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Original Research Article

Impact of conducting hand hygiene audit in COVID-19 care locations of India—A large scale national multicentric study – HHAC study

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ABSTRACT

Purpose: Hand hygiene (HH), the core element in infection prevention in healthcare, especially for multidrug resistant organism's transmission. The role of HH audits and HH adherence rates in the COVID-19 pandemic, especially in resource limited settings, are yet to be established.

Methods: A nationwide multicenter study was conducted in India, involving public, private, teaching and non-teaching COVID healthcare facilities (COVID-HCFs) using the IBhar mobile application based on WHO's hand hygiene audit tool. The HH adherence rates (HHAR) such as complete HHAR (HHCAR), total HHAR (HHTAR), profession specific HHAR, WHO's 5 HH moment specific HHAR and associated variables were measured over 6 month duration (June–December 2021).

Results: A total of 2,01,829 HH opportunities were available and the HHCAR and HHTAR were 27.3% and 59.7%. The HHTAR was significantly higher in the west zone (72.2%), private institutes (65.6%), non-teaching institutes (67.7%), nurses (61.6%), HH moments 2 (71.8%) and 3 (72.1%), and morning shift (61.4%). The HHTAR was better in non-COVID HCFs (65.4%) than COVID-HCFs (57.8%) as well as non-COVID ICUs (68.1%) than COVID ICUs (58.7%). The HHTAR was increased from month 1 to month 6 except a small decrease in the month of December.

Conclusions: The hand hygiene adherence is comparable with adherence rate during COVID-19 pandemic in western countries as well as the resource limited settings. The use of gloves during the pandemic and simplified HH techniques and their influence over the HH adherence to be studied further. The sustainable adherence rate over long duration needs to be ensured by continuing the HH audit using multimodal interventions.

1. Introduction

Hand hygiene (HH) is a simple, efficient measure to reduce healthcare associated infections (HAIs) in COVID-19 health care facilities (COVID-HCFs), but the HH adherence remains low among the Healthcare workers (HCWs), despite increasing awareness in this pandemic [1–8]. The low adherence is possibly due to increased work pressure, misconceptions that HH has no role in COVID-HCFs as all are COVID positive; HCWs are protected with personal protective equipment (PPE) and continuous use of gloves are replacement for HH [2,3,9,10].

A pilot study from a South Indian institute, primarily focused on COVID ICUs, highlights that the HH audits with timely feedback to the stakeholders are essential to improve and maintain the HH adherence in a sustainable way [11]. No data on HH compliance in COVID-HCFs,

Abbreviations: HH, Hand Hygiene; HHAC, Hand Hygiene Audit in COVID-19 care; HCW, Health Care Workers; ICU, Intensive Care Units; HCF, Health Care Facilities; MDRO, Multi-Drug ResistantOrganisms; HAI, Hospital Acquired Infections; PPE, Personnel Protective Equipment; HHAR, Hand Hygiene Adherence Rate; HHCAR, Hand Hygiene Complete Adherence Rate; HHPAR, Hand Hygiene Partial Adherence Rate; HHTAR, Hand Hygiene Total Adherence Rate (i.e. complete and partial); OAS, Other Allied Staff.

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which includes COVID ICUs, non-COVID ICUs, COVID wards and non-COVID wards during the pandemic, is available from any COVID-HCFs in India.

Therefore, a large-scale multicentric study in different COVID-HCFs of India was planned to determine the HH adherence rate, to evaluate the impact of HH audit with regular feedback, to compare HH adherence among various professions, WHO's five HH moments, shifts and institute types and to evaluate the impact of glove use in COVID-HCFs. The study aimed to create a national baseline data of India, which can be used for quality improvement.

2. Materials and methodology

2.1. Study settings

A prospective study was conducted from 92 COVID-HCFs (24 public-teaching; 19 private-teaching; 18 private non-teaching; 4 public non-teaching) across India over 6 months (July–December 2021). All 92 HCFs were selected and included by voluntary participation, by dissemination of study protocol to various institutes all over India. All HCWs from these COVID-HCFs [doctors, nurses, housekeeping staff and other allied staff (OAS)] were audited. The study has ethical approval from the nodal center (JIP/IEC/2021/014 dated May 31, 2021) and all participating centers obtained approval from institute ethics committee (IEC) or concerned authorities of their institutes. The centers with necessary approval were included in the study.

2.2. Data collection method and training of auditor

The HH audits were performed electronically using IBHAR mobile application (IBHAR Technologies Pvt Ltd, India), a direct observation method adapted and modified from the WHO's HH audit tool [4]. The auditors (infection control nurses and resident doctors) followed all COVID appropriate guidelines during the HH auditing [3]. They were trained to reduce inter-auditor variation, observational bias, confirmation bias and confounding bias (induction training through virtual mode by the project principal investigator, site training by the site investigators, monthly training through virtual mode by designated investigators) [11].

2.3. HH audit parameters

The following information was collected—date and time of audit, profession and gender of the HCWs, available HH opportunities (HH moments), presence of gloves during HH, number of steps and duration of HH. The duration of ≥20 min/day and/or until a daily minimum of 20 HH opportunities were recorded. The HH event was marked as 'completely followed' when all the 6 WHO steps of HH were performed for the recommended duration (>20 s for hand rub and >40sec for hand wash). When ≥1 WHO's HH steps were missed and/or the duration of HH was less than recommended, such HH events were marked as 'partially followed' [4–6].

2.4. Interventions implemented

First, onsite advice and corrections by HH auditors were given to the HCWs at the end of every audit to improve the HH practices. Second, a monthly HH audit report was shared to the stakeholders.

2.5. Statistical plan and data analysis

The HH complete adherence rate (HHCAR), HH partial adherence rate (HHPAR) and HH total adherence rate (HHTAR i.e., complete + partial) were determined as previously described [11]. Profession-specific HHAR, gender-specific HHARs and HH moment-specific HHARs were calculated [2,5,9]. The month-wise trend of HHTAR was used to measure the impact of HH audit [10]. All participating centers were divided into East, North, South and West zones. Further subgroup analysis was carried out to determine the differences in HH practices between public and private sector hospitals, teaching and non-teaching hospitals. Data in excel was generated from the IBHAR cloud site. The dependable parameters were expressed in percentage. Differences and significance between the HH practices were analyzed by test, univariate and multivariate analysis using IBM SPSS Statistics 28.0.

3. Results

3.1. Hand hygiene opportunities and overall compliance

A total of 2,01,829 available HH opportunities over 2,31,076 min were captured. Centers from south zone (n = 52/92) captured 1,06,444 opportunities over 1,22,505 min [Supplementary Table 1]. The overall HHCAR and HHTAR 27.3% and 59.7% respectively.

3.2. Specific compliances

These rates specific to zones, institute type, profession, WHO HH moment, area, sex of HCW, working shift and gloves use are shown in Fig. 1 and Supplementary Table 1. The profession specific compliance rates in respect to institute types are shown in Supplementary Table 2 and in respect to WHO HH moment and study months are shown in Supplementary Table 3.

3.2.1. Zone specific compliance

The HHCAR was 37.5% in the west zone, followed by south (31.2%), north (19.9%) and east (17.9%) zone. The west (72.2%) or south (61.9%) zone had significantly higher HHTAR than east (54.1%) or north zone (51.9%). The west zone had significantly higher HHTAR than other zones (RR-1.75; OR-2.4; $p < 0.05$) [Supplementary Table 1].

3.2.2. Institute specific compliance

The HHCAR, HHTAR were significantly higher among private than public institutes (32.4% vs 21.9% and 65.6% vs 53.6%; RR-1.2; OR-1.64; $p < 0.05$ respectively) and significantly higher among non-teaching than teaching institutes (30.1% vs 26.2% and 67.7% vs 56.7%; RR-1.4; OR-1.6; $p < 0.05$ respectively). The HHTAR was significantly higher among private non-teaching institutes (70.1%; OR-2.120; $p < 0.05$) and lower among public teaching institutes (52.5%) [Supplementary Table 1].

3.2.3. Profession specific compliance

The HHCAR was 28.3% among nurses followed by doctors (27.1%), housekeeping staff (26.4%) and OAS (24.2%). The HHTAR of nurses was significantly higher (61.6%; OR-1.2; $p < 0.05$) than other HCWs. There was no difference between the housekeeping and OAS [Supplementary Table 1].

The compliances of various HCWs were similar to zone specific and data [Supplementary Table 2] with few exceptions as follows; HHCAR was significantly higher in public-teaching than public non-teaching institutes among nurses (24.4% vs 19.5%), doctors (23% vs 20.2%) and housekeeping staff (19% vs 16%); HHTAR of doctors from east (60.2%) was higher than south (56.5%); HHCAR of housekeeping staffs was higher in north (17.8%) than east (16.2%); Compliance of OAS was higher in private-teaching (HHCAR-38%, HHTAR-72.3%) than private non-teaching institutes (HHCAR-30.5%, HHTAR-66.9%).

3.2.4. WHO hand hygiene moment specific compliance

The compliance during WHO HH moment 2 (HHCAR-39.6%, HHTAR-71.8%) and 3 (HHCAR-38.7%, HHTAR-72.1%) were significantly higher than other moments (OR-3.09, 3.13 respectively) and moment 5 (HHCAR-18.4%, HHTAR-45.1%) was significantly lower than other moments [Supplementary Table 1].

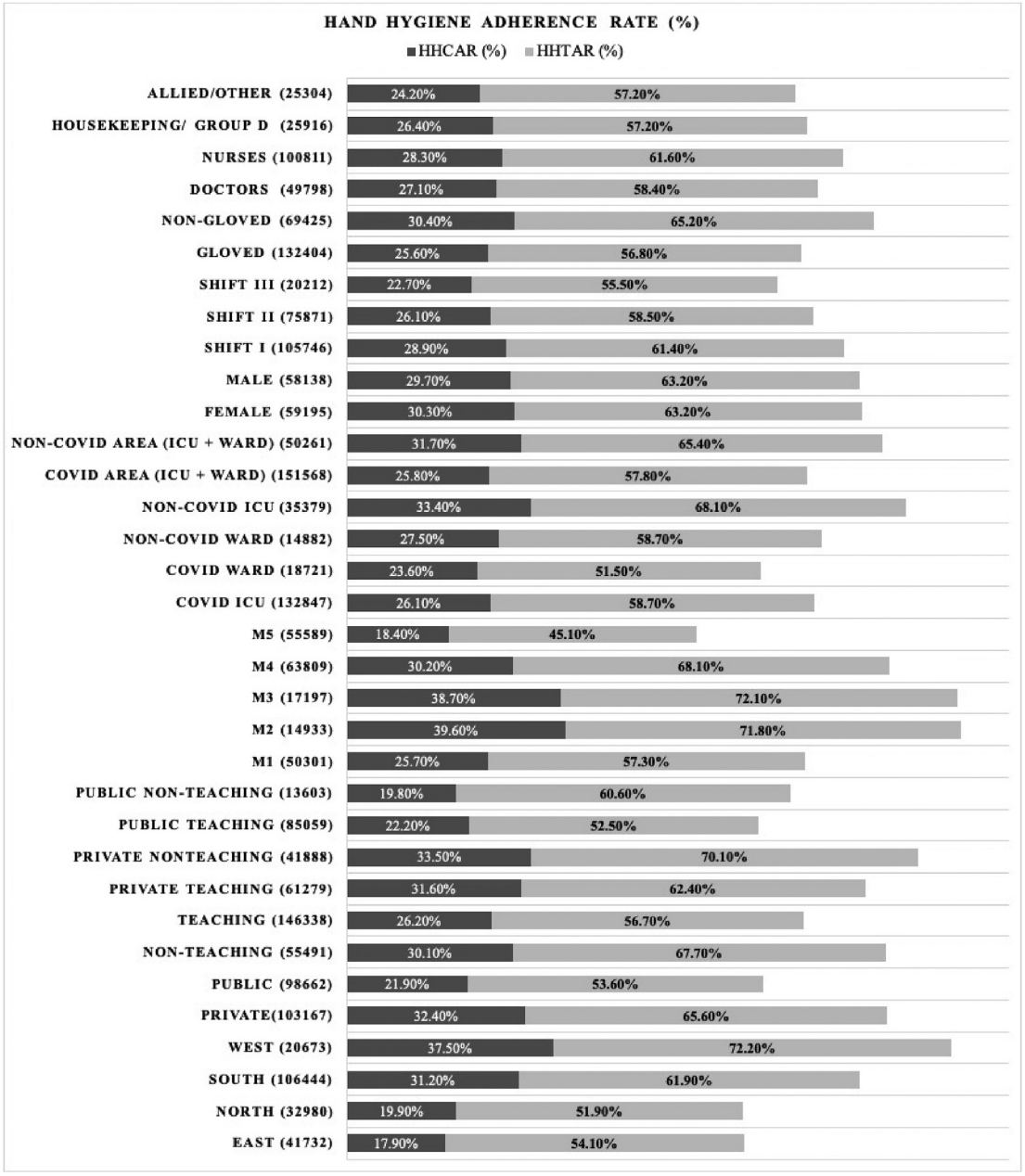


Fig. 1. HHCAR and HHTAR. HHCAR and HHTAR specific to zones, institute type, profession, WHO five hand hygiene moments, area, sex of HCW, working shift and gloves use.

The HHTAR was higher among doctors during the moment 1 (58.9%) and moment 2 (75.6%) than others; higher among nurses during the moment 3 (73.8%) and moment 4 (69.4%) than others; higher among housekeeping (47.7%) and OAS (47.8%) than others during moment 5. The HHTAR was lower among private non-teaching institutes during moment 3 than private teaching [Supplementary Table 3].

3.2.5. *Shift and sex specific compliance*

The compliance was higher among HCWs during the morning shift (HHCAR-28.9%, HHTAR- 61.4%) followed by afternoon shift (26.1%, 58.5%) and less during the night shift (22.7%, 55.5%). There was no difference noticed between male and female HCWs [Supplementary Table 1].

3.2.6. *Gloves specific compliance*

The compliance among the HCWs without gloves had better compliance (HHCAR-30.4%, HHTAR-65.2%) than those with gloves (25.6%, 56.8%) [Supplementary Table 1].

3.2.7. *Area specific compliance*

The HHTAR was higher (OR-1.37, $p < 0.05$) in non-COVID care areas (65.4%) than COVID care areas (57.8%); the compliance was significantly higher in non-COVID ICUs (68.1%; OR-2, $p < 0.05$) followed by COVID ICUs (58.7%), non-COVID wards (58.7%) and COVID wards (51.5%) [Supplementary Table 1].

3.3. *Hand hygiene compliance trend over 6 months*

The compliance increased among various profession and institute types from the onset of study to end of study (Fig. 2). The compliance (both HHCAR and HHTAR) was showing an increasing trend from month 1 of the study to month 6 of the study participation as well as from June

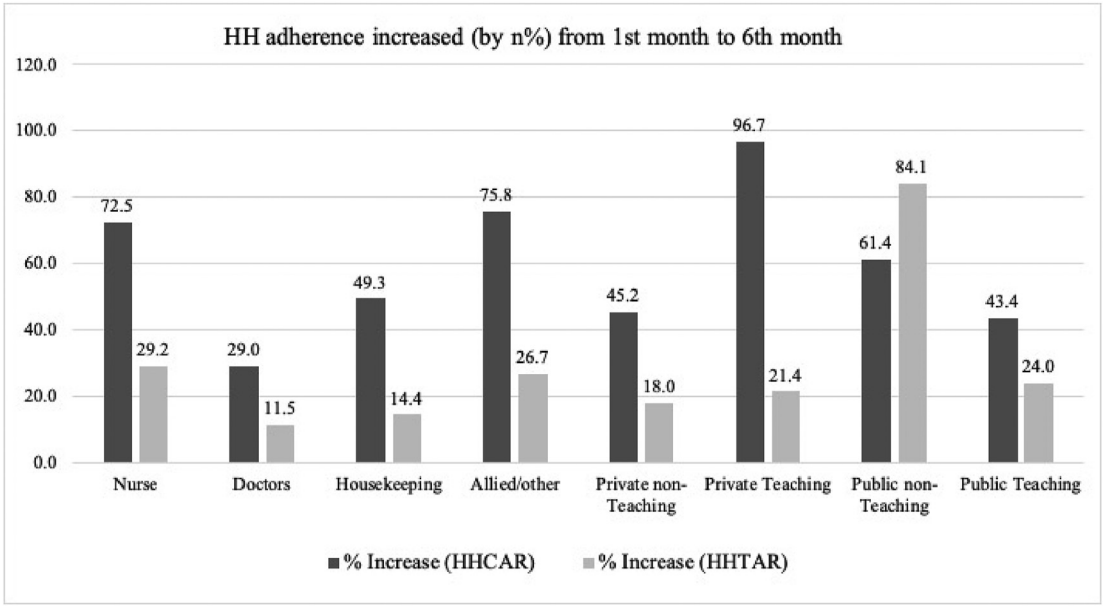


Fig. 2. Percentage increase in HH adherence. The percentage increase in HH adherence from 1st month of study to 6th month of study among various professions and different health care settings.

month to December month. In the month of December overall HHCAR dropped below 20% (Fig. 3).

4. Discussion

The hand hygiene non-adherence is one of the important contributing factors which accounts for the majority of multidrug-resistant organisms and fungi related outbreaks in various ICUs and wards during COVID-19 pandemic [12]. A total of 2,01,829 available opportunities were audited over 6 month in 92 centers all over India, which was the largest documented audit. A recent systematic review by Clancy et al. showed wide range of available HH opportunities (255-59,122) observed by direct method [13]. The overall national compliances from this study were 27.3% (HHCAR) and 59.7% (HHTAR). The study by Clancy et al. showed a wide range of baseline HH compliance (2%–88%) with mean compliance of 41% [14]. The baseline compliance of lower-middle and lower

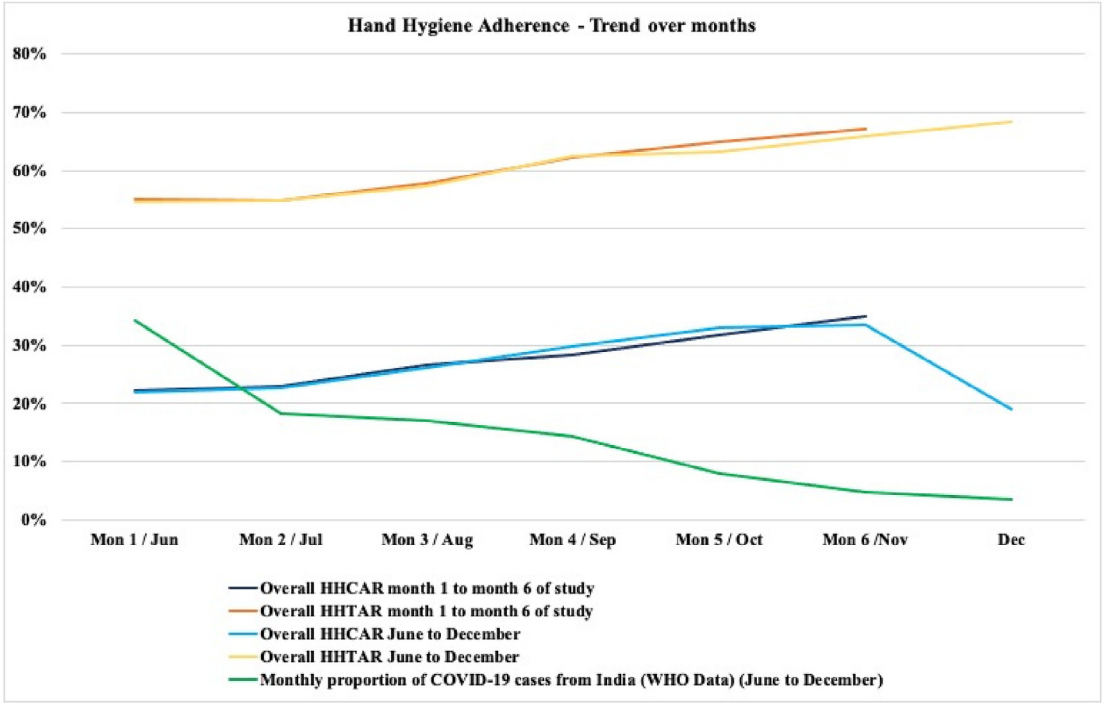


Fig. 3. Hand Hygiene Adherence (HHCAR and HHTAR) trend. Hand Hygiene Adherence (HHCAR and HHTAR) trend over Month 1 to month 6 of study in which all centers assigned according to their months of participation. The trend over July to December calculated by cross sectional HH data on these month specific data rather than institute specific data. Monthly proportions of COVID-19 cases from India were plotted over July to December based on data from WHO over these months.

income countries was 29% [14]. Another systematic review showed the HH compliance from COVID-19 pandemic increased to 74% compared to pre-COVID pandemic studies [15]. The above compliance rates are comparable with our study.

The west (37.5%) and south zones (31.2%) had higher compliances while east (19.9%) and north (17.9%) zones had lower compliances than the overall national compliance. The HHCAR and HHTAR in COVID-19 ICUs of public-teaching institutes from south zone were found to be 30.8% and 65.3% respectively [11]. The complete adherence in resource limited setting using WHO six-step hand rub technique is as poor as 0%–8.5% [16]. In our study, the less HHCAR could be explained by the overall partial adherence rate (32.5%) which was due to either less than recommended duration (<20 s) of HH (13.4%) or partial steps (<6 steps) (4.4%) or both (10.58%). The partial adherence was very poor than a study from a north Indian public-teaching institute where the adherence to steps and duration was 52.8% and 53.1% respectively [17].

The overall HHCAR was higher in private institutes than public institutes and non-teaching institutes than teaching institutes. There were no such studies during the COVID-19 pandemic comparing different HCFs in India as for our knowledge. A multicenter study from private non-teaching institutes in Norway, showed HH compliance of 58.3%; the HH decreased from 65.8% to 51.4% with wide variation among different wards (26.4%–83.1%) [18]. A multicenter study from India before COVID-19 pandemic showed higher compliance rate in private hospitals than academic hospitals (74.2% vs. 66.3%) [19]. The less compliance in public sectors could be explained by following factors: more COVID-19 cases admitted in public sector than private sectors, low HCWs to patient ratio, limited resources and alcohol based hand rub supply. The high compliance in non-teaching institutes possibly explained by their primary focus in patient care than academic activities. The private non-teaching had high compliance rate due to better infrastructure, manpower and resources and administrative support [19].

A recent systematic review shows that during the pandemic period, nurses had the highest compliance rate of 80% (95% CI, 74%–87%) and auxiliary HCW had the lowest compliance rate of 70% (95% CI, 62%–77%) [15]. The study from south zone showed profession-specific HHAR was found to be highest among doctors (67.5%) and nurses (66.4%) [11]. Majority of studies showed higher compliance in nurses while very few studies showed higher compliance among doctors. It is difficult to compare profession specific compliance, because of diverse HCFs, different HCWs under observation, especially HCWs other than nurses and doctors i.e. “other group” [14]. The higher compliance among nurses could be explained by relatively higher patient care activities than other HCWs, which leads to formation of habit of better HH practice while poor compliance among the housekeeping staff due to attitude, educational status, perception on HH and learning skill to practice the HH method [14,18].

The after moments HH adherence was better than before moments may be due to the of HCWs that they perform HH to protect themselves than the patients [18]. Constraints inherently associated with moment specific adherence concepts are the workload, multiple interventions in single patient care activity especially in acute care settings, lack of precise activities in those five moments and complexity in steps with hand rub and hand wash techniques with its duration [14,20]. But, often the concept of five moments are overlooked and misunderstood in various setting which hampers the implementation and compliance of HH related with all moments [21]. Proper implementation of the core elements of WHO's improvement strategy such as system change and reminders in workplace/communication will alleviate the issue related with moment specific compliance [21]. Overcrowding with shortage in HCWs in resource limited countries are another factor which influence the concept of patient zone and health care zone in implementation of WHO 5 moments of HH [16].

There was no significant difference observed among different shifts in HH compliance in the Norway study [18]. study showed more adherence during morning shift. The HH compliance was significantly lower when wearing gloves as compared to those with no glove use (41.3% vs 68.2%) during COVID-19 pandemic in Indonesian PICU [22]. The multicenter study from Norway shows lower compliance during gloved hands (35.3% vs 65.3%) [18]. The above studies are comparable with our study. Failure to remove gloves between patients and the use of hand rub over the gloved hands are associated with cross-contamination and outbreaks [12].

During peak in the COVID-19 wave, the compliance was better and over time from June to December the COVID-19 cases were decreasing in India (Fig. 3) and compliance also was decreasing. The study from the south zone showed a significant rise in HHTAR from 26.7% to 68.4% over months [11]. The majority of HCW completed their first dose of COVID vaccine in the initial phase of study and completed their vaccination schedule during the end of study. The decreased HHCAR and increased HHTAR in end of the study possibly explained by the change in of HCWs to adhere with all HH steps and recommended HH duration due to decline in fear over COVID-19 due to declined COVID-19 cases in India as well as vaccination against COVID-19 among the HCWs. The above possibilities were similar with the Norway study [18].

Studies have demonstrated that Group electronic monitoring significantly improve HH adherence rate [23,24]. A trial showing 3 step technique is equally effective in microbial load reduction with improved HH compliance compared to 6 step technique [25]. Our study shows better compliance when including both complete (all steps with recommended duration) and partial compliance (less than recommended steps and duration). There is a need for more such trials on the HH steps which are especially beneficial in improving compliance in developing countries where the high workload and short timespan for patient care influences the HH compliance. Our study has few limitations such as lack of data on device associated infection rate, volume of hand rub used, feedback from HCWs for the low compliance and multi-modal intervention-based evaluation.

5. Conclusions

The HHCAR was poor among all zones of India, irrespective of type of facility (private, public, teaching, non-teaching), type of HCWs (20–40% considered as poor), gender, shifts and COVID care vs non-COVID care areas. The hand hygiene adherence is poor when considering the complete steps and duration recommended by WHO but it is good when considering the partial adherence rate. The use of gloves during the pandemic and its influence over the HH adherence to be studied further. The HH adherence is increasing over time when continuous feedback is available but the sustainable adherence rate over long duration needs to be ensured by continuing the HH audit using multimodal interventions.

Credit author statement

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