Use of Information Communication Technology Tools Among Nigerian Dental Resident Doctors: An Exploratory Study

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ABSTRACT

Objective: To evaluate Information-Communication-Technology (ICT) tools usage among Nigerian dental resident doctors.
Methods: A 68-item electronic questionnaire (Google Forms) retrieved data on participants' sociodemographic and awareness and use of ICT tools. Retrieved data was analyzed with IBM SPSS Statistic (version 23). Averages were tested for association with t-tests ANOVA and Friedmann's tests (and their non-parametric equivalents). Post-Hoc analysis was carried out. The level of statistical significance was set at $p \leq 0.05$.
Results: A hundred and thirteen residents from 13 teaching hospitals with a 2.3: 1 male: female ratio participated in the study. Participants' ages ranged from 24 to 48 (34.7±4.5) years. 71.7% of participants were junior residents, while 28.3% were senior residents. 38.9% of participants were from Southwestern institutions, while 39.9% were from Northern institutions. The Southeast and South-south contributed 21.2% of participants. There was poor awareness of learning applications with My Dentist® (29.2%) being the most popular. There was a high awareness level for social media tools with Zoom® and Facebook® having 100% awareness. Biomedical databases were similarly popular with PubMed® having 96.5% awareness and 59.3% frequent users. There was a statistically significant difference in the use of the 3 groups of ICT tools {$X2(2, n=113) = 208.4$, $p<0.001$. There was a statistically significant difference in biomedical database use between senior and junior residents ($p<0.001$).
Conclusion: The residents had good awareness of commonly available ICT tools except the medical and dental learning applications. Social media tools were very popular. Biomedical databases were mainly used by the Senior Registrars.

Keywords: Information Communication Technology Tools, Nigerian Dental Residents, Residency training, Internet.

INTRODUCTION

The residency training program in dentistry is a self-driven learning activity with the consultants acting as guides to the residents (Kanmodi et al., 2019; Newman-Nartey et al., 2019).

Citation: Ikusika OF, Aladelusi TO, Adeyemo YI, Adeyemi TE, Idon PI (2022). Use of Information Communication Technology Tools Among Nigerian Dental Resident Doctors: An Exploratory Study. Nig J Med Dent Educ; 4(1):8-19.

The program encompasses academic work, research and service and has been equated to a post-doctoral level of training (Rizo et al., 2002). The volume of information that may be processed by any one resident is enormous. The efficient maximization of information usage by residents could be an indicator of successful outcomes for these resident doctors (Rizo et al., 2002).

ICT tools have become an important component of contemporary learning environments and are versatile aids in maximizing access to information (Weiner & Biondich 2006). These tools alleviate the drudgery of manual searches for information and improve the efficiency of information handling.

ICT tools have been employed in medical and dental education to achieve numerous end points (Cheston et al., 2013). The ICT tools available for enhancing the learning experience of the resident doctor include learning applications, social media platforms and biomedical databases (Mattheos et al., 2008). These repositories of information can serve as primary sources or adjuncts to didactic learning, research and audiovisual demonstrations. The social media platforms in particular provide an avenue for interaction between residents, between residents and their trainers; and between residents and the global health community.

The dental resident may gain access to the internet via several sources (Iqbal & Bhatti 2020; Billon., 2021). These sources may be at varying costs to the resident doctors, and provide them different qualities of service (Fasiku et al., 2020; Adeleke 2021). The timing of access may also vary for different institutions. Internet access and speed have been shown to vary with different periods of the day in many developing countries (Fasiku et al., 2020).

The post COVID-19 era has been described as an era of a new normal (Cahapay 2020). One of the prominent protocols adopted in this so called new normal is a minimization of person to person contact (Hou et al., 2020). Remote and virtual learning have now become increasingly prominent in educational models (Kaur & Bhatt 2020; Lockee 2021). The dental residency program cannot afford to be left out of this emerging protocol as increasing numbers of learning resources are now deployed virtually. An exploratory analysis of the current situation is a scientific burden if the process is to be properly coordinated (Annan 2005).

Exploratory studies are undertaken where there is a limited body of knowledge about a research question (Naslund et al., 2020; Race 2020; Miyauchi & Gewinn 2021). The use of Information Communication Technology (ICT) as tools for learning among Nigerian dental resident doctors, is an area where only few studies have been conducted (Butali et al. 2011; Ajuwon & Popoola 2015; Ehioghae & Madukoma 2020). Many of these studies have been either localized to single institutions, or have been general overviews that did not put the peculiarities of the dental residency program into consideration. (Butali et al., 2011; Ajuwon & Popoola 2015; Ehioghae & Madukoma 2020) This has significantly limited the use of these studies in assessing the dental residency program. Exploratory studies in this aspect of the dental residency program will therefore form a foundation for basic information and further investigations.

This study sought to evaluate the pattern of ICT tools use among dental resident doctors in Nigerian training institutions. It specifically assessed the means and cost of internet access and usage among respondents. It also assessed the level of awareness of ICT tools and their usage among respondents. Finally, it sought to correlate the retrieved data with selected socio-demographic indices related to the respondents.

MATERIALS AND METHODS

The study was an internet-based cross-sectional questionnaire survey. The questionnaires were designed to permit only single responses per respondent. The questionnaire was a 68-item electronic document (Google Forms) that retrieved data on respondents' socio-demographics, specialty, number of years spent in the residency program and institutional affiliation. The questionnaire also documented information regarding respondents' awareness and use of several ICT resources representative of learning applications, social media platforms and biomedical databases; which were considered to be relevant to their training. This data was assessed using a Likert scale. Respondents were characterized as non-users (never), occasional users (rarely, sometimes) and frequent users (often, frequently) of these resources.

The questionnaire was pretested for content and face validity by the investigators (Umanath & Coane 2020). After two sets of corrections, the questionnaire was piloted on two groups of three resident doctors from two centers. The questionnaire was deemed to be easy to understand and easy to fill by both sets of residents. There was over 95% concordance between both sets of residents who piloted the study.

The sample size was determined with an estimated population of 150 respondents. This figure was

arrived at by estimating a population of 15 residents in each of the 10 centers accredited by the National Postgraduate Medical College of Nigeria (National Postgraduate Medical College of Nigeria 2021). The estimated number of residents per institution was made bearing in mind the variations in the sizes of the training institutions. A minimum sample of 109 respondents was determined at 95% confidence interval, 5% margin of error and 50% population proportion with the Sample Size Calculator from www.Calculator.Net. The inclusion criteria for the study was for respondents to be a dental resident doctor at the time of the survey, residents that participated in the pilot were excluded from the study.

Ethical approval (NHREC/28/01/2020/AKTH/EC/3072) was obtained from the Ethics Review Board of Aminu Kano Teaching Hospital. Informed consent form was incorporated into the online questionnaire as a required field to serve as a gate against participation without consent. The online questionnaires were posted on WhatsApp (www.WhatsApp.com) groups for dental residents in institutions across the country. Reminders were sent every two weeks for a 6-week period from April 2021 to May 2021. The online application presented the retrieved data on an electronic spreadsheet.

The retrieved data was analyzed with IBM SPSS Statistics version 23.0. Frequencies were recorded and means and medians were derived as appropriate. The Kolmogorov-Shapiro-Wilks test was used to test for normality. Group averages were compared for association with Independent t-tests and one-way ANOVA, while their non parametric alternatives Mann-Whitney and Kruskal-Wallis tests were used when necessary. Where necessary, the repeated measures ANOVA and Friedmann test were also used to compare averages. The Wilcoxon Signed Rank test (alongside a Bonferroni adjusted alpha value) were used for post-Hoc analysis. The level of statistical significance was set at $p \leq 0.05$.

RESULTS

A hundred and thirteen respondents from 13 teaching hospitals participated in the study. There were 79(69.9%) males and 34(30.1%) female participants. The ages of the participants ranged from 28 to 48 years, with a mean of 34.7(±4.5) years. Majority of participants (71.7%) were junior residents, while 28.3% were senior residents. Majority (90.2%) of respondents had spent longer than one year in the program, most (46.4%) of whom had spent between 1 and 2 years. The Southwest region (38.9%) and the Northern regions (39.8%) had similar number of respondents, while the Southeast and South-South regions together only produced 21.2% of the respondents. The majority of respondents (37.5%) were in Oral Maxillofacial Surgery (OMFS) program, while Family Dentistry (7.7%) had the least number of residents. The demographic characteristics of the respondents are shown in Table 1. The most common means of accessing the internet among respondents (95.6%) was the mobile phone at personal cost. Some respondents (23.9%) accessed the internet from wi-fi signals in their homes, while 5.3% accessed the internet with data dongles at personal cost. Networks provided by the institutions either as Wi-Fi or as Local Area Networks (LAN) returned the poorest access scores among respondents at 4.4% each. Majority (66.4%) of respondents felt the accessed networks were "somewhat reliable", while 5.3% felt they were "not so reliable". While 25.7% reported accessed networks as being "very reliable", only 2.6% considered them to be "extremely reliable".

Majority of respondents attached importance to the use of the internet for learning. About 51.8% and 37.5% of the respondents felt it was "very important" or "extremely important" respectively. There were only a few respondents (9.8% and 0.9% respectively) who felt it was "moderately important" or "slightly important". There was no respondent who felt the internet was "not important" for learning. While 22.1% and 57.5% of respondents claimed that they accessed the internet "every time" and "often times" respectively, 17.7% accessed the net "sometimes". There was a small number of respondents (1.8%) who reported rarely accessing the internet. However, about 1% of respondents claimed never to have accessed the internet in relation to their training.

There were only a negligible proportion (0.9%) of respondents who found internet access "extremely affordable", while a few respondents (8%) found it "very affordable". The larger proportion of respondents (54% and 32.7%) found access "somewhat affordable" or "not so affordable respectively". However, 4.4% of them did not find access "at all affordable". The most frequently reported reason for accessing the internet was to access journal articles. Majority (89.4%) of respondents reported accessing the internet for journal articles. The least frequent reported reason among respondents for accessing the internet was to view demonstration of laboratory procedures with a reported rate of 53.1%. Figure 1 illustrates

the reasons for accessing the internet among respondents.

There was poor awareness of medical and dental learning applications among respondents (Figure 2). My Dentist® (29.2%) was the application respondents were most aware of, while the least awareness was for Kareo® (4.4%). My Dentist® had the most occasional users at 13.3% of respondents. The application with the largest number of frequent users was dC Story® with 3.5% of respondents. Kareo® did not have any users among respondents.

Table 1. Demographic characteristics of respondents

Variables		Frequency (n)	Percent (%)
Gender			
	Female	34	30.1
	Male	79	69.9
Age			
	≤ 30 years	20	18.2
	31 to 35 years	42	38.2
	36 to 40 years	37	33.6
	> 40 years	11	10
Status			
	Junior residents	81	71.7
	Senior residents	32	28.3
Duration of residency training			
	< 1 year	11	9.8
	1 to 2 years	52	46.4
	2+ to 4 years	24	21.4
	> 4 years	25	22.3
Place of residency on regional level			
	South West	44	38.9
	South East/South South	24	21.2
	North	45	39.8
Specialty			
	OMFS	39	37.5
	Pediatric dentistry	22	21.2
	Diagnostics sciences	13	12.5
	Restorative dentistry	13	12.5
	Community dentistry	9	8.7
	Family dentistry	8	7.7

OMFS= Oral and Maxillofacial Surgery

The respondents had a good level of awareness of social media tools as learning aids (Figure 3). Zoom® and FaceBook® had 100% awareness among the respondents, while Teacher Tube® (29.2%) and Edmondo® (20.4%) had the least level of awareness. All other social media tools had at least 65.5% awareness among respondents. Zoom® (87.6%) had the largest number of frequent users. Edmondo® (1.8%) had the least number of frequent users. The respondents had good levels of awareness of many of the biomedical databases available as study aids (Figure 4). PubMed® (96.5%) and Google Scholar® (86.7%) had the greatest awareness rates among respondents. They were least aware (13.3%) about Dimensions®, which none of them had ever used. PubMed® (59.3%) had the largest number of frequent users among respondents. The Kolmogorov test for normality showed scores for utilization of social media tools were normally distributed ($p=0.20$), while those for learning applications and biomedical databases were skewed ($p<0.001$ and $p=0.02$ respectively). There was a statistically significant difference in the utilization scores of the 3 groups of ICT tools tested $\{X^2(2, n=113) =208.4, p<0.001\}$. There was a statistically significant difference between senior and junior residents in their use of biomedical databases ($p<0.001$). The gender of respondents, the location of their training institutions and their specialty did not affect ICT tools utilization in a statistically significant manner. Table 2 illustrates the associations of sociodemographic factors and use of ICT resources.

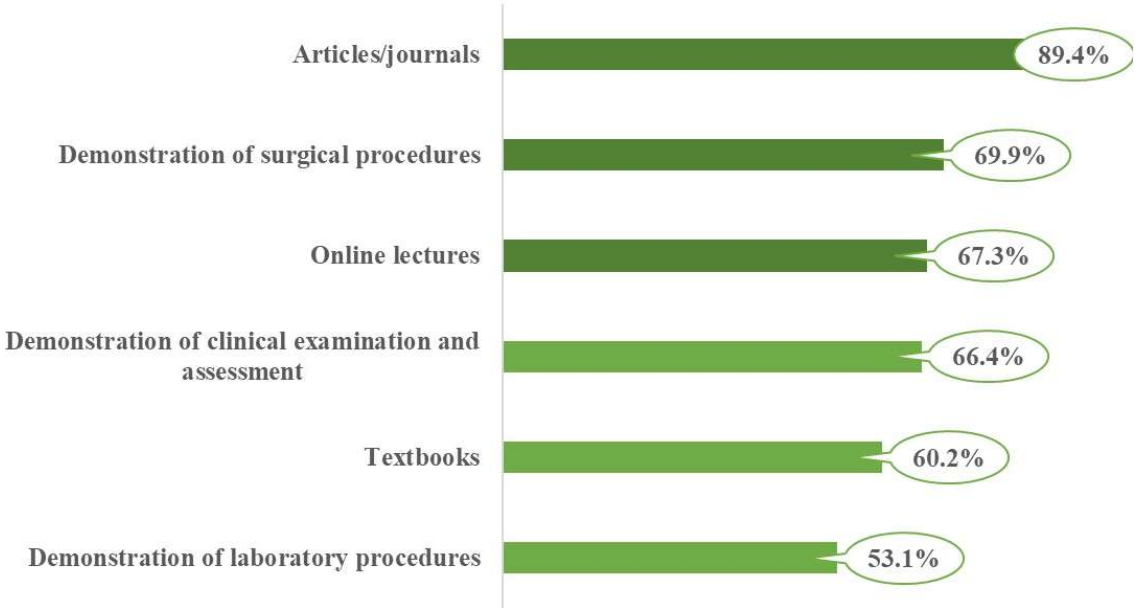

Figure 1: Reasons for Accessing the Internet

DISCUSSION

The three pillars on which the dental residency program is anchored are research, education and service provision (Esan et al., 2014). This training program serves as a reservoir for future specialists and trainers in dental education within the country (Malu 2020). There have been concerns about the quality of training received within the program by residents (Babalola et al., 2021), and by the trainers (Okonofua 2018). A common thread among these concerns is a tendency towards overemphasizing service delivery to the detriment of research and education (Esan et al., 2014; Okonofua 2018; Babalola et al. 2021). The resident must creatively find ways of achieving a balance of service delivery, research and knowledge if the benefits of the program are to be maximized.

The role of ICT in postgraduate dental education, especially in the post COVID-19 period has recently been reemphasized (Ossai 2020). However, the infrastructural challenges present in developing countries regarding ICT use have been well documented (Kabir & Kadage 2017; Al-Balas et al., 2020). The lack of enabling infrastructure is reechoed by our findings regarding internet access among our respondents. The residents are burdened with the responsibility of accessing the internet with their own resources despite the service they provide for these institutions. Assessments of infrastructural facilities are some of the responsibilities of accreditation teams from the Postgraduate Colleges (Bode et al., 2012). These accreditation teams should become firmer with training institutions regarding ICT infrastructure (Omigbodun 2010). The need for minimum standards of excellence should not be sacrificed for the desire to increase enrollment. Reliable access to the internet should be a requirement for centers that desire to train resident doctors in contemporary times.

The training institutions may overcome challenges to funding ICT infrastructural provision by employing the Public Private Partnership (PPP) model (Helmy et al., 2020). The PPP financing model has been advocated for ameliorating funding challenges in the West African sub-region (Effiom 2020). There have been reported challenges with the reproduction of global standards of PPP success in some African countries. The institutions must therefore strive to develop and implement strategies that improve the odds of success (Olojede et al., 2020). The major telecoms providers can be encouraged to provide specialized e-learning packages in these institutions in view of the guaranteed markets that they represent.

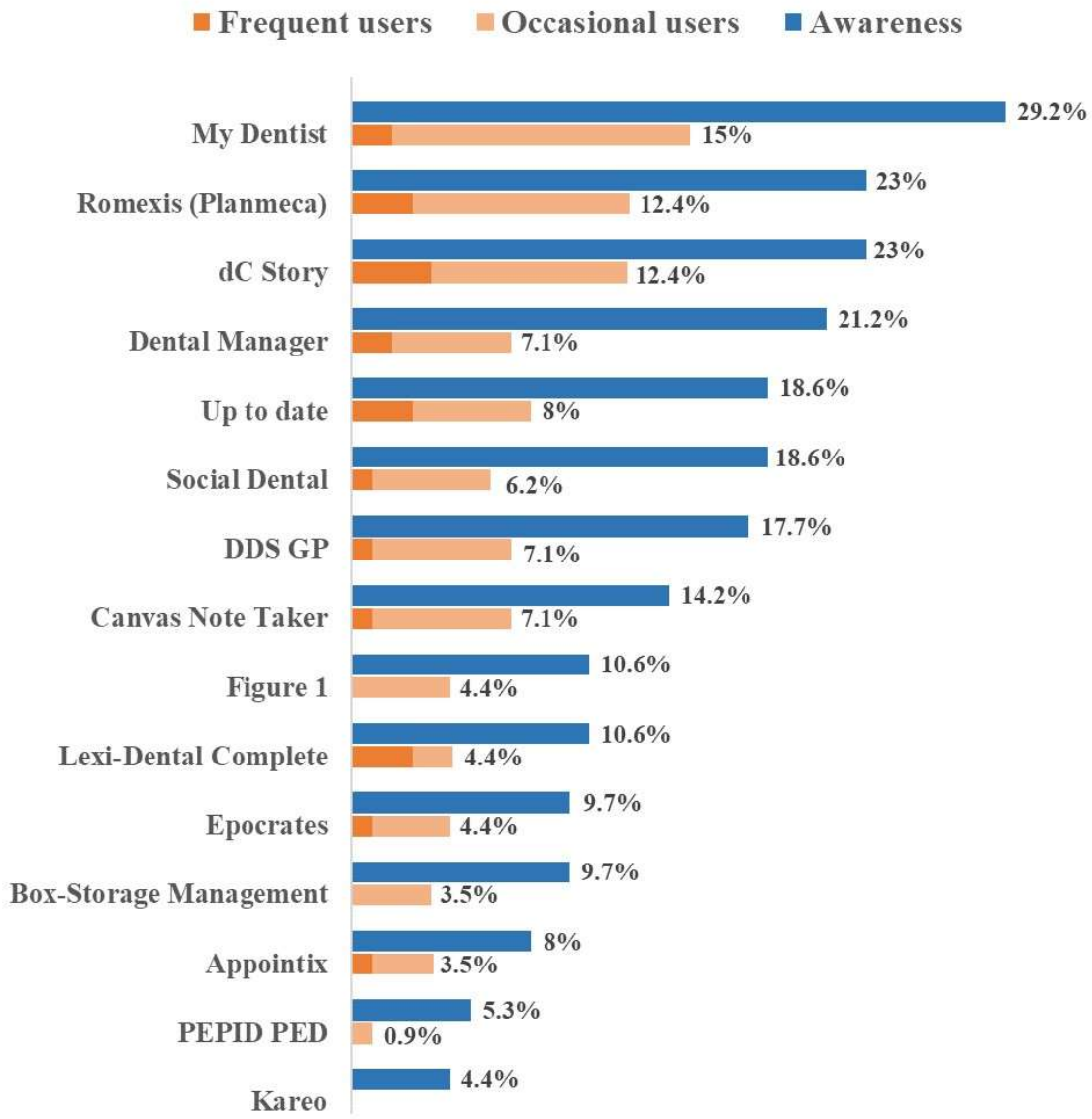

Figure 2: Awareness and Utilization of Medical/Dental Applications

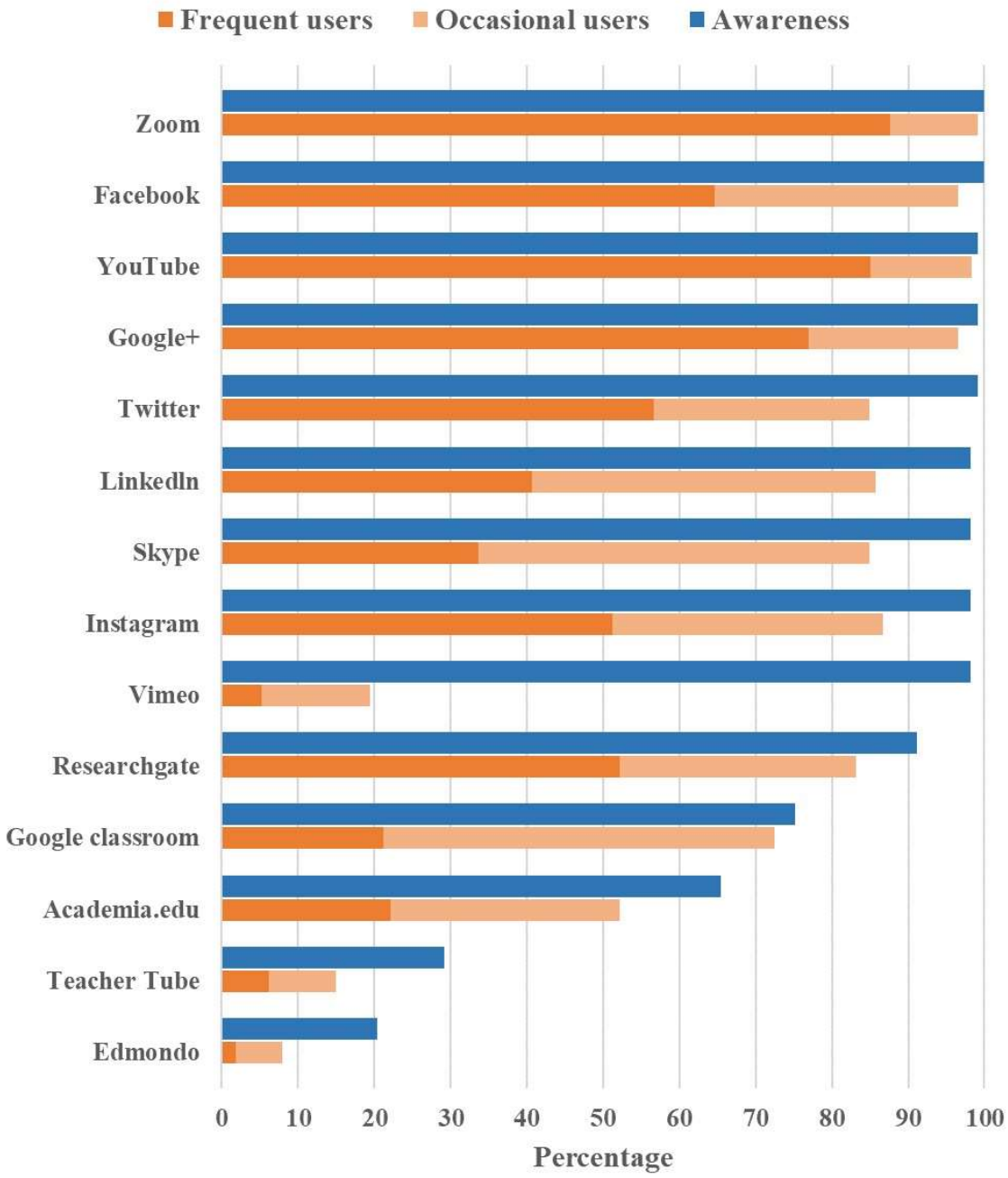

Figure 3: Awareness and Utilization of Social media Tools as Learning Aids

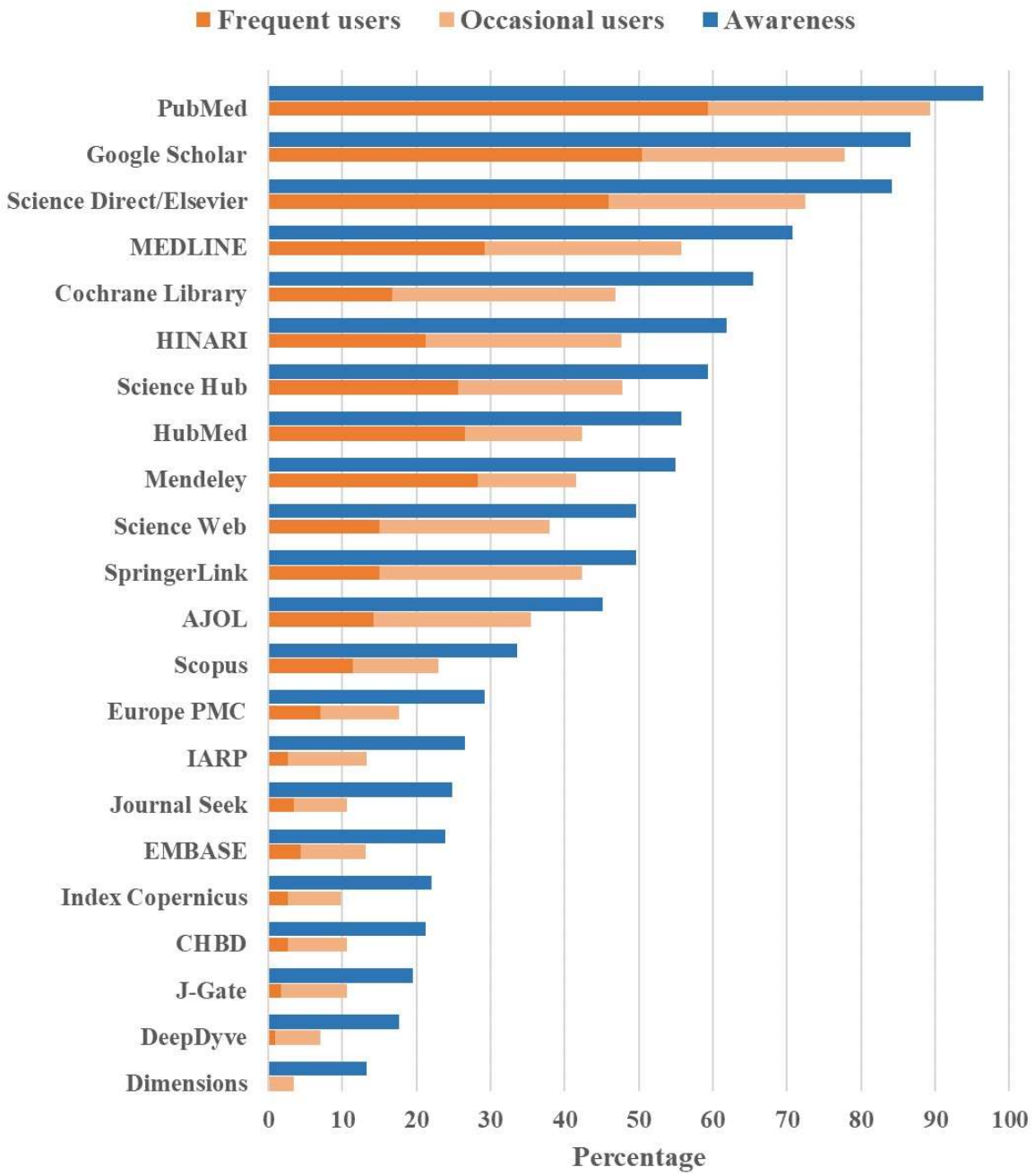

Figure 4: Awareness and Utilization of Biomedical Databases

Medical and Dental learning applications have been reported to improve the quality of dental education and service delivery (Faria et al., 2018). These applications have been shown to improve patient experience during treatment. They have been used to enhance virtual learning with promising results (Moazami et al.,, 2014). However, these applications have been shown to require training of the potential user for productive use (Khatoon et al., 2019). The poor level of awareness and use of these applications recorded in this study strongly indicates the need for formal training concerning the use of these applications among dental residents, and also among their trainers (Sebbani et al., 2021).

Table 2: Comparison of ICT Tools usage with selected socio-demographic variables

Variables		Utilization percentage score (%)		
		Medical/Dental Apps median (IQR)	Social Media mean (SD)	Biomedical database median (IQR)
Gender				
	Female	1.3 (0 to 4)	53.7 (16.5)	23.6 (10.7 to 33.4)
	Male	2.7 (0 to 8)	55.6 (16.2)	23.6 (11.8 to 41.8)
	P-value	0.32	0.57	0.76
Status				
	Junior resident	2.7 (0 to 5.3)	55.4 (15.7)	19.1 (8.6 to 30)
	Senior resident	1.3 (0 to 7.3)	53.8 (17.7)	36.8 (21.8 to 51.8)
	P-value	0.48	0.64	< 0.001*
Place of residency				
	South West	2.7 (0 to 7.7)	54.4 (15.7)	27.3 (11.4 to 45.5)
	SS/SE	2 (0 to 5.3)	54.5 (11.4)	18.6 (9.1 to 31.1)
	North	1.3 (0 to 4)	55.9 (18.9)	23.6 (10.5 to 39.5)
	P-value	0.39	0.89	0.16
Specialty				
	OMFS	1.33 (0 to 4	54.9 (17.0)	17.3 (7.3 to 30)
	Diagnostics	1.33 (0 to 4.7)	53.2 (14.4)	21.8 (16.4 to 33.6)
	Pediatrics	2 (0 to 10.7)	51.6 (17.3)	26.4 (9.8 to 47.7)
	Restorative	4 (2 to 5.33)	54.2 (17.6)	18.2 (7.3 to 46.8)
	Community	0.1 (0 to 4.7)	64.8 (9.1)	27.3 (22.3 to 38.6)
	Family dentistry	1.33 (0 to 5)	47.1 (16.0)	21.8 (11.4 to 27.7)
	P-value	0.40	0.32	0.46

*SS/SE = South South/South East OMFS= Oral and Maxillofacial Surgery, SD=Standard deviation, IQR=Interquartile range *Significant at P < 0.05, P-value obtained using Mann-Whitney and Kruskal-Wallis except for social media utilization scores where Independent T-test and One-Way ANOVA was used.*

Social media resources are emerging tools in medical education based on their versatility and the extensive penetration of internet access. A systematic review carried out as recently as 2013, only found 14 articles that addressed the opportunities and challenges of social media tools in medical education (Cheston et al., 2013). However, there is increased interest in their roles as tools for delivering educational endpoints with the emergence of the COVID-19 pandemic (Sahi et al., 2020; Taha et al., 2020; Zimba et al., 2020). These resources have been advanced to be used as a means of delivering didactic lectures by trainers (Sahi et al., 2020), accessing and sharing data and other research tools (Taha et al., 2020) and for feedback between trainers and trainees (Sahi et al., 2020; Taha et al., 2020; Zimba et al., 2020). The popularity of the Zoom application as a user-friendly video chatting tool during the COVID-19 pandemic has been embraced by many educators. The application has become a popular medium for online seminars and workshops (Anene & Idiedo 2021; Davies et al. 2021).

Biomedical databases are an invaluable resource for research in the dental sciences (Schleyer 2003). They provide a repository of information from which gaps in knowledge can be found for formulating research questions (Yahya et al., 2020). They also provide a researcher with a pool of citations to support their observations (Kafkas et al., 2015). PubMed was the most popular database in use among our cohort. This was not surprising as it was in keeping with findings from other studies (Falagas et al., 2008; Yahya et al., 2020). However, the percentage of frequent users in our cohort is still relatively low at less than 60%. Institutional subscription to these databases may ameliorate the problem of suboptimal utilization by the residents.

The use of biomedical databases was skewed towards senior residents. This is suggestive of these tools being mainly used in preparing dissertations for the final examination in the program. It thus appears that the primary reason for research among respondents was to prepare for and pass examinations. This obsession with examinations may not be unconnected with the dismal pass rates in the fellowship examinations compared to pass rates in other regions of the world. Ohworiole and Obembe (1987) reported a pass rate of about 38% for a 10-year period ending in 1984 for medical residents. Ajah (2018) reported

the low pass rates (28% - 31.5%) in the fellowship examinations for surgeons in his review article in 2018. The authors could not find any reports specifically on the performance of dental residents, but are aware of similar trends among dental residents from their experience as trainers and former residents.

The obsession with examinations by the residents may result from the structure of the training programs by the Postgraduate Colleges. There have been assertions that the Colleges pay too much emphasis on academic evaluation at the expense of clinical skill proficiency of the residents (Ajao & Alao 2016). The results of this study seem to align with this assertion. The miniscule level of use of learning applications among the respondents, and the fact that social media tools were extensively used suggests that there is a generally low level of self-directed search for information, but a high level of transfer of information among the respondents. This is suggestive of the program gradually taking up more of a taught paradigm than being self-directed as originally intended. In an effort to make the program more learner friendly, there have even been calls for training specific to enhancing performance in examinations (Omo & Enabulele 2016). There are however arguments that this approach detracts from the quality of training and subsequently from the products of the training (Ajao & Alao 2016). Resident doctors seem to depend on the revision courses given by both colleges and consider extraneous knowledge counterproductive. This will in the long run reduce their knowledge base in the dental sciences and consequently limit their effectiveness as trainers. We advocate that greater weight be given to extensive oral examinations and multiple-choice questions in the Part I fellowship examination. We also advocate the compulsory participation of junior residents in research activities as a criterion to qualify for examination.

This study, while being an exploratory study, has endeavored to minimize bias. A quantitative method was adopted and all instruments validated before use. We have reported our findings with a strict adherence to the STROBE guidelines for reporting observational studies (Ghaferi et al., 2021). We are confident that our findings are a true representation of ICT tools use among our study population at the time this study was undertaken.

CONCLUSION

The residents generally accessed the internet at their own costs and with their own infrastructure. The mobile phone was the main source of internet access. The residents opined that the internet was important for their training, but; were fairly concerned with the cost of access. The internet was accessed mainly to source for journal articles. The residents had good awareness of commonly available ICT tools except the medical and dental learning applications. Social media tools were most frequently used and biomedical databases were mainly used by the Senior Registrars.

RECOMMENDATIONS

Accreditation committees from the postgraduate colleges should be stricter with training centers concerning minimum infrastructural requirements. The training programs should be revised in line with contemporary realities by introducing ICT-learning modules. This will improve trainee capacity for independent learning and improve research capacity.

Financial support and sponsorship

This work received no specific grant from any funding agency in the public, commercial or not-for-profit sectors

Conflicts of interest

The authors declare that they have no conflicts of interest.

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