Computer equipment used in patient care within a multihospital system: Recommendations for cleaning and disinfection

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Computer hardware has been implicated as a potential reservoir for infectious agents. Leaders of a 22-hospital system, which spans North America and serves pediatric patients with orthopedic or severe burns, sought to develop recommendations for the cleaning and disinfection of computer hardware within its myriad patient care venues. A task force comprising representatives from infection control, medical affairs, information services, and outcomes management departments was formed. Following a review of the literature and of procedures within the 22 hospitals, criteria for cleaning and disinfection were established and recommendations made. The recommendations are consistent with general environmental infection control cleaning and disinfection guidelines, yet flexible enough to be applicable to the different locales, different computer and cleaning products available, and different patient populations served within this large hospital system. (Am J Infect Control 2005;33:233-7.)

Over the past few decades, the usage, and therefore presence, of computers in health care facilities has greatly increased. What was initially a glorified typewriter in medical offices has evolved to include computer-based medical records available at bedside; computerized reminders for preventative care of hospitalized patients; computerized, physician decision-making software in intensive care units (ICUs) or accessible from remote locations, including via handheld devices; and various point-of-care systems. With the introduction of these numerous computer devices into various patient care settings has come reports of computer hardware as potential reservoirs for infectious agents and studies linking nosocomial infections with computer contamination. Bures et al, using molecular markers, have provided the strongest evidence for the hypothesis that keyboards can serve as fomites for cross transmission of microorganisms in a hospital.

Shriners Hospitals for Children (SHC) is a system of 22 hospitals, which are located in the 3 major countries in North America: Canada, the United States, and Mexico. This hospital system specializes in 3 major pediatric areas: 3 hospitals treat specifically burn patients, 18 specialize in orthopedics (with 2 of those providing specialized spinal cord injury services also), and 1 of the hospitals serves all 3 patient populations. The level of risk for nosocomial infections varies greatly from very high risks for badly burned children to lower risks, for example, for patients undergoing rehabilitation for an orthopedic condition. The individual hospitals within the SHC system are at different stages of computerization, based on the services offered and the speed with which new equipment and software can be introduced and assimilated. For example, 17 of the hospitals are now using
RESULTS

Published computer infection control measures

A literature review revealed several studies, which have addressed computer contamination and infection control measures in a medical setting (Table 1). Often, no infection control methods were in place prior to a study being done, whereas, after the study, various means of disinfection and/or hand hygiene procedures were generally instituted or more strongly enforced.

In addition, excellent published guidance also exists relative to general environmental cleaning, disinfection, and infection control in health care facilities, and there is a review written primarily for medical informatics personnel, which addresses general microbiologic and infection control principles relative specifically to computer hardware.

Computer cleaning and disinfection measures within the SHC system

Infection control practitioners (ICPs) in all 22 hospitals were asked by e-mail whether they had a written policy or procedures regarding the cleaning or disinfection of computer hardware and, if so, to forward the procedures to the task force. All hospitals responded. Three hospitals provided written policies/procedures related to infection control for computer equipment. All 3 hospitals used disinfectant cleaners, which met EPA standards for hospital-grade detergent disinfectants, either of the phenolic or quaternary ammonium compound classes, on certain computer keyboards, and 1 hospital specified use of simply their hospital-approved cleaner on computer screens (Table 2).

Criteria for computer cleaning and disinfection in the SHC system

Through brainstorming, the task force decided that certain criteria needed to be met for the computer cleaning and disinfection recommendations that would be sent to all hospitals in the system. Specifically, the recommendations should encompass the following:

- Be consistent with recognized authorities: Centers for Disease Control and Prevention (CDC) Guidelines for Environmental Infection Control in Health-Care Facilities; APIC Text chapter on Cleaning, Disinfection, and Sterilization in Healthcare Facilities.

- Be flexible to fit the many (1) hospital locations from Canada to Mexico, (2) different functions and risk levels from hospital to hospital and within

METHODS

The task force consisted of 5 persons at headquarters, who represented either medical affairs, outcomes management, or the information services departments, and 3 hospital-based persons, who were responsible for infection control at 3 representative hospitals within the system. Meetings were conducted via conference calls, which were supplemented by e-mail communications. The final recommendations of the task force were reviewed by the system-wide Outcome Management Infection Control Workgroup, which consists of a broad selection of infection control practitioners. Final review and approval of the recommendations was obtained from the SHC director of medical affairs and the executive administrator for the health care system.

electronic medical record systems, 14 of which have computerized physician order entry. A few years ago, 1 hospital in the system reported increased colonization of patients with Acinetobacter baumannii. An epidemiologic investigation, which included environmental culturing, showed high levels of this bacterium on bedside computer keyboards, with little or no A baumannii on other environmental surfaces in the patients’ rooms. It was subsequently determined that one reason for the bacteria on the keyboards was that no specific disinfection protocol had been established for the bedside computers, which had been installed 6 months earlier. Once specific computer keyboard disinfection as well as hand hygiene and gloving procedures relative to bedside computers were established, the acquisition of A baumannii returned to baseline levels.

Given the potential risk of computers serving as fomites for pathogens, SHC headquarters instituted a task force to investigate computer cleaning and disinfection throughout the 22-hospital system. It was recognized that 2 processes needed to be considered. Cleaning refers to the removal of visible dirt or biologic debris, often by the use of a detergent. As a result of the cleaning process, microbial load is generally reduced. Disinfection specifically refers to an elimination of most, if not all, pathogenic microbes. Disinfection can be accomplished by using a disinfectant chemical after the surface has been cleaned or by using a hospital-grade disinfectant cleaner, which will both clean and disinfect. The goal of the task force was to make recommendations that would help hospitals to provide computer cleaning and disinfection where needed in a manner that was safe for patients, health care workers, and equipment. The purpose of this paper is to report the experience and results of that task force.

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each hospital, (3) different cleaning and disinfecting agents used/available in each hospital, and (4) different types and manufactures of computer hardware used.

Recommendations

The task force made the following recommendations:

Table 1. Studies investigating computer contamination and infection control measures

<table>
<thead>
<tr>
<th>Year</th>
<th>Author</th>
<th>Study scope</th>
<th>Primary findings</th>
<th>Infection control measures</th>
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<tbody>
<tr>
<td>1995</td>
<td>Masterton et al</td>
<td>Case study, 1 home computer</td>
<td>MRSA on home computer contributed to MRSA carriage by nurse</td>
<td>Decontaminate home computer</td>
</tr>
<tr>
<td>1998</td>
<td>Isaacs et al</td>
<td>27 hospital computers sampled 1 time</td>
<td>Antibiotic-resistant microbes sought not found, but Staph aureus and Pseudomonas isolated</td>
<td>Keyboard covers, 1 time/day disinfection</td>
</tr>
<tr>
<td>1999</td>
<td>Neely et al</td>
<td>Epidemiologic study of A baumannïolonization</td>
<td>A baumannïolonization in patients linked to bedside computer keyboards</td>
<td>Daily keyboard disinfection; change in hand hygiene and gloving policy</td>
</tr>
<tr>
<td>2000</td>
<td>Bures et al</td>
<td>Pulse field gel electrophoresis study of ICU infections</td>
<td>MRSA infections in patients directly linked to computers in ward</td>
<td>Keyboard covers disinfected daily; hand hygiene enforced</td>
</tr>
<tr>
<td>2001</td>
<td>Dewine et al</td>
<td>25 terminals sampled 1 time in 2 hospitals</td>
<td>42% of computers positive for MRSA in hospital A; 8% positive in hospital B; hospital A had higher MRSA transfer rate</td>
<td>Hand hygiene in both hospitals but monitored in hospital B</td>
</tr>
<tr>
<td>2001</td>
<td>Ivey et al</td>
<td>Abstract of computer processing unit (CPU) fan contamination and fungi in patients’ rooms</td>
<td>No correlation between isolates on CPU fans and fungi in patients’ rooms</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>Man et al</td>
<td>209 samples from 85 hospital ward computer terminals</td>
<td>46% of keyboards and mice contaminated with multiple bacteria; 13% with Staph aureus</td>
<td>Keyboard covers routinely disinfected, enforce hand hygiene before and after patient contact</td>
</tr>
<tr>
<td>2003</td>
<td>Schultz et al</td>
<td>100 keyboards from patient care areas in a teaching hospital sampled 1 time</td>
<td>95% positive for microbes including some fungi and antibiotic resistant bacteria</td>
<td>Random cleaning</td>
</tr>
<tr>
<td>2004</td>
<td>Hartmann et al</td>
<td>1118 samples from frequently touched environmental objects in 14 surgical ICU rooms, 222 from keyboards and mice</td>
<td>Keyboards and mice were significantly more often contaminated than other fomites in patients rooms</td>
<td>Routine cleaning</td>
</tr>
<tr>
<td>2004</td>
<td>Hassoun et al</td>
<td>75 PDAs used by health care workers in an acute care teaching hospital, sampled 1 time</td>
<td>96% of PDAs contaminated, 8% with MRSA, 1% with VRE, 4% with fungi prior to cleaning; single wiping with 70% alcohol swab decreased contamination by 75%</td>
<td>93% of users never cleaned PDAs Disinfect hands when working with keyboards or mice</td>
</tr>
</tbody>
</table>

*Modified from Table 2 in reference 20.
Table 2. Summary of computer cleaning and disinfecting procedures in 3 SHC system hospitals prior to SHC task force recommendations

<table>
<thead>
<tr>
<th>Hospital site</th>
<th>Scope of services</th>
<th>Infection control measures for computers</th>
</tr>
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<tbody>
<tr>
<td>Boston, MA</td>
<td>Burns</td>
<td>Washable keyboards or keyboard covers in areas accessed by patients; disinfect keyboards and mice daily and when visibly soiled, with hospital-grade disinfectant cleaner</td>
</tr>
<tr>
<td>Cincinnati, OH</td>
<td>Burns</td>
<td>Keyboard covers used on bedside computer; disinfect keyboards and mice daily with current hospital-grade disinfectant cleaner; HCWs wash hands and glove before using bedside computers</td>
</tr>
<tr>
<td>Minneapolis/St. Paul, Orthopedic MN</td>
<td>Burns</td>
<td>Office keyboards and mice disinfected weekly with hospital-grade disinfectant; computer screens cleaned weekly with hospital-approved glass cleaners</td>
</tr>
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</table>

1. When cleaning or disinfecting computer hardware, use the same type of cleaner or disinfectant and the same frequency of cleaning or disinfecting as would normally be used to clean or disinfect other devices in that area.

   A. If the computer is in a high-risk area, such as a patient’s room, it should be cleaned and disinfected with the disinfecting process that is normally used to disinfect other equipment in the patient’s room. For computer equipment that is stored on rolling stands, the disinfection of this equipment should be done prior to entrance and upon exit of a patient care area/room.

   B. If the computer is in a low-risk area, such as an office, it should be cleaned with the same agents as other devices, such as a telephone, in that office.

2. If the computer or associated equipment, per manufacturer’s recommendations, are not compatible with the cleaner or disinfectant normally used by the hospital, the use of plastic covers on the hardware (keyboards, monitors, keypads, and others) or the use of immersible keyboards should be considered. Alternatively, manufacturer-recommended cleaner or disinfectant agents might be used if available and if they meet the standards for hospital-grade cleaners or disinfectants, respectively.

3. When purchasing computer hardware, consider the design and area at which the equipment will be used. All computer hardware should have as many smooth surfaces as possible to reduce the risk of microbial contamination.

4. Ensure that working with computer equipment is included in policies/procedures for hand hygiene. Specifically, when working with keyboards or mice in high-risk areas, disinfect or disinfect and glove hands.

5. Most major computer companies have Web sites that provide basic cleaning instruction for their computer hardware, but no instructions for disinfection of equipment, as might be needed in a patient care hospital settings. These Web sites can provide information, however, such as the following restrictions about cleaning LCD screens: “Unlike a computer monitor, the LCD is not made of glass therefore requires special cleaning procedures. When cleaning the LCD screen, it is important to remember not to spray any liquids onto the LCD directly nor use a paper towel as it may cause the LCD to become scratched. To clean the LCD screen, we recommend that you use a soft cotton cloth. If a dry cloth does not completely clean the screen, you can apply rubbing alcohol to the cloth and wipe the screen.”

   It is important to remember that, because of the risk of fire, large environmental surfaces should not be cleaned/disinfected with alcohol.

DISCUSSION

The above listed recommendations for cleaning and disinfection of computer hardware are consistent with CDC guidelines and with the APIC Text, neither of which have sections specifically about computer cleaning or disinfection, but both of which authorities provide general guidelines and principles for environmental infection control. In addition, these recommendations incorporate the various infection control measures suggested or implemented as a result of the studies summarized in Table 1, while being flexible enough to include the various control measures already in place in the few hospitals in the SHC system that previously had procedures relative to computer disinfection (Table 2).

Certainly, the CDC Guidelines for Environmental Infection Control can be extrapolated to cover computer hardware; however, there seems to be some trouble in doing this within medical facilities. In the studies listed in Table 1, there were either no infection control measures in place, or procedures were not regularly adhered to until after the study showed the need for having and adhering to certain disinfection and/or hand hygiene practices in regard to computers.

In the SHC system, the general absence of specific infection control policies/procedures relative to

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computer equipment was consistent with this general health care environment. In addition, it seems that sometimes staff do not know about cleaning or disinfection of computer hardware. For example, in one report, a company provided 50 personal digital assistants (PDAs) to physicians and residents in a hospital to improve patient care. Subsequent interviews of the staff indicated that they had no idea whether any cleaning of the devices was being done or how one would prevent infectious matter from being transferred from patients to the handheld device and visa versa. Clearly, health care workers may need to be reminded that, just as with any device, appropriate hand hygiene and device disinfection need to be followed when using these portable PDAs in an acute care area. Actually, the need for disinfection of certain keyboards and of handheld devices in high-risk areas may be somewhat more than for other environmental objects because these computer components may have more frequent hand contact than some other objects. Even in a study in which frequently touched items in patients’ rooms were cultured, significantly more computer keyboards and computer mice were contaminated than were any other objects cultured. Hence, indications both in and outside of the SHC system (Table 1) suggest that, even though there are excellent general environmental infection control guidelines available, there may be a need for more specific attention to infection control measures regarding computer hardware. As indicated by the studies cited in this paper (Tables 1 and 2), no single specific procedure will be appropriate to decrease the risk of computers serving as fomites in all health care circumstances, but statements, policies, or procedures specifically calling attention to the need for proper disinfection and hand hygiene procedures relative to computer hardware in high-risk areas of medical facilities may be warranted. Because the SHC task force needed to make computer recommendations that could apply to the myriad different hospital locales and situations of the 22-hospital system, it was thought that perhaps these recommendations might be of value to medical facilities outside of the SHC system.

References