# Hand hygiene expectations in radiology- a critical evaluation of the opportunities for and barriers to compliance.


## A Jeanes[1], F Henderson[2], N Drey[3] & D Gould[4]

**Corresponding author**

**Annette Jeanes**

**[1]Infection Control Department**

**University College London Hospitals**

**3rd floor East**

**250 Euston Road**

**London NW1 2PG**

**Tel: +44203 447 8974**

**Email: annette.jeanes5@gmail.com**

**Annette.jeanes@nhs.net**

**[2]Radiology Department**

**University College Hospital,**

**3rd floor East**

**250 Euston Road**

**London NW1 2PG**

**[3] City University London**

**Northampton Square**

**London EC1V OHB**

**[4] Cardiff University**

**4th Floor,**

**Eastgate House,**

**35-43 Newport Road,**

**Abstract**

**Introduction**
Good hand hygiene practices reduce the risk of transmission of infection in healthcare. In common with other areas of healthcare, infection control knowledge and practice in radiography has potential for improvement. Regular hand hygiene compliance monitoring indicated poor compliance in radiology which did not accurately reflect practice in one organisation.
Using a quality improvement cycle, the process and context of work undertaken in radiology was examined in order to improve the validity and utility of hand hygiene compliance monitoring data collection process in the department.
**Methods**
Following examination of the evidence base and with agreement of the Radiology team, the chest X-ray process was observed and actions notated. This was then scored using the organisation and the WHO five moments of hand hygiene tool. An alternative risk based scoring system was developed.
**Results**
The hand hygiene compliance score of 22% was obtained using standard measurements. Achievement of 100% compliance would require the radiographer to clean their hands nine times for each X-ray. The sequence of taking a chest X-ray was examined and two points in the process were identified as key points at which hand cleaning should take place to reduce the risk of transmission of infection.
**Conclusions**
Cleaning hands frequently to achieve compliance expectations in this short low risk process is neither feasible nor beneficial. A pragmatic risk-based approach to hand hygiene expectations in predictable procedures such as taking a chest X-ray reduces ambiguity and potentially increases compliance.

**Key words**
Hand hygiene
Compliance
Radiographer
Quality improvement
Monitoring
Sequence

# Hand hygiene expectations in radiography- a critical evaluation of the opportunities for and barriers to compliance.

## Introduction

Good hand hygiene practices reduce the risk of transmission of infection in healthcare (Allegranzi & Pittet 2009). In common with other areas of healthcare, infection control knowledge and practice in radiography has potential for improvement (Mirza et al 2015, O'Donoghue et al 2016). Regular hand hygiene compliance (HHC) monitoring is recommended within organisations (WHO 2009) to improve compliance and provide assurance (Walker et al 2017).

In one acute hospital, the radiography department reported low rates of hand hygiene compliance. This is a description of work undertaken to improve compliance and monitoring of hand hygiene.

The 'gold standard' of healthcare HHC monitoring is by the observation of practice and is frequently based on the 'Five moments of hand hygiene' which determines when hand hygiene is required during patient care (Sax et al 2009). These are defined as hand hygiene opportunities. To achieve compliance, hand hygiene opportunities (HHO) are followed or preceded by hand hygiene.

The validity and quality of the hand hygiene compliance data collected using this methodology has been criticised (Gould et al 2011, Larson 2013). Providing robust and credible data is important in promoting and sustaining best practice and quality improvements. The provision of poor quality HHC data undermines efforts to improve compliance and prevent infection.

Whilst diagnostic imaging has a lower risk of transmission of infection than interventional radiology (Malavaud et al 2012), all such procedures and practices have the potential to transmit infection via staff and equipment (Bibbolino et al 2009, Aso et al 2010). In addition, radiology staff may act as vectors (Lin et al 2005, Nihonyanagi et al 2006) and carry pathogens to other areas of the hospital such as Intensive Care, NICU or Oncology where patients may be particularly vulnerable to infection.

In one organisation, the quality of the HHC monitoring data collected from clinical areas was reviewed and was found to be an inaccurate reflection of practice (Jeanes et al 2015). It was acknowledged that to make improvements in this process it was important to understand the context and feasibility of HHC. In addition, it was recognised that not all areas of practice are the same and that the expectations of compliance should reflect both risk and feasibility.

Radiography managers were unclear where improvements could be made and requested a review of practice and suggestions for improvements in the absence of published evidence-based guidance in this speciality. The aim of this work was to improve the validity and utility

of hand hygiene of the compliance monitoring data collection process in one radiography department.

## Methods

This observational study used elements of the Pronovost quality improvement cycle (Pronovost et al 2009) which were:

- Summarise the science – review the evidence and identify the interventions which will have the greatest positive benefit
- Measure performance –determine the compliance with proposed improvements and collect feedback from users
- Understand the current process and context of work- walk the process with clinicians to identify context, defects and systemic problems
- Ensure patients reliably receive the intervention.

The project team of a senior radiographer and a senior infection control practitioner (ICP) agreed the scope and approach of the project.

## Results – Quality improvement cycle

### Summarise the science

The literature associated with hand hygiene compliance in radiography was examined. Though there are many studies associated with hand hygiene compliance in healthcare few relate to this speciality (O'Donoghue et al 2016). Despite efforts to improve compliance

inadequate hand hygiene continues to be found (Sladek et al 2008, Korniewicz & El-Masri 2010. The reasons for a lack of compliance are complex (Jumaa 2005), but barriers include lack of time (Arenas et al 2005), inadequate facilities (Cochrane 2003), lack of education and awareness (Pittet et al 2004), risk perception (Santosaningsih et al 2017), ambiguity (Gurses et al 2008), lack of self-efficacy (De Wandel et al 2010) and organisational culture and norms (Griffiths et al 2009).

Opportunities to improve compliance include providing education and training (Barrett & Randle 2008), removing ambiguity (Ong et al 2013), improving self-efficacy (Ngo & Murphy 2005), providing positive role models (Buffet-Bataillon et al 2010), and optimal facilities (Noskin &, Peterson 2001), preferably with an organisational culture which supports compliance (Jamal et al 2012).

**Measure performance**

The organisation used an observation based hand hygiene compliance monitoring tool (Lewisham 2006). The radiography department was perceived to be an organisational outlier in HHC reporting. The department at that time achieved a monthly score of <85% compliance against an organisational target of >90%.

**Understand the current process and context of work**

The chest X-ray process was selected as it is a simple procedure which was undertaken frequently. The HHC of radiographers was observed by an ICP in the radiography department

as monitoring in clinical areas would require prolonged periods of observation to obtain a representative sample of practice (van de Mortel & Murgo 2006).

The ICP observed the chest X-ray process in the radiography department of an acute hospital for three hours. The clients were predominantly out-patients but included some low dependency in-patients. Emergency department patients were not included as these X-rays were undertaken in the Emergency department. All X-ray related actions taken by the radiographer were notated at the time. This was then scored using the in-house hand hygiene tool and the WHO five moments of hand hygiene. These scores were then compared. A formal risk assessment was also undertaken.

A proposal for simplifying the monitoring approach was developed and discussed with the radiography team including managers. It was recognised that in the absence of specific guidance relating to radiography that the experience and information from comparable specialities would be extrapolated.

**Results of observing chest x-ray process**

The process of taking a chest X-ray in the radiology department was observed for three hours. An extract of the middle section of the notated observation is included in Box 1.

The organisation HHC measuring tool was applied to a representative extract of the observed chest X-ray process. In the extract below the action observed is followed (in brackets) by the hand hygiene expectation.

Extract

1. Hand wash at sink in room (clean before patient contact)
2. Gets patient (child) in wheel chair into room
3. Checks details of D.O.B, identity, procedure expected (clean after patient contact)
4. Answers phone (clean after contact with equipment)
5. Positions patient (clean after patient contact)
6. Positions equipment (clean after contact with equipment)
7. Adjusts patient position (and tells patient to breathe in and hold) (clean after patient contact)
8. Presses button to take x-ray (clean after contact with equipment)
9. Returns patient to chair (patient leaves with nurse and carer) (clean after patient contact)
10. Cleans x-ray machine with alcohol wipe and changes paper sheet on roll on machine (clean after contact with equipment)
11. Hand wash at sink in room

Result

Hand hygiene opportunities =9

Hand hygiene undertaken =2

Compliance = 22%

The HHC score was lower than that obtained by radiography staff in previous reports.

The process was repeated with the WHO five moments of hand hygiene (Figure 1) and the same extract. In the extract below the action observed is followed (in brackets) by WHO five moments of hand hygiene expectation.

Extract

1. Hand wash at sink in room (moment 1)
2. Gets patient in wheel chair into room
3. Checks details of D.O.B, identity, procedure they expect to have (moment4)
4. Answers phone (moment 5)
5. Positions patient (moment 4)
6. Positions equipment (moment 5)
7. Adjusts patient position (and tells patient to breathe in and hold) (moment 4)
8. Presses button to take x-ray (moment 5)
9. Returns patient to chair (patient leaves with nurse and carer) (moment 4)
10. Cleans x-ray machine with alcohol wipe and changes paper sheet on roll on machine (moment 5)
11. Hand wash at sink in room

WHO moments =9

Hand hygiene undertaken =2

Compliance = 22%

The result was the same as with ~~of~~ the organisation tool.

Each chest X-ray procedure took less than five minutes and sometimes as little as three minutes. The chest X-ray process was a repetitive sequence of actions. The hand hygiene undertaken by the radiographer was assessed by the IPC to be appropriate. A formal risk assessment using a hazard analysis critical control point (HACCP) process (Mortimore & Wallace 2013) was undertaken by the Infection Control team and Radiography department. The chest X-ray process was mapped to a HACCP flow diagram (Diagram 1) which was used to identify potential hazards based on the knowledge and experience of both teams. The

associated controls were matched to the process and the theoretical hazards were analysed (Diagram 2). Two Critical Control points were identified at the beginning and end of the chest X-ray process (Diagram 2). A risk assessment of the proposal to rationalise hand hygiene compliance expectations was then undertaken utilizing the organisational risk assessment matrix (Table 1). This indicated no increased risk in a process for which the infection control risk was already low.

Based on the assessment the following sequence with proposed hand cleaning expectations was discussed and agreed with radiography staff and managers at departmental meetings over a two month period.

Suggested and agreed sequence for chest X-ray:

- Clean hands (with alcohol if visibly clean)
- Get patient from waiting area
- Checks details of D.O.B, identity, procedure expected
- Position patient
- Position equipment
- Press button to take x-ray and check picture via keyboard and screen
- Patient leaves
- Work on key board
- Clean x-ray machine with alcohol wipe and change paper sheet on roll on machine
- Clean hands (with alcohol if visibly clean)
- Work on key board/positions of equipment etc
- Clean hands
- Get next patient

## Discussion & conclusions

The Hawthorne effect (Dickson & Roethlisberger 2004) and issues such as allegiance of staff may affect the scores obtained by observers (Pan et al 2013). It is not uncommon for an unbiased observer to obtain a lower HHC score than internal observers (Dhar et al 2010). In this instance, the extract used for analysis was from a middle section of the observation when the effect of being observed may have waned (Gravetter & Forzano 2011).

This was a procedure which was assessed to have a low risk of infection transmission with serious consequences. To achieve 100% HHC during this process would require nine hand cleansing actions. It is unclear what benefit increasing the frequency of hand hygiene would deliver.

It would increase the time taken to undertake this procedure, which would affect efficiency and increase patient waiting times. This could be detrimental to the patient. E.g. stop and wash or gel hands whilst the patient is correctly positioned or holding their breath.

HHC tools are designed to measure hand hygiene in wards but do not reflect the work and practice of radiography. Changing the work pattern of the radiographer to comply with hand hygiene compliance expectations would be unsafe and could potentially cause harm to patients. The purpose of hand hygiene is to reduce the transmission of infection and increase patient benefit. It would not be beneficial or feasible to stop to wash or gel hands during key

parts of this procedure. However, the tool was designed as a guide and it was envisaged that it would be adapted for specialist areas (Sax et al 2009).

Sequential procedures such as taking a chest X-ray could be assessed and hand hygiene expectations clarified, to optimise infection prevention and take into account feasibility. It could form the basis of consistent and realistic HHC monitoring in areas with predictable processes.

This would have several advantages including simplifying expectations and removing ambiguity for the auditor and audited. This would enable intermittent validation of the scores obtained as the measurement could be replicated. It could also reduce the time required to audit, as it would only require sufficient observation to provide assurance of compliance. The time saved could be used instead to ensure other aspects of infection control are optimal such as maintenance of a clean environment, availability of hand hygiene products, education and knowledge of staff relating to infection prevention and control.

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**Declaration of conflicting interests**

The Authors declare that there is no conflict of interest.

** & ** conceived the review of monitoring. ** researched the literature. **, ** and *** discussed study design. ** analysed the data with input from **, ** & ***. **wrote the first draft of the manuscript with contributions from ** and ***. All authors reviewed and approved the final version of the manuscript.

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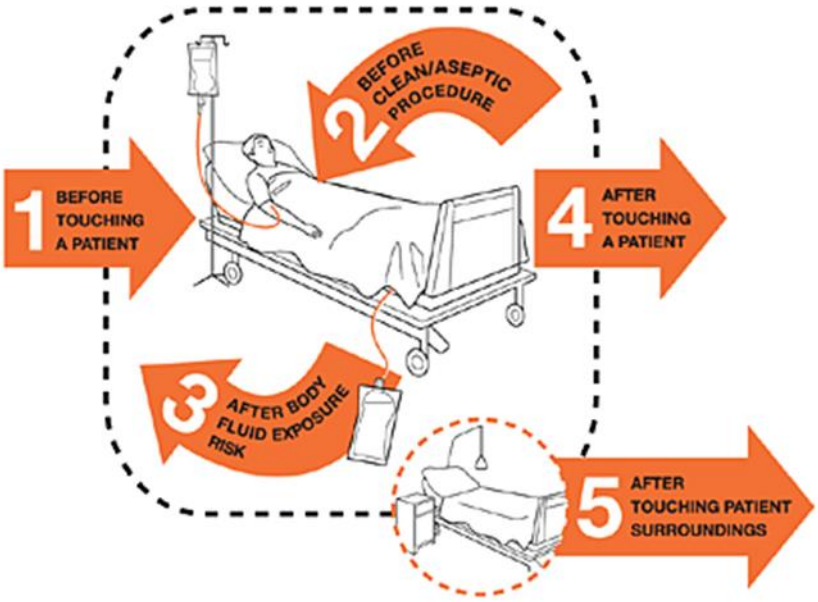
**Figure One The five moments of hand hygiene (Sax et al 2009)**




## Box 1 Extract of detailed observation of chest x-ray process

### Box 1 Extract of detailed observation of chest x-ray process

1. Hand wash at sink in room

2. Gets patient in wheel chair into room (child)

3. Checks details of D.O.B, identity, procedure expected

4. Answers phone

5. Positions patient

6. Positions equipment

7. Adjusts patient position (and tells patient to breathe in and hold)

8. Presses button to take x-ray and then checks picture via keyboard and screen

9. Returns patient to chair (patient leaves with nurse and carer)

10. Cleans x-ray machine with alcohol wipe and changes paper sheet on roll on machine

11. Hand wash at sink in room

12. Works on key board

13. Repositions x-ray equipment

14. Gets patient from waiting area (in wheel chair with oxygen)

15. Checks details of D.O.B, identity, procedure expected

16. Begins to remove outer clothing of patient and discovers they aren't in a gown suitable for chest x-ray

17. Goes outside and gets nurse who was accompanying patient

18. Nurse enters (no hand hygiene undertaken)

19. Radiographer withdraws whilst patient is undressed by the nurse

20. Nurse undresses patient and puts gown on patient (leaves and no hand hygiene)

21. Radiographer re-enters and positions equipment

22. Positions patient (and tells patient to breathe in and hold)

23. Presses button to take x-ray and then checks picture via keyboard and screen

24. Re positions patient in chair

25. Wheels patient out

26. Cleans x-ray machine with alcohol wipe and changes paper sheet on roll on machine – stops halfway through

27. Gives notes to nurse outside

28. Recommences cleaning of x-ray machine with alcohol wipe

29. Hand wash at sink in room

30. Works on key board

31. Gets patient from waiting area (10.13 hours)

32. Checks details of D.O.B, identity, procedure expected

33. Positions patient

34. Positions equipment

35. Presses button to take x-ray and then checks picture via keyboard and screen

36. Patient leaves

37. Works on key board

38. Cleans x-ray machine with alcohol wipe and changes paper sheet on roll on machine

39. Hand wash at sink in room

40. Gets patient from waiting area

41. Checks details of D.O.B, identity, procedure expected (10.18 hours)

42. Works on key board

43. Positions equipment

44. Positions patient

45. Positions equipment

46. Presses button to take x-ray and then checks picture via keyboard and screen

47. Advises patient re results and GP- patient leaves

48. Works on key board

49. Cleans x-ray machine with alcohol wipe and changes paper sheet on roll on machine (10.23 hours)

50. Hand wash at sink in room

51. Gets patient from waiting area

52. Checks details of D.O.B, identity, procedure expected

53. Works on key board

54. Positions patient

55. Positions equipment

56. Presses button to take x-ray and then checks picture via keyboard and screen -patient leaves

57. Cleans x-ray machine with alcohol wipe and changes paper sheet on roll on machine (10.25 hours)

58. Hand wash at sink in room

59. Answers phone

60. Looks for phone numbers

61. Works on key board

62. Leaves room

63. Works on key board

64. Takes paper from someone who walks in

65. Takes them to the changing room and explains about getting changed prior to x-ray

66. Works on key board

67. Patient returns (10.30 hours) Checks details of D.O.B, identity and procedure they expect to have

68. Positions patient

69. Positions equipment

70. Presses button to take x-ray and then checks picture via keyboard and screen

71. Explanation to patient

72. Opens door for patient to leave

73. Cleans x-ray machine with alcohol wipe and changes paper sheet on roll on machine

74. Washes hands (10.34 hours)

75. Works on key board

76. Patient enters. Checks details of D.O.B, identity, procedure expected

77. Positions patient

78. Positions equipment

79. Presses button to take x-ray and then checks picture via keyboard and screen

80. Touches patient in reassurance explanation

81. Opens door for patient

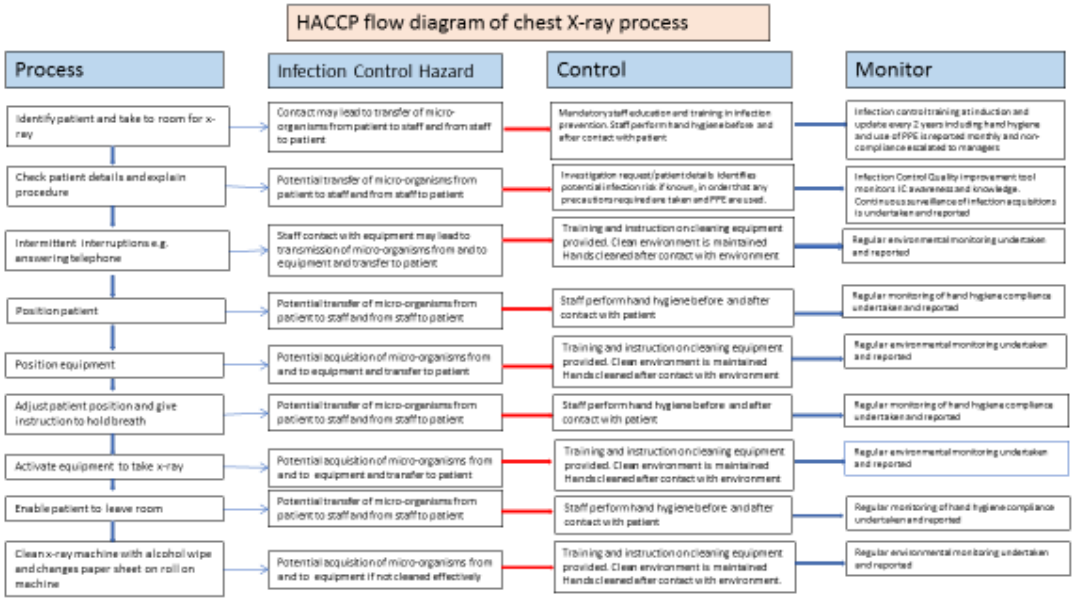
82. Discussion with person outside.

83. Does paperwork

84. Cleans x-ray machine with alcohol wipe and changes paper sheet on roll on machine

85. Washes hands

## Diagram 1 HACCP Flow diagram of chest X-ray process




## Diagram 2 Infection control Critical control points in chest X-ray process

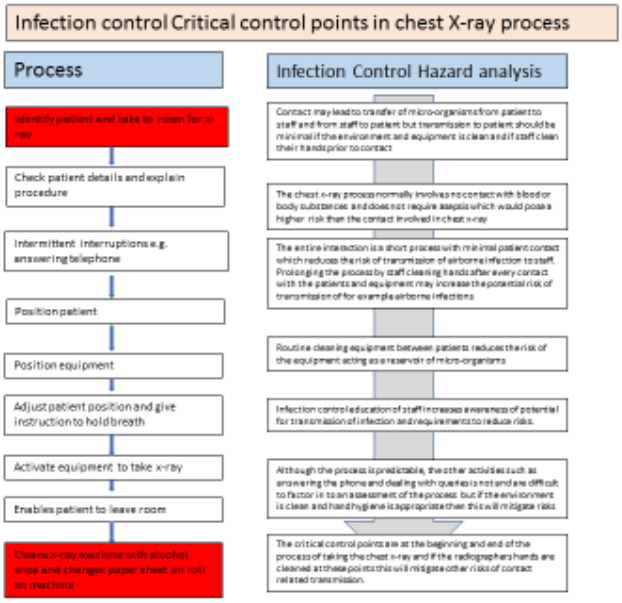


**Table 1 Risk assessment of clarification and rationalisation of hand hygiene in chest X-ray**

| Risk assessment of clarification and rationalisation of hand hygiene in chest X-ray | | | | |
|---|---|---|---|---|
| **Risk rating** (Rate from 1 to 5 for severity and likelihood using the risk matrix) | **Severity** | 2 | **Risk score** | 4 |
| | **Likelihood** | 2 | | |
| **Proposed actions** | - Clarify expectations of hand hygiene in the Chest x-ray process<br>- Reduce the number of times staff are expected to clean their hands from up to nine times to at least twice | | | |
| **Risk rating after proposed action** Re-assess the consequence and likelihood to show how the proposed action will be effective in reducing the risk | **Severity** | 2 | **Risk score** | 4 |
| | **Likelihood** | 2 | | |