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Audit

Improving Adherence to WHO Surgical Hand Preparation Guidelines in Elective Operating Theatres of a Teaching Hospital in Gujrat, Pakistan: A Completed Audit Cycle

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Abstract: *Surgical hand preparation is a core infection prevention practice for reducing surgical site infection risk. This audit assessed adherence to World Health Organization (WHO) recommended surgical hand preparation steps and evaluated the effect of a structured improvement package.* ***Methods:*** *A prospective observational audit was conducted in the elective operating rooms of Aziz Bhatti Shaheed Teaching Hospital, Gujrat, Pakistan. A 16-item checklist adapted from WHO guidance covered pre-scrub preparation, hand and forearm washing, rinsing, drying, and final aseptic steps. Compliance was calculated as the percentage of checklist items correctly performed per scrubbing episode. After baseline observation (pre-intervention), corrective measures were implemented (targeted training, visual reminders, and distribution of a standard operating protocol), and a re-audit was performed.* ***Results:*** *A total of 85 surgical hand preparation episodes were observed at baseline and 85 at re-audit across surgery, orthopaedics, and neurosurgery teams. Overall mean compliance improved from 56.9% (SD 11.9) pre-intervention to 89.2% (SD 8.7) post-intervention, an absolute increase of 32.3 percentage points. At baseline, 0% achieved at least 94% compliance (>=15 of 16 items); post-intervention, 47.1% achieved this threshold, and 20.0% completed 100% compliance.* ***Conclusion:*** *Baseline adherence to WHO surgical hand preparation steps was suboptimal. A simple, low-cost quality improvement package was associated with marked improvement across roles and specialties. Ongoing education, supervision, and periodic re-audits are recommended to sustain gains.*

Keywords: Surgical Hand Preparation; Hand Hygiene; Operating Theatre; Clinical Audit; WHO Guidelines; Pakistan

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Introduction

Proper hand hygiene is a fundamental aspect of infection control in surgical environments, particularly in elective operating theaters where the risk of surgical site infections (SSIs) is heightened. The World Health Organization (WHO) has established comprehensive guidelines that emphasize the importance of hand hygiene, particularly the "Five Moments for Hand Hygiene," which serve as critical checkpoints for healthcare workers (1). However, adherence to these guidelines among healthcare providers across settings, especially in low- and middle-income countries such as Pakistan, remains inconsistent. A review by Ahmed et al. highlights significant gaps in knowledge and practices regarding hand hygiene among healthcare workers, underscoring the need for systematic improvements in this domain (1).

The present audit cycle aims to assess and enhance adherence to WHO surgical hand preparation guidelines within the elective operating theaters of a teaching hospital in Gujrat, Pakistan. Clinical audits are instrumental in driving quality improvement initiatives by evaluating compliance with established protocols and providing feedback through a structured process (2). The repeated application of such audits, as evidenced in other healthcare settings, can significantly uplift compliance rates, thereby improving patient outcomes and reducing postoperative complications (3).

Despite WHO recommendations and the evident need for strict adherence to hand hygiene protocols, challenges persist in implementation. Research has shown that regions with limited resources often have lower compliance with surgical safety measures, underscoring the need for targeted interventions in these areas (4). Similar audits highlight the effectiveness of structured training and protocol reinforcement in achieving notable enhancements in compliance (5). Thus, conducting this audit cycle is crucial not only to address current adherence issues but also to foster a culture of safety and accountability in surgical practices.

Thus, this audit cycle will provide valuable insights into current adherence to WHO surgical hand preparation guidelines within a teaching hospital and will delineate strategies for improvement, thereby making a significant contribution to patient safety and infection control in surgical practice.

The audit standard was 100% compliance with the WHO-recommended surgical hand preparation steps for each observed scrubbing episode. Compliance was assessed using a 16-item checklist adapted from WHO recommendations across the following domains: removal of jewellery and nail preparation, appropriate use of antimicrobial product and scrub duration, systematic coverage of all hand and forearm surfaces, correct rinsing direction and avoidance of contact with sink surfaces, sterile drying technique, and avoidance of recontamination prior to donning gloves.

Methodology

This prospective observational audit was undertaken as a quality improvement initiative to evaluate adherence to the World Health Organization (WHO) surgical hand preparation guidelines and to assess the effect of a targeted improvement strategy. The audit was conducted in the elective operating rooms of Aziz Bhatti Shaheed Teaching Hospital, Gujrat, Pakistan, encompassing general surgery, orthopaedics, and neurosurgery theatres. The local context included a high-volume elective surgical workload with routine preoperative hand preparation performed at designated scrub areas. The audit followed a two-cycle design consisting of a baseline measurement phase and a post-intervention re-

measurement phase, consistent with SQUIRE 2.0 recommendations for assessing change over time.

The participants comprised members of the multidisciplinary surgical team involved in elective surgical procedures during the audit period, including consultants, postgraduate residents, interns or house officers, and operating theatre staff. All individuals performing surgical hand preparation before elective cases were eligible for observation. Emergency procedures were excluded because of the potential impact of urgency on hand-preparation practices. Additionally, scrubbing episodes that were interrupted or incomplete were excluded to maintain consistency in measurement and to reduce variability unrelated to routine practice.

The audit process involved direct, non-participatory observation of surgical hand preparation using a standardized WHO checklist comprising 16 items that represent key steps of the recommended technique. Observations were conducted by a trained observer who was familiar with the WHO guidelines and the audit protocol. Each checklist item was recorded dichotomously as correctly performed or not performed during a single scrubbing episode. The observer did not provide real-time feedback during observations to avoid influencing behavior. All observations were anonymized using coded identifiers for staff members, and no patient identifiers were recorded, ensuring confidentiality and minimizing potential ethical concerns.

Following completion of the baseline measurement, a multifaceted improvement intervention was implemented to address identified gaps in compliance. This intervention included structured educational sessions focused on correct surgical hand preparation technique, duration, and sequence in accordance with WHO recommendations. Visual reminder posters illustrating hand-preparation steps were placed at scrub stations in all participating theatres to reinforce best practices at the point of care. In addition, a concise standard operating protocol was distributed to surgical and theatre staff to standardize expectations and promote consistent practice. Sufficient time was allowed after implementation to enable integration of the intervention into routine clinical workflows prior to the re-audit phase.

The study of the intervention focused on changes in compliance with the WHO checklist between the pre- and post-intervention phases. For each observed scrubbing episode, a compliance score was calculated as the number of correctly performed checklist items divided by the total number of items, multiplied by 100 to generate a percentage score. Compliance was analyzed at the episode level and stratified by professional role and surgical specialty to explore variation across groups. Descriptive statistical methods were used to summarize the data, including calculation of mean, standard deviation, median, and range. Absolute differences in compliance across audit cycles were calculated to quantify the intervention's improvement. This audit was conducted as part of routine quality improvement activities, with no alteration to patient care pathways and no collection of patient-specific data. The findings were reported in accordance with the SQUIRE 2.0 guidelines to ensure transparency, reproducibility, and relevance for quality improvement in surgical practice.

Results

Baseline, compliance was suboptimal across all professional categories, with the lowest mean score observed among interns and house officers (52.3% ± 10.3) and OT staff (53.4% ± 12.2). Following the intervention, marked improvements were observed across all roles. Consultants achieved the highest post-intervention compliance (92.9% ± 6.6), followed closely by postgraduate residents (92.0% ± 6.3). The greatest absolute improvement was noted among OT staff (34.6 percentage points) and interns/house officers (34.0 percentage points), indicating a substantial impact of targeted education and standardization measures across junior and support staff. (Table 1)

Table 2 summarizes compliance according to surgical specialty. Pre-intervention compliance was lowest in general surgery (54.9% ± 11.3) and highest in orthopedics (60.8% ± 12.5). After implementation of the intervention bundle, all specialties demonstrated significant improvement in mean compliance scores. Neurosurgery showed the greatest absolute increase (35.1 percentage points), achieving the highest post-intervention mean compliance (92.5% ± 5.7). Overall compliance improved from 56.9% ± 11.9 to 89.2% ± 8.7, reflecting a substantial increase in adherence to WHO hand-preparation standards across departments. (Figure 1)

Table 3 shows the proportion of observed scrubbing episodes that meet predefined compliance thresholds before and after the intervention. No episodes achieved ≥94% or 100% compliance during the pre-intervention phase. Post-intervention, nearly half of the observations (47.1%) met the ≥94% threshold, and one-fifth (20.0%) achieved complete adherence to all checklist items. Furthermore, the proportion of episodes achieving at least 80% compliance increased dramatically from 2.4% to 91.8%, demonstrating a clinically meaningful and sustained improvement in surgical hand preparation practices following the audit cycle.

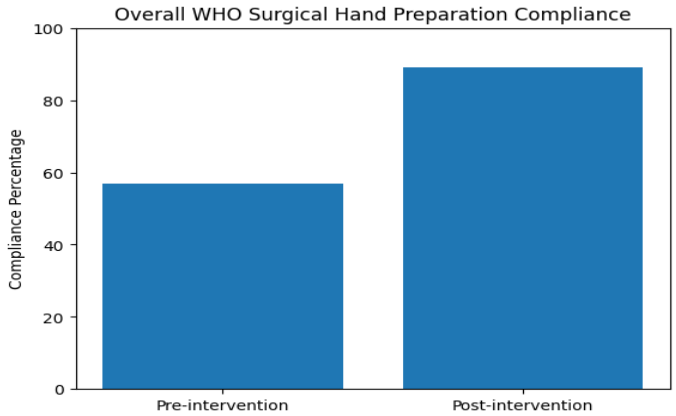

Figure 1. Overall, WHO Surgical Hand Preparation Compliance.

Table 1: Compliance with surgical hand preparation checklist by role (pre-intervention vs post-intervention)

Role	n (pre/post)	Pre mean (SD), %	Post mean (SD), %	Absolute change, pp
Consultant	16/16	65.2 (10.5)	92.9 (6.6)	27.8
PGR	22/22	60.2 (11.9)	92.0 (6.3)	31.8
Interns/HO	38/38	52.3 (10.3)	86.3 (9.7)	34.0
OT Staff	9/9	53.4 (12.2)	88.0 (8.6)	34.6

Table 2: Compliance with surgical hand preparation checklist by specialty (pre-intervention vs post-intervention)

Specialty	n (pre/post)	Pre mean (SD), %	Post mean (SD), %	Absolute change, pp
Surgery	50/50	54.9 (11.3)	87.8 (9.5)	32.9
Ortho	24/24	60.8 (12.5)	90.8 (7.5)	30.0
Neuro	11/11	57.4 (12.5)	92.5 (5.7)	35.1
Overall	85/85	56.9 (11.9)	89.2 (8.7)	32.3

Table 3: Episodes meeting pre-specified compliance thresholds

Threshold	Pre, n (%)	Post, n (%)
>=94% (>=15/16 items)	0 (0.0%)	40 (47.1%)
100% (16/16 items)	0 (0.0%)	17 (20.0%)
>=80%	2 (2.4%)	78 (91.8%)

Discussion

The results of the audit cycle demonstrate a significant improvement in compliance with the WHO surgical hand preparation guidelines across all professional categories following targeted interventions. The baseline compliance rates were notably low, with interns and house officers achieving an average of only 52.3% ± 10.3 and operating theatre (OT) staff at 53.4% ± 12.2. However, post-intervention compliance markedly improved, especially among consultants and postgraduate residents who scored 92.9% ± 6.6 and 92.0% ± 6.3, respectively. The most notable gains were observed in OT staff compliance (34.6 percentage points) and interns/house officers (34.0 percentage points). These findings align with previous studies indicating that structured educational initiatives can lead to significant increases in compliance rates among junior and support staff in surgical settings (6, 7).

Furthermore, the audit data reveal that compliance varied by surgical specialty before intervention, with general surgery at the bottom of the compliance spectrum (54.9% ± 11.3) and orthopedics on top (60.8% ± 12.5). Following the implementation of the intervention bundle, there was a marked uplift across all specialties, with neurosurgery demonstrating the greatest absolute increase in compliance (35.1 percentage points), culminating in a post-intervention score of 92.5% ± 5.7. A comprehensive audit cycle conducted by Sinha and Kadam corroborates the notion that intensive training and standardized protocols yield better compliance with surgical checklists and hand hygiene practices (8,9).

The analysis also highlights a substantial increase in the proportion of observed scrubbing episodes meeting the predefined compliance thresholds. Prior to the intervention, no episodes met the ≥94% or 100% compliance thresholds; yet post-intervention, 47.1% of observations achieved at least 94% compliance, and 20% reached complete adherence to checklist items. This is consistent with findings from studies in which focused interventions improved hand hygiene practices, suggesting that integrating practical demonstrations and continual monitoring can foster a sustainable culture of compliance within surgical teams (6, 10).

Additionally, the improvement in the percentage of episodes achieving at least 80% compliance, from 2.4% pre-intervention to 91.8% post-intervention, is indicative of a clinically meaningful change in surgical hand preparation practices. These findings reflect an upward trend toward meeting WHO's stringent hand hygiene standards, which are crucial for minimizing surgical site infection risk and enhancing overall patient safety (11, 7).

In conclusion, the current audit cycle provides compelling evidence of the effectiveness of educational interventions and standardized practices in improving adherence to WHO surgical hand preparation guidelines. The marked enhancement in compliance metrics not only contributes to safer surgical outcomes but also underscores the importance of ongoing monitoring and reinforcement of hygienic practices in hospitals. Future audit cycles, complemented by ongoing training initiatives, could further embed these practices into the surgical department's culture.

Action plan and recommendations

1. Sustain training: Integrate WHO surgical hand preparation training into staff induction and provide quarterly refresher sessions.
2. Visual aids: Maintain posters at each scrub station and update if damaged.
3. Supervision and feedback: Assign senior theatre staff to provide real-time feedback, particularly for new trainees.
4. Supplies and infrastructure: Ensure uninterrupted availability of antimicrobial products, nail cleaners, and sterile towels; maintain functional taps and sinks.
5. Monitoring: Conduct monthly spot checks and repeat a full re-audit every 3-6 months to confirm sustained compliance.

Limitations

First, observation may have influenced behaviour (Hawthorne effect). Second, this audit measured process compliance and did not link outcomes to surgical site infection rates. Third, compliance was summarised as an overall percentage per episode; item-level adherence was not analysed separately, limiting the ability to pinpoint the most frequently missed steps.

Conclusion

Baseline adherence to WHO-recommended surgical hand preparation steps in elective theatres was suboptimal. A structured package of training, reminders, and a standard operating protocol was associated with a marked improvement in compliance across roles and specialties. Regular reinforcement and periodic re-audits are recommended to sustain and further improve performance.

Declarations

Data Availability statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned.

Consent for publication

Approved

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Conflict of interest

The authors declared no conflict of interest.

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All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the study's integrity.

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