American Journal of Infection Control 41 (2013) 1073-6

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Practice forum

iPads, droids, and bugs: Infection prevention for mobile handheld devices at the point of care

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Key Words:
Wireless
Device cleaning
Phone

Health care providers are increasingly using wireless media tablets, such as the Apple iPad, especially in the hospital setting. In the absence of specific tablet disinfection guidelines the authors applied what is known about the contamination of other nonmedical mobile communication devices to create a "common sense" bundle to guide wireless media tablet infection prevention practices.

Tablet personal computers are becoming commonplace in homes, schools, and health care facilities. The Apple iPad (Apple Corp, Cupertino, CA), debuted in 2010, is one of several wireless media tablets and represents about 70% of the nearly 100 million tablets worldwide.[1] The device, and others like it, provide a light, portable delivery and visualization medium for stored and online documents, images, and video, as well as a portal to a vast array of downloadable application software serving a variety of purposes.[2] As technology in this area has evolved, there has also been a sustained growth in the number and diversity of health care-related applications making the tablet a powerful clinical tool.[3]

Nonmedical electronic equipment, such as cell phones, personal digital assistants (PDA), and, most recently, wireless media tablets (in this article now referred to as *mobile handheld devices* [MHD]) tend to creep quietly into health care facilities with little notice or attention paid to appropriate use or effective cleaning and disinfection. Infection preventionists (IP) and hospital epidemiologists must be aware of the expanding use of MHDs by health care professionals as they provide care both directly to and in close proximity to hospitalized patients, thereby potentially creating an ideal vehicle for the transmission of nosocomial pathogens.

Health care providers practicing at the point of acute care have been swift to adopt wireless media technology to improve the practice and delivery of clinical care. In addition to a sophisticated communication device, iPads are being used by intensive care unit physicians during bedside rounds to engage fellow clinicians, students, and patients in viewing laboratory and imaging results (eg, radiographs); by surgeons in the operating room to view patient data; and to take, store, and transmit photographic images; by bedside nurses to access pharmaceutical inventories and other health care literature and to conduct patient and family education; and by health professions faculty and students as an instructional tool to facilitate learning and clinical performance.[2,4-7] Ottawa Hospital in Canada recently developed a native iPad version of the electronic health record software and put 3000 iPads directly in the hands of frontline workers revitalizing bedside patient rounds and direct care activities.[8] The hospital mobile strategy includes expanding the use of the iPad to more clinicians and working with vendors to add speech recognition. Most recently, the editor of iMedicalApps.com suggests that the new iPad Mini, because of its lighter weight and functionality, is the electronic "clipboard" for which physicians in the clinical setting have been waiting.[9]

It is imperative that infection prevention and control programs be actively engaged in providing health care worker (HCW) guidance and education in how to mitigate the risk of bacterial contamination of their MHDs. Programs also have an important role in working together with health care providers to establish and implement organizational MHD policies and procedures. We know of no published wireless tablet contamination studies, guidelines, or protocols. Therefore, the aim of this article is to apply what is known about the contamination of other nonmedical mobile communication devices (eg, cell phones, PDA) and to suggest an "iPBundle" or a package of common sense interventions that, when used together, could result in better outcomes (eg, less bacterial cross contamination) than when implemented individually.

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Conflicts of interest: None to report.

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http://dx.doi.org/10.1016/j.ajic.2013.03.304

NOSOCOMIAL INFECTION AND MOBILE COMMUNICATION DEVICES

In the United States, health care-associated infections (HAIs) affect approximately 1.7 million patients each year and lead to 4.5 infections per 100 hospital admissions.[10] Bacteria known to cause HAIs contaminate the hospital environment and can be isolated on clinical equipment, devices, and general surfaces. These items serve as potential environmental reservoirs and sources of bacterial cross contamination. Numerous studies have demonstrated that "personal" work tools used at the point of care, such as stethoscopes, pagers, and writing pens harbor pathogenic bacteria.[11-14] Additionally, a growing body of evidence suggests that HCW mobile communication devices provide a reservoir of bacteria known to cause nosocomial infections.[15-23] In the absence of wireless tablet contamination studies, these data provide an appropriate reference point when considering how MHDs could provide a traveling vehicle for nosocomial pathogens as well. Interestingly, a recent survey found that 65% of US physicians believe that mobile computing devices, such as iPads, pose a risk for spreading pathogenic bacteria in hospitalized patients because of poor hand hygiene, multitasking at the patient's bedside, and ignorance of the potential risk.[24]

HCWs are known to carry and use mobile phones and PDAs in the clinical environment, and as many as 50% to 65% admit to using the devices during physical contact with patients.[13,20] The risk of these devices contributing to bacterial cross contamination could be reduced by adequate hand hygiene and device decontamination; however, studies indicate that most HCWs do not regularly clean their mobile devices or perform hand hygiene before or after use.[12,13,20,24] Brady et al found that a majority of physicians were aware that mobile phones could carry pathogenic bacteria but that only 8% cleaned their phones and that almost 90% of HCWs working in the operating room never cleaned their phones.[15] Several authors liken MHDs to a "Trojan Horse" given their capacity to provide a mobile reservoir for the introduction of opportunist pathogens to previously noncolonized areas throughout the hospital via HCWs.[17,20]

Numerous studies have documented the bacterial contamination of HCW mobile phones. Brady et al conducted a review of mobile communication devices as a potential reservoir of nosocomial pathogens and found 9% to 25% contaminated with pathogenic bacteria.[17] Bacteria known to cause HAIs varied by clinical setting and included methicillin-resistant *Staphylococcus aureus* (MRSA), *Acinetobacter* species, vancomycin-resistant enterococci (VRE), *Pseudomonas* species, and coliforms.[17] Borer et al compared the bacteria found on physician and nurses' hands and those found on their mobile phones and discovered that 10% of the participants had cocontamination of multidrug-resistant *Acinetobacter* species.[18] A similar study focused on mobile phones and HCW hands of those working in the operating room and intensive care unit and found that 94.5% of phones demonstrated evidence of bacterial contamination with different types of bacteria and that the distribution of the microorganisms isolated from mobile phones were similar to those isolated from hands.[19] MRSA was isolated in 13% of mobile phones and 10% of HCW hands. Interestingly, infection control aspects of mobile communication are not confined to HCWs. In a recent study on inpatient use of mobile phones, it was demonstrated that 25% of patients with nasal MRSA colonization also had MRSA identified from their phones, 50% of patients with mobile phones had never cleaned them, and 49% would lend their phones to fellow patients if asked.[22] Pal et al found that touch-screen mobile phones are less contaminated than their keypad counterparts and harbor less pathogenic bacteria.[23]

Whereas there is no evidence of a direct link between environmental pathogens on small portable electronic devices and the rate of HAIs, cross contamination among patients may occur via the hands of HCWs after they have touched contaminated devices. Multiple investigators have shown that HCW mobile devices provide a known reservoir of pathogenic bacteria, with the potential to undermine infection control efforts aimed at reducing bacterial cross contamination.[16-25] This potential could be amplified further as HCWs begin to carry additional personal electronic devices such as MHDs without concurrently providing appropriate protocols on decontamination, especially at the point of acute care. This is an important concern given the mounting descriptive evidence of the rapid adoption of MHDs in the health care arena. If the trend continues, MHDs could quickly surpass the use of mobile phones and PDAs.

MHDS AND INFECTION PREVENTION

The Apple iPad, droid, and other tablets share characteristics with both mobile phones and laptop computers but offer a larger and more intuitive interface than the former and are more portable and easier to operate than the latter.[2] This exquisite mobile device has an inviting, brilliantly lit full-color touch screen used with the fingers and fingertips. For pathogenic bacteria that have taken up residence on the MHDs screen or case, a single touch can easily transfer the bacteria via the fingers and fingertips to the eyes, mouth, or nose of the user or to a hospitalized patient at the point of care. The device also has various nooks and crannies around the speakers and connecting ports, creating the potential for fluid ingress and hard to clean debris buildup, all of which adds to the MHDs ability to hold onto bioburden.

Apple recommends the following for cleaning the iPad: (1) use only a soft, slightly damp, lint-free cloth; and do not use abrasive cloths, towels, paper towels, and similar items that may cause screen damage; (2) disconnect the product from any external power source, unplug all cables, and turn off the device; and (3) avoid getting moisture in openings; do not use window cleaners, household cleaners, aerosol sprays, solvents, alcohol, ammonia, or abrasives; and do not spray cleaners directly onto the device.[26] Apple provides no recommendation on disinfecting the device. Given these general recommendations, it must be realized that Apple, as well as other tablet manufacturers, developed MHDs for the consumer market and not for the hospital health care setting where pathogenic organisms causing HAIs reside and cleaning is required after each patient encounter.

INTRODUCING THE iPBUNDLE: INFECTION PREVENTION COMMON SENSE GUIDANCE FOR MHD USE AT THE POINT OF ACUTE CARE

Implementation of a bundle or package of evidence-based practices to prevent HAIs has proven effective for the prevention of central line-associated bloodstream infections, ventilator-associated pneumonias, and catheter-associated urinary tract infections. We took the same approach for designing a package of common sense interventions guided by literature to lessen the possibility of bacteria transmission from the MHD to HCWs or patients.

The Centers for Disease Control and Prevention (CDC) Guideline for Disinfection and Sterilization in Healthcare Facilities (2008) does not address MHD and provides only minimal guidance for point of care computers. The guideline classifies computers in 2 different ways.[27] First, as a *noncritical patient care item* defined as "items that come in contact with skin but not mucous membranes" similar to a crutch, a blood pressure cuff, or a bedpan and second as

Table 1
The iPBundle with corresponding CDC recommendations

iPBundle	CDC recommendation/s	Rationale
1. Use of a waterproof or water-resistant barrier. Place a waterproof or water resistant barrier over the MHD. Barriers may be as complex as a military specification case or as simple as an inexpensive, clear, disposable plastic bag. The barrier should be standardized for equipment brand, facility issued, and specified by policy and procedure.	Recommendation 8: Management of equipment and surfaces[27] 8c. Barrier protective coverings can be used for noncritical clinical contact surfaces that are touched frequently with gloved hands during the delivery of patient care, that are likely to become contaminated with blood or body substances, or that are difficult to clean. Change these coverings when they are visibly soiled, when they become damaged, and on a routine basis (eg, between patients). Disinfect protected surfaces at the end of the day or if visibly soiled.	Many MHD have plastic screen protectors, and plastics are very susceptible to cleaning degradation. Using a waterproof or water-resistant case enables wet disinfection without damage to device. Using a clear plastic bag allows the barrier to be easily removed and discarded after each use.
2. MHD decontamination. Disinfection of the MHD before and after patient/family interface with an approved disinfectant as per facility policy for noncritical items.	Recommendation 3: Indications for sterilization, high-level disinfection, and low-level disinfection[27] 3c. Perform low-level disinfection for noncritical patient care surfaces and equipment that touch intact skin. Recommendation 4: Selection and use of low-level disinfectants for noncritical patient care devices[27] 4a. Process noncritical patient care devices using a disinfectant and the concentration of germicide as listed in Table 1 of the Guideline. 4b. Disinfect noncritical medical devices with an EPA-registered hospital disinfectant using the label's safety precautions and use directions. 4c. Ensure that, at a minimum, noncritical patient care devices are disinfected when visibly soiled and on a regular basis. 4d. If dedicated, disposable devices are not available, disinfect noncritical patient care equipment after using it on a patient who is on contact precautions before using this equipment on another patient.	MHDs are considered noncritical items because they come into contact with intact skin. Noncritical items are unlikely to transmit infectious agents directly to patients; however, they contribute to secondary transmission by contaminating health care provider hands.
3. Automatic reminders. Set alarm on the MHD to remind user to disinfect regularly in addition to the before and after patient/family interface disinfection (for example, daily, hourly)	Recommendation 4: Selection and use of low-level disinfectants for noncritical patient care devices[27] 4c. Ensure that, at a minimum, noncritical patient care devices are disinfected when visibly soiled and on a regular basis. Recommendation 8: Management of equipment and surfaces[27] 8c. Barrier protective coverings can be used for noncritical clinical contact surfaces that are touched frequently with gloved hands during the delivery of patient care, that are likely to become contaminated with blood or body substances, or that are difficult to clean. Change these coverings when they are visibly soiled, when they become damaged, and on a routine basis (eg, between patients). Disinfect protected surfaces at the end of the day or if visibly soiled.	Provides a regular, standardized, redundant schedule for the reduction of bioburden from the barrier on the device.
4. Hand hygiene before and after use of a MHD.	Recommendation 1: Indications for handwashing and hand antisepsis[28] I. Decontaminate hands after contact with inanimate objects (including medical equipment) in the immediate vicinity of the patient.	Cross contamination between patients may occur via the hands of the HCW after they have touched a contaminated MHD.

a *clinical contact surface* defined as "those surfaces that might be touched frequently with gloved hands during patient care or that might become contaminated with blood or potentially infectious material and subsequently contact instruments, hands, gloves, or devices" giving the specific example of a chair-side computer in a dental office. Interestingly, the cleaning and disinfection guidance differs between the noncritical patient care item and the clinical contact surface, the latter being more stringent and including barrier protection and regular cleaning for these surfaces.

The authors believe that, given the ever expanding use and application of the MHD to the clinical environment, the MHD fits within both of the CDC classifications and that the recommendations should be blended or bundled to provide for adequate actionable guidance on how to handle disinfection of the MHD. We propose the iPBundle, a common sense approach to the safe use of the MHD from both an infection prevention standpoint and the need to preserve the functionality of this valuable patient education tool and clinical documentation, communication, and decision support tool.

The iPbundle includes the following elements: (1) A waterproof/resistant, nonporous, hard or soft case for the MHD. (2) Disinfection of the MHD before and after patient/family interface with an approved disinfectant as per facility policy for noncritical items. (3) Set alarm on the MHD to remind user to disinfect regularly in addition to the before and after patient/family interface disinfection (for example, daily, hourly). (4) Hand hygiene as per facility policy for patient interaction and after disinfecting the MHD.

Table 1 provides the iPBundle element with corresponding CDC Guideline for Disinfection and Sterilization in Healthcare Facilities (2008) and the CDC Guideline for Hand Hygiene in Health-Care Settings (2002) recommendations.[27,28]

IMPLICATIONS

Mobile technology certainly has impacted how patient care can be documented and how resources for education can be delivered. However, the impact of these devices should be favorable and not detract from patients' or clinicians' well-being. Unlike other mobile technology (eg, mobile phones and PDAs), tablets are more likely to be shared between and among clinicians, patients, and families and perhaps even the clinicians' family members, increasing the risk of cross contamination. The induction of the community in terms of sharing a "medical" device with them brings with it a whole new potential source of contamination in both directions. Infection prevention measures need to be considered when these devices are used in clinical areas, especially acute care hospital settings. The authors have assembled a set of common sense interventions that, when used together, could have an impact on reducing contamination.

New technologies will always be a part of clinical medicine, and there will always be the risk of new equipment popping up without IP's knowledge of its presence. Therefore, it is imperative that the IPs develop methods to be situationally aware of what technology is presenting within their care areas. For example, the IP should become a member of committees charged with the assessment and adoption of new technologies for the health care facility. Furthermore, the IP should campaign for said committee evaluating all equipment that would be alien to the facility, such as a nursing or medical school presence within a facility that uses MHD's during clinical rotations.

HCW education by the infection prevention department should strive to deliver content directly related to the device. For example, if the device is facility issued, screen savers can promote the safe use of mobile devices and push reminders for compliance with the iPBundle. Learning-management software can be preloaded on facility-owned devices or can be required to be installed on alien devices (non-facility owned) that would house mandatory learning modules in regard to compliance with the iPBundle.

Instant access to information, ability to share data and images with patients and family at the bedside, and secure wireless remote access to electronic medical record is a privilege as compared with how these tasks were traditionally performed. Infection prevention and control programs have an important role in working together with health care providers to implement and monitor evidence-based practices regarding the care that is delivered to the patient. Although the iPBundle is believed to be a novel approach, it is also a common sense approach that may help to decrease the instance of infection transmission related to the use of this technology in clinical practice. Further research is needed related to the impact of MHD use from an infection prevention standpoint, both from the device as a risk for transmission and the device as a tool to prevent infection. The authors encourage formal implementation and testing of the iPBundle in real world clinical application to further the development and effectiveness of the suggested interventions.

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