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Knowledge management infrastructure to support quality improvement: A qualitative study of maternity services in four European hospitals

Anette Karltun[a,b,*], Johan M. Sanne[c,d], Karina Aase[d], Janet E. Anderson[e], Alexandra Fernandes[f], Naomi J. Fulop[g], Par J. Höglund[b], Boel Andersson-Gare[b,h]

[a] Jönköping University, School of Engineering
[b] Jönköping Academy for Improvement of Health and Welfare, Jönköping, Sweden
[c] IVL Swedish Environmental research Institute, Sweden
[d] SHARE – Centre for Resilience in Healthcare, Faculty of Health Sciences, University of Stavanger, Norway
[e] Florence Nightingale Faculty of Nursing, Midwifery and Palliative Care, King's College London
[f] ISCTE, Lisbon University Institute, Portugal
[g] Department of Applied Health Research, University College London
[h] Futurum, Region Jönköping County, Jönköping, Sweden

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ABSTRACT

The influence of multilevel healthcare system interactions on clinical quality improvement (QI) is still largely unexplored. Through the lens of knowledge management (KM) theory, this study explores how hospital managers can enhance the conditions for clinical QI given the specific multilevel and professional interactions in various healthcare systems.

The research used an in-depth multilevel analysis in maternity departments in four purposively sampled European hospitals (Portugal, England, Norway and Sweden). The study combines analysis of macro-level policy documents and regulations with semi-structured interviews (96) and non-participant observations (193 hours) of hospital and clinical managers and clinical staff in maternity departments.

There are four main conclusions: First, the unique multilevel configuration of national healthcare policy, hospital management and clinical professionals influence the development of clinical QI efforts. Second, these different configurations provide various and often insufficient support and guidance which affect professionals' action strategies in QI efforts. Third, hospital managers' opportunities and capabilities for developing a consistent KM infrastructure with reinforcing enabling conditions which merge national policies and guidelines with clinical reality is crucial for clinical QI. Fourth, understanding these interrelationships provides an opportunity for improvement of the KM infrastructure for hospital managers through tailored interventions.

1. Introduction

It is well known that differences in how quality is conceptualized between healthcare policy makers, hospital managers and clinical professionals, as well as insufficient guidance and support (e.g. performance indicators, ICT systems and training) impede successful clinical quality improvement (QI) efforts [1,2]. Moreover, at each healthcare organisational level, profession-based forms of governance interact with healthcare policy guidelines as well as with the support and guidance provided by hospital managers affecting QI efforts [3]. However, the influence of multilevel healthcare system characteristics and interactions on the contextual conditions for clinical QI is still largely unexplored [4,5].

QI in healthcare has been defined as 'better patient experience and outcomes, achieved through changing provider behavior and organisation, using systematic change methods and strategies' [6]. Still, the predominant focus of studies in healthcare quality has been on technical factors that are considered to influence the qual-

* Corresponding author at: Department of Supply Chain and Operations Management, School of Engineering, P.O. Box 1036. SE-551 11 Jönköping, Sweden
E-mail addresses: Anette.Karltun@ju.se (A. Karltun), johan.sanne@ivl.se (J.M. Sanne), karina.aase@uis.no (K. Aase), janet.anderson@kcl.ac.uk (J.E. Anderson), alexandra.fernandes@iscte.pt (A. Fernandes), n.fulop@ucl.ac.uk (N.J. Fulop), par.j.hoglund@gmail.com (P.J. Höglund), boel.andersson.gare@rjl.se (B. Andersson-Gare).

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ity of care [7]. As a consequence, interactions and social processes risk being overlooked although every aspect of care is accomplished through people in their everyday actions. However, greater attention was directed to the process of implementing, sustaining, studying and evaluating QI efforts by Bate et al. [8]. Drawing on this, the current study was based on the 'Organizing for quality' framework [8], which identifies the main challenges for hospital management to address how to improve quality, namely structural, political, cultural, educational, emotional, physical & technological, leadership and external demands (Box 1).

Box 1: Framework for data collection according to the first six common challenges for QI by Bate et al., [8] extended to eight in the QUASER study analysis

1 **Structural** – structuring, planning and coordinating QI efforts
2 **Political** – addressing the politics of change, negotiating the buy-in, resolving conflict surrounding any QI effort
3 **Cultural** – giving 'quality' a shared, collective meaning, value and significance
4 **Educational** - creating and nurturing a learning process that supports continuous improvement
5 **Emotional** – inspiring, energizing, and mobilizing people for QI efforts
6 **Physical & technological** – designing physical systems and technological infrastructures that support QI
7 **Leadership** – providing clear, strategic direction for QI
8 **External demands** – responding to and managing the broader social, political and contextual factors and external demands in relation to QI

The fundamental objectives of quality management and knowledge management (KM) can be considered similar in the sense that they both aim to create organisational knowledge so that improvement can occur [9,10]. The healthcare KM literature highlights the need to design healthcare management processes explicitly for QI purposes [11] to create good QI conditions for clinical professionals [12]. We therefore propose that using KM theory can be a successful approach to understand and develop effective QI efforts in hospitals, for example in terms of learning from experience, and to implement methods for QI. We argue that knowledge creation and management processes in a hospital are affected by multilevel (macro/meso/micro) characteristics and interactions [4,10] as well as manager-clinician interactions [13] represented by different KM models [10]. We further argue that hospital managers have unique opportunities to influence how clinicians are able to learn, and to adapt and align methods and practices for QI through developing a supporting KM infrastructure [12,14].

2. QI efforts through the lens of KM theory

KM refers to the processes whereby information is propagated and transformed in specific ways as a means to support specified goals within an organisation, which is related to multilevel KM models and infrastructure [15].

2.1. KM models

Three types of KM models (top-down, bottom-up or middle-up-down management) suggest different patterns to understand how different structures and processes affect organisational knowledge creation and thereby QI outcome [10,16], see Table 1.

2.2. KM infrastructure

Based on the concept of 'ba' by Nonaka and Konno [17], addressing the contextual conditions for organisational knowledge creation, Choo and de Alvarenga Neto [14] suggested four dimensions of enabling conditions for analyzing knowledge creation and management in an organisation's infrastructure, as summarized in Table 2.

The aim of this study is to develop the understanding of how hospital managers can enhance the conditions for clinical QI given the specific multilevel and professional interactions in various healthcare systems. To this end the theories based on KM models [10,16] (Table 1), and KM infrastructure [14] (Table 2), were selected as an appropriate framework for analysis.

According to the KM models [10,16] in Table 1 hospital managers can be seen as middle managers in hierarchical systems with different levels (macro, meso and micro) and with various professional relations. The dynamics in the relations between hospital managers and clinical professionals can result in different outcomes such as managerial hegemony, negotiation, strategic adaptation, mediation and resistance [18]. Moreover, the ways in which national healthcare policy is formulated (top managers in Table 1) and how outcomes are measured, structure and constrain what hospital managers can do to support how knowledge is created, shared and used by individual professionals at the clinical front line [19].

3. Methods

This article is based on data collected in an EU-funded project *Quality and Safety in European Hospitals (QUASER)* – a multilevel longitudinal comparative case study in ten hospitals in five European countries – with the aim to explore similarities, commonalities and differences in QI (see QUASER study protocol for detailed information regarding design, methods, procedures and analysis [7].

Hospitals were selected according to a range of publicly available indicators of the process and outcome of care was used for the selection, together with information from the regulation/accreditation of hospitals where available. The purpose of the selection was to find hospitals at different stages of QI development. They also represent different types of healthcare funding systems (Table 5). A full description of the selection process is described by Burnett et al. [20]. Two hospitals from each country were selected in the QUASER project, one performing well and the other average against the set of quality indicators. The four hospitals reported on in this article were judged as performing well. These hospitals were able to achieve, and then sustain, high levels of quality because they recognized and had been successful in addressing the first six challenges according to Box 1 below [8].

In the QUASER project quality was defined as encompassing clinical effectiveness, patient safety and patient experience [21,22], (Table 3), and conceptualized as human, social, organisational, and technical accomplishment [8]. In this study quality is anlaysed in terms of multilevel and professional interactions and supporting conditions for QI.

Maternity departments were studied as exemplary micro systems in one well-performing hospital from each of the four countries Portugal, England, Norway and Sweden to make it possible to compare the same clinical specialty. In the Netherlands it was not possible to obtain access to the maternity department due to reorganisation.

Maternity care was chosen as it represents one of the clinical areas with numerous inherent and specific risks where failures may bring great human and societal cost. In England, for exam-

Table 1
A comparison of three multilevel KM models for organisational knowledge creation, modified from Nonaka [10,16]

Management model	Top-Down	Middle-Up-Down	Bottom-up
Management processes	Leaders as 'commanders' Emphasis on information processing. Hierarchical pattern of information processing from top managers.	Leaders as 'catalysts' Emphasis on creating organisational knowledge. Information aligned by middle managers from top to front level propagated from diverse viewpoints.	Leaders as 'sponsors' Emphasis on information processing. Driven from clinical individuals according to their needs.
Agent of knowledge creation and consequences for clinical reality	Top managers (national/ regional level) create concepts and guidelines which become operational conditions for middle managers (hospital level) who in turn decide on operational measures for front-line clinicians. This process makes it more difficult for lower levels to create knowledge in a flexible manner.	Middle managers (hospital level) receive broad directions from the top level (national/regional level) and translate it to be adapted to front-line reality. Knowledge creation takes place in multidisciplinary teams supported by dialogue with middle managers and boundary spanners.	Individual clinicians begin knowledge creation. They are expected to receive support from middle managers (hospital level).
Accumulated knowledge	Explicit. Computerized/ documented.	Explicit and tacit. Shared in diverse forms.	Tacit. Embodied in individuals.
Weakness	High dependency on top management.	Human exhaustion. Lack of overall control of the organisation.	Time consuming. Difficult to coordinate individuals.

Table 2
Dimensions of enabling conditions in KM infrastructure for QI, adapted from Choo and de Alvarenga Neto [14]

	Dimensions	Enabling conditions
1	Strategy/ structure	Hospital managers guidance, structure and leadership to support knowledge creating activities; aligning national regulations with front-line reality through functions and roles, e.g. boundary spanning roles; facilitating knowledge creation through education, courses, training, conference and support of multi-professional clinical learning arenas to improve quality
2	Information systems/ management	Hospital managers support by information and communication systems/tools, e.g. intranet and information management processes to support knowledge creating activities, as development of best practices, and shared understanding of quality
3	Cognitive/ epistemic	Hospital managers supporting the process of developing new knowledge and common understanding within and between professionals which requires professional specific knowledge as well as shared understanding of goals, values and practices between professionals and dialogue with hospital managers
4	Social/ behavioural	Social relationships and interactions as boundary spanning activities and multidisciplinary teamwork based on shared norms and values such as mutual trust and respect, tolerance, interaction, open dialogue and autonomy of freedom

Table 3
QUASER project definition of quality dimensions, see Wiig et al., [1]

Clinical effectiveness	The degree to which healthcare services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge
Patient safety	The avoidance, prevention and amelioration of adverse outcomes or injuries stemming from the process of healthcare
Patient experience	Fast access to reliable health advice Effective treatment provided by trusted professionals Clear, comprehensible information and support for self-care Involvement in decisions and respect for patient preferences Attention to physical and environmental needs Emotional support, empathy and respect Involvement of, and support for, family and careers Continuity of care and smooth transitions

ple, maternity care accounted for a third of the clinical negligence expense in 2012-2013 [23]. Maternity care is further one of those specialties in which clinicians often heavily contest healthcare policy and practice and tend to perceive their own specialty as being different from other specialties [24,13].

3.1. Data collection

Data collection was conducted by research teams in the respective countries according to the agreed study protocol [7] and agreed templates for semi-structured interview guides at meso and micro level, observation guide and mapping of macro level socio-political context.

To guide data collection and analysis at the meso and micro level, we applied the 'Organizing for quality' framework [8] which proposes that all organisations face six QI challenges: structural, political, cultural, educational, emotional and physical & technological. The QUASER study extended the framework to eight challenges, by including leadership for QI and managing external demands in relation to quality (see Box 1).

Macro-level data referring to the national context for QI were collected from documentary sources using an agreed structure across the four countries [25] including funding, access, regulatory framework, accreditation, monitoring and information availability.

At meso and micro levels, a total of 96 interviews and 193 hours of observations related to quality work were conducted over a period of 15 months in the four hospitals (Table 4). Those interviewed included the hospital or deputy CEO, the chief medical officer, hospital board members, department managers, quality improvement managers and/or coordinators, development and

Table 4
Summary of fieldwork data collection on meso and micro level: interviews in total = 96, non-paricipant observations in total = 193

Hospital	Meso level – Hospital managers			Micro level - Maternity care units		
	No. of interviews	Hours of observation	No. of meetings observed	No. of interviews	Hours of observation	No. of meetings observed
England	13	65	16	5	10	3
Portugal	15	0	0	11	43	6
Norway	18	2	3	14	10	1
Sweden	14	20	7	6	4	3
TOTAL	60	87	26	36	67	13

Table 5
Summary of national policy characteristics related to quality of healthcare, see Burnett et al., [32]

Year 2011	Portugal	England	Norway	Sweden
Funding*	Tax-based	Tax-based	Tax-based	Tax-based
Remuneration related to quality of care	Hospitals remunerated in block funds from government with activity targets, 4% budget incentivized for delivering national quality and efficiency targets.	Mainly publicly funded Hospitals remunerated through contracts with commissioners for volume and quality.	Main hospital funding from government through regions not linked to quality but waiting time guarantee with financial penalties.	Financing through County Councils – volume and some quality measure/incentives. Recent schemes of payment from government in relation to access.
Regulatory framework for quality	Regional with some oversight. Requirement to have systems in place to control quality with discretion about how to do this within limits. Hospital accreditation in place.	Explicit focus on quality, targets and use of financial rewards and penalties. Hospital licensing in place through the national Care Quality Commission.	Regional with some oversight. Requirements to have systems in place to control quality with discretion about how to do this. No accreditation system.	Autonomous County Councils/Regions – decision making. Guidelines developed centrally but few requirements and targets. No accreditation system.

QI: quality improvement
* None of the hospitals in the study used private treatment income to supplement or take the place of publicly funded care.

educational directors, clinical managers, clinical physicians, midwives and nurses. All interviews were recorded and transcribed. Field notes of observations were made.

If required, ethical approval was granted in each country and consent obtained from the involved informants. The following institutions approved the project: Norwegian Social Science Data Services, ref. 26636 (Norway); Regional Ethical Committee, Linköping, ref. 2011/164-31 (Sweden); and NRES Committee South East Coast, Surrey, ref. 11/ L010348 (England). Ethical permission for this study was not necessary under Portuguese law as no patient data were collected. In the Portuguese hospital, the board of directors authorized the collection of data, and the ethics committee was informed. In the countries where ethical approval was required, a consent form for staff interviews was signed by each interviewee with permission to use the documented data by the researchers.

3.2. Analysis

The data analysis was undertaken in two main phases. In the first phase the research team in each country analyzed the interview and observational data using NVivo to identify to what extent the eight challenges in Box 1 were met and how. This was done according to an agreed template for analysis to ensure uniform coding across countries. This analysis together with the macro-level documentary analysis was written into separate reports for the hospitals in each country according to an agreed structure and then translated into English as the working language [26].

In the second phase, a two-step analysis was undertaken by the first and second author (AK and JMS): 1) a multilevel within country analysis of the country specific data concerning maternity care, and 2) a cross country analysis comparing and synthesizing the four country specific analyses. Data were analyzed and grouped based on multi-dimensional theoretical frameworks on KM models (Table 1) and KM infrastructure (Table 2) to enable a meta-synthesis [26–29].

The first step covered a comparison regarding to what extent and how the eight challenges (Box 1) were met at the each of the four hospitals according to empirical data. The data were then assigned to the four dimensions of enabling conditions for KM infrastructure [14] in Table 2 for each hospital separately. The macro level data from each country was subsequently analyzed for the hospitals respectively using Table 1 for a multilevel within country analysis. In the second step, a multilevel cross country comparison between the four hospitals and healthcare systems was made to enable a meta-synthesis and explore patterns affecting QI efforts [27–29]. The preliminary analysis was iteratively discussed, refined and then verified by researchers in each country.

4. Results

4.1. Macro-level comparisons

Table 5 shows a summary of the national policy characteristics in each country related to funding, remuneration and regulations for quality. The findings are then presented for each hospital through the lens of the KM framework presented above.

4.2. Multilevel within case analysis

The findings are presented for each hospital through a multilevel macro-meso-micro analysis based on the theories on KM models [10,16] (Table 1) and KM infrastructure dimensions [14] (Table 2).

4.2.1. Portuguese case study – profession-based guidance filling in, conflicts between professions

The Portuguese healthcare system consists of a network of public and private healthcare providers connected to the Ministry of Health that coordinates healthcare provision and provides public healthcare delivery funding. Public health units are allocated global budgets based on contracts with the Ministry of Health. The three QI

indicators of clinical effectiveness, patient safety and patient experience are included in the national definition of QI. Quality of care is measured according to a set of indicators used by the Ministry of Health.

4.2.1.1. Strategy/structure: loose governance. The broadly defined quality regulations at macro level mirrored a lack of guidance, structure and leadership from hospital managers to support knowledge creating activities, trough e.g. multi-professional learning arenas. The Quality Department staff at the Portuguese hospital stressed the situation:

> I think what's particularly lacking in this field [QI] are consistent and long-term guidelines. On the other hand, ten years ago a national strategy for quality in healthcare was defined, but in real and practical terms, it is merely a statement of intent – it's not even a guideline. And then there are conflicting signs, we are all going to implement a model of the King's Fund and Andalusia but then. . .

There was no articulated strategy and structure developed by hospital managers to enable knowledge-creation activities by aligning national regulations with front-line reality. Clinicians therefore used resources such as WHO and professional organisations. Furthermore, a structural separation and subordination between doctors and nurses hampered clinical QI work through conflicts between the two professions.

4.2.1.2. Information systems/management: disparate systems. For a long time, the division between nurses and doctors was mirrored in the design of separate information systems for the two professions. Thus, even if doctor and nurses could resort to various sources for guidance, the lack of information systems to support a shared understanding hampered local QI work. As a consequence, QI work proceeded in parallel with little coordination of measures and effects.

However, a recently introduced IT system shared by doctors and nurses provided an opportunity for increased inter-professional interaction in the clinical work. A doctor said:

> Today, we are all working with ASTRIA, which is very good, very comfortable. If I want to know the result of an amniocentesis, or the results of pathology anatomy, they are all computerized, they are online for the hospital's internal email, I put in the woman's ID, I have it, and then I export it to the information sheet. It's very good.

This system was integrative, as it was used by both doctors and nurses, providing opportunities for knowledge development through sharing of information and collaborative learning.

4.2.1.3. Cognitive/epistemic: low common understanding. There was also a lack of support for mutual learning between professions to agree on common objectives and QI efforts. The dichotomy between nurses and doctors contributed to a low degree of shared goals, values and common understanding of quality, which was further reinforced as doctors could use their working time to update their professional knowledge, which was not the case for nurses. The situation sidelined nurses and put them in a weaker position concerning content and competences. A nurse stated:

> I think there is a major divide, because if the work was done together, the presentation of an issue among doctors and nurses, we would all be mobilized, but that doesn't happen, everyone does their own thing.

Moreover, also contributing to the cultural distance between the two professions was the fact that the main focus in QI efforts at the department was based on clinical efficiency objectives due to physicians' main interest compared to nurses who were more concerned with patient experience and safety. As nurses did not play a big role in clinical efficiency but rather focused on caring for the patients, they found it hard to see QI as a major part of their professional identity and they could only partially link the improvements the maternity ward made in such areas to their collective professional identity.

4.2.1.4. Social/behavioural: lack of team-building. The lack of shared norms and values such as mutual trust and respect, interaction and open dialogue between nurses and doctors had real consequences for both daily work and how QI was shaped. The lack of common understanding of and commitment to quality in multidisciplinary teamwork was clearly seen in everyday work behaviour, which was commented on by a maternity nurse:

> The worst thing is that people are not involved in a mission, they are not involved in a common objective, they are not governed by a guide to achieve a particular goal; we don't have a mission. Each team works based on their management of patients and the day. Doctors manage their waiting list, the nurses manage their team that floats, their auxiliaries which vary and so we are all managing our micro-universes, but we don't have a common philosophy.

This created problems for achieving quality within care processes that stretched across professional boundaries and restricted the development of a shared multidisciplinary perspective on QI issues and means to address them.

4.2.1.5. Summary and potential for improvement of KM infrastructure. The loosely governed healthcare system in combination with the hospital's status as a centre of excellence allowed professionals to resist governmental guidelines and create them from a micro-level perspective. Information processing and knowledge creation were driven from clinical individuals while leaders on hospital and national levels could be characterized as 'sponsors' in line with a bottom-up KM structure (Table 1). In such a KM structure knowledge becomes more embodied in individuals as tacit knowledge.

In terms of enabling conditions for KM infrastructural guidance and support, hospital managers were perceived to provide very little, with respect to the four dimensions in Table 2. Due to lack of support from hospital management, clinicians 'filled in' with professional guidelines in their QI efforts.

However, the case study also provided an example of how hospital managers could contribute to improve enabling KM conditions in clinical work through the newly introduced shared IT system, a good example of an information systems/management enabling conditions. The system could be used by managers to address the separation and subordination of the two professional groups in order to create an arena for mutual learning. A continued use of the system could provide an opportunity for developing mutual trust and respect (Social/behavioural) and shared understanding of goals, values and practices (Cognitive/epistemic) between the two professional groups. Moreover, hospital managers could also explicitly prescribe the quality dimension according to the EU Commission embracing clinical effectiveness, patient safety, and patient experience (Strategy/structure), thereby pushing the two professions to cooperate.

4.2.2. English case study – competing values in metrics and perceived support for QI

The National Health Service (NHS) in England is run through self-governing trusts and the Care Quality Commission is the national regulator that inspects healthcare providers and ensures they meet national standards. Clinical effectiveness, patient safety and patient experience are included in the national definition of QI. There are

two quantitative national standards for maternity care, which differ in important aspects. There are generic national quality regulations and standards for all services. In addition, maternity services have their own QI indicators, partly through those set out through Clinical Negligence Scheme for Trusts whereby trusts that meet certain standards obtain a discount on insurance payments.

4.2.2.1. Strategy/structure: inconsistent metrics. The clinical personnel in maternity care felt that support and guidance from hospital managers regarding QI was inadequate to their specialty. Clinicians perceived that they had to resolve these issues by themselves, through resisting prescriptive measures and striving with bureaucratic QI processes.

The clinical personnel also perceived it as difficult to attend to two different quality standards at the same time, since they sometimes were contradictory. To give an example, the hospital set a target for all services, including maternity, to reduce their ratios of new to follow-up consultations to 1:1.7. At the same time, the commissioners acknowledged the special needs for care provided by maternity services and requested a different ratio of 1:2.1. A senior midwife summarized the problems that these contesting demands caused as follows:

> So, from the point of view of looking at healthcare commission work we were branded poorly because we didn't meet the 1:2.1 ratio that they set as their standards. So, we were in the red for that. From the point of view of the trust, we were in the red because we weren't at the 1:1.7 ratio that had been set for the rest of the organisation. So, there are times where you get a complete dichotomy between what fits in with the generic and how they don't see maternity as being different, and then when they do look at maternity as being different, you're then kind of slated for not meeting that target as well. And in the end, it's probably taken us a good two years to get that sorted.

As the hospital provided no formal education for clinical staff, they had learned about QI methods through different kinds of work experiences by staff rotating between specialist areas within the maternity department.

4.2.2.2. Information systems/management: lack of support for clinical QI. Trust policy, standards, newsletters and guidelines were commonly used by all staff but there was no overarching cohesive IT support for QI at the hospital to support shared understanding and best practices. However, midwives reported developing and checking practices against national standards set by the Clinical Negligence Scheme for trusts.

4.2.2.3. Cognitive/epistemic: different values. While quantitative metrics dominated the prescriptive QI measures at the clinic, maternity staff stressed that good care is also about building relationships with patients through communication and engagement and not only meeting nationally set professional and accreditation standards:

> The majority of women will get three postnatal visits and that's all they'll get. And that's around clinical need, not psychological need, and I think some midwives, particularly as the workforce is older, struggled with that concept in knowing how much that involvement makes a difference to long-term outcomes. But it's not quantifiable and measurable in a way that allows you to do it.

The clinical staff thus had their own understanding and conceptualizations of quality, based very much upon professional standards, which conflicted with metrics imposed from hospital managers.

4.2.2.4. Social/behavioural: inadequate support. Multidisciplinary teams, often led by midwives, primarily drove QI work at the maternity department. Financial constraints on the hospital had led to a restructuring of QI processes in order to improve economic control. Clinicians felt that this had affected interactions and clinicians' autonomy of freedom in a negative way. For example, as a means to reduce costs, the hospital had decided that there was a need to write 'business cases' for various changes. This hampered even small changes in practice, as a midwife argued:

> A simple thing... a foetal pillow, which is a device that is inserted in the vagina of a woman who is going to have a caesarean section... Now if I think that could work very well and I would like to introduce that in our unit, which would seem very reasonable as we have some cases where there was trauma to the foetus and so that would improve quality and reduce risk, I would have to make a business plan about how much this cost, when it is going to be used and having to write a guideline so it is not used on everybody but at the correct times, and that would then have to go to the business manager for a decision on whether it is reasonable to acquire that.

The midwife argued that to make a business plan for this issue could take several months, hence impeding QI efforts in this unit.

4.2.2.5. Summary and potential for improvement of KM infrastructure. This healthcare system implies a hierarchical pattern of information processing where hospital managers have difficulties aligning prescriptive healthcare policy guidelines to clinical reality. This makes it more difficult for front-line clinicians to create organisational knowledge needed for systematic QI in a flexible manner. According to Table 1 this healthcare system could thus be characterized as a top-down KM structure where leaders could be portrayed in terms of 'commanders'.

The clinical personnel felt that hospital managers did not provide adequate support for QI work in terms of enabling conditions (Table 2) and that there were competing values regarding metrics for QI related to lack of shared values and practices. It seems as if the deficiencies in one enabling condition (e.g. Information systems/management to support QI) influenced the development of the other enabling conditions negatively (e.g. Cognitive/epistemic and Social/behavioural support in terms of common understanding, interactions, and clinicians' autonomy).

An example of opportunities for improvement in such a system could be seen from how hospital managers used national campaigns to support QI.

For example, the NHS Lean-based program *Productive Ward* was used to initiate quality improvement activities where clinicians took the lead, perceived to be with sufficient manager support in most cases [30]. In this way, QI processes could more easily be used to align national standards with clinical realities through process mapping and reducing work that does not contribute to patient care quality.

4.2.3. Norwegian case study – contextualizing hospital guidance through organising local support

The healthcare system in Norway is based on a regional self-regulation regime run by the Ministry of Health and supervised by the National Board of Health Supervision. Clinical effectiveness, patient safety and patient experience are included in the national definition of QI. More specifically, QI is to a large extent based on professional guidelines established by professional communities, and national guidelines within specialties. There are four regional health authorities funded by the state and responsible for strategic areas related to QI at the hospitals. All healthcare providers are required to establish an internal control system to ensure that services are provided according to established rules and regula-

tions by developing QI activities adjusted to their service provision. Regional support and funding from the regional health authority promotes project proposals for strategic QI projects, which in turn support learning arenas such as regional quality conferences where QI efforts are presented.

4.2.3.1. Strategy/structure: regional self-regulation. The hospital's improvement program was developed as an overall strategic approach to QI and organisational development for managing QI projects. The strategy relied on a few senior 'quality champions' within the hospital executive management, who were supposed to support clinical management responsibility for QI at the level of the clinical front line.

Maternity service clinicians perceived that the hospital's improvement program and guidance for QI was of little use for their specialty. However, clinicians appreciated when hospital managers negotiated QI measures between national and clinical levels in a patient safety campaign run by the Ministry of Health.

Maternity clinicians relied heavily on professional guidelines, organised local support and developed self-regulating professional guidelines whenever needed. Initiatives to improve enabling conditions came mainly from 'professional development/educational nurses', a formally established position in Norwegian hospitals including a 50/50 division of research/education and clinical work. These nurses formed an important alignment role as boundary spanners in negotiating QI between national, hospital and clinical levels.

Except for the 'improvement program' and the educational nurses holding internal courses there was no other regular/formal education in QI provided by hospital managers.

4.2.3.2. Information systems/management: organising for alignment. There was limited support through QI tools and methods from hospital managers.

Hospital managers did however provide data sources to visualize national quality indicators and established demands for clinical leaders to report their numbers according to these targets. At the maternity department, a midwife and a gynaecology nurse were responsible for screening national guidelines and national initiatives in order to ensure that activities were following professional standards and meeting national expectations, though the clinicians did not always define them as relevant QI indicators for maternity services.

4.2.3.3. Cognitive/epistemic: different mental models of QI. The senior 'quality champions' within the hospital executive management were familiar with concepts of quality improvement and quality improvement projects or processes, while professionals talked about quality as a shared 'collective mechanism' or a 'collective mind', meaning that quality lay at the heart of their professional practice. Quality was said to exist in everything they did; it was not a project or a tool being implemented. We asked a department midwife if she and the hospital's executive quality managers had the same conceptualization of quality and successful service delivery:

> Yes, in principle, but not in practice... it is obvious that their mindset is more related to money, while we think more directly about the patients on a daily basis.

Clinicians regarded QI as the improvement of clinical practice such as updating or developing new professional guidelines.

4.2.3.4. Social/behavioural: different norms for QI efforts. The maternity clinicians benefited from supportive micro-level leadership and multidisciplinary teamwork. The head midwife explained about the chief doctor at the maternity department:

> This person includes midwives in the professional discussions and consults them for their opinion. So, they figure out the solutions together in a collaborative approach. This is not a very hierarchic system.

This multidisciplinary teamwork seemed to have created interactions that promoted open dialogue, shared values and mutual respect. Further, boundary spanning activities by the development/educational nurses supported QI processes.

4.2.3.5. Summary and potential for improvement of KM infrastructure. In the Norwegian hospital, national directions were to some extent translated from national to clinical level through hospital managers in a specific quality improvement program, although maternity clinicians basically did not find them beneficial for maternity services. However, information for QI was to a large extent aligned from national and hospital level to front-line maternity clinicians by development/educational nurses formally assigned by hospital management. This health care system could be characterized as having a middle-up-down KM structure with hospital managers to certain extent acting as 'catalysts' in clinical knowledge creation (Table 1). Regarding guidance and support in terms of enabling conditions, hospital managers provided several enablers related to the four dimensions in Table 2.

Strategic/structural enablers were mentioned in the above paragraph. Hospital managers further provided measures for clinical leaders to report quantitative data according to national targets, however not always perceived in harmony with clinical reality (Information systems/management). Hospital-provided measures were therefore contextualized with departmental clinical measures based upon guidelines from profession-based organisations. The middle-up-down structure with boundary spanning nurses seemed to have enhanced clinicians' development of e.g. multiprofessional dialogue, shared mental models, mutual trust and autonomy of freedom (Strategic/structural, Cognitive/epistemic, Social/behavioural).

An example of a potential for improvement can be seen from how the hospital managers negotiated QI measures between macro and micro levels in the patient safety campaign run by the Directorate of Health. By making it relevant for the maternity front-line reality, this approach could be seen as a potential for further KM improvements.

4.2.4. Swedish case study – management and profession-based quality improvement as complementing practices

The healthcare system in Sweden is regulated by the National Healthcare Act under the responsibility of the Ministry of Health. Quality is governed from the Swedish National Board of Health and Welfare, embracing clinical effectiveness, patient safety and patient experience in the QI definition. The Swedish Association of Local Authorities and Regions (SALAR) constitutes a national body of the 21 county councils and regions, which are individually responsible for the actual delivery of healthcare in their respective geographic area.

4.2.4.1. Strategy/structure: regional self-regulation. In the Swedish hospital, guidance for QI was provided through a network of collaborative functions and an elaborated intranet that supported alignment of national guidelines and profession-based knowledge through protocols and checklists of various types supporting clinical work. This included 'The Guide', which assisted clinicians in developing QI measures relevant to each specialty in alignment with national guidelines and standards.

Hospital managers could through the annual 'dialogues' with each clinical specialty understand to what extent the measures developed in 'The Guide' were followed according to relevant mea-

sures and if the care provided delivered the expected quality on the national level. This allowed for recognizing trends that could be followed over time.

An important functional support at the clinical level initiated by hospital managers was the 'care developer' who worked closely with the clinical first-line managers with a boundary spanning role to strengthen dialogue and leadership in QI work between hospital managers and clinicians.

Strategic and structural support in QI included various improvement processes and a county-commissioned development and education centre. The enabling conditions provided by hospital managers were complementary to and aligned with profession-based resources in maternity services as well as in other specialities.

Furthermore, there was a strong emphasis on education and development at the hospital. Each clinical employee had 10% of his or her working time allocated for education and improvement work and the employees participated on a rotating basis in different improvement groups.

4.2.4.2. Information systems/management: aligning healthcare policy and professional knowledge. In addition to the hospital's efforts to provide supportive information systems there is also a follow-up system of more than 100 National Quality Registries (NQR) in Sweden for specific clinical areas that contains individualized data concerning patient diagnosis, clinical interventions and outcomes which provide feedback and support healthcare professionals in daily QI work. Professional bodies run the registries with financial support from the government and SALAR. Data from NQR and other data sources are also aggregated on a national level and transparently published for feedback and comparison in an annual report called 'Regional comparisons' [31].

4.2.4.3. Cognitive/epistemic: relying on best practice online. Clinical professionals reviewed their operations regularly through 'The Guide' and had an annual dialogue between specialties and hospital managers. Through this process, clinical performance became transparent, providing guidance and common understanding for continuous QI. The NQR also served as facilitators in fostering shared understanding of goals, values and practices.

Interviews further showed how clinical personnel used the intranet checklists and protocols which were perceived to enhance a mutual understanding and standardization of care. A midwife said:

> What has been good from the aspect of specialist maternity services, is the flow charts, for the different [patient] groups, for instance, diabetes, twins and reduced growth rate and so on, because it doesn't matter who they will meet, as all doctors and midwives use the same flow chart and that is an advantage, nothing is being missed, and then there are also some treatment routines which have gained adherence in the care.

This approach was used to identify problems with high-risk pregnancy care check-ups in the main process for obstetrics and further fostered a common knowledge regarding the patient's situation.

4.2.4.4. Social/behavioural: QI processes integrated with professions. The maternity department had worked with QI since the mid-1990s and had a well-integrated structural QI strategy. This development had enhanced multidisciplinary teamwork and communication and fostered shared norms and values as well as integration of QI into daily clinical work. The hospital's emphasis on process orientation with boundary spanning activities permeated the maternity services' QI work where three main process groups (obstetrics, gynaecology and prevention) and twelve sub-process groups were responsible for QI work based on interactions between professionals. This seems to have encouraged interaction, mutual trust, open dialogue and autonomy of freedom together with the use of 'The Guide' (see above).

4.2.4.5. Summary and potential for improvement of KM infrastructure. This was the only hospital in the study enacting QI through explicit process development strategies. It is also an example of a middle-up-down management structure with hospital managers as 'catalysts' in aligning directions from national to clinical level (Table 1). At this hospital, enabling conditions according to all four dimensions in Table 2 were in place.

A number of alignment initiatives seem to be at hand that mutually supported each other, e.g. 'The Guide', the care developers as boundary spanners, and a development and education centre (Strategy/structure, Information systems/management). Together with the quality registries, this supported the development of a shared understanding of QI, good interactions between professionals in teamwork, open dialogue between clinical team members as well as between clinical managerial teams and hospital managers regarding continuous QI (Cognitive/epistemic; Social/behavioural). Further alignment of various KM components is suggested as a potential improvement.

4.3. Cross-case analysis

4.3.1. The impact of KM models for knowledge creation and QI

The cross-case analysis indicates a) the impact of KM models for knowledge creation and QI in the four healthcare systems [10,16] (Table 1), b) the interrelatedness of enabling conditions – a key for QI in the hospital KM infrastructure [14] (Table 2), and c) The importance of a sufficiently developed KM infrastructure to assist professional clinicians' in developing adequate action strategies for QI.

The characteristics of different KM models for multilevel organisational knowledge creation in the four countries according to Table 1 [10,16], seem to have affected the conditions for hospital managers to align macro-level regulations to clinical guidance in a supportive way and create a shared knowledge of quality and QI.

The bottom-up information processing KM characteristics in the Portuguese case appear to have hampered hospital managers' possibility to support clinical QI. In the English case hospital managers had problems in targeting the clinical needs of QI support related to a more top-down information processing. The Portuguese and English cases also showed disparate conceptualizations of quality between hospital and clinical levels which further impeded QI efforts. In the English case this could be related to 'top managers' (national/regional level) as agents for the knowledge creation process making it difficult for hospital managers and clinical professionals to create and share knowledge for QI in a flexible manner (Table 1) [10,16]. In the Portuguese case, where individual clinicians were the main knowledge-creating agents, the accumulated knowledge could be characterized as more tacit and thus also difficult to share (Table 1) [10,16].

A middle-up-down information processing KM practice, as found in the Swedish and Norwegian cases, was associated with more opportunities for hospital managers to align information and guidelines from top management on national and regional levels to clinical level and acting as knowledge-creating agents. In the Norwegian case, hospital managers had to a great extent delegated the alignment function to boundary spanning nurses which seemed to have promoted a shared clinical knowledge for QI, even if the conceptualization of quality differed somewhat between hospital managers and clinicians. In the Swedish case there was a comparatively high coherence in the conceptualization of quality between organisational levels, which contributed to a shared understanding and implementation of clinical QI efforts. This was in turn asso-

ciated to a KM process with a multifaceted alignment between organisational levels. The middle-up-down KM process thus seems to support the sharing of explicit and tacit knowledge in various forms (Table 1) [10,16].

4.3.2. The interrelatedness of enabling conditions – a key for QI

In the Portuguese hospital, doctors and nurses did not have a shared understanding of quality (Cognitive/epistemic). There was also a lack of multi-professional learning arenas for the two professions (Strategy/structure), negatively affecting their social relationships and interactions as teamwork (Social/behavioural), conditions that affected each other and hampered coordinated QI efforts. Furthermore, IT systems did not provide a tool to support shared understanding and knowledge-creating activities (Information systems/management). However, a recently introduced IT system (Information systems/management) increased the possibilities for interactive learning and common understanding between doctors and nurses. This might reinforce the other enabling conditions with further support from hospital managers.

The analysis of the English hospital reveals, as in the Portuguese case, how each one of the enabling dimensions in Table 2 [14] needed to be more sufficiently developed as a prerequisite for strengthened reinforcement. An initiative from hospital managers to engage and support clinical professionals in more participative initiatives in QI processes, for example in considering relevant clinical measures (Strategy/structure), could perhaps be a driving force to develop other enabling conditions.

The Norwegian hospital managers supported several enabling infrastructural KM conditions for QI in line with the four dimensions in Table 2 [14]. For example, the support of knowledge creation activities, and shared understanding through formally assigned development/educational and boundary spanning nurses (Strategy/structure; Cognitive/epistemic; Social/Behavioural) and multidisciplinary teamwork supporting dialogue and shared understanding of quality among professional clinicians (Social/behavioural; Cognitive/epistemic). The analysis also shows how these enabling dimensions reinforced each other. Further improvements could be developed by e.g. enhancing systems for communication of quality data in line with national targets (Information systems/management).

The Swedish hospital illustrates, perhaps in the most obvious way, how the enabling conditions reinforced each other in all four dimensions in Table 2 [14], providing a holistic KM infrastructure in the hospital, which enhanced the support and working conditions for QI.

It seems as if the specific interrelations of the different enabling conditions in each case also provide a key to quality improvement. Potential for QI through KM enablers can thus be traced by analyzing how the various enabling conditions are interrelated and affect the QI potential in hospitals.

4.3.3. Professional clinicians' action strategies – hospital managers' QI support

When guidance and support from hospital managers KM efforts were felt to be inadequate, clinicians 'contextualized' or 'filled in' with professional guidelines or they 'resisted' them by developing competing action strategies. Clinicians consulted national healthcare policy guidelines in order to obtain required support and guidance. Their attempts contributed to various patterns of enabling conditions that constituted the KM infrastructure for their clinical QI efforts. However, it seems that in these cases those became more or less unsatisfactory compromises. When guidance and support from hospital managers was perceived as adequate there was a higher degree of 'complementing' activities more beneficial for QI.

5. Discussion

By applying the KM framework based on Nonaka [10,16] (Table 1) and Choo and de Alvarenga Neto [14] (Table 2), it was shown that the characteristics of the specific multilevel and professional interaction processes in the differently structured healthcare systems affected the clinical conditions for knowledge creation and QI processes. However, given these characteristics, hospital managers can enhance the conditions for clinical QI processes by developing a supporting KM infrastructure through a number of reinforcing enablers.

5.1. How multilevel interaction affects clinical conditions for QI

According to the within case and cross case analysis, the characteristics of national healthcare policy and interaction patterns between macro, meso and micro levels were found to create multilevel steering mechanisms that affected hospital managers' status, role and decision-making latitude to align regulations and support for QI at the clinical level in line with the multilevel KM models for organisational knowledge creation [10,16] (Table 1). The interaction patterns described in the analysis also appear to have affected the conditions for how hospital managers provide an infrastructure for clinical QI efforts according to Table 2 [14].

5.2. KM infrastructure enabling QI

The four dimensions of KM enablers seemed to reinforce or counteract each other, depending on the extent of their interrelatedness, confirming that they need to form a holistic KM infrastructure [14], which to a higher extent was revealed in Swedish and Norwegian cases. In the Portuguese case, the effects of the separation and subordination of nurses versus doctors was aggravated by the lack of hospital managers' support in creating enabling conditions to enhance a shared understanding of QI. In the English case, the effects of the differences between hospital managers' and clinical professionals' values regarding QI was worsened by the lack of enabling KM infrastructure to support alignment of national guidelines and profession-based knowledge for clinical QI tasks. In fact, to a large degree the KM infrastructure had an emergent character that was not the result of explicit and purposeful design as a means to learn and improve. An approach in line with recommendations in the literature on hospital KM infrastructure for QI efforts may have been useful, e.g. [11].

5.3. Professional clinicians' action strategies in QI efforts

The differences in clinical QI support and guidance affected professionals' action strategies in QI efforts in relation to the extent of hospital managers' KM infrastructure support. The more insufficient the support, the more the clinical professionals strived on their own to adapt healthcare policy and regulations to guide their QI efforts through available resources. At the maternity department level, we termed the consequential action strategies as 'filling in', 'competing', 'contextualizing' and 'complementing' to characterize how professionals dealt with the various support and guidance for clinical QI.

5.4. Hospital managers' opportunities to provide an appropriate context for QI efforts

Our findings indicate a potential for hospital managers to contribute to QI through developing an appropriate context supporting clinical QI activities through an adequate KM infrastructure. They can thereby respond to calls suggesting that what leaders can achieve depends on the structural context created by higher-level

leaders such as resources delegated for QI and the organisational capacity to improve [12]. They can do so by analyzing their own composition of KM enablers, how different enablers interrelate, how they could integrate alignment of national guidelines and standards for QI and how they can use that knowledge for improving the conditions for clinical QI efforts.

5.5. What about the relation between finance and quality?

A relevant question to address regarding the contextual conditions for QI is how hospital managers responded to external demands in terms of finance and quality. This was specifically examined in another QUASER article which drew on institutional theory [32]. Although the strength of demands for cost and quality were higher in the Portuguese and English hospitals compared to the Norwegian and Swedish it was concluded that hospital managers' ability to handle this was largely associated with different strategies and competence to align cost and quality demands with an overall QI strategy. Their ability to develop a culture where QI becomes embedded and linking cost reduction measures to the improvement of care was then shown to be crucial.

5.6. Is there one best way to QI?

Given the different and complex characteristics of each healthcare system as the local context for each hospital and external demands in terms of financial constraints, hospital managers cannot copy success from elsewhere. Therefore, the results do not suggest one best practice for QI the in any of the studied hospitals in the four different healthcare systems, but rather an increased understanding of multilevel intertwined patterns of interaction and support affecting local QI efforts. Thus, the results could be used by hospital mangers as guidance in the design of a QI strategy to suit their own organization. In addition, the learnings from the QUASER project have been developed into a reflective guide for hospital managers [33].

6. Limitations

The cross-case analysis was based on case study reports from researchers in each of the four countries. Discrepancies in number of interviews and hours of observation were due to different conditions for access in the hospitals studied. Data was analyzed by researchers in their own language, then written into a case study report translated into English. It is therefore possible that some nuances of the data have been lost in spite of the common framework for collecting and analyzing the data and thorough checks.

There are of course, natural limitations in studying one clinical specialty, in one hospital in each of the four European countries during a limited period of time. However, the study provides a unique macro-meso-micro analysis of detailed data to explore how multilevel and professional interactions in various healthcare systems affect the conditions for clinical professionals' QI efforts and the potential for further improvements through hospital managers creating enabling conditions for QI. The absence of quantitative data may be seen as a limitation. However, with the focus on exploration of complex multilevel interactions and social processes affecting QI, qualitative data was considered the key methodological choice.

7. Conclusions

In this study we applied a KM framework by combining theories on a) multilevel KM models practices and b) KM infrastructure enabling conditions to explore how hospital managers can enhance the conditions for clinical QI in maternity services given the specific multilevel and professional interactions in four different healthcare systems.

Four findings stand out from the analysis: First, the unique configuration of national healthcare policy, hospital management and clinical professionals influence the development of clinical QI efforts. Second, these different configurations provide various and often insufficient support and guidance which affect professionals' action strategies in QI efforts. Third, hospital managers' opportunities and capabilities for developing a consistent KM infrastructure with reinforcing enabling conditions which merge national guidelines with clinical reality are crucial for clinical QI. Fourth, hospital managers' understanding of these interrelationships provide an opportunity for improvement of the KM infrastructure through tailored interventions.

The characteristics of knowledge creation practices in each of the four healthcare systems shaped different patterns of interactions which affected the systems' QI processes. A middle-up-down KM practice where hospital managers were the driving force for knowledge creation promoted multilevel interaction, which indicated benefits for clinical QI efforts compared to a top-down or bottom-up practice where higher level managers or clinical professionals were the driving knowledge creating forces, respectively.

We further propose that the middle-up-down KM practice increases the incentives for hospital managers to develop reinforcing KM conditions to support professionals' knowledge creation and QI activities: e.g. by aligning national regulations with frontline reality, establishing boundary spanning roles, fostering a shared understanding of quality though open dialogue, learning arenas and information tools.

The development of hospital managers' skills in creating complementary enabling conditions for QI, aligned with profession-based reality, is clearly vital. We suggest that the use of the findings in this study can contribute to these skills.

In addition to possible lessons learned for hospital managers to increase their QI efforts, healthcare policy makers can benefit from the light shed on how multilevel interaction patterns affect QI outcomes. The findings in this study point to a need for further research on multilevel contextual conditions for clinical QI. Involving more hospitals and clinical specialties would then be valuable.

8. Authors contributions

This article is part of an EU-funded research project in ten hospitals in five countries. The width of the project therefore required many researchers' contributions. In this paper where healthcare systems in four countries were explored, eight researchers' contributions where needed to collect and analyse data and develop this article. All authors meet the authorship requirements.

Authors, contributions in more detail:

AK contributed to the study design, acquisition of data, led the within and cross-country analysis and interpretation of data, and prepared the manuscript in collaboration with JMS. KA, JEA, AF, PJH, NJF and BAG contributed to study design, acquisition of data, within country analysis in the respective countries, verified the cross-country analysis and commented on manuscript drafts until submission.

9. Competing interests

The authors declare that they have no competing interest.

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11. Ethics Approval

If required, ethical approval was granted in each country and consent obtained from the involved informants. The following institutions approved the project: Norwegian Social Science Data Services, ref. 26636 (Norway); Regional Ethical Committee, Linköping, ref. 2011/164-31 (Sweden); and NRES Committee South East Coast, Surrey, ref. 11/L010348 (England). Ethical permission for this study was not necessary under Portuguese law as no patient data was collected. In the Portuguese hospital, the board of directors authorized the collection of data, and the ethics committee was informed. In the countries where ethical approval was required, a consent form for staff interviews was signed by each interviewee with permission to use the documented data by the researchers.

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