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Gizaw Hailiye Teferi (✉ ghailiye463@gmail.com)

Debre Markos University <https://orcid.org/0000-0002-8187-2366>

Habtamu Guadie Alganeh

University of Gondar College of Medicine and Health Sciences

Binyam Cheklu Tilahun

University of Gondar College of Medicine and Health Sciences

Ashenafi Tazebew

University of Gondar College of Medicine and Health Sciences

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Smartphone Medical Application Use and Associated Factors Among Physician at Referral hospitals in Amhara region north Ethiopia, 2019

Gizaw Hailiye¹, Binyam Tilahun², Ashenafi Tazebew³, Habtamu Alganah²

1: Deber-Markos University, College of Medicine and health Science, Health Informatics Department

2: University of Gondar, College of Medicine and health Science, Health Informatics Department

3: University of Gondar, College of Medicine and health Science, Pediatrics Department

Email Address:

GH: ghailiye463@gmail.com

BT: binigcms@gmail.com

AT: ashenafitazebew1@gmail.com

HA: hab.4431@gmail.com

Abstract

Background:

Information in healthcare is rapidly expanding and updating. Due to this healthcare providers have to access latest scientific evidence timely in anywhere. Smartphone medical applications are tools to access the latest and reputable scientific evidence in the discipline. This study was aimed to assess smartphone medical application utilization and associated factors among physicians working at referral hospitals of Amhara region, Ethiopia.

Methods:

An institutional based cross-sectional study design was conducted among physicians working at referral hospitals in Amhara region, Ethiopia from February 5 to May 27, 2019. Simple random sampling was used to select 423 physicians. Self-administered questionnaire was used to collect the data and analyzed by using SPSS version 21. Binary and multivariable logistic regression analysis was performed to assess factors associated with smartphone medical application use among physicians. $P < 0.05$ at 95% confidence interval was considered statistically significant. The validity of the questionnaire was determined based on the view of experts and the reliability of it obtained by calculating the value of Cronbach's alpha ($\alpha = 0.78$)

Results:

In this study most 374(89.9%) of the respondents had medical application installed on their smartphones. From three hundred seventy-four respondents 264 (63.3%) of them had used medical applications during clinical practice. Most commonly used medical application by the respondents were: Up to date, Medscape, Medcalc and Doximity. According to multivariable logistic regression analysis: attitude (AOR=1.64, CI: [1.05, 2.55]), internet access(AOR=2.82,CI:[1.75,4.54]), Computer training(AOR=1.71,CI:[1.09,2.67]),perceived usefulness of application(AOR=1.64,CI: [1.05,2.54]), IT support staff(AOR=2.363,CI: [1.5-3.08]), and technical skill(AOR=2.52, CI:[1.50-4.25]) were significantly associated with smartphone medical application use.

Conclusion: Most respondents have a smartphone medical application and used it in clinical practice. Attitude, internet access, Computer training, perceived usefulness of application, IT support staff, and technical skill are the most notable factors that are associated with smartphone medical application use by physicians.

Keywords: Application, Medical, Physician, Smartphone.

Background

The main source of information for healthcare professionals at the point of care was text books(1). Health care professional increasingly use electronic tools like Smartphone medical applications for patient care, clinical reference, and education(2). Smartphone applications (apps) are tools that can be downloaded onto smartphones and enhance patient care, increase efficiency, or provide individualized learning for clinicians(3). In 2011 Apple created the Apps for Healthcare Professionals section within the medical category of the iTunes App store, a unique feature among mobile app market place(4). Smartphones have wide range of use from internet to email, they offer on the go access to information never before possible (5).

Study conducted in United kingdom (UK) shows that smartphone medical apps like British National Formulary (BNF) , eLogbook and medical calculator(MedCalc) has been commonly used by physician (7). Technology can lead to improved decision-making and reduced numbers of medical errors and improved communication between hospital medical staff (9–11).

According to the study conducted in UK due to easiness of smartphone medical apps (18.5%) doctors made suggestions to their colleagues to be used as quick reference during clinical practice(7). However lack of support and update of applications by their developers, lack of adequate skill to use applications, lack of creating motivation in using applications, problems related to security and confidentiality of patient information has undermined the utilization of smartphone medical apps at the point of care (8,11,12). Study conducted in Korea shows that the use of smartphone medical apps by physicians is low(6).

Evidence shown that medical app usage is high in developed countries, according to the study conducted in UK medical app usage is higher (72.4%) among doctor group(16).

The other study in united states of America reported that 56% of physician use apps in their clinical practice and there was a decreasing trend towards app use with increased training level and the most useful app types included textbook/reference materials (average response: 55%), classification/treatment algorithms (46%) and general medical knowledge (43%); there was a greater desire for apps among residents relative to fellows and attending physicians, respectively(17).

A study conducted in Korea shows that the usage pattern of smartphone medical applications among residents at clinical practice for counseling and clinical communication (50%), among interns for drug reference (56%) and among extern's resources and e-books (65%)(18).

On the other hand study done in Iran reported that the most popular medical apps were Medscape and Up-to-date, respectively and 61.3% of the physician were using their apps more than once a day and mostly for drug information(19).

According to cross sectional study done in Ghana, Over 43.1% of physicians used medical apps on their smart phone for clinical decision making frequently which shows relatively low use of medical apps than developed countries(13).

Due to different factors physicians remain reluctant to adopt these technologies in clinical practice (2), the most common factors which affect the use of smartphone medical apps are behavioral factors (IT related experience, attitude, computer related skill)(20), factors related to medical app characteristics (perceived usefulness, perceived easiness, privacy and security concerns), organizational factors(infrastructure, IT support , and computer related training)(21). Evidences revealed that underutilization of apps in the point of by healthcare professionals is due to lack of technical skill(6,22). According to the finding of cross sectional study conducted in united kingdom (UK) appear to be looking at phone during clinical practice misinterpreted as checking emails or using social network by colleagues and patients(7,23–26)

Security and privacy are the key factors of the functionality of any m-health system(27), unfortunately, little emphasis was given for security , this will affect the utilization of this apps significantly(22,28-30). Perceived ease of use is another factor which determine the utilization of smartphone medical applications. Apps with user friendly interface are more likely to be used(25,31). The aim of this study was to assess smartphone medical application use and associated factors among physicians in referral hospitals of Amhara region, Ethiopia.

Methods

Study design and setting

Institutional based cross-sectional study was conducted to assess smartphone medical application use and associated factors among physicians in referral hospitals of Amhara region, Ethiopia. The State of Amhara consists of 10 administrative zones, one special zone, 181 woredas, and 78 urban centers. Amharic is the working language of the state. The capital city of the State of Amhara is Bahir-Dar(32). It is located in the North Western and North Central part of Ethiopia. The State shares common borders with the state of Tigray in the North, Afar in the East, Oromia in the South, Benishangul/Gumuz in the South West, and the Republic of Sudan in the West.

Five referral hospitals namely Gondar university referral hospital, Felege Hiwot, Debre Markos, Dessie and Debre Birhan referral hospitals are found in the state which serves an average of 5 million population in their catchment area(33).

Study participant, sample size and sampling procedure

Study participants were selected using simple random sampling method, sample size was calculated using single population proportion formula using the following assumptions; proportion of smart phone medical application use (P) = 50%, margin of error (d) = 5 and 10% for non-response rate; finally, the minimum sample size of 423 was obtained.

Data collection tool and procedure

Data were collected using self-administered questionnaire and comprised of socio-demographic, behavioral, medical app related, and organizational variables. Questionnaire was prepared in English. Before the actual data collection, pretesting of the questionnaire was conducted among 20 physicians at Debre tabor hospital. Then necessary correction was done based on the pretest finding. The validity of the questioner was determined based on the view of experts and the reliability of it obtained by calculating the value of Cronbach's alpha ($\alpha = 0.78$).

Five health information technology professionals who took training and prior data collection experience were assigned for data collection. Three health professionals who

had experience in health information system monitoring supervised the task. The supervisors and investigators checked data completeness and consistency.

Study variable and Operational definition

Dependent variable

Physician's smartphone medical application use (yes, no)

Independent variables

- ❖ Socio-demographic factors: Age, sex, profession, educational status, experience.
- ❖ Medical app related factors: perceived usefulness, perceived easiness, Privacy and security concerns.
- ❖ Organizational factors: Internet access, IT support, computer related training.
- ❖ Behavioral factors: - Knowledge, Attitude, and technical skill, IT related experience.

Operational definitions

- ✚ Physician: Physician in this study includes general practitioners, residents, dentist, specialists, and sub-specialists.
- ✚ Smartphone: class of mobile phone with multipurpose mobile computing capability with features like high definition camera, third-party app installation, Global positioning system(GPS) (15).
- ✚ Medical application: is a computer program or software application designed to run on a mobile device such as smartphone, tablet which is meant to be used for clinical purpose.
- ✚ Smartphone Medical application: Medical application designed to run specifically on smartphone(14).
- ✚ Smartphone Medical application use: Study participants who score the median=5 and above the median out of the 9 category of application were categorized as they have used smartphone medical application(13).
- ✚ Attitude: Study participants who score median and more in five point Likert scale of attitude question were categorized they have good attitude and those who score below the median were categorized as they have poor attitude(34)

- ✚ Perceived usefulness: Study participants who score median and above the median in five point Likert scale of Perceived usefulness question were categorized they thought Smartphone Medical application as useful for their job and those who score below the median were categorized they thought Smartphone Medical application as not useful for their job(35).
- ✚ Perceived easiness: Study participants who score median and above the median in five point Likert scale of Perceived easiness question were categorized they thought Smartphone Medical application as easy to use and those who score below the median were categorized they thought Smartphone Medical application as not easy to use.

Data processing and analysis

Data were entered into Epi-info version 7 and exported to the Statistical Package for Social Sciences (SPSS) version 21 for further analysis. Descriptive statistics were computed in order to summarize variables and the binary logistic regression model used to measure the association between dependent and independent variables. Both Crude Odds (COR) and Adjusted Odds Ratios (AOR) with 95% confidence interval were estimated to show the strength of associations. Finally, a *p*-value of less than 0.05 in the multivariable logistic regression analysis was used to identify variables significantly associated with the use of smartphone medical applications.

Result

Sociodemographic characteristics

A total of 417 physicians were included in this study with response rate of 98.6%. Two third of (65.9%) of the respondents were male. The mean age was 33+_8SD years with the majority of age group were 25-34. More than three fourth (89.9%) of the physicians had medical application installed on their smartphones.

Table 1: Socio-demographic characteristics of physicians working at referral hospitals of Amhara region, North Ethiopia, 2019 n(417)

| VARIABLE | CATEGORY | FREQUENCY (#) | PERCENTAGE (%) |
|-----------------------|----------------------|---------------|----------------|
| GENDER | Male | 275 | 65.9 |
| | Female | 142 | 34.1 |
| AGE | <=30 | 217 | 52 |
| | >30 | 200 | 48 |
| EDUCATIONAL STATUS | General practitioner | 219 | 52.2 |
| | Resident | 127 | 30.7 |
| | Specialist | 71 | 17 |
| DEPARTMENT | Internal medicine | 80 | 19.2 |
| | Pediatrics | 54 | 12.5 |
| | Radiology | 28 | 6.7 |
| | Surgery | 67 | 16 |
| | Ophthalmology | 25 | 6 |
| | Gynecologist | 65 | 15.6 |
| | Dermatology | 18 | 4.3 |
| | ENT | 36 | 8.6 |
| | Other | 45 | 11 |
| WORK EXPERIENCE | 1-3 years | 231 | 55.4 |
| | 3-6 years | 91 | 21.8 |
| | >6 years | 95 | 22.8 |
| MEDICAL APP OWNERSHIP | Yes | 375 | 89.9 |
| | No | 42 | 10.1 |

Smartphone Medical application use of physicians at referral hospitals

According to this study 63.3% (264/417) of the respondents reported that they use apps in their clinical practice (95% CI: [58.3, 67.9]), and most commonly used smartphone medical application categories were Diagnosis/Management (62%) (Table 2).

Table 2: - smartphone medical application use at referral hospitals among physicians, 2019 n(417)

| Medical apps types | General practitioners | Resident | Specialist | Total |
|-------------------------|-----------------------|----------|------------|-------------|
| Diagnosis/Management | 134 | 84 | 43 | 261 (62.6%) |
| Literature search | 120 | 67 | 31 | 218 (52.3%) |
| Browsing | 113 | 54 | 29 | 196 (47%) |
| HIS clients | 106 | 54 | 35 | 195 (46.8%) |
| Clinical score system | 104 | 71 | 34 | 209 (50.1%) |
| Medical training | 104 | 59 | 31 | 194 (46.5) |
| Medication formulary | 97 | 48 | 28 | 173 (41.5) |
| Clinical communication | 87 | 58 | 23 | 168 (40.3%) |
| Procedure documentation | 73 | 51 | 28 | 152 (36.5%) |

According to this study most commonly used smartphone application was Up to date 71.9% (300/417) (Figure 1).

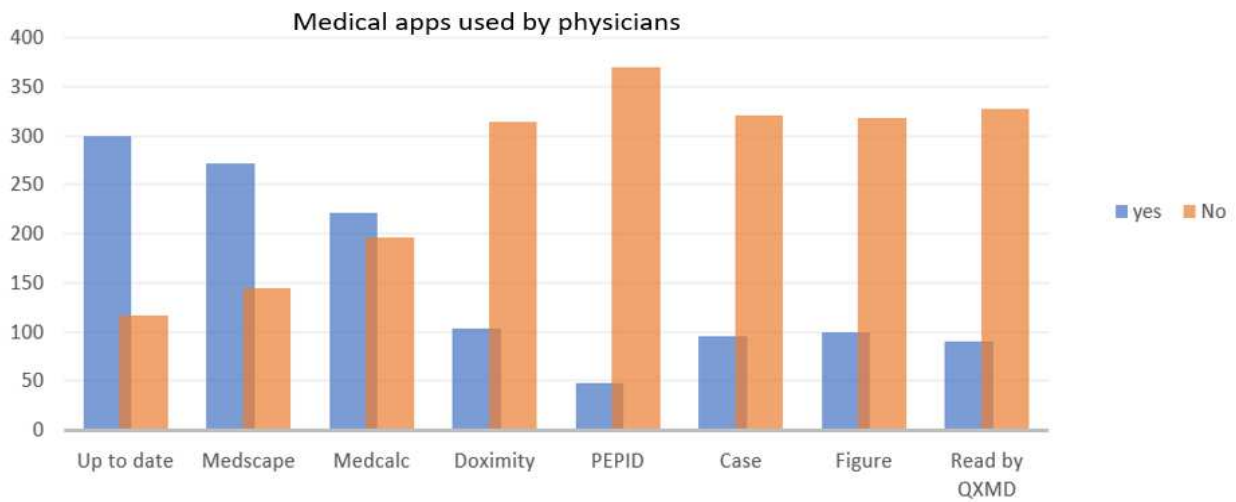


Figure 1:- Medical applications used by physicians working at referral hospitals in Amhara regional state, Ethiopia, 2019.

Most of study respondents (85%) used their applications daily, while 10.5% used them three times a week.

| Medical app | Daily | Three times a week | Once a week | I don't know the time |
|-------------|-------|--------------------|-------------|-----------------------|
| Up to Date | 88.9% | 7.5% | 3.2% | .4% |
| Medscape | 89.4% | 6.6% | 3.5% | .4% |
| Medcalc | 92.3% | 4.8% | 2.4% | .5% |
| Doximity | 90.7% | 6.2% | 3% | 0 |
| Figure | 90.4% | 6.4% | 3.2% | 0 |
| Red by QXMX | 89.4% | 7.1% | 3.5% | 0 |
| Case | 92.3% | 5.4% | 2.2% | 0 |
| PEPID | 86% | 4.7% | 9.3% | 0 |

Figure 2:- Frequency of smartphone medical application use among physicians working at referral hospitals of Amhara regional state, 2019.

Factors Associated with smartphone medical application use among physicians

The multi variable analysis of logistic regression pointed out attitude, internet access, Computer training, perceived usefulness of application, technical skill of physicians, and availability of IT support staff were significantly associated with smartphone medical application use.

In this study physicians with favorable attitude were 1.64 times more likely to use smartphone medical application than those physicians with unfavorable attitude towards smartphone medical application (AOR=1.64, 95% CI: [1.05, 2.55]) Similarly physicians who has IT support staff at hospitals were 2.36 times more likely to be smartphone medical applications user relative their counterpart (AOR=2.36, 95% CI: [1.5,3.08]) (Table 4).

Table 4:- Bivariable and multivariable regression analysis of factors with smartphone medical application use among physicians in referral hospitals of Amhara regional state, North Ethiopia, 2019 (n=417)

| Variable | Category | Application Usage | | Crude OR | AOR |
|-------------------|------------|----------------------|-----------|--------------------------|---------------------------|
| | | Yes | No | | |
| Education level | GP | 142(34%) | 77(18%) | 1.51[.87, 2.60] | 1.68[.91,3.1] |
| | Resident | 83(20%) | 44(11%) | 1.54[.85, 2.8] | 1.7[.88,3.3] |
| | Specialist | 39(9.4%) 32(7.6%) | | 1 | 1 |
| Internet Access | Yes | 210(50%) | 88(21%) | 2.87[1.85,4.45] * | 2.82[1.75,4.5] *** |
| | No | 54(13%) | 65(16%) | 1 | 1 |
| Computer Training | Yes | 179(43%) | 72(17.4%) | 2.36[1.57,3.56] * | 1.71[1.09,2.67] ** |
| | No | 85(20%) | 81(19.5%) | 1 | 1 |

| | | | | | |
|----------------------|-----|----------|----------|------------------------------|-------------------------------|
| IT Support Staff | Yes | 156(37%) | 58(14%) | 2.366[1.57,3.56] * | 2.363[1.5,3.08] *** |
| | No | 108(26%) | 95(23%) | 1 | 1 |
| Technical skill | Yes | 225(54%) | 103(25%) | 2.8[1.73, 4.52] * | 2.54[1.5, 4.30] *** |
| | No | 39(9%) | 50(12%) | 1 | 1 |
| Attitude | Yes | 153(37%) | 69(17%) | 1.67[1.12, 2.5] * | 1.64[1.05,2.55] ** |
| | No | 111(27%) | 84(20%) | 1 | 1 |
| Perceived Usefulness | Yes | 158(38%) | 70(17%) | 1.76[1.18,2.64] * | 1.65[1.06,2.56] ** |
| | No | 106(25%) | 83(20%) | 1 | 1 |

Discussion

This study assessed use of smartphone medical application and associated factors among physicians at referral hospitals in Amhara region. In this study, the use of smartphone medical application by physician was 63.3% (95% CI: [58.3, 67.9]). This result was consistent with study done in Britain 60%(5). On the other hand lower than a study done in Canada 77.0%(8), study conducted in Germany at the Leipzig Medical School 68% (36), study conducted in America on American Society of Plastic Surgeons 72%(37), study conducted in America at the University of Utah and Brigham 77.1%(38). This might be due to well-organized infrastructure at clinical practice site, Awareness of physicians on the use of smartphone medical applications for patient care and availability technological guideline which promote use of smartphone medical applications in America, Canada and Germany. But the result is higher than the study in Ghana 43.1%(13). Possible explanation may be due sample size difference (the sample size of the study in Ghana was 65) and study period (this study was conducted about 4 years ago).

This study indicated that most frequently used medical applications by physicians were Up to date, Medscape and Medical calculator. This result is in line with the study conducted in Canada(8). Most of the physicians (72.2%) preferred smartphone medical application as information source for reference during clinical practice. The result is lower than the current study this might be due to accessibility of smartphone in our setup and sample size difference (the sample size of the study in Ghana was 65).

This study found that perceived usefulness of smartphone medical application was positively associated with medical application use among physicians at referral hospitals in Amhara region (p-value =.043). This is in line with the study conducted in Taiwan (39). Perceived usefulness of application was a significant determinant of application use according to the study conducted in Malaysian public hospital (40). This result is comparable with the current study (OR=1.65, 95% CI: [1.06, 2.56]).

This study revealed that physician who had good technical skill were 2.54 times more likely to use smartphone medical application at clinical practice than those who had poor technical skill (AOR=2.54, 95% CI: [1.5, 4.3]). A study conducted in Czech Republic also

indicated that technical skill was a factor for smartphone application usage (41). This might be because people with good technical skill are more receptive to new technology and capable of operating new applications.

According to this study physicians who were working in institution with internet access (WIFI) were 2.82 times more likely to use smartphone medical application than those who has no internet access (AOR=2.82, 95% CI: [1.75,4.54]). This might be due to availability of internet access makes easier regular update of medical application and exchange of information is possible through medical application like for consultation within senior physicians.

Physicians who were working in institution which has IT support staff were 2.36 times more likely to use smartphone medical application than their counterparts (AOR=2.363, 95% CI: [1.5,3.08]).

This study revealed that physicians with favorable attitude were 1.64 time more likely to use smartphone medical application than their counterparts (AOR=1.64, 95% CI:[1.05,2.55]), which is in line with the result obtained by the study conducted in Iran(34). This implies that attitude of physicians is a key in implementation of such applications in the clinical practice.

Conclusion

The findings of this study showed that smartphone medical application use was 63.3%. Favorable attitude, internet access, computer training, perceived usefulness of application, technical skill of physicians, and availability of IT support staff were the most notable factors that were associated with smartphone medical application use.

Abbreviation and Acronyms

| | |
|----------|--|
| Apps | Applications. |
| Epi-info | Epidemiological Information |
| GPS | Global Positioning System |
| HCPs | Healthcare Professionals. |
| IT | Information Technology |
| M-health | Mobile Health. |
| PDA | Personal Digital Assistant. |
| SPSS | Statistical Package for Social Science |
| UK | United Kingdom |
| MedCalc | Medical Calculator |

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Availability of data and materials

Data will be available upon request from the corresponding author.

Authors' contributions

GH, conceived of the study, coordinate data collection. GH, BT, AT, AND HA performed statistical analysis and drafted the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

Ethical clearance was obtained from the Ethical Review Board of the University of Gondar. Moreover, privacy and confidentiality of information was strictly guaranteed by all data collectors and investigators. The information retrieved was used only for the study.

Consent for publication

Not applicable.

Competing interests

No competing interests.

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Figures

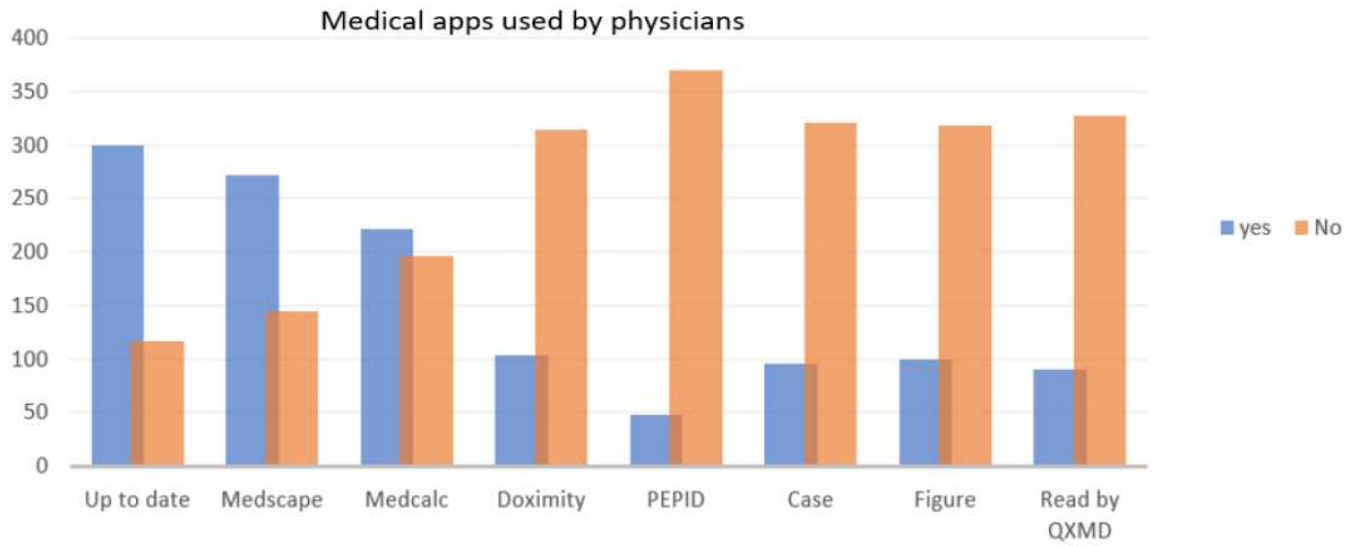


Figure 1

Medical applications used by physicians working at referral hospitals in Amhara regional state, Ethiopia, 2019.

| Medical app | Daily | Three times a week | Once a week | I don't know the time |
|-------------|-------|--------------------|-------------|-----------------------|
| Up to Date | 88.9% | 7.5% | 3.2% | .4% |
| Medscape | 89.4% | 6.6% | 3.5% | .4% |
| Medcalc | 92.3% | 4.8% | 2.4% | .5% |
| Doximity | 90.7% | 6.2% | 3% | 0 |
| Figure | 90.4% | 6.4% | 3.2% | 0 |
| Red by QXMX | 89.4% | 7.1% | 3.5% | 0 |
| Case | 92.3% | 5.4% | 2.2% | 0 |
| PEPID | 86% | 4.7% | 9.3% | 0 |

Figure 2:- Frequency of smartphone medical application use among physicians working at referral hospitals of Amhara regional state, 2019.

Figure 2

Frequency of smartphone medical application use among physicians working at referral hospitals of Amhara regional state, 2019.