Adherence to recommendations designed to decrease intra-operative wound contamination

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ABSTRACT

INTRODUCTION The incidence of wound infection following total hip and knee arthroplasty has fallen with the introduction of laminar vertical laminar airflow, occlusive clothing and prophylactic antibiotics. However, infection still occurs after prosthetic joint replacement and can have devastating consequences. Intra-operative wound contamination is the major source of infection. Measures proven to decrease intra-operative wound contamination include chlorhexidine lavage, removal of jewellery, covering old jewellery, ears, nose, mouth and hair and wearing theatre clothing in an occlusive manner.

PATIENTS AND METHODS Posters explaining this practice were placed at eye level in the scrub area of orthopaedic theatres and adoption of these techniques was observed covertly before and after.

RESULTS Eighty-two personnel were audited before the poster was erected and 90 afterwards. Only 2 of 12 observed standards were adhered to 100% of the time.

CONCLUSIONS Education by posters did not significantly improve adherence to protocols. Compliance with protocols was worse amongst non-scrubbed theatre personnel.

KEYWORDS

Wound contamination – Intra-operative infection – Education

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With the introduction of laminar airflow, occlusive clothing and prophylactic antibiotics, wound infection following total hip or knee arthroplasty has fallen dramatically.^{1–3} Although wound contamination is a risk common to all surgical procedures, it is of particular concern during prosthetic joint replacement because of the very small inoculum required to infect them. A deeply infected joint replacement leads to considerable morbidity and cost.⁴ It is essential to minimise the risk of contamination to reduce postoperative infection rates as far as possible.

The major source of bacterial contamination in operating theatres is theatre personnel. Ritter *et al.*⁵ have shown that, when personnel wearing face masks were present in operating theatres, the bacterial count was 34 times higher than when no-one was present. The interposition of personnel between the source of laminar airflow and the wound increases the bacterial count 27 times.⁶ Madhavan *et al.*⁷ showed a wide variety of practice during joint replacement; many of these practices could cause contamination. The poor compliance with theatre discipline may result from the

lack of evidence on which it is based.⁸ Since the report from the Hospital Infection Society Working Party on Infection Control in Operating Theatres by Woodhead *et al.*,⁸ a significant amount of new data has become available. Evidence-based data includes covering of ears, nose, hair and piercings, tucking in shirts and hoods to occlude bacterial spread from the bellows effects of arm movement on bacteria in the axilla, avoidance of splashing gloves with tap water during scrubbing, use of chlorhexidine lavage and timing of antibiotics before application of tourniquet in total knee arthroplasty (Table 1).^{2,9–15} The aim of this study was to establish whether theatre personnel had the capacity or inclination to incorporate the recommendations for theatre staff (Table 1) and scrubbed staff (Table 2) in their practice.

Patients and Methods

The population being observed were theatre staff present during total hip and knee arthroplasty from 10 July 2006 to 14 July 2006. This population was then re-monitored from

Table 1 Recommendations for theatre staff

Audit criteria	Target	Exceptions	Source of evidence	Instructions for data collection
Ears should be covered	100%	None	Owers <i>et al.</i> ⁹	Observation in theatre
Nose should be covered with a mask	100%	None	Woodhead <i>et al.</i> ⁸	Observation in theatre
Hair should be covered	100%	None	Hubble <i>et al.</i> ²	Observation in theatre
Piercings should be left in and covered	100%	Those that do not have piercings	Bartlett <i>et al.</i> ¹⁰	Observation in theatre
Shirts should be tucked in	100%	None	On the recommendation of the senior arthroplasty surgeon. No published data to support this recommendation	Observation in theatre

24 July 2006 to 28 July 2006. The population was observed as two groups – those who were scrubbed and those who were not. The criteria for each group differed as those scrubbed had additional recommendations for reducing wound infection.

The population included all personnel who were present in the theatre during the operation, from the first incision, to closure of the wound. Data were collected for 82 personnel in the initial audit and 90 in the re-audit; these included consultants, registrars, house officers, anaesthetists, scrub nurses, non-scrubbed nurses (runners and anaesthetist assistants), prosthesis company representatives, porters, nursing and medical students excluding those carrying out the audit. Observations of the above standards were carried out by two observers. Data were collected independently

and compared postoperatively to ensure accuracy. Theatre personnel were not aware that the observations were taking place to avoid influencing practice. One of the 10 consultants, however, was aware of the audit as he was involved in initiating the project.

In the initial audit, each consultant and their theatre team performing total hip or knee arthroplasty during the week, who agreed to have the medical students present in theatre, were observed once. There was one consultant who did not agree to this. There were some personnel, particularly scrub nurses and runners, who were observed on more than one occasion, as consultants do not have independent teams. Following this initial week of observations, a poster of recommendations for reducing wound contamination in arthroplasty (Appendix 1) was placed in each of

Table 2 Additional recommendations for scrubbed staff

Audit criteria	Target	Exceptions	Source of evidence	Instructions for data collection
Gloves should not be splashed during scrubbing	100%	None	Heal <i>et al.</i> ¹³	Observation in theatre
Finger rings should be removed	100%	None	Kelsall <i>et al.</i> ¹¹	Observation in theatre
Hoods should be worn and tucked in	100%	None	Owers <i>et al.</i> ⁹	Observation in theatre
Chlorhexidine lavage should be used	100%	None	Taylor <i>et al.</i> , ¹⁴ Taylor <i>et al.</i> ¹⁵	Observation in theatre
Antibiotics should be given to patient at least 10 min before application of tourniquet in TKR	100%	None	Bannister <i>et al.</i> ¹⁶	Observation in theatre

the scrub areas and changing rooms. This poster was left for a week before a second audit was carried out. This was completed in the same way as the initial audit.

Results

Before the poster was erected, all staff complied with administration of antibiotics 5 min before inflation of tourniquet and lavage with chlorhexidine. Of the staff, 93% left their ear piercings in, 88% covered their nose and mouth, 79% removed their finger rings and 75% ensured that their sterile gloves were not splashed with fluid used to wash their hands. In addition, 68% covered the sinuses left when jewellery was removed and 59% wore a balaclava hood that covered their ears and neck. Less than 50% covered their ears, tucked their hood in their theatre top, covered exposed hair on their heads and only 2% tucked their shirt into the theatre trousers to avoid spread of axillary bacteria.

After the educational poster was erected, 10% more staff tucked their shirts into their trousers ($P = 0.019$), 9% more covered their head hair and there was no difference in any of the other prophylactic measures.

The P -values in Table 3 were calculated to see if the changes seen were statistically significant at the 95% confidence level. Fisher's exact test was performed on the raw data, using the contingency tables for each standard given

in Appendix 1. The only difference that was statistically significant, with a P -value of 0.019, was the number of staff who tucked their shirt into their trousers.

Variations among staff

Neither surgeons, scrub staff, anaesthetists nor support staff in theatre demonstrated any change in practice apart from scrubbed nursing staff, more of whom removed their rings, covered their pierced jewellery, piercing sinuses and ears and head hair after education by poster. However, this improvement was not statistically significant (Tables 2 and 3).

Exceptions to audit criteria

1. It was decided that those who did not wear hoods, did not meet an exception to the audit criteria to tuck them in, and so have been counted as not meeting this criteria.
2. Not everyone has ear/nose piercings and these staff are the exception to the criteria of leaving piercings in but covering them. As exceptions to the audit criteria, they are counted as having met the criteria.

Discussion

This study was carried out in the same operating theatres whose practice was recorded by Madhavan *et al.*⁷ in 1999. It confirms their observations that theatre staff failed to change their practice in response to posters about reducing infection risk that were placed in strategic positions within the theatre. Barriers to adhering to clinical guidelines have been identified in a systemic review and can include a lack of awareness, lack of familiarity with the guidelines, lack of agreement, lack of self-efficacy, lack of outcome expectancy, and inertia of previous practice.¹⁷

In the current study, there are several possible reasons for the observed lack of compliance to the guidelines displayed in the posters. First, it could be that staff failed to read the poster. Unlike other methods of instruction, such as lectures, tutorials and practical sessions, at which attendance can be made compulsory, staff have to be pro-active and make the decision to read the poster. Also, other methods of learning can be interactive, whereas posters are a passive form of communication, which may make people less likely to retain the information they display. Therefore, the results of this study could be a direct result of the weakness of posters as a method of communication, with the barriers to adherence being a lack of awareness and familiarity with the theatre protocol. However, the posters were clearly displayed in the scrub areas of orthopaedic theatres, and it is unlikely that staff did not read the posters while performing the repetitive tasks of scrubbing and gowning that were unlikely to distract attention.

If it is assumed that staff did read the posters, then they did not change their practice because they did not take any

Table 3 The percentage of staff adhering to the given criteria before and after the posters were put up and their corresponding P -value

	Pre-poster (%)	Post-poster (%)	P -value
Covered ears	44	48	0.648
Covered nose/mouth	88	83	0.517
Covered head-hair	29	38	0.261
Piercings left in	93	94	0.759
Covered piercings/holes	68	76	0.311
Shirt tucked-in	2	12	0.019
Gloves not splashed	75	73	1.000
Finger rings removed	79	76	0.781
Hood worn	59	54	0.812
Hood tucked-in	41	38	0.812
Chlorhexidine lavage	100	100	–
Antibiotics	100	100	–

As there was no change for chlorhexidine lavage or timing of antibiotics, no analysis was performed and hence there is no P -value.

notice of the suggested guidelines. Staff may not have taken note of the posters because they did not believe that adherence to the guidelines in the poster would contribute to a reduction in infection rates in the theatre. This belief arises because they did not agree with, or believe, the research evidence to support the guidelines. However, the instructions in the posters related to published practices that are reputed to reduce infection rates. Therefore, it is more likely that the lack of adherence to the theatre protocol was a problem of perception. Inertia of previous practice is unlikely to have led to non-compliance because the existing infection protocol has resulted in deep infection rates at the unit being amongst the lowest reported in the UK.^{3,18} Thus, the lack of adherence to the guidelines in the poster may have been a consequence of the lack of outcome expectancy, which is the belief that a change in behaviour will lead to a particular consequence. Because theatre infection rates were already so low at the unit, staff may have believed that they could not be further reduced by a change in protocol. If this is the case, compliance to clinical guidelines could be improved by educating staff on the importance of their contribution to reducing infection rates.

Conclusions

This study found that communicating practice guidelines through posters did not educate theatre staff. Future research needs to explore the impact of other methods of instruction on improving adherence to theatre protocol.

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Appendix 1

Recommendations for reducing wound contamination in arthroplasty

ALL THEATRE STAFF

- Cover ears
- Cover nose and mouth
- Cover hair
- DO NOT remove ear or nose piercings, but do cover them
- Tuck scrub shirt into trousers

IN ADDITION, FOR THOSE STAFF SCRUBBED-IN

- Ensure outer packaging of sterile gloves is not splashed with water
- Remove finger rings before scrubbing
- Hood should be worn and tucked into scrub shirt
- Use chlorhexidine lavage
- Ensure antibiotics are given at least 10 min prior to inflation of tourniquet

Appendix 2

AUDIT CRITERIA

		Pre-poster (<i>n</i> = 82)	Post-poster (<i>n</i> = 90)
All staff will cover their ears	Yes	36	43
	No	46	47
All staff will cover their nose and mouth		Pre-poster (<i>n</i> = 82)	Post-poster (<i>n</i> = 90)
	Yes	72	75
	No	10	15
All staff will cover all their head hair		Pre-poster (<i>n</i> = 82)	Post-poster (<i>n</i> = 90)
	Yes	24	34
	No	58	56
All staff will leave ear/nose piercings in		Pre-poster (<i>n</i> = 82)	Post-poster (<i>n</i> = 90)
	Yes	76	85
	No	6	5
All staff will cover ear/nose piercings/holes		Pre-poster (<i>n</i> = 82)	Post-poster (<i>n</i> = 90)
	Yes	56	68
	No	26	22
All staff will tuck their scrub shirt into their trousers		Pre-poster (<i>n</i> = 82)	Post-poster (<i>n</i> = 90)
	Yes	2	11
	No	80	79
Scrub staff will ensure the outer packaging of sterile gloves is not splashed with water during scrubbing-up		Pre-poster (<i>n</i> = 28)	Post-poster (<i>n</i> = 33)
	Yes	21	24
	No	7	9
Scrub staff will remove finger rings before scrubbing		Pre-poster (<i>n</i> = 34)	Post-poster (<i>n</i> = 37)
	Yes	27	28
	No	7	9
Scrub staff will wear a hood		Pre-poster (<i>n</i> = 34)	Post-poster (<i>n</i> = 37)
	Yes	20	20
	No	14	17
Scrub staff will tuck their hood into their scrub shirt		Pre-poster (<i>n</i> = 34)	Post-poster (<i>n</i> = 37)
	Yes	14	14
	No	20	23
Chlorhexidine lavage is used		Pre-poster (<i>n</i> = 10)	Post-poster (<i>n</i> = 10)
	Yes	10	10
	No	0	0
Antibiotic is given at least 10 min prior to inflation of tourniquet (in TKR)		Pre-poster (<i>n</i> = 6)	Post-poster (<i>n</i> = 7)
	Yes	6	7
	No	0	0