Captures data and patient information in real time at the bed side
- Provides the opportunity for IPC team members to inform and educate staff "on the spot" through presentations that can be easily reproduced across various clinical settings
- Modern and 'high tech' feel
- They are portable and are wirelessly connected to the trust intranet network

The perceived benefits of using the particular technology are summarised in the following excerpt of a senior nurse in the trust

"[The IPC team] go out with the computers during ward rounds, and that means looking through the case notes, looking through all the information on the ward... they can do all these tasks there and then on the ward rather than having to come back and write the information then put the information down. So it is really helpful. It's also helpful for them going to present in small groups. They tend to, they'll put their presentations in and they can turn the computer round and they can show them the presentation rather than having to talk through it. So, because quite often on the wards they'll speak to about three or four people, so they can use the same presentation and they can use it for that as well, and they can just turn it round and show the presentation. And also if we're in meetings it's handy because you can write, we've got the ones you know, where you can write on them, the notebook, and then basically just convert it into notes and it's typed so it saves you having a pad all the time or whatever, so you can do it. So they've been very successful", [Assistant Director of Nursing for patient safety and infection control]

Regards evidence, a combination of sources was used by the trust team involved in decision making. For 'awareness knowledge' of the product the team used previous experience with the particular PC tablets by other members of staff in the trust, while it was also reported by respondents that information from the internet was also gathered for the same purpose. The supplier company provided evidence about the product's effectiveness and further evidence was obtained through trial. The trial of the product and the previous experience of trust staff with it provided further evidence for the product's practical application and 'how to knowledge'. For 'principle/theory knowledge' (the mechanism behind the product), the team relied on expert advice given by the trust's IT.

Procurement Process

The final decision to procure the particular PC tablets was made in September 2009 while the order with the supplier was placed in November 2010 and the product arrived at the trust a few weeks later in December 2010.

Procurement was delegated to the trust IT department who led the overall process. Procurement was direct from the supplier with involvement of the trust's procurement team. The same type of PC tablet was already in use within the trust by other clinical teams, especially clinical matrons and some managers in the wards. Therefore, the trust procured the PC tablets

for the IPC team from the same company. The IPC team was not given the option of trialling PC tablets from various suppliers. As a senior nurse commented:

"All I said was we need this, we made a decision that we want the tablets, and they had already done all the work around which tablets we buy...we didn't check any different type of tablets we just asked could we have one, and portable, and that was the one we were given. We didn't really get an option for them...we asked for eight tablets and they gave us the ones, and everyone now has got the same tablet, so I'm assuming there's been some sort of tender with that company, but I'm not sure" [Assistant Director of Nursing for patient safety and infection control]

The experience of the above nurse with the procurement of the tablets was very positive and she commented that it was the most straightforward process of the technology selections made by the team.

Implementation Process

The trust piloted the use of the tablets and also relied on the previous experience of other members of staff with the particular product. During the early implementation trial there were some problems identified with suboptimal coverage of the IPC team office by the trust wireless network, which prevented the optimum use of the tablets by the team. These problems were swiftly rectified in collaboration with the trust IT department.

The major issue identified during implementation and through the piloting of the product concerned the operating system (OS) of the tablets (they came with the OS Windows Vista pre-installed). The trust required from the supplier that Windows 7 should be installed instead of Windows Vista, which delayed the final implementation of the product by approximately two months, since the product had to be reconfigured by the supplier. The rationale for this modification in the selected technology is presented in the following quote:

"The tablets needed to be on Windows 7 to be compatible with our systems. So that delayed us getting them up and running, but they've been up ... probably took about two months to get them in and get them converted over", [Assistant Director of Performance]

Overall, the implementation of the PC tablets was very smooth and involved minimum requirements for training of the IPC staff. The system of data collection during ward rounds by infection prevention and control team was already in place and staff that used the tablets were already familiar with using computer technology. Users were internally trained by IT staff on how to use the tablets during the early implementation stage.

Fax Machines

Regarding the fax machine, one was ordered for use by the infection prevention and control team. The rationale for this technology selection is explained in the quote by the respondent below:

"*The fax machine is for infection control, because basically we had all the audits coming in via the fax machine and we didn't have our own, so they kept getting lost in the system. So even though we say everybody has to email, we do still accept fax, because some people just don't email it as they should",* [Assistant Director of Nursing for patient safety and infection control]

Overall this was not considered a particularly innovative technology but it rather met an operational need of the IPC team. The product was swiftly procured in May 2009 and was implemented a few days later and the process was perceived by our informants as very straightforward. The only issue raised was that this selection decision partly contradicted the trust's and IPC team decision to go paper light on reporting with use of email instead of faxing through results. However, as explained in the quote above the decision for the fax machine was finally made on practical grounds.

11.2.2.2. *Medigenic®* Flat Smart Infection Control Computer Keyboards & Fully Enclosed Mice - General Computer Keyboard Skins/Covers

Decision Making Process

The *idea* for the technology came from members of the IPC team who were aware of the use of easy to clean keyboards in other hospitals both in the UK and abroad. At the time when technology selection decisions were being made the issue of high levels of C. *difficile* infections

that had been reported during the preceding year topped the IPC agenda; in fact the trust had been ranked among the worst performers in the country on C. *difficile* infection rates in 2008. Therefore, improving environmental cleanliness was placed high on the trust agenda.

At the same time, the trust embarked on a full decant programme of all wards as a response to the negative results in infection control. One of the issues identified in that process was the suboptimal cleaning of conventional computer keyboards and mice in clinical areas and the lack of ownership among staff in carrying out their cleaning. Conventional computer keyboards and mice are difficult to clean to an adequate hygiene standard because of the shape of the keys and the spaces between them. Hospital staff often need to use keyboards to enter data following patient contact increasing the risk of cross-infection. Thus the introduction of easy to clean keyboards aimed at reducing the risk of transmitting infection. In particular, the focus was on replacing the conventional computer keyboards and mice on the mobile medical carts and the newly introduced Picture Archiving and Communication Systems (*PACS)* with flat and enclosed ones*.*

The above issues where outstanding and the trust's decision to invest in the particular area had already been made prior to the announcement of the award funding. In addition, the trust had already been trialling some Medigenic keyboards on some computers in clinical areas prior to the award. This experience shaped the final technology selection decision. The bulk of awarded funding was allocated to this particular technology and the positive experience following the trial of Medigenic keyboards informed the final technology selection decision in favour of the particular supplier.

The actual technology selection *decision making process* for the flat computer keyboards was *collective* and *inclusive,* with involvement of staff outside the core infection prevention and control team. The IPC team collaborated closely with the trust's IT department to identify the range of companies supplying the product. Nine companies were identified and quotes were requested. The suppliers provided the trust with product samples for trial. The need for consultation with hospital staff, in particular with the cleaning personnel and the potential users of the computer keyboards in the clinical areas, delayed the final technology selection decision. The final decision was made in September 2009. Following the scoping exercise that was undertaken by the IT department the trust decided to invest in the Medigenic keyboards and mice to replace conventional ones for all computers in mobile medical carts and PACS. For all

other computers in clinical areas computer keyboard skins/covers would be used instead, as these were considerably cheaper. This final decision was made by *Infection Prevention and Control, the Business Manager* and *IT* incorporating feedback from cleaning supervisors and consultants using the PACS.

"Part of the feedback was from the consultants, because the first ones we piloted didn't have a ball on the mouse, and quite a lot of them complained about that, so we had to then go back and look to see what we could do about it. So again it was a joint decision on which keyboards would be best. And also around the sleeves, we got different companies in and had a look at them to see what they were like, and how they could be cleaned as well" [Assistant Director of Nursing for patient safety and infection control]

The champions of the particular technology were the Director and Deputy Director of Infection Prevention and Control. The overall process was described by the respondents as *informal* since no specific project team was formed.

Box 34 and Box 35 summarise the key perceived elements of innovativeness of the particular technology and its perceived relative advantage respectively as reported by the respondents in our qualitative interviews.

Box 34: Perceived Innovativeness of *Medigenic*® smart flat PC keyboards

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Perceived Innovativeness

- Smart keyboard that monitors its own cleaning status and signals out when it needs to be sanitised
- The flat smooth and easy to clean touch typing surface of the keyboards

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Box 35: Perceived Benefit of *Medigenic*® smart flat PC keyboards

<div style="border:1px solid black; padding:10px;">

Perceived Relative Advantage

- The Medigenic keyboard's flat design and smooth surfaces quickly and easily wipe clean with ordinary hospital disinfectants enabling all staff to clean them after use; enhances compliance with cleaning
- The Medigenic Alert System: an indicator will flash / bleep when cleaning is required to help monitor and promote good infection control practices
- Scroll functionality on the mouse via the use of push button is also available
- Keyboard being waterproof

</div>

Box 36 illustrates the perceived weakness of the technology as perceived and reported by respondents.

Box 36: Perceived Weaknesses of *Medigenic*® smart flat PC keyboards

<div style="border:1px solid black; padding:10px;">

Perceived Weaknesses
- The lack of scroll functionality on the mouse was perceived as a weakness of the product by the consultants who used the PACS

</div>

Regarding the use of evidence in decision making, it appears that the trust team was not aware of the product having received an RRP 2 recommendation by the HPA. For 'awareness knowledge' of the product the trust used information from the other hospitals and own experience from previous trial. For 'principle knowledge' (what is the theory behind the product), the trust relied on supplier information and evidence about its effectiveness and further evidence was obtained through reviewing published peer reviewed papers. For the practical 'how to knowledge' the product along with other 8 types of similar products supplied by different companies had been trialled by IPC staff on a limited basis. For the trial the 9 suppliers provided product samples.

Procurement Process

The procurement process was delegated to the trust IT department who led the process. IT undertook the scoping exercise on the type, cost and number of keyboards and mice needed to cover all clinical areas in the trust. The Trust Procurement Team was also involved. Procurement was directly from the supplier since the keyboards were trialled briefly on NHS Supply Chain, but were no longer available through a procurement framework when the trust placed the order. The trust (the IT department) asked for quotes and nine different companies were identified that offered flat computer keyboards. All nine companies identified by IT sent product samples for trial and price quotes. In addition quotes and product samples were also obtained for computer keyboard skins/covers.

The decision to procure was made in September 2009 while the order with the suppliers of choice was placed in late December 2009. The products arrived at the trust a few weeks later in January 2010. The trust topped up the award monies by £15,000 and each division contributed financially to cover the extra cost.

Implementation Process

The piloting of the Medigenic keyboards in the trust and a pre-implementation trial of nine different types of flat computer keyboards also informed the implementation of this technology. Flat Medigenic computer keyboards and fully enclosed mice were implemented in all electronic PACS and medical computer carts across the trust. For the rest of the computers used in clinical areas it was decided that covers/skins would be used, since the cost for flat smart keyboards was higher than it had been initially anticipated.

The consultant chest physician who primarily uses the PACS highlighted the lack of scroll functionality on the mouse as a key weakness of the selected product. He highlighted the fact that such a computer mouse would be unattractive for clinicians who use the PACS and are used to scrolling up and down computer screens to view digital images. Thus the lack of scroll functionality could potentially compromise users' compliance with the particular product. Incorporating the feedback provided by the consultants the IPC team asked the supplier for computer mice with a roller for all carts/PACS.

Overall, the flat computer keyboards and skins/covers have been well accepted and people like

the 'feel' of them. They have been fully rolled out across all clinical areas in the trust.

11.2.2.3. Digital Count Up Posters

Decision Making Process

Technology Brief (in-house product)

Battery powered posters that light up displaying a digital number that shows the number of days since the last HCAI in each ward. A standardised template and colour code (yellow) are used in the design of all posters (similar to the design of all IPC posters used across the trust) with the following wording: 'when was your last CDI case', 'when was your last MRSA case'

The *idea* for the technology (digital count up posters) came from the Communications Director of the trust. Similar initiatives had also been undertaken by neighbouring NHS Trusts and a reputable hospital in the USA which members of the IPC team had visited. The exposure of the team to such initiatives by other hospitals further sensitised the IPC team to the idea.

The actual technology selection *decision making process* for the count up posters was *collective* and *inclusive.* There was involvement of staff outside the core infection prevention and control team, in particular of the Director of Communications for the trust and senior nurses, especially the ward matrons. The patient council group in the trust was also consulted in the design of the posters.

The proposal for the posters was led by senior nurses in the IPC team and particularly the DIPC and the IPC matrons. As with the other two technologies selected by the trust, the overall process was described by the respondents as *informal* since no specific project team was formed. The idea for the posters was discussed at the regular monthly meeting with trust senior nurses, a process that informed implementation.

The rationale for the particular technology is summarised in the quote by a senior nurse:

"It shouldn't be private information, should it? If there's an infection on that ward; and what are we doing about it? And I mean, we've had a huge drive around IPC so to us we're quite happy

showing such figures... so it's all going to be displayed for staff and the public to see, so to give them confidence around our infection rates. Because it's about assuring the public that we're transparent and if there's an issue then we deal with it", [Assistant Director of Nursing for patient safety and infection control]

The perceived innovativeness and the relative advantage of the technology as reported by our respondents are summarised in Box 37 and Box 38 respectively.

Box 37: Perceived Innovativeness of Count Up Posters

> **Perceived Innovativeness**
>
> - The count up boards use the same template as the rest of the IPC posters in the trust

Box 38: Perceived Benefits of Count Up Posters

> **Perceived Relative Advantage**
>
> - Improves public confidence
> - Promotes an open, transparent and an honest culture within the trust
> - Provides enhanced assurance to both patients and staff on controlling the risk of infection on the wards
> - The IPC team needs to communicate the MRSA and CDI infection rates to each ward on a daily basis; forces IPC team to routinely reflect on practice and creates an extra communication channel between IPC team and ward staff

Procurement Process

The count up boards were designed locally, and procured direct from a supplier who also delivers all posters to the trust. The product was tailor-made and customised to the requirements of the trust team.

"We went to a supplier who was doing all our posters, all our displayed information around the wards. So we went to him and he designed us a poster specifically with what we wanted and the wording that we wanted on the posters", [Assistant Director of Nursing for patient safety and

infection control]

Procurement was reported as being *smooth* and *straightforward*.

Implementation Process

The biggest issue during implementation was deciding on where exactly to position the posters. The initial idea was to place them in staff rooms. However, following consultation with the ward matrons it was decided that these should be on public display. It was finally decided that the posters would be exhibited in the foyer of all wards. The design of the posters also followed an iterative process taking onboard ideas and suggestions by IPC team members, ward staff, Communications Department and patient representatives. For the exact positioning of the posters in the wards patient volunteers had been consulted on several occasions.

The initial product delivered by the supplier was not very robust, and there was a problem identified in how well the mechanism fitted in poster. The posters had to be sent back to the supplier to rectify the problem. This process delayed final implementation for 3-4 months. Implementation is trust-wide.

11.2.3   Trust Evaluation of the Technologies

In terms of evaluation of the effectiveness of Medigenic keyboards the trust measured the cleanliness of the keyboards on carts and PACS by swabbing and comparing the results with baseline data that had already been collected and stored prior to the implementation of the flat keyboards.

For the count up posters patients and staff perceptions have been reported to be very positive. The trust plans to gauge patient and staff feedback in a systematic fashion next. Overall, the trust perceives the posters to be a success since they publicly display IPC audit information following the CQC guidance.

Regards the portable computer tablets the trust had not planned to systematically evaluate them. Local opinion and ease of use by staff have been considered as the main indicators of

effectiveness for the particular technology. A measure of success for the technology was deemed to be its consistent use by the IPC team members in daily operations. The tablets appear to have already been institutionalised in the daily operational practice of the IPC team.

11.2.4   Discussion

11.2.4.1   The decision making process

The decision making process for the selection of the technologies was widely perceived by respondents as *inclusive*. Besides (a) the core IPC team, input was provided by (b) matrons, (c) the medical consultants, (d) the Communications Director, (e) the trust Assistant Director for Performance, (f) patient representatives and (g) domestic services supervisors. Members outside of the IPC team were involved in generating ideas for use of the award, more directly observed in the case of count up posters.

In spite of the decision to select particular technologies being inclusive, IPC team took the lead and technology champions were clearly members of the IPC team. Following discussion within the IPC team, final decisions were taken by the DIPC and the Assistant Director of Nursing. The trust infection control committee was kept informed of decisions as well as other hospital staff through trust communications and discussion during regular operational meetings.

"It was mainly infection control that decided what we wanted, but we did consult around the keyboards and mice in the wider field...we went to a business manager, a matron, to a consultant, so we consulted with other staff in the hospital and got their ideas onboard, also the idea for the posters came from our Director of Communications but the decision of what we wanted had already been decided within the IPC team" [Assistant Director of Nursing for patient safety and infection control]

All technology decisions were *collective* and *informal* and there were no clear plans for a systematic technology evaluation.

The rationale for this inclusive and collaborative approach reflects the trust's approach to IPC, as explained by the IPC lead on technology selections:

"It's [IPC] everybody's responsibility, and there's been a big drive on that in this trust, around it being everybody's responsibility, rather than it just seen as the people who work in the Infection Control Team's responsibility", [Assistant Director of Nursing for patient safety and infection control]

In Trust 8 the process of decision making was dominated by the nursing profession, with input provided by other professions as already mentioned above.

Further, involving the users in the decision making process was considered necessary for effective implementation.

The resulting technology selections were *predetermined* decisions. All technologies had been selected before the award and the trust was awaiting a funding opportunity to implement them. No new technologies were considered after initiation of the project.

In addition, the trust's technology selection is characterised by *demand pull*; that is, the areas of priority were defined and then relevant technologies were sought to fit with trust's strategic plans.

11.2.4.2   Evidence

Trust 8 used a wide range of sources to get information in three broad areas of technology related evidence Table 51. Overall although those involved in the decision making process looked for the three types of knowledge with reference to the technologies and the IPC priority areas, more emphasis was placed on the 'awareness' and 'how to' knowledge. These technology selections decisions in Trust 8 were principally taken by members of the nursing profession.

Table 51: Type and sources of knowledge used in decision making

Awareness knowledge[65]	*Principles / theory*	*How to* knowledge[67]

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[65] to find out what is available in terms of the range of technologies specific to IPC

	knowledge[66]	
Other Hospitals	Expert advice (internally)	Supplier
Trust Staff / Previous experience with the same or similar technology	Peer review journals	Other Hospitals
	Policy guideline [CQC for count up posters]	Trial
Internet	Supplier	Previous experience with the same technology [PC tablets / Medigenic Keyboards]

(Adapted from Rogers, 2003; Glasby & Beresford, 2006)

The trust used links with a reputable hospital in the USA and other neighbouring NHS Trusts as well as relevant previous experience of own staff with the same or similar technologies for 'awareness' and 'how to' knowledge. The 'principle/theory' knowledge was informed by extant peer review, policy guidelines, evidence provided by suppliers, as well as expert advice by the trust IT department.

11.2.4.3   Procurement

Procurement for all technologies was direct from the suppliers. The procurement process was largely delegated by the IPC team to the trust IT department who undertook the scoping exercise on the type, cost, and number of products required. The procurement process was smooth and efficient. This was attributed by the respondents partly to the close cooperation between the IT department and the trust procurement team and partly to the fact that the trust made predetermined decisions. In two out of the three selections the trust had already contractual relationships with the suppliers.

11.2.4.4   Context

The approach taken by members of the trust team who managed the award as described in the preceding sections and the response to the innovation call from across the trust provides some

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[67] how to put the technology in to use, including all aspects of implementation
[66] why and how a technology works in terms of the underlying scientific principles or theory

insight to the trusts' culture. The trust's *open* and *honest culture,* which promotes dialogue and engagement, has been repeatedly emphasised by respondents:

"And we challenge people as well, like the medical staff are challenged if they don't wash their hands, and they can be challenged by a cleaner, which is really cool, isn't it? And they do, they do challenge them... the Chief Exec's been challenged a couple of times, being on the ward with his jacket on, and people are quite happy to challenge him, and he's quite happy to be challenged, to be honest", [Assistant Director of Nursing for patient safety and infection control]

"We've certainly had a very open and honest culture, particularly around the infection prevention and control issues, which is why they're in a good position now to roll out other patient safety issues", [Assistant Director of Performance]

This open and transparent culture encouraged input by a wide range of stakeholders. It helped break down barriers in communication enabling staff to talk openly about infection control. It also fostered the idea for the count up posters, which is meant to publicise results in HCAI and assure staff and the public.

It was also frequently reported that infection control was widely perceived in the trust as being "everyone's responsibility". Cross-departmental collaboration and a collaborative culture facilitated engagement of frontline staff for clinical and non-clinical innovations. This collaborative culture was manifested in the top up of the award by the divisions, using funding from their own budget.

Innovations were communicated via various channels, including (a) the use of regular trust events, (b) meetings (matron's round meeting), (c) organisational structures (Infection Control Committee), and (d) trust communications.

The respondents prided themselves on being part of an innovative and forward looking organisation. There has been ongoing collaboration with a leading hospital in the USA and strong links have been created with local universities. This pro-innovation culture was largely a positive influence.

11.2.4.5   Implementation

Overall, implementation of the technologies has progressed smoothly and generally according to plan with only minor delays. Specifically, the implementation of the tablets was delayed by two months and of the posters by about 3-4 months. The phased approach followed in implementing the technologies involved pre-implementation trials, which led to technology modifications during the early implementation stage for all three technology selections.

The most complex for implementation of the three technology selections was perceived by respondents to be the tablets; not so much as a product per se but more the overall data capture process. The particular technology implementation involved training people in using the tablets as well as sorting some of the 'glitches' in the technology. The technology involves complex interfaces which needed to be managed successfully for effective implementation. In that respect the fact that the trust had already invested in creating an 'enabling technological platform' provided essential structural compatibility which facilitated smooth implementation.

Engagement of a wide range of stakeholders in the decision making and implementation processes was also essential to customise the technologies to the needs and requirements of end users.

Particularly important has been the fit of technology selections with the strategy of the trust, which allows the trust to create cumulative improvements, and crucially for implementation it creates synergies among innovation choices.

Box 39 and Box 40 summarise the main perceived implementation barriers and facilitators of the innovative technologies as reported by respondents in Trust 8.

Box 39: Perceived Implementation Barriers

Perceived Barriers to technologies Implementation
- Adopting and implementing innovative technologies was an additional task on top of routine operations which stretched the trust innovation co-ordinator
- 'Computer phobia' particularly prevalent among medical staff

Box 40: Perceived Implementation Enablers

Perceived Enablers/Facilitators to technologies Implementation

- Early engagement of frontline clinical staff and technology users in decision making led to technology modification and adaptation
- Involving the users in the decision making process was essential for effective implementation
- Fit with the strategy of the trust *"this way you get the benefits of the technology as it evolves"* / Innovation synergies
- Structural compatibility for the more complex technology: other enabling technologies had already been adopted

Next steps identified by the team in Trust 8 include extending the application of Medigenic keyboards in all clinical settings across the trust in the near future. Within the trust next steps are to continue investing in integrating technologies in information and communication management in the realm of IPC. First choice will be an investment in infection control surveillance software system.

12. Case study – Trust 9

12.1 Context

12.1.1 General Context

Trust 9 is a Foundation Trust. The trust comprises two hospitals, providing a wide range of district general hospital services and specialist (tertiary) services including neurosurgery, renal medicine, spinal injuries, major trauma, vascular surgery and cancer services. The trust has developed strong links with three local/regional universities. The University hospital site is the largest of its type and there are 37 wards. Part of the hospital is managed under a PFI scheme. The hospital site is a district general hospital serving a rural population of 122,000 people, serving an area of 1,000 square miles. 1,400 staff are employed on the DG Hospital site which provides 230 beds.

12.1.2 Trust Performance

Table 52: The Care Quality Commission Assessment[68]

	2005/06	2006/07	2007/08	2008/09
Quality of services	Good	Excellent	Good	Excellent
Quality of financial management	Weak	Fair	Fair	Good

Table 53: PEAT Inspection Results (2010)

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[68] Care and Quality Commission, October 2009

	Environment Score	Food Score	Privacy & Dignity
University Hospital. site (Hospital A)	Excellent	Excellent	Excellent
DGH site (Hospital B)	Excellent	Excellent	Excellent

12.1.3 Infection Prevention and Control Context

12.1.3.1 Trust performance on mandatory HCAI indicators

Table 54 Trust performance on HCAI indicators

	2007/08	2008/09	2009/10
MRSA hospital acquired	63 cases [all reported cases]	24 cases [all reported cases] 11 [trust apportioned]	13 cases [all reported cases] 10 [trust apportioned]
Clostridium difficile	594 cases	492 cases	293 cases

12.2.1 HCAI Technology Innovation Award: Trust IPC Areas of priority and technologies selected

The overall theme was a planned project to enhance cleaning and decontamination in high risk areas within the Trust.

Who was involved and how?

A project development group was convened consisting of two Clinical Matrons, Infection Prevention & Control (IP & C) representatives and Assistant Director of Hotel Services.

Initial options considered

Four possible options were reviewed. After a systematic review of advantages and disadvantages of competing options, a combination of technologies was selected.

The options considered follow.

Option 1 - Sole use of hydrogen peroxide – disinfectant vapour..

The following advantages and disadvantages were indentified.

Table 55 Sole use of hydrogen peroxide

Advantages	Disadvantages
- Strong evidence to suggest that this has had an impact on the reduction of *C. difficile.* - Used previously within the Trust in 2007/09 - Outside contractors complete the works - RRP 1	- Ward moves need to be determined >1 month in advance. - Bioquell need to be booked well in advance, costs to the Trust if cancelled. - Cost £6,000 per ward, £3,500-£4,000 per bay/side room. If decant facility available - Time frame to complete if decant facility available would be 48hours. - Currently the Trust does not have a decant facility due to multiple refurbishment programme. - Not cost effective to be used on single areas, bays etc.

Option 2 - Sole use of Ozone A sanitiser that creates ozone gas

Table 56 Sole use of Ozone

Advantages	Disadvantages
- Can be used as and when required and comply with DH recommendations - Locally driven approach	- Staff training required - Costs £129+VAT per month to rent, £3,000+VAT to purchase - If purchased storage would be required. - No evidence to support efficacy 1hour 30 minutes above terminal clean

	time
	• Not submitted to the RRP
	• The equipment does produce some noise may not be suitable for ward areas during the night
	• Fire Officer, Health & Safety and Occupational health feedback is required.

Option 3 - ATP hygiene monitoring system – 3M™ Clean-Trace™

Table 57 Use of ATP

Advantages	Disadvantages
• Easy to use • Rapid results • Can support real time decisions • Can provide trend data 3M™ Clean-Trace is the only ATP system with the DH RRP 1 recommendation • Trial will cost £200 per 200 swabs and monitoring equipment is loaned free of charge • Possibility of utilising funding for on-going monitoring following trial.	• No nationally agreed level of acceptable protein.

Option 4 – Combination of Option 1, 2 and 3

Table 58 Perceived benefits

• Hydrogen peroxide can still be used in refurbished areas and it has been identified that 5 areas could be completed in September 09   • There is an opportunity to hire the ozone equipment to be used on areas where there is no decant facility and assess efficacy.   • The use of ATP will provide instant results on the hygienic status of the facilities.   • This systems potential will provide the opportunity to work with the PFI contractor

What was finally selected?

The trust selected the three technologies, addressing one IPC priority area, environmental hygiene (Table 59).

Table 59: Technologies, Priority area and Progress (August 2010)

	Technology	IPC Priority Area	Brand / *Supplier*	Procured	Implemented
1	Hydrogen Peroxide Vapour (HPV) Decontamination System	Environmental Hygiene	*Bioquell*	Yes	Yes
2	Ozone Sanitizer Machines	Environmental Hygiene	*OTEX JLA*	Yes	Yes
3	Palm held ATP Bioluminescence Hygiene Monitoring System	Environmental Hygiene / Training	*3M™* Clean-Trace™ Clinical Hygiene Monitoring System	Yes	Trial

12.2.2 Individual technology selection, procurement and implementation

Environmental hygiene was selected as a priority area as other IPC priority areas had previously been invested in. Environmental hygiene was also noted by the facilities manager to be underinvested in according to benchmarking across the trust's hospitals.

12.2.2.1 Hydrogen Peroxide Vapour (HPV) Decontamination System- Bioquell®

Decision Making Process

In the first instance the Hydrogen Peroxide Vapour Disinfection system was suggested by the medical microbiologist. The initial idea for this technology arose through the recent deep clean

which the trust had been involved in. The IPC team reported a reduction in C. *difficile* since the deep clean. However there were no funds to continue this level of cleaning.

The perceived relative advantage to other methods was based on anticipated outcomes as summarised in Table 60.

Table 60 Anticipated benefit of the technology

Perceived relative advantage
Reduction in length of stay Reduction in C. *difficile* infection

Procurement Process

Procurement was through the NHS Supply Chain and was completed in October 2009.

The final costs for implementing the technology were slightly higher than first quoted, as upon examination of the implementation plan the trust noted that further purchases of bed mattresses and bedside lockers were required. This was to furnish the decant ward:

"We had a decant ward that didn't have any beds there was an initial cost of actually hiring beds....in order to allow one area to be completed while another area continued to carry out patient activity...that was an additional cost...if you're going to clean properly you need to just take the patient and leave everything there" [Assistant Director Hotel Services]

Implementation Process

The project team described the implementation phase to be demanding due to a number of factors (Box 41). Particularly when compared to the deep clean process where the trust had been able to plan well in advance, this project caused much disruption to working practice. The project team aimed to make optimum use of the funds and hence planned for as many wards as possible to be vaporised. Operationally this proved to over-stretch capacity. The project team

felt that the process had impacted negatively on infection prevention and control outcomes.

Box 41 Enablers and barriers to implementation

Perceived barriers to implementation	Perceived enablers/facilitators to implementation
• Short project lead in time • Limited decant facilities – 12 hour window • Implementation plan over committed • Planned refurbishment of wards delayed • Limited window for implementation	• Previous experience of use of technology • Cohesive project team Limited window for implementation

The initial plan to commence with the treatment in August 2009 slipped to October 2009 due to planned refurbishment of a ward taking longer than anticipated.

Interestingly the 'limited window for implementation' emerged as both a facilitator barrier and barrier to implementation. As the technology was procured as a managed service implementation needed to occur within year, which meant the project was given priority. However this did stretch the project team and operationally was a challenge.

The hydrogen peroxide programme commenced at the Hospital A 12th October 2009 in the four wards; Nine wards were completed at Hospital B from the 1st to the 16th November 2009.

12.1.5.2. Ozone Sanitizer

Decision Making Process

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The decision making process was described above, and the smaller evidence base for this technology was noted. However the trust felt that evaluation, including patient experience surveys would add to the evidence base:

"Their evidence, they haven't submitted to the Rapid Review Panel which was my big concern...however we know a number of trusts that have actually implemented them successfully...we're going to try and include it in terminal cleaning so, and link it with patient and public involvement, so in terms of actually following up when we actually implement, we'll hopefully do some follow up questionnaires for patients. How did they find their room when they first entered it? And did they feel it was clean? And was there anything there indicating what had, how it had been cleaned, etc? So, there's quite a lot of other things, it's not just about reducing HCAI it's also the public perception which we know is a huge issue that we need to address". [Lead IPC Nurse].

Procurement Process

The procurement of the technology was through the NHS Supply Chain and was a smooth process.

Implementation Process

The company supplied training on setting up the machine up, sealing rooms, vent and fire alarms. Implementation has been partial on one hospital site whilst a revised contract is negotiated with the PFI contractors for the other hospital.

The experience of using the technology was reported as positive, easy to use and easy to train staff.

12.1.5.3. Clinical Hygiene Monitoring System - 3M™ Clean-Trace™

This technology was intended to work in conjunction with the other environmental hygiene technologies and provide instant results on the hygienic status of the facilities.

The trust negotiated a trial period with a pro-bono handheld luminator, and agreed to purchase the swabs. However the initial trial was not fruitful as the trust were not able to establish base lines for different areas. The trust plans to work closer with the domestic staff to develop a schedule:

I think we probably would like to trial it again in a more structured way and with the PFI partners working with the domestics on looking at cleaning and how they're cleaning, where we swab, and make sure that we're swabbing in the same points. There was a lot of, I mean it was a good trial because we picked out a lot of problems...And we got very positive comments from the domestics... But logistically you needed to follow the cleaner and some turned up at different times on different wards and then ten patients could have used it between swabbing again after it was cleaned, so you couldn't use those sort of results [IP Nurse].

The trust is also speaking to other trusts that have used the system to work out an optimal implementation schedule.

12.2.3 Evaluation of technologies

The success of the project as described in the business case, will be measured on the following criteria:
- Potential reduction in *Clostridium difficile* cases and outbreaks within the Trust
- Potential improvement on Patient Environment Assessment Team (PEAT scores in the areas with improved cleaning regimes)
- Potential improvement in the national patient satisfaction survey scores for the Trust in relation to the cleanliness of the environment
- Improvement in staff satisfaction in relation to staff such as clinical matrons who interface with domestic cleaning staff on a daily basis
- Improvement in the key performance indicators related to the Matrons Charter and cleaning

Particularly for the Ozone patient perceptions of a 'cleaner environment' have been reported due to the fresh fragrance left after treatment.

12.2.4 Discussion

12.2.4.1   The decision making process

Overall the decision making process was formal and inclusive of staff outside of the IPC team. This approach was taken in order to communicate progress effectively:

"Inclusivity, that's the way we try to work, is not just on the Infection Control team. Infection control is everybody's business. So we wanted to make sure that we were including people around. Especially with our 2 clinical matrons, because they are members of a group of 25 and so therefore they can spread the information as well, right across our organisation. It's a big organisation,...And so therefore when we set up things like this it needs to be done well so that you can communicate it to all of the areas" [Deputy DIPC].

12.2.4.2   Evidence

The project team made visits to trusts with the technologies in use as well as inviting the suppliers for presentations. The nature of evidence used to inform the decision making process covered the three types of knowledge- principle/theory; how-to and awareness. However there was a call for wider dissemination of national programmes:

"I think there could be more information nationally about the work that is ongoing and the positive results that have come out of it. So how have the Showcase Hospitals a) reduced infection and then how is that being marketed across the NHS? Because the whole issue about learning is to look at the outputs of this, to influence other people to then be able to use that for the benefit and I think sometimes that could be a little bit stronger than it has been" [Deputy DIPC].

12.2.4.3   Procurement

Procurement was efficient as all products were procured to procurement frameworks. The process was well managed by the project team which consisted of the relevant stakeholders for each of the technologies.

12.2.4.4   Context

The large size of the trust and culture affected the way the project was approached, with a formal and inclusive decision making approach as earlier described.

A pro-innovation culture and partnership working was described:

"...there is a real culture in the organisation of looking out how we can go further faster. So not always doing the same but what are, what is around, what's the evidence based technology, how can we link with our PFI providers, for example, on the new technology for cleaning that they could bring in, what does that mean? So I think the whole strategy about the Department of Health focus on infection, but also ours as far as wanting to really reduce to as low as we possibly can" [Deputy DIPC].

12.2.4.5   Implementation

Structural limitations such as lack of decant facilities due to major refurbishment delayed implementation plans. Time constraints on spending the money within year worked both as a facilitator and barrier:

"I think the remit of having to spend the money in the year helped drive something like the HP, but it hasn't helped, although we've spent the money for the ozone we haven't been able to implement it because there's no drive to, we haven't got to do it by a certain time. I think that's a factor."

Table 61 Barriers and facilitators to implementation

Perceived barriers to implementation	Perceived enablers/facilitators to implementation
- Short project lead in time - Limited decant facilities – 12 hour window - Implementation plan over committed - Planned refurbishment of wards delayed - Limited window for implementation - Increased turnaround time for beds with Ozone cleaning - Revision of PFI contract for Ozone cleaning	- Managed service for hydrogen peroxide - Detailed implementation plan - Formal decision making and implementation processes - Learning from other trusts

13. Case study – Trust 10

13.1 Context

13.1.1 General Context

Trust 10 is an acute and specialist trust, and is one of the largest teaching trusts in the country. The trust delivers its services from three hospitals, to a diverse population of around 600,000 people in the immediate and surrounding areas. Employing around 6,000 staff and caring for around 117,000 patients a year, the trust has approximately 1,000 beds and provides acute and emergency care from two hospitals and specialist, continuing care, rehabilitation and respite care at the other. The trust has an annual turnover of £320 million[69]and was involved in conducting over 240 clinical research studies in 2009/10[70].

In 2009 the trust was given a go-ahead for a new single site acute hospital, with an estimated cost of around £480 million. An invitation to companies and consortia to bid to build the new hospital is set to be issued in late 2010, and the preferred bidder to be selected in 2012/13, with construction set to commence soon after. The new hospital is planned to open in 2015/16[71]. The trust is also in the process of working towards Foundation Trust status.

Table 62: Trust 10 at a Glance

Trust type	Teaching hospitals
Trust size	6,000 staff
Number of sites	3
Population coverage	600,000
Number of beds	1,000
Patient turnover	117,000
Financial turnover	£480 million / year

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[69] Trust website
[70] Trust Quality Account 2009/10
[71] Trust website:

13.1.2   Trust Performance

The Care Quality Commission rated the trust as 'Good' for both the quality of services and use of resources; maintaining the similar scores of the previous year[72].

Table 63: The Care Quality Commission Assessment

	2005/06	2006/07	2007/08	2008/09
Quality of services	Fair	Good	Good	Good
Quality of financial management	Weak	Fair	Good	Good

The results for the most recent (2010) Patient Environment Action Team (PEAT) assessments for all the trust's hospital sites are outlined in the table below[73], showing a score of 'Good' across all measures for all sites. Similar results were achieved in the previous year, with the exception of the food score which fell from its 'Excellent' score for all four hospitals.

Table 64: PEAT Inspection Results (2010)

	Environment Score	Food Score	Privacy & Dignity
Hospital A	Good	Good	Good
Hospital B	Good	Good	Good
Hospital C	Good	Good	Good
Hospital D	Good	Good	Good

13.1.3   Infection Prevention and Control Context

The trust has a dedicated team of infection control specialists working to reduce healthcare associated infections. The team includes Medical Microbiologists, Specialist Infection Control Nurses, Antibiotic Pharmacists, Clinical and Biomedical Scientists and Data Analysts[74].

Ongoing initiatives to reduce and prevent infections include:

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[72] Care Quality Commission, October 2009
[73] Patient Environment Action Team (PEAT) Assessment 2010, National Patient Safety Agency
[74] Trust website

- Promoting hand hygiene compliance for staff, patients and visitors; with hand washing sinks and facilities available throughout wards and departments
- Promoting the use of alcohol hand gel in all clinical areas by staff patients and visitors. Alcohol gel is also available at bedsides
- A CD-ROM programme 'Germs Don't Give Them a Hand' is available free to all patients via the patient information terminals which aims to provide patients and staff with a visual information on good hand hygiene
- Strict trust quality control measures to ensure food served to patients is of the highest standard
- Ensuring visitors use the chairs provided and do not sit on patient beds.

13.1.3.1   Trust performance on mandatory HCAI indicators

Table 65: Trust Performance on Mandatory HCAI Indicators

	2007/08	**2008/09**	**2009/10**
MRSA *bacteraemia*	46 cases	21 cases	14 cases (target, Max no of cases 33)
Clostridium difficile	423 cases	237 cases	306 cases

13.1.3.2   Trust Infection Prevention and Control Interventions

In recent years, the trust had been struggling with achieving HCAI related targets and there had been major changes in the infection control team. During 2007, a new Chief Nurse was appointed to the trust and became Executive Lead for HCAI and a new Director of Infection Prevention and Control was appointed.

Following a review of the current state of infection control activities, a number of bids were put to commissioners and significant new investments were put in place, including both additional staffing and monies to support new technologies. A communications strategy was put in place to ensure that all staff were kept regularly updated as to the current status in terms of infection

rates, incidents and outbreaks and any audit or surveillance information. The concept of the 'Ten Key Rules' was developed, which was felt to have a major influence on clarifying areas of individual responsibility for staff in terms of HCAIs and the mandatory training programme was revamped to ensure that it focussed on these areas.

The results of these endeavours were dramatic, with rapid falls in rates of MRSA bloodstream infections, central venous catheter related bloodstream infections and *Clostridium difficile* infections.

13.2.1 HCAI Technology Innovation Award: Trust IPC Areas of Priority and Technologies Selected

The trust came up with a proposal to evaluate and introduce a number of new technologies all under the general *theme* of ***reducing environmental contamination*** with a view to roll forward those which appear to offer a "*clear benefit"* and "*ease of use".*

Who was involved and how?

Technology selection decision making was *exclusive* to the IPC team with minor involvement of the hotel services manager. The initial decisions for selecting technology types were taken at the weekly IPC operational meetings, in which the core IPC team was involved. These initial decisions were later discussed and communicated to a broader group of hospital stakeholders at the Infection Control Executive Group, which is a strategic group chaired by the Chief Executive Officer and with representation from the Finance Director, Chief Operating Officer, Medical Director and Chief Nurse. The final decisions were made by the IPC team and chiefly by the DIPC (consultant microbiologist), with involvement of the decontamination manager and clinical scientists.

Initial options considered

The award was firstly discussed informally at the weekly IPC team operational meeting and later in detail at the Infection Control Executive Group.

"Although the group reiterated their delight at having been awarded the prize, concern was expressed about how the injection of a single non-recurrent large sum of money during this financial year might impact on what was already perceived to be a significant new investment in infection control in subsequent years. It was agreed that any subsequent ongoing costs from the original investment could not be assured and would have to go through the usual channels of business cases to the Trust's strategic investment group and compete with other Trust-wide priorities, particularly at this time when all healthcare organisations were aware that there would be a major tightening of financial positions in subsequent year", [DIPC]*.*

Considering the above, the Infection Control Team identified the following initial options as priority areas investment in technologies:

(a) <u>Early diagnosis of infection</u>

A major thrust of Trust 10 strategy had been rapid and early diagnosis of infection. The trust had pioneered the use of point of care testing for PCR based MRSA screening and had already been commissioned by the HCAI Technology Innovation Programme to evaluate the impact of this technology. The trust had also pioneered a new algorithm for testing for *Clostridium difficile* infection (CDI), using a combination of screening with GDH antigen and confirmation with PCR and presentations and publications regarding the success of this strategy were already in place.

Review of other new diagnostic technologies by the trust suggested that most were similar to those the trust already had in place and did not offer any substantial benefits.

(b) <u>Hand hygiene, antisepsis, intravenous and urinary catheters, bowel management systems</u>

The hand hygiene products in the trust were already the subject of a detailed tender and contract. Although in the longer term the trust would be interested in alcohol-free products, the IPC team did not feel that they would be in a position to either evaluate these or change to a different product. Trust 10 was already using recommended products for skin disinfection before

central line insertion and blood culture taking and was already promoting the use of antimicrobial impregnated catheters.

Two products within this type of category were of interest to the trust. The IPC team had not previously considered the use of faecal management systems for patients with CDI, either as an infection control measure or as a means of administering intracolonic antibiotics.

The Sage Products Antiseptic Body Cleaning Washcloths were of particular interest to the IPC team as the trust already had a high profile around MRSA screening and was in fact, committed to evaluating the impact of trust's screening programme which included evaluating the efficacy of decolonisation treatment on reducing contamination of the environment.

The problem with the introduction of both of these products, however, remained that there would be a recurrent expenditure in subsequent years and any bids for introduction would be subject to stringent scrutiny from the trust, therefore the monies would need to be used for a rigorous evaluation with well-documented outcomes.

(c) <u>Cleaning and disinfection</u>
The Trust had moved to using ChlorClean for all cleaning in clinical areas; however, ward staff found the process of having to continually make up the reagents clumsy and difficult. A simple but equally effective method of cleaning was high on the trust's agenda for development. The product that had particularly attracted the attention of the IPC team was the Clinimax CLEANKILL DIFFICIL-S non-chlorine based agent but it had been a problem in resourcing the evaluation and training that would be required to introduce it in the trust.

A long term development which the IPC team had raised on numerous occasions at all levels, including Board level, was to develop systems to monitor levels of cleanliness and contamination in clinical areas; the trust had previously relied on visual inspection only for such monitoring and the IPC team felt that the scientific literature was clear that visual inspection is often inadequate. The IPC team had for some time wished to evaluate an ATP Hygiene Monitoring System as an additional tool to monitor levels of cleanliness and contamination in clinical areas but there had not been sufficient time resource to develop this and particularly to

find out whether this indeed contributed to identifying areas which were contaminated with important pathogens such as MRSA and C. *difficile*.

What was finally selected?

The outcome of the considerations outlined in the preceding section was that there was no single new piece of technology which the trust wished to introduce that would use all of the monies in the first year without ongoing revenue considerations for subsequent years.

The trust finally decided to evaluate and introduce a number of new technologies all under the general *theme of reducing environmental contamination*. The trust finally made *four main technology selections*, addressing *two IPC priority areas* (Table 66)

Table 66: Technologies Priority area and Progress

	Technology	**IPC Priority Area**	**Brand / *Supplier***	**Procured**	**Implementation**
1	Evaluation of palm held ATM bioluminescence Hygiene Monitoring Systems	Environmental Hygiene	SystemSURE Plus ™ *Hygiena*	Yes (prior to award)	Evaluation trial Yes
			3M™ Clean-Trace™ ATP	Yes	Evaluation trial Yes
2	Evaluation of non-chlorine based disinfectant	Environmental Hygiene	*Clinimax* CLEANKILL DIFFICIL-S®	No / Trial	Trial Product temporarily discontinued
3	Faecal management system	Environmental Hygiene / Patient Hygiene	Zassi/ActiFlo Bowel Management System. *Hollister*	Yes	Yes
4	Antiseptic Body Cleaning Washcloths 2% Chlorhexidine Gluconate	Patient Hygiene	*Sage®* 2% Chlorhexidine Gluconate (CHG) Cloth	No	No

13.2.2 Individual technology selection, procurement and implementation

13.2.2.1 Evaluation of palm held ATP Hygiene Monitoring Systems (*Hygiena SystemSURE Plus & 3M™ Clean-Trace™*)

Decision Making Process

The *idea* for the technology came internally from within the trust since hotel services had already procured, prior to the award, the SystemSURE Plus™ ATP Hygiene Monitoring system. However, this technology had only been used as a training aid and had not been adopted as a monitoring system for cleaning and decontamination. At the weekly IPC operational meetings the team discussed the potential to conduct an evaluation study using the award monies with an aim to roll the technology out across the trust pending positive evaluation results.

It was initially decided that the trust would be using SystemSURE Plus™ ATP Hygiene Monitoring system not only as a teaching and audit tool within the trust's cleaning department, but also comparing with microbiological environmental surveillance as an aid to evaluate a number of new technologies or approaches to environmental decontamination. At a later stage the scope of the evaluation was broadened to include the 3M™ Clean-Trace™ ATP Hygiene Monitoring system, which had received an HPA RRP 1, and also compare the two systems.

The technology selection *decision making process* for the ATP Hygiene Monitoring Systems was *collective* and primarily *exclusive* to members of the IPC team, with only minor involvement of hotel services staff. The decision to invest in the particular technology area was made around June 2009, while the comparison of the two systems commenced in January 2010 when the contract with 3M™ was finally signed. The supplier had been invited to present to the trust on more than one occasion.

Box 42 summarises the key perceived elements of innovativeness of the particular technology as reported by the respondents in our qualitative interviews; Box 43 summarises the technology's perceived relative advantage; Box 44 summarises the technology's perceived weaknesses.

Box 42: Perceived Innovativeness of ATP Hygiene Monitoring Systems

Perceived Innovativeness

- Rapid checking of the thoroughness of cleaning regimens
- Instant feedback to users and other interested parties which makes it a valuable training aid tool / *"more persuasive than cultures where you have to wait for days to get results and the link between the specimen and the result is not always clear to users and interested parties"*
- A radical technological innovation *"no similar technology is or was available"*

Box 43: Perceived Benefit of ATP Hygiene Monitoring Systems

Perceived Relative Advantage

- Results could be used for update training of domestic cleaning staff on the wards and as a means of recording improvements in cleaning
- Easy to use, lightweight and portable
- Offers the potential for more objective measuring of the effectiveness of cleaning *"you can get lower levels when an area is cleaned"… "there is a number attached to the results and a score which makes it a valuable indicator and an easier concept for people to understand"*
- Promotes collaboration with other departments such as hotel services
- *"Opening people's eyes to the fact that something can look clean and it isn't"*
- Rapid checking and feedback … *"It gives instant results there is no waiting"*
- Complements visual inspection

Box 44: Perceived Weaknesses of ATP Hygiene Monitoring Systems

Perceived Weaknesses

- Inability to correlate bacterial counts with the relative light units RLUs scores (the score as displayed by the ATP devices) ... *"what these RLUs represent from an IPC point of view is not clear... I am wondering what we are actually telling people"* [DIPC]

- There is potential danger for the use of the product to create conflict among staff becoming a "yardstick" to punish people ... *"if you're out there working hard as a domestic, you don't want someone coming along and saying, you've not cleaned this,*

> *and these results have shown it"* [Decontamination Manager]
>
> - Potentially creates additional workload

Regards evidence, a combination of sources was used by the trust team involved in decision making. For 'awareness knowledge' of the product the team used previous experience with the particular technology in the trust, as well as relevant information and articles in peer reviewed journals and presentations which referred to the application of the technology in the food industry. The trial of the product and the previous experience of trust staff with it, as well as demonstration by the supplier company provided further evidence for product's practical application and 'how to knowledge'. For 'principle/theory knowledge', the team relied on published articles in peer reviewed journals.

Procurement Process

SystemSURE Plus™ ATP Hygiene Monitoring system had already been procured prior to the award by Hotel Services.

The 3M™ Clean-Trace™ ATP Hygiene Monitoring system was procured as a service agreement contract for one year with the supplier. The product was procured direct from the supplier. The decision to procure the 3M™ Clean-Trace™ ATP Hygiene Monitoring system was made in June 2009, though procurement was completed only in January 2010, approximately six months later.

The order was written and placed by the clinical scientist to the trust supplies department. The supplies involved medical engineers, as they wrongly perceived it (according to our respondents) to involve buying capital equipment and this consultation delayed the whole procurement process. Finally the order was sent off to the company and the equipment arrived at the trust in January 2010. The procurement experience was perceived by our respondents as protracted, but overall rather straightforward.

"It did take a little bit of time just to get them, because it was a contract rather than purchasing a piece of capital equipment. It did take just slightly longer. I think there were also some

misunderstandings. Someone from the supplies thought it was equipment we were buying when actually we were buying a service contract and this confusion caused considerable delay ... so, once that had been sorted out, then it was quite smooth", [Clinical Scientist]

Following the completion of the trial for the roll out and implementation of -™ CleanTrace™ ATP Hygiene Monitoring System across the two hospital sites 6 luminometers and associated materials for 24 months were procured by the trust.

Implementation Process

For the implementation of the ATP Hygiene Monitoring Systems, training was provided by the company (3M™ as part of the service agreement) but also internally via the laboratory staff on the swabbing technique. A protocol was developed for conducting the evaluation trial and a phased approach was adopted during early implementation, using both products at the same time (3M™ & Hygiena). The trial started in one of the hospital sites and was then rolled out to the other. The A&E, the Medical Assessment Unit and the Isolation Ward were initially used for the trial and then it expanded to cover a medical and an orthopaedic ward. The rationale for the selection of the sites during implementation is presented in the quote below:

"On an isolation ward, we'd expect the standard of cleanliness to be very high. Areas, like A&E and Medical Assessment Units, would be a lot of throughput, so the traffic there would be very heavy, the beds are not very often left empty for long. And then, of course, we looked at just your standard ward. We looked at an orthopaedic ward and a medical ward to get a whole range of data, because, the idea is that when we give these to Hotel Service supervisors, - because it would be those staff doing it , that they've actually just got one figure to work on... we have developed a threshold which will be a pass, a caution or a fail, throughout the trust" [Clinical Scientist]

The implementation trial conducted by the trust is detailed in section 13.2.3.

Regarding next steps, a meeting had been planned by IPC team with Hotel Services on 21st July 2010 to reflect on the trial experience and co-agree the plan to roll out the system to the whole trust, with ATP becoming part of the trust's routine cleaning monitoring system. The trust-wide implementation will follow a staged process and was planned to start in August 2010.

Following completion of the evaluation trial the recommendation to the trust has been that the 3M™ Clean-Trace™ will be the only ATP Hygiene Monitoring system to be procured by the trust in future purchases. This has now become part of the trust policy and has been incorporated into the guidelines of the trust's stock rationalisation group, which is chaired by the Head of Supplies.

13.2.2.2 Evaluation of *Clinimax CLEANKILL DIFFICIL-S* non-chlorine based cleansing & disinfectant

Decision Making Process

The initial *idea* for the technology came from an exhibition at the National Federation of the Infection Societies meeting, which was attended by members of the IPC team.

Trust 10 had been using Chlor-Clean for all cleaning in clinical areas. However, ward staff found the process of having to continually make up the reagents clumsy and difficult and they would prefer to move away from Chlor-Clean and other similar chlorine based products should a simple but equally effective method of cleaning be available. The Clinimax CLEANKILL DIFFICIL-S non-chlorine based agent had been high on the IPC team agenda even prior to the award, but it had been a problem in resourcing the evaluation and training that would be required to introduce it in the trust. The IPC team members were aware that the product had received a RRP 2. So, once the award monies were available the IPC team decided to invest in it. The supplier of the product was invited to present to the trust and the IPC team.

The technology selection *decision making process* for the non-chlorine based disinfectant (CLEANKILL DIFFICIL-S) was *predetermined* as discussed above, and *exclusive* to the IPC team, with some input from the hotel services. The technology was championed by the decontamination manager. Box 45 summarises the key perceived elements of innovativeness of the particular technology and Box 46 summarises its perceived relative advantage, as reported by the respondents in our qualitative interviews.

Box 45: Perceived Innovativeness of DIFFICIL-S

Perceived Innovativeness

- Non-chlorine based disinfectant being very effective against C. *difficile*

Box 46: Perceived Benefit of DIFFICIL-S

Perceived Relative Advantage

- Equally effective as Chlor-Clean, but more convenient in its use
- Time savings, especially for nursing staff in the wards, as solutions do not need to be made up (unlike Chlor-Clean currently used by the trust)
- Very simple to use with the potential to increase compliance in cleaning
- Non Chlorine-based (avoiding the smell and overuse of chlorine products in the hospital environment)

Procurement Process

The product has not been procured. Free product samples were used for the evaluation trial and this was negotiated by the IPC team in collaboration with the suppliers.

Implementation Process

Infection control in conjunction with hotel services undertook a trial to compare the effectiveness of "Chlor-Clean" & "Tuffie 5" wipes (current trust cleaner/disinfector) against "Difficil – S". The trial was undertaken on 2 wards. Training on how to make up Difficil –S was provided by the supplier company. The trial had to be suspended however, just eight days later due to a health and safety incident. The evaluation implementation trial is presented in section 13.2.3

A decision has been made by the IPC team to postpone the evaluation or proceed with putting the product into general use until such time as a more user friendly mechanism of making it up has been developed.

13.2.2.3 *Hollister Zassi* (ActiFlo) Bowel Management System

Decision Making Process

The Trust had already identified, even prior to the award, the faecal management system as a technology worth investigating under the overarching theme of reducing environmental contamination. The Infection Prevention and Control Team reviewed the available technologies in this area and a series of external speakers were invited to present. It was finally decided that the optimal system for the trust would be the Zassi Bowel Management System because in addition to containing diarrhoeal stools it also allows for the administration of intracolonic antibiotics especially vancomycin and this provided an important route of treatment of CDI. The decision for the particular technology was taken by the core IPC team.

Boxes 47 and 48 respectively summarise the perceived innovativeness and benefit of the Zassi Bowel Management System respectively, as reported by the respondents.

Box 47: Perceived Innovativeness of Bowel Management System

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Perceived Innovativeness

- Permits the delivery of rectally administered medications [vancomycin]
- The whole concept is a wholly new idea – nothing similar pre-existed

</div>

Box 48: Perceived Benefit of Bowel Management System

<div style="border:1px solid black; padding:10px;">

Perceived Relative Advantage

- It allows administering of rectal vancomycin
- Fully closed system which helps prevent environmental contamination in patients with C. *difficile* infection

</div>

The trust proposed to conduct an evaluation trial of the technology. The aim was to compare environmental contamination in rooms where patients were being treated using the faecal management system with rooms where other patients with CDI were being treated. The excerpt from the DIPC describes the key underlying questions for the evaluative trial:

"Well that's a completely new idea isn't it? It's a way of giving vancomycin intracolonically, which is very, very convenient, and if you choose the right patients you could probably cut down on your skin damage and so on. But our big question is, does it also reduce environmental contamination? Is it safe to leave somebody on an open ward, or not have to give them a proper side room, and so on? And if it did that that would be very, very interesting, but it's not for everybody, and as I say, at the moment we see a lot of very mild C. difficile, so how big an impact I'm not sure, but there will be some people who will definitely benefit from that", [DIPC]

Procurement Process

A short supply of products was procured direct from the supplier, without involvement of the trust procurement team..

Implementation Process

The nurses on the wards where patients with severe CDI were likely to be were trained (the supplier was involved in the training) to use the Zassi Bowel Management System. In addition, a protocol for the use of intracolonic vancomycin was added to the Trust CDI policy and was formally approved.

However the evaluation of the technology was not possible to be carried out due to a very limited number of patients with C. *difficile* infection present in the trust during the project's time span.

Worth noting is the fact that the clinical team in the trust's Intensive Care Unit had already been using a similar product, namely, the Flexi-Seal® Faecal Management System. The IPC team was not aware of that at the time when selection decisions were being made, potentially due to the highly exclusive approach in the decision making taken by Trust 10. This lack of cross-departmental coordination led to structural incompatibility issues, as there are currently two different types of similar technology in the trust.

"We've struck now with a problem with the bowel management system that I had focused on one [Zassi] but our intensive care unit like the other [Flexi-Seal], so we probably need to spend

a little bit of time still deciding which one, because otherwise it's mad! Because if they put one in intensive care and transfer the patient, then the IPC team on the ward are familiar with using a different product. We need to decide again which of the two we're going to use, and we might need to just invest in a little bit more training to bottom that out", [DIPC]

The trust intends to continue using the product on a limited scale, though the structural incompatibility issue highlighted above has to be resolved first.

13.2.2.4   *Sage®* Antiseptic Body Cleansing Washcloths

Decision Making Process
The IPC team exclusively made the technology selection decision. The DIPC championed the particular technology and was very keen to trial it in the trust.

The rationale for selecting the Sage Products Antiseptic Body Cleaning Washcloths with 2% chlorhexidine gluconate for washing of MRSA colonised patients, was again in accordance with trust's endeavour to prevent environmental contamination with MRSA

The perceived benefit of using the Sage antiseptic body washcloths as reported by the respondents in our qualitative study is summarised in Box 49.

Box 49: Perceived Benefit of Sage Antiseptic Body Washcloths

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Perceived Relative Advantage

- the antiseptic sits on the body for an extended period of time
- Very handy and easy to use

</div>

Despite initial endorsement the DIPC and the IPC team following a more detailed investigation of the technology they felt that there was very little independent evidence available other than that provided by the supplier. This **lack of independent evidence** and the **high ongoing costs** were the key impediments to the adoption of the technology:

"about the chlorhexidine washes, we couldn't get anything, we had to speak to the company, there was nothing independent out there. It is very, very difficult I think to actually get something, I would just say, if you just go on the RRP notes, you only get four lines, it's really not very much, and I think it's quite obscure as to what exactly some of that is saying, even for the RRP 1s, I got the wrong impression about some things just by having a look", [DIPC]

Procurement and Implementation Processes

A sample of the product was used for starting the evaluation trial on a small scale. The commencement of the planned trial had to be postponed due to problems with both funding issues and difficulties with gaining ethical approval for a clinical trial. In the following quote the DIPC explains these issues in detail:

"The intention was to undertake a small clinical trial, following a study we were already committed to doing looking at decolonisation treatment following MRSA screening. This initial study has taken an extremely long time to get off the ground because of numerous problems receiving ethical approval for the study and therefore a further evaluation of a different product for skin decolonisation would be extremely delayed. Overall the feeling now is that in the current financial climate it is extremely unlikely that the use of this product would be funded and that there are other pressing tasks and evaluations which would be a better use of the Infection Control Team's time" [DIPC]

Therefore the trust did not procure nor implement the Sage antiseptic washcloths within the scope of project.

13.2.3 Trust Evaluation of the Technologies

This section summarises the trust's evaluation process and outcome for each of the four technology selections as reported by Trust 10 in March 2010.

(a) **Monitoring of environmental contamination using ATP Bioluminescence** (Source: Trust 10 Evaluation Report March 2010)

Introduction
ATP bioluminescence can be used as a rapid method for determining the cleanliness of surfaces. The

testing of surfaces by ATP bioluminescence detects not only bacteria, but any ATP containing material, which make up the bioburden present on surfaces. The advantage of using ATP bioluminescence over conventional environmental screening by culture is the rapidity of the test as results are produced in a matter of minutes, rather than the days.

Although the initial proposal was to evaluate only the potentially simpler and less costly Hygiena systemSURE Plus product, initial results gave some cause for concern regarding utility and it was quickly decided that the opportunity should be grasped to compare this system with the more widely used the 3M ™ Clean-Trace™ system so that all further evaluations looked at both products.

We evaluated two ATP monitoring devices, designed to detect surface ATP using ATP bioluminescence, the Hygiena systemSURE Plus and the 3M ™ Clean-Trace™ system. Both are hand-held devices, which require the use of special swabs containing luciferase/luciferin reagent, which when mixed with ATP, produce light in proportion to the amount of ATP present in the sample. The light produced is detected by a luminometer and the result expressed as relative light units (RLUs).

Hygiena systemSURE plus luminometer
The Hygiena systemSURE plus luminometer was supplied with an operating manual and software, to run on a PC, for storing and manipulating data. The luminometer was powered by AA batteries. The Hygiena systemSURE Plus luminometer was purchased outright and the Ultrasnap ATP swabs for sampling were obtained as required.

3M ™ Clean-Trace™ NGi luminometer
The 3M ™ Clean-Trace™ NGi luminometer was supplied with a battery charger unit and USB cable to connect to a PC. The 3M ™ Clean-Trace™ system could not be purchased as a capital item and was obtained on a contract basis. The contract we opted for was for a one year use of the luminometer together with 12 monthly deliveries of Clean-trace Clinical ATP test swabs (100). Software to store and analyse data was downloaded from the 3M™ website.

Comparison of Hygiena and 3M™ ATP devices
The sampling of surfaces using the Hygiena or 3M™ swabs was no different to conventional environmental sampling. Once collected the samples could be tested immediately, or left for up to four hours before testing. Both luminometers needed a brief self-calibration period before testing could be carried out. With the 3M™ swabs ATP measurement was initiated by pushing the swab through a membrane into a reagent filled sac within the swab sheath, followed by shaking for a few seconds. The complete swab was then placed into the luminometer and the RLUs measured. In the case of the Hygiena swabs ATP measurement was started by snapping a reagent vial contained in the top of the

swab and then squeezing the reagents onto the swab. After a brief period of shaking the complete swab was placed into the luminometer and the RLUs measured. Both luminometers were extremely easy to use and results of the tests were clearly displayed on a LCD panel. With both systems the time to result was approximately 30 seconds. Preset thresholds could be programmed into both luminometers so that a warning would be displayed along with the RLUs should the value be higher than the preset threshold thus alerting the operator that the sample had failed. Both manufacturers give suggested pass and fail values, but these are only a guide.

Comparison of RLU values obtained for the same test surfaces showed that the 3M™ luminometer usually gave RLU readings 10 – 30 times higher than values obtained with the Hygiena system. However, it is difficult to directly compare the two luminometers as results are recorded as RLUs and not ATP concentrations. The differences in RLUs between the two systems are likely to be due to differences in the reagents used for detection and the properties of the luminometers.

When ATP monitoring was compared with aerobic total viable counts there was little correlation with either system. This is not unsurprising given that the ATP measured can come from many sources of other bacteria. However, the 3M™ system did show better correlation when testing surfaces spiked with increasing concentrations of bacteria than the Hygiena system.

Our overall impression of the two ATP measuring systems is that the 3M™ Clean-Trace™ system is more user friendly and robust than the Hygiena system. The 3M™ luminometer is better designed having a fold-out stand, which allows the luminometer to be free-standing, making it easier to use. The 3M™ swabs were simpler to use than the Hygiena swabs as activation of the reaction merely required the swab to be pushed further into the swab sheath.

Potential uses for ATP monitoring
Over 90% of the tests we carried out comparing surface ATP levels pre and post cleaning there was a drop in the ATP levels following cleaning. Also, as expected, surfaces in occupied bed spaces had higher ATP levels than surfaces in cleaned and unoccupied bed spaces. This highlights one of the main uses for ATP monitoring, which is the rapid checking of the thoroughness of cleaning regimens. We also found that certain difficult to get at areas, such as the floor behind and under beds tended to have higher ATP levels. These areas would be highlighted by ATP monitoring and the results could be used for update training of domestic cleaning staff on the wards and as a means of recording improvements in cleaning.

Proposed further studies with ATP monitoring
    1. When using ATP monitoring different ward areas need different pass / fail thresholds. For

example treatment rooms should be maintained at a higher level of cleanliness than public areas, such as corridors. Therefore, one of the next phases to our study is to locally determine pass / fail threshold values for the various ward areas

2. ATP monitoring has an important role in measuring the effectiveness of changing cleaning practices and assessing new disinfectant products. Comparing ATP levels using current cleaning methodologies with levels obtained using revised cleaning protocols or new products would ensure that the proposed changes were of benefit

3. Hydrogen peroxide misting is becoming more widely used for intensive cleaning of side rooms used for high-risk patients. We want to investigate whether ATP monitoring can be used as method for ensuring the effectiveness of this form of treatment.

(b) Evaluation of Clinimax CLEANKILL DIFFICIL-S (Source: Trust 10 Evaluation Report March 2010)

Introduction

Difficil-S is a disinfectant that is made up as required by diluting two powders, each 12.5g into 10 litres of cold water to make a working solution of up to 300 ppm of dissolved chlorine dioxide. Difficil-S was given a recommendation 2 from the department of Health's rapid review panel.

The purpose of the trial was not only to establish if Difficil –S provides a means of effective decontamination of the environment but also to evaluate the effectiveness of the ATP Hygiene monitoring device as a monitoring tool that could be used against the National standard of cleaning audit.

A controlled trial of the product and evaluation was started in early June 2009 but had to be suspended after 8 days. The effectiveness of Difficil –S as a decontamination agent was compared against that of Chlor-Clean and Tuffie5 wipes during the first 5 days of the trial. The sampling method and sites were identified prior to the trial commencing.

Difficil- S vs. Chlor-Clean/Tuffie 5

Infection control in conjunction with hotel services undertook a trial to compare the effectiveness of "Chlor clean" & "Tuffie 5" wipes (current trust cleaner/disinfector) against "Difficil – S". To reduce bias and validate results the trial was undertaken on 2 wards with similar ward layout, number and type of patients. Training sessions on how to make up Difficil –S, Personal protective equipment required and uses for the product in relation to equipment and the environment was delivered to staff by the Head of

international product development, Clinimax Ltd during the 10th -12th June 2009. All cleaning products were removed from the ward where Difficil-S was being used. The trial commenced as scheduled on Monday 15th June 2009.

Table 1: Proposed schedule

Ward	W/C15th June 2009	W/C 22nd June 2009
D43	Chlor clean & Tuffie 5 Wipes	Difficil - S
D47	Difficil - S	Chlor clean & Tuffie 5 Wipes
NB. Prior to 15th June both wards will be using Chlor clean & Tuffie 5 Wipes		

Sampling methodology and sampling sites had been decided prior to the trial commencing.

Table 2: Sampling method and site

	Sampling method	Sites Sampled
1	10 x contact plates taken pre and post cleaning from designated sites on each ward daily for 5 days from designated sites outlined below	- Patient Chair right arm - Patient Chair seat - Bed Locker upper surface - Bed Frame - Curtain hem - Floor - Under bed - Skirting Board - Macerator - Commode Seat
2.	Adjacent sampling by means of Hygeina system sure plus machine of predesignated sites taken pre and post cleaning.	
3.	Environmental sampling for MRSA and C. *difficile* swabs moistened in PBS.	

Evaluation

Environmental monitoring was conducted am and pm on Ward D47 and D43 using contact plates and the Hygiena system sure plus hand held device.

Trial Suspended

The trial commenced as scheduled on the 15th June with D47 using Difficil – S.   D43 commenced using the product on 22nd June and on the 23rd June 2009, 8 days into the trial, the trial was suspended. Health effects were noted amongst some staff (no patients were affected) included coughing, shortness of breath, streaming eyes, and a chemical skin burn. Apart from the person who

required medical attention for the chemical skin burn no other staff member was assessed by either the A&E department or Occupational Health Department.

Following the investigation that occurred after the suspension of the Trial of Difficil-S it was identified that:

- A more structured training programme would have to be introduced by the company and a partnership between the company and the trust in delivering the training be agreed.
- Manual Handling of 10 litres of chemical was an issue for a predominately female work force that would not be able to sustain manual handling without either the company reducing the volume that the containers held or investment by the trust to lower the fixed facilities (sinks and worktops) within existing domestic rooms and dirty utility areas.
- Providing adequate ventilation during the make up stage of the chemical is problematic due to the design and age of the hospital site. The domestic facilities and dirty utilities would have to be upgraded to provide the level of ventilation required to safely make up the product.

The findings of the evaluation and incident report have been fully discussed at a range of Infection Control meetings. It would appear that the promise of a safer and easier to use product has not been realised following the evaluation of this cleaning agent and serious concerns have been raised about the acceptability of its use in our hospital setting, although we recognise that it has been used successfully elsewhere. A decision has been made that we would not continue with the current evaluation or proceed with putting this product into general use until such time as a more user friendly mechanism of making it up has been developed.

(c) Faecal management systems (Source: Trust 10 Evaluation Report March 2010)

The Trust had not had a formal policy for the use of faecal management systems although some were being used in an uncoordinated way by various clinical areas. The Infection Control Team organised a review and a series of external speakers and then decided that the optimal system to use would be the Zassi Bowel Management System because as well as the benefits of containing diarrhoeal stools it also allowed for the administration of intracolonic antibiotics especially vancomycin and this provided an important route of treatment of *Clostridium difficile* infection(CDI) for us. Formal training for the nurses on the wards where patients with severe CDI were likely to be used was instituted and an protocol for the use of intracolonic vancomycin was added to the Trust CDI policy and formally

approved.

The intention was to compare environmental contamination in rooms where patients were being treated using the faecal management system with rooms where other patients with CDI were being treated. This has been done on a limited scale but in fact we have found every little environmental contamination with C. *difficile* in either setting so have not really been able to undertake a comparison.

We have also been fortunate in not having many patients with severe CDI requiring this type of system so have not needed to use very many of these expensive devices. However we do not foresee any problems with the wards ordering a limited supply in the future given that the pathway has been approved through Trust systems.

(d) The Sage Products Antiseptic Body Cleaning Washcloths (Source: Trust 10 Evaluation Report March 2010)

Unfortunately the evaluation of this product, although still desirable, appears to have defeated all our endeavours. Because of the high ongoing costs and no real opportunity to use the initial monies other than for an evaluation, it was made clear that future funded use of these products would need to be subject to a robust business case showing a significant benefit over existing products.

The intention was to undertake a small clinical trial, following a study we were already committed to doing looking at decolonisation treatment following MRSA screening. This initial study has taken an extremely long time to get off the ground because of numerous problems receiving ethical approval for the study and therefore a further evaluation of a different product for skin decolonisation would be extremely delayed. Overall the feeling now is that in the current financial climate it is extremely unlikely that the use of this product would be funded and that there are other pressing tasks and evaluations which would be a better use of the Infection Control Team's time.

13.2.4   Discussion

13.2.4.1   The decision making process

The decision making process started by systematically scanning the environment for opportunities to invest in innovative technologies; the DH initiatives were a source of inspiration and a depository of such knowledge according the respondents:

"So we really started talking about it, I started pulling off things from the RRP website, downloading them, having a look, cross checking, speaking to people from the Showcase Hospitals, trying to get more information. We'd already, but in the end it was, came down to there was nothing there that we didn't know about, we already had this plan about the environment, we had already seen the C.diff, the DifKill, whatever the product's called, DifficileS, and was really just looking at other things, was there a more single thing that we could buy, and just hunting for that one thing, and there just wasn't really. So we kept coming back to the same idea, but we did, in a way it would have been easier just to go and procure one big thing for £150,000, but we just at the end of the day couldn't think of anything like that. So in the end we're not going to have something if we can point everybody there before, and that in a way is a bit of a shame, but I think in the end of the day it would be no use to buy something that we didn't think was going to deal with that", [DIPC]

The decision making process was *exclusive* to IPC team members and *predetermined*. When compared to other trusts in the sample Trust 10 can be mapped out as one of the trusts which followed a highly exclusive and predetermined approach. The process started as *informal* and gradually became *formal,* by forming a project team, delegating project leads, designing and conducting the evaluations and reporting on the outcome.

The rationale behind the particular technology selections was to benefit as many stakeholders in the trust as possible rather than focusing on developing further capacity in a narrow technical IPC activity area:

"Everybody benefits from the technologies we selected, that's the other good thing, I think if we'd got a laboratory piece of equipment it wouldn't have had quite the, at the end of the day you could have all the cleaners using the, all the supervisors using the ATP measurements, you could have the DifficileS in every ward, every nurse, every cleaner using it, it would really be spread so widely, which would be absolutely great, rather than just one machine somewhere. Well as I say, I think for, the DifficileS for the nurses would be just fantastic, to just reach for a

product and be able to clean, and not have to worry about all the toxicity and all the making up, and all the getting rid of it, would be inestimable, but it's got to be able to deliver otherwise maybe something, we've had previous things that were very convenient, but they didn't get rid of Difficile spore, so it's got to do both. I think the ATP, the domestic supervisors have been crying out for some other tool, really something to regalvanise themselves too, because people need feedback don't they? And obviously we have a lot of inspections for visual cleanliness, loads and loads, and loads, but something that was more memorable, that you could say, this is yours, I've assessed you, and so on, and this figure's going to be in the computer forever, I think would be really, really helpful. And in all the talks I've given they've been very excited about that. So those would the benefits if it was so widely spread out", [DIPC]

13.2.4.2   Evidence

Table 67: Type and sources of knowledge used in decision making

Awareness knowledge[75]	*Principles / theory* knowledge[76]	*How to* knowledge[77]
Presentations Trust previous experience with the same or similar technology Peer reviewed journals Showcase Hospitals 'Clean safe Care' website HPA RRP (website + products received RRP 1)	Peer reviewed journals Supplier HPA RRP 1	Supplier Trial of the technologies Previous experience with the same technology Showcase Hospitals

(Adapted from Rogers, 2003; Glasby & Beresford, 2006)

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[75] to find out what is available in terms of the range of technologies specific to IPC
[76] why and how a technology works in terms of the underlying scientific principles or theory
[77] how to put the technology in to use, including all aspects of implementation

13.2.4.3 Procurement

Due to the intention of the trust to evaluate and trial a number of new technologies the trust did not procure technologies in the first place but used either free samples for trial or purchased small quantities direct from the suppliers. Only at a second stage the trust procured one technology (3M™ Clean-Trace™ ATP Hygiene Monitoring System) after positive evaluation outcome and invested about 10% of the award funding. The IPC team had not anticipated potential structural compatibility issues from the procurement of technologies as it was the case with the bowel / faecal management systems. Earlier involvement of the trust procurement team might have streamlined similar issues of misalignment in the supply of technologies with similar scope.

13.2.4.4 Context

The award played an important role in allowing the IPC team to further communicate its successes to staff and other healthcare economy partners

The freedom to innovate and take risks was emphasised by respondents as a crucial factor that encourages engagement of the staff in pro-innovation activities. In particular the fact that the trust is not a teaching Trust it was perceived that further boosted such freedom since it avoided the bureaucracy burden:

"A very small, dynamic management team, real opportunities for people to make individual big leadership impacts, and we're not allied to a medical school or anything, so we don't have a lot of the bureaucracy and things that you have when you're in a big, it is a teaching hospital, we get medical students, but we're not the teaching hospital. So it's a bit more free, quite a bit of freedom therefore for individuals to do their own things", [DIPC]

Sustainability considerations and the importance of 'balancing the books' was also often mentioned by the respondents as important contextual factors that shaped technology selection decisions and implementation.

The high levels of support that the IPC team received by the trust was also frequently quoted:

"Well firstly, soon after I started we got a very, very big injection of money, very large investment, and that's maintained, and they [senior trust management] have supported things that nobody else has got, like point of care testing for MRSA, like a two stage algorithm for C. diff, I think we're the only trust that does that kind of things, we get 100% support on that. And yesterday they had a conference for all the consultant staff in the whole organisation, and the first thing that the chief executive and the medical director said was, we've come a long way, and the example, the first example they gave was infection control. So we just could not have better, honestly you could not have better support, and also complete trust in me, so they don't really question as I say, absolutely fantastic, couldn't be better", [DIPC]

The trust has a long history and tradition in infection prevention and control and values highly the reliance on scientific evidence for informing decision making.

Finally leadership was mentioned as a particularly dynamic contextual factor that underpinned the whole processes of decision making and implementation

13.2.4.5   Implementation

Involving the users of the technology was a precondition for effective implementation:

"And if you don't bring your staff with you, we could just see they were going to have a million handling issues, they were going to have, already had a major toxicity issue, it ended up with a whole head of health and safety involved, litigation flying, it wasn't for us" [DIPC]

Box 50: Perceived Implementation Barriers

Perceived Barriers to technologies Implementation

- The one off nature of the award funding
- 'Innovation fatigue' of IPC staff involved in a number of innovation and change practice programmes in recent years
- Old physical infrastructure in one of the hospital sites difficult to ventilate (significant problem for the use of DIFFICIL-S or other similar product)
- Having underestimated the need for training even in what appears to be simple tasks (Difficile-S)

- The non involvement of the hotel services personnel earlier in the design and testing of the ATM Hygiene Monitoring system, which would have potentially saved in time and effort for training during the stage of trust-wide roll out of the technology
- Cross-departmental collaboration is essential, especially for the implementation of innovative technologies that are to be rolled out trust-wide (The limited collaboration or suboptimal communication between the IPC team and the Intensive Care Unit team led to structural incompatibility issues, as there are currently two different types of the same technology [Bowel Management System] available in the trust)
- Not very detailed implementation planning

"Considering we didn't have a plan, so that's gone well. From my experience, with the Difficil-S, with looking at that chemistry, we didn't plan enough and I don't think we looked at the environment, the infrastructure properly. I think we just saw the product there and thought, this is going to be a good thing, without giving that too much thought" [Decontamination Manager]

"We would do the monitoring, had them right at the beginning with the swabs, so they'd be fully trained to do it. Now we've found it, we've done the testing, now we're going to be training them and getting them involved all the way along and we've then, just a slightly different way of doing it" [Clinical Scientist]

Box 51: Perceived Implementation Enablers

Perceived Enablers/Facilitators to technologies Implementation

- Support by trust's senior management facilitated implementation by mobilising staff and encouraging staff engagement in implementation efforts
- Pre-existing experience with conducting evaluations among the members of the IPC team was a valuable resource
- Well developed laboratory infrastructure with and a supportive pro-innovation environment
- Staff capacity of IPC team and a wide variety of skills available which included laboratory clinical scientists, data analysts, senior nurses, medical consultants, decontamination manager, antibiotic pharmacist
- The small number of potential users of the technology (i.e. ATP) which render changing working practices and training easier to manage (this is in contrast to the experience with DIFFICIL-S which is to be used by a large number of staff in the

trust)
- Hands on training provided by expert staff was key [lab personnel training the users of ATP on the swabbing technique]
- Emphasis needs to be placed on the communicating of the innovative technologies [and the results of the evaluations] to key people who are involved or can influence implementation

14. Case study – Trust 11

14.1 Context

14.1.1 General Context

Trust 11 is a large busy acute trust with an annual budget of over £360 million, more than 7,000 staff and almost one million patients being seen every year. The trust provides general hospital services and emergency care to the local community including a full range of medical, surgical, diagnostic, rehabilitation and therapy services. Specialist services are provided to the region. It is a Teaching Trust with well established links to two local universities. The Trust provides services across two sites which contain three hospitals (one of them being a dental hospital). Hospital A, which is a University Hospital is situated in city centre and comprises 39 wards and has a capacity of over 850 beds. Hospital B comprises 9 wards, has over 180 beds and is located in a suburban area.

14.1.2 Trust Performance

The trust's performance was rated as "Excellent" for both the quality of its services and financial management by the Care Quality Commission in the latest annual health check in 2008/09. This is compared to the "Good" and "Excellent" scores received for quality of services and financial management respectively for the previous year.

Table 68: The Care Quality Commission Assessment[78]

	2005/06	2006/07	2007/08	2008/09
Quality of services	Good	Good	Good	Excellent
Quality of financial management	Fair	Good	Excellent	Excellent

The annual Patient Action and Environment Team (PEAT) scores show that the Hospital site B received a score of 'Excellent' for its food and 'Good' for privacy and dignity and environment.

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[78] Care and Quality Commission, October 2009

Hospital site A scored 'Excellent' in all three areas. The scores for food have improved from 'Good' to 'Excellent' compared to previous year assessment..

. Table 69: PEAT Inspection Results (2010)

	Environment Score	Food Score	Privacy & Dignity
Hospital site A	Excellent	Excellent	Excellent
Hospital site B	Good	Excellent	Good

14.1.3 Infection Prevention and Control Context

14.1.3.1 Trust performance on mandatory HCAI indicators

Table 70: Trust performance on HCAI indicators[79]

	2007/08	2008/09	2009/10
MRSA *bacteraemia*	58 cases	34 cases	18 cases
Clostridium difficile	795 cases	600 cases	391 cases

14.1.3.2 Trust infection prevention and control interventions

Trust 11 in collaboration with a PCT and another acute trust in the area (Trust 8 in this study) have developed strong collaborative links with a top USA based hospital focusing on improving patient safety and quality of care. The main aim of the collaborative service agreement that has been developed through the involvement of the respective SHA, is to help the three trusts improve infection prevention and control systems.

14.2.1 HCAI Technology Innovation Award: Trust IPC Areas of Priority and Technologies Selected

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[79] HPA website 2010

Who was involved and how?

It was repeatedly reported by informants that the technology selection decisions made by the trust followed a *"multidisciplinary and engaging approach"*. The decision making process was led by the DIPC, who is also Director of Nursing for the trust and Director of Operations. There was involvement of: (a) the infection prevention[80] team leader nurse; (b) the nurse consultant for infection prevention and control, who is also the MRSA steering group lead; (c) the infection prevention doctor[81], who has medical microbiology background and primarily provided feedback to the rest of the team regarding the evidence base behind the technologies considered; (d) one antibiotic pharmacist; (e) matrons from the trust departments that had been targeted for technology implementation. The above group of actors discussed the award for generating ideas.

The DIPC and the infection prevention team leader prepared the paperwork for the bids. Infection prevention and control priority areas for improvement had been identified first and the selection of relevant technologies followed. The technology selections were later discussed in the MRSA steering group and other pre-existing trust forums (such as the matron business meetings and the monthly senior nurses' forum). In such forums, technology selection decisions were communicated to all relevant stakeholders involved in implementation.

Initial options considered

Trust 11 had initially decided to spend the £50,000 of the HCAI Technology Innovation Award (the £150,000 was split equally among three NHS Trusts in the same SHA region) on rapid PCR testing for MRSA, which could provide results within a 4 hour turnaround timeframe. The pre-existing MRSA culture method of screening in the trust took approximately 24-48 hours for the results to be notified to the clinical areas. The perceived benefits of using this alternative method of screening were the potential for rapid identification of MRSA patients, earlier commencement of decolonisation treatment, appropriate bed management, and ultimately enhanced patient safety through the implementation of appropriate cross-infection preventive measures, such as isolation of infected patients.

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[80] The title of infection prevention rather than infection control was emphasised by the IPC team members interviewed
[81] The title of infection prevention rather than infection control was emphasised by the IPC team members interviewed

The trust had conducted a brief option appraisal of the available PCR testing products in early spring 2009 and had also taken into account the experiences of other trusts, notably from Blackpool and Birmingham.

However, following careful consideration of the implications of this technology selection on staffing, the additional workload for the trust's microbiology laboratory, the need for additional staff training, and the cost related to the maintenance of equipment and stocks, it was finally concluded that the £50,000 was not enough for the full implementation of the particular technology option.

What was finally selected?

The trust made three technology selections (selecting four individual technologies) to address three IPC priority areas, namely, patient hygiene, environmental hygiene, and hand hygiene (Table 71). The decision making process lasted five to six months and the final technology selection decisions were taken around July - August 2009. All selected technologies have been procured and implemented.

Table 71: Technologies, Priority area and Progress

	Technology	IPC Priority Area	Brand / *Supplier*	Procured	Implemented
1	*2% Chlorhexidine Gluconate (CHG)* impregnated Antiseptic Body Cleansing Washcloths	Patient Hygiene	Sage® Products INC	Yes	Yes
2	Palm held ATP Bioluminescence Hygiene Monitoring System (+ fridges to store swabs)	Environmental Hygiene	*3M™* Clean-Trace™	Yes	Yes
	UV lamp for hand hygiene control	Hand Hygiene	*UV Light Technology*	Yes	Yes
3	Individual Patient MRSA	Patient Hygiene	Packs created in-house	Yes	Yes

14.2.2 Individual technology selection, procurement and implementation

14.2.2.1 *Sage*® Antiseptic (2% CHG) Body Cleansing Washcloths

Decision Making Process

The technology selection *decision making process* for the *Sage* antiseptic body cleansing washcloths was unanimously reported by informants as being *collective* and *exclusive* to the core infection prevention and control team. Once the final decision to allocate the award money to specific technologies (including the Sage antiseptic washcloths) was reached within the IPC core team, the matron in Critical Care Unit was also consulted to better plan implementation of the particular technology. The decision was further discussed in the MRSA steering group and communicated to other trust stakeholders.

The proposal was led by the DIPC, who also made the final decision to allocate part of the award money to the particular technology and decided upon a more *"targeted and controlled implementation"* rather than a trust-wide implementation for the *Sage* antiseptic washcloths. The technology was championed by the infection prevention doctor who had advocated the rolling out of the technology even outside the Intensive Therapy Unit (ITU).

The following excerpt by the DIPC refers to the final stages of the decision making process. The main considerations for implementation that shaped the final adoption decision are clearly outlined (highlighted in bold):

*"We would love to roll it [Sage wipes] out trust-wide. However, **sustaining it in the long term** wouldn't be possible. We would be raising expectations within the organisation, which we couldn't continue with. Because we knew that we couldn't afford to fund chlorhexidine cloths trust-wide, particularly with MRSA screening being put in place for all emergency patients this*

*year. So that's a vast number of patients coming into the organisation. And so you're automatically going to find positives just by screening. The expense would have just been far too much. So it's about **managing it in a controlled way**. I think that was one of the biggest challenges for us about **managing expectations** and what we could do and actually **putting some controls in place to** say these are the **areas where it will have the biggest impact**. Yes, we would like to go with it trust-wide but actually we can't really afford to do so",* [DIPC]

The final technology selection decision was taken in late July 2009. Then, the supplier of the technology was invited to present to the IPC team and to the ward sisters and the clinical matron from ITU. Procurement was swift and the technology implementation started very quickly after the final selection decision had been made.

A number of factors influenced the final technology selection decision for the *Sage* antiseptic body cleansing washcloths. Box 52 and Box 53 summarise the key perceived elements of innovativeness of the particular technology and its perceived relative advantage as reported by the respondents in our qualitative interviews

Box 52 Perceived Innovativeness of the *Sage* antiseptic body cleansing washcloths

Perceived Innovativeness

- Rinse-free whole body washcloths that allow for easy and rapid decolonisation of MRSA positive patients
- Persistent anti-infective action once applied on the skin

Box 53 Perceived Benefit / Relative Advantage of the *Sage* antiseptic body cleansing washcloths

Perceived Relative Advantage

- Effective against resistant micro-organisms including MRSA
- Very quick and easy in application in preoperative care instead of washing off patients, and postoperative care in selected high risk units
- Contributed significantly to reduction in cross-contamination in ITU (old building, set

up and design of the unit suboptimal from IPC point of view) from patients colonised with MRSA

- The washcloths come with a little warmer and can be at body temperature when used on patients
- Well received by both staff and patients "*staff loved them...they are fabulous*" [DIPC / Infection Prevention Team Lead]

The high cost associated with the use of the *Sage* antiseptic washcloths hindered its trust-wide application as reported by all informants and was the key drawback identified by the respondents. Box 54 highlights the perceived weaknesses of the technology as reported by the informants in the trust.

Box 54 Perceived Weaknesses of the *Sage* antiseptic body cleansing washcloths

Perceived Weaknesses

- High cost
- Extra clinical waste from the use of disposable cloths

Regards evidence, the trust IPC team used a combination of sources for this. For 'awareness knowledge' of the product, Trust 11 used information from hospitals in the USA (i.e. The Johns Hopkins Hospital) and the NHS (i.e. St Thomas' Hospital in London) that had already implemented the technology in Intensive Care Units and Critical Care Units. They also contacted the supplier to ask for additional information and evidence. About the technology's effectiveness and 'principle or theory knowledge' (see section 14.2.4.2 for definitions), Trust 11 relied primarily on published relevant evidence in peer-reviewed journal articles; the supplier also provided such evidence as mentioned above. Through liaising with colleagues in other NHS Trusts the IPC team gathered more information about the practical application of the technology.

Procurement Process

The trust's Supplies Purchasing Group (SPG) was involved in the early stages of the decision making process and reviewed the product on the basis of its cost-effectiveness, its anticipated benefit to patients and its compliance with relevant guidelines. Procurement was direct from the supplier. A formal quote was requested and the trust placed the order with support provided by the SPG. The procurement process was described by informants as *"smooth"*, *"uncomplicated"* and *"straightforward"* and it was reported being "*swift"*. The products arrived to the trust within a couple of weeks from the time the order had been placed. Overall, about 40% of the awarded funding of £50,000 was allocated to the particular technology. A batch of *Sage* antiseptic washcloths was purchased in a single order; the products are stored in the IPC team office and their use in the implementation targeted areas is controlled by the IPC team.

Implementation Process

The technology had been initially trialled in Intensive Therapy Unit (ITU). There were discussions with the supplier for rolling the technology outside ITU and there have been thoughts by the trust of doing so in the breast unit and the newly created 'fractured neck of femur' unit within orthopaedics. The rationale behind this exploratory evaluative work is presented in the following quote by the Infection Prevention Doctor:

"We wanted to get as much as we could out of this investment [HCAI Technology Innovation Award], so we met with the company and we are apparently the first trust in the world to be looking at really seriously taking it [Sage washcloths] outside of ITU. We don't need to repeat the evidence base that has been shown in patients on ITUs across America; St Thomas's in London are also using this technology in ITU; we have also trialled it in ITU. So we're discussing with the company to do a pilot study with our breast surgeons who are dealing with young, fit people, breast and cancer surgery now is an all in one, they remove the cancer, they reconstruct, it's plastic surgery and if they get infections, it's huge. And we've recently done an audit that shows there is a problem in that area; both us and the company are keen in expanding the evidence base and we are keen to publish the results and share our experience with the rest of the NHS", [Infection Prevention Doctor]

The high cost implications of rolling the technology out across the trust led the IPC team to follow a *"controlled and carefully targeted implementation process"*. The technology has been

implemented in Critical Care, namely, Intensive Therapy Unit (ITU), High Dependency Unit (HDU) and Postoperative Care Unit (PCU). The quote by the DIPC provides the justification behind such a decision:

*"We're very selective about the wards that we've rolled out and we have to **have some control over the wipes because they are costly** and **there is already another way to decolonise patients, which is a bit more arduous than the wipes but it's less expensive**. So I think it's around having control measures in place and actually **using the wipes where you're going to get the best impact**. And certainly **critical care, it's much easier to manage it within that environment**. So I don't think we'll be going big bang across the whole organisation with the wipes. We would like to and if the cost of them came down we probably would do because they're much easier to use and are certainly very good",* [DIPC]

14.2.2.2 *3M™Clean-Trace™*ATP Hygiene Monitoring System - *UV Light Technology* Hygiene Inspection System

Decision Making Process

The *idea* for the particular technology selection came from previous involvement of the trust in a Smart Solutions[82] evaluation project (managed by *Trus*TECH® NHS Innovations North West on behalf of the DH HCAI Technology Innovation Programme), which had been implemented in the previous year and lasted for nine months. The project trialled the use of Ultra Violet (UV) lamps from *UV Light Technology Ltd*, to assess the cleanliness of surfaces in selected medical, surgical and 'specialist services for the elderly' wards. The project engaged the housekeepers to systematically assess the cleanliness of surfaces on wards before and after cleaning, feeding back results to nursing and domestic staff and to trust's nurse consultant for infection prevention and control (who was also the Principal Investigator for the project). Apart from visual inspection, palm held ATP bioluminescence swabs were also used by the trust staff to test surfaces for evidence of contamination. Audits of the cleaning processes were carried out with and without UV light lamps. User feedback questionnaires and ATP results from the swabbing

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[82] Smart Solutions is part of the DH HCAI Technology Innovation Programme which assesses innovative products and technologies and evaluates the most suitable ones in a healthcare setting; Smart Solutions is run by *Trus*TECH®, the North West Innovation Hub.

of ward surfaces were fed back to *Trus*TECH® for further processing and evaluation of the technologies piloted in the trust.

The trust having been sensitised by the above project used part of the award funding to build on and extend the work already done by further investing in the two technologies to further improve hospital cleaning.

"Well basically what had given us the idea is that actually we've done this on a small scale as part of the TrusTECH project, we've provided them with a lot of data. Following completion of the project the UV lights would have gone back, because they were only on loan. So the funding from the award enabled us to purchase the UV lights. We also only had a small number of ATP swabs for the project. So basically by using some of the [award] funding we decided to roll it out bigger within the organisation, targeting the areas that had the higher incidence of healthcare associated infection", [DIPC]

The nurse consultant for infection prevention and control took the lead on the particular technology selection decision. For selecting the specific technologies, she and other members of staff reviewed the Clean Safe Care website and also attended the DH Performance Improvement Network (PIN) conference on 7 May 2009 in London.

A number of factors influenced the selection decisions for the two specific technologies. Box 55 and Box 56 summarise the key perceived elements of innovativeness of the particular technology and its perceived relative advantage as reported by the respondents in our qualitative interviews

Box 55 Perceived Innovativeness of UV lights and ATP Hygiene Monitoring Systems

UV Light Technology	3M™ Clean-Trace™ ATP Hygiene Monitoring System
• UV light technology can reveal contamination that is invisible to the naked eye	• ATP provides a rapid numeric piece of information and that can be compared and communicated easily

Box 56 Perceived Benefit / Relative Advantage of UV lights and ATP Hygiene Monitoring Systems

UV Light Technology	3M™ Clean-Trace™ ATP Hygiene Monitoring System
• UV light technology can reveal contamination that is invisible to the naked eye • Powerful training aid tool for educating staff and the public in improving cleaning practices *"very convincing with immediate effects in changing behaviours"* • "The light can be shined everywhere i.e. covering a whole room rather than a sample of surfaces" • It provides a rapid indication of the level of cleanliness	• Reasonably simple for staff to use and understand • The technology can reveal contamination that is invisible to the naked eye and in addition offers a **numerical value** to assess effectiveness of cleanliness instead of relying solely on visual inspection • Introduces a sense of *"healthy competition among teams of housekeepers, nurses and among wards"* • Makes cleaning more interesting and helps involving staff and patients • *"It is an alternative to taking loads of mounts of microbiology swabs flooding the lab with swabs"* [Nurse Consultant] • *"The speed at which you can provide advice on cleaning practices and act on it"* [Matron] • Provides additional assurance to staff, the trust board and the public around cleanliness • The ATP can be used to check cleaning procedures, identify problem areas and train staff

Box 57 Perceived Weaknesses of UV lights and ATP Hygiene Monitoring Systems

UV Light Technology	3M™ Clean-Trace™ ATP Hygiene Monitoring System
• UV light technology does not provide a	• *"The restriction is that you can't swab all*

'numerical back up' or a 'numerical value' to assess levels of cleanliness or allow comparisons / degree of improvement achieved • Size: big and heavy to carry around • Often it gets very hot	*over the place, you can only do small areas, you are getting a sample rather than the whole picture"* [Nurse Consultant for IPC] • Need to buy two fridges to store the swabs (not clear from the beginning of the trial)

Regards evidence for the two individual technologies the trust IPC team used a combination of sources. For 'awareness knowledge' Trust 11 had been already familiar with both technologies during the Smart Solutions project. Additional information for the technologies was obtained at the PIN meeting. The use of both technologies at the hospital during the Smart Solutions evaluation project offered evidence about the 'how to knowledge'. The suppliers provided additional information and evidence. About the technology's effectiveness and 'principle or theory knowledge', Trust 11 relied primarily on peer-reviewed articles and for the ATP on the 'Clean Safe Care' website which included evaluation reports for the 3M™ Clean-Trace™ ATP system.

Procurement Process

The trust's Supplies Purchasing Group (SPG) was involved in the early stages of the decision making process and reviewed the products. Procurement was direct from the supplier. The procurement process was described by informants as *"simple"* and *"straightforward"*. About 50% of the awarded funding of £50,000 was allocated to the particular technology selection.

"I think it was around us deciding what we wanted to do, tried and tested, looked at what potentially other organisations had used. And about the cost of the ATP and UV lights, we didn't actually have to go out to formal tender because it wasn't a big amount of money. It was simple; it felt like we'd like to do that, and just did it really", [Nurse Consultant for Infection Prevention and Control]

Implementation Process

A phased approach to implementation (of both technologies) was employed: implementation started in one ward and was gradually rolled out to other wards; initially one of the two trust's

hospital sites (Hospital A) was included. Hospital B had been selected for early implementation because it showed the highest reported incidence of HCAIs. Implementation had started in August 2009 and involved a two weeks trial of the technology on the surgical ward and in early September 2009 expanded to include a medical ward. By May 2010 about 50% of the wards in the main hospital site (Hospital A) were using the *3M™ Clean-Trace™* ATP Hygiene Monitoring System and the *UV Light Technology*. Further roll out of the technologies in Hospital A has taken place since June 2010, while in Hospital B the technologies were planned to be introduced in September 2010.

Both technologies have been used as an aid to training and audit tool for cleaning targeting "hot spot areas" in the trust that had the highest incidence of HCAIs. In particular, the *Clean-Trace™* ATP Hygiene Monitoring System is being used in connection to the trust-wide deep clean programme.

Implementation was informed by the experience gained from the Smart Solutions evaluation project during the preceding year. To better inform implementation members of the IPC team also visited the Showcase Hospital in Manchester to have a *"hands on experience of the technology in use in another NHS setting"*.

Initial training had been provided by the suppliers. Building on the experience from the use of the technologies in the Smart Solutions evaluation programme and as part of the trust's revised cleaning strategy internal training was also provided to housekeepers, nurses, and domestic supervisors.

The main users of both technologies have been the housekeepers. Their early involvement in the planning of technology implementation heightened feelings of ownership and enabled the spread of the technologies among the users in a grassroots approach, rather than being a top down dissemination process:

"You know when we talked about how did we spread it out amongst the organisation? The housekeepers started off using the ATP and the UV lights; and then one started teaching the other and the use of these technologies moved on to other wards. So it was great and, in a way from the grassroots, started to standardise things, the girls were making the difference. They knew what they were doing and could also see the outcomes which made the cleaning far more

meaningful and interesting. Also from a patient's perspective, when they see the girls go around with their trolleys wiping and cleaning, whatever, the patients would notice, they couldn't help but notice, but they weren't suspicious and I think that was important, patients also became engaged", [Matron surgical ward]

There has been very positive feedback especially for the *3M™ Clean-Trace™* ATP Hygiene Monitoring System and the housekeepers became passionate advocates of the particular technology. Patients also developed a positive attitude towards the use of the technology. The reason behind these developments is presented in the excerpts provided by three different key informants who represent diverse organisational roles:

"The housekeepers have been really passionate about it [ATP] because they've actually owned it. And they've put an application together for a regional innovation award because of their involvement in it", [DIPC]

"...a dull task became suddenly a healthy competition contest", [Nurse Consultant Infection Prevention & Control]

"So everyone was involved but the domestic wasn't taking any offence by the patients' comments. And then when I'd walk in, 'uh oh, stand guard she's here, she's here'; so it was laughable and the patients, as I say, they got involved: 'she never did that yesterday love, she has never done that'; winding me up, so that I was winding them up. But honestly, it was a lovely atmosphere. Nurses, doctors, everyone was included. And as I say, we started off as one housekeeper and then it rolled off onto other wards, so now It's really snowballed and it's been an experience, honest to God it has", [Housekeeper surgical ward]

14.2.2.3. Individual Patient MRSA Decolonisation Packs

Decision Making Process

Technology in brief (in-house product pack)
Elective surgical patients are screened for MRSA in the pre-operative assessment clinics.

Healthcare staff who undertake the screening administer a decolonisation programme for patients who are identified as MRSA positive.

The technology according to respondents comprises a **protocol** and the dispensing of **individualised MRSA decolonisation packs**. Specifically it involves the following: (a) Patient information leaflet re pre-operative screening; (b) Instructions to MRSA positive patients for skin decolonisation regime including illustrations of appropriate drug application; (c) Patient Group Direction (PGD) for the supply of MRSA decolonisation medication (the protocol was written by the antibiotic pharmacist); (d) Pre-labelled aqueous Chlorhexidine 4% skin cleanser (Hibiscrub) in containers for individual patient use; (e) Mupriocin 2% nasal ointment (Bactroban) for individual patient use. MRSA positive patients receive the skin antiseptic and nasal ointment to use for 5 days pre-operatively.

The *idea* came from a matron (trust's longest serving matron) and the antibiotic pharmacist who both were involved in the trust's technology selection decisions.

*"One of our matrons wanted to screen and decolonise all her patients before they went to theatre and recognised the fact that we had a larger bottle that was shared between patients. So realistically we needed a **small pack that we could give to each person for individual use** and then we rolled that out at the pre op. She's really passionate about MRSA and CDT and infection prevention generally; she's just shining isn't she? So she linked in with the antibiotic pharmacist and developed the idea for the packs",* [Infection Prevention Team Lead]

The matron championed passionately the particular technology selection and since she has been well respected by colleagues and other staff in the trust her support provided impetus to the initiative and facilitated the engagement of key staff. The matron liaised closely with the pharmacist and the nurses who screen the patients in the wards:

"The matron is very passionate about what she does and she has lots of ideas and it's about sitting down together and pulling out the ones that were workable and doable", [Antibiotic Pharmacist]

The idea was further discussed at the MRSA steering group and gained further support by key stakeholders in the trust. The selection decision process started informally and towards the end became formal with identified project leads for each technology selection.

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Box 58 and Box 59 summarise the key perceived elements of innovativeness of the particular technology selection and its perceived relative advantage as reported by the respondents in our qualitative interviews.

Box 58 Perceived innovativeness of Individual Patient MRSA Decolonisation Packs

Perceived Innovativeness

- The technology comprises a product (the individual sized packs of drugs), a protocol (PGD) and a process which provides for a holistic patient's journey from start to finish (in contrast to a fragmented process in the past)
- Being a more proactive and open process, *"whereas beforehand it was like a secret, everyone was finding out about MRSA after the patient had been admitted"*, [IPC Nurse Consultant]
- The technology standardised MRSA screening and decolonisation across the trust

All respondents reported a positive experience with the technology. The following quotes by the Matron and the IPC Nurse Consultant aptly summarise the reviewed patient journey via the use of the technology and emphasise significant perceived benefits. The perceived benefits highlighted in bold were widely shared among respondents:

*"Let's say you are the patient, you would come in, to pre op, we'd go through everything with you, tell you about the MRSA screening, why we're doing this and do the screening. Then you'd go home. You might come back positive. The nurse would track your case, bring you back to the hospital, go through everything with you, how to use the Bactroban and everything, give you patient information. And then the patient would go off with that and start the treatment. So it's **engaging with the patient** as well, which is fantastic. From the ward point of view, when we got the patient, instead of starting the treatment when the patient came in, it had already been initiated. For the trust it is no more a blame culture as it used to be with patients saying oh it is [Trust 11] that gave us MRSA. Well not anymore, you see, patients are screened before they come in, **the procedure is clearly communicated to patients**, and it's wonderful. The **packs are** great, **very structured**",* [Matron]

*"Everything is all set up when patients come back to the pre op nurses, and follow a set procedure. And patient information, how to wash, is clearly identified because everyone washes differently. The process is now **standardised** for both staff and the patients. And I did think that has made a massive difference",* [IPC Nurse Consultant]

Box 59 Perceived benefit of Individual Patient MRSA Decolonisation Packs

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Perceived Relative Advantage

- Standardisation of patient MRSA screening and treatment which reduces variability in patient care and thus improves service quality and enhances patient safety: *"It's about making sure that the patient gets the right equipment/drugs, the right pack, the right information. Previously it was dependent on which nurse you saw. And it's foolproof now, there's the pack and that's what you give to the patient and it's got everything in it, whereas it could have been what the nurse gave you. So it stops it from going wrong",* [DIPC]
- Streamlines communication among members of a multi-disciplinary workforce: *"We all now speak the same language, across the trust",* [Matron / IP Team Lead]
- Individual sized bottles (of antiseptic for use by MRSA patients) are more cost-effective and increase patients' compliance to decolonisation treatment regimes
- Individualised packs that prevent cross-contamination among patients who used to share a common large bottle of antiseptic
- Advantages for the patient in terms of accessibility of treatment, improved information and reassurance: *"It's just easier for patients, they get more information so they can better understand, they also now get the leaflets telling them generally about why they're being swabbed and what the results mean"* [IPC Nurse Consultant]
- Nurses feel more valued as they can prescribe the drugs and follow up individual patients easier becoming more involved in clinical practice compared to the past
- Reduces patient stay in the hospital and saves staff time and financial resources
- Eases off the pressure from the pharmacy: *"pharmacy do not have to do the prescriptions there and then because we supply the stock already made up",* [Antibiotic Pharmacist]
- Patient information includes a pictorial diagram of how to wash; this addition eases off communication challenges of the past, which exist due to cultural, linguistic and literacy level diversities among the trust's patient population

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Procurement Process

The trust had already been using the Chlorhexidine 4% skin cleanser / antiseptic (Hibiscrub) and the Mupriocin 2% nasal ointment (Bactroban) to decolonise MRSA positive patients. The trust arranged with companies in pharmacy who do pre-pack to create the individual sized bottles for distribution to the patients at the pre-admission and pre-operative clinics. 10% of the £50,000 of the award monies was spent on developing the packs. The purchasing manager in the pharmacy was involved and asked various companies to send samples and price quotes for the pre-packs. Pharmacy staff created and distributed the full medication packs for individual patient use, which were stocked in the clinical wards ready to be delivered by the nurses together with the accompanied documentation under the PDG. The procurement of the pre-packs was reported as being "smooth" and "swift".

Implementation Process

All patients coming in for pre-operative assessment are screened for MRSA and those found positive are given the pack, which contains individual patient doses of MRSA decolonisation medication and an information leaflet. The technology has been implemented trust-wide, including both hospital sites.

Implementation has been widely reported by the respondents as successful. On the one hand the "structured", "very slick" and "well thought" implementation plan, and on the other, the "engaging of staff and patients" in decision making (staff) and implementation (staff and patients) were identified by the respondents as key for implementation success:

*"We used our pre-op nurses to do the pre-op screening obviously but it was important that **the lessons learnt from them was cascaded trust-wide**, so it's presented at things like clinical governance and at C Diff and MRSA meetings. But I think it is **key that we've got everybody involved in the decision making process** in what's happening in their area to get them on board; they've got to take some ownership for such initiatives to feel that it belongs to them and it's their contribution rather than us directing change from the top",* [DIPC]

Particularly helpful for the implementation success of the technology had been the co-development of the various elements of the technology in the form of a "cluster": the introduction of PDG enabled the creation of the packs and streamlined implementation:

"The patient group directive allows the nurses, under a set of criteria, to give the medication. So together with the medication the nurses have also to give to the patient an information leaflet with the full information of what to do if something goes wrong or if they can't do it or if they've got any questions who to ring. So we've got all that assurance as well, that did not happen beforehand...now we have packs available at ward level ready to be proscribed under a PGD by a nurse for immediate implementation rather than waiting for it to be prescribed, the prescription to go to pharmacy, and then for that to be brought back to the wards", [Antibiotic Pharmacist]

14.2.3   Trust Evaluation of the Technologies

For all technologies the trust applied a number of similar broad criteria to measure success. These criteria included the impact of the selected technologies on: (a) patient satisfaction and perceived quality of care, (b) staff satisfaction, (c) infection rates. In addition, (d) cost implications, especially for the long term sustainability of the technologies were taken into account.

The difficulty with evaluating effectiveness, and more specifically, clinical efficacy and cost-effectiveness, was reported by the key informants. With numerous interventions and factors collectively contributing to reduction in infection rates evaluating the impact of technologies was deemed a complex task. Similarly complex was experienced to be the evaluation of costs associated with the specific technologies. Technology evaluation therefore was less systematic along these criteria.

For all technologies patient satisfaction was assessed through patient surveys. Staff satisfaction was evaluated via the use of informal feedback and questionnaires. The *Sage* body antiseptic washcloths and *the 3M™ Clean-Trace™* ATP Hygiene Monitoring system received particularly high positive evaluations of user friendliness by hospital staff, as did the individual patient MRSA decolonisation packs, which was also positively rated by patients.

For the individual patient MRSA decolonisation packs the length of stay and the holistic picture of a patient's journey were key criteria used to assess success on the intervention, and the technology was positively rated against this criterion:

"We used to bring patients in three days off; we're now bringing them in a day off. As a patient you don't want to be here longer than you have to. We can actually manage that situation, it's wonderful and evaluating the success in implementing the packs a key measure we had considered was reduced length of stay which has actually happened", [Infection Prevention Team Lead]

"If we just purely look at surgical elective, length of stay for just surgical is 3.9 days, which is good and reduced compared to almost 5 days prior to implementing the packs intervention", [DIPC]

14.2.4 Discussion
14.2.4.1 The decision making process

The decision making process was a combination of pre-determined and emergent decisions. Three of the individual technologies (ATP, UV Lights, Camera) had already been selected and trialled by the trust before the award. The remaining two individual technologies (Sage washcloths and MRSA patient pack) were considered after initiation of the project.

It was widely reported by informants that the technology selection decisions made by the trust followed an *"engaging approach"* in the early stages of idea and options generation. A number of staff from various departments and diverse occupational groups were consulted including the matrons, the facilities managers, trust laboratory, pharmacy. However, in the later stages of the decision making process the approach became more exclusive to the core IPC team and was led by the DIPC; therefore, final decisions were confined within the core IPC team members.

"At the start of the process, when it was quite at the informal stage, because the consultation was so wide and there were so many people that were involved, we probably did get quite a wide range of views. I think because so many people were involved in the beginning that we were getting too many diverse views weren't we? In that we needed to concentrate on the core areas and so for that fact we had a sub group of that meeting to focus into the nitty gritty bits about what do we want to achieve, what evidence have we got to support us to do it, what are going to be the implications for the departments involved", [Infection Prevention Team Lead]

"The whole process was fairly loose to start with. It wasn't done in a straight business planning model.... it started by being informal then it's pushed into formal processes" [Infection Prevention Doctor]

When compared to other trusts in the sample, Trust 11 took a midway approach between the extremes of highly IPC exclusive or inclusive decision making. In addition, as illustrated in the quotes above, the overall process started as *informa*l and then became more *formal* with specific members of the core IPC team taking up the lead to coordinate evidence synthesis, procurement and implementation for each of the selected technologies.

Technology selection by the trust can also be described as 'demand pull'. This means that the priority areas were identified first and relevant technologies were sought afterwards.

"If we took a whole trust-wide approach in making decisions, we've got something like, when we first started we had 54 wards, our wards have reduced slightly since then, and to get everybody in from those ward areas would be difficult. So we needed to focus on our hot spot areas, which were predominantly the emergency floor, renal, ICU and some of our surgical wards and the lead and coordination of the process were undertaken by IPC team", [DIPC]

14.2.4.2   Evidence

Table 72 summarises the type and sources of knowledge used as evidence during technology selection decisions by the trust.

Table 72: Type and sources of knowledge used in decision making

Awareness knowledge[83]	*Principles / theory* knowledge[84]	*How to* knowledge[85]
Professional networks – pharmacists forum [Individual patient packs - PGD]	Professional networks Peer review journals Supplier	Supplier Other NHS Trusts Showcase Hospitals [ATP]

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[83] to find out what is available in terms of the range of technologies specific to IPC

[84] why and how a technology works in terms of the underlying scientific principles or theory

[85] how to put the technology in to use, including all aspects of implementation

RRP 1) [ATP] Showcase Hospitals [ATP] Other NHS Trusts [Sage washcloths, ATP] Hospitals outside the UK [Sage washcloths] Supplier Previous experience using the product in a Smart Solutions evaluation project [ATP, UV Lights] DH HCAI PIN conference [UV Lights]	Clean Safe Care website [ATP]	Previous experience with the same or similar technologies

(Adapted from Rogers, 2003; Glasby & Beresford, 2006

14.2.4.3   Procurement

The trust's Supplies Purchasing Group (SPG) was involved in the early stages of the decision making process and reviewed the initially selected technologies on cost-effectiveness, assessed their anticipated benefit to patients and their compliance with relevant procurement and NHS policy guidelines. The pharmacy procurement manager was involved in early stages with respect to the individual patient MRSA decolonisation packs. This early engagement was perceived by respondents as key to "smooth", "efficient" and "swift" procurement and implementation of the selected technologies. Procurement in all cases was direct from the supplier and formal quotes were requested by the trust.

14.2.4.4   Context

The approach to decision making and implementation of the technologies provides some insight to the trust's culture. There has been unanimous agreement by the respondents on the positive change in the trust's response to IPC during the recent years, which is also reflected in the improved performance of the trust in the reported incidence of HCAIs. The new DIPC that was

appointed about three years ago tried to change the trust culture on patient safety, viewing the role of IPC as more strategic and coordinating rather than being narrow and technical. She also introduced a direct approach to tackling issues and encouraged challenging of clinicians by other staff:

*"... it was around **infection control is not necessarily our business**, **it's the business of the infection control team**. And we had lots of challenges when we tried to implement bare below the elbows but actually they stuck at it. And initially the reaction was, 'fine, show us the evidence', which was really difficult and subjective to provide. But my argument back was, 'if I was stood here in front of you and we were one of the best performing organisations in the country for healthcare associated infection, I'd say to you, fine, I fully agree with you, the evidence around bare below the elbows is not there, so we're not going to do it. Just carry on because actually our performance is fantastic. I said, but I'm stood here in one of the worst hospitals in the country on HCAIs so unless you can prove otherwise, I suggest you get your sleeves rolled up and let's get on and do it'. And so that **direct approach** has had an impact. And **we do regularly challenge clinicians** but what I would say was we've probably got about 98% compliance with that when we do walk rounds, we probably find the odd junior doctor that the message has not got through to, the odd consultant, particularly surgeons, who think that they still can wear their cufflinks etc. We challenge them, the matrons challenge them, nurses challenge them. **And the culture has changed radically in the last few years so we've seen some significant improvements**. And I'm proud to say now that from a C. diff perspective we're one of the best performing trusts in the country, because our numbers are so low"*, [DIPC]

A more pro-active and pro-action approach to tackling the challenge of HCAIs has been fostered, which has been further strengthened by an open, direct and honest culture on HCAIs challenge:

"It's about completing that whole, because I think this trust three years ago had a history of actually doing things and looking at things, auditing, finding out the reasons why they'd got difficulties and then not doing anything to complete the cycle. And we've changed that really, we're very keen to act on results from whatever source, actually to make improvements across the whole organisation", [DIPC]

"We have weekly meetings and where we discuss quite openly the areas in the hospital that

have problems with infections and it's not a secret, everybody knows, and I think that the people who look after those areas would be really very proactive", [Infection Prevention Team Lead]

The cultural change described above further reinforced a trust pro-innovation culture for which respondents often prided themselves during the qualitative interviews. There is an organisation innovation steering group and big research budget affiliation with a local university also conducting research in HCAIs. This organisational climate facilitated staff engagement in generating ideas, getting involved in the decision making and implementation. Staff have been keen to experiment with ideas and have been involved in research projects. The housekeepers for the work they did in the Smart Solutions project and the HCAI Technology Innovation Award applied for various innovation awards within the trust and national.

14.2.4.5   Implementation

Among respondents the support provided by senior management was reported to be key for implementation success since it helped mobilise resources and legitimated the initiative:

"We've always known we've had the support from the hierarchy and I think that makes the difference as well. Because sometimes you can go off on a mission and nothing happens if you haven't got the support. But because of the support by our senior exec team and the senior people who engage with us, we were allowed and supported in our journey to bring the ideas around the table and then put them in practice. And that, I think that made the difference as well, I do honestly", [Infection Prevention Team Lead]

Engagement of key actors early in the decision making process facilitated the operationalisation of the technologies across the implementing units. Communicating the key messages to front line staff created an enabling environment for change.

"I think if we go back to the MRSA steering group it, was discussed at that and there was very key people there like the DIPC, infection control, micro, the matrons. So it was about having that discussion higher and then everybody taking it back to their area and cascading that down from the top", [Infection Prevention Team Lead]

In conjunction with senior management support the engagement of technology users was perceived by respondents to be almost as important as the experience with the implementation of ATP and UV light technologies illustrate:

*"Because obviously the housekeepers were **very motivated**, **very involved**, f**elt part of it, took ownership for it** and then was driving it forward. **And as a result the implementation process has been really straightforward and smooth"**,* [IPC Nurse Consultant]

Good and clear communication of the rationale (behind technology selection) and the implementation strategy via existing trust forums facilitated staff engagement and support to the initiatives since the scope and the 'roadmap' to change was clear to managers and users in implementing units. This also helped to work out a carefully structured planning:

*"...at the MRSA screening steering group we had representatives from all 34 directorates, and divisions. And that's where we discussed this is what we're going to do, this is the implementation strategy, this is how we'll do it. And that group meets regularly to discuss problems, issues, challenges, etc. And we're linking very closely with our colleagues within community as well. And it's been **engagement via existing forums** as well, we have a monthly senior nurse forum, we have monthly matrons away days. We have fortnightly matrons business meetings, we have bi-monthly time outs with the ward managers for a full day. We have all sorts of **arenas where we can get key messages across to staff"**,* [IPC Nurse Consultant]

Overall barriers and facilitators to implementation as perceived by the respondents in Trust 11 are summarised in Box 60 and Box 61 respectively.

Box 60: Perceived Implementation Barriers

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Perceived Barriers to technologies Implementation

- High ongoing costs hindered the full, trust-wide roll out of the technology [Sage antiseptic washcloths]
- Value of the award [initial decision to go for rapid PCR testing could not be funded]
- Need to buy an additional fridge to store the ATP swabs

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Box 61: Perceived Implementation Enablers

Perceived Enablers / Facilitators to technologies Implementation

- Support by senior management in the trust facilitated implementation by mobilising resources and providing legitimacy to the technology change initiatives
- Involving users at an early stage heightened ownership of the technology. Early involvement of the technology users in the decision making and implementation planning processes helped to obtain users' buy-in and provided feedback to customise the technology to better fit the local context
- Early engagement and regular steering by managers who are responsible for the service areas in which implementation is to take place
- Structured and detailed planning paid attention to potential challenges to implementation and allowed for reflective action whenever necessary
- Good routine working relationship of IPC team with ward staff [technology implementation not being perceived as an ad hoc project but part of an ongoing collaborative relationship]
- A direct open and honest culture which allowed for any issues to be raised, discussed and solved in early stages rather than creating bottlenecks in the later stages of implementation
- The trust developed a well planned implementation roadmap with 'quick wins': the innovative technologies were initially piloted in the areas where success was most likely: i.e. the surgical ward was selected for this purpose because there is a very enthusiastic and highly motivated matron who supported the planned change [ATP / UV lights]
- Bottom up introduction of the innovative technology and "grassroots spread" of the technology among users through 'word of mouth and try and error learning' heightened ownership by users and led to swift and efficient technology roll out [ATP / UV lights]
- Enabling technologies facilitated full technology implementation: i.e. the introduction of the PDG protocol facilitated the trust-wide standardisation of individual patient MRSA packs
- Previous experience with the same or similar technology
- Attention was paid to provide thorough training even for what appeared to be simple interventions [i.e. individual patient MRSA pack]
- Effective and clear communication of the rationale (behind technology selection) and the implementation strategy via existing trust forums facilitated staff engagement and support. Communication efforts streamlined information flow across the trust and led to everyone "speaking the same language"

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15. Case study – Trust 12

15.1 Context

15.1.1 General Context

Trust 12 is a Primary Care Trust located in an inner city area. Being a PCT, Trust 12 brings together services offered by General Practitioners (GP's), Community Nurses, Practice Nurses, other community services and other agencies dealing with health matters across the city in which it operates. The PCT is also responsible for commissioning healthcare services, managing a large range of contractual relationships with healthcare providers, including local hospitals and Community Health, the core of which cost £590m in 2008/09, rising to £630m in 2009/10. It is a large PCT with an annual budget of over £800 million, employing over 3,200 staff. The trust is a designated co-ordinating PCT for 6 major contracts[86]. Trust 12 has one inpatient site with 76 beds. The services it provides include intermediate care, community clinical assessment and rehabilitation.

15.1.2 Trust Performance

The trusts' performance was rated as "Good" for both the quality of its services and financial management by the Care Quality Commission in the latest annual health check in 2008/09.

Table 73: Care Quality Commission assessment

	2006/07	2007/08	2008/09
Quality of commissioning services	N/A	N/A	Good
Quality of financial management	Fair	Good	Good
Providing services (meeting core standards	N/A	N/A	Fully met

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[86] PCT annual report, p22

The results for the most recent (2010) Patient Environment Action Team (PEAT) assessments for the trust's intermediate care unit are outlined in the table below[87]

Table 74: PEAT Inspection Results (2010)

	Environment Score	Food Score	Privacy & Dignity
Intermediate Care Unit	Good	Good	Excellent

15.1.3 Infection Prevention and Control Context

15.1.3.1   Trust performance on HCAI

The CQC on a recently published inspection report (August 2010) found "*no cause for concern regarding the provider's compliance with the regulation on cleanliness and infection control*"[88] following an inspection audit of 14 measures / inspection points.

Table 75 Trust performance on HCAI indicators[89]

	2007/08	2008/09	2009/10
Clostridium difficile	835 cases	730 cases	445 cases

15.1.3.2   Trust infection prevention and control initiatives

Tackling infection in hospitals and in the community is one of the top priorities for the PCT as documented in its annual report[90]. The PCT in collaboration with the two main acute trusts (Trust 11 and Trust 8 in this study) in the area have developed strong collaborative links with a top USA based hospital focusing on improving patient safety and quality of care. To build further improvements in successfully tackling healthcare infections the trust and the respective SHA have commissioned the services of the above USA hospital, which *"has been named as the 'Hospital of the Year' in the USA for 18 years for its unbroken record on patient safety"*[91]*.* The main aim of this collaborative service agreement is to help the three trusts improve infection prevention and control systems.

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[87] Patient Environment Action Team (PEAT) Assessment 2010, National Patient Safety Agency
[88] CQC Inspection Report August 2010, p4
[89] Health Protection Agency website (August 2010)
[90] Annual Report, p24
[91] Annual Report, p24

15.2.1 HCAI Technology Innovation Award: Trust IPC Areas of Priority and Technologies Selected

Who was involved and how?

The £150,000 award sum was split equally amongst three trusts in the SHA region. Hence Trust 12 (as well as Trusts 8 and 11) received £50,000 each in February 2009. To invest the £50,000 of the HCAI Innovation Technology Award the trust *firstly* identified a *HCAI priority issue for the trust* and *a service area* for implementing interventions and *then* selected appropriate technologies to help fight HCAIs. At the time when decisions were being made, Trust 12 had not managed to reduce community C. *difficile* infection rates as dramatically as other PCTs in England. Therefore, tackling C. *difficile* infection was a major issue for the trust at that time. The PCT Lead for Infection Control, the DIPC, and the rest of the PCT Infection Control Team jointly decided to invest the award monies in procuring technologies to be implemented in the Intermediate Care Unit (a nurse led unit providing rehabilitation to patients based on a 'step-down [from hospital] - step-up [from the community] model of care'). The Unit, which primarily cares for elderly people, is very busy and, according to informants, represents a high risk area for C. *difficile* infections. The Unit was also chosen as the selected service area for introducing the selected technologies since it was easier to monitor implementation and conduct evaluation trials in a more controlled setting.

The Lead Infection Control Nurse for Clinical Quality and Health Outcomes, who works in the commissioning section of the PCT, was largely the person driving the technology selection decisions. S*he made the final technology selection decisions* for the trust:

"In terms of the selection, it hasn't been a large group of people, and if I'm honest with you, I have solicited views from people, but the final decision making has been with me", [Lead Infection Control Nurse for Clinical Quality and Health Outcomes]

Ideas for potential technologies were discussed with the nurses of the PCT Infection Control Team (at that time there were four nurses, while currently there are six). The Matron and the Estates Manager from the Intermediate Care Unit (ICU) were also involved in the selection of the *Sterinis* Hydrogen Peroxide Vapour decontamination system.

"I led on it, but it wasn't solely me, I've contradicted myself a little bit, but the Infection Control Team all had a say in what they thought and also they had to give a rationale behind their preferred option. I had some ideas around the cleaning equipment, which obviously, put the biggest dent in the budget... but a lot of the other equipment, the camera, the [UV] light machines and so on, and the handheld [ATP] bioluminator as well, was something I'd suggested and they met that with enthusiasm", [Lead Infection Control Nurse for Clinical Quality and Health Outcomes]

The DIPC was not directly involved in the decision making process, though was kept informed by the IPC Lead. In the later stages of the decision making process the team of housekeepers from ICU were also engaged to better plan implementation.

Initial options considered

Trust 12 initially explored the possibility of near patient testing technologies for MRSA and C. *difficile*. Following a rapid appraisal such an option proved to be *"too expensive"* considering the value of the award. In addition, it was perceived to be "*logistically problematic"* to roll it out effectively across the primary care health economy.

What was finally selected?

The trust made three technology selections, addressing three IPC priority areas (Table 75). The overall theme focused on *cleanliness* and tackling C. *difficile* infection. Three individual technologies (ATP, UV light, digital camera) were selected in the IPC priority area of training – jointly comprising one technology selection category. The selected technologies were used or trialled primarily in the Intermediate Care Unit. All 5 individual technologies have been procured and implemented. The technology selection decision process lasted six to seven months, and decisions were finalised around September 2009. The procurement of the technologies was protracted and was completed only by March 2010, which is five to six months after the final technology selection decisions had been made.

Table 76: Technologies, Priority area and Progress (August 2010)

Technology	IPC Priority Area	Brand /	Procured	Implemented

			Supplier		
1	Hydrogen Peroxide Vapour (HPV) Decontamination System	Environmental Hygiene	Sterinis® *Gloster Sante Europe*	Yes	Yes
2	Virusolve+ RTU Ready to use spray disinfectant Virusolve+ Concentrate Cleaner & Disinfection Solution Virusolve+ Impregnated disinfectant wipes	Environmental Hygiene	Virusolve+® *Cairn Technology*	Yes	Yes
3	Palm held ATP Bioluminescence Hygiene Monitoring System	Environmental Hygiene / Training	SystemSURE Plus™ *Hygiena*	Yes	Yes
	Hand Inspection UV light kits (Hand Inspection Cabinets & Glow and Show cream) training aid units	Hand Hygiene / Training	*DaRo UV Systems*	Yes	Yes
	Digital Camera + memory card	Training	*Sony* DSC-W210	Yes	Yes

15.2.2 Individual technology selection, procurement and implementation

15.2.2.1 *Sterinis®* Hydrogen Peroxide Vapour (HPV) Decontamination System

Decision Making Process

The *idea* for the particular technology came from a neighbouring hospital (Trust 11 in this study), from which the PCT commissions services. There was already in place a Service Level Agreement between the PCT and the local hospital, which involved the use of the *Sterinis* HPV decontamination system in case of outbreaks in ICU. The trust wished to explore the option of investing part of the award monies in procuring the particular piece of technology rather than continue paying the hospital for the service.

The Lead Infection Control Nurse together with the Matron visited the hospital (Trust 11) and attended a demonstration of the technology by the hospital staff. To make the final decision, the Lead Infection Control Nurse consulted with staff from the ICU, namely, the Matron and the Estates Manager. The technology selection process is explained in the following quote:

*"We went to the hospital because they'd actually trialled a lot of equipment. So, instead of us going through that whole process of evaluation again, we went straight to them and asked if they could give us some feedback on Sterinis; they were happy with this technology and they gave us a demonstration; the decision was then taken [by the PCT trust] in terms of the **cost** and **sustainability** really",* [Lead Infection Control Nurse for Clinical Quality and Health Outcomes]

The supplier company had been invited to the trust to present prior to the final selection decision. The informants did not consider the recommendations by the HPA Rapid Review Panel for evidence of effectiveness of the specific technology or the availability of similar technologies (i.e. Bioquell, which had received a RRP 1 recommendation).

The selection of the particular technology aligned with the goals of the PCT Intermediate Care Strategy, which had been launched around the time when decisions were being made by the trust. Among other objectives, the strategy promoted good bed management and prompt cleaning of rooms to reduce the length of stay in the ICU to 21 days. The trust perceived the use of the *Sterinins* HPV decontamination system as contributing to the implementation of the above strategy, also providing the additional assurance of a deep, thorough clean of rooms and equipment in ICU.

Box 62 and Box 63 illustrate the perceived innovativeness and benefit of using the *Sterinis* HPV decontamination system as reported by the informants in the research interviews.

Box 62: Perceived Innovativeness of *Sterinis* HPV Decontamination System

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Perceived Innovativeness

- Ability to decontaminate those areas which are normally inaccessible

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Box 63: Perceived Benefit / Relative Advantage of *Sterinis* HPV Decontamination System

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Perceived Relative Advantage

- Useful for decontaminating equipment and furniture that is difficult to clean manually
- Even very large rooms or wards can be disinfected effectively
- The technology will be readily available to use by the trust without delay (being onsite and owned by the trust instead of paying the hospital for the service)
- Potential to roll it out to community care services, especially care homes

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Procurement Process

The technology was procured direct from the supplier. The money was transferred from the Finance Department of the Commissioning division of the PCT to the Intermediate Care Unit budget. The Buildings Manager of the ICU placed the order, with guidance and support provided by the trust procurement team. The purchase of the unit has taken longer as the PCT procurement team had expected that the IPC team should have gone to tender. The issue was raised because the value of the technology exceeded the £10,000 threshold. Following consultation with the hospital procurement team (Trust 11), which had relevant procurement experience, it was finally decided that a tender was not required.

"There was something that came from procurement to say actually because it'd gone over the £10,000, was supposed to go to tender wasn't it? So we had a conversation with them, just said look this work has already been done by the [local acute trust] and we will be using this in just four wards, they've been using the technology in many wards. So they obviously must have spoken to procurement in the [local acute trust] for evidence, but anyway it was agreed [to buy direct from the supplier], it wasn't a problem", [Head of Nursing for Unplanned Care & Infection Control]

The order was finally placed in March 2010 (almost seven months after the selection decision), being the last of the technologies to have been procured by the trust. The procurement was perceived as *protracted* by the respondents. The delay was attributed by the respondents to internal organisational misalignments rather than to issues with the supplier. As with the rest of the selected technologies, the respondents emphasised the frustrating difficulties they faced to transfer the money from the Commissioning to the Provider arm of the PCT. This delay had a negative impact on the duration of the whole procurement process.

Implementation Process

The *Sterinis* HPV decontamination system has been implemented in Trust 12 since March 2010. The technology has been used within the 72-bedded Intermediate Care Unit and the Critical Care Assessment Unit. Training was provided by the supplier to the team of housekeepers in the Intermediate Care Unit. The trust was familiar with the technology since it had been occasionally used in the past under the Service Level Agreement with Trust 11.

The use of the technology aims to contribute to improve the cleaning of patient care items, such as commodes, customised toilet seats and physiotherapy equipment that challenged cleaning plans already in place by the trust. The technology is planned to be used to terminally clean rooms where patients infected with C *difficile*, MRSA, and Norovirus had been managed. In addition it will be used to deep clean the Units every six months and following an outbreak. Implementation has been smooth and both the IPC team and the housekeeping team have reported a positive experience from the in-practice use of the technology.

15.2.2.2 *Virusolve+* Disinfectants and Cleaning Solutions

Decision Making Process

The *idea* for the *Virusolve+* came from the Lead Infection Control Nurse who was targeted with marketing material by the supplier via email. Unlike the *Sterinis* HPV, which the trust had already considered even prior to the time of the award, the idea for the *Virusolve+* emerged once the trust was given the award. There was an identified need before the monies came through. As mentioned, C. *difficile* infection control and environmental hygiene were perceived as high priority areas for action by Trust 12. The IPC team were keen to identify an effective non-chlorine based agent for cleaning and disinfection, but were not aware of any similar products to fit with their needs until the marketing material for the *Virusolve+* arrived.

Further information about the technology was obtained through the supplier's web site and the IPC team was particularly attracted to the technology due to its application in patients' homes by Torbay PCT. Members of the IPC team phoned Torbay PCT to collect additional information and evidence of effectiveness. The company presented to the IPC team and to staff from the Intermediate Care Unit, namely, Estates and Facilities personnel.

The perceived innovativeness and anticipated benefits of the technology are set out in Box 64 and Box 65 respectively.

Box 64: Perceived Innovativeness of *Virusolve+* Disinfectants & Cleaning Solutions

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Perceived Innovativeness

- Non-chlorine based cleansing and disinfection agent which is at least equally effective as chlorine
- Combines cleansing and disinfection properties in one product
- Once made up it lasts for long periods of time – it expires after two years

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Box 65: Perceived Benefit / Relative Advantage of *Virusolve+* Disinfectants & Cleaning Solutions

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Perceived Relative Advantage

- More cost-effective for the trust using one product for cleansing and disinfection (instead of seven different products); the spray form appears to be particularly cost-effective
- Standardisation of cleaning and disinfection practices via the use of one product (instead of seven different products)
- The Virusol+ spray was relatively cheap
- Far more 'gentle product' compared to chlorine, while being as effective in bactericidal and virucidal action as chlorine
- Very versatile and compatible with a variety of materials and surfaces, such as floors, walls, mattresses, chair coverings, plastics, metal (non-corrosive)
- Easy to apply and available in different forms (solution, spray, impregnated wipes)
- Pleasant odour (unlike chlorine-based agents) – there is also the option of an odourless variant
- The technology can support the IPC team in both planned and emergency cleaning
- It is compatible with any type of spillage and body fluids (vomit, urine etc)
- Increased compliance and the frequency of cleaning because it is easy to use (spray and wipes)

Box 66 illustrates the perceived weakness of the technology as reported by respondents during the research interviews. This information reflects the experience of the trust with the technology following its application during the implementation trial.

"The only downside was the not very positive feedback from the housekeepers for the floor cleaner solution [Virusolve+ concentrate]; they very much favoured the spray, they thought that was fantastic, but the floor cleaner, they felt that they couldn't get some of the marks off the floor, even with buffing and applying the proper cleaning techniques, but there was a variation between wards", [IPC Nurse]

Box 66: Perceived Weaknesses of *Virusolve+* Disinfectants & Cleaning Solutions

Perceived Weaknesses

- Harder to get the scuff marks off the floor using the floor cleansing/disinfection solution *[Virusolve+ Concentrate]*
- The floor cleansing/disinfection solution was relatively expensive *[Virusolve+ Concentrate]*

Procurement Process

The trust procurement team were involved once the bid was approved by the IPC team. No other providers were approached for the particular or other similar types of technology. The purchase was direct from the supplier. An initial batch of products was purchased for conducting an evaluation trial initially in the Intermediate Care Unit and later in the community care setting.

The process of procuring the product from the supplier was described by the respondents as *straightforward.* However, the respondents perceived the overall procurement process as *protracted,* due to internal organisational issues of suboptimal communication between the Commissioning and Provider arms of the PCT (being in line with the experience reported for the rest of the technologies procured by the trust).

Implementation Process

Trust 12 had initially planned to conduct an evaluation trial of the technology in two different settings. Firstly, the trust intended to mimic the work done by Torbay PCT by trialling the use of *Virusolve+* spray in the homes of patients with recurrent C *difficile* infection. The patient would receive advice on the use of the spray to be used in high-risk areas e.g. bathrooms or equipment such as commodes. Secondly, the trust had planned to trial the other forms of the *Virusolve+* (liquid and wipes) in the Intermediate Care Unit. This initial implementation plan is detailed by the Lead Infection Control Nurse:

"There are two strands [on the implementation trial of the technology]: one is about the patients in their own home, say if their house isn't too clean, or the bathroom and they're re-infecting themselves through contact with contaminated articles. We need to explore some work with our lawyers as well, to see how far we can go. Well, it is people's homes and obviously we require their consent...The other strand is in our Intermediate Care, trialling the product with a view to future procurement in the inpatient unit. We've met with the representative from Cairn Technology ourselves and there is a planned meeting and a demonstration to come and talk to the housekeeping staff, the Facilities Manager, the Matrons, the Infection Control Team and the staff, and then ultimately it'll involve the patients, about patient experience around the use of some of these approaches", [Lead Infection Control Nurse for Clinical Quality and Health Outcomes]

The implementation trial of *Virusolve+* in the community has been delayed. The main impediment to implementation was the difficulty in trialling out the technology in such a diverse and diffused setting as is the community care sector, with multiple and different types of stakeholders involved in the process. In addition, technical issues put further impediments such as the need to seek legal advice on carrying out the trial in patients' homes and the lack of a surveillance nurse to identify cohorts of patients who repeatedly get infected with C. *difficile.* Although there has been considerable delay in appointing the surveillance nurse (it took over six months) the nurse was finally appointed in May 2010, and has received training by the IPC team. The implementation of *Virusolve+* in the community is planned to start in late autumn 2010. Upon positive results the technology is planned to be rolled out across all care homes in City where Trust 12 commissions services.

The implementation trial of *Virusolve+* in ICU started soon after the technology was procured. The rationale for choosing the ICU (as the setting for the trial) is set out in the quote below:

*"We just used it [Virusolve+] for trial in ICU in the four wards because it's a **closed unit**, **so we could monitor it** and, apart from prison health, it's the only inpatient unit that we have",* [Lead Infection Control Nurse for Clinical Quality and Health Outcomes]

In preparation for the evaluation trial a task group was formed in ICU involving: (a) the housekeeping managers, (b) the building manager, and (c) the matron. The task group coordinated the disposal of all cleaning and disinfection products that were in use in ICU at the time to prevent parallel use of the pre-existing cleansing and disinfection products, which would have skewed the results of the trial.

The implementation evaluation trial in ICU started in March 2010 and ended in July 2010. Audits of effectiveness of the technology have been completed in the four wards of the ICU where *Virusolve+* had been used. The ATP Hygiene Monitoring System (also introduced using the award monies) has been used to evaluate the effectiveness of cleaning of *Virusolve+* and will compare results with the pre-existing cleansing and disinfection agents used by the trust. Since no baseline data had been used, the trust planned to revert to the pre-existing products for one month, during August 2010 to enable the comparison. This, together with feedback from staff and patients regarding the 'aesthetics' of using the alternative technologies will determine the final technology evaluation outcome.

Upon completion of the trial in ICU and pending on a positive evaluation outcome, *Virusolve+* is to be implemented together with the *Sterinis* HPV decontamination system in the routine cleaning and decontamination of the ICU.

15.2.2.*3 Hygiena SystemSURE Plus™* ATP Hygiene Monitoring System – *DaRo UV Systems* Hand Inspection UV light kit

Decision Making Process

Trust 12 **had already been using UV light hand inspection units** and "glow and show" cream as training aid tools to promote good hand hygiene practices. There was only one unit to be shared among the four nurses of the IPC team. Following a recent expansion of the IPC team to six nurses and building on the positive experience with this type of technology, five more units were decided to be procured with the monies of the award. Members of the IPC team attended a conference on prevention of HCAIs in London organised by the DH (the respondents could not recall exactly which one); this is where the **idea** for the *DaRo UV Systems* UV light kit (being a different brand from the pre-existing UV light unit available in the trust) came from.

"We had an old fashioned [UV light unit]; it was like a big box thing that you'd carry round and with all the materials and it was like a suitcase. But we went down to an event in London, a gov.uk around healthcare associated infection prevention, and there was a lot of reps there and they had these tiny ones that fold away in a little light carry case. So we got a lot of information, myself and the Infection Control Manager and came back and looked at that and other stuff and decided on that", [Lead Infection Control Nurse for Clinical Quality and Health Outcomes]

The **idea** for the ATP came from the use of the technology by a neighbouring acute trust (not Trust 11) which is co-located with trust's ICU.

"What prompted us to explore this [ATP Hygiene Monitoring System] was its use in one of our local Trusts, they'd taken it in on a trial basis", [Head of Nursing for Unplanned Care & Infection Control]

The rationale for selecting the *Hygiena SystemSURE™*ATP Hygiene Monitoring System is

explained by the Lead Infection Control Nurse in the following excerpt:

*"And what prompted the acute trust to pursue it [ATP], and ourselves, was that it's an **excellent tool to use for as an aide memoire, and also a quality control check**, that if you think you've cleaned a room that's contaminated with C diff, you've got this as evidence really. And the housekeepers loved it! So it all goes hand in hand, so they can use this say in Intermediate Care, in a care home when they go in to do audits and things, so that was the idea behind this technology",* [Lead Infection Control Nurse for Clinical Quality and Health Outcomes]

The decision to select both technologies was confined within the IPC team and was led by the Lead Infection Control Nurse. The decision making process was informal since no project team had been formed and a business case had not been presented to the trust board.

The perceived innovativeness of the two individual technologies are summarised in Box 67. *Hygiena SystemSURE™* ATP Hygiene Monitoring System was perceived as being innovative for the trust while *UV Systems DaRo* UV light kit was a technology the trust was already familiar with (though comprising an improved version of the pre-existing technology).

Box 67 Perceived Innovativeness of UV light kit and ATP Hygiene Monitoring System

UV Systems DaRo UV light kit	Hygiena SystemSURE™ ATP Hygiene Monitoring System
• UV light technology can reveal contamination that is invisible to the naked eye • The technology was not perceived as particularly innovative by the IPC team since the trust had already been using a similar product (same type of technology)	• It provides a rapid numeric piece of information that can be compared and communicated easily to various stakeholders

Box 68 sets out the perceived relative advantage or benefit for both technologies. It was repeatedly stressed by various informants the fact that the IPC team was able to procure enough UV light hand inspection units to go around and be used by all members of the team, as well as the ease of use of the particular technology due to its technical features (lightweight,

smaller size, folding) when compared to the UV light unit the trust already had in use.

"We only had one light box and with essentially all of these services to cover and the training and so on, and so that's why this was put down to support training around hand hygiene, not just for healthcare workers but support staff, allied health professionals, but also the public; and they have been great because it's not one waiting around for a piece of equipment, they can all go off and five of them can do training at the same time if necessary. And they're very lightweight, so they're very portable, easy to use", [Lead Infection Control Nurse for Clinical Quality and Health Outcomes]

No perceived weakness of the two technologies was mentioned by the respondents in the research interviews. The **only concern** raised was regards the ATP Hygiene Monitoring System as per the following quote:

"the microbiologists [in the acute trust] weren't too keen [about the ATP Hygiene Monitoring System], they didn't think it was a very scientific way of monitoring cleanliness, which maybe it isn't, it's a swab that illuminates and gives a broad indication of cleanliness", [Lead Infection Control Nurse for Clinical Quality and Health Outcomes]

Box 68 Perceived Benefit / Relative Advantage of UV light kit and ATP Hygiene Monitoring System

UV Systems DaRo UV light kit	Hygiena SystemSURE™ ATP Hygiene Monitoring System
- UV light technology can reveal contamination that is invisible to the naked eye - Powerful training aid tool for educating healthcare workers, support staff, allied health professionals and the public in improving cleaning practices and hand hygiene compliance; enables better quality control in cleaning - Very portable: smaller in size than the pre-existing UV light unit, lightweight and easy to use, can be folded and carried around in a small case	- Reasonably simple for staff to use and understand - The technology can reveal contamination that is invisible to the naked eye and in addition offers a **numerical value** to assess effectiveness of cleanliness instead of relying solely on visual inspection - Introduces a sense of *"healthy competition among wards"* [IPC Nurse] - Makes cleaning more interesting and helps involving staff and patients; "housekeepers love it" *"Provides speedy feedback on cleaning practices and allows for immediate*

	remedial action to be taken" [Nurse ICU] • Provides assurance to staff, patients and the public around cleanliness • Enables the rapid evaluation of cleaning & disinfection products providing a broad indication of effectiveness

Regards evidence for '*awareness knowledge'* for: (a) the UV light technology, the previous experience the trust had with a similar type of technology informed trust's final selection decision, while the IPC team got information about a more user-friendly product of the same in principle technology from a DH conference; (b) the ATP Hygiene Monitoring System, Trust 12 became aware of it from a neighbouring acute trust which had been trialling out the particular technology. For *'principle / theory knowledge'* for both technologies the trust primarily relied on evidence provided by the suppliers, and own experience (UV lights) or the experience of other NHS organisations that had used the technology (ATP). For *'how to knowledge'*, the trust consulted other NHS organisations (ATP), built on their previous experience with a similar technology (UV light), and trialled the technologies (both).

Procurement Process

The trust procurement team were involved once the bid was approved by the IPC team. No other providers were approached for the particular or other similar types of technology. The purchase was direct from the supplier.

"For the UV light machines, we got the details down in this event in London and again as with the ATP the same principles were around getting a code for each through procurement and then being able to order it", [Head of Nursing for Unplanned Care & Infection Control]

As with the previous technology selections the process of procurement for the two individual technologies from the supplier was described by the respondents as *straightforward*. However, the respondents perceived the overall procurement process as *protracted,* due to the internal organisational issues of suboptimal communication between the Commissioning and Provider arms of the PCT.

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Implementation Process

For the implementation of the ATP Hygiene Monitoring System a sampling strategy was drawn up by the IPC team in collaboration with members of the ward staff in ICU. The nurses in the IPC team are using the particular technology (not the facilities managers or the housekeepers) before and after cleaning and it has been reported by the Infection Control Team that the use of the technology has helped in gaining compliance with housekeeping staff. It was unanimously reported by the informants that the technology motivated the housekeepers and was positively perceived by ICP team members, housekeepers, patients and visitors. The technology has been used by the IPC team in ICU to evaluate the effectiveness of *Virusolve+* cleansing and disinfection products currently being under trial using money from the award.

"The Infection Control Team use the ATP swabs; the housekeeping staff don't use them. We do some pre cleaning swabs, and it's like a demonstration really, and then after the housekeeping has taken place we'll show them the results before and after. It has resulted in getting a bit of a healthy competition going on between wards because there are four wards on the unit, and so if they're getting higher numbers on the swab or whatever, it's making them comply a bit, work a bit harder...no it is a simple to use technology and the implementation in ICU has been smooth without any issue really", [IPC Nurse]

The UV light inspection system has been used to support hand hygiene training in the prevention of C *difficile and HCAIs* more generally. The technology has been used to raise awareness of hand hygiene among staff and the public in ICU, while the infection control team has been supporting partner agencies in community care settings to use it in gaining patient and public engagement and participation. No issue about the implementation of the technology has been raised since the trust had already been using the same type of technology prior to the procurement of the new UV light systems.

The challenges of implementing the particular technologies and others in community care due to the diffuse nature of the latter are highlighted in the following quote:

"When you're in a building site that's shared with charity organisations or local authority agencies and all sorts of things it is very challenging to implement initiatives; it becomes very,

very muddy sometimes outside, primary care; it's a real challenge trying to do infection prevention and control outside ward-based settings where you've got obviously your four walls", [Head of Nursing for Unplanned Care & Infection Control]

DIGITAL CAMERA

- Not really innovative technology – continuation of a pre-existing approach
- Saving time for staff by using it as a training aid tool – especially as nurses prefer visual aids to written material
- Captures data and patient information in real time at the bed side
- Provides the opportunity for IPC team members to present and educate staff "on the spot" in a clinical setting

Procurement Process

Though being the cheapest item purchased by the trust the procurement of the camera was the most complicated to complete because the product was not available on the Oracle internal procurement system.

Implementation Process

The camera will be used, by the infection control team, to photograph images of e.g. contaminated equipment, unclean premises, fixtures and fittings (anonymised) for use in infection control training. This approach is being used already by the IPC team with a positive impact on the training of health and social care staff and carers across the city – but the team had been using their own equipment.

15.2.3 Trust Evaluation of the Technologies

Three of the five individual technologies selected by the trust had already been in use prior to the award (UV light inspection system, *Sterinis*, digital camera). No evaluation of the above technologies was deemed necessary by the IPC team.

Regards the remaining two individual technologies evaluation trials have been conducted by the trust.

For the **Hygiena SystemSURE™ ATP Hygiene Monitoring System** the evaluation of the technology focused on the ease of use and its practical application as an aid tool for promoting effective cleanliness. The evaluation process was initially informal and involved sharing experience among the IPC team members. Very positive feedback was obtained from the infection control nurses who are using the technology. There are plans to involve the Audit Department to conduct a more systematic evaluation and summarise the trust experience with the particular technology in a report.

For **Virusolve+** the evaluation of the technology during the implementation trial in ICU involved: (a) the use of the ATP Hygiene Monitoring System to compare its effectiveness in relation to pre-existing cleansing and disinfection products (as detailed in the implementation section above). The trust planned to re-introduce the pre-existing cleansing and disinfection products for a month (during August 2010) to enable the comparison. This is done in retrospect because the ATP technology was not available when the evaluation trial for *Virusolve+* had started; (b) questionnaires have been handed out to patients and the staff who are using it, including the housekeepers, to obtain feedback; (c) the associated cost for the use of each form of the technology (solution, spray, wipes) has been estimated during the four months evaluation trial; (d) the impact from using *Virusolve+* on C. *difficile* infection rates during the trial period has also been monitored (this is purely used as a broad complementary indicator since the impact on C. *difficile* infection rates is hard to be attributed to just one particular intervention). This is to be compared to C. *difficile* infection rates recorded during the period when the pre-existing products would be re-introduced.

The comparative evaluation between *Virusolve+* and the use of the pre-existing products had not been completed at the time when this report was drafted. The preliminary outcome appears to be positive for the continuation of the particular technology. The positive feedback and experience on *Virusolve+* *spray* is noted:

"Much better and stronger, positive report was about the handheld spray; it actually increased compliance because it was sitting on isolation carts outside of rooms, inside of rooms, it's very cheap as well, it's about 18p a bottle to make up, it's very cost effective, and it actually increased the frequency of cleaning items in the room and worked well as an aide memoire for cleaning. Now we're going to stop using this [Virusolve+] and go back to what we did before the trial and we're going to monitor if there's any adverse effects. For example, we haven't seen any C diff on the unit for months now. I suppose the only thing for me I would say we also introduced the four hourly isolation for the C diff as well, so my gut feeling is it might be a mixture of the two", [Head of Nursing for Unplanned Care & Infection Control]

15.2.4   Discussion

15.2.4.1   The decision making process

The process of decision making for technology selections was exclusive to the IPC team. And although collective, involving consultation among the IPC team members, the decisions were dominated by the Lead for Infection Control Nurse who made the initial selection choices and took the final selection decisions. In addition, the nursing profession dominated the decision making process with minimal involvement of other professional / occupational groups.

Further, the decision making processes were informal since no project team was formed nor was formal approval by the Trust Board sought. Infection prevention and control priority areas for improvement had been identified first and the selection of relevant technologies followed. The technology selection was a combination of predetermined and emergent decisions. Three out of the five individual technologies adopted had been selected before the award, whereby the trust awaited a funding opportunity (*DaRo* UV light system, *Sterinis* HPV, *Sony* camera). There were two emergent technology selection decisions (*Virusolve+, SystemSURE Plus ATP*) which were considered after initiation of the project.

When compared to other trusts in the sample, Trust 12 took a highly inclusive approach to decision making and the technologies selected were more predetermined than emergent.

15.2.4.2 Evidence

Various types of evidence supporting each of the selected technologies were used by the decision makers; such were scientific evidence of efficacy and associated costs of using the technologies. The sources of such evidence also varied as illustrated in the following excerpt:

*"I went in onto the **website** and I got the girl who works for me, to **contact the companies** to collect the **scientific evidence** for each technology, if I couldn't find that already on the website, but that's usually very easy to locate. But other things like **costs**, aren't always readily available, which influence procurement decisions. Such additional evidence often are not there, because it might deter people taking the process further, so I asked her to go with the list of products and to look at things like, expiry dates and costs for consumables, did it include VAT or not, all this kind of thing"*, [Lead Infection Control Nurse for Clinical Quality and Health Outcomes]

Expert opinion was sought to verify the scientific evidence behind the technologies. In addition, evidence related to the technology in use were taken into account as shown in the quote:

*"When I first started to look into the ATP, I **talked to two microbiologists** locally and they were very negative, saying no, don't waste your time with this [ATP], but sometimes you have to come out of the box and think a bit more what are some of the **benefits or evidence of this technology in a more practical sense**, again **talking to somebody who's actually put it into use** and they explained about the co-opting of the housekeepers and their higher engagement in the cleaning process..."*, [Lead Infection Control Nurse for Clinical Quality and Health Outcomes]

The types and sources of evidence for all technology selections made by the trust are summarised in Table 77.

Table 77: Type and sources of knowledge used in decision making

Awareness knowledge[92]	Principles / theory knowledge[93]	How to knowledge[94]

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[92] to find out what is available in terms of the range of technologies specific to IPC
[93] why and how a technology works in terms of the underlying scientific principles or theory
[94] how to put the technology in to use, including all aspects of implementation

Other NHS Trusts [ATP, HPV]

Previous experience of the trust using the same or similar product [UV light, HPV, camera]

DH HCAI conference [DaRo UV light]

Supplier marketing material [Virusolve+] | Other NHS Trusts [ATP, HPV]

Peer review journals

Supplier

Health Professional experts [Microbiologists in neighbouring trusts] | Supplier

Other NHS Trusts

Previous experience of the trust using the same or similar technologies

Evaluation Trial [Virusolve+, ATP] |

(Adapted from Rogers, 2003; Glasby & Beresford, 2006

15.2.4.3   Procurement

The trust procurement team were involved once the final technology selection decisions were made by the IPC team. The purchase of all selected technologies was direct from the suppliers. The process of procuring the products from the suppliers was described by the respondents as *straightforward.* However, the respondents perceived the overall procurement process as *protracted,* due to inherent organisational issues of suboptimal coordination of action between the Commissioning and Provider arms of the PCT.

15.2.4.4 Context

The large size and the organisational complexity of the PCT (a multisite trust with a 76-bedded inpatient intermediate care unit, comprising commissioning and provider arms, and managing services at the interface between social and healthcare sectors) was not a consideration at the technology selection stage, but did have an impact on the implementation process. A phased approach to implementation was required. Implementation of the technologies in the community care settings required a well managed and staggered implementation plan which involved the engagement of a wide variety of diverse stakeholders and the investment of additional resources by the IPC team (i.e. a surveillance nurse, a district nurse). In contrast, the

implementation in the more "controlled" ICU setting started earlier and will inform implementation in the community care setting which will follow.

"...it's not just like the hospital building where all employees are hospital employees, they're not independent contractors like the GPs; there's a whole variety of things here. And a lot of our work as commissioners is with the local authority since PCTs are joined with the local authority. So, say around the care home agenda, anything we do has to involve very carefully the local authority contracts and compliance teams", [Lead Infection Control Nurse for Clinical Quality and Health Outcomes]

The trust has developed strong collaborative links on IPC and patient safety with the two main acute hospitals in the city and a reputable hospital in the USA. In addition, the trust has liaised with the National Patient Safety Agency on developing cleaning standards for primary care. The trust's embeddedness in such networks inspired the trust to procure innovative technology ideas and roll them out across the social and health care interface.

"The team and myself have been working with the National Patient Safety Agency around developing cleaning standards for primary care, whereas it was just in the hospitals before. So we're going to start to think about rolling out ATP in care homes, dental practices and so on", [Lead Infection Control Nurse for Clinical Quality and Health Outcomes]

Further, the winter pressures and the effect of the newly introduced Intermediate Care Strategy compounded by the flu outbreak increased the implementation challenges in ICU and delayed implementation until the spring 2010.

Culturally, the respondents prided themselves on being part of an innovative organisation and the HCAI Technology Innovation Award reinforced this perception. This legacy led the trust to consider ways of involving a variety of settings across primary care and social care to implement the selected technologies.

"We have been quite innovative in terms of our approach in the community as well; we were the first PCT in the country to appoint a commissioning infection control person. And also, our expansion of the teams, so it wasn't just covering the NHS provider, the PCT services, we created an expanded team to cover all of the services, GPs, and we have a dental nurse

covering the city, all of the care homes, pharmacies, optometrists, everything, and a matron whose responsibility is around the cleanliness and hygiene across the city", [Head of Nursing for Unplanned Care & Infection Control]

15.2.4.5   Implementation

Box 69 and Box 70 summarise the perceived barriers and enablers to the implementation of the selected technologies by Trust 12.

Box 69: Perceived Implementation Barriers

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Perceived Barriers to technologies Implementation

- Legal barriers to implement interventions at patients' homes, even when involving as simple technologies as distributing a cleansing and disinfectant agent
- Social barrier to implementing a technology: hard to tell patients (end users of the technology) their routine house cleaning is not good enough and persuade them to use an alternative cleaning and disinfection agent. Such barriers undermine patients' compliance in using the new product
- Loose / diffuse boundaries of community and social care, involving many and diverse stakeholders which makes coordination during implementation very challenging: need to cross multiple boundaries such as achieving coordination among independent contractors, linking in coordinated action with other sectors such as local authorities

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Box 70: Perceived Implementation Enablers

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Perceived Enablers / Facilitators to technologies Implementation

- Support by the organisation (trust); infection control being high on the agenda and building on previous interventions in the field
- Well resourced IPC team which enables the rolling out of the technologies by IPC team members and relies less on engaging other actors outside the IPC core team
- Support by senior management in the trust facilitated implementation by mobilising staff in the implementing units and providing increased legitimacy to implementation initiatives

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- Early engagement and regular steering of the process by managers who are responsible for the service areas in which implementation is to take place (i.e. buildings managers in ICU)
- Engaging users of the technologies in the planning of implementation (i.e. housekeepers and facilities managers in ICU for *Virusolve+*)
- Technologies selected were initially trialled to tailor them to the local setting. Learning through trial and error
- Phased approach to implementation: starting the implementation from the most "controlled" setting (ICU) and gradually rolling it out to the most "diffused" (PCTs, community and social care)
- Enhanced user friendliness of the technology increased its utilisation by the users (i.e. DaRo UV lights being more portable and easy to use compared to the pre-existing UV light technology)
- Embeddedness of the trust in various networks informed not only the technology selection decisions but also implementation (through sharing of experiences). Such networks were identified at various levels, being local (collaborative work with acute NHS Trusts), national (NPSA) and international (commissioned services on patient safety from a leading USA hospital).

Next steps involve the rolling out of the selected technologies outside ICU to cover all aspects of the PCT's health economy. The trust appear to be very positive in the continuation of using *Virusolve+* spray and the wipes, as well as the *Sterinis* HPV decontamination system.

"Probably on balance we will go back to using the spray [at the end of the evaluation trial], people really like that to use for managing spillages, but they felt, I think they'll feel happier using something else for environmental cleaning maybe, and with the Sterinis that will continue of course", [Lead Infection Control Nurse for Clinical Quality and Health Outcomes]

16. CROSS CASE ANALYSIS

16.1 Technologies Selection Overview

Thirty eight technology selections were made across the trusts with 34 different technologies. The majority of trusts made 3 or more technology selections. Trust 2 made the maximum technology choices with 6 technologies. Two of the trusts dedicated the complete award to one technology.

Looking at the range of IPC areas which the technologies sought to address, environmental hygiene was the most targeted area.

Only one technology aimed to specifically address catheter care. The IPC priority areas used to group the technologies have been constructed from various sources[95] [96] and our own conceptualisation. By grouping the technology selections we provide a broad mapping of areas of investment. Some technologies do not fit neatly into one category; hence the tally is indicative of IPC targeted areas. For example the Biopatch Chlorhexidine dressing in Trust 4 may be grouped under catheter care (in this case renal catheters) and patient hygiene. The individual technologies were presented earlier in Chapter 3 (Table 2).

In addition the technology selection needs to be taken in context with recent IPC interventions in each trust (see individual case studies Chapters 4-15).

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[95] Weston, D., (2008), Infection Prevention and Control: Theory and Practice for Healthcare Professionals, Wiley-Blackwell

[96] Pratt, R.J., Pellowe, C.M., Wilson, J.A., Loveday, H.P., Harper, P.J., Jones, S.R.L.J., McDougall C., Wilcox, M.H., (2007) epic2: National Evidence-Based Guidelines for Preventing Healthcare-Associated Infections in NHS Hospitals in England, Journal of Hospital Infection (2007) 65S, S1–S64

Figure 5 Selected technologies by IPC priority area
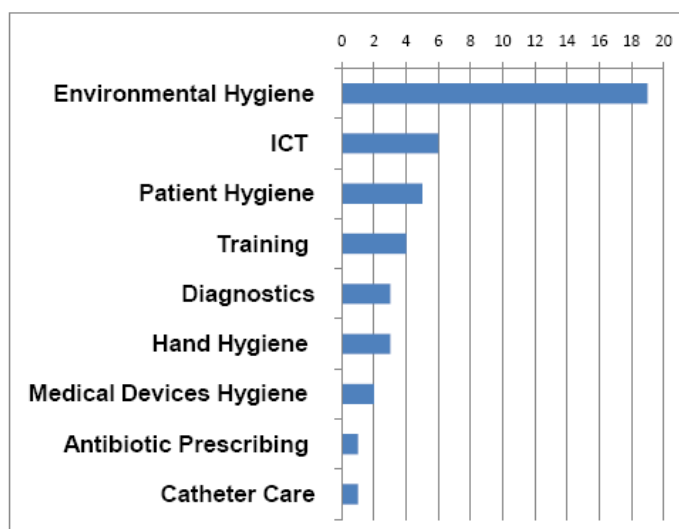
16.2 Comparative Decision Making Processes

The process of technology selection was examined along a number of dimensions.

First we looked at who was involved in the decision making process and the role played by these stakeholders. We looked at how formal the decision making process was, for example was a project team constructed? Were meeting notes taken? We then looked at when the technology was considered, for example had this been considered and investigated prior to the award monies? Finally we explored the use of 'evidence' in decision making and we discuss this theme in section 16.5.

We found that the decision making process overall was dominated by the IPC team in the majority of trusts. This was attributable in part to the scope of the award and the responsibility of the IPC team to lead on interventions to combat HCAIs. Whilst six of the trusts included other departments in idea generation for technologies, final decisions were overall exclusive to the

IPC team in the majority of trusts. There was one outlier to this approach, Trust 2, whereby the decision making process was highly inclusive of the whole trust. This trust adopted a formal consultation process inviting bids from trust staff. Final decision making in the outlier trust was led by the Assistant Director of Quality and the Medical Director. The approach to decision making shaped the selections, with more inclusive approaches consistent with a wider, generalist conceptualization of IPC. For example an inclusive approach taken by Trust 4 in later iterations of idea generation resulted in the Biopatch technology for patient hygiene and renal catheter care suggested by the Renal Unit. In Trust 2, synergies between the endoscopy unit and IPC were identified and customized endoscopy sinks were procured. Trust 7 adopted a suggestion from clinical engineering in the use of single-use patient packs (including BP cuffs and oximeters).

In order to understand better the interplay between approach and resultant technologies, we looked at when in the timeline the selected technologies had been first considered. That is, before the announcement of the award or after the announcement of the award. Some trusts had already identified through IPC strategic plans, technologies which they wished to procure, or IPC priority areas to invest in. In some of these cases funding had been a barrier to technology procurement and the award provided a timely opportunity to progress with plans. Trust 1, Trust 3, and Trust 10 are examples of this scenario. Trust 1 and Trust 3 selected one technology each, while Trust 10 selected four. In all three cases the decision can be described as *'predetermined'* to the award and also *'exclusive'* to the IPC team.

These three trusts were clear in their rationale for the approach and selected technology; Trust 3 for example had previously procured all 6 RRP 1 technologies, and had identified surveillance as the next high priority area:

"I'm very clear that we must have in this Trust, a robust surveillance system, because I absolutely fundamentally believe that a robust surveillance system will allow the Trust to direct its money most effectively on interventions that will support directly patient care and so for me, there was absolutely no question what we would spend this money on" [Trust 3].

Similar was the case for Trust 10, which had already adopted and implemented most of RRP 1 technologies available, and had identified environmental cleanliness as the next high priority area to invest in and evaluate a number of technologies:

"We didn't have a lot of other options to be honest, I'm very, very sceptical about a lot of the new technologies, I think many of them are not proven, don't have the evidence base, and the ones that did have the evidence base we thought we'd already introduced ourselves, so we've got rapid screening for MRSA, we've got PCR testing for C.diff, we've got the hydrogen peroxide machines, we'd already bought the OTEX system for our laundry, everything we liked we already had so there weren't a lot, there wasn't a big short list of things that would use up the whole award, it was more saying there's some smaller things that are out there now that we'd like to evaluate, so it was balancing those two things a chance to evaluate things, and a long standing desire to look more carefully at the environment" [Trust 10].

A minority of trusts used funds for a combination of technologies – some predetermined and others considered after the award; described here as *'emergent'*. Trust 2 which adopted a highly inclusive approach of trust departments, resulted in one predetermined technology with the remaining five emerging through iterations of the consultation process.

Another factor which influenced the decision making across some of the trusts was interpretation of the purpose of the award monies. Although all trusts were provided with the same information, some trusts (Trusts 4, 5, 10) had understood the award specifically for the 'trialing' and 'evaluation' of new technologies. These trusts considered therefore, in the decision making the 'trialability' of the technologies with short-term results to inform future roll out. One trust, felt that they would have taken a different approach had the aim been clearer:

Across the cases, but particularly in the teaching trusts, the 'ability to evaluate' the technology impacted on technology selection. Three teaching / university affiliated trusts had interpreted the purpose of the award to be specifically for evaluating technologies. The potential for evaluation may be considered as an attribute of the technology or of the adopting context. Difficulty to evaluate was a barrier to adoption in some cases.

Of the 12 trusts, 4 started the process in an informal manner and later adopted a more formal approach with creation of a project team, scheduling regular meetings, keeping minutes and developing business cases. The most formal processes included approval by the Executive Board, whilst in the majority of cases the Board was 'kept informed' of purchasing decisions.

To inform decisions, different suppliers for the same technology type were invited in 3 trusts to present products and demonstrate. Visits to Showcase Hospitals events as well as liaising with other trusts with technologies in use also informed decision making.

Upon direct questioning we found that the decision making was characterized by 'demand pull' whereby a priority area or need is identified and technologies sought. In the minority cases selections were characterized by technology push as in the following case.

R: *We chose our technologies first...*
I: *So you started with a technology rather than with an [IPC] area?*
R: *Yes. And I think then we thought, where is the best area to apply this, and in choosing the areas we looked at which areas perhaps have got high infection rates for instance.* [Trust 4]

Informing patients and the public about adopting innovative technologies was deemed a useful tool for raising the profile of trusts and facilitating patient involvement, but was lacking in the majority of cases. Only one technology selection in one of the trusts employed patient consultation in the decision making process. No other trusts reported engagement with patient groups during the decision making process. Many of the trusts communicated the award to the public through the website or the trusts newsletter or through patient representatives. For example, Trust 7 did not invest in patient communication activities and in retrospect realised that patients 'took the new technologies for granted' and did not appreciate the extra effort and resources invested by the trust. In contrast, Trust 11 invested significantly in patient communication when introducing the individual patient MRSA decolonisation packs. This resulted in high patient involvement, with better informed patients, and as reported by staff, less patients blaming the hospital for catching MRSA.

"You wouldn't ever say that that was consulting with them on what we were going to buy. It's just, you know, again these technologies are often at the forefront of practice, therefore, what likelihood is there of the patients being able to recommend or not recommend or contribute" [Trust 5]

Regards final decision making and professional groups we found that doctors (particularly medical microbiologists) and Infection Control Nurses made final decisions. We found no evidence in our cases of general managers or other professional groups being final decision makers.

16.3 Comparative Procurement Processes

There was much variation in experiences of procurement across the trusts and for individual technologies within. Whilst some IPC teams described the process as protracted and difficult, others found the process to be smooth and efficient.

Two factors influenced this experience. First the point at which procurement had been involved. In three trusts procurement teams were involved early on, through their usual attendance at IPC meetings. Others made a concerted effort for this project. Where procurement teams were not engaged earlier, this was cited as a learning point from the project.

"*They* [procurement] *should have been involved from the very early stages. And I think if they were maybe things would have gone a bit smoother, maybe it would have been a high profile thing for them* [procurement]. *Because this whole technologies award is a really big deal for the trust, you have such a good thing to say, you've won an award because of your turnaround of your infections…maybe communications between us would have been a bit more open and freer. So I think possibly if there was, if I could have the time over again I think that possibly to involve them in the early stage"* [Trust 4].

Another of the trusts that did not engage with procurement until late in the process found that their stepwise approach of buying hand signage units, had in fact taken them over the threshold which requires quotes from multiple suppliers. This had delayed further procurement of a technology that the trust had evaluated and found to be effective. The procurement team had not been invited earlier as perceived to stifle innovation; and this event went to reinforce this perception.

This is in direct contrast to the approach of a financially constrained trust where a highly productive working relationship had been developed over some time:

"We've got somebody who is also quite an innovator in there and who is as passionate about getting procurement right" [Trust 1].

Second, if the product was procured through a regional or national framework, or the procurement was described as efficient. However, the majority of technologies outside of such frameworks were procured direct from the supplier, and knowledge of regional frameworks was weak. In some cases there was a perception that going direct to the supplier could attract special concessions and discounts.

Two small IPC teams encountered a unique difficulty by virtue of not holding an IPC spending account. They then relied on the other departments relevant to the technologies to carry out this function. This created an additional layer of bureaucracy and procurement was protracted.

"About five or six weeks were lost because we didn't know who had, who was sitting on the order form within the trust, which is very bad actually. That was around Christmas time, and once the thing was ordered I had loads of emails...who's got it, who's doing the ordering, where is, you know… that kind of thing. The basic problem is that we as infection control people don't have a spending account" [Trust 7]

In Trust 12 poor communication between the commissioning and provider arms of the primary care trust caused a delay in release of funds.

Across the trusts where ICT (the second most popular IPC priority area) was procured, the IT department were delegated to liaise and negotiate with suppliers through the procurement team.

Trusts reported no major difference in the route of procurement of the technologies studied here when compared to previous technology procurement. Inevitably, the internal processes were quicker in that the award monies were present, fast tracking the application as it was not subject to a competitive bidding process.

One trust (Trust 8) topped up the funding for the technology with trust monies within the research project timeline. One trust (Trust 9) made additional investment (bed mattresses) as a direct impact of implementing the technology:

"We had a decant ward that didn't have any beds there was an initial cost of actually hiring beds....in order to allow one area to be completed while another area continued to carry out patient activity...that was an additional cost...if you're going to clean properly you need to just take the patient and leave everything there" [Trust 9].

16.4 Comparative Implementation Processes

Implementation plans for the trusts varied from strong and detailed to more unstructured. Implementation plans were coupled with plans to evaluate, and on self assessment some trusts felt that evaluation plans were weaker than desired. Low staff capacity within the IPC team as well as in wards/units implementing the technologies had an impact on implementation. Two trusts (Trust 4 and 7) experienced unusually high turnover of staff, further compounded by staff sickness absence which impacted on implementation. Staff sickness absence in Trust 2 also resulted in sub-optimal implementation of one technology. Trust 4, took steps to compensate delays by employing a research nurse to oversee the project for the remainder of the year.

Two trusts (Trust 6 and 10) had strong implementation plans driven by the goal to evaluate the technologies. In addition, the majority of trusts procured short-term supplies of technologies to conduct a pilot of the technology before procurement decisions.

All trusts evaluated the process of implementation focusing on ease of use and compatibility of the technology with trust structures. Aims for more systematic evaluation with outcomes including patient benefit, reduction in site specific HCAIs was planned by most of the trusts with evaluation timelines of up to a year. Conclusions around cost-effectiveness were complicated for some technologies.

Overall, engagement of technology users in the decision making led to more effective implementation of the selected technologies. User feedback and involvement during the stage

of technology selection assisted in better aligning the technology with the delivery system and the expectations of those who use it. In particular, technology customisation to the needs of the users improved effective implementation by increasing technology acceptability.

For example, in Trust 8 flat Medigenic computer keyboards and fully enclosed mice were implemented in all portable electronic Picture Archiving and Communication Systems (PACS). The consultant chest physician who primarily uses the PACS pointed out that the lack of scroll functionality of the mouse made it unattractive to clinicians who use the PACS and are used to scroll up and down computer screens to view digital images. Thus the lack of scroll functionality could potentially compromise users' compliance with the particular product. Incorporating the feedback provided by the consultant (being the user of the technology), the IPC team in consultation with the supplier replaced the initial computer mouse with another one which had a push button for scroll functionality. Although simple, this product modification was particularly important for effective implementation of the technology.

Engagement in decision making or early implementation of managers and key staff in implementing units provided vital support for successful implementation:

"I mean the company sold it to us as the bees knees, there is a very, very small study with, involving literally one patient with inside rooms...and it reduces infection to nothing, and you know the germ count went down to nothing,...but not quite convincing, but I thought well I'll keep an open mind, because we have high risk patients. And if it does help at, you know something that's given to me by the trust, and little cost of maintenance, compared to having to buy the things, yes, I would be in favour of, for the safety of patients. If it doesn't convince me, if just the count has not reduced so much, then I think maybe the trust should invest the money into something else, that is actually proving, rather than being seen to do something, do something that actually works, yeah" [Trust 4]

A summary of the facilitators and barriers to implementation is provided below.

Table 78 Barriers and facilitators to implementation

	Barriers	Facilitators
Structural	Low staff capacity within IPC team	Well developed Infrastructure relevant to the technology

	Low staff capacity within implementing units	IPC resources
Cultural	Technology / Computer Phobia particularly prevalent among medical doctors	Pro-innovation culture
		No blame open and honest culture
		Commitment: endorsement and continuing support for the technology by champions
Attributes of the technology	High cost	Low ongoing / maintenance costs
	High complexity due to large number of users involved	
	High architectural complexity: comprising many components & linkages, combining software and hardware elements	
Technical	Underestimating the need for training even in what appears to be simple tasks	Knowledge and skills of staff in IPC and in implementing
		Previous experience with the same or similar technologies in the trust
Strategic / Tactical	One off nature of award funding	Fit with the strategy of the trust
	Timing of the award	Early engagement of frontline clinical staff and technology users in decision making
	Timing of when selection decisions were made: coinciding with the winter pressure and flu outbreak	Leadership: support by senior management in the trust mobilising resources
	'Innovation fatigue' of IPC staff involved in a number of innovation and change practice programmes in recent years	

	Promotion of ownership amongst 'grass roots' / end users of the technology
Legal	Legislation regarding technologies (eg. Non-chlorine based cleaning products)
	Boundary spanning – hygiene standards in patient homes outside of realm of trust staff

The next steps identified by the trusts included discounting the technology due to unmet expectations, poor evaluation results, or high cost implications. Other technologies were to be put forward for future procurement through longer term business cases.

16.5 Discussion

The key considerations in technology selection can be understood through the interplay between the perceived attributes of the technology and attributes of the adopter & context. We look at each in more detail below. Whilst these are treated separately, the interactions between each of the dimensions impacts on the adoption success.

16.5.1 Attributes of the technology

Innovativeness: How innovative a technology was considered by trusts depended on views of the 'hardware' and software' associated with the technology. Some trusts used simple technologies with new processes and practices and viewed the concept to be the innovation. A minority of trusts made decisions based on the innovation related to the 'hardware' of the technology.

"I'm not quite sure how they'll [DH] take it because it's not exactly high tech...it's not...what I would you call innovative. It depends in which way you look, I look upon it as an innovative. A lot of people out there might not, but I think it's the whole, it has to be sold on the whole concept, with the whole package" (Trust 1; Urinary catheter packs).

The majority of selected technologies were not 'radical' in the sense of being new to the NHS (Box 71). Most technology selections were new to the adopting trust either well established products or in use in other NHS trusts. Some of the trusts felt they needed to select the more radical technologies to justify as an 'innovative technology'.

Box 71 Example of an incremental approach

Incremental approach versus radical approach

Trust 1 did not select the RRP 1 product – the silver coated catheters. The RRP 1 product was significantly more expensive than the standard package. The project lead, the IPC Matron had wanted the RRP 1 product but was not supported by the trust's R&D committee.

"They [R & D committee] actually asked Bard and said, would you be willing to do more studies? And they said, categorically no and as soon as they said that then the R & D said, well if they're not willing to go back and relook at some things and they're going to stand by the evidence from sort of X number of years ago which actually does say, when it was peer reviewed every peer review does actually say needs further work or should have more trials'[Matron].

The project lead accepted that this 'enhanced'/'radical' technology may be re-considered later as follows:

If we reach a plateau [in reducing CAUTIs] that's the time I then have to relook and say, OK we've got so far, we've got the knowledge and skills in place, we've got the right equipment, everyone is doing everything right, we've got the acute PCT seamless service and everything is working out there. Why have we still got a problem and we cannot reduce it any further? That's the time I would go back to the board and say, OK we've done everything now, now it's time to approach it in a different way and this would be the time to put the silver coated in to see if it actually does reduce it that step further, that's my rationale behind it" [Matron].

So this Trust adopted an incremental approach to innovation adoption and the technology was part of a care bundle to improve urinary catheter care.

Costs: Cost considerations made in selecting technologies were around the initial investments and on-going costs. High running costs were the main financial considerations as the award was one off. Trusts used three main strategies to maximise this funding opportunity: by selecting high cost technologies that would have been unfeasible without the award; by procuring technologies with low on-costs for sustainable solutions; by selecting a number of different technologies to allow local trial within the trust to inform future procurement decisions. To illustrate, Trusts 1 and 3 procured single technologies which they felt were central to the IPC strategy. In addition Trust 3 invested monies in the ICT surveillance system with lower initial costs compared to another system; thus allowing for a longer term investment (3 years) and ongoing evaluation. Trusts 2, 4, 5, 7 and 10 used the opportunity to make some smaller investments to trial a number of technologies and make future procurement based on these findings. Trust 9 selected high cost technologies to make substantial products/equipment investment in environmental cleaning.

Whilst business cases were made for some of the technologies, demonstrating short-term cost-effectiveness was a challenge for some technologies:

"Well, when you talk about cost, we talk about different levels of cost... if you take a price per test [PCR Norovirus] it's more expensive [to do it in-house] but if it reduces your closed bed days, your ward closures by 48 hours, there's no comparison because however much that costs, so overall it will reduce the cost but it'll cost more for the department" [Trust 2]

Effectiveness: Evidence of effectiveness of technologies was considered for each of 38 technology selections. However the sources of evidence and definitions of effectiveness varied. The main sources of evidence used were, peer reviewed literature, technologies in use in other trusts, supplier information technology evaluations from NHS and DH innovation work streams, specifically RRP 1 and the Showcase Hospitals Programme. On definition of effectiveness, this ranged from local opinion including patient perceptions, ease of use by staff, to controlled trials data. Trust 7 intend to conduct patient feedback surveys for evaluating patient experience with the single use patient admittance packs (including disposable BP cuffs & SpO2). Trust 9 and Trust 4 have had patient feedback about the air sanitizer units.

Many trusts noted that for these technologies, no particular technology could be solely or directly attributable to reducing HCAIs. Impact was attributable to ongoing multifaceted approaches. There was in some teams an inherent tension as to what constitutes 'evaluation' and 'effectiveness:

*"Part of the problem with these evaluations, it becomes less an evaluation of does the technology work but more an evaluation of is the technology easy to use. And you need to know that it works before it's even worth thinking about whether it's easier to use, and I'm sure this has happened in other projects as well, and it's very much a nurse way, a nursing way of looking at products. It's not what is the clinical evidence that this works, it's the, do the staff like using it, so that becomes a priority, the main question...So it, it's, the way it's happened it's **become much less scientific than I would like it to have been.** But to devise scientific experiments on infection control is really challenging and the literature's full of very poorly performed studies. So it's, to throw money at people who don't have a lot of research experience and expect them to come up with something really interesting is, it's a challenge"* [Trust 4]

Four trusts viewed this funding opportunity to specifically develop methodologies to evaluate the technology interventions. Nine trusts intended to write up findings for wider dissemination. One trust appointed a research nurse to manage the implementation and evaluation process.

Types and sources of knowledge: On wider knowledge sought in making decisions we mapped to three types of knowledge required to make effective innovation adoption decisions[97]/[98] /[99]; awareness knowledge, principles/theory knowledge, and 'how to' knowledge.

Project teams used a wide range of sources to get information from these three broad areas:

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[97] Rogers, E (2003) Diffusion of Innovations 5th Edition, Free Press

[98] Glasby, J. and Beresford, P. (2006) Who knows best? Evidence-based practice and the service user contribution, Critical Social Policy, 26(1), 268-284

[99] Walshe, K., (2009), "Pseudoinnovation: the development and spread of healthcare quality improvement methodologies." International Journal for Quality in Health Care, 21(3): 153

Knowledge awareness: to find out what is available in terms of the range of technologies specific to IPC

Principles or theory knowledge: why and how a technology works in terms of the underlying scientific principles or theory.

How to knowledge: how to put the technology in to use, including all aspects of implementation

Overall the 'how to' knowledge was given less priority when compared to the other types of knowledge and this had implications for implementation. Practical issues such as requirements for dedicated fixed power supplies to technologies and hidden costs for replacement parts became apparent after procurement in those cases where 'how to' knowledge had not been adequately understood.

One example of unclear information on 'how to knowledge' was Trust 5's experience with the Ultrasonic cleaning tanks:

"It was very definitely sold as a replacement for manual cleaning, and not just manual cleaning. we embarked on that in the belief that using the tank would mean that when the equipment came out at the other end and was dried, it was safe to go on for use with the next patient" [Trust 5]

An example where detailed attention was given to 'how-to' aspects at the time of procurement, resulted in appropriate decision making. Trust 8, earlier discussed (16.4) where a fully enclosed computer mouse without a scroll wheel had to be replaced by another mouse with scrolling functionality by incorporating user's (chest consultant) feedback and adapting accordingly the procurement of technology supplies:

"had we not changed the computer mouse to replace it with one that has got a push scrolling button, the targeted users would not have used it at all; it is highly likely that they would have replaced them with normal computer mouse instead...so we changed the order for the remaining and we procured computer mice with a push button for scrolling functionality to be used with the PACS" [Trust 8]

16.5.2   Attributes of the adopter & context

Trust size: The trust size had a greater impact on the *process* adopted by the trust in making the technology selection decision rather than the technology type. For example none of the larger trusts consulted with staff outside of the core IPC team to generate ideas for consideration. Conversely, smaller in sized trusts, with small IPC teams relied more so on the cooperation of directorate/ward staff for generation of ideas and technology implementation.

Trust 7 is one example of a very small IPC team comprising one consultant microbiologist as the DIPC, an IPC matron, an IPC nurse and an administrator.

PFI sites: PFI status was seen as a barrier by two of the trusts. Specifically, Hydrogen Peroxide Vapour Decontamination System was discounted by one trust as this would have implications for PFI contracts requiring expensive adjustments. The same technology was discounted by another trust because the PFI provider had raised concerns of the technology causing damage to buildings in the long term. However, other PFI sites in our sample had adopted the technology previously. These trusts attributed the relationship with the contactors being conducive to joint working and raising quality. In addition, with the exception of one trust, PFI status did not impact on decision making when the technology was procured as a fully managed service, which implied minimal training or involvement of the PFI personnel. Other options needed to be considered by one trust for hand signage, due to PFI considerations.

Ability to evaluate: Across the cases, but particularly in the teaching trusts, the 'ability to evaluate' the technology impacted on technology selection. The potential for evaluation may be considered as an attribute of the technology or of the adopting context. Difficulty to evaluate was a barrier to adoption in some cases.

Pro-innovation culture: Across the trusts there were a range of trust-wide programmes to encourage innovation across disciplines. The extent to which IPC teams were engaged with these wider activities varied. Whilst this pro-innovation culture was largely a positive influence,

there were instances of disjointed efforts. Cross-departmental collaboration is essential, especially if innovations are to be rolled out trust-wide. For example in Trust 10, the Intensive Care Unit team already had invested in a Faecal Management System, however the IPC team selected another similar system with essentially the same functionality as were unaware of this previous procurement.; This gives rise to duplication of training, inconsistencies and issues of compatibility for staff and patients Pro-innovation was consistent with a non-blaming open and honest culture.

Wider organisational culture such as openness and non-hierarchical forms may act as an enabler to innovation adoption. For example the infection prevention assistants in one trust reported that they were very comfortable challenging doctors who were not 'bare below the elbows' - whereas in some trusts nurses did not feel able to do this.

Professional groups and evidence: By considering the interplay between technologies and adopters across various professional and functional groups within the trusts we identified that the same technologies had been defined and interpreted differently by dissimilar categories of adopters. The nature of evidence and how this communicated was important to some stakeholders.

For instance, in Trusts 4, 7 and 10 the clinical microbiologist valued highly principle/theory knowledge to value judge the effectiveness of the technology, looking primarily at peer reviewed papers for such information.

In Trust 7, in contrast the clinical matron would rather prefer to use more simple information about technology effectiveness and would discount very technical accounts:

"You don't want such jargonistic information. You need to make it very simple to say this is how it works. These are the benefits, blah, blah, blah, rather than going to such, you know, higher level of microbiology" [Trust 7; Clinical Matron]

An IPC nurse in the same Trust highlighted the importance of combining 'how to' and 'Principle/theory' knowledge:

"You need both evidence paper and the practicality of using the product. It's very important"
[Trust 7; IPC nurse]

The perceived benefits and weaknesses of the technologies reviewed by the trusts, as well as the 'evidence' supporting them and the sources and type of evidence sought varied across adopter categories. For instance clinical microbiologists and clinical matrons or infection control nurses looked at the same technologies differently and made dissimilar judgments about the value of specific technologies, or valued dissimilar sources and types of evidence. Professional training, experience and role, as well as personal interests of adopters all shaped technology selection decisions across the trusts studied.

Leadership roles: Differing views of leadership roles and professional training of decision makers also influenced selections made. For example in Trust 1 and Trust 10, though of similar professional training, the DIPCs adopted very different leadership roles in the decision making process. In Trust 1, the DIPC was clear about differentiating her role as a manager from her professional training as a microbiologist. In Trust 10, the DIPC felt that this management role was only possible as a medical microbiologist.

"I'm a microbiologist by background but, and this is something that I learnt right at the beginning when I took on this post, when you actually become a clinical manager or a clinical leader you have to drop your knowledge of your own...because that professional background starts interfering... I think that is important for clinicians who become either leaders or managers of any sort, that they really have to let the expert professionals guide and say, this is what we need to do, and the role of the manager or leader is just to facilitate"

"We do get a lot of brochures through the post, and they do send them to the wrong people as far as they get to the Chief Exec and get to the Chief Nurse, and they just all look wonderful, and I think it's a real, real problem for trusts that perhaps have a DIPC who's not a microbiologist, [to have the expert knowledge to judge for the validity of technology effectiveness claims / evidence]"
(Trust 10)

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(Trust1)

16.5.3 Learning from the decision making process

Who was involved? The approach to decision making varied in terms of who was involved within and outside of the core IPC team. Decisions were either highly exclusive to the core IPC team or inclusive of the wider trust. IPC leadership approach, and size of trust were strong factors in which process was adopted. Support by senior management in the trust, at the point of decision making facilitated implementation by mobilising resources and providing increased legitimacy to the initiatives. Early involvement of the intended technology users in the decision making process helped to obtain user 'buy-in'. Early engagement of frontline clinical staff and technology users in decision making also led to feedback to suppliers. For example, in Trust 8 feedback from consultants resulted in appropriate procurement of computer devices consistent with working practices as well as compliant with infection prevention guidelines. In addition, the presence of an IPC matron in the core decision making team facilitated communication and ensured high levels of cooperation by ward matrons with significant positive implications for implementation. An example of excluding relevant stakeholders is hotel services personnel being excluded in the design and testing of the ATP Hygiene Monitoring system, which would have potentially saved time and effort for training during the trust-wide roll out of the technology.

When was the technology first considered? For some trusts preparatory work for technologies considered before the award informed decision making whilst others viewed the award as a starting point. We identified technologies predetermined before the award and those emergent after the award notification.

Extremes in approaches had definite strategic or cultural reasons underpinning the approach. For example one trust with a highly 'predetermined' and 'exclusive' approach was guided by an identified IPC priority area. The trust with the most inclusive approach to decision making reflected the trust's culture and leadership style.

16.5.4 Learning from the procurement process

Procurement frameworks or direct to supplier: For the trusts which used the NHS Supply Chain (all when the product was available) or other national procurement frameworks procurement was described as smooth and efficient. For the remainder of products all technologies were procured direct from the supplier and knowledge of regional procurement frameworks was weak.

Involvement of trust procurement teams: Procurement   Action   Groups or similar models were found in the majority of the trusts. However involvement of the procurement team varied, from up front and early involvement to delayed involvement. Consistently, where procurement links were made late, the process was protracted as important considerations had been overlooked. Late involvement was due to inexperience of IPC individuals in procuring products, or the perception that the procurement team would act as barrier to adoption. This is another example of insufficient attention of 'how to' knowledge.

Those trusts facing particularly hard financial constraints involved procurement earliest, and viewed this expertise as a facilitator to innovative practice.

16.5.5 Enablers and barriers to implementation

Capacity: Consistently the biggest barrier encountered during implementation was lack of staff capacity, within IPC and also trust-wide in intended implementation wards / units. Many trusts commented on the short notice of the award having impact on decision making. For example where decision making and procurement were not completed until early winter, the window for implementation of certain technologies was missed due to winter pressures compounded by flu outbreak. Implementation therefore was delayed until late spring / summer in these trusts. Adopting and implementing innovative technologies was an additional task on top of routine operations which stretched the trust innovation co-ordinator; the impact was higher on trusts with small IPC teams.

'How to' knowledge: The second significant barrier, above any structural or cultural barriers to

implementation which emerged was insufficient attention to the 'how to knowledge'. Where detailed implementation plans had been formulated addressing this area and had been discussed with the supplier, managers in implementing units and technology users within the trust, implementation followed smoothly. None of the trusts reported resistance by staff and this may be attributable to consistency of the decision making processes with organisational culture.

The regulatory framework: In the context of the project the regulatory framework within the specified area (HCAI) was a strong enabler for the adoption of innovative technology, as HCAIs are high on the agenda both trust-wide and nationally. However, there were conflicts with other regulations / national performance targets for the trusts which raised barriers to technology adoption and implementation. For example admitting patients within four hours in A&E created tension with need to test for MRSA.

Implementation plans: Optimum implementation occurred when relevant involvement of actors and consideration of implementation at the point of decision making was made, coupled with well structured and managed implementation plans. Early engagement of frontline clinical staff and technology users in decision making led to technology modification and adaptation to fit the local context at implementation stage. Early engagement and regular steering of the process by a core group of managers, responsible for the service areas, facilitated the implementation process. Cross departmental team working, champions and endorsement from senior management were evident to varying degrees across the trusts, but all helped implementation.

Learning through training: Training was in some cases underestimated particularly where the technology was viewed as incremental (versus radical) and / or 'simple' and 'focal' (versus complex and multifaceted). For example, in Trust 7 introduction of single use patient admittance packs would have been smoother with better induction and training of staff. In addition training intentions were sometimes not realised due to staff capacity constraints, for example pressures on ITU staff in Trust 1 meant that training was delayed. Learning from previous technology adoption particularly in conducting evaluations was a valuable resource for IPC teams.

Technology – adopter interface: Technologies which consist of many components or processes involving a high number of diverse stakeholders appeared to be more complex and demanding during implementation. For example, the aim to diversify users involved in diagnostics to widen access to MRSA testing failed. In Trust 2, ward based, matron led diagnostics was aborted due to incompatibility with roles and workload. The trust reverted to technology adoption in the microbiology laboratory.

Technology – strategy fit: Fit of the technology with the IPC strategy of the trust allowed for sustainable investment in the particular technology. The trust anticipated benefits of the technology to be amplified over time as the technology evolves. This approach was taken to allow for synergies with other technology investments made by the trust and create complementarities. One such example is Trust 3 investing in a trust-wide IT surveillance system. The aim here was to monitor HCAI trends and hotspots to areas and teams, thus identifying future IPC technology. Fit with wider trust strategy was demonstrated in Trust 6, with use of the trust-wide Information Management platform, and development of a module specific to IPC consistent with the prevailing system.

Enabling Technologies: Pre-existing or co-adopted technologies facilitate implementation of new technologies by resolving issues of structural compatibility. For example, the introduction of the Patient Group Direction protocol facilitated the trust-wide standardisation and subsequent implementation of individual patient MRSA packs in Trust 11. The adoption of a universal adapter prior to the introduction of the disposable BP cuffs and SpO2 sensors in Trust 7 provided for structural compatibility irrespective of the type and brand of monitors and enabled the rolling out of the disposable packs to all trust wards. In Trust 6 wireless technology created an enabling environment for portable laptops for real-time data capture and monitoring.

17. CONCLUSIONS AND KEY POINTS – IMPLICATIONS

The findings from this study raise issues which are useful to a number of stakeholders in the NHS innovation landscape. By exploring the processes of decision making, procurement and implementation we find useful insights to the role of different professional groups, of 'evidence' and the structural and cultural context in which technology adoption plays out.

This award, one off in nature, provided a valuable opportunity for the trusts. However coupled with this was some ambiguity about the 'doing justice' to this significant sum of money, which some trusts were able to reconcile quicker than others. The timing of the award also presented some challenges, particularly where delays in decision making or procurement pushed implementation to the winter months, with added pressures.

In summary our key learning points for the major stakeholders in the innovation landscape in addressing HCAIs, which are generalisable to innovation adoption across the NHS are as follows:

17.1 For trusts

- Early involvement of the trust procurement team is essential to ensure effective and sustainable innovation decisions.
- Coordinating activities across in-house innovation programmes can promote locally relevant learning and avoid duplication. Organisational learning will be important to inform future adoption decisions.
- Encouragement and support for staff to visit other NHS Trusts and attend specialised conferences / workshops is important. In conjunction with staff participation in professional forums / networks exposure to innovation dissemination events encourages knowledge exploration and exploitation of such knowledge by trusts.
- Dedicated funding and time for training is important.

17.2 For IPC

- Understanding the 'how to' knowledge through appropriate channels requires as much investment as is currently given to the 'principles/theory knowledge'. Identifying appropriate individuals to obtain this knowledge is critical.

- IPC is evolving from a highly technical service to one that requires a more strategic and general management approach. This also needs to be reflected in how adoption decisions are made, who is involved, and implications for implementation need to be considered early on.

17.3 For industry/suppliers

- Providing 'how to' knowledge alongside principle/theory knowledge appropriate to staff who will be using the technologies is important to successful adoption. This includes appraising the adopting environment for structural compatibility.
- Work with national and trust procurement to create sustainable solutions.

17.4 Future research

- Longitudinal research of technology adoption in NHS trusts will build on and complement previous work such as the Showcase Hospitals work stream. Such studies will provide learning beyond the trialling and short-term implementation of technologies, focussing on technology routinisation and sustainability.
- Effective procurement models and processes are central to the technology adoption process. However this process requires deeper exploration and understanding.
- Use of theory based analysis is important to provide meaningful and generalisable learning of innovation adoption.

Appendix 1   Interview topic guide

<u>Assessment of purchasing choices and innovation adoption of HCAI technology award recipients</u>

Respondent information

Trust	Date
Researcher	Respondent name
Employment in trust since	Department/ position/ profession
Respondent email	Telephone
Technologies:	

Interview questions

All questions apply to your trust, and we are interested in your perceptions on the following. If you do not feel you are able to comment please say so.

1. **<u>Decision-making: technology selection</u>**

a. **Who was involved in the decision(s) on how the award is to be spent?**

- Have you had any involvement in the process? (If yes probe)
- (If group involved), how was consensus achieved?
- "Who prepared the paperwork"?
- What influence did professional and functional/managerial groups have?
  prompt: how does this compare to other groups?
- Has there been cross-departmental collaboration or has the technology selection decision been confined within the IPC team?
- Are you aware of a champion in promoting the selection and adoption of a particular technology?

b. **What form did the organisational decision making process take?**

- Has there been a formal approval process? (i.e. Trust's board decision, Decision made by Heads of Departments, issue discussed in Steering Groups / Committees?)
- Level of involvement by senior management: awareness / approval or disapproval of specific propositions / level of support provided
- Did the trust form a project team with respect to the selection / procurement / implementation of a particular technology?
c. **What factors were considered in reaching a decision for allocating the money to particular service areas / departments?**
  prompts cost, previous interventions (success/failure), particular expertise in the trust, eco-friendly/green.

d. How did you learn about the range of technologies available?

- For the selected technologies what was the source of information? **prompts** presentations (by whom), workshops, vists to other institutions, networks or memberships.

- What information about the selected technologies was available through these sources?

e. What factors were considered for selecting particular technologies?

- Was evidence in relation to proposed HCAI technologies used?
- What evidence / data supported the technology selection decision?
- Has the process, included seeking views from trust staff?
- Has the process, included seeking views from patient groups?
- If yes, Have these views influenced the technology selection decision making process?

f. Which factors facilitated or hindered the selection of new technologies?

- Intra-organisationally (available capacity / skills / resources / alignment with Trust – Department strategies / Trust's tradition or character)
- Contextual (Alignment with DoH strategies and policy frameworks / Regulative frameworks / pressing societal or health priorities)

g. How long did the technology selection process take?

h. Did sustainability feature in the decision making process?

- Is it a one-off project or are there plans for developing future capacity and investing in the particular area related to the selected technology?
- Influence of financial pressures – current competence and need for capacity/competence development

2. Attributes of the Innovative Technology

- Nature of the technology: Equipment / Material / Product / Protocol / Process
- Is the technology new/innovative or has it been well established and already validated?
- What has been particularly innovative in relation to the selected technology compared to the pre-existing technology or pre-established practice that the innovation is intended to replace?
- What is the perceived anticipated benefit of the selected technology to:
  - Patients
  - Staff:
  - Organisation (The Trust)
  - The NHS
- What is the perceived anticipated benefit of the selected technology to different professional groups / different functional groups within the organisation? Does the selected technology relate more to the scope of work of some health professionals than others?

- What is the perceived ratio of benefits / risks for different professional functional groups within the organisation from the adoption of the selected technology?
- Does the selected technology have a relative advantage over the pre-existing technologies / systems that had been in place?
- Has anyone challenged the selection decision? What are the perceived weaknesses/risks of the selected technology or areas of concern, if any?
- How complex is the selected technology? (to understand its functionality, ease of use, explain to users and other interested actors)
- Is the new technology compatible with pre-existing systems / structures / processes – working practices / values and culture of the people in the organisation?
- Are you aware of the Showcase Hospitals Project? Have you considered any of the technologies promoted through the Showcase Hospitals? (RRP 1 technologies?)

3. Procurement

- Once the award had been made how and with what ease did your Trusts process them?
- Did the procurement take place within any of the existing national frameworks? (NHS Supply Chain)
- Has there been any advice from the regional / local procurement office?
- Was the value of the award considered significant or sufficient?
- Does the £150,000 cover capital cost only (explore)
- Was the award topped up by individual Trusts?
- What was the process of procurement?
- Who was involved?
- How long did the procurement process take?

4. Adoption

- What has been the adoption process for the new technology?
- What were the implementation issues for clinicians, NHS managers and others for each particular technology (people, processes or infrastructure)?
- Which professional and functional/managerial groups were involved in adoption and implementation decisions?
- Who were the champions of the new innovative technology?
- How have patients been involved/informed in this process?
- Has there been any resistor to the innovation?
- How easily was it adopted? What have been the facilitating factors and barriers in the adoption and implementation process?
- What did your Trust see as being the measures of success for the adoption and implementation of the innovation?
- Was the innovation considered successful by these measures?

Thank you for your participation in this important research, is there anybody else who you think could provide further insight to the issues discussed today?

Appendix 2   Field work

A2.1 Field Visits – Respondents Trust 1

Number of visits – 2 / dates of visits July 09; June 2010

Number of interviews	5
Respondents = 4	- Director of Infection Prevention & Control - Matron (interviewed twice) - Nurse Infection Prevention & Control - Technology Representative. (BARD)

A2.2 Field Visits – Respondents Trust 2

Number of visits: 5

Dates of visits: July 2009;September 2009; October 2009; November 2009; June 2010

Number of interviews	13
Respondents = 9	- Associate Director of Clinical Quality - Clinical Innovation Coordinator - Matrons x 2 - Senior Nurse, Infection Prevention & Control x 2 - Acting Deputy General Manager, Pathology, GUM, Diabetes, Diagnostics & Outpatients - Microbiology Manager - Nursing Auxiliaries x 2 – endoscopy unit

A2.3 Field Visits – Respondents Trust 3

Number of field visits:1

Dates of visits: November 2009

Number of interviews	2

| Respondents = 2 | o Lead IPC Nurse |
| | o Senior IPC Nurse |

A2.4 Field Visits – Respondents Trust 4

Number of visits – 3

Dates of visits – 25.11.09; 24.06.10; 12.07.10

Number of interviews	5
Respondents = 6	o Ward manager
	o Medical microbiologist/infection control doctor
	o ITU nurse
	o Research nurse
	o Medical Director
	o Lead IPC Nurse

A2.5 Field Visits – Respondents Trust 5

Number of visits: 2

Dates of visits: Sept 2009; May 2010

Number of interviews	3
Respondents = 6	o Deputy Chief Nurse
	o Microbiologist - Tom
	o Medical Microbiologist - CHRISTINE BATES (interviewed twice)
	o Senior infection control nurse - PATTY HEMPSHALL (interviewed twice)
	o Infection control assistant
	o Infection control assistant

A2.6 Field Visits – Respondents Trust 6

Number of visits: 2

Dates of visits: Aug. 2009; June 2010

Number of interviews	5
Respondents = 4	o Decontamination Lead/ Consultant
	o Lead IPC Nurse
	o Medical Microbiologist
	o IPC nurse

A2.7 Field Visits – Respondents Trust 7

Number of visits 2

Dates of visits: November 2009, August 2010

Number of interviews	6
Respondents = 5	o Director of Infection Prevention & Control / Director of Microbiology (interviewed twice)
	o Clinical Matron
	o Nurse Infection Prevention & Control
	o Medical Engineering Manager
	o Domestic Services General Manager

A2.8 Field Visits – Respondents Trust 8

Number of visits: 2

Dates of visits: December 2009; July 2010

Number of interviews	3
Respondents: 2	o Assistant Director of Nursing for Patient Safety and for Infection Control (interviewed twice)
	o Assistant Director of Performance

A2.9 Field Visits – Respondents Trust 9

Number of visits: 2

Dates of visits: September 2009; May 2010

Number of interviews	13
Respondents = 9	o Clinical Matron IPC Lead (Interviewed twice)
	o Clinical Matron
	o Clinical Matron (interviewed twice)
	o Director of Infection Prevention and Control
	o Deputy Director of Infection Prevention & Control (Interviewed twice)
	o Assistant Director Design and Property
	o PFI representative
	o PFI representative Operations Manager
	o Assistant Director Hotel Services (Interviewed twice)

A2.10 Field Visits – Respondents Trust 10

Number of visits: 2

Dates of visits: September 2009; July 2010

Number of interviews	4
Respondents: 3	o Director of Infection Prevention & Control (interviewed twice)
	o Decontamination Manager
	o Clinical Scientist

A2.11 Field Visits – Respondents Trust 11

Number of visits: 2

Dates of visits: November 2009; May 2010

Number of interviews	10
Respondents = 7	o Infection Prevention Team Leader for the trust (interviewed twice)
	o Antibiotic Pharmacist
	o Nurse Consultant for Infection Prevention and Control

	interviewed twice)
	o Clinical Matron General Surgery
	o Housekeeper Surgical Wards (interviewed twice)
	o Consultant Medical Biologist / Infection Prevention Doctor
	o Director of Nursing and Quality, and Director of Infection Prevention and control

A2.12 Field Visits – Respondents Trust 12

Number of visits: 2

Dates of visits: November 2009; July 2010

Number of interviews	7
Respondents = 5	o Head of Nursing for Unplanned Care – Infection Control (interviewed twice)
	o Lead Infection Control Nurse Clinical Quality and Health Outcomes (interviewed twice)
	o Infection Prevention & Control Nurse
	o Nurse Intermediate Care Unit
	o Manager Intermediate Care Unit

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