aerobic bacteria (a water-quality indicator) from the same samples inoculated immediately after the samples were removed from the building water system; *Legionella* culture results correlated well with results from spread plate analyses and were available far sooner (at least 80% reduction in time required to deliver results) compared with spread plate analyses of shipped water samples. Data on comparison of methods, accuracy, precision, specificity, and sensitivity have been previously published and are cited in our article.

Our WMP was effective because it (1) united the expertise of infection control, facilities operations, facilities engineering, and industrial hygiene personnel, who all have key responsibilities in providing safe potable water at our facilities; (2) resulted in systematic risk characterization of areas in the facility so that we could focus on the highest patient risk; (3) resulted in development of one consistent plan that all stakeholders could understand and follow; (4) clarified and improved the management of resources necessary to implement the plan; (5) established a process to independently confirm and document implementation of the plan (verification); (6) provided a systematic basis to decide what to test for, where to test, and how much testing was necessary to assess hazard control (validation); and (7) provided a process to make scientifically defensible decisions about how to manage our building water systems.

Several compelling facts led us to select and to now advocate the HACCP framework for building water system management: (1) the *Legionella* Outbreak Response Team from the Centers for Disease Control and Prevention has since year 2000 advised facility managers involved in outbreaks of Legionnaires' disease to develop WMPs based on HACCP principles for their facilities; (2) the World Health Organization proposed HACCP for water system management then extensively and formally recommended use of these principles as the basis for water safety plans; and (3) in response to widespread, successful use of HACCP-based water management programs for the prevention of disease and injury associated with building water systems, NSF International has developed an educational and training certificate program that is now available nationwide. The reader is referred to our article for citations of peer-reviewed journal articles and other references that document effective application of HACCP principles to building water system management.

ACKNOWLEDGMENTS

Potential conflicts of interest. D.A.K., A.F.K., M.S.B., and A.J.W. report being employed by the Mayo Clinic during the time of the original study and state here that they have no commercial interest or conflicts of interests regarding this work. M.J.D. and W.F.M. report being employed by Phigenics, which provides consultative and analytical services to the Mayo Clinic; however, the work presented in the original study does not require exclusive use of any proprietary product or service provided by Phigenics. All authors submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and the conflicts that the editors consider relevant to this article are disclosed here.

Dale A. Krageschmidt, PhD, CIH;[1] Allen F. Kubly, CHFM;[1] Mark S. Browning, PMP;[1] Alan J. Wright, MD;[1] Martin J. Detmer, CHM, CPWSO;[2] William F. McCoy, PhD[2]

Affiliations: 1. Mayo Clinic, Rochester, Minnesota; 2. Phigenics, LLC, Naperville, Illinois.

Address correspondence to William F. McCoy, PhD, 1701 Quincy Avenue, Suite 32, Naperville, IL 60540 (wmccoy@phigenics.com).

Infect Control Hosp Epidemiol 2014;35(10):1311-1312

 0899-823X/2014/3510-0019$15.00. DOI: 10.1086/678074

REFERENCES

1. Shelton BG. Failure of a hazard analysis and critical control point–based Legionnaires' disease prevention program: 2 definite nosocomial cases tell the story. *Infect Control Hosp Epidemiol* 2014; 35:1310–1311 (in this issue).
2. Krageschmidt DA, Kubly AF, Browning MS, et al. A comprehensive water management program for multicampus healthcare facilities. *Infect Control Hosp Epidemiol* 2014;(35):556–563.

The Importance of the Central Sterile Supply Department in Infection Prevention and Control

To the Editor—Transmission of infectious agents through unclean and unsterile medical devices is a possibility. Breakdown in the sterility of medical devices may lead to the transmission of bacterial and viral pathogens, including those associated with multidrug resistance. Since reprocessing of expensive medical devices has to be done, it is very important that the process of cleaning, disinfection, and sterilization is subjected to stringent quality control.[1] The central sterile supply department (CSSD) plays a critical role in ensuring that costly medical equipment is sterilized and delivered to various users in the hospital in a quality-assured environment. The objective of this study is to describe the operations of the CSSD of a 167-bed oncology center in the eastern part of India so that users of its services are aware of its vital role in ensuring safe practices within a hospital.[2]

The physical infrastructure of the CSSD consists of several separate work areas, including a decontamination room, a packaging room, a linen preparation room, and a sterile storage area (total floor area of CSSD at Tata Medical Center, ~3,000 square feet).[2,3] The equipment and accessories that are essential for its smooth functioning include automated washer disinfector, ultrasonic cleaner, disinfection tank, instrument wash basin, handwashing sink, air and water jet guns, drying cabinet, linen folding table, instrument packing

TABLE 1. Sterilization Methods and Product Output of the Central Sterile Supply Department of Tata Medical Center (March 2014)

Sterilizers	Capital cost of equipment	Cycle time	Cycle runs per month	Total items sterilized per month (%)	Approximate sterilization cost
Autoclave	2,927,387 (50,117)	1 hour	212	10,368 (73)	500 (8.56)[a]
ETO	1,725,000 (29,533)	12–14 hours	20	3,694 (26)	25 (0.43)[b]
Plasma	4,823,604 (82,582)	55–75 minutes	25	90 (1)	1,000 (17.12)[a]

NOTE. Data are Indian rupees (US dollars), unless otherwise indicated. ETO, ethylene oxide.
[a] Per surgical set.
[b] Per pack.

table, rotary sealer machine, steam sterilizers, ethylene oxide (ETO) sterilizer, plasma sterilizer, and bar code system.

The workflow in the CSSD is unidirectional, and materials to be sterilized move from dirty area (decontamination room) to semiclean area (preparation zone) to clean area (sterile storage) after proper disinfection and sterilization process. Laundered linens and dressing materials are also products that the CSSD sterilizes.

The entire CSSD process must be quality controlled to ensure reliability of the process. The quality control of washer disinfector and ultrasonic cleaner is ensured by the soil test and foil test, respectively. Sealers are tested weekly by seal check indicator, whereas the steam sterilizer is tested by a Bowie-Dick test, a leak test, various chemical indicators, a process challenge device, and a biological indicator that contains 1 million live spores of *Geobacillus stearothermophilus*. The biological controls used for ETO and plasma sterilizers include *Bacillus atrophaeus* and *G. stearothermophilus*, respectively.

The steam sterilizers (prevacuum) are used for the sterilization of heat-resistant items, such as surgical instruments, which after cleaning are packed in wire mesh baskets (eg, from Aesculap or specialized thermolock Wagner containers). The ETO and plasma sterilizers are used for the heat-sensitive items, such as rubber, plastic, and flexible scopes. Both ETO and plasma sterilizers have some advantages and disadvantages with respect to time (Table 1; ETO cycle time is 14 hours, whereas plasma cycle time is 1–2 hours) and penetration of narrow lumen devices (ETO is superior to plasma). ETO is potentially toxic compared with plasma.

Equipment overload can affect the whole sterilization process. The CSSD technician should know loading techniques in washer and sterilizer for proper cleaning, disinfection, and sterilant penetration. Mineral-free (low total dissolved solids, low surface tension) water should be used for all types of surgical instruments to avoid corrosion. In the Tata Medical Center, the water supply of the CSSD is provided through a combination of reverse osmosis and electrodeionization systems.[2] The water quality is also checked for total dissolved solids, chlorine, and microbes (membrane filtration technique). Enzymatic detergent with a neutral pH must be applied for instruments during manual cleaning and solution with acidic and alkaline pH during mechanical cleaning by proper dosing system (dosimeter). Appropriate record keeping is important for legal and recall procedures.

The central sterile service area must meet specific temperature (20°–22°C), humidity (50%–60%), and air exchange rate (at least 15 per hour) requirements.[4] Air flow should go from clean area (positive air pressure) to dirty area (negative air pressure) to avoid cross contamination. The CSSD sterile storage wall is plastic painted, and the floors are epoxy coated with no crevices to facilitate easy cleaning.[2]

Personnel traffic inside the sterile area should be restricted, and dress code requirements may change as CSSD technicians move from dirty zone to clean zone. Wearing of proper personal protective equipment is essential for all CSSD personnel, especially those who are working in the decontamination area. Hand hygiene practices with liquid soap and water as well as alcohol-based hand rub are essential to prevent contamination.

To reduce the number of expired items, the users are encouraged to maintain the first in, first out system, and CSSD uses the batch monitoring labels in every item sterilized for easy tracking of the expired items, wet pack, poor sterilization quality by recall system. In the Tata Medical Center CSSD, the shelf life of a product sterilized by autoclave is 3 months, by ETO 12 months, and by plasma 6–12 months. This can be checked through a sterility test in microbiology (Table 1).

The CSSD represents a neglected area of infection control systems of a hospital. Investment in a well-equipped CSSD infrastructure is essential for the smooth functioning of a hospital. The resources should be directed not only for the development of physical infrastructure and the equipment in the CSSD but also for the recruitment and retention of technically qualified human resources who are able to operate the system effectively. Every CSSD technician must know the importance of infection control and thoroughly understand their role in the process. Ensuring effective functioning of the CSSD is essential for any hospital in infection prevention.

ACKNOWLEDGMENTS

Potential conflicts of interest. All authors report no conflicts of interest relevant to this article. All authors submitted the ICMJE Form for Disclosure

of Potential Conflicts of Interest, and the conflicts that the editors consider relevant to this article are disclosed here.

Debabrata Basu, BSc;[1]
Sanjay Bhattacharya, MD, DNB, DipRCPath, FRCPath;[1]
Aseem Mahajan, MBBS, MHA;[1]
Venkata Raman Ramanan, MS;[1]
Mammen Chandy, MD, FRACP, FRCPA[1]

Affiliation: 1. Tata Medical Center, Kolkata, India.

Address correspondence to Sanjay Bhattacharya, MD, DNB, DipRCPath, FRCPath, Tata Medical Center, South Lab, 14 Major Arterial Road (E-W), New Town, Rajarhat, Kolkata 700 156, India (drsanjay1970@hotmail.com).
Infect Control Hosp Epidemiol 2014;35(10):1312-1314
 0899-823X/2014/3510-0020$15.00. DOI: 10.1086/678072

REFERENCES

1. Sangthong K, Soparat P, Moongtui W, Danchaivijitr S. Development of quality indicators for sterilization practices of the central sterile supply department. *J Med Assoc Thai* 2005;88(suppl 10):S128–S32.
2. An overview of central sterile supply department of the Tata Medical Center, Kolkata. In: *Scientific Operating Procedures for Sterilization Practices in India*. New Delhi: Office of the Principal Scientific Adviser to the Government of India, 2012:165–183.
3. Niléhn B. Role of the environment in hospital infections: design of C.S.S.D. *J Sterile Serv Manage* 1983;1(3):20–22.
4. Leung M, Chan AH. Control and management of hospital indoor air quality. *Med Sci Monit* 2006;12(3):SR17–SR23.

Shared Hoppers: A Novel Risk Factor for the Transmission of *Clostridium difficile*

To the Editor—The environment plays a central role in transmission of *Clostridium difficile* infection (CDI) within hospitals. Surfaces and objects become contaminated with spores when in contact with feces, and these hardy spores may endure for months. Patient placement factors—such as rooming with or residing in a bed previously occupied by a CDI patient—are cited as risk factors for acquisition.[1,2] One geographic feature that may increase risk for CDI is the presence of a shared hopper room in the patient care area. A hopper is a flushable, raised basin with an extendable arm that produces a high-pressure spray when flushed. This rimless basin is used by hospital staff to dispose of waste fluids and wash out receptacles. *C. difficile* has been isolated from air samples after flushing lidless toilets, leading to contamination of proximate surfaces.[3]

Our trauma-surgical intensive care unit (TSICU) historically has had the highest burden of CDI in our facility. The 2010 rate of hospital-acquired CDI for the TSICU was 3.5 cases per 1,000 patient-days compared with other intensive care units (range, 1.5–2.4 cases per 1,000 patient-days). Despite implementation of infection prevention measures—including hand hygiene with soap and water, a nurse-driven early CDI testing strategy, empirical contact precautions while awaiting test results, environmental cleaning with hypochlorite (bleach) solution, and cleaning audits—the high rates persisted. During the spring of 2011, we observed a cluster of CDI cases in our TSICU. Two patients acquired CDI while housed in a double room adjacent to a patient in contact precautions with CDI in a private room. The 2 rooms were joined by a shared hopper room. Neighboring patients who did not share the hopper, however, did not become infected. We hypothesized that transmission occurred by healthcare worker contamination of hands, uniform, and fomites via splashing and droplet aerosol during hopper flushing and use of the sprayer. We sought to examine patient and environmental risk factors for CDI acquisition.

We conducted a case-control study at Harborview Medical Center, a 413-bed, level 1 trauma and burn center with a 24-bed TSICU. The study spanned the 12-month period from December 15, 2010, through December 14, 2011. Generally, cases were defined as those with new onset diarrhea and a positive polymerase chain reaction (PCR) test for *C. difficile* toxin B greater than 48 hours from TSICU admission. Patients with a recent acute or long-term care hospital stay were excluded to minimize misclassification of exposure. The control group had a TSICU stay of greater than 36 hours and no positive *C. difficile* PCR test for at least 30 days after discharge from the TSICU. Approximately 3 concurrent controls were randomly selected within 1 week of admission for each case.

Electronic health records were reviewed for a history of CDI within the past 3 years. Potential risk factors for acquisition were determined for the exposure period through the date of diagnosis or through TSICU stay for controls. Demographics, laboratory data, and clinical data were abstracted from the electronic health record both electronically and manually by infection control professionals. Severity of illness data were obtained from the University HealthSystem Consortium. The study protocol was approved by the institutional review board of the University of Washington, and the need for informed consent was waived.

Univariate analysis was performed, using χ^2 and Fisher exact tests on categorical variables. Multivariate analysis was performed using STATA (ver. 11.0; Stata). A 2-sided $P \leq .05$ was considered significant, and relevant confounders were retained in a backward stepwise logistic regression model.

For the study period, 28 patients with hospital-acquired CDI were identified, and 26 remained after the exclusion of 2 patients who developed CDI after readmission from other floors. Seventy-three concurrent controls met inclusion criteria. Overall, 61 (61.6%) patients were male and 78 (78.8%) of Caucasian race. For CDI patients and controls, mean age ($\pm$ standard deviation) was 43.1 $\pm$ 20.2 and 53.5 $\pm$ 20.6 years, respectively, and mean length of stay was 27.5 $\pm$ 17.9