

COVID-19 Pandemic: A Narrative Review of Factors Impacting Hand Hygiene Practices among Healthcare Workers in India

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ABSTRACT

Introduction: Hand hygiene (HH) is one of the most important parts of infection control practices and is the single most important activity that prevents the transmission of microorganisms. And hand washing is known to be the first line of defence against COVID-19 and its spread during the current pandemic. This narrative review highlights the factors impacting hand hygiene practises among health care professionals and also provides strategies to improvise them during the COVID-19 pandemic.

Material and methods: The articles were searched from 2015 to 2020 that were available in electronic databases such as Pubmed, Embase, Medline, Google Scholar and Cochraine Library. The search included key words: hand hygiene, health care professionals, hand hygiene compliance, hand washing and India.

Results: A total of 31 articles were utilized for the final review. Overall there was low to moderate knowledge on hand hygiene yet low compliance. The barriers for good hand hygiene practices were low awareness, lack of training, limited resources and the infrastructure was not adequate.

Conclusions: Hand washing is one of the preventive measures in decreasing hospital associated infections and spread of COVID-19. Evidence suggests that factors impacting good hand hygiene practices needs to be addressed in the COVID-19 era. Facing the pandemic is challenging but these challenges can be converted to opportunities to improve and maintain good HH practices

Keyword: COVID-19, Hand Hygiene, Hand Washing, Healthcare Workers, India.

INTRODUCTION

Hand washing has received considerable attention during the coronavirus disease (COVID-19) pandemic. It is a simple, primary preventive measure that most people can do independently and is known to be the first line of defence against COVID-19 and its spread during the current pandemic.¹ Therefore, hand hygiene (HH) is one of the most important parts of infection control practices and is the single most important activity that prevents the transmission of microorganisms. Proper hand hygiene is important to prevent the spread of Severe Acute Respiratory Syndrome (SARS) -CoV-2 virus which causes the COVID19.² According to the Centers for Disease Control and Prevention (CDC), effective hand hygiene means washing hands with soap and water for at least 20 seconds, antiseptic hand wash, antiseptic hand rub (i.e. alcohol-based hand sanitizer including foam or gel), or surgical hand antiseptics.³ Therefore it is highly recommended to wash hands frequently.

COVID-19 was first identified as an epidemic in the city of Wuhan, the capital of Hubei province in China, in December 2019 and by the end of December 2020, it had spread to 218 countries. It was declared as a pandemic by the WHO on March 11th 2020.⁴ COVID-19 was first diagnosed in India where a medical student studying at Wuhan University had returned to Kerala in January 2020.⁵ At present, India has the world's second-highest number of COVID-19 infections in the world after the United States. Studies indicate that COVID-19 can be transmitted from person to person through respiratory droplets generated when an infected person coughs, sneezes, breathing or through contact with a surface that has been contaminated^{6,7} and through aerosols-airborne micro-droplets.^{8,9} The clinical manifestations ranged from mild to severe respiratory syndrome influenza-like illness with mainly lower respiratory tract symptoms, complicated by pneumonia and acute respiratory distress syndrome (ARDS), high fever, and headache. In many cases, loss of taste and smell and severe gastrointestinal symptoms were reported, as are cardiac problems, with the latter being perhaps secondary to a cytokine storm.¹⁰ Since this disease does not currently have treatment for cure, the public health officials and scientists initiated policies for preventing the spread of the virus. As vaccines are become available and been recommended, countries around the world are hurrying for quick implementation.

The risk of COVID-19 transmission is magnified when people contact an infected person, or when they abut surfaces that an infected person has contaminated. The lasting effects of coronavirus in the hands may be erased with hand washing using soap and water, especially when done correctly.¹¹ Currently, in a systematic review on hand washing among children and adults had observed a 16% relative reduction in the number of people with acute respiratory infections (ARIs) suggesting benefits of hand washing.¹² Implementing the correct hand hygiene practices will break the chain of

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How to cite this article: Jacob SM, Srijayanth P. COVID-19 pandemic: a narrative review of factors impacting hand hygiene practices among healthcare workers in India. International Journal of Contemporary Medical Research 2021;8(4):D1-D13.

DOI: <http://dx.doi.org/10.21276/ijcmr.2021.8.4.10>



transmission and reduce the spread of COVID-19. Healthcare workers are most valuable and vital part of a health care system. Front line health workers include doctors, nurses, laboratory technicians, community health workers, pharmacists, ward helpers, and others who provide care directly to the patients and community. In the hospital setting, HCWs are regularly exposed to infections which may cause them morbidity and mortality. Healthcare workers could acquire SARS-CoV-2 at work through direct or indirect contact with infected patients or other HCWs, or as a result of ongoing community transmission.¹³ In September 2020, around 10,088 healthcare workers across nine states and Delhi had tested positive.¹⁴ However, there is underreporting and is just the tip of the iceberg. And there is no central data on COVID-19 among health care workers in the country. A recent study stated that compliance with preventive practices like hand hygiene has increased slightly during the COVID-19 pandemic, though more efforts are required to ensure that HCWs follow all steps of hand hygiene for adequate time.¹⁵ The compliance of effective HH has been found to be suboptimal due to multiple reasons. A heavy workload, inadequate staff, patient ratio, poor infrastructure, ignorance and stakeholder indifference are some of these reasons.¹⁶ Other reasons are that HCWs fail to realize that they are carrying organisms in their hands because pathogens are not visible, unavailability of hand rub dispensers.¹⁷ In India, the awareness about hand hygiene practices among medical students is low. A study from Mumbai showed that nearly 57% of medical students never received any formal training throughout their course of medical undergraduate study.¹⁸ A medical college in South India reported nearly 85% of the students failed to adhere to proper HH practices although knowledge related to HH was good.¹⁹ These findings are a challenge for the control of spread of COVID-19. Therefore the objective of this review was to explore the barriers to hand hygiene practices and to identify methods for improvement in the COVID-19 era.

MATERIAL AND METHODS

A literature search was carried out to date using internet search engines and the following databases: Medline, Excerpta Medica Database (Embase), Google Scholar and Cochrane Library and the website of World Health Organization on hand hygiene practices in India. The search was done for published articles (accessible with abstract and full text) in English from 1st December 2020 to January 15th 2021. Articles that were published in peer reviewed academic journals from 2015 to 2020 were included. The keywords that were used in the search strategy included “hand hygiene”, “hand wash”, “barriers”, “health care workers”, “health care professionals”, “hand hygiene in health care”, “improve hand hygiene practices”, “hand sanitizers”, “hand rub”, “infection control”, “medical students”, “hand hygiene adherence,” “factors impacting hand hygiene” and “hand hygiene and India”. The search strategy identified a large no. of articles but the literature search narrowed down articles relevant to hand hygiene practices and COVID-19. After

screening through the articles, 31 articles that were closely connected with the factors impacting hand hygiene practices were reviewed.

RESULTS

Historical Background:

The COVID-19 pandemic has taught us that one of the most effective ways to prevent the spread of infection is hand hygiene. However, the importance of HH was noticed way back in early to mid-nineteenth century when young women died with fever within the first few days of child birth (puerperal fever). In the USA, in mid 1840s, Dr Oliver Wendall Holmes argued that the physicians with unwashed hands were responsible for transmitting puerperal fever from patient to patient.²⁰ At the same time, it was at a Vienna Hospital that Dr. Ignaz Philipp Semmelweis began investigating the causes of puerperal fever, against the resistance of his superiors who believed it to be non-preventable. In 1847 he demonstrated that puerperal fever was contagious and that its incidence could be drastically reduced by enforcing appropriate hand washing by medical care-givers.²¹ He encouraged doctors to wash their hands with chlorine and lime solution and the rate of deaths decreased considerably. As a result he was known as the Father of Infection Control. However both of their concepts on HH practices were not accepted initially. Then 1850s, Florence Nightingale started a Sanitary Commission after she pointed out that the unsanitary conditions of the soldiers were a major cause of death. Her work led to reduced death rates from 42% to 2%.²² Thus, washing hands with soap and water was identified cost effective in infection prevention.

Advantages of hand hygiene practices:

Several Clinicians on the global front opined that HH was a critical factor in reducing hospital-acquired infections (HAIs) and this was substantiated, during the initial development of healthcare systems.¹¹ Literature showed that frequent hand-washing would reduce the risk of viral transmission by 55%.¹² Soap molecules disrupt SARS-CoV-2's outer lipid membrane, killing the microbe; running water then flushes away the viral fragments.²³ Chao Yang stated that the efficacy of hand hygiene in reducing transmission of influenza may be decided on one issue: Is SARS-CoV-2 virus spread primarily by large droplets or by small-particle aerosols? And the more likely the virus transmitted by large droplets, the more likely that hand hygiene will reduce transmission.²⁴ Moreover SARS-CoV2 can survive on surfaces for extended periods of time. However in the same paper Chao Yang cautioned that individuals may venture into crowds under the false illusion that hand hygiene can prevent them from acquiring or transmitting SARS-CoV-2 if we overemphasize hand hygiene. In Italy, it was observed that proper hand washing of HCWs appears to be a key intervention in interrupting *Clostridium difficile* cross infections regardless of age and type of department in which the patient is admitted.²⁵ A study from India concluded that regular monitoring of hand hygiene compliance is vital to prevent the spread of nosocomial methicillin resistant staphylococcus aureus

(MRSA).²⁶ Study from Nigeria reported that hand hygiene practices might be more effective in infection control than antibiotic medication and could be of public health importance in an Ebola endemic region.²⁷ Hand sanitizers are effective against *Klebsiella pneumoniae* and *Staphylococcus aureus* than *Escherichia coli* and *Pseudomonas aeruginosa*.²⁸ At present due to the COVID-19 pandemic, alcohol based hand rubs (ABHRs) and hand sanitizers are easily available and used frequently even in situations where there is lack of running water.

Factors impacting hand hygiene practices

Factors responsible for poor HH practices among HCWs are well documented. In resource limited settings, many of the factors are common such as lack of knowledge, formal training, lack of infrastructure and lack of facilities. According to Aiello et al's meta-analysis, improvements in HH resulted in a 21% reduction in respiratory illnesses and a 31% reduction in gastrointestinal illnesses in community-based settings.²⁹

The factors impacting good hand hygiene practices are summarized in Table 1.

Lack of knowledge: WHO had introduced 5 moments of hand hygiene in 2009 in order to reduce the hospital associated infections. Five moments include proper hand washing before touching a patient, before aseptic procedure, after body fluid exposure, after touching a patient and after touching the patient's surroundings. When medical students and doctors do not know proper HH, the knowledge among the lay population would be much less. A study from Saudi Arabia concluded that the majority of the medical students and interns knowledge regarding HH was not up to the mark; however, female students had better knowledge compared to males.³⁰ Studies from different States of India had reported lack of knowledge on effective HH among HCWs^{15,19,26,31-36} residents and staff nurses,^{37,38} and medical, dental and nursing students.³⁹⁻⁴²

Insufficient training: Hand hygiene plays an important part in the COVID-19 era. Therefore, formal training is very important for HCWs and medical and paramedical students. A study from Ethiopia, shows that 84% of the nurses had no training in effective HH.⁴³ Studies from India also shows that there is lack of formal training among HCWs,^{33,34,44,45} Postgraduate and undergraduate students.^{39,41,46} Other reasons for low compliance to HH were due to lack of awareness.⁴⁷⁻⁵⁰ and turnover of staff.⁵¹

Lack of Infrastructure: In India health care system can be divided as government and private run facilities both in urban and rural areas. Adherence to good hand hygiene would require adequate infrastructure in a hospital environment. Lack of sinks, faucets, running water, buckets, etc will lead to low HH compliance. In many health care facilities, the sinks might be situated in inaccessible areas for the HCWs. Not many outpatient departments have these facilities in semi urban and rural areas hospitals. Facilities that have sinks are usually having manual closing faucets. Faucets with a lever

that allows opening and closing with elbow and automatic closing faucets may not be common in many hospitals. A study of Primary Health Centers in India reported providing outpatient services are constrained in their functioning during the COVID-19 pandemic due to weak infrastructure contributing to suboptimal patient safety and infection control measures which including hand washing and hand hygiene.⁵² Basic healthcare facilities such as running water, electricity, soap for hand washing, sinks are a challenge in low and middle income countries. Studies across India had observed difficulty in accessing wash basins, running water and shortage of sinks affecting proper HH.⁵³⁻⁵⁶

Limited resources: One of the main challenges in the implementation of HH program in many health facilities is inadequate supply of soaps, clean towels and disinfectants. No ABHRs rub nearby was named as the main reason for not performing HH in a study among transplant doctors in Poland.⁵⁷ A study among medical, nursing students and junior doctors from Manipur reported that 40% of participants used common towels and 58% used personal handkerchief which was not a good practice.⁴⁰ Other studies highlighted lack of adequate facilities such as hand washing cleansers, hand rub solutions and wash basin, clean towels, poor quality soaps and lack of soaps.^{19,31,53,55,58-60}

Other factors impacting good HH

Forgetting to wash hands and not being familiar with hand washing protocols may be one the main reasons for decreased HH compliance. In the Indian setting, due to the busy workload, overcrowding, and due to the shortage of staff, HCWs forget to wash hands (Table 1). Sometimes the healthcare providers are resistant to change,³¹ lazy⁶¹ and even the smell of sterilium may reduce HH compliance.⁶² Another factor that influences hand hygiene compliance was skin irritation and dermatitis. Washing hands several times during a shift with hand sanitizers and ABHRs may result in pain and irritation and may discourage the HCWs in exercising effective HH practices. And most of all, there is lack of active participation in hand hygiene promotion at individual or institution level,⁵⁹ lack of surveillance and feedback assessment.³¹

STRATEGIES TO STRENGTHEN HAND HYGIENE PRACTICE

Vaccines are available against COVID -19, but in reality we may have to live with it a long time. Access to good HH facilities will result in good HH compliance. This would help the HCWs to protect themselves and also to prevent infections.

A. Accountability: The authorities and leaders in the health care facility and hospitals need to openly support and promote HH practices. In a study from UAE, HCWs perceived leaders or supervisors and consultants influenced their hand hygiene performance.⁶³ Likewise the behavior of medical students is influenced by their mentor's attitude at the bedside. The senior physicians should take care of the HH practices regularly so that their juniors can learn and make it

S. No.	Author (Year)	Sample Characteristics	Aim and methods	Key findings & factors impacting HH Practices	Ref
1	Agarwal A, et al (2021)	HCWs across India (956)	To evaluate the preventive practices being followed by HCWs through a web based questionnaire and telephonic interviews	52.8% of the HCWs properly followed the steps of hand hygiene (52.82%) and ensured that they washed hands for at least 20 s (53.14%). Factors impacting HH practices: lack of knowledge, long duty hours, cumbersome nature of sanitizing hands a lot of times.	15
2	Arthi E, et al (2016)	HCWs in a tertiary care hospital in Puducherry (n=140)	To assess the knowledge, attitude and practice of hand hygiene among HCWs through questionnaire	The HCWs had moderate knowledge on hand hygiene but their attitude was not satisfactory. Factors impacting HH practices: inadequate supply of hand rub solutions, difficult to access wash basins.	19
3	Sharma A, et al (2019)	HCWs posted in all wards and intensive care units (ICUs) of a tertiary care hospital in Rajasthan(n=62)	To detect the carriage of MRSA in the hands of HCWs during patient care to check awareness among HCWs to follow proper hand hygiene protocol.	It showed that 51.61% HCWs' hand cultures was positive for MRSA before using hand rub and after use 9.68% was still positive. Factors impacting HH practices: understaffing, high workload, insufficient knowledge, and may be more significantly underestimating the importance of cleaning and disinfection of hands.	26
4	Sagar M, et al (2020)	Healthcare providers in ICUs and wards of a tertiary care teaching hospital in Punjab (n=400)	To assess the gap in knowledge, perceptions, and practices of HH using questionnaire and direct observation	Despite adequate knowledge, consultants and residents showed lower compliance with HH practices as compared to nurses s. Factors impacting HH practices; lack of time, Lack of knowledge and awareness, Heavy workload, Ignorance and negative attitude of the healthcare providers. Resistance to changing habits, Understaffing, Poor quality of the soap for hand washing and less availability of hand-rub and Lack of surveillance and feedback assessment	31
5	Sai M.S. et al (2015)	Health care providers working in different tertiary care Hospitals attached to medical colleges, in and around Hyderabad, in Telangana State (n=315)	To evaluate the awareness and compliance of hand hygiene among different health care providers through questionnaire	Only 16.5% of participants had good knowledge regarding hand hygiene. Factors impacting HH practices: lack of proper orientation and lack of knowledge, insufficient time due to high workload and understaffing	32

6	Patankar FN & Behera A (2019)	HCWs in a tertiary care hospital in Navi Mumbai (n=140)	To study knowledge regarding hand hygiene through questionnaire	88.54% of the study participants had average to poor knowledge and only 69.3% had received formal training in hand hygiene. Factors impacting HH practices: Lack of formal training,	33
7	Bhagawati G (2018)	HCWs in a superspecialty hospital in Ghaziabad, Uttar Pradesh (n=104)	To assess the awareness and attitude regarding hand hygiene through questionnaire	Awareness was found to be unsatisfactory regarding the most frequent source of germs in hospital setting (39.42%) and effective time of proper hand rub (42.30%). Lack of awareness regarding adequate time of hand wash among doctors (85.71%) was an important issue. Factors impacting HH practices: lack of awareness regarding the most frequent source of germs in a hospital among doctors and nurses. Lack of training for paramedical staff.	34
8	Choudhury, J & Mahapatra A (2017)	HCWs working in Neonatal and pediatric ICUs of a tertiary care hospital in Odisha (n=50)	To assess the knowledge of hand hygiene of HCWs using questionnaire	70% HCWs had knowledge about my five moments for hand hygiene. They were more likely to use soap and water (63.8%) compared to alcohol-based hand hygiene disinfectant (36.2%) Factors impacting HH practices: unpleasant irritant effects on the hands by alcohol based agents, lack of knowledge	35
9	Chakraborty T, et al (2018)	Health care providers in a Tertiary Care Hospital in Tripura (n=193)	To access the knowledge, attitude and practices about hand washing through questionnaire	Study revealed that 67.2% of health workers have the knowledge of steps of hand washing technique, but 48.3% of them wash hand with soap followed by liquid hand wash (44%). Factors impacting HH practices: lack of knowledge on the steps of hand washing.	36
10	Bawankar S. et al (2018)	Residents and Nursing Staff at Tertiary Care Hospital, Chattisgarh (n=190)	To assess the knowledge, attitudes, practices and satisfaction of facilities available to HCWs amongst residents and nurses through questionnaire	Respondents from both groups (95 each) had average knowledge regarding WHO steps of hand washing (55% and 58% respectively), Factors impacting HH practices: Lack of knowledge of guidelines/ protocols, Non availability of alcohol based hand rubs, soap and water.	37
11	Bhatt A& Sharma (2018)	Staff nurses working in community health centers in Gujarat (n=50)	To assess the knowledge and compliance to HH using structured questionnaire.	76% of staff nurses had average knowledge regarding Hand Hygiene and 70% had average level of compliance. Factors impacting HH practices: lack of knowledge	38

12	Gore CA, et al (2018)	Medical, dental and nursing students (n=150) in a Tertiary care teaching Institute in Bangalore, Karnataka.	To assess the knowledge regarding HH among medical, dental and nursing students-a cross sectional, questionnaire based survey	The knowledge about HH was not satisfactory among the students. Factors impacting HH practices: Lack of knowledge and lack of training	39
13	DuttaG, et al (2020)	Undergraduate students (medical and nursing) and junior doctors in teaching hospital, Imphal, Manipur(n=924)	To assess the knowledge and practice of hand hygiene through self administered questionnaire	Nearly half (49.1%) of the participants had poor knowledge about hand hygiene: Factors impacting HH practices: lack of knowledge, busy schedule, forgetfulness	40
14	Naziarezee I, et al (2019)	Dental students in a Dental college, Chennai (n=50)	To assess HH technique among dental students by direct observation	Only 10% of participants are aware of proper six steps of hand washing technique. Factors impacting HH practices: Lack of awareness and training	41
15	Mehta A & Tripathi K (2019)	Nurses and nursing students of Government Medical College and associated District Hospital, Datia, Madhya Pradesh (n=130)	To assess levels of knowledge, attitude and practice of HH through self administered questionnaire	Most of nurses and nursing students (75%) showed moderate level of correct practices in HH. Factors impacting HH practices: forgetfulness and lack of awareness	42
16	Modi PD, et al (2020)	Healthcare professionals and students in the Mumbai Metropolitan Region. (n=1562)	To assess the awareness of COVID-19 disease and related infection control practices through questionnaire	52.5% of the responders were aware of the preferred hand hygiene method for visibly soiled hands. Factors impacting HH practices: lack of training	44
17	Rameswarapu R, et al (2015)	Health care professionals in India (n=373)	Hand hygiene assessment using WHO Hand hygiene self assessment framework	The five components of the WHO tool showed that reminders in the workplace scored 67%, & system change 64%. Evaluation and feedback scored 62% & institutional safety climate scored 58%. Education and training scored the least at 55%. Factors impacting HH practices: education and training was indeed a neglected area, lack of leadership and dedicated teams	45
18	Ravichandran B, et al (2019)	Postgraduates (PGs)and Compulsory rotatory resident internship (CRRIs) of Govt Medical college and hospital, Chennai (n=275)	To assess the knowledge, attitudes, practices and satisfaction of facilities available to PGs & CRRIs with regard to hand Hygiene	The knowledge among the study group was found to be moderate (90.9%). Factors impacting HH practices: lack of adequate facilities, non-availability of paper/clothes for drying hands, training programs,	46

19	Tyagi M, et al (2018)	Healthcare providers working in 49 newborn care units and 35 labor rooms in Telengana and Andhra Pradesh	To assess HH compliance during examination and common procedures. by non participatory observation	Overall hand hygiene compliance was 23% in newborn care units, 44% in private and 12% in public facilities. Factors impacting HH practices: lack of awareness	47
20	Reddy V K, et al (2018)	HCWs at a tertiary care hospital in southern India (n=799)	To measure the knowledge, attitude and practices of HH through questionnaire	Regarding practice, 53.77% of the faculty reported practicing as WHO recommended hand washing practices while medical and paramedical scored below 38.92% and 42.77% respectively. Factors impacting HH practices: lack of awareness and sensitivity	48
21	Ahuja S & Pandey A (2019)	HCWs of a tertiary care hospital in Western Uttar Pradesh (n=149)	To assess the effectiveness of structured teaching on knowledge of hand hygiene through pre and post test questionnaire	Moderate knowledge (70%) of hand hygiene Factors impacting HH practices: Lack of awareness	49
22	Kumar AP & Chougale RA (2019)	HCWs from a tertiary care hospital in Kholapur, Maharashtra (n=70)	To evaluate the awareness, attitude of HH among healthcare workers and stimulate the improvement in HH practices by using questionnaire and direct observation	overall rate of hand hygiene compliance during pre-intervention phase was 35.4% and increased to 86% post intervention. Factors impacting HH practices: lack of awareness and understaffed	50
23	Patwardhan N & Patwardhan S (2019)	HCWs in a superspeciality tertiary healthcare hospital in Maharashtra (n=594)	Assessment of compliance to HH by direct observation	The compliance rate to be low in months when there was a turnover of staff, that is, some old staff members left and new staff were recruited. Factors impacting HH practices: lack of training sessions and sometimes negligence	51
23	Hussain SA (2018)	HCWs in a teaching hospital in Srinagar, Kashmir (n=106)	To assess the level of knowledge, attitude and practices among healthcare workers using questionnaire	The study group had relatively good knowledge and attitude but poor practice of hand hygiene Factors impacting HH practices: Forget to wash, lack of soap and water, towels/paper for drying hands and lack of time.	54
24	Rejani R & Ratan R (2017)	HCWs in a tertiary care hospital in Pune (n=30)	To assess the HH practices among health care workers and to assess reason for non compliance using questionnaire and direct observation.	Doctors showed compliance rate of 75%. and nurses 91%. Factors impacting HH practices: Too busy, forgot, unsure of the need, out of products, product at inconvenient locations	54

25	Jose GE & Valsan C (2017)	HCWs from a Mission hospital, Kerala (n=300)	To explore the existing knowledge, attitudes and practices through a validated questionnaire and direct observation	Knowledge of HH seemed to be good with 63.3% and overall compliance among the HCWs to adhere to correct HH practices were noted to be 46%. Factors impacting HH practices: lack of time, staff shortage, lack of facilities such as handwash, handrub and washbasin, lack of awareness and knowledge	55
26	Semwal R, et al. (2019)	Doctors working in a Govt. Tertiary care Hospital.	To assess the knowledge and attitude of doctors and explore perceived barriers to HH using semi structured questionnaire	44% doctors have not received any training regarding hand hygiene, 53% do not have knowledge about "5 moments of hand hygiene" and 19% do not use alcohol based Hand Rub. Factors impacting HH practices: workload, Lack of time, encouragement, hand rubs, soaps, water. Location and Shortage of Sinks.	56
27	Mohanty A, et al (2020)	HCWs of a newly set up teaching hospital at Rishikesh, Uttharakhand (171)	To assess the knowledge and perception towards hand hygiene through structured questionnaire	Overall HH compliance was seen in 32% HCWs. Factors impacting HH practices: lack of alcohol based hand rubs and single use towel and lack of infection control policy	58
28	Diwan V, et al (2016)	HCWs in a rural Indian teaching hospital in Ujjain, Madhya Pradesh (n=259)	To describe self-reported practices and assess knowledge and attitudes regarding hand hygiene through questionnaire	HCWs reported to 'always' practice HH varied from 40-96%. Factors impacting HH practices: high workload, scarcity of resources, lack of scientific information and the perception that priority is not given to hand hygiene, either on an individual or institutional level.	59
29	Bharara T, et al (2020)	HCWs of intensive care unit of a Delhi hospital (n=266)	To assess hand hygiene compliance by direct observation spanning over three years	The overall HH compliance was 21% in 2015, 20% in 2016, and 59% in 2017. Factors impacting HH practices: non availability of clean running water, soap, Hand Rubs, and a general attitude of noncompliance amongst healthcare providers towards even basic procedures of infection control.	60
30	Subbalakshmi E, et al (2020)	HCWs at a Teaching Hospital in Chennai (n=134)	To find lacunae in HH and to formulate measures to prevent HAIs and multidrug pathogens using questionnaire	The overall knowledge about HH was good. Hand washing was complied with by (46.7%) doctors and 15 (39.5%) nurses. Factors impacting HH practices: laziness, too many patients and forgetfulness	61

31	Ansari SK et al (2016)	HCWs in Paediatric Nursery in a children's hospital in New Delhi (n=713 hand hygiene opportunities)	To assess the compliance of hand hygiene by direct observation	Overall compliance was 51.6%. Factors impacting HH practices: Dryness of hands, unpleasant smell of Sterilium, inconsistent supply of facilities.	62
1. HCWS-Healthcare Workers; 2. HH-Hand Hygiene					
Table-1: Summary of Relevant studies					

a part of their daily practice. It is also important to teach HH in the undergraduate level in the curriculum or by organizing workshops on a regular basis.³⁰ Mentor's attitude at bed side which has a strong influence in moulding the behaviour of young medical and nursing students should be exploited to serve as role models for them.⁵⁵ Every facility, big or small should have infection control teams who can motivate and have a positive effect on students and staff.

B. Peer effect: Motivation is one of the best approaches to improve hand hygiene compliance.³⁷ Peer reminders, witnessing others' performance and making comparisons with peers and colleagues were considered triggers for HCP to perform hand hygiene.⁶³ This is otherwise known as the social network effect. In a study among 540 nurses from US hospitals reported that feedback from a patient or a colleague would likely lead to an increase in future HH action.⁶⁴ Thus performance of peers motivated the HCWs and had a positive effect on their HH compliance.

C. Sufficient knowledge on Hand Hygiene: A present, suboptimal hand washing has been observed as a significant risk factor for COVID-19.¹⁵ This shows the importance of improving the current training programs targeting hand hygiene practices among HCWs. The housekeeping staff also needs to be empowered. Teaching of elementary HH practices along with coupling of lectures in the undergraduate curriculum can be done so as to prime the medical students to this basic necessity of performing HH.⁵⁵ Provisions to arrange for regular training of health workers when they join work is essential to emphasize the awareness of microbial transmission by hands, stressing the importance of hand hygiene and its indications and to demonstrate the correct procedures for hand rubbing and hand washing. All these can be achieved using regular presentations, e-learning modules, posters, group activities, videos, self-learning modules, practical demonstrations, feedback forms during assessment, pre and post assessment, arranging training sessions.^{19,26,45,61}

D. Hand Hygiene education among health care workers Every health care facility should implement regular HH education programs and every unit should be encouraged to maintain and sustain good HH compliance. Every unit should identify and delegate a staff member to monitor the compliance. It is suggested continuous public health education of HCWs on SARS-COV-2 infection control and prevention.⁴⁴ Studies from India found that the knowledge levels of medical students about HH is far below expectations and that the administrators should take upon themselves

to include this topic in the educational curriculum^{39,51} and should make it a requisite for clinical skill assessment.³³ And the presence of infection control notice boards in the workplace will have a positive influence on adherence to hand hygiene.^{19,47}

E. Adequate supplies: Hand cleansing products are increasingly used during the COVID-19 pandemic. The administration of health facilities should supply adequate lotions, hand sanitizers, ABHRs, gloves, soaps and clean towels. During the early months of pandemic, there was a dearth of hand sanitizers in the market. To overcome this, hospitals and laboratory authorities encouraged to make the product locally using the WHO formulation. The COVID-19 testing laboratory of the University made hand sanitizers and distributed it among the staff. They take less time and are cost effective. The efficacy of hand rubs is dependent on multiple factors such as proper technique, its consistency of use, and the quantity of product used. Hand sanitizers and hand rub do not contribute much when hands are soiled and when bacterial load is high.²⁶ The best way to be safe in such a situation is to wash hands with water and soap. The HCWs should have access to clean disposable paper towels. To improve the HH facilities, a hospital in China changed 150 hand twist taps to non-hand twist taps, increased the number of paper towels and ABHR dispensers, and equipped all hands faucets with paper towels. ABHR dispensers were installed on the walls in patients' rooms, on the clinical trolley in general ward areas, and at every bedside in the intensive care unit, infectious disease wards and patient wards with other invasive operations.⁶⁵ And study from India reported that HH practices will improve significantly in clinical setting if adequate towels are provided to HCWs.⁴⁰

F. Provision for adequate staff: Healthcare workers are crucial to any health-care system¹³ During the recent pandemic the HCWs in the hospitals, laboratories and in the community worked long hours using personal protective equipment, continuously for many days in a stressful environment exposed to the pathogens. Thus they were vulnerable to acquire or transmit infection. This risk was increased by the rapid scaling up of intensive care unit (ICU) capacity in affected regions, the redeployment of clinical staff to frontline positions (eg, ICUs or COVID-19 wards), and the recruitment of less experienced staff (eg, newly qualified students or health-care staff moving from their specialism) to the workforce in response to the pandemic.¹³ Therefore health care facilities should have adequate staff.^{32,55} This will

ensure their safety and further increase the quality of care. Infection control teams, surveillance system and adequate staff should be there to motivate all other cadres of staff to implement good HH practices.

G. Sufficient and suitable infrastructure: Facilities for hand washing with easy access should also be guaranteed.⁵⁵ A study from Nigeria reported that a large proportion of HCWs used cups, bowls and ladle to pour water from a bucket to wash hands. This practice will further increase the risk of recontamination due to continued contact with the unwashed ladle or cup which had been touched previously with unclean hands. And the same study recommended having elbow-sensor- operated, or automated taps for handwashing.⁶⁶ Alternatively the sinks should be fully functional with running water. And automated soap dispensers will help in better compliance.³⁷ Therefore access to hand washing facilities is urgently needed to combat COVID-19.

H. Erase the myths and misconceptions

Lack of knowledge can lead to many false beliefs and misconceptions. The commonest reason for not implementing hand hygiene practices was after using gloves. The HCWs thought that it was not necessary and that gloves obviate the use of hand hygiene.^{19,40} Undergraduate medical students in Gujarat,⁶⁷ nursing students from Madhya Pradesh⁴² and junior doctors from Chennai⁴⁶ believed that hand rub may cause dryness of hands. Incorporation of teaching and training of HH practices in the undergraduate teaching during the initial study years is the need of the hour to prevent further emergence of antimicrobial resistance and health care associated infections.⁶⁷

I. Regular feedback

Timely and regular feedback might be a key factor in improving and maintaining the compliance rate. Incorporating HH into the medical quality evaluation, and feedback to the department chief attracted attention in the study conducted in a hospital in Guizhou, China.⁶⁵ Studies from India suggested that lack of compliance due to forgetfulness can be countered by placing reminders such as posters, installing wash scans or digital screening of hands, through HH auditing with regular feedbacks and also by ongoing education processes.^{47,50,55}

J. Rewards/incentives

Hand hygiene accountability increased with recognition, awards, rewards and incentives.¹¹ A systematic review by Luangasanatipet al states that addition of goal setting, reward incentives, and accountability strategies can lead to increase in the increased HH compliance.⁶⁸ The Health care providers (HCP) suggested regular sensitization and training sessions, decreased workload of HCPs, effective surveillance and feedback, incentives and disincentives, and improved communication among all HCP.³¹

J. WHO multimodal hand hygiene improvement strategy

In addition to outlining the evidence base for focusing on hand hygiene improvement as part of efforts to reduce HAIs, the WHO 'Guidelines on Hand Hygiene in Health Care' (World Health Organization, 2009b) introduced the Multimodal

Strategy for Hand Hygiene Improvement as a means to achieve and sustain optimal hand hygiene behaviour. In brief, the five components of this multimodal strategy are System change, Staff education and training, Evaluation and feedback, reminders in the workplace, Institutional safety climate.⁶⁹ The implementation of this strategy can make a change in the existing system and improve compliance.^{46,48,60}

CONCLUSION

Facing the COVID-19 pandemic is challenging but these challenges can be converted to opportunities to improve and maintain good HH practices in both government and private sector. Hand washing is one of the preventive measures in decreasing hospital associated infections and COVID-19. Evidence suggests that factors impacting good hand hygiene practices needs to be addressed in the COVID-19 era. It may be added as a clinical skill in the undergraduate curriculum. Health care professionals when working with patients should seriously implement WHO's "Clean care is safer care" program. There is an urgent need to develop basic infection control programs in every healthcare facility in India both in urban and rural areas. There needs to be improvement in accountability, infrastructure, resources and continuous health education and capacity building in all cadres of staff in a health care facility. This is the time to implement WHO's multimodal HH improvement strategies for better compliance.

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Source of Support: Nil; **Conflict of Interest:** None

Submitted: 13-02-2021; **Accepted:** 15-03-2021; **Published:** 28-04-2021