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Short Report

Compliance with clothing regulations and traffic flow in the operating room: a multi-centre study of staff discipline during surgical procedures

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SUMMARY

This multi-centre study assessed operating room (OR) staff compliance with clothing regulations and traffic flow during surgical procedures. Of 1615 surgical attires audited, 56% respected the eight clothing measures. Lack of compliance was mainly due to inappropriate wearing of jewellery (26%) and head coverage (25%). In 212 procedures observed, a median of five people [interquartile range (IQR) 4–6] were present at the time of incision. The median frequency of entries to/exits from the OR was 10.6/h (IQR 6–29) (range 0–93). Reasons for entries to/exits from the OR were mainly to obtain materials required in the OR (N=364, 44.5%). ORs with low compliance with clothing regulations tended to have higher traffic flows, although the difference was not significant (P=0.12).

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Introduction

Surgical site contamination may originate from the operating room (OR) staff or OR environment, although the transmission mechanisms remain unclear [1]. A correlation between air contamination with micro-organisms and wound contamination after total hip or knee surgery has been reported in the past [2], and identical *Staphylococcus* spp. have been cultured from OR staff skin flora, OR air and patient wounds during cardiothoracic surgery [3].

Recommendations on OR staff behaviours are mainly based on surgical attire (wearing a cap and scrub suit) and restriction of traffic in the OR. These two factors have been advocated as a means to decrease air contamination and wound colonization [4]. However, recommendations in this field are based on expert advice as no robust scientific evidence is available to substantiate them.

A recent literature review suggested an impact of surgical team behaviour on the risk of surgical site infection and, therefore, opportunities for improvement [5]. Door openings have been demonstrated to have an adverse effect on air exchange, air quality and positive pressure in the OR compared with adjacent rooms [6]. Moreover, studies demonstrated that traffic flow is a cause of distraction and interruption for the surgical team, and therefore contributes to the risk of adverse events [7].

This study assessed the discipline of OR staff by measuring compliance with clothing regulations and traffic flow during surgical procedures, and investigated the reasons for non-compliance.

Materials and methods

From January to September 2015, 41 healthcare facilities (HCFs) in western France were invited to take part in this study, and 17 agreed to participate. Of these, two (12%) were university hospitals, seven (41%) were public facilities and eight (47%) were private facilities. Initially, orthopaedic surgery (hip or knee replacement), gastro-intestinal surgery (hernia), obstetric surgery [caesarean section (CS)], gynaecological surgery (hysterectomy) and other types of surgery were included in the survey. Some hospitals decided to extend the survey to urology, ophthalmology, ear/nose/throat and cardiovascular surgery. Procedures included were elective or urgent surgery, and conventional or laparoscopic surgery for hospitalized or ambulatory adult patients. All categories of healthcare workers (HCWs) present in the OR during the observation period were included in the evaluation of clothing and traffic flow.

Compliance with clothing regulations was observed at patient entry in the OR in 17 HCFs among 61 surgical teams. The following criteria were assessed: (1) scrub suit worn; (2) no ordinary clothes worn under the scrub suit; (3) surgical cap/hood worn; (4) surgical cap/hood covering hair completely; (5) mask worn by 'scrubbed and non-scrubbed' staff in the OR; (6) mask placed correctly on the mouth and nose; (7) no nail polish or jewellery on hands; and (8) specific OR shoes or shoe covers. A score of one point was given for compliance with each of these individual criteria, and the addition of these points gave a final composite score from 1 to 8. The mean score for HCWs belonging to the same OR was computed to assess compliance at team level.

Traffic flow was assessed in 15 HCFs and 43 surgical teams by estimating the number of, and reasons for, entries to/exits from the OR during the period from incision to wound closure; all HCW categories were included. The number of people present in the OR at cutaneous incision was recorded.

Direct observations were performed by either nurses on the surgical team or infection control team members, and HCWs were informed of the audit. Univariate comparisons used Chi-squared test or Mann–Whitney *U*-test, as appropriate. These analyses were performed using Stata Version 10.0 (Stata Corp LP, College Station, TX, USA).

Results

Among the 295 operations included in the clothing evaluation, 26 (9%) were performed in university hospitals, 125 (42%) were performed in public hospitals and 144 (49%) were performed in private hospitals. Orthopaedic surgery accounted for 102 (35%) procedures, 72 (24%) were gastrointestinal, 54 (18%) were gynaecological, 19 (64%) were obstetric, and the remaining 48 were in five other specialties. Procedures were elective in 260 (88 %) cases and urgent in 14 (4%) cases; this information was not recorded for the remaining 7% of cases. Among the 1615 professionals observed, 295 (18%) were surgeons, 445 (27%) were anaesthetists, 566 (35%) were nurses and 309 (19%) belonged to other categories (Figure 1).

When aggregating the eight criteria, 56% (N=904) of the 1615 HCWs observed were fully compliant with the clothing regulations. The mean score for compliance with clothing regulations was 7.4 among the eight indicators assessed. Analysis by subcategory showed greater compliance for HCWs working in orthopaedic surgery (mean score 7.45, $P<0.01$) compared with other specialities, and for surgeons and nurses compared with anaesthetists and other HCW categories (mean scores 7.5 and 7.6 vs 6.9 and 7.3, respectively; $P<0.01$).

For HCWs complying with six criteria or fewer, the lack of compliance was due to either the position of the head cover (56–79%), the presence of hand jewellery (69–86%) or the position of the face mask (19–59%).

Traffic flow of HCWs in terms of entries to/exits from the OR was observed during 212 operations: 66 (31%) orthopaedic procedures (25 hip replacements, 14 knee replacements and 27 others), 64 (30%) obstetric and gynaecologic procedures (17 CS, nine hysteroscopies, seven hysterectomies, six tumorectomies and 25 others), 57 (27%) gastrointestinal procedures (28 hernia repairs and 10 cholecystectomies), 11 cataract operations, nine cardiovascular procedures, two urological procedures, one dermatological procedure and one ear/nose/throat procedure. Among the 212 procedures, 200 (94%) were elective and 12 (9%) were urgent. The median turnaround time of procedures was 37 min [interquartile range (IQR) 22–61] from wound incision to closure.

The median number of people present at wound incision and median frequencies of entries to/exits from the OR from incision to closure are displayed in Table I. Variability in the number of people present differed significantly by specialty ($P<0.01$), and was non-significantly higher during urgent procedures (6.1 vs 5.3 in elective procedures, P=0.09) and in university hospitals (5.9 vs 5.4 in general hospitals and 5.16 in private hospitals, P=0.22).

Among the 212 procedures observed from wound incision to closure, a median of 10.6/h (IQR 6–20) entries to/exits from