American Journal of Infection Control 41 (2013) 922-4

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Brief report

Interactions between anesthesiologists and the environment while providing anesthesia care in the operating room

L. Silvia Munoz-Price MD [a,b,c,d,*], David A. Lubarsky MD, MBA [b], Kristopher L. Arheart EdD [c], Guillermo Prado PhD [c], Timothy Cleary PhD [e], Yovanit Fajardo-Aquino MD [d], Dennise DePascale MT [d], Scott Eber MD [b], Philip Carling MD [f], David J. Birnbach MD, MPH [b,c]

[a] Department of Medicine, Miller School of Medicine, University of Miami, Miami, FL
[b] Department of Anesthesiology, Miller School of Medicine, University of Miami, Miami, FL
[c] Department of Public Health Sciences, Miller School of Medicine, University of Miami, Miami, FL
[d] Jackson Memorial Hospital, Miami, FL
[e] Department of Pathology, Miller School of Medicine, University of Miami, Miami, FL
[f] Department of Medicine, Boston University School of Medicine, Boston, MA

Key Words:
Anesthesia providers
Environmental contacts
Hand hygiene
Intraoperative

We describe 1,132 contacts between anesthesiologists and the operating room. Objects most commonly touched included anesthesia machines and keyboards. Only 13 hand hygiene events were witnessed during 8 hours of observations. Line insertions, bronchoscopies, or blood exposures were not followed by hand hygiene. Stopcocks were accessed 66 times and only disinfected on 10 (15%) of these occasions.

During the past decade, the inanimate hospital environment has been found to be a reservoir for resistant organisms. Horizontal transmission of bacteria commonly occurs through contaminated health care worker's hands, which becomes especially problematic in settings with suboptimal hand hygiene, deficient cleaning of the environment, and high number of interactions among health care worker hands, patients, and environment. Recent literature shows that the frequency of hand hygiene among anesthesiologists while providing care in the operating rooms (ORs) is less than optimal (<1 hand hygiene event per hour),[1,2] which probably contributes to the transmission of bacteria.[3,4] Furthermore, contamination of anesthesiologists' hands has been previously implicated in surgical outbreaks.[5]

Despite the general consensus of the importance of hand hygiene, there are no clear hand hygiene guidelines for anesthesia personnel while providing care in the OR. Nevertheless, the high frequency and high pace of interactions in the OR might preclude frequent hand disinfections. However, quantification of the number of contacts between the anesthesia providers and the environment has not been previously performed. Therefore, the aim of this study was to quantify the number of interactions among the hands of anesthesia personnel, their patients, and the OR surfaces, as well as their relationship with hand disinfection and glove usage while performing their duties in ORs.

METHODS

This project was performed at Jackson Memorial Hospital, a 1,500-bed public teaching hospital affiliated with the University of Miami Miller School of Medicine. All data were collected in a de-identified fashion by the Infection Control Department as part of a system-wide behavioral intervention. As such, the Institutional Review Board and the Human Subjects Research Office concluded that this study met the criteria for nonhuman/nonresearch determination.

During the later part of 2010, anesthesia personnel were observed over the course of a week while providing customary anesthesia-related care within the ORs. To minimize interobserver variability, only 1 person from the Infection Control Department (L.S.M-P.) performed these observations. The number and timing of hand hygiene events were recorded as well as the type of anesthesia provider involved (ie, physician anesthesiologist or nurse anesthetist). During these observations, all consecutive objects touched by the hands of anesthesia providers were documented. In addition, we recorded presence or absence of gloves, timing glove

* Address correspondence to L. Silvia Munoz-Price, MD, LSMP Park Plaza West L-302, 1611 NW 12th Avenue, Miami, FL 33136-1096.
E-mail address: smunozprice@med.miami.edu (L.S. Munoz-Price).
Conflicts of interest: P. Carling has served as a consultant for Steris, Ecolab, and the American Society for Healthcare Environmental Services. L.S. Munoz-Price has received a speaker honorarium from Steris. The remaining authors report no conflicts.

0196-6553/$36.00 - Copyright © 2013 by the Association for Professionals in Infection Control and Epidemiology, Inc. Published by Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.ajic.2013.03.306

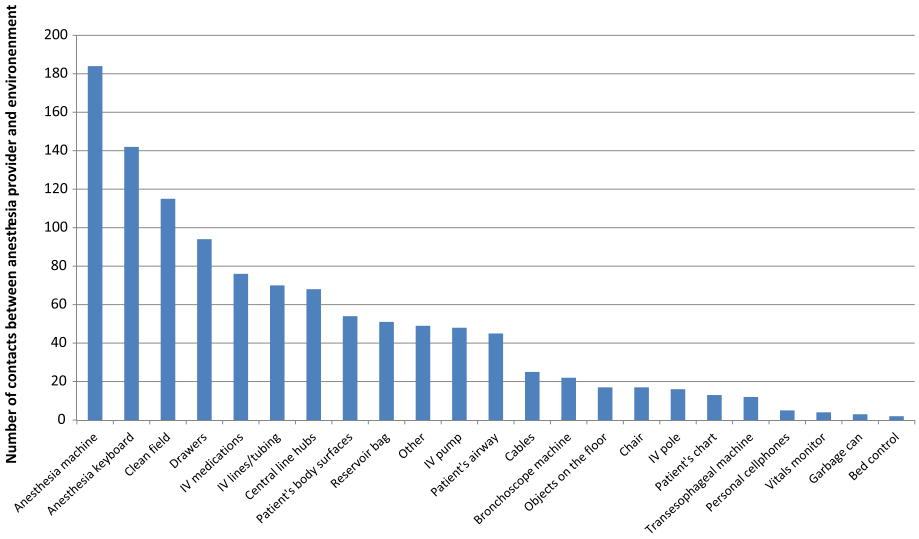

Fig 1. Number of contacts between anesthesia personnel and environment.

usage, and type of surgical procedure being performed. The anesthesia provider was aware of the presence of the recorder but did not know the nature of the observations.

RESULTS

A total of 7 surgical procedures were observed during the span of 1 week (5 cardiothoracic surgeries, 1 craniotomy, and 1 abdominal surgery). During 8 hours of observations, 19 anesthesia providers were observed performing their regular duties within ORs. The mean duration of observation per procedure was 78 minutes (range: 35-133 minutes). Four (57%) of these observations were performed during the induction of anesthesia, 1 (14%) involved the end of the surgical procedure, and 2 (29%) observations were performed during anesthesia maintenance.

A total of 1,132 surfaces were touched by anesthesia personnel during our observations (Fig 1). The objects touched the most were the anesthesia machines (either switches or monitors) (184; 16%), keyboards (142; 13%), and clean fields on top of the anesthesia machines (115; 10%). There were 2 intubations performed and 1 bronchoscopy; none was immediately followed by hand hygiene, and all 3 were handled with gloves. Only the pair used during bronchoscopy was promptly removed. Obvious blood exposure of hands was observed in 3 instances, 2 of them occurred while wearing gloves, which were not subsequently removed; hand hygiene did not follow any of these 3 blood exposures. Interestingly, and somewhat alarming, contact with objects from the floor occurred in 17 instances. None of them were followed by hand hygiene. Furthermore, intravenous lines were frequently observed draping down on the floor and manipulated prior to accessing stopcocks.

Stopcocks were accessed 66 times, and 31 (47%) of them were preceded by contact with the anesthesia machine's clean green field. Disinfection of the stopcocks prior to access occurred only in 10 (15%) occasions. Additionally, we observed the placement of 4 lines (2 peripheral and 2 arterial lines) and 1 nasogastric tube. None of these 5 procedures was preceded or followed by hand hygiene.

A total of 13 hand disinfections were witnessed (all with alcohol hand sanitizer), from which 6 (46%) disinfections were done by nurse anesthetists during a single hour of observation. No hand disinfections were witnessed at any time during 3 (43%) of the 7 procedures observed.

Duration of glove use was available for 21 pairs of gloves. The median duration of uninterrupted use of a single pair of gloves was 6 minutes (range: 1-28 minutes), and the median number of objects touched per single pair of gloves was 13 objects, with up to 88 objects touched by a single pair of gloves. Hand hygiene followed only 5 (24%) of the 21 glove removals.

DISCUSSION

In this quality improvement project, we found that anesthesia providers touched 1,132 objects during 8 hours of observations and performed a total of only 13 hand disinfections. Furthermore, hand hygiene failed to precede or follow procedures, blood exposures, or contacts with the floor. Gloves were used uninterruptedly for extended periods and with contact of up to 88 consecutive objects.

During the past few years, work by Loftus et al documented transmission of bacteria from the anesthesia machines to the patient's intravenous stopcocks.[3,4] Such a finding may be a reflection of ongoing OR surface contamination as evidenced by our recent documentation that 17% of OR surfaces contain bacterial pathogens despite routine terminal cleaning protocols being in place.[6] Whereas disinfectant limitations could have an impact on our findings, a study by Jefferson et al evaluating 71 ORs across 6 acute care hospitals found an average daily cleaning rate of 25% of the objects monitored.[7] When the study was expanded to 16 sites, the documented thoroughness of terminal cleaning was unchanged at 26.5%.[8] Given the diverse geography and the wide range of case-mix complexity of these hospitals, it would appear that the opportunity to improve OR cleaning may be widespread. Whereas more extensive studies are needed, our further evaluation of OR bacterial contamination showed that contamination decreased from 17% to 3.2% ($P > .01$) when cleaning thoroughness improved to 82%.[6] Such results raise the possibility that thoroughness of disinfection cleaning is a potentially relevant safety issue in the OR as it has been shown to be in other health care settings.[9]

Our study does have limitations. Even though we observed over 1,000 interactions between anesthesia providers' hands and surfaces while in the OR, our results reflect only 8 hours of observations in a single center. Furthermore, observations were performed only during certain portions of the surgical procedures. Additionally, selection bias of the surgical procedures observed might have occurred because we used a convenience sample rather than a random case selection. Finally, some anesthesiologists may have been aware of being monitored, and a Hawthorne effect could have influenced their behavior.

Although compliance with the World Health Organization's[10] and Centers for Disease Control and Prevention's[11] recommendations might be the ideal, given the large number of hand contact events we observed per hour, logistical limitations could negatively impact the efficiency of patient care in the OR suite. We believe that there is a need for more specific hand hygiene guidelines tailored to anesthesia personnel providing care in the OR setting. Whereas the risk of transmission of bacteria from OR surfaces remains to be further quantified, our findings suggest that it could be productive to more completely involve the anesthesiology staff in developing optimized safe infection prevention practices in this setting.

Acknowledgment

The authors thank Noah Godwin for his help during this study.

References

1. Koff MD, Loftus RW, Burchman CC, Schwartzman JD, Read ME, Henry ES, et al. Reduction in intraoperative bacterial contamination of peripheral intravenous tubing through the use of a novel device. Anesthesiology 2009;110:978-85.
2. Krediet AC, Kalkman CJ, Bonten MJ, Gigengack AC, Barach P. Hand hygiene practices in the operating theatre: an observational study. Br J Anesth 2011; 107:553-8.
3. Loftus RW, Muffly MK, Brown JR, Beach ML, Koff MD, Corwin HL, et al. Hand contamination of anesthesia providers is an important risk factor for intraoperative bacterial transmission. Anesth Analg 2011;112:98-105.
4. Loftus RW, Brown JR, Koff MD, Reddy S, Heard SO, Patel HM, et al. Multiple reservoirs contribute to intraoperative bacterial transmission. Anesth Analg 2012;114:1236-48.
5. Wenger PN, Brown JM, McNeil MM, Jarvis WR. Nocardia farcinica sternotomy site infections in patients following open heart surgery. J Infect Dis 1998;178: 1539-43.
6. Munoz-Price LS, Birnbach DJ, Lubarsky DA, Arheart KL, Fajardo-Aquino Y, Rosalsky M, et al. Decreasing operating room environmental pathogen contamination through improved cleaning practice. Infect Control Hosp Epidemiol 2012;33:897-904.
7. Jefferson J, Whelan R, Dick B, Carling P. A novel technique for identifying opportunities to improve environmental hygiene in the operating room. AORN J 2011;93:358-64.
8. Carling, PC, Po JL. OR environmental hygiene: redefining a standard. Program and Abstracts of the 59th AORN Congress, Session No. 5128. New Orleans, LA, March 23, 2012.
9. Hayden MK, Bonten MJ, Blom DW, Lyle EA, van de Vijver DA, Weinstein RA. Reduction in acquisition of vancomycin-resistant enterococcus after enforcement of routine environmental cleaning measures. Clin Infect Dis 2006;42: 1552-60.
10. Sax H, Allegranzi B, Uckay I, Larson E, Boyce J, Pittet D. My five moments for hand hygiene: a user-centered design approach to understand, train, monitor and report hand hygiene. J Hosp Infect 2007;67:9-21.
11. Centers for Disease Control and Prevention. Guideline for hand hygiene in health-care settings: recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. MMWR 2002;51:1-16.