Section: Microbiology

Original Research Article

MICROBIAL FLORA OF HEALTH CARE WORKERS ACCESSORIES - A POTENTIAL SOURCE OF HEALTHCARE-ASSOCIATED INFECTIONS

K. Snehaa[1], Sukriti Singh[2], Vineeta[3], Shwetha V R[4], Ruby Thomas[5]

[1]*Assistant Professor, Department of Microbiology, ANIIMS, India*
[2]*4th Year MBBS Student, Department of Microbiology, ANIIMS, India*
[3]*Assistant Professor, Department of Microbiology, ANIIMS, India.*
[4]*Associate Professor, Department of Microbiology, ANIIMS, India.*
[5]*Professor and HOD, Department of Microbiology, ANIIMS, India.*

Received *: 03/02/2026*
Received in revised form *: 20/03/2026*
Accepted *: 05/04/2026*

Corresponding Author:
Dr.K. Snehaa,
Assisstant Professor, Department of Microbiology, Andaman and Nicobar Islands Institute of Medical Sciences, Sri Vijayapuram, India..
Email:sneha.lhmc@gmail.com

DOI:10.70034/ijmedph.2026.2.108

Source of Support: Nil,
Conflict of Interest: Nonedeclared

Int J Med Pub Health
2026; 16 (2); 637-643

ABSTRACT

Background: Healthcare-associated infections (HCAIs) pose a significant risk to hospitalized patients, with healthcare workers (HCWs) and their accessories often acting as potential sources of transmission. This study aimed to assess the microbial contamination of common HCWs accessories, such as mobile phones, stethoscopes, pens, and finger rings, to better understand their role in spreading infections and antimicrobial resistance.

Materials and Methods: This cross-sectional study was conducted from September to October 2023 at Andaman and Nicobar Islands Institute of Medical Sciences, Sri Vijayapuram. A total of 63 HCWs (52 doctors and 11 nurses) participated. Samples were collected from mobile phones, stethoscopes, finger rings, and pens using sterile cotton-tipped swabs. The samples were processed for microbial growth as per the standard bacteriological protocols, followed by antimicrobial susceptibility testing using the Kirby-Bauer disc diffusion method.

Results: Among the 193 samples collected, 76.1% were contaminated with pathogens, with mobile phones (84.1%) showing the highest contamination rate, followed by finger rings (79.2%), stethoscopes (74.4%), and pens (68.3%). The predominant microorganisms isolated were Coagulase Negative *Staphylococcus* (CONS) (55.1%) and *Staphylococcus aureus* (42.1%). A significant proportion of these pathogens were resistant to common antibiotics, with 48.38% of *S. aureus* being methicillin-resistant (MRSA) and 44.44% of CONS being methicillin-resistant (CONS-MR).

Conclusion: This study highlights the high prevalence of bacterial contamination of HCWs accessories, particularly mobile phones. It underscores the need for routine disinfection of these items and improved hand hygiene practices to prevent the transmission of harmful pathogens in hospital settings. The findings also suggest the potential role of these accessories in the spread of antimicrobial-resistant organisms, warranting stricter infection control protocols in healthcare settings.

Keywords: Healthcare-associated infections, healthcare workers, microbial contamination, mobile phones, stethoscopes, finger rings, pens, antimicrobial resistance

INTRODUCTION

Healthcare-associated infections (HCAIs) remain a significant hazard for hospitalised patients. The health care workers (HCWs) can be a potential source of these infections. Transmission of infections through contaminated accessories such as mobile phones, stethoscopes, finger rings, pens, etc. of the HCWs is possible as these are in direct contact with the patient and the hospital's

environmental surface. [1]Healthcare professionals constantly handle mobile phones, stethoscopes, pens, etc. for their day-to-day routine work. The contamination of mobile phones and the diaphragm of the stethoscope with pathogens has been very well documented in studies.[2,3]This is attributed to the lack of proper and regular disinfection of these accessories, strict adherence to the moments of hand hygiene, and hand washing techniques among the HCWs.

Furthermore, antimicrobial resistance is an emerging public health concern now. These accessories harbouring the colonized pathogens may probably get contaminated with the micro-organisms which become resistant to multiple drugs as they acquire resistant genes on subsequent transmissions from one patient to another. Infections with these resistant pathogens substantially contribute to the prolonged duration of stay at the hospital along with the increasing health care expenditure and reduction in the patient's quality of life with the need for more expensive as well as alternative drugs.[4]

The present study will help us to understand the dynamics of microbial flora contamination of the accessories of the HCWs, the extent of their survival, and the antimicrobial susceptibility patterns of the isolates. The risks associated with these contaminated items are yet to be determined. There is a paucity of data to bridge the gaps of knowledge in this area. Moreover, the disinfection procedures of these are hardly covered under any guidelines of Hospital Infection Control to meet the standards of hospital hygiene. This study will also help to increase the awareness among the HCWs of the magnitude of infection control practices and HCAIs. It would also help to improve the clinical outcomes by preventing the transmission of multi-drug resistant pathogens in the hospital among the patients.

MATERIALS AND METHODS

The study was conducted in the Department of Microbiology, Andaman and Nicobar Islands Institute of Medical Sciences, Sri Vijayapuram. The study was conducted after obtainingthe Institutional Ethics Committee approval and taking written consent from the study population for a period of 02 months from September2023 to October2023.

Study Design: Cross-Sectional Study

Study Population:

Inclusion Criteria: The HCWs- the Doctors and Nurses working in the hospital during the study period.

Exclusion Criteria: The HCWs who do not give consent for participation in the study.

Sample Size: A total of 63 participants were included in the study. The HCWs –52 Doctors and 11 Nurses working in the hospital during the study period were included in the study.

The details of the participants regarding the demography and samples collected were taken as detailed in the proforma.

Samples: Samples were collected from all the health care worker's accessories– Mobile phones (screen, keypad, sides and back), Stethoscopes (including the diaphragm), finger rings, and pens.

Sample Collection: The samples were collected following the standard aseptic techniques. The samples were collected with a sterile cotton-tipped swab moistened with sterile normal saline by swabbing/rotating the swab around the HCWs accessories, labeled, and transported to the microbiology laboratory immediately without any delay.

Sample processing : The swabs were then inoculated into Blood Agar and MacConkey Agar, for overnight incubation @ 37ºC.After incubation, the colonies on blood agar (hemolytic and non-hemolytic) were identified by – the Catalase test, Gram's Stain, and conventional biochemical reactions – Slide coagulase and tube coagulase tests and interpreted by standard bacteriological protocols. [5] The lactose fermenting and non-lactose fermenting colonies on Mac-Conkey Agar were identified by the following –Gram's Stain and Conventional Biochemical Reactions- Indole, Citrate test, Urease test, Triple Sugar Iron test, Mannitol motility medium and interpreted by the standard bacteriological protocols.[5]Antimicrobial susceptibility testing of the isolate was performed by Kirby Bauer Disc Diffusion method and interpreted according to the Clinical Laboratory Standards Institute (CLSI)guidelines 2023. [6] The Gram-positive organisms panel included - Erythromycin, Clindamycin, Cloxacillin, Linezolid, Gentamicin, Doxycycline and Gram Negative panel included- Imipenem, Meropenem, Piperacillin tazobactam, Ceftazidime. Methicillin resistance in *Staphylococcus aureus* was detected by using Mueller Hinton agar with 30-µg cefoxitin discas per CLSI guidelines.[6]

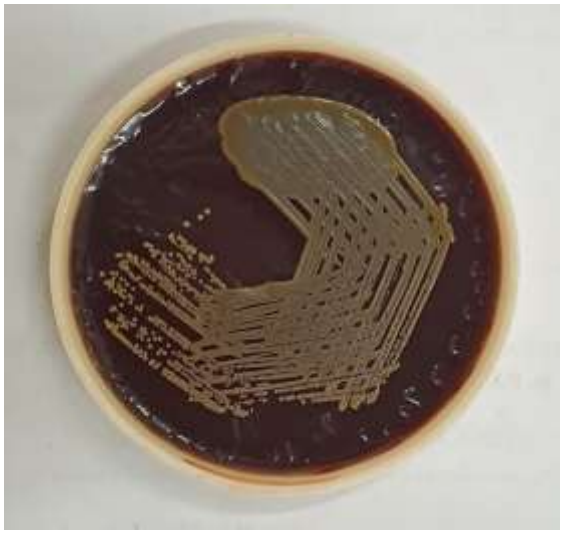

Figure 1: Colonies on Blood Agar

Triple Sugar Iron Agar, Urease, Mannitol, motility medium

Figure 2: Biochemical Reactions- Indole, Citrate, Triple Sugar Iron Agar, Urease, Mannitol Motility Medium

Figure 3: Antimicrobial Susceptibility Testing

RESULTS

Out of the total 63 participants –52 were doctors and 11 were Nurses. A total of 193 samples were collected from the participants which included Mobile phones (n=63), Stethoscopes (n=43), Finger rings (n=24), and Pens (n=63). Among the 63 participants, 33 (52.3%) were females and 30 (47.6%) were males, sex ratio being 1.1:1.The maximum number of Health care workers were present in the age group of 21-30 years followed by 31-40 years. [Figure 4]

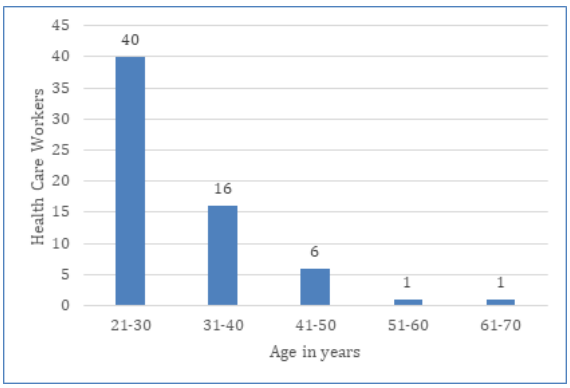

Figure 4: Age distribution of the Health Care Workers

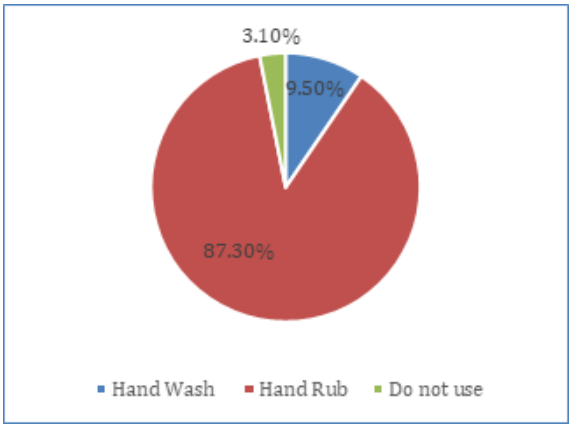

Figure 5: Disinfection Techniques

Figure 5 depicts that Hand rubs (87.3%) were being used as a part of routine infection prevention techniques followed by Hand washing (9.5%).

Out of the total samples (193), 76.1 % (147) of samples had growth on culture while 24% (41) of the samples did not show any growth. [Figure 6]

Among the various samples collected from the HCWs accessories- 84.1% of mobile phones, 79.2% of finger rings, 74.4% of Stethoscopes, and 68.3% of Pens were contaminated with the various pathogens. The most common accessory harbouring pathogens amongst all was mobile phones followed by finger rings, stethoscopes, and pens concerning their total numbers. [Figure 7]

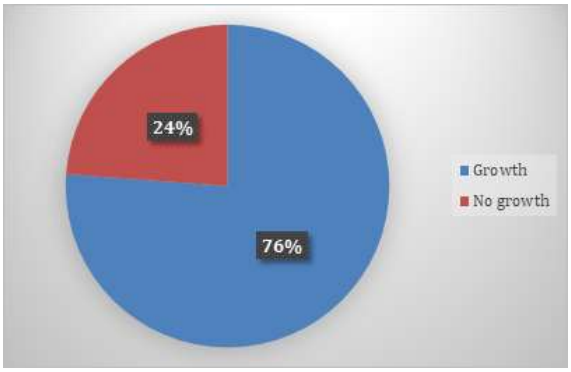

Figure 6: Growth of organisms from total samples (n=193)

Of the 147 culture-positive samples, the predominant organism isolated was Coagulase Negative *Staphylococcus (CONS)* (55.1%) followed by *Staphylococcus aureus* (42.2 %). [Table 3 and Figure 8]

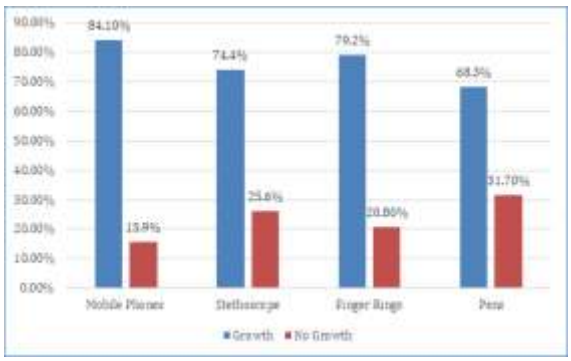

Figure 7: Growth of microorganisms from HCWs accessories

Table 3:Organisms isolated from the various HCWs accessories

Organisms Grown	Mobile Phones (63)	Stethoscopes (43)	Finger Rings (24)	Pens (63)	Total accessories
Staphylococcus aureus	20 (37.7%)	13(40.6%)	11(57.9%)	18(41.9%)	62(42.1%)
Coagulase Negative Staphylococci [CONS]	32 (60.4%)	17(53.1%)	8 (42.1%)	24(55.8)	81(55.1%)
Acinetobacterspp	0	2(6.3%)	0	0	2(1.4%)
Klebsiella spp	1 (1.9%)	0	0	1(2.3%)	2(1.4%)
Total growth	53 (84.1%)	32 (74.1%)	19 (79.1%)	43 (68.3%)	147

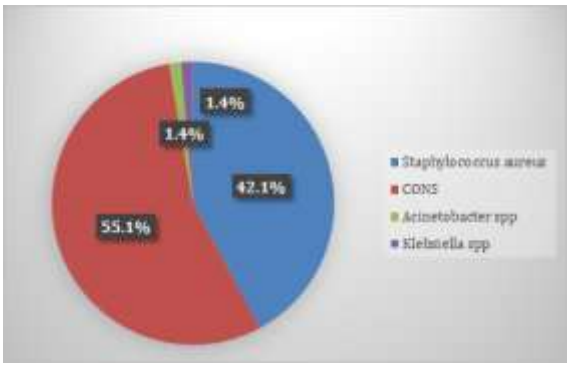

Figure 8: Spectrum of Organisms isolated from HCWs accessories growth positive cultures (n=147)

Figure 9: Sensitivity pattern of CONS (n=81)

The antibiotic sensitivity pattern of CONS – the isolates were sensitive to Linezolid (100%) and Gentamicin (98.76%) and resistant to Erythromycin (44.4%), Cloxacillin (30.90%), Doxycycline (20.90%) Clindamycin (17.80%). Most of the isolates were resistant to erythromycin (Figure 9)
Among the clinical pathogens, *Staphylococcus aureus* was sensitive to gentamicin (96.8%), clindamycin (96.8%), linezolid (100%) and resistantto the erythromycin (58.10%), cloxacillin (33.80%) and doxycycline (16.13%) (Figure 10) Overall, among the gram-positive organisms most of the isolates were resistant to erythromycin. The gram-negative organisms were 2 each of *Acinetobacter* spp. and *Klebsiella* spp. All four isolates were sensitive to ceftazidime, piperacillin-tazobactam, and resistant to Imipenem and meropenem. Of the total S. aureus, 48.38% was MRSA and among the total CONS, 44.44% were CONS-MR. [Figure 11 and 12]

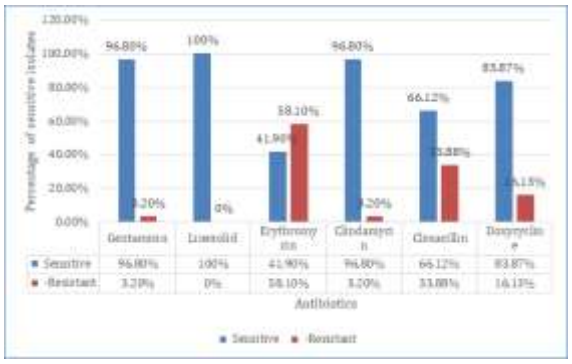

Figure 10: Sensitivity pattern of S.aureus (n=62)

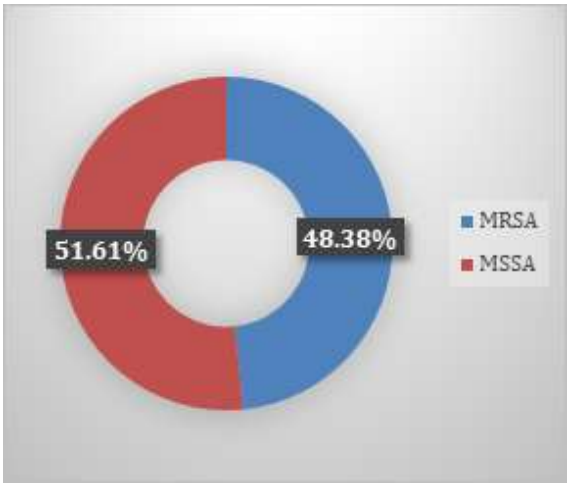

Figure 11: Spectrum of Methicillin Resistance among S.aureus (n=62)

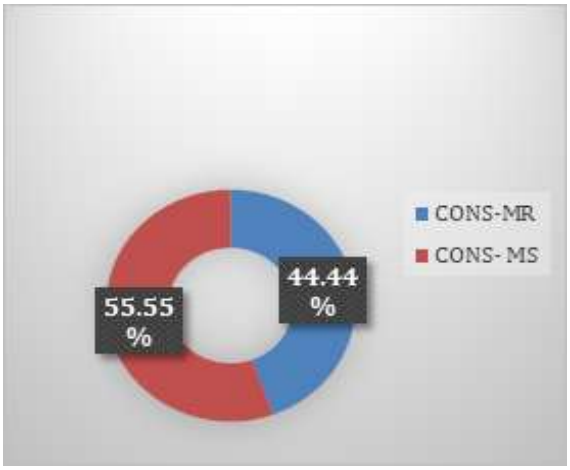

Figure 12: Spectrum of Methicillin Resistance among Coagulase Negative Staphylococcus (n=81)

DISCUSSION

Health Care Associated Infections (HCAI) have become one of the major public health hazards with significant morbidity and economic burden especially in the developing nations. Healthcare workers and the accessories used by them can play a major role in the transmission of infections in hospitalized patients. The acquisition of pathogens and infections depends upon the contamination of the hospital environment. The pathogens can be transferred in patients by direct contact through persons or inanimate objects example mobile phones, stethoscopes, pens, finger rings, etc. These accessories can harbour various clinical pathogens and may act as a source of infection to the patients via the HCWs if proper infection prevention strategies are not being followed.

The present cross-sectional hospital-based study aimed to evaluate the microbial flora and the pathogens contaminating the HCW's accessories – mobile phones, stethoscopes, finger rings, pens, and also the antimicrobial susceptibility pattern. The results demonstrated that 76.1% of the total HCW accessories were contaminated with various pathogens. Similar rates were reported by C J Uneke et.al 2010,[3] with 78.5% of the accessories which included mobile phones and stethoscopes. A much higher rate of 94.2% was reported in the study by Bodena et.al 2019.[2] The current study demonstrates a much higher rate of 76.1% in comparison to the previous study by Lavanya J et al 2016,[7]in Northern India which reported a percentage of 44.92 %. Such variation in rates of the contamination of HCW accessories may be attributed to the differences in the geographical areas and distribution of various microorganisms. It may be also related to the level of awareness among the HCWs to the Infection prevention strategies.

Amongst the accessories, mobile phones (84.1%) were the most common accessory contaminated by the micro-organism. A similar result was reported by Lavanya J et al 2016,[7]which stated that mobile phones are the most contaminated accessory for healthcare workers.

In the hospital setup, mobile phones are being constantly used by the HCWs for the sharing of information and communication. This may be one of the reasons for the high rates of contamination of mobile phones. Although its use is indispensable, they serve as reservoirs of various pathogens responsible for outbreaks in hospital settings. Despite the regular use of hand rubs by the HCWs, still, the accessories used by them grew different organisms, giving us an insight into the improper technique of hand hygiene practiced by them. Poor hand-washing practices may also predispose the colonization of the HCW's mobile phones through contaminated hands. Regular disinfection of the hands and mobile phones should be emphasized in hospitals.

Apart from mobile phones, the contamination of finger rings, stethoscopes, and pens was 79.1%, 74.1%, and 68.3% respectively. Similar contamination rates of stethoscopes have been observed in the study of 78.5% by CJ Uneke et.al 2010 [3] in comparison to 54% and 52% by Weldegebreal et.al 2019,[1] and by Lavanya J et al 20161.[7] The diaphragm of the stethoscope is prone to get colonized by microorganisms as it comes in direct contact with multiple patients. Regular disinfection of the same needs to be carried out regularly as it may continuously impose the risk of infections serially to all the patients in contact. Furthermore, the practice of draping around the neck may result in recontamination of the normal flora and pathogens by the earpiece of the HCWs. Lack of disinfection in routine practice may also lead to the transmission of antibiotic-resistant bacteria. The percentage of contamination of finger rings was much higher (79.1%) as compared to other studies (40%) by U Mahajan et al. 2014,[8] and Lavanya J et al 2016 [7]

In our study, the majority of the isolates were Gram-positive bacteria – Coagulase Negative *Staphylococcus* (CONS) being the most common isolate followed by *Staphylococcus aureus*. CONS

was the most common isolate from mobile phones, stethoscopes, and pens followed by *S.aureus*. This is in concordance with various studies in India: JRK Samal et al 20161,[9] and Lavanya J et al 20161.[7] Globally many studies with similar findings of CONS being the most common isolate followed by *S.aureus* were observed by Bodena et.al 2019,[2] and A Darge et.al 20191.[10] However, in contrast, this several other studies stated *S.aureus* as the most common isolate followed by CONS: C J Uneke et.al 2010,[3] T Worku et.al 2018,[4] Weldegebreal et.al 2019.[1] CONS is a common human skin commensal. This may be a possible attribute for CONS being the most common isolates grown from the HCWs accessories. Poor hand hygiene and disinfection practices are responsible for the contamination of the accessories. It also gets transferred through direct contact and also to the objects in contact with Moreover, electronic devices such as mobile phones are in constant use by HCWs, and the heat generated during the use may provide a conducive environment for the growth of commensal on the device. Although these are skin commensal, they may be pathogenic to the immune-compromised host. As a result of transmission of the flora through the hands and accessories of HCWs, sooner or later these may emerge as a pathogen in hospital-based settings.

Staphylococcus aureus was the most common clinical pathogen isolated from all the HCWs accessories – mobile phones, Stethoscope, finger rings, and pens. This may be attributed to their survival on the dry surfaces. High rates of contamination by *S.aureus* warrant additional attention as the passage of these pathogens by multiple hands and accessories might develop resistance and hence can be more harmful to the direct patient care areas. Among the Gram-Negative bacteria, only two isolates each of *Acinetobacter* spp (1.4%) and *Klebsiella* spp(1.4%) grew. This is in concordance with many studies (5-15%): Bodena et.al 2019,[2]T Worku et.al 2018,[4] and G Singh et.al 2018,[11]which reported comparatively lesser gram negatives. This may be attributed to the lesser survival time of gram-negative bacteria as compared to gram positives.

The antibiotic sensitivity pattern of CONS showed 20-40% resistance to clindamycin, cloxacillin, and doxycycline whereas almost 45% of the isolates were resistant to erythromycin. The antimicrobial susceptibility pattern of *S.aureus* showed resistance to erythromycin (58.1%), cloxacillin (33.88%), and doxycycline (16.13%). Overall, among the gram-positive organisms, most of the isolates were resistant to erythromycin. Almost 48.38% of the total *S. aureus* were MRSA isolates and 44.44% were CONS-MR. The gram-negative organisms were 2 each of *Acinetobacter* spp and *Klebsiella* spp. All four isolates were sensitive to ceftazidime, piperacillin-tazobactam, and resistant to Carbapenems- Imipenem and meropenem.

CONS being a skin commensal has shown resistance to multiple drugs which indicates that during transmission these organisms would have acquired resistance genes. These could later on act as pathogens in hospitals and ultimately increase the duration of stay of the patients and economic burden also.

CONCLUSION

The high prevalence of bacterial contamination in the Healthcare worker's accessories highlights that disinfection of the same needs to be practiced regularly on a routine basis. In our study, the most common accessory was found to be the mobile phone. Explicit guidelines on the use of mobile phones in hospital settings need to be incorporated such as limited or restricted use of the phones/ the use of headphones/ use of intercom facilities for communication inside hospitals may help reduce the contamination and transmission of bacteria. Also, the hospital setup can start with digitalization to limit the use of pens especially in intensive care units.

Apart from the disinfection of the accessories, it is also necessary to strictly follow hand hygiene practices before and after the use of accessories. This is to prevent the continuous cross-contamination of the patient's flora/pathogens to the HCW's hands/accessories and vice versa.

Further, the data from this study can help strengthen the infection prevention control strategies of the hospital. Continuous training of the HCWs needs to be done regularly on infection prevention, regular disinfection of the HCWs accessories and patient safety needs to reduce the contamination rates.

Limitations of the Study

1. Sample size and time frame are the limiting factors in the study. a larger sample size, equal distribution of the samples from accessories of HCWs, and a longer duration of study would have made this study much better.
2. Since ours was a cross-sectional study to find the microbial flora contamination of HCWs accessories, we took the samples from the accessories only. However, if samples from the hands of HCWs had been included we could have correlated with the contamination of HCWs accessories.
3. Apart from the above limitations, the complete panel of antibiotic discs was not put up due to its unavailability.

REFERENCES

1. Weldegebreal F, Admassu D, Meaza D, Asfaw M. Non-critical healthcare tools as a potential source of healthcare-acquired bacterial infections in eastern Ethiopia: A hospital-based cross-sectional study. SAGE Open Med. 2019 Jan 2;7:205031211882262
2. Bodena D, Teklemariam Z, Balakrishnan S, Tesfa T. Bacterial contamination of mobile phones of health

professionals in Eastern Ethiopia: antimicrobial susceptibility and associated factors. Trop Med Health. 2019 Feb 27;47:15.
3. Uneke CJ, Ogbonna A, Oyibo PG, Onu CM. Bacterial contamination of stethoscopes used by health workers: public health implications. J Infect Dev Ctries. 2010 Aug 4;4(7):436-41.
4. Worku T, Derseh D, Kumalo A. Bacterial profile and antimicrobial susceptibility pattern of the isolates from stethoscope, thermometer, and inanimate surfaces of Mizan-Tepi University Teaching Hospital, Southwest Ethiopia. International journal of microbiology. 2018 Jun 27;2018.
5. Tille PM. Overview of bacterial identification methods and strategies. In: Tille PM, editor. Bailey & Scott's Diagnostic Microbiology, 13th ed. St Louis: Elsevier Mosby;2013:193-231.
6. Clinical laboratory Standards Institute (CLSI), Performance Standards for Antimicrobial Susceptibility Testing, 32nd ed. CLSI supplement M100 (ISBN 978-1-68440-134-5[Print]; ISBN 978-1-68440-135-2[Electronic].Clinical and Laboratory Institute,USA,2022.
7. Lavanya J, Manoj J, Virendra K, Kumar GR. Bacterial Contamination of Healthcare Workers Accessories: A Potential Risk to Pediatric Intensive Care Unit and Nursery Patients. International Journal of Microbiology Research. 2019; 8 (1),717-719
8. Maharjan U,Rajbanshi L, Gurung G, Gautam R, Nepal HP.Are Personal Accessories Safe In Hospital Settings? Journal of Chitwan Medical College 2014; 4(8): 29-31.
9. Samal JR, Chopra S. Sensitivity pattern and correlation of organisms isolated from the hands and mobile phones of persons in healthcare setup. International Journal of General Medicine and Pharmacy (IJGMP). 2016;5(5):33-42.
10. Darge A, Kahsay AG, Hailekiros H, Niguse S, Abdulkader M. Bacterial contamination and antimicrobial susceptibility patterns of intensive care units medical equipment and inanimate surfaces at Ayder Comprehensive Specialized Hospital, Mekelle, Northern Ethiopia. BMC research notes. 2019 Dec;12:1-8.
11. Singh G, Singh R. A study of microbial flora of mobile phones used by health-care professionals in a tertiary care hospital in North India. Journal of Patient Safety and Infection Control. 2018 Sep 1;6(3):83-9.