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EVALUATION OF HAND HYGIENE COMPLIANCE AMONG BACHELOR OF DENTAL SURGERY STUDENTS DURING CLINICAL PATIENT ROTATIONS

Original Article

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Short Title: Hand Hygiene Compliance Among Dental Students

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Abstract

Background: Hand hygiene is a cornerstone of infection prevention, yet compliance among healthcare trainees often falls below recommended standards. Dental students, who are frequently exposed to blood, saliva, and aerosolized particles, represent a critical population for evaluating adherence to infection control practices.

Objective: To assess the level of hand hygiene compliance among Bachelor of Dental Surgery students during clinical patient rotations and identify factors influencing adherence.

Methods: A four-month cross-sectional study was conducted at a dental teaching institution in Lahore. A total of 216 third-, fourth-, and final-year dental students were observed using a validated World Health Organization (WHO) "Five Moments for Hand Hygiene" checklist. Each participant was monitored during five patient encounters, yielding 5,400 total hand hygiene opportunities. Data were analyzed using descriptive statistics, independent t-tests, chi-square tests, and one-way ANOVA with a significance level of $p < 0.05$.

Results: Overall compliance was 50.8%, with the highest adherence observed after exposure to body fluids (73.9%) and the lowest after contact with patient surroundings (20.8%). Female students demonstrated higher compliance than males (54.7% vs. 45.2%, $p = 0.02$). Final-year students achieved the highest overall adherence (56.8%), followed by fourth-year (51.3%) and third-year students (44.9%) ($p = 0.01$). Compliance during surgical procedures (62.4%) exceeded that of non-surgical interventions (46.7%, $p = 0.03$).

Conclusion: Hand hygiene compliance among dental students was moderate and varied by gender, academic level, and clinical procedure type. Targeted education and reinforcement are essential to improve adherence and reduce the risk of healthcare-associated infections.

Keywords: Cross-Sectional Studies, Dental Students, Hand Disinfection, Hand Hygiene, Infection Control, Patient Safety, Risk Factors.

Introduction

Hand hygiene is universally recognized as the cornerstone of infection prevention in all healthcare settings, serving as one of the most effective measures to reduce the transmission of pathogenic microorganisms(1) . Despite its simplicity and cost-effectiveness, lapses in hand hygiene compliance continue to contribute significantly to healthcare-associated infections (HAIs), posing a persistent challenge to patient safety (2). In dentistry, where practitioners work in close proximity to patients and are frequently exposed to blood, saliva, and other bodily fluids, the importance of strict hand hygiene practices cannot be overstated (3). The dental clinical environment presents unique risks for cross-contamination, making proper hand hygiene an indispensable element of both patient care and occupational safety. However, ensuring consistent adherence to recommended protocols remains a complex issue influenced by knowledge, attitudes, training, and environmental factors (4). Dental students, particularly those in Bachelor of Dental Surgery (BDS) programs, occupy a critical position in this context. During clinical rotations, they transition from theoretical learning to hands-on patient care, a period during which foundational habits and professional behaviors are formed (5). This stage is pivotal not only for their education but also for the development of lifelong practices in infection control. Evidence from previous studies has highlighted a concerning trend: while awareness of hand hygiene guidelines is generally high among healthcare students, actual compliance often falls short of recommended standards. Factors such as time constraints, skin irritation, workload pressure, inadequate supervision, and a perceived lack of risk have all been cited as barriers to proper hand hygiene (6). These challenges underscore the need for continuous evaluation and targeted interventions to reinforce the critical role of hand hygiene in clinical training environments (7).

The World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC) have both established comprehensive guidelines for hand hygiene, emphasizing moments of care where handwashing or the use of alcohol-based sanitizers is essential (8). Adherence to these protocols is not merely a matter of personal discipline; it reflects the broader culture of safety within healthcare institutions (9). Among dental students, compliance is particularly important because dental procedures frequently involve aerosol generation, use of sharp instruments, and exposure to potentially infectious oral secretions. Even minor lapses in hygiene practices can increase the risk of transmitting infections to patients, peers, and the students themselves (10). Thus, understanding the current level of compliance among BDS students is a critical step in identifying gaps that may compromise both education quality and patient safety. Despite the recognized importance of hand hygiene, the literature reveals a scarcity of focused research evaluating adherence among dental students during their clinical training. Most available studies have centered on medical and nursing students, with comparatively limited attention given to dental education. This gap is noteworthy because dental clinical settings differ in several respects, including the nature of patient contact, the frequency of exposure to bodily fluids, and the specific infection control protocols required (11). Moreover, the transition from pre-clinical to clinical training introduces a new set of challenges for dental students, who must balance patient care responsibilities with academic demands. Without systematic assessment, institutions may lack the data needed to design effective educational strategies or to implement policy changes that promote higher compliance.

The present study addresses this critical gap by examining hand hygiene compliance among BDS students during clinical patient rotations. By assessing how consistently students adhere to established protocols, this research seeks to provide insight into the current state of infection control practices within dental education. Understanding these patterns is essential for informing curriculum development, reinforcing professional responsibility, and ultimately safeguarding patient health. The objective of this study is to evaluate the extent of hand hygiene compliance among Bachelor of Dental Surgery students during clinical practice sessions, thereby identifying areas for improvement and contributing to the development of targeted interventions that promote a stronger culture of infection prevention.

Methods

This cross-sectional study was conducted over a period of four months at a well-established dental teaching institution in Lahore, Pakistan, with the primary aim of assessing the level of hand hygiene compliance among Bachelor of Dental Surgery (BDS) students during their clinical patient rotations. The study was carefully designed to provide an accurate snapshot of current practices and to identify areas that require targeted improvement in infection control education. The methodology was structured to ensure both scientific rigor and ethical integrity, enabling the findings to serve as a reliable basis for future interventions. The study population consisted of undergraduate dental students enrolled in the third, fourth, and final years of the BDS program, as these cohorts are actively engaged in clinical practice and have direct patient contact. Students in their first and second years were excluded because they are primarily involved in pre-clinical training and do not participate in routine patient care. Additional exclusion criteria included students who were on academic leave during the study period, those unwilling to provide informed consent, and individuals with documented dermatological conditions that might limit hand hygiene practices. Using the formula for sample size calculation for proportions with a 95% confidence level, a 5% margin of error, and an anticipated compliance rate of 50% based on previous literature to account for maximum variability, the minimum required sample size was estimated to be 196 participants. To account for potential non-response, the sample size was increased by 10%, resulting in a final target of approximately 216 students, which ensured adequate statistical power to detect meaningful differences in compliance rates. The final sample comprised 216 students who met the eligibility criteria and consented to participate, fulfilling the target sample size.

Data collection involved direct, non-intrusive observation of students during their routine clinical sessions. Observations were conducted by two trained researchers who were calibrated prior to data collection to ensure consistency and minimize observer bias. To avoid influencing students' behavior, the observers maintained a discreet presence in the clinical area and did not disclose the exact purpose of the observations at the time of data collection. Compliance was measured using a structured observation checklist adapted from the World Health Organization's "Five Moments for Hand Hygiene" framework, which specifies critical instances for hand hygiene, including before patient contact, before aseptic procedures, after exposure to body fluids, after patient contact, and after contact with the patient's surroundings. Each student was observed over multiple patient encounters, specifically an average of five encounters per participant for a total of 1080 encounters, to capture an accurate representation of typical hand hygiene behavior. This yielded 5400 distinct hand hygiene opportunities for analysis. The checklist recorded whether students performed hand hygiene at each indicated moment and the method used, such as handwashing with soap and water or the use of an alcohol-based hand rub. Additional variables, including gender, year of study, and type of clinical procedure performed, categorized as surgical or non-surgical, were also documented to explore potential associations with compliance levels. Data normality was assessed using the Shapiro-Wilk test.

This study has several important limitations to consider. Its cross-sectional nature provides a snapshot of compliance at a single point in time and cannot establish causality or track changes in individual behavior over time. Direct observation, while standardized, carries a risk of the Hawthorne effect, where participants may alter their behavior due to awareness of being observed, potentially inflating compliance rates. The study was conducted at a single dental teaching institution, which may limit the generalizability of the findings to other settings or regions with different resources and training protocols. Furthermore, the observation checklist captured behavioral compliance but did not assess the quality or duration of the hand hygiene act, nor did it evaluate the subsequent impact on clinical infection rates. Future studies would benefit from a multicenter design, longitudinal follow-up, and the integration of microbiological or patient outcome data to strengthen the evidence base.

Results

The study included a total of 216 Bachelor of Dental Surgery students who met the eligibility criteria and consented to participate. The mean age of the participants was 22.6 ± 1.4 years, with a range of 21 to 26 years. Of the total cohort, 128 (59.3%) were female and 88 (40.7%) were male. Distribution by year of study showed that 72 (33.3%) were in the third year, 74 (34.3%) in the fourth

year, and 70 (32.4%) in the final year. All participants were actively engaged in clinical rotations at the time of data collection, and no significant differences were observed in baseline demographic characteristics across the three academic levels (Table 1). Direct observation of 1,080 patient encounters, with an average of five encounters per participant, yielded a total of 5,400 hand hygiene opportunities based on the WHO Five Moments for Hand Hygiene. Overall, hand hygiene was correctly performed in 2,746 instances, corresponding to an overall compliance rate of 50.8%. Compliance before patient contact was recorded in 1,062 of 2,160 opportunities (49.2%), while adherence before aseptic procedures was observed in 668 of 1,080 opportunities (61.9%). After exposure to body fluids, compliance was highest, with 532 of 720 opportunities (73.9%) being followed by appropriate hand hygiene. After patient contact, hand hygiene was performed in 334 of 720 opportunities (46.4%), and after contact with patient surroundings in 150 of 720 opportunities (20.8%), representing the lowest adherence rate (Table 2). Use of alcohol-based hand rubs accounted for 67.5% of all compliant actions, while 32.5% involved handwashing with soap and water.

When analyzed by gender, female students demonstrated significantly higher overall compliance compared with male students (54.7% vs. 45.2%, $p = 0.02$). Compliance rates also varied by year of study, with final-year students exhibiting the highest overall adherence (56.8%), followed by fourth-year (51.3%) and third-year students (44.9%) ($p = 0.01$). Post hoc analysis confirmed that the difference between third- and final-year students was statistically significant ($p = 0.008$). Further analysis of specific hand hygiene moments revealed that final-year students achieved the highest compliance rates in all WHO-indicated moments except after contact with patient surroundings, where compliance remained uniformly low across all academic levels (Table 3).

Procedure-specific observations showed that compliance was higher during surgical procedures compared to non-surgical interventions. Students performing extractions or endodontic treatments exhibited an adherence rate of 62.4%, whereas those conducting routine examinations or prophylactic procedures demonstrated a compliance rate of 46.7% ($p = 0.03$). Alcohol-based hand rub was the preferred method across all procedure types, with no significant difference in usage pattern between males and females. The mean number of compliant actions per student was 12.7 ± 4.3, with a range of 6 to 21. The Shapiro–Wilk test confirmed normal distribution of data ($p = 0.21$), supporting the use of parametric tests. Independent sample t-tests demonstrated significant differences in compliance between genders, while one-way ANOVA revealed a significant effect of academic year on adherence rates. No significant association was found between age and compliance ($p = 0.36$). These findings indicate moderate overall compliance, with marked variation across gender, academic level, and type of clinical procedure. The lowest adherence was consistently observed for hand hygiene after contact with patient surroundings, highlighting a critical gap in routine infection control practices (Table 4, Figures 1 and 2).

Table 1: Demographic characteristics of participants (n = 216)

Variable	*n (%) or Mean ± SD*
Age (years)	22.6 ± 1.4
Gender	
Male	88 (40.7)
Female	128 (59.3)
Year of study	
Third Year	72 (33.3)
Fourth Year	74 (34.3)
Final Year	70 (32.4)

Table 2: Overall hand hygiene compliance by WHO Five Moments

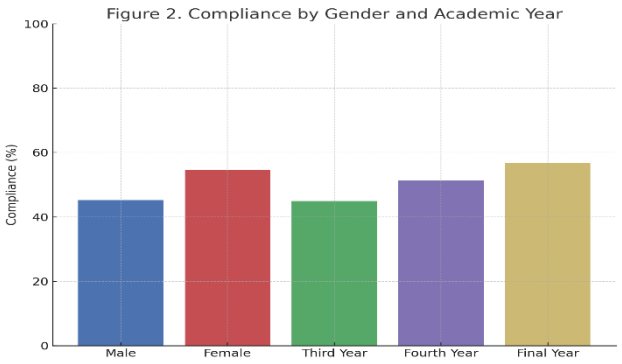
Hand Hygiene Moment	*Opportunities (n)*	*Compliant Actions (n)*	*Compliance (%)*
Before patient contact	2,160	1,062	49.2
Before aseptic procedure	1,080	668	61.9
After exposure to body fluids	720	532	73.9
After patient contact	720	334	46.4
After contact with patient surroundings	720	150	20.8
Overall	5,400	2,746	50.8

Table 3: Compliance by gender and academic year

Variable	*Compliance (%)*	*p-value*
Male (n=88)	45.2	
Female (n=128)	54.7	0.02
Third Year	44.9	
Fourth Year	51.3	0.01
Final Year	56.8	

Table 4: Compliance by type of procedure

Procedure Type	*Compliance (%)*	*p-value*
Surgical procedures	62.4	0.03
Non-surgical procedures	46.7	



Discussion

The findings of this study revealed moderate overall compliance with hand hygiene protocols among Bachelor of Dental Surgery students during clinical rotations, highlighting both progress and persistent gaps in infection control practices (12). An overall adherence rate of 50.8% indicated that while knowledge and awareness of hand hygiene principles may be present, translation into consistent practice remains suboptimal (13). The highest compliance was observed after exposure to body fluids, whereas the lowest adherence occurred after contact with patient surroundings (14). This pattern aligns with existing literature, where healthcare students and professionals frequently prioritize hand hygiene when they perceive a direct risk of contamination but are less vigilant in situations considered to be of lower risk (15). Similar trends have been reported in studies conducted among dental and medical students in Asia and Europe, suggesting that perceived risk and immediate visual cues strongly influence hand hygiene behavior (16). Gender-based differences observed in this study, with female students demonstrating higher compliance than their male counterparts, reinforce previous research showing that female healthcare trainees often exhibit greater adherence to infection prevention protocols (17). This disparity may reflect differences in health-related attitudes, risk perception, and conscientiousness, which have been reported across various healthcare disciplines (18). The progressive increase in compliance from third-year to final-year students further emphasizes the impact of clinical experience and repeated exposure to infection control training (19). Senior students are likely to have developed a stronger understanding of patient safety principles and a heightened sense of professional responsibility, both of which contribute to improved hand hygiene practices (20). This finding underscores the importance of integrating robust infection control education early in the curriculum to foster lifelong habits and reduce the lag in compliance observed among junior students.

The study also revealed that compliance was significantly higher during surgical procedures compared to non-surgical interventions. This outcome reflects the heightened awareness of infection risks associated with invasive treatments, where the consequences of lapses in hygiene are more immediate and potentially severe (21). Such findings are consistent with observations in other healthcare settings where hand hygiene adherence increases during high-risk procedures. However, the uniformly low compliance after contact with patient surroundings is concerning, as this moment plays a critical role in preventing indirect transmission of pathogens. The neglect of this practice highlights an area requiring targeted educational reinforcement, as environmental contamination is a well-documented source of healthcare-associated infections (22). These results carry important implications for dental education and clinical training. The moderate compliance rate suggests that existing infection control programs, while beneficial, may not be sufficiently impactful to ensure consistent practice. Structured interventions such as repeated hands-on training, visual reminders, and real-time feedback have demonstrated effectiveness in improving hand hygiene behavior in medical settings and could be adapted to dental curricula. The inclusion of periodic audits and direct observation, combined with individualized feedback, may further enhance adherence and foster a culture of accountability (23). Moreover, addressing behavioral factors such as risk perception and habitual practices is essential to achieving sustained improvements.

This study possesses several strengths, including a robust sample size, direct observation of real clinical encounters, and the use of a validated WHO-based measurement tool. These methodological features enhance the reliability and generalizability of the findings within the context of dental education. The use of trained observers and rigorous inter-observer calibration minimized the potential for measurement bias, while the inclusion of multiple clinical years allowed for meaningful comparisons across different stages of training. Nevertheless, certain limitations must be acknowledged. The observational design, while necessary to capture authentic behavior, may have introduced the Hawthorne effect, whereby participants modify their actions due to awareness of being observed. Although efforts were made to minimize this through discreet observation, some influence cannot be excluded. The study was also limited to a single dental institution, which may restrict the generalizability of the results to other settings with differing curricula, infection control policies, or cultural norms. Additionally, compliance was measured only during the study period and may not reflect seasonal variations or long-term trends. Future research should explore multi-center studies to provide a broader understanding of hand hygiene compliance across diverse educational and cultural environments. Investigations incorporating qualitative methods could help identify the underlying behavioral and institutional factors influencing adherence, including attitudes toward risk, availability of resources, and the impact of peer modeling. Intervention-based studies assessing the effectiveness of targeted training, automated monitoring systems, or digital feedback tools would provide valuable insights for improving compliance and sustaining long-term behavioral change.

Conclusion

This study demonstrated moderate compliance with hand hygiene protocols among dental students, with significant variation by gender, academic level, and clinical procedure. Although senior students and female participants showed higher adherence, gaps remained, particularly after contact with patient surroundings. These findings emphasize the need for early, targeted infection control education and structured reinforcement to ensure consistent hand hygiene practices and reduce the risk of healthcare-associated infections in dental clinical settings.

Author' Contributions

Author	Contribution
Abdul Samad	Designed the study, performed data collection and analysis, and prepared the manuscript. Approved the final draft for submission.
Muhammad Ilyas	Contributed to study design, data acquisition, interpretation of findings, and performed critical review and editing of the manuscript. Approved the final draft for submission.
Mahin Ather	Significantly contributed to data collection and analysis. Reviewed and approved the final manuscript for publication.
Aleena Jabir*	Has given Final Approval of the version to be published Provided final review and consent for the published version.

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