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DoccPlus

Connecting Doctors & Patients

**Abstract**

For successful treatment, the correct recognition of the disease and its causes, the determination of the characteristics of the patient's body and the course of the disease, and the knowledge of the action of various drugs are needed. There are many different ways to diagnose and treat diseases, but technology does not stand still, and humanity needs ever-more convenient, faster, and better solutions to problems. Finding new and improving old methods of medical diagnosis is one of the most promising directions in medicine. However, the problem of delayed diagnosis of diseases is always a crucial issue because often patients are temporarily inactive to help doctors, for which there are several reasons, such as lack of time or money, fear or distrust of doctors, hope only for own strength and many other aspects.

Given this fact, it is relevant to create a system that would help the doctor to determine the diagnosis and find a cure. At the same time, patients, in addition to consultations in clinics, will be able to analyze the symptoms, what they are concerned about, and which doctor it is necessary to contact to cure the disease using the application on a smartphone.

This article aims to develop an application system to capture the symptoms of a patient's disease, determine a preliminary diagnosis, and provide recommendations for contacting a doctor of a particular specialization, as well as a reminder about taking the cure.

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**Introduction & Background**

The development of smartphones and tablets with enhanced capacity and function, improved memory, larger screens, and the ability to access the internet and download software has made them ever-present within medicine. Through their wide range of uses, including communication, diagnostics, self-monitoring, and access to specialist medical software packages or ‘apps’ [[1](https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-015-0356-8#ref-CR1)], mobile devices are increasingly employed by medical students and physicians in the workplace [[2](https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-015-0356-8#ref-CR2),[3](https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-015-0356-8#ref-CR3)]. Smartphone technology would seem to be part of a technological revolution within medical practice [[4](https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-015-0356-8#ref-CR4)]. Identifying and keeping up-to-date with technological developments to support workplace learning is a crucial challenge for medical educators. The position and appropriation of technology within the learning sphere is that it should support, serve and develop understanding rather than drive the learning experience [[5](https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-015-0356-8#ref-CR5)]. Technology that provides help when needed and is responsive to learners’ developing knowledge and skills can offer a form of dynamic scaffolding [[6](https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-015-0356-8#ref-CR6)]. Sfard [[7](https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-015-0356-8#ref-CR7)] argues that learners need both to acquire knowledge and participate in learning processes, thereby acknowledging and incorporating the context of learning through participation and the individual attainment of knowledge.

The premise that learning entails knowledge acquisition and participation is central to workplace education and training and is especially relevant at significant points of participatory learning, such as during the transition from a medical student to a newly qualified doctor. The development of learning through acquiring explicit knowledge (for example, from textbooks) and learning through participation is central to the new medical practitioners’ learning experience in the workplace. Mobile technology has the potential to support not only the acquisition of explicit knowledge but also the new doctors’ engagement in the workplace by, for example, keeping their preparation for patient encounters and their dialogue with members of medical teams. However, much of the research on the use of mobile technology is confined to medical curricula, and evidence on how mobile resources may support trainee doctors’ learning in the workplace is limited. The pace and spread of developments in mobile technology and medically relevant applications are in stark contrast to the much slower rhythms of research and subsequent publication of evidence.

In this paper, we report findings from the evaluation of an intervention that provided newly qualified doctors in Wales with a library of cross-searchable medical texts on their smartphone devices via an app. The first years of medical practice are when rapid access to reliable information resources is essential for learning and practice. While several studies have explored how smartphones can improve communication within education and training, few have considered how smartphones are used as a reference resource within workplace (typically hospital) settings [[8](https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-015-0356-8#ref-CR8)].

The main emphasis in current research is on exploring attitudes to smartphone use, estimating the extent and primary purpose, and identifying perspectives on potential benefits and challenges [[1](https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-015-0356-8#ref-CR1),[9](https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-015-0356-8#ref-CR9),[10](https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-015-0356-8#ref-CR10)]. Regarding availability, there are differences in the projected numbers of doctors or medical students using mobile technology. One systematic review [[11](https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-015-0356-8#ref-CR11)] concluded that within health care, the uptake and use of personal digital assistants (PDAs), a forerunner to smartphones, had increased but was variable. More recently, high smartphone ownership rates among medical students and junior doctors have been reported [[12](https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-015-0356-8#ref-CR12)]. Another study [[13](https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-015-0356-8#ref-CR13)] found high usage, with 77% of medical students in Monash University, Australia, owning a smartphone, of which 76% used medical apps. Students were identified as having positive opinions about smartphones, with the conclusion that smartphone devices have the potential to play a significant role in medical education. A review of the literature on the use of PDAs by health professionals and medical students also reported a positive attitude towards their use in medicine [[14](https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-015-0356-8#ref-CR14)], and another review found evidence of clinicians making effective use of handheld devices to access information and guidelines and improve diagnostic decisions [[15](https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-015-0356-8#ref-CR15)].

The repeated message from the research is widespread support for using smartphones in medicine. However, the availability of mobile technology does not equate to its use to enhance learning and training. Concerns have been expressed about the potential of mobile devices to cause doctor distraction [[16](https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-015-0356-8#ref-CR16)] and dependency on technology and its use as a substitute for critical clinical thinking [[12](https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-015-0356-8#ref-CR12),[17](https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-015-0356-8#ref-CR17)]. The widespread informal use of mobile technology in medical education and the difficulties of researching proper use make it hard to assess the benefits of learning and training. Practical barriers to smartphone use have also been recognized, including cost, availability of technology, effective monitoring of usage, and problems of synchronization with alternative resources [[12](https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-015-0356-8#ref-CR12)].

Although we know a lot about medical students’ and doctors’ views on the use of mobile devices in support of learning, less is known about how newly qualified doctors to practice using them. In a previous phase of our project, we documented that having access to a smartphone library of medical texts improved user confidence and enhanced patient care [[18](https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-015-0356-8#ref-CR18)]. In this article, we contribute to the field by examining how smartphones are used to other types of resources available in the workplace and report changes in their use over time. We also consider the perceived need for smartphones in the workplace and how at ease the participants’ felt about using the device in front of patients and ward staff.

**Analysis of known systems (Literature Review)**

Today, many different mobile applications are used in the medical industry. Diagnose, Epocrates Plus, WebMD, iTriage, and Prognosis: Your Diagnosis is the most common.

"Diagnose" is an application designed by medical professionals and trainees to diagnose patients and improve their care and medical education. The application allows users to include approved findings from the history of the disease, physical examination, and research to calculate the probability of disease occurrence based on specific facts. When examining a patient with a diagnosis such as a stroke, doctors can now see in real-time what particular data on the history, physical and laboratory examination of patients lead to a change in the probability of the disease. The program includes many diseases of different complexity, such as cancer, ectopic pregnancy, stroke, flu, pneumonia, sinusitis, injuries, headache, and others.

The application has several significant disadvantages, among which are:

It is intended only for medical professionals or people with the necessary knowledge in the medical area, without localization [4].

Epocrates Plus is a medical resource for healthcare professionals and students. The main idea of the application is to provide improved patient care by providing the necessary information when it is most needed.

Epocrates Plus has the following features:

* Information on the use of any types and brands of remedy and all the nuances of their use;
* testing for the presence of potentially harmful influence of medicinal products if they are taken in the same period;
* access to medical news and research information;
* medical calculator that calculates body mass index;
* information on diseases and alternative medicines.

Although Epocrates Plus is designed for doctors, patients can use it relatively quickly, unlike the previous application. However, the disadvantages include the complexity of development and lack of localization.  
WebMD is an application that provides round-the-clock access to web health information and decision support tools. The user can:

* Choose the part of the body that worries and find out the causes of the symptoms and possible problems;
* find out about medicines, methods of treating a particular disease, and other important information (instructions for medications, side effects) provided by an extensive database;
* to identify prescription and non-prescription drugs by type and form;
* access emergency medical information, no Internet connection when needed;
* find the nearest hospital or pharmacy according to the current location or search for cities;
* create lists of medicines and view them at any time and anywhere;

WebMD is a leading health information service provider that serves consumers, doctors, healthcare providers, and healthcare employers via public and private Internet portals, mobile platforms, and healthcare-oriented publications [5].

Despite the numerous advantages, there are several disadvantages: the presence of advertising, the complexity of development, and the lack of localization. iTriage is a medical application created by ambulance doctors, similar to WebMD. It provides access to a medical database that allows you to search for symptoms, learn about their possible causes and find appropriate treatment. A feature of iTriage is the presence of a close relationship with the doctor, namely:

* to the current location or search for
* Search for the most suitable medical institution or doctor;
* finding the nearest hospital, pharmacy, emergency department, mental health clinic, public health centers, etc .;
* determine the average waiting time for some emergency and emergency hospitals, telephone numbers, and online doctor consultations [6].

The disadvantages of iTriage are similar to WebMD.

Prognosis: Your Diagnosis is a game application that allows one to test one's decision-making skills at risk, assess clinical knowledge, and learn more about the disease in a few minutes.

The app is a series of scenarios-clinical cases that assess the decision-making process and skills of the player. Each scenario takes a few minutes and is accompanied by a brief discussion of diagnostic considerations and critical lessons that can be applied to everyday practice. All systems are based on real cases with patients considered by specialist doctors. All designs are based on real issues with patients whom a group of specialist doctors has evaluated. The app is an embodiment of an exciting idea and is an excellent way for practicing physicians to develop and maintain their clinical wisdom at risk. This is also a good practice for medical students and other health professionals. However, a significant disadvantage is mandatory medical training [7].

Based on the analysis, we can conclude that most of the applications are aimed at helping doctors, healthcare professionals, and students. Some are also intended for people who do not have special knowledge in medicine, but such programs have several disadvantages, which greatly complicate the work. Although decision-making in diagnosis will always remain for the person, the help provided by the technique becomes more and more significant. In view of this, the actual task is to create an information and consultation system with the help of which an ordinary person can find a possible diagnosis and receive recommendations for improving health.

**Methods**

**The intervention**

The DoccPlus project was established in 2021 when we offered newly qualified doctors in Lahore PDAs preloaded with medical textbooks. These textbooks were specially presented for smartphone usage and included a cross-searchable facility. In the second phase, we offered our participants a preloaded smartphone [18]. Following feedback from the evaluation, including an expressed reluctance to carry two devices (the DoccPlus phone and their own, often more up-to-date device), in Phase 3, we provided a license key that the newly qualified doctor participants used to download the Dr. Companion© software and five key texts onto their device. Once downloaded, use was internet complimentary. The texts on the DoccPlus app were: the British National Formulary - BNF, the Oxford Handbook of Clinical Medicine, the Oxford Handbook of Emergency Medicine, the Oxford Handbook of Clinical Specialties, and the Oxford Handbook of Clinical Surgery. The expectation was that this supplementary learning tool would enable doctors easily to consult the explicit knowledge provided on the app, which would support their clinical practice. Phase 3 of the DoccPlus project ran for 12-months from August 2021, and evaluation data from this phase is our focus here.

The DoccPlus project participants are Foundation doctors. The King Edward Foundation Training Programme bridges the gap between medical school and specialist training. The number of Foundation Year 1 (F1) trainee doctors in Lahore in 2021/22 was 322. Participation in the DoccPlus project was voluntary. Although participants were required to complete a baseline questionnaire to access the resource, they were not prevented from using it if they subsequently chose not to participate further in the evaluation.

**Survey design and administration**

The baseline questionnaire collected data on workplace information sources, including mobile devices (frequency, type, usefulness, and variation in use). The baseline questionnaire was issued when participants were newly in post. Participants completed an exit questionnaire at the end of the data collection phase (July 2022). The exit questionnaire included questions from the baseline and additional questions to explore the effects of the intervention. All questions were optional. Questionnaire design was informed by findings from the previous phases (along with focus group discussions during the initial setup of the DoccPlus intervention programme). Questionnaires were confidential but not anonymous.

**Data analysis**

In this paper, we present an analysis of the relationship between the data at baseline and exit.

Matched data from baseline and exit questionnaires were entered into SPSS v.20. All variable frequencies were reviewed. As the data were ordinal, a non-parametric statistical test (Wilcoxon Signed Rank test) was used to explore relationships between variables. In line with statistical assumptions, results were considered significant when the p-value was less than 0.05 [20].

**Results and discussion**

**Survey respondents**

Baseline and exit questionnaires were completed by 125 F1 trainees, representing 39% of the total of F1s in Lahore at that time. Of those who disclosed their gender, 54% of respondents were female (n = 67).

**Use of the DoccPlus app by junior doctors**

Respondents were asked to indicate their use of the DoccPlus app. Of the sample, 91% (n = 114) reported using the app for more than seven months. Over half the participants (n = 65) reported using the app daily (see Table 1).

**Information sources used by trainee doctors in the workplace**

Respondents were also asked about their use of alternative resources. Data generated by the questionnaires at baseline and exit showed the most frequently used information sources in the workplace daily were: senior medical staff (75% at baseline; 84% at exit), peer door 9% baseline; 67% withdrawal); other staff in the medical/nursing team (53% baseline; 58% exit) and the internet (62% baseline; 35% withdrawal). See Table 2.

Regarding workplace information resources, results displayed significant changes during the year. Hard-copy textbooks/journals were reported to be accessed daily by only 8% of participants at exit compared to 39% at baseline, a significant decrease in their use during the year (Z = −6.326, p < 0.001). Likewise, electronic textbooks/journals accessed via a PC also declined significantly (Z = −3.004, p < 0.003). The percentage of respondents who never accessed lecture notes increased significantly (20% at baseline; 62% at exit; (Z = −6.758, p < 0.001). Participants use of the internet as a workplace resource also decreased significantly (Z = −4.646, p < 0.001) during this period. However, it remained a source of daily information in the workplace for 35% of participants at the exit.

In terms of people-based resources, participants observed a significant difference in the use of senior medical staff (Z = −4.646, p = 0.001), where daily use increased from 75% to 84%. No significant difference was found in using peers and other staff as workplace information sources.

**Using mobile technology in the workplace**

We asked respondents to rate on a scale of 1-10 whether they thought there was a place for smartphone technology in the workplace (where 1 = 'no place' and 10 = 'essential'). Ninety-two percent (n = 115) of respondents gave a rating of 7 or more in the baseline questionnaire, a proportion that remained consistent at exit (95%; n = 119). However, the percentage of respondents rating 10 along the Likert scale, indicating they thought smartphone use had an ‘essential’ place in the workplace, significantly increased from 20% (n=25) to 37% (n=46) (Z=−4.050, p=0.001).

Questions in the baseline and exit questionnaires asked respondents to indicate whether they would feel comfortable using a mobile device containing textbooks in front of patients and senior medical staff in the workplace (see Table 3). At baseline, 33% (n = 41) of participants strongly agreed or agreed that they would feel comfortable using a mobile device containing textbooks in front of patients. At the exit, the percentage of agreeing or agreeing significantly increased (45%; Z = −2.491, p = 0.013). For using a smartphone containing textbooks in front of senior medical staff, the exit data showed that 73% of participants strongly agreed or agreed that they would feel comfortable,

**Conclusion**

The transition from medical student to a new doctor is a time of intense change in responsibility and practice. The advent of increased responsibility and decision-making can be challenging. Our findings indicate that access to a mobile app enabling timely, internet-free access to essential textbooks supports newly qualified doctors' learning and practice during this critical development phase. Interestingly, results display an increase in the use of senior colleagues by participants after the period of DoccPlus app use. Rather than an over-reliance on information from the app in decision-making, these findings suggest that the app was used strategically to complement, not replace, discussions with medical team members. Participants’ uncertainty about using a mobile device with the textbook app in front of others was shown to ease over time.

After completing this stage, it can be concluded that availability of a new connecting resource is a viable solution for new graduating doctors. Now the baseline was accessing the interest of medical staff in using an application in addition to their day job. This study shows promising outcomes and now further development can be started, completing the portals for both doctors and patients. This will provide a viable path for timely communication with medical professionals. Further development of product starts with the completion of first stage. Now proceedings with customer interests and Human Computer Interface experts will be required in developing the portals for an efficient and user-friendly interface. Further inquiry will be needed to establish the optimal communication between clientele.

**Abbreviations**

App: Application software;

F1: Foundation year 1;

DoccPlus: Name of the app;

PC: Personal computer;

PDA: Personal digital assistant;

SPSS: Statistical package for the social sciences;

UK: United Kingdom.

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