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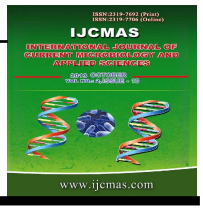

Review Article

Accessories of health care workers: a boon or a curse to patients in pediatric ICU and Nursery?

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A B S T R A C T

Hundreds of millions of patients are affected by health care-associated infections worldwide each year, leading to significant mortality and financial losses for health systems, especially in pediatric intensive care unit and nursery. Health care workers play an important role in cross transmission of infection as they provide essential services to patients. Hands of health care workers have long been known to be the potential source of infection. But the accessories like stethoscopes, mobile phones and pens used by the health care workers for the betterment of the patients have now become a major threat to critically ill patients in pediatric ICU and nursery. As they are constantly in contact with hands of health care workers and in the vicinity of patients, contamination of these accessories with multi drug resistant organisms is inevitable. Thus the present review article is designed to throw light on these highly neglected accessories which is turning out to be a curse to patients and also methods to control them has been described.

Introduction

Health care-associated infections (HCAI), or "nosocomial" and "hospital" infections, affect patients in a hospital or other health-care facility, and are not present or incubating at the time of admission. They also include infections acquired by patients in the hospital or facility but appearing after discharge, and occupational infections among staff. Of every 100 hospitalized patients at any given time, 7 in developed and 10 in developing countries will acquire at least one health care associated infection. In high-income countries, approximately 30% of patients in intensive care units (ICU) are affected by at least one health care-associated infection. In low- and middle-income countries the frequency of ICU-acquired infection is at least 2─3 fold higher than in high-income countries. Newborns are at higher risk of acquiring health care-associated infection in developing countries, with infection rates three to 20 times higher than in high-income countries (FACT SHEET. WHO).

Transmission of HCAI

Transmission of infection within a health care setting requires three elements: a source of infecting microorganisms, a susceptible host, and a means of transmission for the microorganism to the host.

Source of Microorganisms

Two major groups of microorganisms may be found on the skin:

1) Transient flora- microorganisms that colonize the host for hours to weeks but do not establish themselves permanently.

2) Resident flora- microorganisms that are always present on or in the body and are not easily removed by mechanical friction.

Unless introduced into body tissues by trauma or by medical devices such as i.v catheters, the pathogenic potentials of resident flora is usually regarded as low. In contrast, transient flora causes most health care associated infections resulting from cross transmission. The potential sources of transient flora in health care workers are Hands and their accessories like Mobile phones, Stethoscopes, Pens and finger Rings. According to a scientific review, the most common sources of infectious agents causing HCAI are (listed in decreasing frequency) the individual patient, medical equipment or devices, the hospital environment, the health care personnel, contaminated drugs, contaminated food, and contaminated patient care equipment (Pittet *et al*., 2006).

Host Susceptibility

Susceptibility of patient to develop an infection after exposure to a pathogenic organism depends on several factors. Some people will never develop symptomatic disease because they can resist increasing microbial growth or have immunity to specific microbial virulence properties. Others exposed to the same microorganism may retain the organisms as an asymptomatic carrier (colonization) or develop an active disease process. Intrinsic risk factors that predispose patients to HCAIs are immune-compromised status because of age (neonate, elderly), underlying diseases, and severity of illness, immunosuppressive medications, or medical/surgical treatments. Thus severity of a patient's illness in combination with multiple risk factors contributes to the highest infection rates in ICU patients. HCAI rates in adult and paediatric ICUs are approximately three times higher than elsewhere in hospitals(Pittet *et al*., 2006).

Extrinsic risk factors include surgical or other invasive procedures, diagnostic or therapeutic interventions and personnel exposures. In addition to providing a portal of entry for microbial colonization or infection, invasive devices also facilitate transfer of pathogens from one part of the patient's body to another, from health care worker to patient, or from patient to health care worker to patient. A study revealed that the highest proportion of adverse events during hospitalization was not related to surgical procedures but linked instead to the subsequent monitoring and daily care lacking proper antisepsis steps (Pittet *et al*., 2006).

Means of Transmission

Among patients and health care personnel, microorganisms are spread to others through four common routes of transmission: contact (direct and indirect),

respiratory droplets, airborne spread, and common vehicle. Vector-borne transmissions (from mosquitoes, fleas, and other vermin) are atypical routes. Contact transmission is the most important and frequent mode of transmission in the health care setting and includes,

1. Direct contact- organism transferred through contact between an infected or colonized patient and a susceptible health care worker or another person.

2. Indirect contact- Patient organisms can be transiently transferred to the intact skin and accessories (i.e. stethoscopes, mobile phones, pens, rings) of a health care worker (not causing infection) and then transferred to a susceptible patient who develops an infection from that organism. An infected patient touching and contaminating a doorknob, which is subsequently touched by a health care worker and carried to another patient, is an example of indirect contact.

The five sequential steps (Casewell and Phillips, 1977) for Transmission of health-care-associated pathogens from one patient to another via health-care workers' hands are.

1. Organisms are present on the patient's skin or have been shed onto inanimate objects immediately surrounding the patient.
2. Organisms must be transferred to the hands and accessories of health-care workers.
3. Organisms must be capable of surviving for at least several minutes on health-care workers' hands and accessories.

4. Hand washing or hand antisepsis by the health-care worker must be inadequate or omitted entirely, or the agent used for hand hygiene inappropriate.

5. The contaminated hand(s) and accessories of the caregiver must come into direct contact with another patient or with an inanimate object that will come into direct contact with the patient.

Organisms that shed from infected patients into the surrounding environment can be carried away not only by the hands of health care workers during patient care, but also by their accessories like Stethoscopes, Mobile phones, Pens and Finger rings that come in frequent contact with their hands and patient surroundings. Evidences in support of this are as follows:

Stethoscopes

Stethoscopes are the most commonly used medical device to assess the health of patients. Several studies compared the contamination of stethoscopes between doctors and other health care workers, and majority of them found doctors' stethoscopes to be highly contaminated based on the fact that doctor's stethoscopes contacted more patients. Bhatta *et al*., (2011) reported that the diaphragm of stethoscopes was used more often (100 %) by the HCWs than the bell (77.58 %). Therefore bacterial contamination of the diaphragms (89.65%) was much higher than the bacterial contamination of the bells (65.51%). Other studies have also reported the presence of pathogenic bacteria on stethoscope diaphragms, which is worrisome. The diaphragm of stethoscopes has a relatively larger flat surface and has direct contact with the patient's skin or clothes, thereby increasing the chances of bacterial colonization.

Contaminated Stethoscopes are more harmful and infectious in children than in adults. These premature and very low birth weight infants have immature, often abraded skin, and a variety of skin wounds resulting from intravenous access and recent surgeries. When the contaminated stethoscopes are placed near the potential site of access for bacteria, transmission of potential pathogens occur in infants increasing morbidity and mortality in children admitted to pediatric ICU and nursery.

There are increasing reports of the risk of transmitting antibiotic resistant microorganisms from one patient to another on stethoscopes. These antibiotic-resistant organisms are capable of initiating severe infections in a hospital environment and could require contact isolation and aggressive treatment to prevent the spread of the organisms (Bhatta *et al*., 2011; Uneke *et al*., 2010). Many studies also reported CoNS (85%) as the most commonly isolated organism, followed by S.aureus (19%), MRSA, Acinetobacter, Klebsiella, E.coli and other bacterial isolates (Bhatta *et al*., 2011; Smith *et al*., 1996). CoNS have been implicated in a majority of health care associated infections. S.aureus is also a major pathogen encountered in a variety of infections like surgical site infections and blood stream infections. It is clear from the above findings that gram positive cocci (GPC) were isolated more than gram negative bacilli (GNB). This is because of differences in survival time i.e. half life of GNB is less than an hour, whereas GPC can survive longer on diaphragm of stethoscopes. Acinetobacter species are important agents of health care associated infections that can remain alive on various inanimate surfaces and are frequently observed, especially in Intensive Care Units (Nunez *et al*., 2000).

Mobile phones

Today India has 287 million mobile phone users and this account for 85% of all the communications users. In the health care setting, they are essential for quick and easy access to laboratory and imaging results, for consultations, and sometimes for life threatening emergencies (Kapdi *et al*., 2008).

These can be put in vibratory mode in intensive care units, post-operative wards and operation theatres etc. however they are seldom cleaned and are often touched during or after examination of patients and handling of specimens without proper hand washing. These cell phones can harbor various potential pathogens and become an exogenous source of nosocomial infection among hospitalized patients and also a potential health hazard for self and family members. In a study it was discovered that an average cell phone is dirtier than either a toilet seat or the bottom of your shoe (Arora *et al*., 2009).

Usha arora *et al*., (2009) screened 160 cell phones belonging to doctors and paramedical staff working in various departments at govt. medical college and hospital, Amritsar for bacterial isolates. Out of total 160 cell phones, growth was obtained in 65 (40.62%) cell phones. 31(19.37%) from clinical workers and 34 (21.25%) from non-clinical workers. Coagulase negative staphylococcus was the most commonly isolated organism.

Jayalakshmi *et al* ., (2008) screened 84 cell phones belonging to doctors in clinical and 60 cell phones belonging to doctors in the pre and para clinical department for bacterial isolates. Except for the 12 new cell phones, all the others (91.6%) were found to be contaminated, 76

(90.4%)owned by clinical doctors and 56(93.3%) owned by non-clinical doctors. The contaminating pathogens were coagulase negative staphylococcus (108), Bacillus spp (46), Staphylococcus aureus (33) and others constituting 229 bacterial isolates (Jayalakshmi *et al*., 2008).

Behavior of HCWs contributing to bacterial growth on mobile phones is:

1. Infrequent cleaning of mobile phones during patient care.

2. Some doctors are unaware of the fact that mobile phones can also act as the vector for transmission of pathogenic organisms to patients.

3. Most of them who are aware of its pathogenic potential also don't clean, as per the instructions of mobile phone manufacturers that contact with water or liquid disinfectant might damage the software of their expensive mobile phones. Thus health care staff are risking their as well as patient's health in an attempt to save their mobile phones from getting damaged.

Contamination of mobile phones could be due to many reasons. Most important is low compliance of hand washing, thus bacteria that are carried by hands are transmitted to mobile phones that are usually in contact with the hands.
Only hand washing does not prevent transmission of infection from mobile phones, but disinfection of mobile phones with isopropyl alcohol needs to be practiced. Otherwise bacteria present on mobile phones get transferred to clean hands and the cycle of cross infection continues. Currently in many institutions, strict guidelines have not been implemented to restrict medical staff from carrying mobile phones into the sterile environment of the OT, ICU or other critical areas. There are also no cleaning guidelines for mobile phones of HCWs. People tried many ways to clean and sterilize their mobile phones but the best way is ultrasonic cleaning by an ultrasonic cleaner which clean the mobile phones thoroughly and safely (The best way to clean your cell phone -ultrasonic cleaning, 2010). Thus there is need for following strict infection control practices to minimize HCAI.

Restriction of using mobile phone while working hours is not the practical solution of the problem. In resource poor hospital settings like India, ultrasonic cleaner is not available at most of places. Therefore simple measures like hand washing, cleaning of mobile phones with 70% isopropyl alcohol, using hand free mobile phone while working hours, well controlled infection control plan and regular training to HCWs are recommended to reduce the rate of health care associated infections.

Pens

The contamination of doctors' and nurses' pens with MRSA and VRE may merely be a reflection of staff hand contamination. Nevertheless, staff may unwittingly re inoculate their hands with these organisms if they use their pens after hand washing. Pathogens might spread between staff if they share pens and pens might be the route of transmission of infection between wards (French *et al*., 1998).

In the intensive care unit, respiratory therapists are required to wash their hands and put on new gloves before each patient they visit, but few respiratory therapists disinfect their writing implements between

patients. Unlike stethoscope, a pen usually doesn't directly contact the patient, and clinician may not touch pen until patient interaction is completed, a pen can be a fomite (Wolfe *et al*., 2009).

Parmjeet Kaur *et al* found that 37(49.3%) out of 75 pens showed growth. Coagulase negative staphylococci was the most common isolate obtained from 8(10.6%). Staphylococcus aureus, *Bacillus* spp, M*icrococcus* spp, *Corynebacterium* spp, *Enterococcus* spp and other gram negative bacilli were obtained from 7(9.3%), 7(9.3%), 5(6.6%), 4(5.3%), 2(2.6%) and 4(5.3%) pens respectively.28.6% *Staphylococcus aureus* and 12.5% CONS were found to be methicillin resistant by using cefoxitin disc (Gill *et al*., 2011).

Christian datz *et al*.,(1997) examined 42 writing tools and detected that 52.4% of pens had one bacterial strain, where as 40.5% of pens showed more than 1 genus. Coagulase negative staphylococci were recovered from 71% (30/42) of pens; methicillin resistant coagulase negative staphylococcus was isolated 14% (6/42) of pens.

David f wolf *et al.,* (2009) obtained pens from 20 respiratory therapists' detected growth on 17 pens. Coagulase negative staphylococci were found on all 17 pens.

Gary French *et al.,* (1998*)* tested 36 pens from six wards affected by MRSA, and 9(25%) were contaminated by this pathogen. The antibiotic resistance patterns of the pen isolates were same as that of the outbreak strain on the ward concerned.6 pens were collected from the VRE ward and 1(17%) was positive for VRE. None of the 8 pens from MDR klebsiella ward was contaminated by this pathogen.

Bacterial isolation depends on the type of pen used and the survival ability of these bacterial isolates on different types of pen. Previous studies reported that on rubber grip pens, *S.aureus* and CoNS survived upto 72 and 48 hours respectively. On plastic pens both survived upto 48 hours and on metallic pens upto 24 and 18 hours respectively. Gram negative bacilli survived for less than 18 hours on all three types of pens (Gill *et al*., 2011).

These results re-emphasise the importance of hand washing in the prevention of cross-infection. But no cleaning guidelines exist for pens. Regular disinfection with alcohol might reduce contamination of pens. In high risk areas like PICU and nursery, special pens that are disinfected regularly and disposed of after discharge might be kept by each patient's bed. However as survival time of organisms was less on metallic pens, usage of pens with metallic body may be encouraged and rubber grip pens should be discouraged in hospitals to prevent cross infection.

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