



HANDHELD DEVICES (HHD) USE AMONG FAMILY MEDICINE RESIDENTS IN RIYADH CITY, KSA

*Dr. Faisal Ibrahim Almohaileb

Family and Community Medicine Department, College of Medicine, Qassim University, Qassim, Saudi Arabia PO Box 143 Buraidah 51411 Saudi Arabia.

*Corresponding Author: Dr. Faisal Ibrahim Almohaileb

Family and Community Medicine Department, College of Medicine, Qassim University, Qassim, Saudi Arabia PO Box 143 Buraidah 51411 Saudi Arabia.

Article Received on 10/01/2018

Article Revised on 30/01/2018

Article Accepted on 20/02/2018

ABSTRACT

Background: Among health care providers, especially physicians, the use of Handheld Devices (HHD) including smartphones and tablets has evolved since the handheld devices technology keeps improving. There are specific applications that were designed for medical staff to provide updated information to help them enhance their knowledge and skills. Doctors can hold textbooks, medical calculators, and drug references to look up indications for a recently approved medication, and review clinical guidelines. The rapid retrieval of updated evidence-based medical information through the use of electronic devices including handheld devices is becoming necessary for fast, efficient and safe medical practice. Currently, no literature was found to determine the handheld devices effects on family medicine residents on Riyadh. **Objectives:** The study's aim is to identify the prevalence of handheld devices ownership and to determine the different practices and utilizations of handheld devices among family medicine residents in Riyadh Family Medicine residency program. **Methods:** This is a cross-sectional, an online based questionnaire, which was developed and distributed to all family medicine residents in Riyadh, Saudi Arabia. Participants were asked whether they have handheld devices and if they used any medical related application on their handheld devices to enhance their clinical and learning needs. The frequency of their usage and type of application used were also investigated. **Results:** 124 residents responded, equating to a response rate of 60%. All respondents owned smartphones 100%, and 69% (n=89/124) of them owned tablets, iOS being most prevalent among both devices (62% and 50% respectively) compared to Android (38% and 16% respectively). Almost all residents 96% (n=119/124) had medical applications installed on their handheld devices, 40% (n=50/124) of them had a 2-5 application installed. Approximately 38% (n=47/124) of respondents were using their devices for learning needs several time a day. The duration spent on the handheld device for medical or clinical purposes mostly 52 % (n=65/124) were 10-30 minutes' daily. 59% (n=73/124) of the respondents find handheld device very useful. Residents were asked about the impact of the HHD, 40% (n=49/124) agreed to be a vital part of their learning, 59% (n=73/124) considering it a useful aid, in contrast, 2% (n=2/124) find it not helpful. When respondents were asked about their attitude regarding the use of HHD in the clinic or wards 15% (n=19/124) strongly disagree, 25 % (n=31/124) disagree that they will spend less time with patients. On the other hand, 12% (n=15/124) strongly agreed if used HHD in the clinic or wards the will spend less time with patients. **Conclusion:** Handheld devices are adopted by almost all residents who perceive them as a very useful tool in their clinical practices and learning needs. These technologies are becoming more popular among all healthcare providers, by providing point-of-care tools.

KEYWORDS: Handheld device, Smartphone, Mobile Technology, Family residents, Questionnaire.

1. INTRODUCTION AND LITERATURE REVIEW

Hand-held devices (HHD) including smartphones and handheld tablets are portable, small and lightweight computers. Nearly all HHD have wireless access either through a cellular data services or Wireless Ethernet (Wi-Fi) which made their utilization become a common behavior among the general population, besides voice and video calls, it also gives on-the-go access to a variety of options such as email, built-in camera, calculators and

net browsing.^[1,2] Furthermore, the newer versions of HHDs are easy to use and featured software auto-update, making their performance and usage more straightforward and smooth.^[3]

Among healthcare providers, especially physicians, the use of HHD has evolved since the HHD technology keeps improving. There are specific applications that were designed for medical staff to provide up-to-date information to help them improving their knowledge and

skills.^[4] Several studies were found investigating the subject.

A survey conducted in United Kingdom by Payne et al. showed that most of the junior doctors (74.8%) owned a smart phone.^[5] The study demonstrated that in the last 24 hours' applications were used for between 1–20 minutes. The respondents favor and agreed for the needs of the development of more applications to support their education and clinical practice. The authors recommend that organizations and developers should focus not only on appropriate app development but also on the perceptions of health care professionals and users on the use of mobile technologies in clinical areas.^[5]

Another study done in 2002 by Criswell, D. F, and M. L. Parchman, about the use of handheld computers among all residents registered in family medicine programs (AAFP and ACOFP) in United States reported that handheld computers were used in two-thirds of their residency programs.^[6] In addition to the installed notepad, calendar and contacts book, the most commonly used medical applications in HHD were medication reference tools, medical calculators and electronic textbooks programs. Furthermore, the adoption HHD have led to improvement in the patient care. The readily available specific application about the patient at point-of-care made complete and accurate information to reduce potential errors or outdated information. Likewise, the availability of updated online clinical information sources and electronic textbook encourage their users as lifelong learners. The authors concluded that further studies are required to recognize how to implement HHD in residency programs curricula and to know the possible effect of HHDs use on patient healthcare. However, the data from this study were published in 2002 that outdated.^[6] Furthermore, the study aimed to evaluate the handheld computers that are currently less available, harder to use and expensive compared with the now existing technologies.^[6]

Hayley Goldbach et al. did another study in Republic of Botswana (2013) aimed to compare the performance of the residents in answering clinical scenarios, using medical applications on their smart phones at resource-limited settings about a specifically given topics. The study showed that residents who are using medical apps scored a higher score compared with the other group.^[7] As these applications designed to be user-friendly and present information in aggregated topic-specific and easily accessible information that includes primary literature and treatment options with evidence-based analyses that assist clinical decisions about topics such as medications dosing and treatment regimens. In this study, authors evaluated which smart phone tools may be beneficial to clinicians in resource-limited settings also emphasized on evidence-based care.

A study was done by Rudkin et al., (2006) in physicians who used HHD in emergency medicine department were

more likely to correct the initial diagnosis or treatment of a patient twice as often as paper texts. Interestingly, they found that generally patients accepted the use of HHD by their physician without an unwanted effect on confidence. Additionally, the authors found HHDs were used more commonly than paper texts while access times were similar.^[8]

A survey done by Tim Robinson et al., (2012) about smart phone use and its acceptability among medical students demonstrates that the majority of students own a smart phone, and using it in their learning.^[9] Also, respondents were generally positive towards the idea of using smart phones in their education and seemed to be confident using them. Participants suggested smart phones would be beneficial as immediate sources of information or for administrative and organizational purposes. The results of this investigation suggest medical students are receptive towards using smart phones in their education, and the authors recommend to ensure these devices are employed in the correct context.

A local study was done by Alsadoon, (2012) about the use of cell phones in education at King Saud University in KSA found that the majority (97%) of the participants own laptops and almost all of them own smart phones devices (99.6%) in Saudi Arabia.^[10] Results indicated that Saudi students perceived the cell phone as a polling device and text messages as a way of delivering instruction.

No data from Saudi Arabia or in the neighboring countries on the use of HHD and utilization of medical applications among family medicine resident were found at the time of the literature review.

2. METHODOLOGY

Research Design

Cross-sectional study.

Target Population

Family medicine residents.

Study setting

Family medicine training centers in Riyadh city, Kingdom of Saudi Arabia.

Sampling Technique

All Family Medicine residents in Riyadh will be invited to participate in the study.

Eligibility Criteria

All Family Medicine residents in Riyadh city of both genders who are willing to volunteer in participating in the study.

Data Collection

The original questionnaire was produced by the head researcher on another study^[2] that permit unrestricted use if the primary research is properly cited and was

reviewed by four experts for content validity and reliability. Modifications on the original questionnaire were done to meet the objectives of the study by determining the prevalence of HHDs' ownership in family medicine residents in all training centers in Riyadh and the impact related to their usage in the education and clinical practice. Also, residents were asked about their frequently used medical related applications and residents' attitude regarding the use of HHD. Then the questionnaire was pilot tested on five residents, who were representative of the study population within one training center and altered accordingly. After that, an online digital 17-question questionnaire was designed through Google Forms and distributed via email and WhatsApp Inc. messages. A total 206 family residents in Riyadh were invited to participate in the study by filling the questionnaire provided in the link sent. No incentive was offered to all participants. The first survey request was sent on May 9, 2016, followed by two reminders two weeks apart to increase the response rate. The questionnaires were completed from May 9 to Jun 27, 2016.

Data Analysis

The responses were automatically recorded into a database and tabulated by Google Forms as frequencies and used for descriptive statistics. Chi-square analyses and Fisher's exact tests were applied to perform group comparisons of the categorical results. A t-test was carried out to compare continuous variables. A p-value

of <0.05 was considered significant for all tests. The data were statistically analyzed using a statistical package for social sciences (SPSS, Version 20 for Windows).

3. Ethical considerations

Ethical approval was obtained from the research ethics committee at Research Center in Prince Sultan Military Medical Center. Information on the nature of this study was provided to all participants, and consent implied by an individual's voluntary completion of the questionnaire.

4. RESULT

The questionnaire was distributed through email and WhatsApp Inc. to all family medicine residents in Riyadh (206), the respondents were 124 residents, with 60% response rate. Of the 124 responded residents, 74 were males and 50 were females median age was 29 years (29.6 ± 4), and 55% were married ($n=69/124$).

Among these residents, 15% ($n=19/124$) were first-year trainees (R1), 23% ($n=29/124$) were second-year trainees (R2), and 41% ($n=51/124$) were third year-trainees (R3), 20% ($n=25/124$) were fourth-year trainees (R4). All training centers' residents participated, most of the responses were from Prince Sultan Military Center training program 45% ($n=56/124$) followed by King Khalid University Hospital training program with response rate of 20% ($n=25/124$). Sociodemographic and job characteristics are shown in Table 1.

Table 1: Sociodemographic and job characteristics (n=124).

Variable	Mean \pm SD*	Frequency	Percentage (%)
Age			
	29.6 \pm 4		
Total			
Gender			
Male		74	59.7
Female		50	40.3
Total		124	100.0
Marital Status			
Single		50	40.3
Married		69	55.6
Divorced		5	4.0
Total		124	100.0
Training Level**			
R1		19	15.3
R2		29	23.4
R3		51	41.1
R4		25	20.2
Total		124	100.0
Training Center			
Prince Sultan Military Center		56	45.2
King Saud Medical City		3	2.4
Security Forces Hospital		12	9.7
King Khalid University Hospital		25	20.2
King Abdulaziz Medical City		20	16.1
Other		8	6.5
Total		124	100.0
* SD: Standard Deviation			
** R: Residency Level			

All respondents owned smartphones 100% (n=124/124), and 69% (n=89/124) of them owned tablets, iOS being most prevalent among both devices (62% and 50% respectively) compared to Android (38% and 16% respectively).

Overall, 96% (n=119/124) of the respondents had medical applications installed on their handheld devices, 40% (n=50/124) of them had a 2-5 application installed. Approximately 38% (n=47/124) of respondents were using their devices for learning needs several time a day, while 2% (n=3/124) are using them less than once a week. The duration spent on the handheld device for medical or clinical purposes mostly 52% (n=65/124) were 10-30 minutes daily, whereas 8% (n=10/124) are using >60 minutes. 59% (n=73/124) of the respondents find handheld device very useful compared to 6%

(n=8/124) who find it of little use in their medical practice.

Residents were asked about the impact of the HHD, 40% (n=49/124) agreed to be a vital part of their learning, 59% (n=73/124) considering it a useful aid, in contrast, 2% (n=2/124) find it not helpful.

When respondents were asked about their attitude regarding the use of HHD in the clinic or wards 15% (n=19/124) strongly disagree, 25% (n=31/124) do not agree that they will spend less time with patients. On the other hand, 12% (n=15/124) strongly agreed if used HHD in the clinic or wards the will spend less time with patients. Table 2 shows the distribution of questionnaire's variables and resident's responses.

Table 2: The distribution of questionnaire's variables and resident's responses (n=124).

INFORMATION	NUMBER	PERCENTAGE (%)
Do you have a Smartphone?		
No	0	0.0
Yes	124	100.0
Total	124	100.0
If Yes, which type of Smartphone do you have?		
iOS	77	62.1
Android	47	37.9
Total	124	100.0
Do you have a Tablet?		
No	38	30.6
Yes	86	69.4
Total	124	100.0
If yes, which type of Tablet do you have?		
iOS	63	50.8
Android	20	16.1
Windows	3	2.4
Total	86	69.4
Do you have any specific medical applications installed in your Handheld Device to improve your learning needs?		
No	5	4.0
Yes	119	96.0
Total	124	100.0
How many medical applications installed to your Handheld Device?		
1-2	45	36.3
2-5	50	40.3
>5	26	21.0
Total	121*	97.6
How frequent do you use your Handheld Device for your learning needs?		
Less than once a week	3	2.4
Once a week	13	10.5
Two or three times a week	28	22.6
Once or twice a day	33	26.6
Several times a day	47	37.9
Total	124	100.0
Table 2 (Continued)		
Give a rough estimate to the duration that you spend on an average every day using your Handheld Device for medical or clinical applications		
<10 minutes	26	21.0

10 - 30 minutes	65	52.4
31 - 60 minutes	23	18.5
> 60 minutes	10	8.1
Total	124	100.0
How useful would you find a Handheld Device in your medical practice?		
Little Useful	8	6.5
Useful	43	34.7
Very Useful	73	58.9
Total	124	100.0
What impact do you think a Handheld Device would have on your learning?		
Not helpful	2	1.6
Useful Aid	73	58.9
Vital part	49	39.5
Total	124	100.0
"Having access to a Handheld Device during clinic or ward work would mean I spent less time with patients".		
Strongly Agree	15	12.1
Agree	18	14.5
Neutral	33	26.6
Disagree	39	31.5
Strongly Disagree	19	15.3
Total	124	100.0

* Three respondents did not answer

Several types of applications were used to help the residents with their clinical activities, medication formulary/drug reference applications, clinical scoring system/ medical calculator and disease management

were commonly used (81%, 66%, 66% respectively). Figure 1 shows all types of medical applications used by respondents with their percentage.

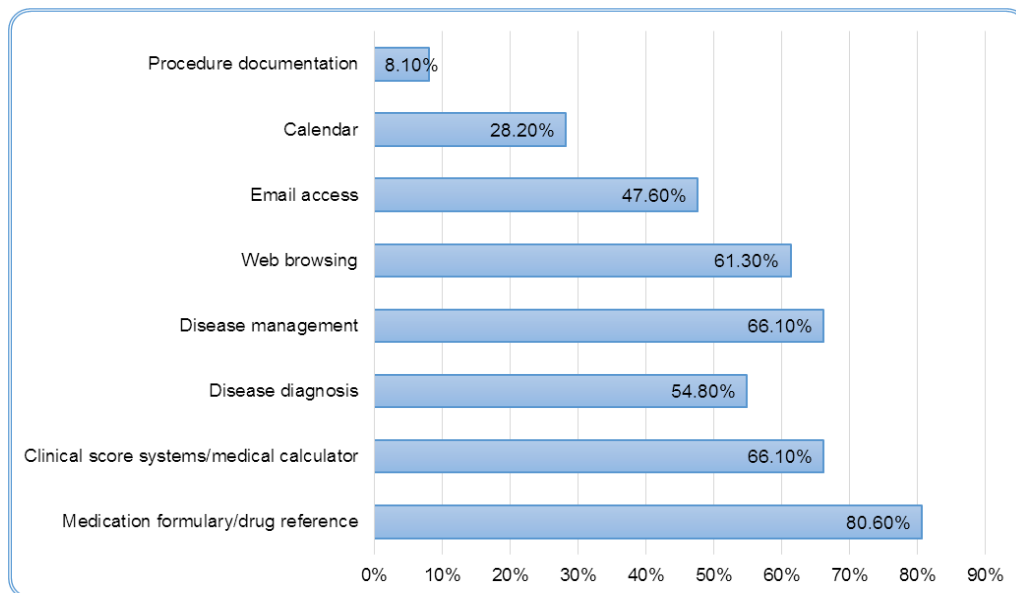


Figure 1: Percentage of each medical related application category.

There was no association between age and number of medical related applications installed to HHD ($p = .873$), and no significant association found between age and the duration spent on using HHD for medical and clinical purposes ($p = .059$). HHD usefulness was highly associated with younger age ($p = .002$). There was no significant association between gender and having installed medical applications ($p = .988$), although females spend more time using medical related

application ($p = .012$). Respondents are using different types of applications; male residents are using disease diagnoses application more than female residents ($p = .046$). Training level and owning medical application installed in HHD has no association ($p = .52$). Table 3 shows the Chi-squared test of association between training level and the questionnaire's variables.

Table 3: The chi-squared test of association between training level and questionnaire’s variables (n=124).

		Training Level					P-value*
		R1	R2	R3	R4	Total	
Do you have any specific medical applications installed in your Handheld Device to improve your learning needs?	Yes	18	28	50	23	119	.528*
		94.7%	96.6%	98.0%	92.0%	96.0%	
	No	1	1	1	2	5	
		5.3%	3.4%	2.0%	8.0%	4.0%	
Total	19	29	51	25	124	100.0%	100.0%
How many medical applications installed to your Handheld Device?	1-2	9	15	15	6	45	.139 ^Δ
		47.4%	51.7%	30.0%	26.1%	37.2%	
	2-5	7	10	25	8	50	
		36.8%	34.5%	50.0%	34.8%	41.3%	
	>5	3	4	10	9	26	
	15.8%	13.8%	20.0%	39.1%	21.5%		
Total	19	29	50	23	121	100.0%	100.0%
How frequent do you use your Handheld Device for your learning needs?	Less than once a week	2	0	1	0	3	.636*
		10.5%	0.0%	2.0%	0.0%	2.4%	
	Once a week	1	3	5	4	13	
		5.3%	10.3%	9.8%	16.0%	10.5%	
	Two or three times a week	3	6	16	3	28	
		15.8%	20.7%	31.4%	12.0%	22.6%	
	Once or twice a day	6	8	12	7	33	
	31.6%	27.6%	23.5%	28.0%	26.6%		
Several times a day	7	12	17	11	47		
	36.8%	41.4%	33.3%	44.0%	37.9%		
Total	19	29	51	25	124	100.0%	100.0%
Give a rough estimate to the duration that you spend on an average every day using your Handheld Device for medical or clinical applications	<10 minutes	4	6	13	3	26	.249*
		21.1%	20.7%	25.5%	12.0%	21.0%	
	10 - 30 minutes	6	18	23	18	65	
		31.6%	62.1%	45.1%	72.0%	52.4%	
	31 - 60 minutes	6	3	11	3	23	
		31.6%	10.3%	21.6%	12.0%	18.5%	
> 60 minutes	3	2	4	1	10		
	15.8%	6.9%	7.8%	4.0%	8.1%		
Total	19	29	51	25	124	100.0%	100.0%
How useful would you find a Handheld Device in your medical practice?	Little Useful	1	1	1	5	8	.174*
		5.3%	3.4%	2.0%	20.0%	6.5%	
	Useful	8	11	18	6	43	
		42.1%	37.9%	35.3%	24.0%	34.7%	
	Very Useful	10	17	32	14	73	
	52.6%	58.6%	62.7%	56.0%	58.9%		
Total	19	29	51	73	124	100.0%	100.0%
What impact do you think a Handheld Device would have on your learning?	Not helpful	0	0	1	1	2	.239*
		0.0%	0.0%	2.0%	4.0%	1.6%	
	Useful Aid	9	22	27	15	73	
		47.4%	75.9%	52.9%	60.0%	58.9%	
	Vital part	10	7	23	9	49	
	52.6%	24.1%	45.1%	36.0%	39.5%		
Total	19	29	51	25	124	100.0%	100.0%
Medication formulary/drug reference	Yes	15	21	44	20	100	.506 ^Δ
		78.9%	72.4%	86.3%	80.0%	80.6%	
	No	4	8	7	5	24	
		21.1%	27.6%	13.7%	20.0%	19.4%	
Total	19	29	51	25	124	100.0%	100.0%
Clinical score systems/medical calculator	Yes	12	20	31	19	82	.590 ^Δ
		63.2%	69.0%	60.8%	76.0%	66.1%	
	No	7	9	20	6	42	

		36.8%	31.0%	39.2%	24.0%	33.9%	
	Total	19	29	51	25	124	
		100.0%	100.0%	100.0%	100.0%	100.0%	
Disease diagnosis	Yes	12	15	28	13	68	.867 ^Δ
		63.2%	51.7%	54.9%	52.0%	54.8%	
	No	7	14	23	12	56	
		36.8%	48.3%	45.1%	48.0%	45.2%	
Total	19	29	51	25	124		
		100.0%	100.0%	100.0%	100.0%	100.0%	
Disease management	Yes	14	22	30	16	82	.395 ^Δ
		73.7%	75.9%	58.8%	64.0%	66.1%	
	No	5	7	21	9	42	
		26.3%	24.1%	41.2%	36.0%	33.9%	
Total	19	29	51	25	124		
		100.0%	100.0%	100.0%	100.0%	100.0%	
Procedure documentation	Yes	2	2	3	3	10	.713 [*]
		11.1%	6.9%	5.9%	12.0%	8.1%	
	No	16	27	48	22	113	
		88.9%	93.1%	94.1%	88.0%	91.9%	
Total	18	29	51	25	123		
		100.0%	100.0%	100.0%	100.0%	100.0%	
Web browsing	Yes	8	17	35	16	76	.234 ^Δ
		42.1%	58.6%	68.6%	64.0%	61.3%	
	No	11	12	16	9	48	
		57.9%	41.4%	31.4%	36.0%	38.7%	
Total	19	29	51	25	124		
		100.0%	100.0%	100.0%	100.0%	100.0%	
Email access	Yes	8	15	23	13	59	.861 ^Δ
		42.1%	51.7%	45.1%	52.0%	47.6%	
	No	11	14	28	12	65	
		57.9%	48.3%	54.9%	48.0%	52.4%	
Total	19	29	51	25	124		
		100.0%	100.0%	100.0%	100.0%	100.0%	
Calendar	Yes	2	8	16	9	35	.310 ^Δ
		11.1%	27.6%	31.4%	36.0%	28.5%	
	No	16	21	35	16	88	
		88.9%	72.4%	68.6%	64.0%	71.5%	
Total	18	29	51	25	123		
		100.0%	100.0%	100.0%	100.0%	100.0%	
"Having access to a Handheld Device during clinic or ward work would mean I spent less time with patients"	Strongly Agree	1	6	6	2	15	.344 [*]
		5.3%	20.7%	11.8%	8.0%	12.1%	
	Agree	2	3	9	4	18	
		10.5%	10.3%	17.6%	16.0%	14.5%	
	Neutral	8	10	12	3	33	
		42.1%	34.5%	23.5%	12.0%	26.6%	
	Disagree	5	9	15	10	39	
		26.3%	31.0%	29.4%	40.0%	31.5%	
Strongly Disagree	3	1	9	6	19		
	15.8%	3.4%	17.6%	24.0%	15.3%		
Total	19	29	51	25	124		
		100.0%	100.0%	100.0%	100.0%	100.0%	

* Fisher's Exact Test is used

Δ Chi-Square used

5. DISCUSSION

The goal of this study was intended to identify the prevalence of handheld devices (HHD) including smartphones and tablets ownership and to determine the different practices and utilization of HHD among all residents in Saudi Board of Family Medicine Training Program in Riyadh. The result of the survey demonstrates that all residents own smartphones, and the majority of the residents have tablets (69%). Almost all

respondent residents have installed medical related applications to improve their learning needs among both genders in all training levels (96%), with most of the residents report that HHD is a useful aid in their medical practices and learning needs (98%).

Several studies published previously were conducted to explore HHD prevalence among healthcare providers, not surprisingly, with the accelerating manufacturing

technology in smartphones and tablets, a rapid global increasing trend's of HHD ownership among the general population was noticed in recent years.^[11,12] In 2011 a study was done in the United Kingdom (UK) by Payne et al., found that 74.8% of junior doctors owned a smartphone.^[5] A local survey was done in 2012 exploring personal digital assistances (PDA) and smartphones ownership among physicians and dentists at King Saud Medical City hospital in Riyadh found the prevalence rate is 61%.^[13] These studies were published more than four years ago, a slightly long time frame in the rapidly growing mobile technology. Compared to a recent survey was done in 2015 in the UK found nearly all doctors have smartphones and almost 75% have tablets.^[14] This study was conducted to demonstrate the current prevalence rate of HHDs' ownership in all family medicine residents in Riyadh. The study found that 100% of the respondent residents own smartphones, while 69% of the residents have tablets. Mobile technology companies eagerly develop and customize their products to meet consumers' expectations and to optimize their experience which has led to the noticeable increase in mobile devices ownership. New innovations in mobile technology such as connectivity, portability and availability have changed people perspective on HHD in recent decades. A recent report presented mobile users were 80 million in 1995 with a population penetration of 1% compared to 5.2 billion in 2014 with a population penetration of 73%, it also stated that 2.8 billion were using the internet, also smart devices' has more growth rate of adoption in contrast to laptops.^[15] In Saudi Arabia, according to Communications and Information Technology Commission (CITC) latest report on 2015, 82% of surveyed population own smartphones, and 47% are using both smartphones and tablets, the majority of HHD users (91%) are aged 15-35 years. Furthermore, the expanding internet network coverage in KSA and increased internet speed have led to increased HHD adoption.^[16]

Apple smart devices were more popular than the other types in this study. Respondents reported that 62% are using iPhones and 51% using iPads, where 37.9% are using Android smartphones and 16.1% Android tablets, Windows tablets were the least popular of tablet users. Similar data were found in several studies, a study exploring smartphone ownership among students, residents, and faculty members of 4 Canadian medical universities in 2012 by Boruff et al., reflecting that Apple devices were the most commonly utilize followed by Android devices.^[17] Another study also showed iPhone prominence among other devices too.^[18] Apple devices' dominance among healthcare providers was noticeable in many studies, one of the proposed reasons, that Apple applications' market contains more medical related applications when compared with other platforms including Android.^[19]

Interestingly, almost all residents (96%) were having medical applications that were installed on their HHD

and the majority of them (61%) have more than two specific medical application installed, most of the residents (64%) reported a daily usage of their installed medical applications for >10 minutes. There was no pattern of association between gender or training level and using any medical application, the number of installed application, the frequency of their usage or duration spent each time. Similar data were noticed in several studies.^[5,18,14] Moreover, in a systematic review done to summarize twenty-three studies on HHD usage by healthcare personnel observed HHDs' adoption was more prevalent family medicine physicians compared to other specialties.^[20] Likewise, family medicine residents were more likely to utilize HHD for educational purposes when they are involved in training program.^[21]

A significant percent of medical application usage is apparent in this study demonstrating a high demand on the medical related application. It was estimated on 2015 that 500 million HHD users globally are using medical applications.^[22] The advancement of medical technologies has a crucial role in healthcare system including physicians and patients, in particular, HHD provides several features to physicians including diagnostic tools, continuing medical education, and patient records. With the advancement of health information technology, clinical practices going to be more digitized.^[23]

Several previous studies have assessed the impact of HHD on clinical practices. Notably, a systemic review done by M. Prgomet et al. revealed a beneficial impact of handheld technology in supporting physicians' clinical practice and patient care by providing the clinicians with point-of-care decision support tool to facilitate patient management through accessibility of medical information and error prevention.^[24] In line with this study, across all residents participated, they agreed on the usefulness of HHD and its positive influence on their clinical practice and learning needs.

Concerning the attitude of the resident in this study toward using the HHD, the majority (46.8%) considered HHD access during clinics or wards not necessarily means that they will spend less time with the patient. While 26.6% reported access to HHD in clinics or wards will reduce the time spent with the patient. A similar attitude was found in another study where 31% of participants thought access to a smartphone in wards would reduce time spent with patient.^[9] On the one hand, fast uptake and utilization of HHD among healthcare providers has its drawbacks, including interruption of the standard practice of education and patient care. Unwanted effects such as distraction as most of the HHD are "always on", and patient privacy. Unmanaged access to HHD during working hours may involve the personal related utilization rather than medical information seeking. On the other hand, it provides the right information at the right time from trustworthy source.^[25] Parallel to previous studies medication formulary and

drug reference applications were the most commonly used among respondents (80%), followed by clinical scoring systems (66%) and disease management applications (66%).^[5] Giving the nature of family medicine specialty and the wide variety of topics and patients' characteristics encountered in the clinical practice, residents require rapid point-of-care decision tools to improve their knowledge and skills.^[26] Prescribing errors considered being one of the leading cause of medication errors that might have led to the increased number of drug reference applications.^[27] Procedure documentation applications were the least used (n=10/124) among all residents responded, a similar result was noticed in another study.^[5] We found no association between training level and different HHD's usage for any medical purposes.

6. Limitations

We believe that the sample size is relatively small with a response rate of 60% which was greatly affected by the method of the questionnaire distribution as stated on the methodology it was electronically distributed through Google forum link by emails and messages. The questionnaire contained questions dependent on personal reporting which may lead to recall bias. However, a primary objective was to determine the prevalence of HHD usage; our result was consistent with other similar studies with larger sample size. Another limitation as this is an electronic based questionnaire we believe the usefulness of smart devices might be inflated as more technology-driven residents will respond to the questionnaire.

7. CONCLUSION

Handheld devices are adopted by almost all respondent residents who perceive them as a very useful tool in their clinical practices and learning needs. These technologies are becoming more popular among all healthcare providers, by providing point-of-care tools.

8. Recommendations

Given the very high prevalence of HHD adoption among family medicine residents, the medical education policy makers in program training centers should be aware of the potential of the HHD to improve clinical learning and patient care. We also encourage medical educators to integrate this technology in the process of the education.

Healthcare organizations and application developers should focus more on developing medical-related applications particularly drug formulary, disease management and decision support tools, that specifically designed for HHD and to be more user-friendly and evidence-based applications.

Despite the very high perceived usefulness of HHD in clinical practices among the participants' further study should be carried to assess the risk associated with medical applications prior their use to eliminate possible harms. Residents' high adoption rate to HHD and their

orientation toward medical technology might facilitate implementation of new medical technologies in their hospitals such as electronic health record system.

Healthcare organizations and application developers should focus more on developing medical-related applications particularly drug formulary, disease management, and decision support tools, that specifically designed for HHD and to be more user-friendly and evidence-based applications.

Future researches need to be done to address the patient points of view regarding physicians using HHD.

ACKNOWLEDGMENT

I would like to acknowledge the incredible assistance provided to me by Dr. Tarek Elsaid who gave his support, and this work would not be achieved without his guidance.

Appendix 1: The Questionnaire

1. Age
2. Gender:
 - Male
 - Female
3. Marital status:
 - Single
 - Married
 - Divorced
 - Widow
4. Please state your current level of training:
 - First-year R1
 - Second-year R2
 - Third-year R3
 - Fourth-year R4
5. Please state your training center:
 - Prince Sultan Military Center
 - Security Forces Hospital
 - King Khalid University Hospital
 - King Abdulaziz Medical City
 - Other
6. Do you have a Smartphone?
 - No
 - Yes
7. If yes, which type of Smartphone do you have?
 - iOS
 - Android
 - Windows phone
 - Blackberry
8. Do you have a tablet (mobile computer)?
 - No
 - Yes

9. If yes, which type of tablet do you have?
- iOS
 - Android
 - Windows
 - Blackberry
10. Do you have any specific medical applications installed in your Handheld Device to improve your learning needs?
- No
 - Yes
11. How many medical applications installed to your Handheld Device?
- 1-2
 - 2-5
 - >5
12. How frequent do you use your Handheld Device for your learning needs?
- Several times a day
 - Once or twice a day
 - 2-3 times a week
 - Once a week
 - Rarely used
 - Never used
13. Give a rough estimate to the duration that you spend on an average every day using your Handheld Device for medical or clinical applications:
- <10 minutes
 - 10 – 30 minutes
 - 31 – 60 minutes
 - >60 minutes
14. How useful would you find a Handheld Device in your medical practice?
- Very useful
 - Useful
 - A little use
 - Not useful
 - Completely useless
15. What impact do you think a Handheld Device would have on your learning?
- Vital part
 - Useful aid
 - Not helpful
 - Distraction
16. In relation to the following types of applications please indicate which of them you use to help you with your clinical activities (you may choose more than one):
- Medication formulary/drug reference
 - Clinical score systems/medical calculator
 - Disease diagnosis
 - Disease management
 - Procedure documentation
 - Web browsing
 - Email access
 - Calendar
 - Other (please specify)
17. “Having access to a Handheld Device during clinic or ward work would mean I spent less time with patients.” Considering this statement, do you:
- Strongly agree
 - Agree
 - Neutral
 - Disagree
 - Strongly Disagree

REFERENCE

1. Sarwar M, Soomro TR. Impact of Smartphone's on Society. *European Journal of Scientific Research*, 2013 Mar; 98(2): 216-26.
2. Smith A. 46% of American adults are smartphone owners. *Pew Internet & American Life Project*. 2012 Mar 1.
3. Falaki H, Mahajan R, Kandula S, LyMBERopoulos D, Govindan R, Estrin D. Diversity in smartphone usage. In *Proceedings of the 8th international conference on Mobile systems, applications and services 2010 Jun 15 (pp. 179-194)*. ACM.
4. Dala-Ali B, Lloyd M, Al-Abed Y. The uses of the iPhone for surgeons. *The Surgeon*, 2011; 9(1): 44-48.
5. Payne K, 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(1).
6. Criswell DParchman M. Handheld Computer Use in U.S. Family Practice Residency Programs. *Journal of the American Medical Informatics Association*, 2002; 9(1): 80-86.
7. Goldbach H, Chang A, Kyer A, Ketshogileng D, Taylor L, Chandra A et al. Evaluation of generic medical information accessed via mobile phones at the point of care in resource-limited settings. *Journal of the American Medical Informatics Association*, 2014; 21(1): 37-42.
8. Rudkin S, Langdorf M, Macias D, Oman J, Kazzi A. Personal digital assistants change management more often than paper texts and foster patient confidence. *European Journal of Emergency Medicine.*, 2006; 13(2): 92-96.
9. Robinson T, Cronin T, Ibrahim H, Jinks M, Molitor T, Newman J et al. Smartphone Use and Acceptability Among Clinical Medical Students: A Questionnaire-Based Study. *J Med Syst.*, 2013; 37(3).
10. Hamadah S. Alsadoon. 'Use of Cell Phones in Education at King Saud University in the Kingdom of Saudi Arabia'. A dissertation presented to the faculty of The Patton College of Education of Ohio University, (2012).
11. Mobile Technology Fact Sheet [Internet]. *Pew Research Center: Internet, Science & Tech.*, 2013

- [cited 3 August 2016]. Available from: <http://www.pewinternet.org/fact-sheets/mobile-technology-fact-sheet>.
12. IDC: Smartphone OS Market Share [Internet]. www.idc.com. 2016 [cited 3 August 2016]. Available from: <http://www.idc.com/prodserv/smartphone-os-market-share.jsp>
 13. Saddik B, Barakah D, Aldosari B. A study of PDA and Smartphone adoption rates at King Saud Medical City Hospitals. 2012 6th International Symposium on Medical Information and Communication Technology (ISMICT). 2012.
 14. Mobasheri M, King D, Johnston M, Gautama S, Purkayastha S, Darzi A. The ownership and clinical use of smartphones by doctors and nurses in the UK: a multicentre survey study. *BMJ Innov.*, 2015; 1(4): 174-181.
 15. Meeker M. Internet Trends 2015-Code Conference. *Glokalde.*, 2015; 1(3).
 16. ICTC mobility in Saudi Arabia report [Internet]. www.citc.gov.sa. 2016 [cited 3 August 2016]. Available from: <http://www.citc.gov.sa/en/reportsandstudies/Reports/Documents/IT%20007%20E%20-%20IT%20Report%202014.pdf>
 17. Boruff J, Storie D. Mobile devices in medicine: a survey of how medical students, residents and faculty use smartphones and other mobile devices to find information. *J Med Libr Assoc.*, 2014; 102(1): 22-30.
 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): e001099.
 19. Research2Guidance. Data report to size opportunities in the mHealth app market 2015-2020. 2015 Research2Guidance.
 20. Garrity C, El Emam K. Who's using PDAs? Estimates of PDA use by health care providers: a systematic review of surveys. *J Med Internet Res.*, 2006 May 12; 8(2): e7.
 21. Morris CG, Church L, Vincent C, Rao A. PDA usage and training: targeting curriculum for residents and faculty. *FAMILY MEDICINE-KANSAS CITY-*, 2007 Jun 1; 39(6): 419.
 22. Mosa A, Yoo I, Sheets L. A Systematic Review of Healthcare Applications for Smartphones. *BMC Med Inform Decis Mak.*, 2012; 12(1).
 23. How Smartphones Are Changing Health Care for Consumers and Providers [Internet]. [Chcf.org](http://www.chcf.org). 2016 [cited 3 August 2016]. Available from: <http://www.chcf.org/publications/2010/04/how-smartphones-are-changing-health-care-for-consumers-and-providers>
 24. Prgomet M, Georgiou A, Westbrook J. The Impact of Mobile Handheld Technology on Hospital Physicians' Work Practices and Patient Care: A Systematic Review. *Journal of the American Medical Informatics Association*, 2009; 16(6): 792-801.
 25. Allace 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): e001099.
 26. Bennett N, Casebeer L, Kristofco R, Collins B. Family physicians' information seeking behaviors: A survey comparison with other specialties. *BMC Med Inform Decis Mak.*, 2005; 5(1).
 27. Kohn L, Corrigan J, Donaldson M. *To err is human*. Washington, D.C.: National Academy Press, 2000.