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ORIGINAL ARTICLE

USE OF SMARTPHONES AMONG MEDICAL STUDENTS IN THE CLINICAL YEARS AT A MEDICAL SCHOOL IN SUB-SAHARA AFRICA: A PILOT STUDY

Nasiru A **Ibrahim**, MBBS, FWACS[1], Mohammad **Salisu**, MBBS, FWACPaed[2], Abiodun A **Popoola**, MBBS, FWACS[3], Taofeeq I **Ibrahim**, MBBS[4]

[1]Department of Surgery, Lagos State University College of Medicine, Ikeja, Lagos State, Nigeria; [2]Department of Paediatrics, Lagos State University College of Medicine, Ikeja, Lagos State, Nigeria; [3]Department of Radiology, Lagos State University College of Medicine, Ikeja, Lagos State, Nigeria; [4]Federal Medical Centre, Ebute Metta, Lagos State, Nigeria

Corresponding author: Nasiru A Ibrahim, Department of Surgery, Lagos State University College of Medicine, 1–4 Oba Akinjobi Street, Ikeja, Lagos State, Nigeria. Tel: +2348023044971, E-mail: ibrahimakanmu@yahoo.com

Background: Smartphones help in quick access to medical information, enhance student learning in clinical environment and increase their knowledge score. We conducted a pilot study of medical students in the clinical years to assess their current utilization of mobile phones, the perceived advantages and barriers.

Methods: A cross-sectional survey of 5th and 6th year medical students using a pre-tested questionnaire was conducted. Information gathered were bio-data, type of mobile phone owned, usage pattern in terms of frequency and applications, perceived advantages and barriers. Data was analysed employing SPSS version 15.

Results: All the 123 participants owned smartphones and the greatest use among majority (>63%) was for routine functions such as receiving or making calls, sending or receiving SMS and e-mails, as schedule/calendar/planner and as dictionary. Less frequent usage (41% to 59%) was to access and take lecture notes, access medical videos, electronic textbook and for medical research. They were rarely used (<32%) as clinical tools in patient management, for course evaluation and as log book. Battery life, small size screen, slow speed, limited memory and cost were the major barriers to mobile learning while the greatest advantages were mobility of the device, ease of use, access to current information and ease of access to resources.

Conclusions: Our medical students appeared comfortable with the use of smartphones for routine personal applications, searching academic resources as well as accessing and taking lecture notes without institutional assistance. With minimal support, they could be encouraged to use their mobile phones for greater education activities and accessing clinical materials.

Journal MTM 3:2:28–34, 2014 doi:10.7309/jmtm.3.2.5 www.journalmtm.com

Background

Use of smartphones has become an important and useful component of medical education. With increasing amount of information available in medicine today, use of these portable devices help in quick access to medical information and

improves clinical management of patients[1]. These devices, also referred to as personal digital assistants (PDAs), have various applications in medical learning and care of patients. They include the iPhone, Blackberry and iPad. Common learning activities are formal instruction, conducting real-time surveys via wireless units, feedback to students, course administration, students gathering data to post to the course or to other students, question and answer sessions, and assessment[2,3]. Bedside use include calculation of clinical prediction rules, checking for drug interactions, expanding differential diagnoses by consulting references, electronic order entry and patient tracking[4,5]. These functions are found to enhance student learning in the clinical environment and increase their knowledge scores[6]. Studies have shown that 60% to 70% of medical students in the clinical years and residents use PDAs for educational purposes or patient care. In addition, high level of satisfaction was observed and this correlated with the level of handheld computer experience[7].

Several factors influence adoption of mobile learning in medical education. These include building specialized network for smartphones, provision or subsidizing cost of the device to students, adapting materials specifically for the phones, providing training and technical support to students and staff[7,8]. On the other hand, insufficient security, requirement for change, costs, poorly designed packages, inadequate technology, lack of skills, need for a component of face to face teaching, time intensive nature of e-learning, computer anxiety and lack of institutional support are some of the identified barriers[9–11].

Functions of smartphones have been increasing in scope since the release of the Apple Newton and Palm Pilot smartphones in 1993 and 1996 respectively. Apple's *iPhone* released in June 2007 blended the features of the PDA with those of the mobile phone. Current devices are smaller, lighter in weight and have sufficient memory to store large amounts of data and reference material. They also have larger number of applications including those designed for specific medical fields.[12,13]. Access to mobile phones is rapidly growing in Africa while internet facilities are also increasing with installation of multiple undersea fibre-optic cables[14]. Mobile telephony employing the Global System for Mobile Communication (GSM) was introduced into Nigeria in the year 2001. Presently, vast majority among the population own mobile phones with many having the latest versions of smartphones.

Mobile learning has not been fully incorporated into the medical education methods in majority of sub-sahara African medical schools. This is largely due to poor communication infrastructure and limited financial resources. A survey among health care students and tutors in Uganda revealed that 98% owned mobile phones but access to the internet was poor[15]. Nigeria has 25 medical schools; 21 were established by Government and students pay subsidized fees while the remaining 4 were privately owned. Lagos State University College of Medicine (LASUCOM) established less than two decades ago by the Lagos State Government is reputed to be one of the fastest growing medical schools in Nigeria in terms of infrastructure and manpower. Improving quality of teaching and learning in the school by wider and institutionalized use of modern information and communication technology in the educational process is desirable. We, therefore, conducted a single institution survey of medical students in the clinical years to assess their current utilization of smartphones, the perceived advantages as well as barriers to the use of the device. Results from this pilot study may assist in identifying areas of needed support to the students and inform the need for a wider study that may help in producing well trained Doctors that would contribute meaningfully to health care delivery especially in resource-poor settings.

Methods

Participants

One hundred and twenty five medical students in the 5th and 6th (final) clinical years at the Lagos State University College of Medicine were the target study population. They had completed the basic medical sciences and the laboratory medicine classes and had commenced direct interaction with patients in the course of their learning in the medical school. They are expected to be in greater need for the various clinical applications developed for smartphones that aid learning and patient care. The final year students have, at least, one year extra clinical exposure over their 5th year colleagues. The survey was conducted in November 2012. The National Health Research Ethics Committee deemed this survey exempt from health research ethics committee oversight as the study is to evaluate education instructional strategy and improve student learning experience. In addition, it

poses no added risk to participants. Statement of consent to participate was incorporated into the survey form. Participants were informed about the objectives of the study and were assured that their responses shall be anonymous and confidential. It was also stated that participation in the study shall be voluntary.

Measures

The survey questionnaire used in the study was adapted from the one used in a previous study[11]. The questionnaire was in four parts. The first section described the gender, level of study and information regarding the type of mobile device owned by the students. In the second part, various activities that mobile phones could be used for were listed and participants were asked to tick the ones they use their device for. They were also required to state the frequency of such usage in the past one year. Participants were asked to tick five greatest barriers to using mobile phones for clinical and learning activities among nineteen identified options in the third part while the fourth section required respondents to tick five greatest advantages to the use of the device among fourteen listed options. They were also allowed to make other comments if they so desired in this section.

Procedure

Pre-test of the questionnaire was conducted among ten fourth year medical students who have had some exposure to clinical medicine. Areas of ambiguities that were identified were modified to achieve clarity. Printed survey forms were then distributed to the eligible students through their respective heads of class who were also mandated to collect the filled forms and submit to the first author.

Data analysis

Variables were coded and data entered electronically into SPSS version 15 spread sheet. Frequency distribution and percentages were produced for categorical variables while statistical comparison was conducted using chi-square test. Level of statistical significance was set at $p < 0.05$.

Results

Completed survey questionnaires were returned by 123 out of 125 eligible students giving a response rate of 98.4%. Among 110 respondents who indicated their sex, 64 (58%) were males while 46 (42%) were females. Sixty three (51.2%) were 5th year medical students while the remaining 60 (48.8%) were in the 6th year. All the participants owned smartphones with majority (58.5%) having the Blackberry brand. Other brands owned by respondents are as shown in Table 1. The phones were less than 2 years old in 101(82%) respondents. Gender and year of study did not significantly influence the brand of phone owned by the respondents ($p > 0.05$).

Activities smartphones were used for are as shown in Table 2. Greatest use among majority (>63%) was for routine functions such as receiving or making calls, sending or receiving SMS and e-mails, as schedule/calendar/planner and as dictionary. Other frequent usage (41% to 59%) were to access and take lecture notes, access medical videos, electronic textbook and for medical research. Usage as clinical tools in patient management, course evaluation and as log book were the least frequent (<32%). Activities were not influenced by gender of participants ($p > 0.05$). Activities influenced significantly by year of study were making and receiving calls which was more frequent among 5th year students ($p = 0.043$) while 6th year students were using their phones more frequently in taking notes ($p = 0.014$), accessing journal articles ($p = 0.022$) and as planner/scheduling/calendar ($p = 0.021$).

Table 3 shows barriers and advantages of smartphones in mobile learning as perceived by the students. Battery life, small size screen, slow speed, limited memory and cost were the major barriers to mobile learning while the greatest advantages were mobility of the device, ease of use, access to current information anywhere anytime and ease of access to resources. There is no significant difference among the respondents regarding perception of barriers and advantages to use of smartphones in mobile learning in terms of their gender or year of study

S/N	Brand of phone	Number	percentage
1	Blackberry	72	58.5
2	Nokia	26	21.1
3	Apple i phone	8	6.5
5	htc	5	4.1
6	Samsung	4	3.3
7	Others	8	6.5
	Total	123	100

Table 1: Brand of phones owned by the students

Activities	Daily		Weekly		Monthly		2–10 times		Once		Never		No response	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Make/Receive calls	122	99.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.8
Send/Receive sms	109	88.6	9	7.3	0	0.0	0	0.0	0	0.0	0	0.0	5	4.1
Planner/Scheduling/ Calender	81	65.9	2	1.6	2	1.6	3	2.4	9	7.3	17	13.8	9	7.3
Send/Receive e-mail	77	62.6	5	4.1	13	10.6	6	4.9	3	2.4	16	13.0	3	2.4
Dictionary	77	62.6	6	4.8	3	2.4	4	3.6	7	5.6	18	14.6	8	6.5
Medical websites	77	62.6	4	3.3	0	0.0	2	1.6	11	8.9	19	15.4	10	8.1
Access lecture notes	73	59.3	5	4.1	5	4.1	7	5.6	6	4.9	22	17.9	5	4.1
Electronic textbook	62	50.4	1	0.8	1	0.8	0	0.0	9	7.3	42	34.1	8	6.5
Access medical videos	54	44	1	0.8	2	1.6	1	0.8	15	12.2	33	26.5	17	13.8
Taking notes	53	43.1	0	0.0	0	0.0	0	0.0	10	8.1	48	39.0	12	9.8
Medical research	50	40.7	2	1.6	0	0.0	0	0.0	20	16.3	40	32.5	11	8.9
Journal articles	45	36.6	1	0.8	1	0.8	1	0.8	14	11.4	51	41.5	10	8.1
Course survey/evaluation	39	31.7	1	0.8	0	0.0	0	0.0	7	5.7	54	43.9	22	17.9
Clinical algorithms /Guidelines	**37**	**30.1**	**1**	**0.8**	**1**	**0.8**	**2**	**1.6**	**8**	**6.5**	**62**	**50.4**	**12**	**9.8**
Clinical calculators	**37**	**30.1**	**1**	**0.8**	**0**	**0.0**	**2**	**1.6**	**6**	**4.9**	**67**	**54.5**	**10**	**8.1**
Medical reference tool	**35**	**28.4**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**12**	**9.8**	**61**	**49.6**	**15**	**12.2**
Course exams/quizzes	**32**	**26**	**0**	**0.0**	**1**	**0.8**	**0**	**0.0**	**16**	**13.0**	**55**	**44.7**	**19**	**15.5**
Recording patients information	**14**	**11.4**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**6**	**4.8**	**98**	**79.7**	**5**	**4.1**
Medical records	**13**	**10.6**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**6**	**4.9**	**94**	**76.4**	**10**	**8.1**
Laboratory reports	**7**	**5.6**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**8**	**6.5**	**100**	**81.3**	**8**	**6.5**
Patient tracking	**6**	**4.9**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**107**	**87.0**	**10**	**8.1**
Log books	**6**	**4.9**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**4**	**3.3**	**105**	**85.3**	**8**	**6.5**

No = Number of respondents
% = Percentage

Table 2: Activities smartphones were used for by the respondents

($p > 0.05$). Extra comments were not made by the respondents.

Discussion

Although, smartphones could be used for different activities such as routine personal applications, searching academic resources, clinical references and electronic medical records, pattern of usage vary among medical students. Most frequent usage of mobile phones in this study were for personal applications, accessing lecture notes and searching academic resources. This pattern of usage is similar to what was found among final year medical students in Oman[11]. In contrast, clinical students in two medical schools in the United States of America (USA) used handheld devices more frequently as drug references and clinical calculator. However, pre-clinical students in the two schools used their mobile phones mainly for personal scheduling and task lists[16], similar to usage pattern in this study. Other studies conducted in developed countries also reported greater use of mobile devices by students for medical care purposes[17,18]. Poor usage of smartphones by our students for activities relating to patient care could be because support medical services in the hospital are not fully computerized and are not accessible electronically. In addition, our students have only limited responsibility in patient care and this may also be factor. Masters et al[11] suggested similar reason for poor point of care usage of mobile phones by final year students in his institution.

Participants usage of smartphones for educational purposes was mainly in self-directed learning in form of electronic textbook and to access lecture notes, academic resources and medical videos. Similar trend was observed among health care students in Uganda[15]. Formal teaching and evaluation of students using mobile technology have not been incorporated into our medical education

Barrier	No	%	Advantages	No	%
Battery life	78	63.5	Mobility	98	79.7
Small size screen	65	52.8	Ease of use	75	61
Slow speed	48	39	Access current information	74	60.2
Limited memory	46	37.4	Anywhere/anytime access	64	52.0
Cost	45	36.6	Ease of access to resources	54	43.9
Technical difficulty	26	21.1	Saves time	52	42.3
Bandwidth	23	18.7	Accuracy	28	22.8
Poor quality of softwares	22	17.9	Evidence based practice	23	18.7
Lack of training	21	17.1	Cheap/free software	18	14.6
Small size of keyboard	19	15.4	Small size advantage	15	12.2
Prefer pen and paper	16	13	Enhance health care delivery	13	10.6
Slow data entry	16	13.0			
Loss of data	14	11.4	Improved patient care	11	8.9
Poor data entry interface	11	8.9	Easy to complete documentation	10	8.1
Privacy concern	8	6.5	Reduced risk of error	8	6.5
Device too delicate	6	4.9			
Lack of support	5	4.1			
Poor vision	2	1.6			
Interference of other devices	2	1.6			

No = Number of respondents
% = Percentage

Table 3: Barriers and advantages of smartphones in mobile learning as perceived by students

system. Many schools especially in developed nations have adopted this valuable tool in the classroom setting for the students and their teachers. Advantages include downloading lecture materials before-hand thereby allowing students concentrate during lectures, real-time assessment of students knowledge, documentation of clinical and procedural experiences instead of using traditional logbooks and teaching evaluation[1–3,7,19].

Majority among the students found mobility, ease of use, quick access to current information and resources as the main advantages in the use of smartphones in medical learning. These factors were cited by medical students in other studies as facilitating use of these devices[11,18]. Although, improvement in the quality of care, efficiency and clinical knowledge were considered by medical students as the main advantages of mobile devices in a study conducted by Stephens et al[17] in an institution that supports medical computing, these were less important to students in this study. Since majority among the students rarely use their phones for clinical purposes, it could explain why these important point of care attributes of smartphones were not appreciated by our students. Similar observations were made by Masters et al[11] among medical students in Oman, a similar developing nation. Provision of smartphones uploaded with clinical decision support software (CDSS) to medical students was associated with increased use in clinical settings and improved knowledge of evidence-based medicine[20]. Resident Doctors who shoulder greater responsibility in patient care consider smartphones an important tool in enhancing productivity, quality of patient care and services[21].

More than half among participants cited battery life and small size screen as the greatest barriers to using smartphones. These physical features of the phones were also reported to be major barriers in other studies[11,21,22]. Increasing the screen size may negates the pocket size feature of mobile phones which is considered an advantage[23]. Cost of smartphones was a limitation among 40% in this study. Concerns regarding cost were also reported in other studies[11,18,24]. Type, level of sophistication of device and the number of medical application software incorporated into the phones owned by students determine the cost and may influence the way they perceive this as a barrier. Other important limitations reported were lack of technical support as well as training on the use of the device[16,17]. These were mentioned mainly by students in institutions that

support and encouraged mobile learning either by providing PDAs to their students or having computer-based hospital information system. Less than a third among our students considered these as barriers. Possible reason could be because they use their smartphones mainly for routine functions and to search academic resources and not for sophisticated medical applications.

Use of smartphones in medical learning, teaching and patient care is rapidly expanding and may eventually become universal. With the potential of improving learning, patient safety and care, medical institutions have commenced incorporating use of these devices in the curriculum as an educational tool[17,19,25]. Institutional support to encourage adoption of the new technology included training for students and staff and creation of specific and customized teaching applications for the device[7,19]. However, concerns were equally raised regarding some perceived drawbacks of the new technology. Encouraging superficial learning as against internalization of knowledge which is a traditional part of medical education[18], over-reliance on the device[21] and security of patients information[18] were some of the challenges. Our medical students are being trained to become Doctors, well-equipped to meet the ever increasing challenges of modern medical practice. They should keep pace with ever increasing body of knowledge, evidence based practice and changing protocols and guidelines in the management of diseases that are specific and relevant to our environment e.g. HIV, Tuberculosis and Malaria. Therefore, they should not be left behind in current trends in medical learning. Achieving this poses a greater challenge in our setting with inadequate resources to fund education.

Conclusions

Our medical students were able to own smartphones and appeared comfortable with the use of the device for routine personal applications, searching academic resources like medical videos and electronic textbook as well as accessing and taking lecture notes without institutional support. They could be encouraged to use their smartphones for more educational activities with minimal support. Such activities include allowing students download lecture notes before time. This allows the students listen and concentrate during lecture time. Also, assessment of students can be conducted by posting questions on-line while they respond at the same time allowing real-time assessment and interactivity. In addition, they could be assisted and guided in assessing clinical materials such as clinical decision software, practice guidelines, medication reference tools and electronic textbooks available on the web. Our hospitals should be encouraged to move towards electronic data base and information system which will allow students greater use of their mobile devices for point of care activities. Furthermore, there is need for a multi-centre study involving public and private medical schools to give the findings a nationally representative perspective.

Conflict of interest

All the authors declare no conflict of interest

References

1. Fischer S, Stewart TE, Mehta S, et al. Handheld Computing in Medicine. *J Am Med Inform Assoc.* 2003;**10**(2):139–49.

2. Masters K. The extent to which m-learning is used by early adopters of educational technology: an international survey of Ed-Media In: Siemens G, Fulford C, editors. *World Conference on Educational Multimedia, Hyper-media and Telecommunications*; Chesapeake, VA: AACE; 2009

3. Menon AS, Moffett S, Enriquez M, et al. Audience response made easy using personal digital assistants as a classroom polling tool. *J Am Med Inform Assoc.* 2004;**11**:217–20.

4. Torre DM, Wright SM. Clinical and educational uses of handheld computers. *South Med J.* 2003;**96**:996–9.

5. Adatia F, Bedard PL. "Palm reading" 2. Handheld software for physicians. *Can Med Assoc J.* 2003;**168**: 727–34.

6. Sutton J, Stockton L, McCord G, et al. Handheld computer use in a family medicine clerkship. *Acad Med.* 2004;**79**:1114–9.

7. Kho A, Henderson LE, Dressler DD, et al. Use of Handheld Computers in Medical Education: A Systematic Review. *J Gen Intern Med.* 2006;**21**(5):531–7.

8. Cacace F, Cinque M, Crudele M, et al. The impact of innovation in medical and nursing training: a hospital information system for students (HISS) accessible through mobile devices. In: Attewell J, Savil-Smith C, editors. *Mobile learning anywhere anytime everywhere (MLearn 2004)*; Rome: Learning and Skills Development Agency; 2004.

9. Lu YC, Xiao Y, Sears A, et al. A review and a framework of handheld computer adoption in healthcare. *Int J Med Inform.* 2005;**74**(5):409–22.

10. Childs S, Blenkinsopp E, Hall A, et al. Effective e-learning for health professionals and students–barriers and their solutions. A systematic review of the literature–findings from the HeXL project. *Health Info Libr J.* 2005;22 Suppl 2:20–32.

11. Masters K, Al-Rawahi Z. The use of mobile learning by 6th-year medical students in a minimally-supported environment. *International Journal of Medical Education.* 2012;**3**:92–7.

12. White JS, Sharma N, Boora P. Surgery 101: evaluating the use of podcasting in a general surgery clerkship. *Med Teach.* 2011;**33**:941–3.

13. Oehler RL, Smith K, Toney JF. Infectious diseases resources for the iPhone. *Clin Infect Dis.* 2010;**50**: 1268–74.

14. Finishing the job. The Economist. 2009 Sep 24th.

15. Chang LW, Mwanika A, Kaye D, et al. Information and communication technology and community-based health sciences training in Uganda: perceptions and experiences of educators and students. *Inform Health Soc Care.* 2012;**37**:1–11.

16. Grasso MA, Yen MJ, Mintz ML. Survey of handheld computing among medical students. *Comput Methods Programs Biomed.* 2006;**82**:196–202.

17. Stephens MB, Waechter D, Williams PM, et al. Institutional support for handheld computing: clinical and educational lessons learned. *Med Ref Serv Q.* 2010;**29**:28–36.

18. Wallace S, Clark M, White J. 'It's on my iPhone': attitudes to the use of mobile computing devices in medical education, a mixed-methods study. *BMJ Open*. 2012;2(4). pii: e001099. doi: 10.1136/bmjopen-2012-001099. Print 2012.

19. Bertling CJ, Simpson DE, Hayes AM, et al. Personal digital assistants herald new approaches to teaching and evaluation in medical education. *WMJ.* 2003; **102**:46–50.

20. Johnston JM, Leung GM, Tin KY, et al. Evaluation of a handheld clinical decision support tool for evidence-based learning and practice in medical undergraduates. *Med Educ.* 2004;**38**:628–37.

21. McAlearney AS, Schweikhart SB, Medow MA. Doctors' experience with handheld computers in clinical practice: qualitative study. *BMJ.* 2004;**328**: 1162.

22. Lu YC, Lee JK, Xiao Y, et al. Why don't physicians use their personal digital assistants? *AMIA Annu Symp Proc*. 2003;405–9.

23. Farrell MJ, Rose L J. Use of mobile handheld computers in clinical nursing education. *Nurs Educ.* 2008;**47**:13–9.

24. Payne KB, Wharrad H, Watts K. Smartphone and medical related App use among medical students and junior doctors in the United Kingdom (UK): a regional survey. *BMC Med Inform Decis Mak*. 2012;**12**:121. doi: 10.1186/1472-6947-12-121.25

25. Jackson M, Ganger AC, Bridge PD, et al. Wireless Handheld Computers in the Undergraduate Medical Curriculum. *Med Educ Online [serial online]*. 2005; 10:5. http://www.med-ed-online.org. . .