

**A Survey of Knowledge of Antiseptic and Disinfectant Use Among Interns in a Tertiary Care Hospital.**

<sup>1</sup>Dr Adit Atul Deshmukh, Junior Resident, Department of Pharmacology, B.J. Government Medical College and Sassoon General Hospital, Pune

<sup>2</sup>Dr Sangeeta Sanjay Dabhade, Associate Professor, Department of Pharmacology, B.J. Government Medical College and Sassoon General Hospital, Pune

<sup>3</sup>Dr Balasaheb Baburao Ghongane, Professor and Head, Department of Pharmacology, B.J. Government Medical College and Sassoon General Hospital, Pune

**Correspondence Author:** Dr Sangeeta Sanjay Dabhade, Associate Professor, Department of Pharmacology, B.J. Government Medical College and Sassoon General Hospital, Pune.

**Acknowledgements** – Dr Smita Anand Tiwari (Assistant Professor, Department of Pharmacology, B.J. Government Medical College and Sassoon general Hospital, Pune) for her great help in the collection of data.

**Conflicts of Interest:** Nil.

**Sources of Funding** – None

**Abstract**

**Objective** - To find the knowledge of the interns about the use of antiseptics and disinfectants.

**Methods** - This questionnaire-based cross-sectional study was conducted in a tertiary-care government hospital among medial interns. Questionnaire consisted of 20 multiple choice single response type questions and it evaluated the domains like definitions, knowledge about the uses, time required by the antiseptics to kill the germs, special precautions while handling antiseptics and disinfectants, and storage conditions. These 20 questions were scored and expressed in grading from excellent to unsatisfactory.

**Results** – A total of 215 interns were included in the study. None of the interns could score more than 75% marks (“Excellent”). 26.0%, 69.8% and 4.2% interns scored the grades “Good”, “Satisfactory” and “Unsatisfactory”, respectively. The questions which were answered correctly by 97.7% (maximum) of interns checked the basic knowledge of definitions of the words Antiseptic and Disinfectant. However only 4.2%

(minimum) of the interns knew about the agents used for fumigation of Operation theatres. The maximum score was 75% which was scored by two interns.

**Conclusion** – Medical interns is a stratum of Health care workers which has a direct contact with patients during their daily job. That’s why unless proper precautions are taken; there are high chances of the causation and spread of Hospital-acquired infections among the hospitalized patients by these interns. To avoid this, the interns should have a proper knowledge of the infection control practices. Our study, therefore, emphasizes the need of conducting frequent training programmes, workshops and courses to equip the interns with the knowledge and awareness about the Hospital-acquired infections and ways to prevent them.

**Keywords:** Knowledge, Antiseptics; Disinfectants, Interns.

**Section 1: Introduction**

There is an impending fear that the world is nearing the end of “antibiotic era” due to the growing concern of resistant pathogens. Hence, there is an emphasized need of

infection control practices among health-care workers; along with search for newer molecules. Hospitals are the potential source of the risk of acquiring an infection during the healthcare delivery. Hospital-acquired infections (HAIs) are associated with increased attributable mortality, length of stay in the hospital, and healthcare costs incurred by patients and healthcare facilities. Hospital-acquired infections are a growing problem at every level of the healthcare system. World Health Organization (WHO) estimated that it affects hundreds of millions of people worldwide and it is a major global issue for patient safety.[1] In India, the rate of HAIs is 41% according to one study.[2]

An estimated 20% to 40% of HAIs have been attributed to cross infection via the hands of health care personnel. Contamination of the hands of health care workers could in turn result from either direct patient contact or indirectly from touching contaminated environmental surfaces.[3] Disinfection and sterilization are essential for medical and surgical instruments to ensure that they do not cause such HAIs.

Antiseptics and Disinfectants are the chemical agents used for the control of microorganisms in the skin or other living tissue, without appreciably affecting them (Antiseptic) or for the destruction of microorganisms in inanimate objects (Disinfectant). They are a crucial part of infection control practices.[4]

Antiseptics and Disinfectants are commonly used in hospitals. Various types of antiseptics and disinfectants used in hospitals are phenol, glutaraldehyde, formaldehyde, sodium hypochlorite, Benzalkonium chloride, povidone iodine etc.[5]

Effectiveness of Disinfectant depends on many factors like Type of contaminating microorganism, Degree of contamination, Chemical nature of disinfectant,

Concentration and quantity of disinfectant, Contact time and temperature, etc.[6]

Among the different healthcare workers, medical interns form a stratum which is directly in contact with the patients during their duties. Therefore they are likely to transfer the infections from one patient to the other. So, for implementation of all the preventive measures to decrease the risk of infection hazards and maintain safety of the patients, adequate knowledge of the interns about infection control measures and policies are essential.[7]

### **Section 2: Purpose of the Study**

Medical Interns have a direct contact with the patients during their duty. And because of this, there are high chances of spread of Nosocomial infections among hospitalized patients by the interns. Disinfection and Sterilization measures help to reduce the nosocomial infection rate.

Therefore this study was planned to assess the knowledge of use of antiseptics and disinfectants among the medical interns of a tertiary care government hospital.

**Section 3: Objective** - To find the knowledge of the interns about the use of antiseptics and disinfectants.

### **Section 4: Materials and Methods –**

This is a questionnaire-based cross-sectional study. It was conducted in a tertiary-care government hospital. Prior approval from Institutional Ethics Committee was taken. Initially a pilot study was conducted among 10 interns and depending on the performance of the interns in this study the questionnaire was validated after alteration in some of the questions. The main study was conducted using this validated questionnaire. A total of 215 interns were included in the study. Written informed consent was obtained from the interns who were willing to participate. The questionnaire was given to all 215 interns after taking their consent as all were willing to participate. The questionnaire consisted of 17 Multiple Choice Questions

(MCQs) having four options for each question, 2 True and False type questions and 1 question having 5 options with only one correct answer to be marked.

Questions covered various aspects like Definitions, uses of various compounds like Phenol, Potassium permanganate, Iodophores, Cresol, Chlorosan solution. Some questions checked the knowledge of interns about the compounds like Chloroxylenol, Glutaraldehyde, about the time required for alcohol based swabs and alcohol based hand wash to kill the microbes.

Knowledge about the agents used for fumigation of Operation theatres and for post-fumigation neutralization was assessed by two questions. Other questions tested the knowledge about some important aspects like Concentration of agents, Decontamination of body fluids, Levels of disinfectants, agents requiring protection from Sunlight. One question was based on the Hand hygiene methods applicable in different situations.

Each correct answer was given one mark and wrong answer or un-attempted question received zero marks.

Marks obtained by each intern were calculated along with percentage marks obtained. Then percentage marks of these interns were categorized as per grades from excellent to unsatisfactory.

Total number and Percentage of interns who solved respective questions correctly was also calculated.

### **Section 5: Results:**

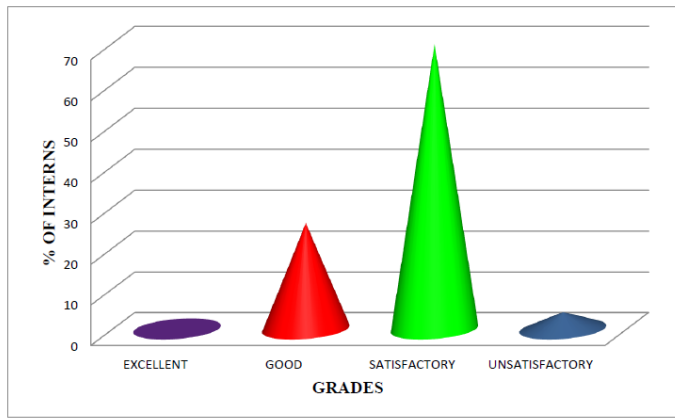
The percentage of interns scoring grade “Good” (50-75% marks) was 26.0% whereas 69.8% interns were graded “Satisfactory” (25-50% marks). The grade “Unsatisfactory” (Less than 25% marks) was scored by 4.2% interns. It is noteworthy that none of the interns could bag the grade “Excellent” (more than 75% marks).

The question-wise analysis revealed that 97.7 % interns knew the definitions of the terms “Antiseptic” and “Disinfectant” (Question 1 and Question 2, respectively).

60.5% interns had the knowledge that Glutaraldehyde is a high level disinfectant (Question 17). How many grams of Saniquad is present in how many millilitres of water in 2% w/v solution of Benzalkonium Chloride (i.e Saniquad) was known to 59.5% interns (Question 10). 50.7% interns had the knowledge regarding the agent used for decontamination after spillage of body fluids like blood (Question 16). Uses of Cresol (Question 7) were known to 49.3% interns. 44.2% and 38.1% interns had the correct knowledge about the uses of Potassium Permanganate and Iodophores, respectively (Questions 5 and 6). Some important aspects about the use of Glutaraldehyde, such as what should be done before using Glutaraldehyde (Question 14), special precautions to be taken while handling Glutaraldehyde (Question 18) and the duration within which the Activated solution of Glutaraldehyde should be used (Question 20) were known to 10.7%, 43.3% and 39.1% interns, respectively. 39.1% interns were aware about the type of hand hygiene method to be used in different situations (Question 9). The same percentage of interns had knowledge about the applications of the Chlorosan solution (4-6% Sodium Hypochlorite solution) (Question 11). A couple of questions were regarding the Alcohol based disinfectants. Question 15 asking about the minimal time required for alcohol based hand wash to kill most of the germs on the hands was correctly responded by 34% interns, whereas 21.9% interns could answer the Question 8 correctly, which checked the knowledge of the minimal time needed for alcohol based swabs to kill most of the bacteria during hypodermic injection. Some other aspects like Agents requiring protection from sunlight (Question 19) and Uses of Phenol (Question 3) were known to 33% and 14.4% interns, respectively. Chloroxylenol (e.g. Dettol) is a very commonly used disinfectant. But to our surprise, very few (22.3%) interns could answer Question 4 correctly which

checked their knowledge about Chloroxylenol. Knowledge of interns regarding the fumigation of Operation Theatres (O.T.) was tested in two questions. Question 12 asked about the agent used for neutralization after formaldehyde fumigation of O.T and it was responded correctly by 17.2 % interns. Question 13 which was answered correctly by minimum percentage of interns (4.2%) tested the interns’ awareness about the agents used for fumigation of O.T.

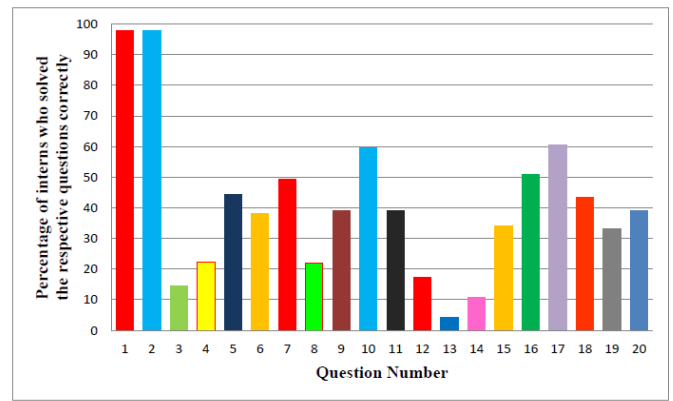
**Graph 1: % of Interns with Their Respective Grading.**



**Table 1: Number and Percentage of Interns as per their respective grades.**

% Marks	Grades (In Words)	No of Interns	% of Interns
More than 75	Excellent	0	0
50-75	Good	56	26.0
25-50	Satisfactory	150	69.8
Less than 25	Unsatisfactory	9	4.2
TOTAL		215	100

**Graph 2: Percentage of Interns who solved the respective questions correctly.**



**Section 6: Discussion**

Disinfection is very important to prevent the transmission of infection in hospital settings. Disinfection results in removing dirt, reducing microbial load and eliminating multi-resistant strains of micro-organisms.[8] The interns start their practical training of different specialties in hospital. That’s why they should have the proper knowledge of the use of various antiseptics and disinfectants so as to prevent the spread of HAIs.

In this study it was observed that interns were aware about the definitions of the terms “Antiseptic” and “Disinfectant” (97.7%) which suggests that they have the knowledge of the difference between the agents used on living surfaces like skin and mucosa (Antiseptics) and agents used for inanimate objects like surgical instruments (Disinfectants).

Phenolic disinfectants are used for decontamination of the hospital environment, including laboratory surfaces, and noncritical medical items.[6] Despite the widespread use of Phenolic compounds, only 14.4% interns were aware about the uses of Phenol.

Potassium permanganate has a diversified use, for example it is used for treating skin diseases like eczema, dermatitis, acne, vaginal thrush and vulvovaginitis. It is also used for Wound cleaning in ulcers and abscesses and

in fungal infections.[9] 44.2% interns in our study had the correct knowledge about the uses of this compound.

Few antiseptics remain to be relevant for the prevention and treatment of infection in wound care. These include iodine carriers (iodophores) with polyvinylpyrrolidone (PVP or povidone) iodine. Povidone iodine is an antiseptic used for skin infections, wound healing. In an aqueous medium, free iodine is released into solution from the Povidone iodine complex and this iodine is the active moiety which oxidises pathogen nucleotides and fatty/amino acids and thus deactivates proteins as well as DNA/RNA. Povidone iodine has many characteristics that make it an antiseptic of choice in various conditions. These characteristics are its broad antimicrobial spectrum, lack of resistance, efficacy against biofilms, good tolerability and its effect on excessive inflammation.[10] To our surprise, only 38.1% interns knew about the uses of Iodophores, indicating the gaps in knowledge of the interns about the commonly used agents like Povidone iodine.

Researchers have recommended the preparation of skin prior to injections .Swabbing the injection site with a saturated 70% alcohol swab for 30 seconds and allowing it to dry for 30 seconds is essential in order to reduce the number of pathogens.[11] Only 21.9% interns were aware that within how much time skin becomes sterilized after using alcohol swab before hypodermic injection administration and 34% interns were aware that the minimal time required for alcohol based hand rub to kill most of the

germs on your hands is 20 seconds. Noncritical environmental surfaces (e.g., bed rails, bedside tables and medical equipment that subsequently contacts patients like stethoscope and sphygmomanometer) are frequently touched by hands of health-care workers, potentially could contribute to secondary transmission by contacting.[4]

Sanitizers are easily accessible — at the bed side, at the doorway, or as personal carriage. They are fast-acting, killing germs in as little as 15 seconds.[12] Health care worker must have the knowledge of sterilization time when alcohol swab is used as antiseptic before hypodermic injection and that when alcohol based hand rub is used in between checking the patient or using same stethoscope or sphygmomanometer for more than one patient. Otherwise it may give false sense of safety from infections.

A 37 % aqueous solution of Formaldehyde is called Formalin – which is used of fumigation of spaces.[5] Regarding knowledge about agents used for fumigation of OT only 4.2% interns answered correctly but only 17.2% interns were aware that ammonia is used to neutralize OT after fumigation with Formalin. Exposure to formaldehyde can lead to allergic reactions in certain individuals. In sensitized individuals, formaldehyde can cause asthma, contact dermatitis, anaphylactic reactions and, in rare cases, haemolysis. Formaldehyde is classified as a suspected human carcinogen, based on evidence obtained from human and/or animal studies. Chronic exposure to formaldehyde has been linked to chronic gastritis, hematemesis (i.e. vomiting blood), inflammation of the lungs and airways, pulmonary oedema.[13] It is noteworthy that health care workers must know the uses as well as adverse effects of Formaldehyde.

Regarding knowledge assessment on glutaraldehyde, 39.1% interns were aware about within how many days activated glutaraldehyde solution has to be used, 43.3% of interns were aware about the special precautions to be taken while handling glutaraldehyde, while only 10.7% interns were aware about what should be done before using Glutaraldehyde. Glutaraldehyde is a toxic chemical that is used as a cold sterilant to disinfect and clean heat-sensitive medical, surgical and dental equipment. Health



care personnel can get exposed to Glutaraldehyde during its use. Short term contact with glutaraldehyde liquid and vapour can severely irritate the eyes, and at higher concentrations burns the skin. Breathing glutaraldehyde can irritate the nose, throat, and respiratory tract, causing coughing and wheezing, nausea, headaches, drowsiness, nosebleeds, and dizziness. Prolonged exposure can cause a skin allergy and chronic eczema, and afterwards, exposure to small amounts produces severe itching and skin rashes. It has been implicated as a possible cause of occupational asthma.[14]

Chloroxylenol is a widely used antiseptic and disinfectant. When used as an antiseptic for wounds and other skin damage, it should be applied as a 1 in 20 dilution of 5% concentrate in water. Whereas, for disinfection of instruments, a 1 in 20 dilution of 5% concentrate in alcohol (70%) is used. An important precaution to be taken while using Chloroxylenol is that its aqueous solutions should be freshly prepared; because it loses its activity if diluted in water and kept for some time. Skin sensitivity is reported in some cases with the use of Chloroxylenol as an antiseptic.[15] In our study, only 22.3% interns were aware that Chloroxylenol loses its activity if diluted in water and kept for some time, which is a matter of concern, looking at the widespread use of this compound.

Only about half (50.7%) of the interns in the study were aware that Sodium Hypochlorite is used for decontamination after spillage of body fluid like blood. This type of lack of knowledge may lead to spread of diseases like HIV and Hepatitis B among the healthcare workers if proper decontamination after spillage of body fluids is not done. This also underlines the need for conducting different training workshops for medical interns regarding management of biomedical waste and

what precautions has to be taken when health care worker (HCW) comes in contact with biological fluids.[4]

39.1% interns were aware about the uses of Sodium Hypochlorite solution and that it should not be used for sterilization of instruments. Hypochlorites are also the agent of choice in disinfecting surfaces or in bathrooms but the major disadvantage of hypochlorites include corrosiveness to metals in high concentrations (>500 ppm).[4]

Thousands of people die every day around the world from infections acquired while receiving health care. Hands are the main pathways of germ transmission during health care. Hand hygiene is therefore the most important measure to avoid the transmission of harmful germs and prevent health care-associated infections.[16] In our study, 39.1% interns had the correct knowledge regarding the type of hand hygiene method to be used in different situations, like before taking Blood Pressure, before palpation of abdomen, etc.

Benzalkonium chloride is a Quaternary ammonium compound. It is used as a topical antiseptic. It is used for treating minor cuts, scrapes, and burns of the skin. One of the important precautions to be taken while using it is that it is for external use only. So exposure of eyes to Benzalkonium chloride solution should be avoided. In case of exposure to the eyes, they should be rinsed immediately with cool tap water.[17] In our study, 59.5% interns had the knowledge that 2% w/v solution of Benzalkonium chloride contains 2gm of Benzalkonium chloride in 100 ml of water.

The Disinfectants are classified into three types viz; High level disinfectants, Intermediate level disinfectants and Low level disinfectants. High level disinfectants destroy vegetative bacteria, mycobacteria, fungi and enveloped (lipid) and non-enveloped (non-lipid) viruses, but not necessarily bacterial spores. High level disinfectant

chemicals (also called chemical sterilants) must be capable of sterilization when contact time is extended. Intermediate level disinfectants kill vegetative bacteria, most viruses and most fungi but not resistant bacterial spores. Low level disinfectants kill most vegetative bacteria and some fungi as well as enveloped (lipid) viruses (e.g., Hepatitis B, Hepatitis C, Hantavirus and HIV). Low level disinfectants do not kill mycobacteria or bacterial spores. Low level disinfectants are typically used to clean environmental surfaces.[6] The fact that Glutaraldehyde is a high level disinfectant was known to 60.5% interns.

Our study tested the knowledge of interns regarding the uses of commonly used disinfectants, one of which is Cresol. Cresol is used as a local antiseptic, parasiticide and disinfectant.[18] 49.3% interns in this study were aware about the uses of Cresol.

The knowledge about the uses of various antiseptics and disinfectants is important, but equally important is the awareness regarding the precautions to be taken during storage of these chemicals. In our study only 33% interns knew that Sodium hypochlorite requires protection from sunlight.[19] Such gaps in knowledge may lead to inadequate disinfectant action by agents used; which may give a false sense of security while still promoting the spread of infection.

HAIs are a man-made medical crisis. Of every 100 hospitalized patients at any given time, 7 in developed and 10 in developing countries will acquire at least one HAI. It equally affect patients, health-care workers (HCWs) and entire health-care system leading to increased morbidity, mortality, duration of hospital stay, health-care costs, multi-drug resistance, and safety risk to HCWs. Therefore in order to ensure that the doctors of the future are safe practitioners, it is essential that they have the relevant knowledge of the ways to prevent the spread of HAIs

which will ensure the appropriate professional behaviour.[20]

**Section 7: Conclusion** - Medical interns is a stratum of Health care workers which has a direct contact with patients during their daily job. That's why unless proper precautions are taken; there are high chances of the causation and spread of HAIs among the hospitalized patients by these interns. To avoid this, the interns should have a proper knowledge of the infection control practices. Our study, therefore, emphasizes the need of conducting frequent training programmes, workshops and courses to equip the interns with the knowledge and awareness about HAIs and ways to prevent them.

### References

- [1] Yallem WW, Kumie A, Yehuala FM. Risk factors for hospital-acquired infections in teaching hospitals of Amhara regional state, Ethiopia: A matched-case control study. *PLoS One*. 2017;12(7):1–11.
- [2] Ramasubramanian V, Iyer V, Sewlikar S, Desai A. Epidemiology of healthcare acquired infection – An Indian perspective on surgical site infection and catheter related blood stream infection. *Indian J Basic Appl Med Res*. 2014;3(4):4663.
- [3] Weber DJ, Rutala WA, Miller MB, Huslage K, Sickbert-Bennett E. Role of hospital surfaces in the transmission of emerging health care-associated pathogens: Norovirus, *Clostridium difficile*, and *Acinetobacter* species. *Am J Infect Control* [Internet]. 2010;38(5 SUPPL.):S25–33. Available from: <http://dx.doi.org/10.1016/j.ajic.2010.04.196>
- [4] Rutala WA, Weber DJ. Draft guideline for disinfection and sterilization in healthcare facilities. *US-Centre Dis Control Prot*. 2008;1–161.
- [5] Tripathi KD. *Essentials of Medical Pharmacology*. 7th ed. 2013. Chapter 65, Antiseptics, Disinfectants and Ectoparasiticides; Pg 897-904.

- [6] Gamage B. BCCDC Laboratory Services A Guide to Selection and Use of Disinfectants. BC Cent Dis Control. 2003;1–18.
- [7] AlZahrani S, AlAmry F, Ghonaim M, AboSalem O. Awareness & knowledge of medical students & interns about infection control measures. *Int J Med Sci Public Heal* [Internet]. 2013;2(3):331. Available from: <http://www.scopemed.org/?mno=30125>
- [8] Ferreira AM, Andrade D de, Rigotti MA, Almeida MTG de, Guerra OG, Santos Junior AG dos. Assessment of disinfection of hospital surfaces using different monitoring methods. *Rev Lat Am Enfermagem* [Internet]. 2015;23(3):466–74. Available from: [http://www.scielo.br/scielo.php?script=sci\\_arttext&pid=S0104-11692015000300466&lng=en&tlng=en](http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0104-11692015000300466&lng=en&tlng=en)
- [9] Wasserman R. Medical Uses for Potassium Permanganate. Available from: <https://www.livestrong.com/article/247213-medical-uses-for-potassium-permanganate/>
- [10] Bigliardi PL, Alsagoff SAL, El-Kafrawi HY, Pyon J-K, Wa CTC, Villa MA. Povidone iodine in wound healing: A review of current concepts and practices. *Int J Surg* [Internet]. 2017;44:260–8. Available from: <http://linkinghub.elsevier.com/retrieve/pii/S1743919117305368>
- [11] Cocoman A, Murray J. Intramuscular injections - To swab or not to swab. 10/27/2017; Pg 1-3. Available from: <https://www.inmo.ie/MagazineArticle/PrintArticle/6696>
- [12] Thompson KM. Using Disinfectants to Help Reduce the Risk of Infection : Table of Contents. 1.
- [13] Division of Environmental Health & Safety Best Management Practices. Formaldehyde- Safe Work Practices. UCONN. Available from: <http://www.ehs.uconn.edu/Word%20Docs/Formaldehyde%20Hazards%20and%20Precautions.pdf>.
- [14] United States Department of Labor. Occupational Safety & Health Administration. Healthcare Wide Hazards Glutaraldehyde. Available from: <https://www.osha.gov/SLTC/etools/hospital/hazards/glutaraldehyde/glut.html>
- [15] Disinfectants and antiseptics. 2004. Available from: <http://archives.who.int/eml/wmf/2004/English/Disinfectants%20and%20antiseptics.pdf>.
- [16] World Health Organisation. Hand Hygiene: Why, How and When? *World Heal Organ* [Internet]. 2009;(August):1–7. Available from: [http://www.who.int/gpsc/5may/Hand\\_Hygiene\\_Why\\_How\\_and\\_When\\_Brochure.pdf?ua=1](http://www.who.int/gpsc/5may/Hand_Hygiene_Why_How_and_When_Brochure.pdf?ua=1)
- [17] Antimicrobial Cleanser. Available from: <https://www.drugs.com/cdi/benzalkonium-chloride-solution.html>
- [18] Pubchem Open Chemistry Database. M-cresol. Available from: <https://pubchem.ncbi.nlm.nih.gov/compound/342>.
- [19] Dvorak G. Disinfection 101. *Cent Food Secur Public Heal* [Internet]. 2005;(February):1-22. Available from: <http://www.cfsph.iastate.edu/BRM/resources/Disinfectants/Disinfection101Feb2005.pdf>
- [20] Dogra S, Mahajan R, Jad B, Mahajan B. Educational interventions to improve knowledge and skills of interns towards prevention and control of hospital-associated infections. *Int J Appl Basic Med Res*. 2015;5(4):54–7.

**Statement:**

The manuscript has been read and approved by all the authors. All the requirements for authorship have been met, and each author believes that the manuscript represents honest work.