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The effect of hand hygiene audit in COVID intensive care units in a tertiary care hospital in South India



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A B S T R A C T

Background: In the era of COVID-19 pandemic, there is an upsurge of healthcare-associated infections (HAI) in COVID intensive care units (ICUs), which can be reduced by following proper hand hygiene (HH) practice. Performing HH auditing in COVID ICU and providing timely feedback to the stake holders is crucial to reduce HAIs.

Methods: From November 2020- April 2021, HH audit was conducted in COVID ICUs. HH complete adherence rate (HHCAR), HH partial adherence rate (HHPAR) and HH total adherence rate (HHTAR) were analyzed. Profession-specific HHTAR and moment-specific HHTAR (for each WHO moment) were also calculated.

Results: HHCAR, HHPAR and HHTAR were found as 30.8%, 34.5% and 65.3% respectively. There was a significant increase in the monthly HHTAR from 26.7% to 68.4% ($P < .001$). The profession-specific HHAR was found to be highest among doctors (67.5%) and nurses (66.4%). As the HHTAR increases there is a significant decrease in device associated infection (DAI) rate from 24.7 to 11.5 per 1,000 device days.

Conclusions: Auditing HH and providing timely feedback significantly improved HH compliance. The need of the hour is to regularly conduct HH audit in COVID locations of all healthcare facilities to reduce HAI rate among the COVID- 19 infected patients in ICUs.

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The COVID-19 pandemic caused by [severe acute respiratory syndrome coronavirus 2 \(SARS-CoV-2\)](#) is more than just a global health crisis; causing a significant social and economic disruption. In addition to its rapid surge in community, it has also become a major healthcare associated infection (HAI), affecting large number of healthcare workers (HCWs) and patients in hospitals.¹⁻³ The mode of transmission of SARS-CoV-2 is mainly through respiratory droplets, which occurs within 1 m distance from an infected person. However, individuals who are present outside the 1 m range of infected persons can still contract the infection via contact transmission—either direct contact (person to person contact) or indirect contact (via fomites present in the vicinity). Following contact, the virus can only be transmitted by touching a person's mouth, eye or nose with his contaminated hand.^{2,4} Therefore, frequent Hand hygiene (HH) subsequent to potential contact exposure is critical to prevent this type of

transmission. HH can be performed by hand washing with either soap and water or by the use of alcohol-based hand sanitizers. The HCWs should have a HH compliance rate of more than 90% as recommended by The World Health Organization (WHO) for effective prevention of HAIs including COVID-19.⁵ To break the chains of COVID-19 transmission and minimize the HAI in hospital settings, HCWs should adhere to the WHO's "My 5 Moment for HH" and strictly follow the six steps of HH technique as advised by the WHO.⁶⁻⁸

WHO states that nearly 80% of people who develop symptoms, recover from the disease without requiring hospital treatment? Only 20% of individuals infected with COVID require hospitalization, out of that 15% need oxygen and 5% requires admission in ICUs. A majority of ICU patients requires mechanical ventilation, with a mortality and morbidity of up to 80%.⁹ A Meta-Analysis done by Abate SM et al revealed that globally, nearly one-third of patients with coronavirus infection were admitted to ICU and the prevalence of mortality among them was 39%.¹⁰ The outcomes of individuals infected with COVID are very variable. The patients having increased sputum

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production and higher requirement of supplemental oxygen at admission, and with underlying risk factor such as diabetes or chronic kidney disease are at increased risk for severe illness and therefore are at a higher risk of being admitted to COVID ICU. Patients in COVID ICU are usually critically ill, immunocompromised and have increased vulnerability to HAIs. Respiratory failure, acute respiratory distress syndrome, sepsis, septic shock, thromboembolism, multiorgan failure are the complications leading to death in COVID patients.⁹

Although the awareness about HH among the general public and HCWs had increased during the COVID pandemic due to active involvement of WHO, CDC (Centers for Disease Control and Prevention), government initiatives and social media,¹¹ the HH compliance is found to be low among the HCWs working inside COVID care settings, which can be attributed to increased work pressure, false beliefs that continuous use of gloves obviates the need for HH, priority for patient care procedures and continuous donning of personal protective equipment (PPE) which gives a sense of discomfort.¹² As a result of this, there has been an upsurge in the cases of HAIs due to multidrug resistant organisms (MDROs) leading to increased mortality and morbidity.^{7,13,14} More so, the data on HH compliance among HCWs in COVID care settings is lacking. Therefore, to fill the gap between theoretical knowledge about HH and practice,¹⁵ monitoring of HH by auditing is crucial, which will eventually help in reducing HAIs among patients in COVID care settings.^{16–18} So, the present study has been undertaken to determine the HH compliance rate among HCWs in COVID care settings and further evaluate the impact of HH compliance in reducing the HAIs in COVID Intensive care units (ICU) settings by auditing HH practice.

MATERIALS AND METHODS

This was a prospective study conducted for 6 months (November 2020–April 2021) in COVID ICU at JIPMER, a tertiary care hospital located in Pondicherry, South India. The HH audit was performed to monitor the HH practice of HCWs posted in COVID ICU. The HCWs such as doctors (ie, consultants and resident physicians), nurses and ancillary staff (ie, attenders and sweepers) posted in COVID ICU were the study participants included in the audit. The COVID ICU had 10 beds, with around 8–10 HCWs working at given point of time. The auditors selected to perform HH audit were the infection control nurses (ICNs) and resident doctors posted in the Hospital Infection Control and Prevention (HICP) unit.

A control room was allotted for HICP unit in COVID location which functioned 24 × 7 for use by the auditors. The auditors used to follow the COVID personal protective equipment (PPE) protocol of the hospital for performing donning and doffing the PPE.^{3,12}

The HH audit was conducted by direct observation method according to WHO's HH audit tool¹⁹ and the data was collected electronically through an App (IBHAR HH audit App), which was developed in-house by the HICP unit. It has a comprehensive set of mobile enabled tools and web based analytical dashboards designed based on the WHO HH audit tool kit.¹⁹ By using the IBHAR HH Audit tool, the auditors recorded the HH opportunities (HH moments) of multiple professionals simultaneously, marked whether the HH is followed or not (missed) for that moment and when followed they recorded the exact duration of using handrub or handwash.

The HH event was marked as '*completely followed*' when all the 6 WHO steps of HH were performed,^{8,19,20} for the recommended duration (>20 seconds for handrub and >40 seconds for handwash). When ≥ 1 WHO's HH steps were missed and/or the duration was less than recommended, such HH events were marked as '*partially followed*'. The auditors also monitored and ensured the availability of consumables (eg, handrubs, handwash, tissue papers) in the COVID ICU all the time.

Immense efforts were taken to reduce all the possible bias expected to raise during the audit process and to ensure standardization and reliability of the audit. The auditors were trained prior to the audit to reduce inter-auditor variation in data collection. The auditors conducted the HH audit simultaneously along with their other routine work in COVID ICU (eg, HAI surveillance work) so that the HCWs posted in COVID ICU would not realize that their HH practice were being monitored¹⁹; thus, minimizing the *observational bias* (ie, Hawthorne effect). For each month, a different auditor was allotted to conduct HH audit in a month-wise rotation basis to minimize *confirmation bias*. The audit was carried out in a random schedule, thus obviating the *confounding bias* of work pressure influencing the HH compliance.

The HH audit was conducted for an observation period of 20 mins/d for a period of 6 months in the COVID ICU. Thus, in total there were 123 observation periods (each conducted for 20 minutes) and 2887 minutes of observation were completed during the entire study period. The HH complete adherence rate (HHCAR), HH partial adherence rate (HHPAR) and HH total adherence rate (HHTAR, complete + partial) were calculated. Profession-specific HHTAR (eg, doctors, nurses, and ancillary staff) and moment-specific HHTAR (for each WHO moment) were also calculated.^{6–8} The monthly HH audit report and the feedback were shared to the clinical team of COVID ICU and also presented in the hospital infection control committee meeting.¹⁶ Since, an improvement in HH compliance could lead to decrease in HAIs, which includes device associated infections (DAI), the impact of conducting the HH audit has been assessed by comparing the month-wise HHTAR with the DAI rate of COVID ICU.¹⁸ The data on DAI rate was obtained from HAI surveillance data, which was conducted by HICP simultaneously every month based on standard operating HICP manual and the National Healthcare Safety Network guideline.²¹ The collected data has been entered into Microsoft excel and analyzed using SPSS version 21 software (IBM-SPSS Inc, Armonk, NY). The month-wise HHTAR, profession-specific HHTAR, moment-specific HHTAR and DAI rates were reported as percentages and the association between the above-mentioned parameters were done using chi-square test and chi-square for trend. A *P*-value of $<.05$ was considered as statistically significant.

RESULTS

As shown in [Table 1](#) and [2](#), 232 opportunities were recorded during the entire study period. The HHTAR, HHCAR and HHPAR for the study period were found to be 65.3% (1458 out of 2232), 30.8% (688 out of 2232) and 34.5% (770 out of 2232) respectively. It was also observed that monthly HHTAR increased progressively during the study period from 26.7% in November 2020 to 68.4% in April 2021. To determine whether this monthly increase in HHTAR is statistically significant, we have proceeded with the chi-square for trend analysis and reported a *P*-value of $<.001$. The highest HHTAR was documented in the month of March 2021 (79.8%).

The profession-specific HHTAR was depicted in [Table 2](#), which was found to be highest among doctors (67.5%; 702 out of 1040) and nurses (66.4%; 505 out of 761) compared to ancillary staff (57.5%; 218 out of 379). Even though, the HHTAR kept fluctuating, there was a progressive increase in the HH compliance towards the end of the study period among doctors, nurses and ancillary staff. With the chi-square for trend analysis, we found that there was an increase in trend in the monthly HHTAR among doctors ($P <.001$), nurses ($P <.001$) and ancillary staff ($P <.001$).

The moment-specific HH adherence was shown in [Figure 1](#), which explains that WHO's moments 2 and 3 have shown to have highest HH compliance (83.3% and 93.1%, respectively) as compared with WHO's moments 1, 4, and 5 (61.6%, 75.1% and 54.6%, respectively).^{6–8} The improvement in monthly HH compliance during the study period

Table 1
HH adherence in COVID ICU

Month	HH Opportunities(n)				HH total adherence rate (%)		
	Moments available	Completely followed	Partially followed	Not followed	HHCAR	HHPAR	HHTAR
November-20	363	16	81	266	4.4%	22.3%	26.7%
December-20	354	142	130	82	40.1%	36.7%	76.8%
January-21	368	54	227	87	14.7%	61.7%	76.4%
February-21	358	125	98	135	34.9%	27.4%	62.3%
March-21	396	252	64	80	63.6%	16.2%	79.8%
April-21	393	99	170	124	25.1%	43.3%	68.4%
Total	2,232	688	770	774	30.8%	34.5%	65.3%

HHCAR, HH complete adherence rate; HHPAR, HH partial adherence rate; HHTAR, HH total adherence rate (complete + partial).

Table 2
Profession-specific HH total adherence rate (HHTAR)

Month	Doctors	Nurses	Ancillary staffs
November-20	36.2% (46/127)	16.9% (20/118)	27.1% (32/118)
December-20	79.0% (169/214)	78.0% (71/91)	67.3% (33/49)
January-21	70.6% (96/136)	86.0% (111/129)	70.9% (73/103)
February-21	49.2% (65/132)	68.1% (111/163)	76.2% (48/63)
March-21	79.2% (175/221)	81.3% (126/155)	75.0% (15/20)
April-21	71.9% (151/210)	62.9% (66/105)	65.4% (17/26)
Total	67.5% (702/1040)	66.4% (505/761)	57.5% (218/379)

NOTE. Values are presented as %[n/N]; doctors ($P = < .001$), nurses ($P = < .001$) and ancillary staff ($P = < .001$)

for moments 1, 4 and 5 showed an increase in trend in the monthly HHTAR with the chi-square for trend analysis with a P - value of $< .001$ for moment 1, moment 4 and moment 5 each.

The comparison of month-wise trends of HHTAR and DAI rates was depicted in Figure 2. It was observed that HHTAR inversely correlates with DAI rates. As the HHTAR increases, there was a decrease in DAI rate from 24.7 to 11.5 per 1,000 device days.¹⁸

DISCUSSION

In the wake of dramatic increase in the prevalence of MDROs in COVID care locations causing increased morbidity and mortality, implementation of simple infection prevention measures like HH plays a significant role in reducing cross-transmission of MDROs in healthcare settings, thus enhancing the effectiveness of a good healthcare system.^{7,13,14} High standards of HH practice in COVID location not only helps in preventing nosocomial spread of MDROs, but also will block the contact transmission of SARS-CoV-2 itself.⁶ However, it is often observed that the HH practice is extremely poor in COVID location compared to non-COVID area; which may due to multiple factors, of which the most important is continuous use of gloves by the HCWs giving a false sense of being protected.²² Therefore, robust monitoring of infection control practices such as HAI surveillance, HH audit, care bundle audit and biomedical waste audit in COVID locations is of utmost importance.¹⁶

To the best of our knowledge, this study is first of its kind to conduct structured infection control audits in COVID locations in India.

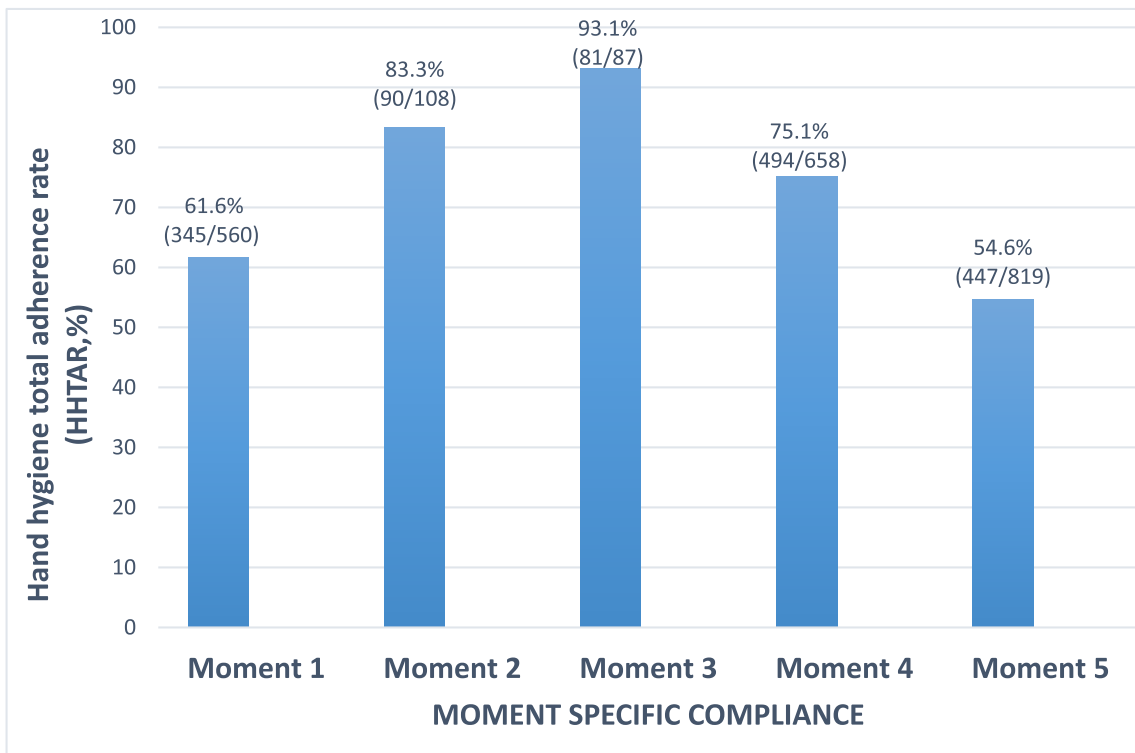


Fig 1. Moment-specific HH total adherence rate (HHTAR) (HH acts performed [complete and partial]/opportunities available). Note: Moment 1, before touching the patient; moment 2, before doing an aseptic procedure; moment 3, after doing an aseptic procedure or body fluid exposure risk; moment 4, after touching the patient; moment 5, after touching the patient's surrounding.

Most of the COVID facilities in India seldom conduct infection control audit, which is because of several challenges such as absence of a well-established HICP unit, paucity of ICNs available, scarcity of PPE available and/or difficulty in donning and doffing PPE to visit COVID locations.¹⁶ Our hospital, being an institution of national importance under the Ministry of Health and Family Welfare, Government of India has given a prime importance to the infection control monitoring in COVID location. It has a designated HICP control room inside its COVID location, where the ICNs and Microbiology postgraduate residents are posted 24 × 7 for monitoring the various aspects of infection control. This study was undertaken to monitor the HH practices of HCWs posted in COVID ICU, with an objective of gradual improvement of HH compliance by providing them timely feedback.

The HH audit was conducted for a period of six months in COVID ICU, during which a total of 2,232 HH opportunities were observed with a mean HHTAR, HHCAR and HHPAR of 65.3%, 30.8% and 34.5% respectively (Table 1). There were numerous studies.^{14,15,17,18,24-28} on HH compliance before and during the COVID-19 pandemic, both in general wards and critical care units; however none of them was from COVID intensive care units. A previous large-scale study conducted for one year at the same facility in 14 different non-COVID critical care areas documented HHTAR, HHCAR and HHPAR of 66.8%, 45.5% and 21.2% respectively.¹⁵ In concordance, there are several studies on HH auditing in non-COVID ICUs published elsewhere which documented HH compliance ranging from 14% by Bhattacharya et al,²⁵ 56.0% by Lohiya et al,¹⁷ 66.0% by Rodriguez et al²⁶ to 73.17% by Naglaa et al.²⁷

We have made an effort to analyze HHTAR (complete and partial) in this study, even though WHO does not recommend to monitor partial compliance. This attempt was taken in order to encourage the HCWs in a hope that their partial HH adherence will be converted to complete adherence in the subsequent audits.

In the present study, the month-wise trend analysis showed that there was a significant improvement of HHTAR (27%–68%), HHCAR (4%–25%) and HHPAR (22%–43%) from November 2020 to April 2021 (Table 1). This signifies that providing feedback of HH performance to the HCWs on a daily basis and displaying HH audit report in hospital infection control committee monthly meetings immensely helps in improving the compliance. Even though the HHCAR improved from 4%–25%, this is very less when compared to WHO's recommended HH compliance rate (90%).⁵ The reason of poor HH compliance may be attributed to the false sense of security because of wearing gloves continuously in COVID ICU. Further strategies may be needed to improve compliance such as augmented educational intervention, displaying individual specific HH compliance with punish-reward mechanism, and avoiding frequent rotation of HCWs posted in the staff in ICU.

A mega study conducted at the same facility in 14 different non-COVID ICUs documented a significant improvement in HHCAR from

37.5% to 51.8%.¹⁵ Another extensive study conducted at the same facility showed a significant increase of HHCAR from 3% to 70% following a multi modal intervention.²⁴ In the last month of the study, there was a slight decrease in HHTAR. The possible reason could be due to the increased workload of the HCWs posted in COVID ICU as there was an acute surge of COVID cases in April 2021 in our locality leading to increased bed occupancy. There was also an increase in the proportion of sick patients admitted in our COVID ICU, which resulted in HCW's increased concern over patient care procedures like intubation, cardiopulmonary resuscitation etc., directly affecting the compliance.²³

As depicted in Table 2, the profession-specific HHTAR was highest among doctors (67.5%) and nurses (66.4%), followed by other HCWs (57.5%). Discordance to this observation, several other studies documented a higher HH compliance in nurses when compared to doctors; for example A.S. Sastry et al.(58.9% vs 46.6%),¹⁵ Lohiya et al (77% vs 52%)¹⁷ and Karaaslan et al (41% vs 31%).²⁸ The reason of improved HH compliance among doctors as par with that of the nurses could be due to their increased awareness of HH in COVID pandemic era, which is welcoming and appreciable. Month wise trend analysis showed there was a progressive increase in the HHTAR towards the end of the study period even though it was fluctuating between the months among doctors ($P < .001$), nurses ($P < .001$) and ancillary staff ($P < .001$). Similarly, A.M. Laskar et al. documented a significant improvement in HHCAR among doctors (2.3%–50%) and nurses (3.6%–80%) following a multimodal intervention.²⁴

The HCWs were continuously insisted to follow “My 5 Moments for HH” emphasized by the WHO.⁶⁻⁸ Before moments (ie, moments 1 and 2) protect the patients from risk of microbial transmission from HCWs, whereas after moments (ie, moments 3, 4, and 5) prevent risk of microbial transmission from patients and their surroundings to HCWs. In our study, the HH compliance rates were found to be highest for moments 2 and 3 (93.1% and 83.3%, respectively) when compared to moments 1, 4 and 5 (61.6%, 75.1% and 54.6%, respectively). The rationale behind this observation could be the increased concern of HCWs for HH when performing an aseptic procedure, compared to other moments which don't involve any invasive procedures, although all the 5 WHO moments should be considered equally important. This finding is also in contrast to few other studies where HH compliance rate was higher for other WHO moments; for example, increased compliance for after moments was documented by A.S. Sastry et al, A.M. Laskar et al., Rodriguez et al., and Naglaa et al; whereas increased compliance for before moments was reported by Lohiya et al.^{15,17,24,26,27}

Month-wise comparison of HHTAR and device associated infection (DAI) rates was depicted in Figure 2. A good HH compliance directly reflects in reduction in HAIs and eventually results in effective healthcare system. It was also observed in our study that the HHTAR inversely correlated with DAI rates. With the corresponding

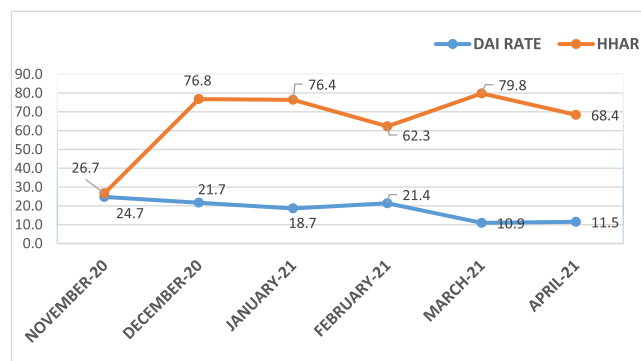


Fig 2. Comparison of month-wise trends of HH adherence rate (HHTAR) and device associated infection (DAI) rates.

increase in the HHTAR, there was a significant decrease in DAI rate from 24.7–11.5 per 1,000 device days. This is in concordance with several other studies such as A.S. Sastry et al, Roshan et al and Lohiya et al.^{15,17,18} HH is one of the most essential component of care bundle practices which need to be followed for the prevention of DAI rates.²⁹

The limitations of this study include- HH compliance based on shift variation, gender variation, diurnal variation and experience specific variation were not studied. The observation periods were based on convenience sampling, but not randomized. The duration of the study was also short. The HHCAR was found to be very low compared to the WHO's recommended HH compliance of 90%.⁵ With a multimodal and strong administrative intervention conducted for longer duration, the HH compliance can further be improved with a significant decrease in HAI rates. In our future research, we will focus on these areas.

CONCLUSION

This was one of the first study on HH audit conducted inside COVID ICU, with an objective of improving HH compliance. We conclude that by conducting HH audit and providing timely feedback to the stakeholders has a significant influence on HH compliance in COVID ICU. Therefore, we urge the infection control departments of the healthcare facilities to regularly conduct HH audit in their COVID locations, which is the need of the hour. More emphasis needs to be given to improve the HHCAR by following all the WHO steps and for the recommended duration. A behavioral change is warranted to achieve a higher standard of HH compliance, which is sustainable in spite of the increased work pressure.

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