Original Article

DOI: 10.7860/JCDR/2024/67067.19271

Microbiology Section

Assessment of Knowledge and Compliance with Hand Hygiene among Health Personnel to Reduce Methicillin Resistant *Staphylococcus aureus* Nosocomial Infections: A Prospective Observational Study from a Tertiary Care Hospital in Southern India

KALANGARI SWATHI[1], SANKARARAMAN KANDASAMY[2], V SANGAMITHRA[3], KANDASAMY CHITRESH SHANKAR[4], DUDEKULA KUSHBU[5]

ABSTRACT

Introduction: Following a significant recovery from Coronavirus Disease-2019 (COVID-19) pandemic, the world has recognised that Hand Hygiene (HH) and facial masks are key preventive measures against various cross infections, particularly in hospital settings. Studying the incidence of Methicillin Resistant *Staphylococcus aureus* (MRSA) as a part of Healthcare Associated Infections (HAI) surveillance is crucial, as MRSA transmission can be effectively prevented through HH.

Aim: To assess the knowledge and compliance of HH among health personnel using the World Health Organisation (WHO) HH questionnaire.

Materials and Methods: A prospective observational study was conducted at Bhaarath Medical College and Hospital, Chennai, Tamil Nadu, India, over one year, from December 2020 to November 2021. The Hospital Infection Control Committee (HICC) team carried out an HH survey using the WHO HH questionnaire to evaluate knowledge and attitudes among 115 Healthcare Workers (HCWs), including doctors and nursing staff, in a tertiary care hospital in Kanchipuram, Southern India. The study also involved monitoring monthly MRSA incidence density rates in Intensive Care Unit (ICU) settings as part of HAI surveillance, followed by regular HH audits. MRSA infectivity rates were statistically analysed using paired t-tests with Statistical Package for Social Sciences (SPSS) software version 21.0 to determine p-values and address standard deviations.

Results: In this study, 26 (65%) of doctors had undergone training, while 57 (76%) of nurses reported recent formal HH training. Only 16 (40%) of doctors and 21 (28%) of nurses used alcohol-based handrub. Doctors exhibited knowledge ranging from 60-77.5% on germ transmission and hand rub-related questions, while nurses demonstrated better knowledge ranging from 72-93.3%. HH adherence was 30% among doctors and 72% among nurses. The MRSA infectivity rate varied over the year, starting at 1.33 per 1000 resident days before HH audits and decreasing to 0.3. Each HH audit led to a significant improvement in MRSA rates, with a p-value <0.0001, indicating statistical significance.

Conclusion: Present study evaluated HCWs knowledge and attitudes toward HH, along with the impact of HH audits on reducing MRSA rates, has proven to be beneficial for hospital infection control practices, particularly during the COVID-19 pandemic and its aftermath, when vigilance tends to decrease over time.

Keywords: Cross infections, Infection control committee, Surveillance, World health organisation

INTRODUCTION

It is a well-documented that contaminated hands of HCWs play a crucial role in spreading microorganisms such as MRSA, *Klebsiella* spp, *Acinetobacter* spp., *Enterococcus* spp., and *Clostridium difficile* among patients [1]. This transmission commonly occurs during HCWs' interactions with patients and surfaces in hospitals, including physical examinations like auscultation and palpation, as well as procedures such as changing wound dressings [2]. These frequent exposures lead to a bidirectional exchange of organisms between HCWs' hands, patients, and objects, gradually replacing harmless flora with pathogenic microorganisms that can swiftly disseminate throughout the hospital environment [3]. These pathogens not only jeopardize patient treatment but also pose risks to exposed HCWs [4]. Despite significant advancements in healthcare, hospital-acquired infections still impact 10% of patients in developed countries and 25% in developing nations [5]. This high infection rate during hospital stays results in prolonged hospitalisation, increased morbidity and mortality rates, and substantial financial burdens on both patients and economies [3]. Among healthcare personnel, doctors and nurses, who extensively interact with patients, are crucial potential sources and carriers of infections. Therefore, their adherence to HH is paramount in preventing infections among patients [6]. Proper HH practices are fundamental in preventing and reducing HAIs, including multidrug-resistant strains like MRSA [7]. The attitudes and compliance of HCWs play a pivotal role in disease prevention [8].

The HH is a straightforward practice, and health organisations have made substantial efforts to promote it in healthcare settings. These include HH knowledge questionnaire for HCWs developed by WHO [9]. Here in the study, great efforts have been taken to understand and combine the behavioural pattern of the participants and management services for better utilisation of evidence-based clinical studies. Present study had tried to implement the novel strategy of Plan-Do-Study-Act (PDSA) [10] by designing the possible

ways of choosing the participants, formulating the questionnaires, obtaining their consents, strategic analysis of their knowledge, attitude and behavioural patterns. By evaluating incidence of MRSA in a much timely phase, the performance reciprocation and drawing conclusions by auditing is best compilation to bring out best Infection control practices in this study.

This study aims to evaluate the knowledge and compliance of HH among healthcare personnel using the WHO HH questionnaire. The study also aims to:

1. Assess the effectiveness of HH practices in reducing HAI like MRSA by analysing MRSA infectivity rates.
2. Conduct the WHO HH survey with a questionnaire among HCWs followed by audits.
3. Compare HH practices between doctors and nurses, develop HH guidelines, and conduct regular HH audits to enhance infection control practices.

In this study, comprehensive efforts were made to understand participants' behavioural patterns and management services to optimise evidence-based clinical studies. Implementation of the PDSA strategy has been explored to improve HH practices and infection control measures.

MATERIALS AND METHODS

This prospective observational study was conducted at Bhaarath Medical College and Hospital, Chennai, Tamil Nadu, India, over a one-year period from December 2020 to November 2021. Approval was obtained from the Institutional Ethical Committee (BIEC-082-23), and informed consent was obtained from all 115 participants, including 40 doctors and 75 nurses, before the study commenced.

Hospital infection surveillance: A new team of HICC conducted surveys on nosocomial infections, particularly newly diagnosed MRSA cases, in patients admitted to both medical and surgical ICUs during October and November 2020. Subsequently, an HH surveillance program was initiated, followed by an audit. The HICC team included Core Committee members such as the Medical Superintendent, Head of Department of Microbiology, HIC officer, HIC nurses, HIC lab technician, data entry officers, clinical department heads, and supportive department members.

Inclusion criteria: Doctors, including house surgeons, postgraduates, and Professors, nurses, working in the ICU wards and willing to provide informed consent were included in the study.

Exclusion criteria: Not willing to provide informed consent, fourth-class employees, as they may not fully comprehend the questionnaire were excluded from the study.

All participants were asked to complete an HH questionnaire and engage in discussions regarding the importance of HH in preventing HAIs like MRSA. The study was conducted using the PDSA model, also known as the Shewhart cycle, which is an iterative design and management method for process and product control and continuous improvement.

MRSA infectivity rate calculation: The MRSA infectivity rate was calculated using samples such as nasal swabs, sputum samples, blood samples, skin and soft tissue infections, and surgical wound infections. The nosocomial MRSA infectivity rate was determined monthly over the one-year period from December 2020 to November 2021 to assess the implicit association between HH audits conducted in the hospital and their outcomes. The MRSA infection rate was calculated using the number of resident days for the population at risk [11].

Total positive clinical culture MRSA/resident days (Average number of admissions per day×Average 30 days in a month)×1000=Infections per 1000 resident days.

STATISTICAL ANALYSIS

The MRSA infection rates were assessed after each HH audit and compared using paired Student's t-tests analysed with SPSS software version 21.0 to determine the standard deviation by deriving the p-value.

RESULTS

Among the total 115 participants, 40 were doctors and 75 were nurses. A total of 26 (65%) of doctors and 57 (76%) of nurses reported having formal training in HH. The use of alcohol-based hand rub was relatively low in both groups, with only 16 (40%) of doctors and 21 (28%) of nurses using hand rub routinely [Table/Fig-1]. The majority of participants responded correctly regarding the main route of cross-transmission, frequent sources of germs, the minimal time needed for alcohol-based hand rub to kill germs, and which HH method to use before giving injections or after visible exposure to blood, as shown in [Table/Fig-1].

Factors affecting the adherence pattern of HH practice among doctors and nurses are noted in [Table/Fig-2]. It was observed that 12 (30%) doctors and 54 (72%) nurses correctly adhered to hand hygiene practices at all times. However, a significant number of doctors, 30 (75%), did not prioritise HH at times, citing more important tasks to attend to.

S. No.	Questions	Doctors (n=40)	Nursing staff (n=75)
1.	Did you receive formal training in Hand Hygiene (HH) in the last three years?	26 (65%); Ans: Yes	57 (76%); Ans: Yes
2.	Do you routinely use an alcohol-based handrub for HH?	16 (40%); Ans: Yes	21 (28%); Ans: Yes
3.	Which of the following is the main route of cross-transmission of potentially harmful germs between patients in a health-care facility? a. Health-care workers' hands when not clean b. Air circulating in the hospital c. Patients' exposure to colonised surfaces (i.e., beds, chairs, tables, floors) d. Sharing non invasive objects (i.e., stethoscopes, pressure cuffs, etc.,) between patients	24 (60%); Ans: a	59 (78.6%); Ans: a
4.	What is the most frequent source of germs responsible for healthcare-associated infections? a. Before touching a patient b. Immediately after a risk of body fluid exposure c. After exposure to the immediate surroundings of a patient d. Immediately before a clean/aseptic procedure	28 (70%); Ans: c	60 (80%); Ans: c
5.	Which of the following HH actions prevents transmission of germs to the healthcare worker? a. After touching a patient b. Immediately after a risk of body fluid exposure c. Immediately before a clean/aseptic procedure d. After exposure to the immediate surroundings of a patient	26 (65%); Ans: a	59 (78.6%); Ans: a
6.	Which of the following statements on alcohol-based hand rub and handwashing with soap and water are true? a. Hand rubbing is more rapid for hand cleansing than handwashing b. Hand rubbing causes skin dryness more than handwashing c. Hand rubbing is more effective against germs than handwashing d. Handwashing and hand rubbing are recommended to be performed in sequence	26 (65%); Ans: c	57 (76%); Ans: c

7.	What is the minimal time needed for alcohol-based hand rub to kill most germs on your hands? a. 20 seconds b. 3 seconds c. 1 minute d. 10 seconds	28 (70%); Ans: a	54 (72%); Ans: a
8.	Which type of HH method is required in the following situations? Rubbing or Washing a. Before giving an injection b. After visible exposure to blood	31 (77.5%); Ans: Before giving an injection Rubbing; After visible exposure to blood-Handwashing	70 (93.3%); Ans: Before giving an injection-Rubbing; After visible exposure to blood-Handwashing
9.	Which of the following should be avoided, as associated with increased likelihood of colonisation of hands with harmful germs? a. Wearing jewellery b. Damaged skin. c. Artificial fingernails d. Regular use of a hand cream	31 (77.5%); Ans: c	63 (84%); Ans: c

[Table/Fig-1]: Comparison of HH knowledge using WHO questionnaire among doctors and nursing staff.

S. No.	Statement	Doctors (n=40); Ans: Yes	Nursing staff (n=75); Ans: Yes
1.	I adhere to correct HH practices at all times	12 (30%)	54 (72%)
2.	Sometimes I have more important things to do than HH	30 (75%)	16 (21.3%)
3.	Emergencies and other priorities make hygiene more difficult at times	32 (80%)	67 (89.3%)
4.	Sometimes I miss out HH simply because I forget it	25 (62.5%)	32 (42.6%)
5.	The frequency of HH required makes it difficult for me to carry it out as often as necessary	18 (45%)	55 (73.3%)
6.	Infection prevention notice boards remind me to do HH	37 (92.5%)	72 (96%)
7.	Adhering to HH practices is easy in the current set-up	38 (95%)	70 (93.3%)

[Table/Fig-2]: Factors affecting the adherence pattern of Hand Hygiene (HH) practice among doctors and nurses.

Though the medical professionals are enough trained in HH etiquette, its implementation gets wavered on daily basis due to reasons which can be major or minor depending on the situation or the attitude of the individual. The following prototype of questions [8] was chosen as more relevant to graduated medical professionals than to students who can have the possibility of juvenile perspective in this regard. HH audit protocol is described in [Table/Fig-3].

1.	Announcement of results depicted by the WHO survey among various HCW.
2.	Importance of HH practice in preventing Nosocomial infection.
3.	Discussed briefly the story of Semmelweis, the father of aseptic surgery.
4.	Discussed and demonstrated the HH procedure.
5.	Oral feedback about the audit.
6.	Minutes of the meeting recorded.

[Table/Fig-3]: HH audit protocol.

The MRSA infectivity rates were calculated for each month, with a rate of 4 recorded in the month of June. This could potentially be attributed to a relaxation among HCWs as the severity of the COVID-19 pandemic decreased [Table/Fig-4].

HH audits were conducted three times to improve MRSA infectivity rates and reduce HAIs overall. MRSA infection rates were assessed after each HH audit and compared using paired Student's t-tests [Table/Fig-5].

The comparison between MRSA infectivity rates and HH audits revealed that the infectivity rates decreased after each HH audit. The MRSA infectivity rate showed significant improvement after each HH audit, with a p-value <0.0001, indicating statistical significance. This underscores the importance of HH audits in reducing HAIs such as MRSA.

S. No.	Month and year	MRSA % per 1000 resident days
1.	December 2020	1.33
2.	January 2021	2
3.	February 2021 after the I HH audit	0.3
4.	March 2021	1.33
5.	April 2021	2
6.	May 2021	1.33
7.	June 2021	4
8.	July 2021 after II HH audit	1.33
9.	August 2021	1.33
10.	September 2021	1.3
11.	October 2021 after III HH audit	0.3
12.	November 2021	0.3

[Table/Fig-4]: MRSA infectivity rate during the period of one year.

Variable	Mean±SD infection rates	p-value
Before HH audit	3.33±0.47	Reference category
After first HH audit	8.96±1.38	<0.0001; S
After second HH audit	3.96±1.01	<0.0001; S
After third HH audit	0.6±0.52	<0.0001; S

[Table/Fig-5]: MRSA infection rates with standard deviation with p-value.
S: Significant; Student paired t-test was performed

DISCUSSION

Nosocomial infections present a significant threat in the current era of antibiotic resistance, with multidrug resistant microorganisms like MRSA, *Clostridium difficile*, and various *Candida* species are commonly found colonising the hands of HCWs. In this study, MRSA infectivity rates were selected as indicators of HAIs.

Training: The study revealed that 65% of doctors and 76% of nurses had undergone formal training in HH, while only 40% of doctors and 28% of nurses used alcohol-based hand rubs routinely. In terms of adherence to HH practices, only 30% of doctors and 72% of nurses reported practicing HH at all times. Similar findings were reported in a study by Jayakar DS and Reddy BK, where 65% of doctors, 75% of nurses, and 53% of lab personnel had received HH training [12].

Knowledge of HH: Participants in the study demonstrated good knowledge of HH practices, with responses ranging from 60-77.5% for doctors and 72-93.3% for nurses. Comparable results were found in studies by Mehta A and Tripathi K where nursing staff and students exhibited moderate levels of HH knowledge [13]. A study observed by Maheshwari V et al., in a tertiary care hospital studied regarding the attitudes among nurses (62.5%) when compared to residents (21 .3%) pertaining to HH practices which were meant to be observed every time in their patient contact which was highly significant (p-value <0.001) [14].

Adherence to HH practice: In this study, only 30% of doctors accepted that they adhere to HH practices while among nurses 72% adherence was noted; there was a significant gap between doctors and nurses with respect to HH adherence. In comparison, when other adherence factors were considered not much difference in percentages were noticed between the two groups. One study, over a period of three years showed a modest rise from 21% to 59% (p<0.0001) in HH compliance quoted by Bharara T et al., during 2015-2017 in their study [15]. As per Sharma R et al., the compliance rate for HH was significantly high among nurses (94%) and doctors (86.2%) compared to other staff (76.2%) [16]. HH compliance study done in Istanbul revealed 41.4% among nurses and only 31.9% among doctors (p-value=0.02) were compliant [17]. As per Randle J et al., the HH compliance was quite significant among the allied health personnel which was 78%, 75% among nurses, 59% for ancillary and associated personnel with least compliance noted among doctors as 47% with p-value <0.001 [18].

MRSA infectivity rates fluctuated throughout the year in the current study, ranging from 1.33 per 1000 resident days before the HH audit to 0.3 post-audit. A notable increase to 4 in the month of June 2021 was attributed to a relaxation in HCW attitudes following a decrease in the severity of the COVID-19 pandemic. Subsequent audits showed a decrease in MRSA infectivity rates, emphasising the importance of continuous monitoring and adherence to HH protocols.

The rates of Nosocomial infection associated with MRSA were calculated every month and were followed regularly. The results of these postaudit were quite impressive as the number of new MRSA had significantly lowered in the following months of January, February, March, April and May. Peterson LR and Schora DM had clearly quoted in their article the clear indication of when a healthcare organisation should implement a MRSA control plan. Defining to be when an organisation has total MRSA clinical infections above 0.3/1,000 patient days or bloodstream infections of MRSA greater than 0.03/1,000 patient days, the need for the MRSA curtailing programme has to be planned and implemented [19]. Mehta Y et al., has reported Methicillin resistance in 13–47% of *Staphylococcus aureus* infections of isolates in India [20]. *Staphylococcus* constituted as the most predominantly isolated microbe (64.8%) in study of SSI, which is a HAI, of which 28.1% were MRSA as per Pal S et al., [21].

In another study by Pittet D et al., compliance of HH (p-value <0.001) and decrease of nosocomial infection was studied between 1994-97 with significant improvement, with special emphasis on MRSA transmission rates (p-value <0.001) which decreased from 2.16 to 0.93 episodes per 10,000 patient-days [22]. Turabelidze G et al., focussed on the hygiene factors and MRSA outbreak in his case study in a Missouri prison during 2002-2003. The study concluded that a low composite hygiene score was the key factor for the MRSA outbreak [23]. A four year prospective study by Stone SP et al., stated that because of HH policies, the MRSA rates declined (1.88 to 0.91 per 10,000 bed days) but MSSA bacteraemia rates did not fall even after HH audits [24].

In the current study, the results were unaffected by the COVID-19 pandemic; however, the pandemic played a significant role in reducing nosocomial infections due to the increased use of hand sanitisers during that period. Following the easing of lockdowns in June 2021, there was a decrease in the usage of hand sanitisers and face masks, potentially leading to a higher risk of infections. This highlights the crucial role of HH in controlling the spread of infections, especially in a hospital setting where non compliance can result in the development and spread of multidrug resistant microorganisms like MRSA, leading to difficult-to-treat hospital-acquired infections.

Looking ahead, it is essential to conduct regular HH audits to enhance the knowledge and compliance of HCWs in HH practices. This proactive approach can help in controlling and preventing nosocomial infections in healthcare settings.

Limitation(s)

The present study only included subjects from the ICU, and individuals from the OP and OT wards were not included. Additionally, other staff members, including Class IV employees, were excluded. Another limitation of the study was that the sample size was not statistically calculated. Future studies with larger sample sizes can address this limitation.

CONCLUSION(S)

The results of this study indicate that regular HH audits and practices have a significant impact on improving hospital management and preventing nosocomial infections, especially during the ongoing pandemic where compliance tends to decrease over time, even after the COVID-19 pandemic.

Acknowledgement

The authors express their gratitude to all the participants, including doctors and nursing staff, for their time in completing the questionnaires. Special thanks to the technical staff in the Department of Microbiology for their prompt and timely data management. Acknowledgments to Dr. Kausalya from the Department of Pathology and Dr. Riyaz from the Department of Pharmacology in Anantapur for their technical support.

REFERENCES

[1] Borkow G. Use of biocidal surfaces for reduction of healthcare acquired infections. Heidelberg: Springer Press, 2014.
[2] Kampf G, Löffler H. Hand disinfection in hospitals- benefits and risks. J Dtsch Dermatol Ges. 2010;8(12):978-83. Doi: 10.1111/j.1610-0387.2010.07501.x.
[3] Ansari SK, Gupta P, Jais M, Nangia S, Gogoi S, Satia S, et al. Assessment of the knowledge, attitude and practices regarding hand hygiene amongst the healthcare workers in a tertiary health care centre. Int J Pharm Res Health Sci. 2015;3(3):720-26.
[4] Collins AS. Preventing Health Care–Associated Infections. In: Hughes RG, editor. Patient Safety and Quality: An Evidence-Based Handbook for Nurses. Rockville (MD): Agency for Healthcare Research and Quality (US); 2008 Apr. Chapter 41. Available from: https://www.ncbi.nlm.nih.gov/books/NBK2683/.
[5] Rao M, Arain GM, Khan MI, Taseer I, Talreja K, Ali G, et al. Assessment of knowledge, attitude and practices pattern of hand washing in some major public sector hospitals of Pakistan (a multi-center study). Pakistan J Med Res. 2012;51(3):76-82.
[6] Ahmadipour M, Dehghan M, Ahmadinejad M, Jabarpour M, Mangolian Shahrbabaki P, Ebrahimi Rigi Z. Barriers to hand hygiene compliance in intensive care units during the COVID-19 pandemic: A qualitative study. Front Public Health. 2022;10:968231. Doi: 10.3389/fpubh.2022.968231. PMID: 36062108; PMCID: PMC9433968.
[7] Mathur P. Hand hygiene: Back to the basics of infection control. Indian J Med Res. 2011;134(5):611-20.
[8] Nair SS, Hanumantappa R, Hiremath SG, Siraj MA, Raghunath P. Knowledge, attitude, and practice of hand hygiene among medical and nursing students at a tertiary health care centre in Raichur, India. ISRN Prev Med. 2014;2014:608927.
[9] Hand Hygiene Knowledge Questionnaire for Health-Care Workers (revised August 2009). Available from: https://www.who.int/teams/integrated-health-services/infection-prevention-control/hand-hygiene/monitoring-tools.
[10] Reed JE, Davey N, Woodcock T. The foundations of quality improvement science. Future Hosp J. 2016;3(3):199-202. Doi: 10.7861/futurehosp.3-3-199. PMID: 31098226; PMCID: PMC6465814.
[11] Al-Talib HI, Yean CY, Al-Jashamy K, Hasana H. Methicillin-resistant *Staphylococcus aureus* nosocomial infection trends in Hospital UniversitiSains Malaysia during 2002-2007. Ann Saudi Med. 2010;30(5):358-63. PMID: 20697171. Doi: 10.4103/0256-4947.67077.
[12] Jayakar DS, Reddy BK. Assessment of knowledge, attitude and practice of hand hygiene among healthcare workers in the AIMSR and district government hospital of Chittoor, Andhra Pradesh- An observational study. J Evolution Med. Dent. Sci. 2019;8(25):2012-17. Doi: 10.14260/jemds/2019/442.
[13] Mehta A, Tripathi K. Knowledge, attitude and practices of hand hygiene among nurses and nursing students in a tertiary healthcare center of Central India: A questionnaire based study. Int J Community Med Pub Health. 2019;6(12):5154-60.
[14] Maheshwari V, Kaore NC, Ramnani VK, Gupta SK, Borle A, Kaushal R. A study to assess knowledge and attitude regarding hand hygiene amongst residents and nursing staff in a tertiary health care setting of Bhopal City. J Clin Diagn Res. 2014;8(8):DC04-DC07.
[15] Bharara T, Gur R, Duggal S, Chugh V. Evaluation of hand hygiene compliance over the years, in an intensive care unit of a north Delhi hospital preparing for accreditation: A 3-year study. J Family Med Prim Care. 2020;9(4):1939-43.
[16] Sharma R, Sharma M, Koushal V. Hand washing compliance among healthcare staff in Intensive Care Unit (ICU) of a multispecialty hospital of North India. J Hosp Adm. 2012;v1(2):27.

[17] Karaaslan A, Kadayifci EK, Atıcı S, Sili U, Soysal A, Çulha G, et al. Compliance of healthcare workers with hand hygiene practices in neonatal and pediatric intensive care units: Overt observation. Interdiscip Perspect Infect Dis. 2014;2014:306478. Doi: 10.1155/2014/306478.
[18] Randle J, Arthur A, Vaughan N. Twenty-four-hour observational study of hospital hand hygiene compliance. J Hosp Infect. 2010;76(3):252-55. Doi: 10.1016/j.jhin.2010.06.027. Epub 2010 Sep 20. PMID: 20850899.
[19] Peterson LR, Schora DM. Methicillin-Resistant *Staphylococcus aureus* control in the 21st century: Laboratory involvement affecting disease impact and economic benefit from large population studies. J Clin Microbiol. 2016;54(11):2647-54. Doi: 10.1128/JCM.00698-16.
[20] Mehta Y, Hegde A, Pande R, Zirpe KG, Gupta V, Ahdal J, et al. Methicillin-resistant *Staphylococcus aureus* in intensive care unit setting of India: A review of clinical burden, patterns of prevalence, preventive measures, and future strategies. Indian J Crit Care Med. 2020;24(1):55-62. Doi: 10.5005/jp-journals-10071-23337.
[21] Pal S, Sayana A, Joshi A, Juyal D. *Staphylococcus aureus*: A predominant cause of surgical site infections in a rural healthcare setup of Uttarakhand. J Family Med Prim Care. 2019;8(11):3600-06. Doi: 10.4103/jfmpc.jfmpc_521_19.
[22] Pittet D, Hugonnet S, Harbarth S, Mourouga P, Sauvan V, Touveneau S, et al. Effectiveness of a hospital-wide programme to improve compliance with hand hygiene. Infection Control Programme. Lancet. 2000;356(9238):1307-12. Doi: 10.1016/s0140-6736(00)02814-2.
[23] Turabelidze G, Lin M, Wolkoff B, Dodson D, Gladbach S, Zhu BP. Personal hygiene and methicillin-resistant *Staphylococcus aureus* infection. Emerg Infect Dis. 2006;12(3):422-27. Doi: 10.3201/eid1203.050625.
[24] Stone SP, Fuller C, Savage J, Cookson B, Hayward A, Cooper B, et al. Evaluation of the national Clean your hands campaign to reduce *Staphylococcus aureus* bacteraemia and Clostridium difficile infection in hospitals in England and Wales by improved hand hygiene: Four year, prospective, ecological, interrupted time series study. BMJ. 2012;344:e3005. Doi: 10.1136/bmj.e3005.

PARTICULARS OF CONTRIBUTORS:
1. Assistant Professor, Department of Microbiology, Bhaarath Medical College and Hospital, Chennai, Tamil Nadu, India.
2. Associate Professor, Department of Microbiology, Bhaarath Medical College and Hospital, Chennai, Tamil Nadu, India.
3. Professor and Head, Department of Microbiology, Bhaarath Medical College and Hospital, Chennai, Tamil Nadu, India.
4. Family Physician, Department of General Medicine, Sudharshan Diabetology Clinic, Chennai, Tamil Nadu, India.
5. Assistant Professor, Department of Pharmacology, Government Medical College and Hospital, Anantapur, Andhra Pradesh, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Kalangari Swathi,
Assistant Professor, Department of Microbiology, Bhaarath Medical College and Hospital, Chennai-600073, Tamil Nadu, India.
E-mail: swatikalangri@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Aug 22, 2023
- Manual Googling: Dec 21, 2023
- iThenticate Software: Feb 08, 2024 (5%)

ETYMOLOGY: Author Origin

EMENDATIONS: 7

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. No

Date of Submission: **Aug 19, 2023**
Date of Peer Review: **Nov 01, 2023**
Date of Acceptance: **Feb 10, 2024**
Date of Publishing: **Apr 01, 2024**