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Original Research Article

Uncovering trends in hand hygiene compliance: A multi-stratification analysis from a tertiary care centre

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Abstract

Background: Hand hygiene [HH] is the single most, least expensive preventive measure of HAI emphasized by World Health Organisation [WHO] towards patient safety, which is neglected many a time due to lack of awareness, knowledge and resources. Improving HH compliance and monitoring the adherence rates play an important role in infection prevention. Stratified trend analysis of hand hygiene compliance helps in implementation of targeted interventions.
Materials and Methods: This prospective observational study was conducted for 5 years involving 17 high risk areas by trained observers. Android application was used to collect the data on hand hygiene adherence, both complete and partial. Detailed trend analysis of profession, location and moment specific compliance was performed to identify specific patterns and areas for improvement.
Results: 1,62,278 hand hygiene opportunities were recorded during the entire study period, with maximum moments recorded in surgical speciality [50.6%]. Paediatric speciality demonstrated maximum compliance throughout the entire study period. Nurses were more compliant to complete hand hygiene adherence through the entire study period though increasing trend of compliance was seen among all professions. Moment 3 had been maximally followed with a notable upward trend in all 5 moments.
Conclusion: To conclude, hand hygiene is a basic yet powerful practice that promotes safety for both patients and healthcare workers at minimal cost. Conducting a stratified trend analysis of hand hygiene audit data is crucial for identifying specific areas of improvement and informing targeted interventions to address gaps in compliance to strengthen infection prevention.

Keywords: Hand hygiene, Trend, Adherence rate, Moments, Compliance.

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1. Introduction

The prevalence of healthcare-associated infections (HAIs) in healthcare settings is alarming, as they result in substantial patient harm, increased healthcare expenditures, and prolonged hospital stays, making their prevention a critical priority, especially given that many HAIs are avoidable with evidence-based practices and rigorous infection control measures. Emergence of multi drug resistant pathogens with fewer antibiotic reserve, demands re-looking into infection control practices to contain the spread of the resistant organisms. Hand hygiene [HH] is the single most, undisputed and least expensive preventive measure of HAI emphasized by World Health Organisation [WHO] towards patient safety, which is neglected many a time due to lack of awareness, knowledge and resources.[1,2]

Enhancing hand hygiene compliance is a crucial strategy to get rid of transient flora and mitigate the spread of multidrug-resistant organisms.[3,4] The compliance to hand hygiene can be improved by continuous educational interventions, displaying posters in hand hygiene area, routine auditing in high-risk areas and regular feedbacks to modify the factors related to noncompliance.[5,6] Though there are several methods of monitoring the compliance to hand

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hygiene, direct observation is considered the gold standard by WHO as all occurring hand hygiene opportunities can be recorded and location, moment and profession specific compliance data can be generated in addition to identifying complete or partial adherence.[7]

Stratifying hand hygiene compliance data by location, moment, and professional category provides a nuanced understanding of the strengths and weaknesses in hand hygiene knowledge, attitude, and practice among specific groups, thereby facilitating precision-focused initiatives to address gaps and optimise hand hygiene compliance. Ongoing surveillance of hand hygiene compliance over an extended period can provide valuable insights into adherence trends, allowing for a direct comparison with device-associated infection rates and informing strategies to optimize hand hygiene practices and reduce infection rates.[8]

Mobile-based applications revolutionize data collection by providing a hassle-free, accurate, and efficient alternative to manual methods, enabling robust long-term data storage and insightful trend analysis capabilities. Set against the context of hand hygiene's critical importance, this study was conducted at a public sector healthcare facility in South India, with a concentrated emphasis on compliance with the WHO's evidence-based 'Five Moments of Hand Hygiene' framework through conducting audit using a mobile-based application.

2. Materials and Methods

2.1. Setting

This prospective observational study was conducted over a period of five years [2019- 2023] in a tertiary care teaching hospital in South India. 17 high risk areas of the hospital including 14 intensive care units, 1 dialysis unit and two labour rooms were targeted where the hand hygiene audit was performed by trained observers [infection control nurses] posted in hospital infection control and prevention unit of the facility. The study encompassed all healthcare workers, including doctors, nurses, group D staff and other HCWs [ECG/ X-ray /Dialysis technician], working in the designated target locations during the specified study period.

The infection control nurses were certified as trained observer by providing prior training of HH audit by direct observation using simulated ICU scenarios for HH. Measures were taken to minimize the confounding factors and bias including scheduling audits at random time-points to eliminate the confounding influence of work pressure on HH compliance, blinded audits by conducting HH audit along with other infection control activities to reduce the Hawthorne effect and rotational posting of auditors in the targeted locations to reduce the confirmation bias. Inter-observer bias was eliminated by providing prior training of the observers.

Apart from real time feedback, multiple interventions were implemented to improve HH compliance, including, orientation programs for interns, biannual educational sessions for doctors, monthly educational sessions for nurses and support staff, visual reminders through posters highlighting hand hygiene steps and key moments, ensuring consistent availability of hand hygiene products, regular meetings of the Hospital Infection Control Committee and sharing monthly compliance data and also recognizing and rewarding top-performing locations with a rolling trophy.

2.2. Data collection

Android application [JIPMER–Ibhar hand hygiene audit software] was used to collect the data on hand hygiene adherence, both complete and partial specific to profession, location and moments. Complete hand hygiene adherence requires performing hand rub or wash for the full recommended duration, following all the prescribed steps. Any deviation from this standard, such as skipping steps or abbreviating the duration, constitutes partial adherence. Hand hygiene complete adherence rate [HHCAR] and HH partial adherence rate [HHPAR] were calculated using standardised formula provided by WHO.[7]

Following the calculation of Hand Hygiene compliance rate, a detailed trend analysis over 5 years was conducted, segmented by location, profession, and moment, to identify specific patterns and areas for improvement. As per WHO only complete adherence rate is considered significant as partial adherence has no role in infection prevention. Therefore, partial adherence data was excluded from this specific analysis.

2.3. Statistical analysis

All the data sets were entered into MS Excel and inferential statistical analysis was done using SPSS Software version 29. Odds ratio and P value was calculated. P Value <0.05 typically indicates that the results are statistically significant.

3. Results

A total of 17 high risk areas which comprised 4 medical, 10 surgical sand 3 paediatric subspecialities were targeted for hand hygiene surveillance for a period of 5 consecutive years [2019-23]. 1,62,278 hand hygiene opportunities were recorded during the entire study period. The surgical units presented the greatest number of hand hygiene opportunities [82142, 50.6%], whereas the paediatric units demonstrated the highest level of hand hygiene adherence [HH total adherence rate- 89.16%], showcasing exemplary compliance.

Figure 1 illustrates the overall trend of complete, partial and total HH compliance. HHCAR went up significantly from 24.1% to 57.7% [$p \leq 0.05$] by the end of the study whereas HHPAR decreased to 23% from 39.3% in the initial phase of the study. **Figure 2** demonstrates the trend analysis of specific specialities. All the specialities showed a significant improvement in HH compliance over years while maximum compliance was seen with paediatric speciality all

through the study [35% in 2019 to 74.9% in 2023]. Trend analysis of each subspeciality is presented in **Table 1**. All medical, surgical and paediatric subspecialities showed significant improvement in HHCAR except for medical ICU which showed decline in HHCAR from 54% to 43.7%.

Profession specific trend analysis is represented in **Figure 3**. Throughout the entire study period, the nursing staff consistently demonstrated the highest level of hand hygiene compliance. 2023 marked a significant improvement in hand hygiene practices among doctors, with a peak compliance rate of 49.1%. Group D workers achieved highest compliance in 2022 [49.2%] with a slight decrease in 2023[47.6%]. Other group of health care workers including dialysis/ECG technician also showed maximum compliance in 2023[51.9%]. The moment-specific hand hygiene trend analysis is depicted in **Figure 4**, providing a detailed snapshot of compliance patterns to WHO 5 moments of hand hygiene. Remarkable increase in hand hygiene adherence was seen for all the moments over time. Moment 3 was the maximum followed moment in all the 5years.

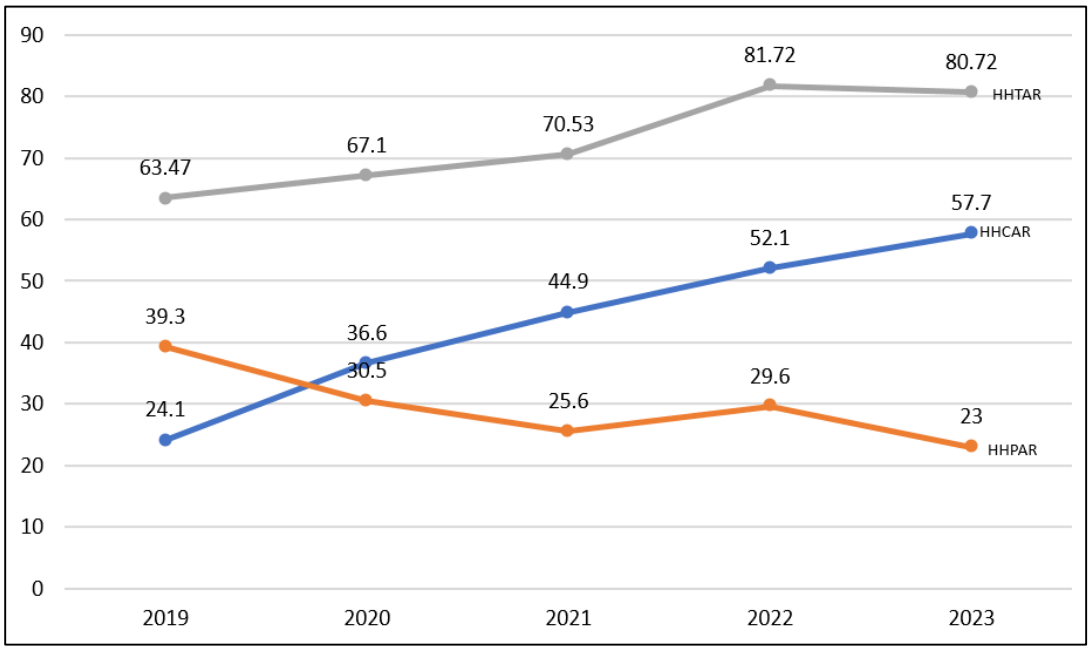

Figure 1: HHCAR HHPAR and HHTAR trend analysis

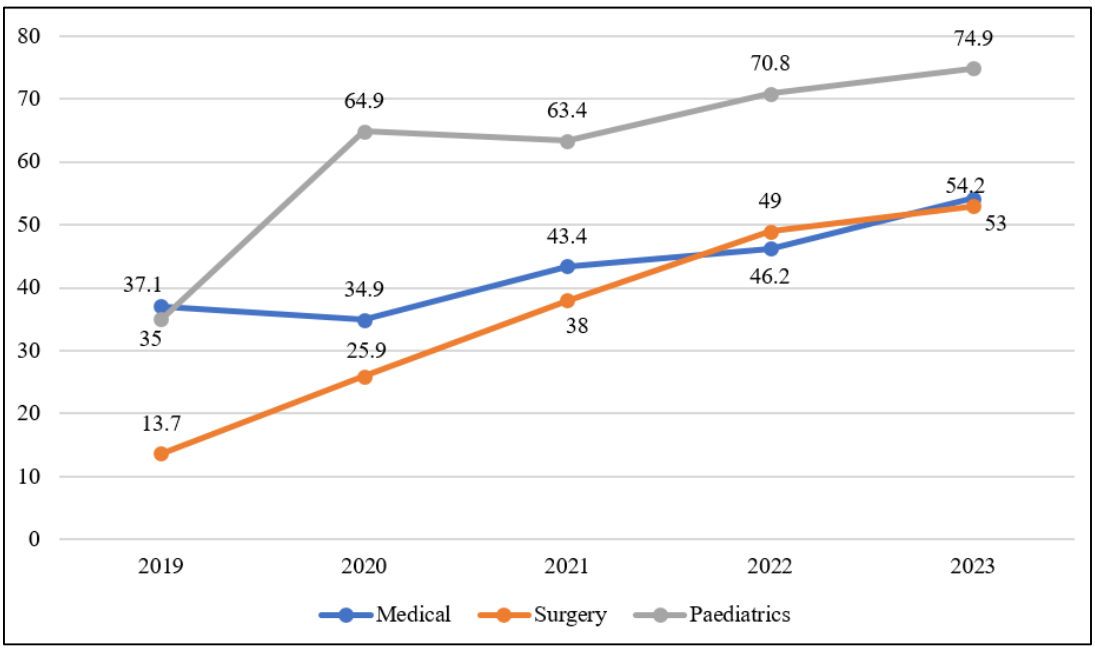

Figure 2: Trend analysis of speciality specific HHCAR

Table 1: Trend analysis of location specific HH compliance HHCAR

Year		2019	2020	2021	2022	2023
Medical		HHCAR% (n/N)				
	Medicine ICU	54.0 (623/1154)	30.9 (527/1705)	38.5 (1116/2899)	46.6 (1565/3358)	43.7 (1783/4082)
	Neuromedicine ICU	33.9 (336/989)	58.5 (558/954)	55.8 (818/1467)	52.2 (1297/2484)	54.8 (1999/3650)
	Dialysis unit	21.9 (191/873)	14.5 (116/802)	34.1 (674/1977)	39.5 (1332/3376)	61.0 (2204/3615)
	Medical Oncology ICU	31.3 (100/320)	36.7 (170/463)	49.3 (1208/2451)	49.1 (1180/2404)	59.9 (1801/3009)
Surgical		HHCAR% (n/N)				
	CTVS ICU	19.6 (178/909)	39.1 (360/921)	39.8 (946/2374)	46.7 (1561/3345)	56.6 (1971/3485)
	Critical care ICU	14.2 (142/1002)	13.2 (153/1157)	34.1 (1092/3207)	36.6 (1126/3077)	50.6 (2163/4273)
	Neurosurgery ICU	14.3 (53/370)	29.6 (170/575)	55.5 (1257/2264)	65.0 (1926/2961)	60.6 (2133/3522)
	Obstetrics ICU	17.3 (64/370)	57.4 (85/148)	39.6 (846/2136)	44.6 (682/1529)	59.5 (337/566)
	Surgery ICU	13.8 (125/904)	34.9 (543/1558)	37.6 (1000/2661)	39.8 (1148/2886)	39.8 (1296/3257)
	Surgical gastroenterology ICU	22.4 (85/379)	10.4 (53/510)	40.1 (702/1752)	34.8 (854/2453)	44.0 (1499/3404)
	Trauma care ICU	30.2 (232/768)	42.9 (457/1066)	48.9 (1071/2191)	52.1 (1066/2048)	54.5 (1512/2776)
	Plastic surgery ICU	20.2 (101/500)	23.24 (132/568)	32.9 (165/501)	47.5 (881/1854)	43.3 (1483/3428)
	Clean labour room	8.8 (134/1519)	15.1 (258/1704)	14.5 (315/2179)	54.6 (1937/3547)	62.3 (2429/3898)
	Septic labour room	9.1 (100/1100)	10.2 (127/1245)	22.6 (287/1271)	51.3 (1211/2361)	62.5 (1487/2379)
Pediatric		HHCAR% (n/N)				
	Neonatal ICU (medical)	45.3 (430/949)	69.5 (1631/2347)	64.3 (2207/3431)	76.4 (2628/3442)	81.8 (3667/4482)
	Pediatric ICU (medical)	26.8 (229/855)	66.2 (947/1431)	62.2 (2260/3632)	75.9 (3100/4086)	79.3 (3607/4547)
	Pediatric surgery ICU	32.4 (346/1069)	37.0 (168/454)	63.9 (1296/2029)	54.5 (1331/2443)	57.5 (1671/2907)

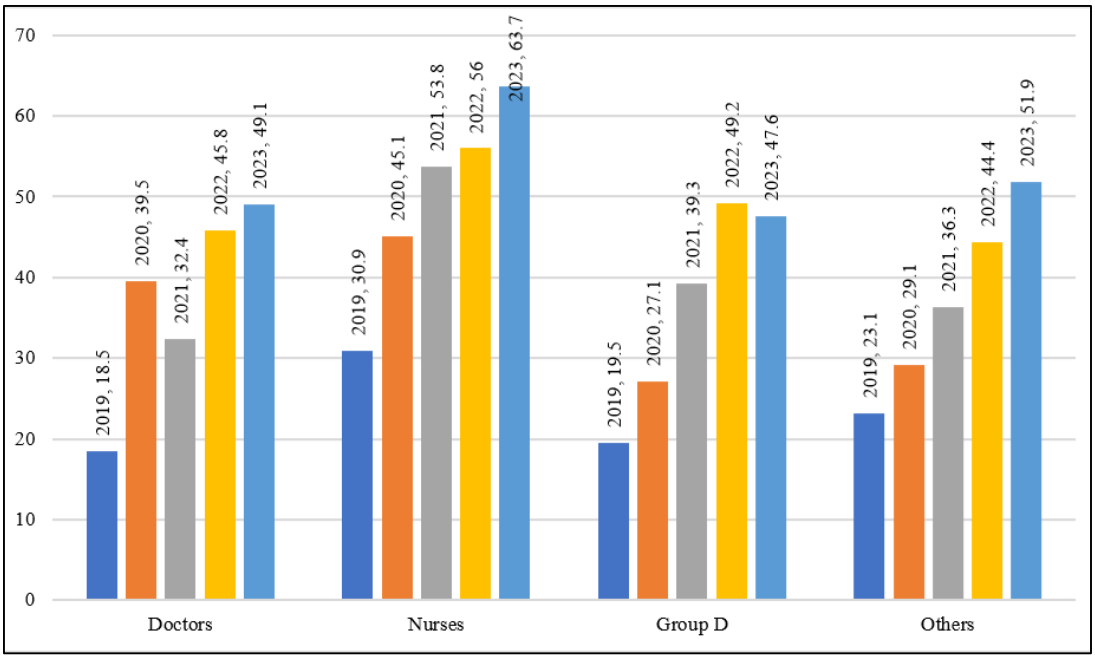

Figure 3: Trend analysis of profession specific HHCAR

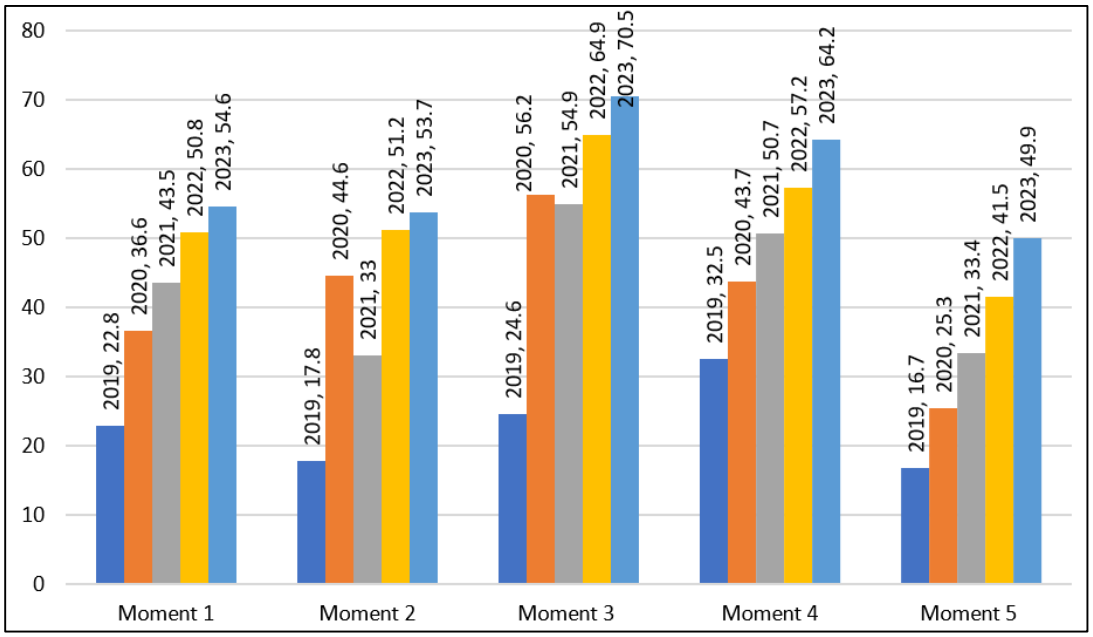

Figure 4: Trend analysis of moment specific HHCAR

4. Discussion

Over a century and a half ago, Semmelweis identified hand hygiene as a critical factor in preventing the transmission of infections, a groundbreaking insight that remains a cornerstone of healthcare practice till date.[1,4,9] Marking a significant milestone in infection control, the CDC introduced the inaugural hand hygiene guidelines in 1975, providing a foundational framework for healthcare facilities nationwide that have since been widely adopted and refined.[10]

Hand hygiene compliance is a crucial and proven strategy for reducing the risk of hospital-associated infections, ensuring the well-being of patients and healthcare workers alike.[11] Compliance to hand hygiene can be measured by various methods including direct observation, measuring product use, conducting surveys, etc. We employed prolonged direct observation for five years to evaluate the impact of consistent monitoring on hand hygiene compliance, enabling us to determine its effectiveness in driving behavioural change.

Initially, all three hand hygiene rates were suboptimal, but as the study continued, a notable enhancement was observed in the complete adherence rate, indicating progressive improvement in hand hygiene practices. Partial adherence rate has declined over years with increase in

complete adherence rate. (**Figure 1**). This clearly indicates that continuous monitoring with real time feedback has a consistent effect in adherence to hand hygiene practices. This result is similar to that of the study conducted by Webster et al where they have used audible alert to increase hand hygiene compliance.[12]

Overall HHCAR was higher with paediatric speciality compared with medical and surgical specialities. All the medical subspecialities showed increase in HHCAR except medicine ICU which showed increase in HHPAR. This deviation may be attributed to the dynamic environment of the Medicine ICU, characterised by frequent staff rotations and high-acuity procedures, which can pose challenges to maintaining optimal hand hygiene practices.

Increasing trend of HHCAR was observed in all surgical subspecialties with mild fluctuations in neurosurgery ICU, obstetrics ICU and surgical gastroenterology ICU. Marked increase in HHCAR was seen in clean and septic labour room which is attributed to the fact that continuous educational sessions and onsite feedback has significant impact in bringing about behavioural change overtime. This is similar to previous studies in literature.[13-15] Phan et al. conducted a multi-faceted educational approach to promote hand hygiene, incorporating various interventions such as 10-min video outlining the reasons for hand hygiene, role-playing game, small group discussion to determine the 5 moments of hand hygiene and lecture about the efficacy of alcohol-based hand-rub to drive behavioural change and significant improvement in hand hygiene compliance was observed from 43.6 to 63%.[14]

Within the paediatric subspecialty, a notable upward trend in HHCAR was observed, and remarkably, the NICU maintained the highest level of hand hygiene compliance throughout the entire study duration. This implies the dedication and commitment of the healthcare workers of all cadre in neonatal ICU. Consistent with our findings, Phan et al. and Lam BC et al observed high hand hygiene adherence from the beginning of their study, highlighting a shared trend in successful hand hygiene practices.[14,16]

In profession specific HHCAR trend analysis, our findings showed that nurses outperformed other healthcare professionals in hand hygiene compliance consistently, highlighting their dedication to upholding hand hygiene standards. Our study findings align with various other studies where nursing professionals had higher hand hygiene compliance than other health care workers. [17-22] This finding was discordant in few other studies where nurses showed better hand hygiene compliance. Only next to allied professionals.[23,24] The discordant results of these studies could be a consequence of methodological limitations, specifically the small sample size and short duration of only 24 hours, which may not be representative of typical hand hygiene practices. Relatively low hand hygiene compliance among doctors was seen throughout the study, but with a positive upward trend over the years. This comparatively low hand hygiene compliance among doctors is of particular concern, as they perform more invasive procedures facilitating the transmission of infection easier and their influence can shape the attitudes and practices of junior healthcare workers. Therefore, tailored educational programs are crucial for enhancing hand hygiene (HH) compliance, and their impact cannot be overstated.

Further analysis of our data revealed that hand hygiene compliance was highest during the 'after procedure' moment, surpassing all other WHO 5 Moments for Hand Hygiene. Similar findings were seen in various studies from Indian setting.[19,23,25] The reason for this could be HCWs' perception of higher infection risk from patients' bodily fluids driving them towards diligent hand hygiene practices. Before moments [Moment 1, 2] had comparatively lower compliance though the trend seems increasing. Studies in literature shows similar findings of lower compliance to before moments.[19,25] This clearly states the deficit in knowledge and attitude towards before moments and more focussed educational sessions are required to facilitate compliance to moment 1 and 2 demanding the need to curtail the spread of infections from health care workers to patients.

Our study's limitations include the lack of correlation between hospital-acquired infection rates and hand hygiene adherence rates. Thus, the study couldn't confirm the role of hand hygiene compliance in reducing HAIs

5. Conclusion

To conclude, hand hygiene is a basic yet powerful practice that promotes safety for both patients and healthcare workers at minimal cost. Additional interventions are necessary to improve hand hygiene compliance among doctors as they can lead the entire team of HCWs and more focused action is required to enhance the compliance of before moments, neglect of which can lead to disastrous consequences.

6. Source of Funding

None.

7. Conflict of Interest

None.

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