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ORIGINAL ARTICLE

Dentist's Knowledge and Behavior on the Use of Smart Phones in Clinical Environment and their association with Cross Infections

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ABSTRACT

Background: The use of smart phones inside hospitals especially in clinically sensitive areas is a subject of debate because it may improve the quality of healthcare but can also be a vehicle of hospital acquired infections.
Aim: To determine dentist's knowledge and behavior related to the use of smart phones in clinical environment and to determine the presence of microbial growth on these devices.
Methods: This is a cross-sectional study in which validated survey tool was used to collect data about knowledge and behavior of 397 dental graduates from 8 dental colleges of Pakistan, regarding their usage of smart phones in clinical environment. Bacterial isolates were collected from the smart phones of 45 participants from Fatima Memorial Dental Hospital, Lahore.
Results: The SPTC Scale was used to divide the participants into 3 categories; low, moderate and high users. The behavior related to smart phone usage in clinical environment was significantly different among the participants. Moderate users had significantly higher average behavior score of 3.7 (p-value = 0.034). The growth of pathogenic bacterial flora was greater on high users of smart phones (95%,) whereas those participants who were low users the percentage was 37%.
Conclusion: Hospital-acquired infections (HAIs) are increasing significantly in number of patients and these can be prevented by adhering to proper hand hygiene practices and if hand hygiene is improved the amount of bacterial load will be less and disinfection of smart phone devices will not be required.
Keywords: Smartphone; Dental Clinics; Smartphone time consumption scale (SPTC); cross infection; Hand washing

INTRODUCTION

Health care professionals are using smart phones everywhere whether it be the dinner tables, restaurants, or even their bathrooms[1]. Health care professionals are using smart phones in healthcare settings for communication within hospitals and dental clinics[1,2]. This smart phone usage in clinical practice is becoming a cause of concern and they may be oblivious of the risk associated with them[3]. An adequately clean device when handled with clean hand are less likely to become vector of disease. However, the hand hygiene practices among health care professionals are poor and inadequate in hand hygiene practices were center of BEME guidelines and various interventions have been advised in this regard[4]. The smartphone devices are sparingly sanitized and rarely disinfected. These devices are difficult to clean, only high-end smart phones have IP67 certification, and smart phone companies are not recommending the smartphone sanitation or disinfection. Smart phones can carry a variety of pathogens and they are cumbersome to clean due to presence of broken screens, crevices for charging, speaker, ports and protective casing[5,6]. Due to poor hand hygiene practices of these contaminated devices, significant associations have been found showing that smart phones carry potential pathogens[7] and they may become vector for transmitting pathogens to patients and cause nosocomial infections[8]. Microbial infection is a risk associated with infrequent disinfection of these devices, infrequent hand-washing and poor compliance of disinfection protocols, all this may lead to the risk of microbial transmission in different settings[9,11]. Dentist's hands can be easily undergone antisepsis using antiseptics that are available readily across all hospitals and medical facilities. However, compliance is poor as mentioned the BEME guide has observed that hand hygiene is a neglected part of our day-to-day practice[10]. This becomes a core issue during the COVID-19 pandemic and hand hygiene is reemphasized. These devices maybe harboring bacteria if hand hygiene is not properly practiced [11]. This association has been tested in clinical and non clinical environment in medical students[3]. Dentists may be using smart phones differently their knowledge and behavior in clinical settings may cause variation of bacterial flora on these devices[13].

So, the objective of our study was to determine dentist's knowledge and behavior on the use of smart phones in clinical environment and how this behaviour may lead to different bacterial flora on these devices.

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MATERIALS AND METHODS

This is a multi-method study consisting of three parts, development of smart phone time consumption (SPTC) scale, development of survey tool and a cross-sectional conduction to access the knowledge and behavior of participants regarding the use of smart phones in clinical environment and to conduct survey, finally third part where we collected bacterial sample from smartphone of participants. Bacterial samples were collected from the participants' smart phones to isolate bacteria harboring on them and to compare their practice with their behavior. This study was conducted from 13th of July 2019 to 10th of June 2021 at different dental institutes in Punjab. This study was delayed by the Covid-19 pandemic and new phenomenon was observed.

The development of SPTC Scale: Smart phone usage classification scale named Smart Phone Time Consumption (SPTC) scale was developed keeping in view the various smart phone usage modes by the consumers. The modes of usage included the daily usage of smart phone for (i)Calling (minutes), (ii)Text messaging (No of text messages, including WhatsApp and other text messaging applications), (iii)Data usage (MBs of data used for browsing) and the (iv)time spent on games played on smart phones (minutes). A classification criterion was developed using percentile scoring, the responses of the entire 397 respondents were analyzed and the percentile scores for each mode of smart phone usage were obtained. Respondents with percentile score less than 25th percentile were classified as low user, and the respondent with percentile scores between 25th and 75th percentile score were classified as moderate users and the ones with percentile score more than 75th percentile score were classified as high users, respondents with no usage were coded as zero. Using

the above-mentioned criterion, the classification criterion given in table 1 was developed.

Table 1: Smartphone time usage classification criterion based on SPTC

Variables	Low users	Moderate Users	High Users
Calling time	0- <20(1)*	20 - 60(2)*	above 60(3)*
Texts number	0-< 50(1)*	50 – 200(2)*	above 200(3)*
Data usage	0-<200(1)*	200 - 800(2)*	above 800(3)*
Gaming time	0- <15(1)*	15 - 30 (2)*	above 30(3)*

*The brackets show percentile scores of each variable

The assigned scores were given in the parenthesis next to each category formed and the aggregate scores were obtained. Overall minimum aggregate score could be 0 and maximum will be 12. Following criteria was applied to determine the overall smart phone usage. (0-4) Low Users, (9-8) Moderate Users and (9-12) High Users

Survey tool development: A questionnaire was developed using seven-step process, mentioned in the AMEE guide (Guide No.87) [13] . First, focus group discussions of 8 participants were arranged after taking an informed consent, participants were asked open ended questions which included variables like knowledge and behavior on the use of smart phones in clinical environment. These steps synthesized survey design techniques to organize these variables into a cohesive process for questionnaire development. Each of these steps were addressed systematically to improve the probabilities of the survey [13]. After the development of this tool, experts' opinions were sought. Finally, a pilot study was run which included twenty-five participants. The data obtained from the pilot survey was reviewed by the IRB research cell associated with Fatima memorial hospital for its content and statistical validity. The tool consisted of three sections comprising of 27 questions, the Cronbach alpha of the tool was found out to be 0.7. After the synopsis approval from Institutional review board (IRB), the questionnaires were submitted to the dental institutes. A total of 397 hard copies of questionnaires out of 445 were collected from respondents from eight dental institutes of Punjab, the response rate was 88%. The study population included house officers, postgraduates, general dentists and consultants from over eight cities of Punjab.

Bacterial sample collection: This survey was conducted in two phases from 13th of July 2019 to 10th of June 2021, at Fatima Memorial Hospital (FMH) Lahore, Pakistan. Therefore, only 45 samples were collected from smart phones of volunteering participants at FMH who were asked to complete a written questionnaire and informed consent prior to sample collection.

Before Covid-19 pandemic we have conducted the pilot study 2nd February to 18th February, 2020. During this pilot we collected five bacterial swabs from smart phone of participants from dental department using Amies agar gel transport swabs. For sample collection, swabs were rotated over the front and back screens of smart phones. All swabs were immediately transported to FMH Clinical Laboratories and processed within 1 hour. The subsequent cultures were carried out on blood and MacConkey agar plates and incubated aerobically at 37◦C for 18-24 hours. All culture plates were examined for visible growth. Colonies grown on both blood and MacConkey agar plates were tested using standard microbiological methods. Preliminary identification of isolates was made by colony morphology, cultural characteristic, and Gram staining. Also, the biochemical confirmation of bacteria to appropriate genera was made using ID cards in VITEK-2 compact system (BioMérieux, France). Further antimicrobial susceptibility tests were carried out for all the isolated organisms using AST cards by VITEK 2 compact system (BioMérieux, France) and interpreted according to the Clinical and Laboratory Standards Institute guidelines[3]. Post Covid-19, after resumption of academic activities, 45 bacterial samples were collected from smart phones of volunteering participants at FMH who were asked to complete a written questionnaire and informed consent prior to sample collection. Due to financial constraints and amid of Covid-19 pandemic this study got delayed and the targeted sample size was reduced. The results are mentioned in table 4.

Data analysis: Statistical data analysis was carried out using SPSS version 22.0. The responses in the survey were assigned a 1 to 5 number and then aggregated to produce a score, these results were then grouped into "knowledge" comprises of questions such as health hazards of using mobile phone in clinical environment, contamination of smart phones in the clinical environment, and "behavior" comprises of questions such as use of smart phones in toilets, use of disinfectants to clean the surface of smart phones, and the use of smart phones at work. Kruskal-Wallis and Chi-square test was used to analyze the knowledge and behavior of different groups separately based on SPTC scale for statistical significance. The correlation between knowledge and behavior was assessed after assigning them specific numbers. Using one-way analysis of variance, the means of all microbial isolates and the type of organisms found were compared to determine the significant abundance of each organism based on SPTC scale.

RESULTS

In the first phase, a survey was conducted to assess knowledge and behavior and in second phase the actual practice was correlated to knowledge and behavior. The total number of participants were 397. The number of male dentists were 108 (31.4%) and number of female dentists were 237 (68.7%). Our study results showed that out of 397 participants, 88 (25.5%) participants were high users compared with 4 51 (14.8%) low users of smart phones, remaining 206 (59.8%) participants were moderate users of smart phones. Other general characteristics of participants on the basis of SPTC Scale are shown in table 2.

The knowledge related to smart phone use in clinical environment was not significantly different among the different participants based on SPTC Scale but the behaviors related to their use in clinical practice was found out to be significantly different as shown in table 3.

Moderate users had significantly higher average behavior score 3.7(p-value = 0.034) as compared to low and higher users with average score 3.5. We were unable to find significant difference in the average knowledge score of three user groups. In the second phase of this study, 45 bacterial samples were obtained from the various surfaces of smart phones of participants at Fatima Memorial Dental Hospital. 20 participants were high users (44.4%), 16 participants were low users (35.5%) and remaining 9 were moderate users (20.2%) of smart phones, also all participants were using their smart phones at work every day.

The percentage of microbial populations on the tested on smart phones of participants who were high users of smart phones was 95%, whereas those participants who were low users the percentage was 37%. The percentage of dentists disinfecting their smart phones on a daily basis before COVID-19 pandemic was found out to be 71% as compared to the 29% participants who were not disinfecting their smart phones. The percentage of dentists disinfecting their smart phone on a daily basis after COVID-19 pandemic was found out to be 84.5% as compared to the 15.5% participants who were not disinfecting their smart phones. The percentage of microbial populations on the tested smart phones during the pilot study before the outbreak Covid-19 pandemic was 100%, of which the most abundant isolates were Methicillin Sensitive Staphylococcus aureus which accounted for >60% of total samples. The percentage of microbial populations presented on the tested smart phones during the pandemic was 84.4%, of which the most abundant isolates were Coagulase-negative staphylococci, which accounted for > 60% of the total samples. The results are mentioned in table 4 & 5.

Table 2: General characteristics of respondents on the basis of SPTC Scale

	Low users 51 (14.8%)	Moderate users 206 (59.8%)	High users 88 (25.5%)	P-value*	
Age	24 (22-42)	25 (20-48)	24 (21-35)	0.663	
Gender	Male Dentists (n=108)	21 (6.1%)	64 (18.6%)	23 (6.7%)	0.182**
	Female entists'(n=237)	30 (8.7%)	142 (41.2%)	65 (18.8%)	
Designation	House Officers	40 (11%)	130 (35.8%)	63 (17.4%)	0.157**
	Post Graduates	9 (2.5%)	53 (14.6%)	16 (4.4%)	
	Consultants	3 (0.8%)	9 (2.5%)	1 (0.3%)	
	General Dentists	4 (1.1%)	29 (74.4%)	6 (15.4%)	
Years of Practice	1 year (1-16)	2 years (1-18)	1 year (1-24)	0.594	
Experience in Private practice	1 year (0-7)	2 years (0-15)	1 years (0-6)	0.196	
Experience in Hospital practice	1 year (0-14)	2 years (0-18)	1.50 years (1-11)	0.257	

* Kruskal wallis test, **Chi-square test

Table 3: Knowledge and behavior of dentists on the basis of SPTC Scale

	Low users	Moderate users	High users	P-value
	Median (Range)	Median (Range)	Median (Range)	
Knowledge of participants	4 (2.33-5)	4 (2.50-5)	4 (1.83-5)	0.129
Behavior of participants	3.5 (2.29-4.57)	3.7 (1.71-5)	3.5 (1.14-5)	0.034

Table 4: Different microbial isolates isolated from smart phones of dentists based on SPTC Scale post-COVID-19 (year 2021)

Isolated pathogens	Low users	Moderate users	High users	Total
Total samples = 45	16	9	20	
Coagulase-negative staphylococci (Normal flora)	11	6	10	60%
Aspergillus and Mucor	2	-	5	15.5%
Bacilli species	-	1	3	8.9%
S.aureus	1	-	-	2.2%
Pseudomonas	1	-	1	4.4%

Table 5: Different microbial isolates isolated from smart phones of dentists based on SPTC Scale pre-COVID-19 (year 2020)

Isolated pathogens	Low users	Moderate users	High users	Total
Total samples = 5	1	1	3	
Methicillin-sensitive Staphylococcus aureus (MSSA)	-	1	2	60%
Methicillin-resistance Staphylococcus epidermidis (MRSE)	-	-	1	20%
Methicillin-sensitive Staphylococcus epidermidis (MSSE)	1	-	-	20%

DISCUSSION

The objectives of this study were to determine dentist's knowledge and behavior on the use of smart phones in clinical environment and to assess how these behaviors affect cross infection related to smart phones in clinical practice. The participants were aware about the risks of smart phones usage in clinical environment but many of them were excessively dependent on their use. The smart phones may get microbial contamination in clinical settings due to their continuous use at home and clinical environment[1,2]. These smart phones will become reservoir for the spread of microbial flora. Participants were oblivious of the fact that their practice may harm or lead to the spread of nosocomial infections.

The knowledge of all dentists was termed adequate and no difference was found among the various length of time of mobile use. The similar relation was found in the study conducted in Jeddah, Saudi Arabia[3]. However, this study was conducted on dental students, their behavior in clinical practice was not assessed. Here we have found that behavior differs with amount of smart phone usage, and it becomes more insignificant with increased use of smart phones, as it is difficult for participants to have two phones for home and clinical use. One reason may be for this high usage could be a lack of practice guidelines in clinical environments or due to improper management by hospital administration. Fewer studies have reported variable results regarding the correlation of smart phones usage in clinical environment and their association with cross infections[4,5].

A significant event happened during this study and that is COVID-19 pandemic. Before the start of this study we performed a pilot, the bacterial flora was diverse and contained resistant organisms, the institution remains closed due to COVID-19 pandemic in 2020. When the institution was reopened in 2021, we conducted the second phase, we have observed a significant change in participant's behaviors. The hand hygiene practices changed significantly. It was depicted in our culture results as shown in table 4. The possible explanation of this phenomenon is that hand hygiene practices have changed due to pandemic; these devices were less contaminated after COVID-19 pandemic as manifested by presence of normal flora on smart phones. The difference in types of flora shows the possible interpretation that if dentists are just carrying out good hand hygiene practices the devices will be predominantly contaminated by skin flora. This shows if hand hygiene is improved only, the colonization of nosocomial flora would be less on smart phones. Hence, there is no need to disinfect these devices in clinical environment.

Strengths: A time scale for smart phones usage was developed, and correlated it to study knowledge and behavior and its link with clinical practice. An important observation was made that if hand hygiene practices are improved the contamination of smart phone devices will become minimal.

Limitations: The limitations of this current study are that although knowledge and behavior data was collected from multiple institutions but cultures were collected from one institution only, the COVID-19 pandemic disrupted the duration of this process. Another limitation was that bacterial counts of the isolated microorganisms were not carried out and this may interfere with the assessment of the levels of contaminating microorganisms present per square cm.

CONCLUSIONS

A direct link was found between knowledge and behavior of dentists on the use of smart phones in clinical environment. Hospital-acquired infections (HAIs) are increasing significantly in number of patients and these can be prevented by adhering to proper hand hygiene practices and standard infection control guidelines. Moreover, if hand hygiene is improved the amount of bacterial load will be less and disinfection of these devices will not be required.

Conflicts of interest: The authors have no conflicts of interest.

Contribution of authors: KM: Research idea, synopsis writing, data collection, data analysis and manuscript writing

Dr Alia Batool: Research supervisor, Research idea refinement, synopsis review, data analysis and manuscript writing, research quality assurance, **MI**: Research mentor, Research idea refinement, poster presentation reviewer, data analysis and manuscript writing, **SH**: Research Co-supervisor, Research idea refinement, synopsis review, data analysis and manuscript writing, **MAS**: Research mentor, Research idea refinement, poster presentation reviewer, data analysis and manuscript writing., **QA**: Research mentor, Research idea refinement, poster presentation reviewer, data analysis and manuscript writing.

REFERENCES

1. Singh S, Acharya S, Bhat M, Rao SK, Pentapati KC. Mobile phone hygiene: potential risks posed by use in the clinics of an Indian dental school. Journal of Dental Education. 2010 Oct;74(10):1153- 8.
2. Brady RR, Verran J, Damani NN, Gibb AP. Review of mobile communication devices as potential reservoirs of nosocomial pathogens. Journal of Hospital Infection. 2009 Apr 1;71(4):295-300.
3. Zakai S, Mashat A, Abumohssin A, Samarkandi A, Almaghrabi B, Barradah H, Jiman-Fatani A. Bacterial contamination of cell phones of medical students at King Abdulaziz University, Jeddah, Saudi Arabia. Journal of Microscopy and Ultrastructure. 2016 Sep 1;4(3):143-6.
4. Mathai E, Allegranzi B, Seto WH, Chraïti MN, Sax H, Larson E, Pittet D. Educating healthcare workers to optimal hand hygiene practices: addressing the need. Infection. 2010 Oct 1;38(5):349- 56.
5. Jayalakshmi J, Appalaraju B, Usha S. Cellphones as reservoirs of nosocomial pathogens. Vol. 56, Journal of Association of Physicians of India. 2008. p. 388–9.
6. Shahaby, A F, Awad, N S, El Tarras, A E, et al. Mobile phone as potential reservoirs of bacterial pathogens. African J Biotechnol [Internet]. 2012;11(92):15896–904.
7. Pal S, Juyal D, Adekhandi S, Sharma M, Prakash R, Sharma N, Rana A, Parihar A. Mobile phones: Reservoirs for the transmission of nosocomial pathogens. Advanced biomedical research. 2015;4.
8. Jahagirdar VL, Davane MS, Aradhye SC, Nagoba BS. Candida species as potential nosocomial pathogens--A review. Electronic Journal of General Medicine. 2018 Mar 1;15(2). 7
9. Conrad A, Kaier K, Frank U, Dettenkofer M. Are short training sessions on hand hygiene effective in preventing hospital-acquired MRSA? A time-series analysis. American journal of infection control. 2010 Sep 1;38(7):559-61.
10. Grayson ML, Jarvie LJ, Martin R, Johnson PD, Jodoin ME, McMullan C, Gregory RH, Bellis K, Cunnington K, Wilson FL, Quin D. Significant reductions in methicillin resistant Staphylococcus aureus bacteraemia and clinical isolates associated with a multisite, hand hygiene culture change program and subsequent successful statewide roll out. Medical journal of Australia. 2008 Jun;188(11):633-40. 11. Bokhari SA, Sufia S, Khan AA. Infection control practices among dental practitioners of Lahore, Pakistan. Pak J Med Sci. 2009 Jan 1;25(1):126-30.
11. Brady RR, Wasson A, Stirling I, McAllister C, Damani NN. Is your phone bugged? The incidence of bacteria known to cause nosocomial infection on healthcare workers' mobile phones. Journal of Hospital Infection. 2006 Jan 1;62(1):123-5.
12. Artino Jr AR, La Rochelle JS, Dezee KJ, Gehlbach H. Developing questionnaires for educational research: AMEE Guide No. 87. Medical teacher. 2014 Jun 1;36(6):463-74.