Assessment of healthcare worker’s hand hygiene and infection prevention practices of their personal belongings in a healthcare setting: a survey in pre COVID-19 era and literature review on standard disinfection practices

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Keywords
Healthcare workers • Mobile phones • Stethoscope • Hands • Aprons • Hygiene practices • COVID-19

Introduction
Developing countries face a high burden of nosocomial infections [1]. It affects the disease course of hospitalized patients by increasing length of hospital stay, morbidity, mortality and imposes an additional financial burden. Many of these infections are caused by drug resistant microorganisms which are difficult to treat [1, 2]. Microorganisms causing nosocomial infections could be acquired from the hospital environment. Healthcare workers (HCW) act as a potential source of transmission through their hand and contaminated personal belongings (clothes, stethoscopes and electronic devices) [3-7]. Hand hygiene is the single most effective intervention in reducing health care associated infections. Time and again this has been reinforced among HCWs yet the practice of hand hygiene has been found to be contaminated by various pathogenic bacteria. Studies have demonstrated the presence of Methicillin-resistant Staphylococcus aureus (MRSA), Vancomycin-resistant Enterococcus (VRE) and Clostridium difficile on their surfaces. In the absence of adequate disinfection practices they can cause cross transmission [9, 10]. Infection prevention compliance and instrument disinfection practices among healthcare workers is poor [11]. Similar is the case with mobile phones, stethoscopes, and aprons in addition to reinforcing hand hygiene practices.

Background. Healthcare workers’ (HCW) hands and personnel belongings are vehicles of transmission of nosocomial infections. Knowledge, attitude, and practice of hand hygiene have been extensively studied suggesting adequate knowledge but poor compliance. Similar data on aprons, mobile phone and stethoscope disinfection practices are lacking. This becomes an extensively important topic of discussion in current COVID-19 pandemic where inadequacy in hygiene practices is devastating.

Aim. To study the knowledge, attitude, and infection prevention practices of HCWs aprons, electronic devices, stethoscopes, and hands.

Methods. A cross sectional questionnaire-based survey was conducted among HCWs of Medicine ward and ICU.

Results. Sixty-six HCWs responded to the survey. Awareness that hands, aprons, mobile phones, stethoscopes could cause cross transmission and knowledge of correct practices was present in majority of the respondents. Hand hygiene was performed by 65.2% of the respondents before touching a patient and 54.5% after touching the patient surroundings while 13.6% performed only when it was visibly soiled. Mobile phones and stethoscopes were disinfected by 13.6 and 30.3% of the respondents after each patient encounter, respectively. Aprons were washed after using them at a stretch for a median duration of 5 days (1-30 days). Forgetfulness, lack of reinforcement, lack of time, inadequate awareness on standard disinfection practices and fear of damaging electronic devices from disinfectants use were reasons for poor compliance.

Conclusions. There is an urgent need to spread awareness and formulate standard guidelines on disinfection practices especially for mobile phones, stethoscopes, and aprons in addition to reinforcing hand hygiene practices.
conducted with the objective of assessing knowledge, attitude, and infection prevention practices of HCWs
aprons, electronic devices, stethoscopes, and hands.

Methods

A questionnaire-based cross-sectional study was conducted during November and December 2019 among
health-care workers working in wards and Intensive Care Unit (ICU) of Medicine Department at a tertiary care
centre in New Delhi, India. Health-care workers included doctors and nurses. This study was ethically approved
by institute ethics committee.

A preformed questionnaire using the Google forms format was made. The questions were pertaining to
hygiene practices among healthcare workers with respect to hand, aprons, stethoscope, and electronic
deVICES. The questions under each section were framed to assess their knowledge, their attitude towards infection
prevention, and their day-to-day practice. A set of questions were circulated as pilot among 10 participants
and the following questions were finalized based on their feedback and applicability along with suggestion
from experts. Final questionnaire (Tab. I) included five questions each for assessing hand hygiene, stethoscope,
and apron disinfection, while there were six questions for electronic devices. The questionnaire was circulated
among the HCW via the Google link and could be filled only once. The respondents could voluntarily take up
the survey. Confidentiality was maintained by not using any respondent identifiers and making the responses to
the questionnaire completely anonymous. A descriptive statistical analysis involving frequencies and percentages
was performed to assess the hygiene practices.

Results

Sixty-six healthcare workers in Medicine wards and ICU responded to the questionnaire during the study
period (Tabs. I, II). It included 38 junior residents, 21 senior residents, 3 nurses, 2 consultants and 2 interns.
Fifty-nine (89.4%) of them worked in medicine ward and seven (10.6%) of the HCWs worked in ICU. Median
experience of working in a healthcare setup was 4 years (range: 1-18 years).

Assessment of hand hygiene practices revealed that, all healthcare workers were aware of the significance of
hand washing and that lapses could cause cross transmission. Ninety-four percent reported that they were
sure of all the steps of hand washing and the rest were unsure. All HCWs reported that they washed their
hands however the scenarios in which they did it were different. Majority, 81.8% HCW did hand washing
before any clean or aseptic procedures, 87.9% of them washed their hands after encountering body fluids and
77.3% after touching a patient. However, only 65.2% of them practiced hand hygiene before touching a patient
and 54.5% after touching the patient surroundings. Hand hygiene practices were followed by 13.6% HCWs only
on being visibly soiled. Alcohol based hand rubs were used by 94% of them and 71.2% washed their hands
with soap and water when they were visibly soiled. Eight healthcare workers reported that they did not practice
adequate hand washing due to forgetfulness, lack of on spot reinforcement and lack of time.

All healthcare workers carried electronic devices to the hospital which universally included the mobile phones.
Other devices used were tablets, laptops, and pulse oximeters. Usage of electronic devices amidst patient care
was reported by 78.8% HCWs. Although all were aware that electronic devices can cause cross transmission,
only 89.4% of them cleaned their devices, out of which only 13.6% disinfected it after each patient encounter
and 75.8% did it only when it was visibly soiled while 10.6% HCW never disinfected their devices. Alcohol
based disinfectant were commonly used by 85.9% HCW to disinfect their devices. Lack of knowledge of correct
technique of disinfection and the fear of damaging their devices due to disinfectant formulae were the reasons
provided by those who did not disinfect their device.

Stethoscopes are routinely used for patient care by around 91% HCWs and infection prevention practices
involving this commonly used medical device were evaluated in our study. Around 98.5% HCW were aware
that stethoscopes could be potential sources of cross transmission of infection. Although 93.9% of them
disinfected their stethoscopes only 30.3% of them did it after each patient encounter, 6.1% of them never
disinfected and the rest of them did it only when it was visibly soiled. Alcohol based disinfectant was used by
all of them and mainly the diaphragm (46.9%) was disinfected. Lack of knowledge was reported as the
reason for not disinfecting their stethoscopes.

Aprons are worn by over 91% HCW regularly during patient care. About 97% HCW were aware of risk of cross
contamination, yet most of the study population involving around 94% of them carried aprons back home after
duty. Unwashed aprons were used at a stretch for a median of 5 days (range: 0-30 days). Tap water with detergent was
used for disinfection. All of them reported of washing their aprons however those who did not regularly wash
gave the reason of lack of time. Everyone, irrespective of the practicing speciality, reported the need for hospital
scrubs for patient care which could thereafter be left back in the hospital itself for disinfection.

Discussion

Our study was done to assess the knowledge, attitude, and practice of infection prevention measures amongst
HCWs. All potential sources of infection including hands, electronic devices, clothing, and stethoscopes were
analysed for hygiene practices. Wide spectrum of HCWs were sampled including consultants, residents, interns,
and nurses working in both ward and ICUs.

Almost all HCWs in our study reported that they were aware of the fact that hands, electronic devices, aprons,
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and stethoscopes are potential fomites causing cross transmission and also agreed of having a fair knowledge on hygiene practices, however few lapses were observed in the responses pertaining to their practice of the same. Multiple studies have also reiterated the same with regards to poor compliance and practice of infection prevention hygiene practices among healthcare workers [12, 14, 15, 17-20].

WHO has recommended various steps and movements of hand hygiene [21]. However, the practice of five movements around the patient zone was variable. Majority of them performed hand hygiene after patient contact, after exposure to body fluids and before aseptic procedures, however just above half of them did it before touching the patient and after touching the surroundings. Furthermore, 13.6% did it only when it was visibly soiled. A similar study reported 86% of respondents having knowledge about hands being a vehicle of transmission while only 53.8 and 32.5% knew about movements around the patient zone was variable. Majority of them performed hand hygiene after patient contact, after exposure to body fluids and before aseptic procedures, however just above half of them did it before touching the patient and after touching the surroundings. Furthermore, 13.6% did it only when it was visibly soiled. A similar study reported 86% of respondents having knowledge about hands being a vehicle of transmission while only 53.8 and 32.5% knew about movements.

Tab. I. Responses to the survey.

| Question | Response - number (%), n = 66 |
|----------|-----------------------------|
| **I. Hand hygiene** | |
| 1. Are you aware that hands can cause cross contamination and infection in your patients? | Yes: 66 (100%) No: 0 |
| 2. Will you be able to perform all the steps of hand washing? | Yes: 62 (94%) Maybe: 4 (6%) No: 0 |
| 3. Under what scenarios do you wash your hands? | A. Before any clean or aseptic procedures: 54 (81.8%) B. After touching body fluids: 58 (87.9%) C. After touching the patient: 51 (77.3%) D. Before touching the patient: 43 (65.2%) E. After touching patient surroundings: 36 (54.5%) F. Only when hands are visibly soiled: 9 (13.6%) |
| 4. Disinfectant used | A. Alcohol based hand rub: 94% |
| 5. Reasons for not performing adequate hand hygiene | 8 (12.1%): Forgetfulness and lack of on spot reinforcement, lack of time |
| **II. Electronic device disinfection practices** | |
| 1. Do you carry electronic devices to your workplace? | Yes: 66 (100%) No: 0 |
| 2. What electronic devices do you carry? | A. Mobile phones: 66 (100%) B. Tablets: 20 (30.3%) C. Pulse oximeters: 20 (30.3%) D. Laptops: 12 (18.2%) |
| 3. Are you aware that electronic devices can cause cross contamination and infection in your patients? | Yes: 66 (100%) No: 0 |
| 4. Do you use your device while caring for your patients? | Yes: 52 (78.8%) No: 14 (21.2%) |
| 5. Do you clean your devices and under what circumstances? | Yes: 59 (89.4%) A. Only when visibly soiled: 50 (75.8%) B. After each patient encounter: 9 (13.6%) No: 7 (10.6%) |
| 6. Disinfectant used | Alcohol based disinfectant: 85.9% |
| **III. Stethoscope disinfection** | |
| 1. Do you use stethoscope during routine patient care? | Yes: 60 (91%) No: 6 (9%) |
| 2. Are you aware that stethoscopes can cause cross contamination and infection in your patients? | Yes: 65 (98.5%) No: 1 (1.5%) |
| 3. Do you clean your devices and under what circumstances? | Yes: 62 (95.9%) A. Only when visibly soiled: 42 (63.6%) B. After each patient encounter: 20 (30.3%) No: 4 (6.1%) |
| 4. Which part of the stethoscope do you clean? | A. Diaphragm only: 31 (46.9%) B. Diaphragm and tubing: 18 (27.3%) C. Diaphragm, tubing and earpiece: 13 (19.7%) D. Soiled portion: 10 (15.2%) |
| 5. Disinfectant used | Alcohol based disinfectant: 100% |
| **IV. Apron disinfection** | |
| 1. Do you use apron regularly during routine patient care? | Yes: 60 (91%) No: 6 (9%) |
| 2. Are you aware that aprons can cause cross contamination and infection in your patients? | Yes: 64 (97%) No: 2 (3%) |
| 3. How many days at a stretch do you wear your unwashed apron? | Median (Range): 5 days (0-30 days) |
| 4. Disinfectant used | Tap water and detergent: 100% |
| 5. Which do you think is the best mode of getting your aprons washed? | Hospital should provide scrubs for patient care which can be left back in the hospital for disinfection: 100% |
and steps of hand hygiene [1]. A metaanalysis revealed compliance of 52% (27-86%) for hand hygiene [22]. If similar compliance rates are followed in the current COVID-19 pandemic era, infection prevention would be impossible to achieve and hospitals would thus be hotspots of infection transmission rather than control and prevention.

Hand hygiene is the corner stone for prevention of hospital acquired infections. Poor compliance despite adequate knowledge is a major bottleneck for adequate infection control and prevention. Respondents in our study blamed lack of time as the reason for inadequate hand hygiene similar to other studies which has identified “being busy” as one of the factors influencing hand hygiene behaviour [23]. Availability of point of care hand hygiene products which includes alcohol based hand rubs closer to the patients and on-site reinforcement of importance hand hygiene will facilitate better integration of hygiene practices in the workflow [24].

Mobile phones are universally used by all healthcare workers and majority reported of it being used during patient care. However only 13.6% of them disinfected after each patient encounter and 10.6% of them never disinfected their devices. Similar results have been published by a study wherein only 37% admitted of cleaning it regularly [25]. The benefit of using mobile phones in clinical areas should be weighed against the potential risk of contamination and cross infection. It is best avoided during patient care or to be disinfected with 70% isopropyl alcohol after each patient encounter taking care that moisture does not enter any of the openings and perform proper hand hygiene [26].

The most common reason for not disinfecting was out of the fear of damaging the device and many did not know the proper method of disinfection. There are concerns that more than 50% alcohol damages the screen and the phone manufacturing companies do not recommend any chemical being used. However in the wake of COVID-19 pandemic they too have recommended 70% isopropyl alcohol wipes [27-29]. There is no clear evidence that mobile phone hygiene reduces disease transmission. Nevertheless, mobile phone use should be minimized, hand washing, disinfectant wipes, headphone use and washable covers should be encouraged [26]. Extrapolating available data to current scenario could signify that HCW would carry coronavirus back home inevitably thus promoting fomite transmission of COVID-19 to family and friends. Hence there is an urgent need to stress on infection prevention

measures and even better refrained use of electronic devices during patient care in present day situation.

Stethoscopes are the most common medical device used and a recognized fomite, yet disinfection practices are poor. Only one third of them disinfected stethoscopes after each patient encounter and 61.1% never disinfected stethoscopes in our study. Studies by Sahiledengle B and Ghumman GW et al. have also reported that only 39.7% and 29% respectively disinfected their stethoscopes regularly, the rates have been less than 50% usually [18-20]. Several studies have concluded that disinfection of stethoscopes with 70% isopropyl alcohol reduces 99% of bacteria [30]. However lack of awareness of standard infection prevention guidelines and favourable attitude towards infection prevention are independent predictors of stethoscope disinfection after every use [20]. Regular disinfection of stethoscope, followed by hand hygiene and avoidance of sharing them has been suggested to prevent spread of COVID-19 [31].

Aprons/Lab coats are frequently used by healthcare workers during patient care. They are potential yet neglected cause of cross transmission. In our study it was seen that almost everyone carried back their aprons home and was washed at a median of 5 days with a maximum of a month at a stretch being unwashed. This is potentially dangerous and can lead to infection of the family members as well. Many agreed to lack of time being the reason for not washing their aprons. We suggest that hospital provide fresh scrubs daily for healthcare workers which can be left back for disinfection in the hospital before going back home.

The study design being cross sectional questionnaire-based survey, although throws light on important infection prevention practices prevailing, there might be response bias as the data is solely based on how faithfully HCWs reported on their practices as the study did not involve direct observation of their practices. Yet the reported correct practice was low in accordance with the published literature. Extrapolation of data on a larger scale would mandate larger prospective studies wherein the practices are observed for stronger evidence. Results may not be generalizable to various specialties of healthcare considering the setup of medical wards and ICU only considered in our study. Nevertheless, this study could be food for thought to implement more strict compliance with infection prevention measures by healthcare workers. The suggested recommendations on infection prevention hygiene practices in this manuscript can increase awareness among HCWs and help fight the COVID-19 pandemic.

### Conclusions

Healthcare workers and their belongings are undoubtedly potential sources of infection. Despite adequate knowledge, poor compliance to infection prevention practices has hampered the progress in reducing nosocomial infections. Akin to widespread dissemination of information on
hand hygiene, standard guidelines, and reinforcement of hygiene practices for potentially infectious yet neglected fomites like mobile phone, stethoscopes, and aprons among all cadre of healthcare workers is necessary.

The immediate pre-COVID era data discussed acts as a baseline to evaluate infection prevention practices prevailing amongst HCW and hence could be helpful to formulate strategies and infection prevention guidelines to combat the infectious pandemic.

Ethics statement

The work has been approved by institute ethics committee and that subjects gave informed consent to the work.

Acknowledgements

Funding sources: this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflicts of interest statement

The authors declare no conflict of interest.

Authors’ contributions

VCK, AK conceived the study. VCK, AK, NR and MS were involved in making the questionnaire and collecting the responses. VCK wrote the manuscript and was guided by AK. MAK was involved in statistical analysis and script editing. AK, NR and MS were involved in script editing. NW was involved in script editing and script critical review. All authors read and approved the final version of the manuscript.

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Received on August 30, 2020. Accepted on March 1, 2021.

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How to cite this article: Kumar A, Keri VC, Khan MA, Ranjan P, Rastogi N, Sahu M, Wig N. Assessment of healthcare worker’s hand hygiene and infection prevention practices of their personal belongings in a healthcare setting: a survey in pre COVID-19 era and literature review on standard disinfection practices. J Prev Med Hyg 2021;62:E104-E109. https://doi.org/10.15167/2421-4248/jpmh2021.62.1.1742

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