Abstract
Title: Hand hygiene compliance monitoring in anaesthetics: feasibility and validity

Background

Hand hygiene compliance scores in the anaesthetic department of an acute NHS Hospital were persistently low.

Aims

To determine the feasibility and validity of regular accurate measurement of HHC in anaesthetics and understand the context of care delivery, barriers and opportunities to improve compliance.

Methods

The hand hygiene compliance of one anaesthetist was observed and notated by a senior infection control practitioner (ICP). This was compared to the WHO five moments of hand hygiene and the organisation hand hygiene tool.

Findings

In one sequence of 55 minutes there were approximately 58 hand hygiene opportunities. The hand hygiene compliance rate was 16%.

The frequency and speed of actions in certain periods of care delivery made compliance measurement difficult and potentially unreliable. During several activities, taking time to apply alcohol gel or wash hands would have put the patients at significant risk.

Discussion

We concluded that hand hygiene compliance monitoring by direct observation was invalid and unreliable in this speciality. It is important that hand hygiene compliance is optimal in anaesthetics particularly prior to patient contact. Interventions which reduce environmental and patient contamination such as cleaning the patient and environment could ensure anaesthetists encounter fewer micro-organisms in this speciality.

Background

Optimal hand hygiene compliance (HHC) by healthcare workers contributes to the reduction and acquisition of healthcare associated infection (Pittet et al 2000). Monitoring HHC is an established method of providing assurance of compliance with infection control practice (NICE 2011). Tools such as the WHO five moments of hand hygiene (Sax et al 2009) have been used widely to measure HHC and produce a score based on observed compliance (WHO 2009). This method is generally accepted to be the 'gold standard' (Boyce & Pittet 2002) of HHC monitoring and the results obtained are used for assurance and comparison.

The use of observation as to measure HHC has been criticised as it may provide an inaccurate reflection of practice (Eckmanns, Bessert, Behnke et al 2006) (Gould, Drey, Creedon 2011). In addition, auditors may produce inconsistent results depending on many factors including training and experience (Gwet 2014).

It has been recognised that consistently attaining 100% HHC may not be feasible and could interfere with care (Voss & Widmer 1997, McArdle et al 2006, Steed et al 2011), whilst achieving low levels of HHC may be viewed as failure and persistent non-compliance may be considered deviant (Pittet & Boyce 2001, Goldmann 2006).

The hand hygiene compliance of anaesthetists has been researched previously (Magee et al 1995, El Mikatti et al 1999, Pittet et al 2003, Krediet et al 2011, Loftus et al 2011, Biddle & Shah, 2012, Scheithauer et al 2013). The delivery of anaesthesia frequently requires invasive procedures and contact with body substances including blood (Chakravarthy 2010). There is a significant risk of transmission of infection in this speciality (Loftus et al 2012, Scheithauer et al 2013). Several pathogens have been identified in the anaesthetic environment and on equipment handled by anaesthetic staff including phones, laryngoscope handles and stopcocks (Hall 1994 , El Mikatti 1999, Brady et al 2007, Jeske et al 2007, Call et al 2009, Loftus et al 2012). The hands of anaesthetists have been found to be a significant vector of micro-organisms (Magee et al 1995, Loftus et al 2011). However, a key finding in studies of hand hygiene in anaesthetics has been a low level of HHC (El Mikatti et al 1999, Pittet et al 2003, Krediet et al 2011), which increases the potential risk of transmission of infection at a critical point in patient care.

Several interventions have been proposed to improve HHC in anaesthetics. These include education (Bellaard-Smith et al 2012), coaching and feedback of performance (Martin et al 2013), cleaning of the environment (Munoz-Price et al 2012 & 2013, Rowlands 2014), decolonisation or cleaning of patients prior to surgery (Loftus et al 2015) and improved work flow (Pittet et al 2003).

A key barrier to improving compliance is the rapid actions or 'task density' (Scheithauer et al 2013, Biddle & Shah 2012) and the 'intensity of patient care' (Pittet et al 2003) required in anaesthetics. This impedes achieving high levels of HHC in this speciality. There is an expectation in some organisations that the HHC of anaesthetists is comparable to other health care workers and is monitored with a standard observation based tool which may not reflect the rapidity and complexity of the work undertaken.

In our organisation anaesthetics, were persistent outliers in HHC reporting performance with reported monthly scores ranging from 60-100% (Jeanes et al 2015). The policy of the organisation was to undertake an investigation to improve performance whenever a score fell below 75%. The staff conducting the audits attributed the results to poor practice but anaesthetic staff recognised that the measurement method did not take into account the type of work undertaken. A review of the hand hygiene practice of anaesthetists was requested by managers and anaesthetists.

The aims were:

- to determine the feasibility and validity of regular accurate measurement of HHC in anaesthetics using the organisation hand hygiene tool
- to understand the context of care delivery, potential barriers and opportunities to improve compliance.

This paper describes the observed clinical work and hand hygiene practice of one anaesthetist in an acute hospital in London. It discusses the feasibility of achieving standard expectations of hand hygiene compliance in this rapid and complex speciality and the reliability of compliance measurements based on observation.

Methods

A quality improvement methodology was used (Pronovost et al 2009) to review the current monitoring process in theatres in the context of the workplace. Managers and staff of the anaesthetic department met with a senior infection prevention and control practitioner (ICP). It was agreed that the ICP would undertake an extended session of the regular observation of HHC undertaken in theatres for compliance monitoring assurance. This was to concentrate specifically on anaesthetic practice in order to also understand the context and complexity of the work undertaken in the speciality. In addition the feasibility of the observation and measurement of HHC of anaesthetics would be assessed and results fed back to the group. One consultant anaesthetist agreed to be observed and liaise with colleagues about the results.

A 'typical' example of the work undertaken by a consultant anaesthetist during a morning operating list was overtly observed by the ICP. The primary focus of the observation was the manual activity including hand hygiene of the anaesthetist. The sequence of work undertaken by the anaesthetist was manually notated.

The anaesthetist was observed for approximately 3 hours and thirty minutes on one morning. The reason for the presence of the ICP was explained to the staff working in the area. There were some brief interruptions in the work undertaken primarily for the anaesthetist to provide assistance and support in other areas. Only the actions of the anaesthetist were recorded.

These recorded actions were retrospectively correlated with the WHO five moments of hand hygiene (Sax et al 2007) and the standard organisation hand hygiene tool which was based on the Lewisham HH tool (Rao et al 2002).

The observations and compliance measurements were fed back to the observed clinician on the same day. A report and feedback was subsequently provided to managers and anaesthetic staff.

Subsequently a typed copy of the main sequence of observed actions was sent to ten experienced hand hygiene monitoring staff for review to identify when they would expect hand hygiene to occur in the sequence. The consistency of the auditors was calculated by means of the Fleiss's kappa coefficient statistic using unweighted interrater agreement with STATA 12 [StataCorp. 2011. Stata Statistical Software: Release 12. College Station, TX: StataCorp LP].

This was part of the continuous quality improvement (CQI) work (Mc Laughlin & Kaluzny 1999) undertaken in the organisation. Hand hygiene compliance monitoring is an established part of many HCW's role. The Healthcare Quality Improvement Partnership (HQIP) guidelines for CQI research (Dixon 2009) were utilized to assess for the presence of significant ethical issues in this work. It was concluded that there was no requirement for ethical approval as regular hand hygiene compliance monitoring of healthcare workers has been established for more than a decade (Storr 2005) and consent is not required. In addition, the data collection process did not fringe on patients' rights, did not involve a departure from usual clinical care and no data was collected from patients or about patients.
The anaesthetist volunteered for this work (and is an author) and the organisation agreed to the publication of this work.

Results

During the observation, there was minimal hand hygiene in the presence of many actions which are classified as HHO's in the initial stages of the reception of the patient and during anaesthetic delivery. The anaesthetist wore non sterile disposable gloves and changed them rather than gel or wash hands during some stages of care delivery. Once the patient was in theatre and stabilised, there were less actions and proportionally more hand hygiene activity.

Paradoxically, the frequency of hand hygiene increased as the risks of transmission decreased. After the initial rapid activity of induction and movement of the patient from the anaesthetic room to the theatre, the use of gloves decreased and the use of alcohol hand gel increased as the patient was stabilised.

The longest unbroken sequence of direct patient care was for approximately 55 minutes during which time the anaesthetist sequentially anesthetised and cared for two patients. An extract from this sequence is in Table 1. During this time the anaesthetist performed 76 observed actions; ≥58 which are classified as hand hygiene opportunities (HHO) using the WHO criteria, and the anaesthetist cleaned his hands six times (i.e. six hand hygiene events) resulting in < 10.3% HH compliance.

By contrast, the organisation tool classified ≥56 actions as HHO as it requires hand hygiene before and after glove use but merges some actions into sequences. This includes intubation,

naso-gastric tube insertion, suction of naso-gastric tube and securing of tubes to the patient's head, as these would be done in quick succession as one complex operation. Examples are actions 11, 12, 13 (Table 1).

The HHC rate for the 55 minute sequence using the two methods ranged from <10.3% to <10.7% depending on the auditing tool and the interpretation of the tool by the auditor. (Table 1). However the frequent use of disposable gloves for sequences of activities made this calculation more complex. If the use of gloves is assumed to be appropriate in the presence of body substances and the changing of gloves is assumed to be a surrogate for hand hygiene then approximately 20 actions could be removed from this HHO calculation. The HHC score then ranged between <15.7 and<16.6%. There was little difference between the results of the two tools, both suggesting unacceptably low scores, although the ICP assessed the actions observed were appropriate within the context of the care delivered and risks encountered.

The anaesthetist was assisted at times, particularly at induction and intubation, but often worked alone. He had to gather and manage his own equipment which included going from the theatre to the anaesthetic room to get drugs. A personal mobile telephone was used which enabled him to remain in communication with his colleagues in other theatres.

The working environment of the anaesthetic room was tight and the equipment required was near to hand. The environment was visibly clean but there were many items such as pre-filled syringes, infusions and intubation kit, ready to use on surfaces which could become contaminated prior to use. The environmental surfaces frequently touched by the anaesthetist in the anaesthetic room and theatre included the anaesthetic trolley, the anaesthetic machine, doors and door handles, flat surfaces used for drug preparation and storage and the moveable sides of the patient trolley. During the same period the anaesthetist touched the head, neck, arms, intravenous and ventilator devices, auscultated chests and assisted with the movement of the patient onto and off the operating table. The only surfaces regularly cleaned during the observation were the anaesthetic machine and some flat surfaces.

Whole sequences of care rather than periods of time were observed but the frequency and speed of actions in certain periods of care delivery meant that even for an experienced ICP it was difficult to identify when hand hygiene should and could take place, particularly during

certain sequences of care associated with induction and intubation. Consequently scoring hand hygiene opportunities was done retrospectively and was potentially subjective. It was unclear if different observers would produce consistent scores for the same observed actions. As real-time validation of the scoring was not possible, it was agreed that infection control nurses with > 1 years' experience of HHC monitoring would be asked to score part of the documented observation. Ten people including staff working in other acute units were invited to participate and were asked to indicate which of the actions identified should be accompanied by hand hygiene.

Five of the ten hand hygiene monitors invited completed the review of 55 minute sequence, a section of which is shown in Table 1 This revealed a general lack of consistency in the decisions made by the auditors. (Figure 1; Kappa = 0.012). This is in spite of at least three auditors at one time in agreement within each action (not always the same three auditors across all actions). There was agreement that no hand hygiene was required for three actions and that hand hygiene was required for action 14. The number of HHO identified ranged from 8 to 65. (Figure 1) This illustrated a lack of consistency in expectations in this sequence.

Discussion

The measured HHC was low reflecting other published studies (El Mikatti et al 1999, Pittet et al 2003, Krediet et al 2011). In this instance, it was assessed to be appropriate but there is considerable scope for improving HHC and infection prevention which will benefit patients.

Compliance results obtained by observation in this speciality may be unreliable, particularly when measuring different stages of the anaesthetic process. The potential lack of consistency in expectations of observers further undermines the results obtained. Observer bias (O'Leary et al 1975), the experience and training of the monitor and the Hawthorne effect (Eckmanns et al 2006), may also be significant.

HHC measurement in this speciality could be onerous using the WHO and other HHC compliance monitoring tools which are dependent on manually recording observations in practice. It was particularly difficult to calculate compliance when disposable gloves were in use.

Anaesthetics is not comparable to work undertaken by staff on most general hospital wards. It was often not feasible or desirable to stop to wash or gel hands during critical stages of the anaesthetic process; such as after administration of the initial intravenous anaesthetic and prior to maintaining the airway. The speed and skill of delivering the anaesthetic and caring for the anesthetised patient is crucial to the patient outcome and disruption of this safe process could be detrimental. It may be more rational to ensure the anaesthetist encounters fewer micro-organisms from the environment and patient rather than seek unachievable expectations of compliance based on little evidence of benefit.

The process of anaesthesia risks introducing infection to the patient (Scheithauer 2013, Loftus et al 2008), though this is primarily associated with aseptic technique and the use of invasive devices (Bennett et al 1995). These actions are more likely to occur at the beginning of the anaesthetic process where the contamination originates from the hands of the anaesthetist (Loftus et al 2011), the previous patient (Rowlands et al 2014), and the current patient's flora (Ayliffe 1991). In addition, intravenous devices, anaesthetic equipment and the immediate intra-operative patient environment (Loftus et al 2011), have been found to be significant reservoirs of micro-organisms in this environment (Loftus et al 2012).

Good design of the environment and equipment, careful cleaning and preparation of the environment (Dancer et al 2009, Wilson et al 2011) and the patient, particularly head, arms and chest prior to the anaesthetic could reduce contamination and transmission risks. These combined with an emphasis on scrupulous hand cleaning by the anaesthetic team before each initial patient contact, together with careful aseptic practice could be a possible strategy. This could form the basis of a compliance assessment. This is not the first time a novel approach (Biddle & Shah 2012) or system change (Pittet 2003) for HHC in anaesthetics has been suggested.

This short observation of a single anaesthetist may not be representative or generalizable although similar findings have been reported in more extensive studies (Pittet 2003, Biddle & Shah 2012, Rowlands et al 2014). In addition the effect of overt observation may have affected the results obtained (Eckmanns et al 2006), or simply reflected the habits of one anaesthetist. However, the purpose of this work was to understand the context and determine the feasibility of measurement of HHC using an observational methodology in anaesthetics.

It was concluded that the compliance scores obtained using observation were unlikely to provide accurate assurance. This method of measurement ceased to be used in this speciality and instead the focus shifted to removing ambiguity about expectations of compliance and removing barriers to compliance. A quality improvement measurement tool which monitors barriers and opportunities for improvement taking into account the local context and risks is now used to monitor infection prevention and control performance in the organisation.

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Declaration of conflicting interests

The Authors declare that there is no conflict of interest.

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

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