

# Few ICT Applications for Improved Healthcare Service Delivery in Developing Countries

Zain Abbas, S. M. Aqil Burney and Abdul Bari

**Abstract**— Healthcare sector of developing countries like Pakistan suffer due to dearth of experienced physicians, professional caregivers, patchy infrastructure, and poor populace. Modern Information and Communication Technology (ICT) devices can overcome these impediments due to their low cost, penetration in urban, rural and remote areas; and ease of use. The work reviews the recent ICT growth together with e-health and m-health; and present some successful applications (namely DocsLab, Drugs-Pharma and Health Care App) based on these. The apps reported have been designed, deployed and tested in Karachi, Pakistan.

**Keywords**— E-health, Healthcare, ICT and M-health

## I. INTRODUCTION

Health Information Technology, E-health, Telemedicine or Tele-health is the use of ICT in healthcare. E-health refers a firm commitment by all stakeholders to improve the quality of healthcare being provided to the patients by utilizing the growth in ICT sector [1]. Telemedicine, in particular, refers to the use of ICT in provisioning of healthcare services at a remote or distant location.

The discipline of e-health lies at the crossroads of Computer Science, Information Technology, Information Science and Healthcare (see Fig. 1). It not only deals with a number of techniques used in storage, retrieval, handling, and transfer of information in healthcare but also spans clinical guidelines, formal medical procedures and terminologies, and communication systems. A detailed discussion has been carried by the authors in [2]. E-health is having a large impact in developing countries that lack adequate financial means to provide reasonable status of healthcare delivery [3]. Moreover, the influence is more exemplified in the poor countries where experts are rare; distances are large; and infrastructure is limited [4]. Although, the history of telemedicine dates back to 1950, when it was first used at the National Bureau of Standards, United States [5], but the real use in developing countries has commenced since the exponential growth of ICT during the past decade.

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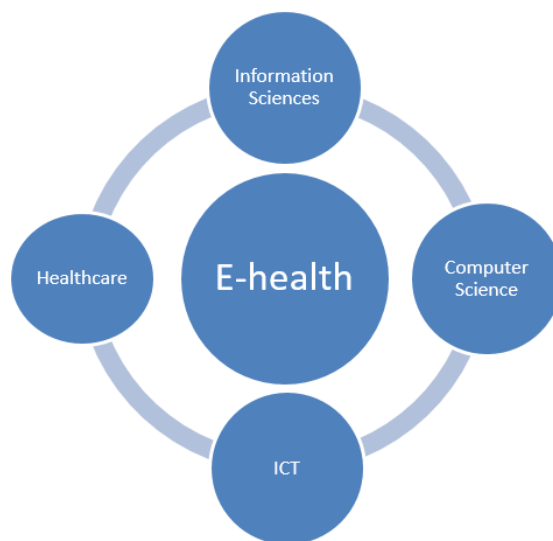


Fig. 1. The concept of e-health

The expansion of mobile and wireless technologies around the world has set up an unprecedented opportunity for global health delivery. The International Telecommunication Union estimates that total mobile cellular subscriptions reached almost 7 billion by the year 2015, corresponding to a global penetration of 97% [6], with more than 70% of them residing in developing countries. Mobile phone networks cover at least 90% of the world's population, including over 80% of those living in rural areas [7]. Mobile health, now

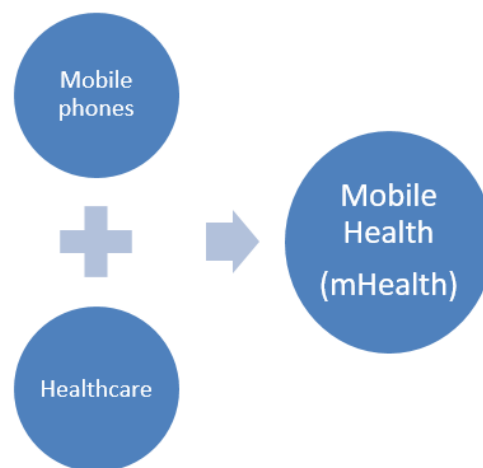


Fig. 2. Mobile Health or M-Health

commonly referred to as m-health capitalizes on the successes of the mobile telephony to deliver health information and care in an efficient and improved manner (see Fig. 2).

The rest of the paper is organized as follows: Section 2 highlights the growth of ICT during the past decade. Section 3 reports the e-health and m-health applications developed. Conclusion and outcomes are shown in Section IV followed by references.

## II. GROWTH OF ICT

The unprecedented growth in Information and Communication Technologies over the past decade and a half, has served as perfect accelerator for social, economic and industrial progress [2]. The rate of diffusion of ICT in the

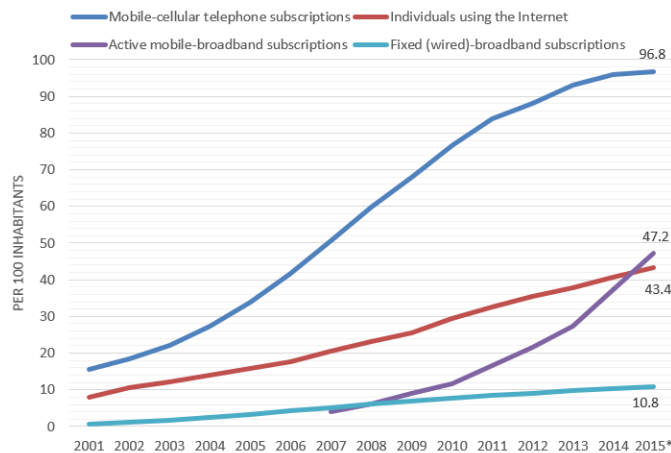


Fig. 3. Global ICT Developments, 2001 to 2015

society has taken everybody by surprise. The global ICT development during these years has been summarized in the discussion to follow.

The data shown has been obtained from International Telecommunication Union key data highlights published in 2015 [6]. Fig. 3 presents a summary of the global ICT development (mobile subscriptions, internet users and fixed

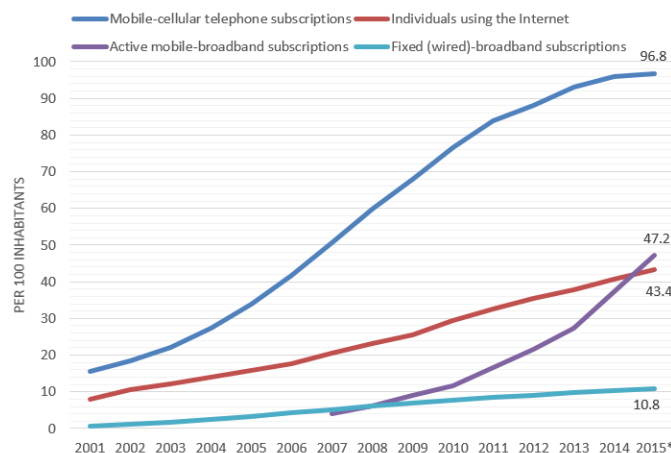


Fig. 4. Mobile subscriptions, total and per 100 inhabitants, 2001-15

broadband users) recorded between 2001 and 2015. More interesting is the fact that in terms of increase in the use of telecommunications developing countries have left behind the developed countries consider, the number of mobile telephone subscriptions for instance. Fig. 5 presents several comparative trends shown by the developing and the developed world.

## III. E-HEALTH AND M-HEALTH APPLICATIONS

The advancements in ICT and related services have paved way for availability of cost effective facilities to the people around the globe [8]-[11]. The increased penetration of communication devices into consumer markets has amplified the interest in storage and transmission of images or digital data using different communication media such as mobile phones to enhance the availability of healthcare services at local and distant sites [12].

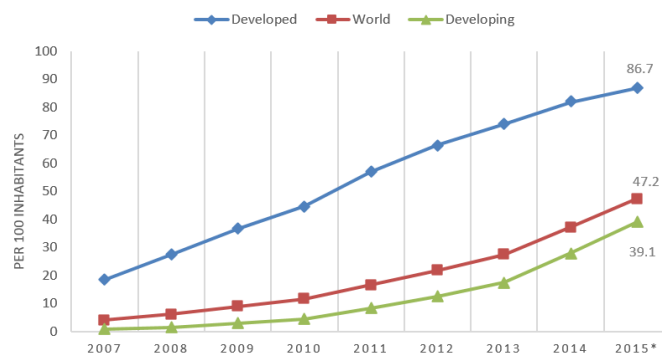


Fig. 5. Active mobile-broadband subscriptions per 100 inhabitants, 2007-15

The usage of wireless communication technologies in providing e-health services is referred as m-health. In general terms, m-health is the application of communication technologies, medical sensors and computing for providing or enhancing healthcare services. As Istepanian [13] defined “Mobile Health is a synergy of emerging mobile medical computing, medical sensor technologies, and communication technologies.”

Mobile technology promises a wide range of functions with intelligent handsets called Smartphones. The functions include remote diagnostic monitoring, data collection, information dissemination, and public education and alerts systems [14].

Some new implementations based on e-health and m-health for improvement of healthcare delivery are presented consequently. They application were built and tested in Karachi (Pakistan).

### A. DocsLab

Finding a doctor is a routine activity that is carried out by all persons who wish to seek advice in case of any ailment. Patients generally refer to family doctors for routine checkup but in case of some specific advice, specialists are approached. Similarly, doctors may refer the patient for some laboratory testing as part of diagnosis of the disease. Finding nearby laboratories whose results are authentic and pricing is

minimal, is another hassle. E-health and m-health can be effectively used to handle this scenario.

*DocsLab* is a mobile and web app designed to serve the purpose. The application lets a person search for a specialist or a laboratory throughout a city. Specialists are listed specialty wise as well as a location wise in order to provide easy-to-use search ability to the user. A user may search for all specialists available in a clinic, all specialists available nearby as well as specialists available at a particular time of day.

Fig. 6 shows the ER diagram of *find-a-doctor* feature. The diagram suggests that every specialist has a specialty and all specialist works at some clinics at different days and time. All clinics are at some location that has appropriate coordinates in terms latitude and longitude. Moreover, the app has a list of laboratories along with location and test directory. The user may find price of any test and compare price of a test among different laboratories.

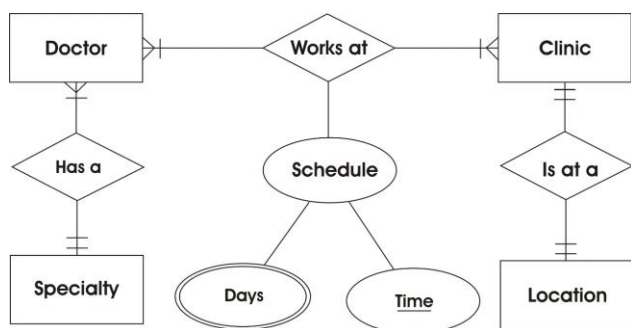


Fig. 6. ERD of *Find-a-Doctor* feature of *DocsLab* Web and Mobile App

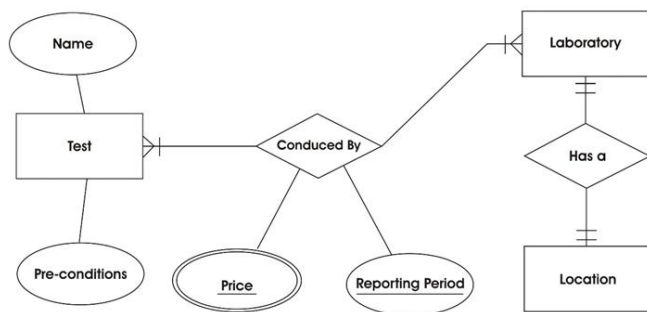


Fig. 7. ERD of *Find-a-Test* feature of *DocsLab* Web and Mobile App

The ER diagram of *find-a-test* feature of *DocsLab* is shown in Fig. 7 and the flow of data is highlighted in Fig. 8.

In order to carry out the project within a limited time and resource scope, several thickly-populated areas in Karachi (Pakistan) were selected and real data regarding the physicians and laboratories was gathered and added to the application. MySQL® was used for development of the app and information regarding around 500 doctors working in different areas of Karachi (Pakistan) was collected and incorporated. The app was distributed among a number of students as well

as among general audience for their feedback which continues to be incorporated in consequent versions.

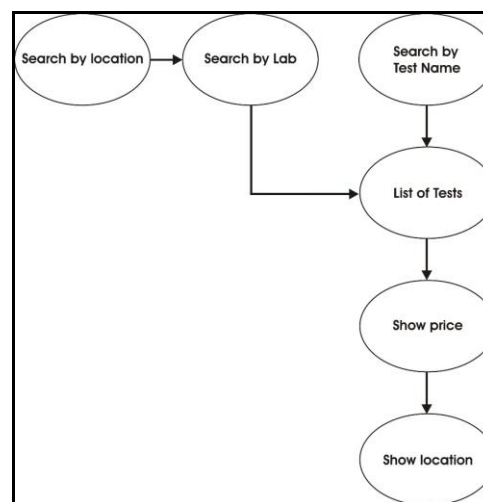


Fig. 8. Flow diagram of *find-a-test* feature of *DocsLab* App

In the future, we plan to extend the application to entire city (Karachi) and host it at various mobile app markets as well as web in order to facilitate the general populace. A mechanism is also being chalked out to issue login information among all the doctors and labs so that they may change or update their information in the application as well as the ability for a general user to maintain a profile and provide review rating and comments regarding a physician or a hospital.

## B. *Drugs-Pharma*

Searching for medicines is a troublesome task for patients. It often happens that a physician suggest chemical formula of some drug with dosage instructions but doesn't name the brand in the prescription. In other cases, physician writes a medicine that is not available in the market and the patient wants to research about similar drug in other brands. Moreover, a price comparison with some other brand is desired. Similarly, a patient may want to read about the uses of a particular medicine, different forms, dosage and possible side effects. An elderly or household person may wish to order medicine for delivery at their premises.

In this era of ICT applications offering this information is readily used. This is the basic scenario behind the design of our app *DrugsPharma*. A user may carry out all the activities mentioned above using the application through a web or mobile interface. Formally stating, following are the main uses:

- Find out about the uses of a medicine, the forms available, dosage information and possible side effects.
- Find out about different brand names of a particular drug by chemical name.
- Compare pricing information of different brands.
- Find alternate drug (under advise of pharmacist) when prescribed drug isn't available.

- Find out about medicines used to treat a particular ailment.
- Deliver medicines at home at a minimal delivery charge and shortest possible time.
- Possible interaction among different medicines as determined by many drug interaction systems available online.

Health Care		DETAILS	
<b>ABDEC</b> Aspirin 80 mg/0.6ml, Calciferol 500 IU/0.6ml, Nicotinamide 10 mg/0.6ml, Paracetamol 400 mg/0.6ml, Pseudoephedrine 1 mg/0.6ml, Salicylic Acid 200mg/0.1ml, Salicylic Acid 100mg/0.1ml, Thiamine HCl (Vitamin B1) 1 mg/0.6ml Trade Price 24 Retail Price 28	Drops	Manufacturer	Abbott
<b>ABOCAIN</b> Bupivacaine (HCl) 0.5 mg/ml Trade Price 94 Retail Price 111	Inj	Brand Name	ABOCAIN SPINAL INJECTION
<b>ABOCAIN</b> Bupivacaine (HCl) 0.5 mg/ml Trade Price 188 Retail Price 221	Inj	Generic Name	Bupivacaine (HCl) [7.5 mg/ml]
<b>ABOCAIN SPINAL INJECTION</b> Bupivacaine (HCl) 0.5 mg/ml Trade Price 194 Retail Price 229	Inj CS	Dosage Form	Inj CS
		Packing	2mlx5s
		Trade Price(Rs)	194
		Retail Price(Rs)	229

Fig. 9. Result obtained using find-a-drug feature of *DrugsPharma*

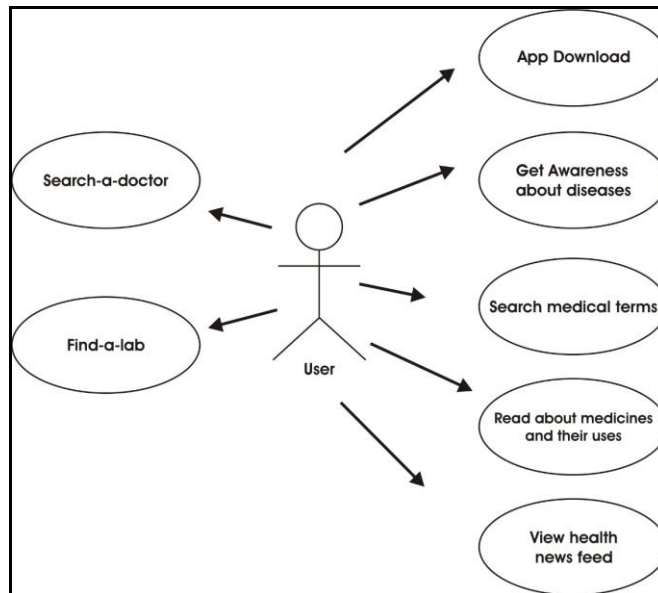


Fig. 11. Use case diagram of Health Care App



Fig. 10. Home screen of Health Care App

A simple search result regarding the medicines was run and the result is shown in Fig. 9. The details obtained regarding the medicine contain the manufacturer, brand name, generic name, dosage form, packaging, trade price and retail price.

### C. Healthcare App

In order to target a broader segment of society, another mobile app named “Health Care” was also developed as part of thesis. This app was developed for Android® operating system due to heavy usage among all classes of the society. The basic purpose of the app was to provide about different diseases as well as general medical terms. The interface of the app is shown in Fig. 10.

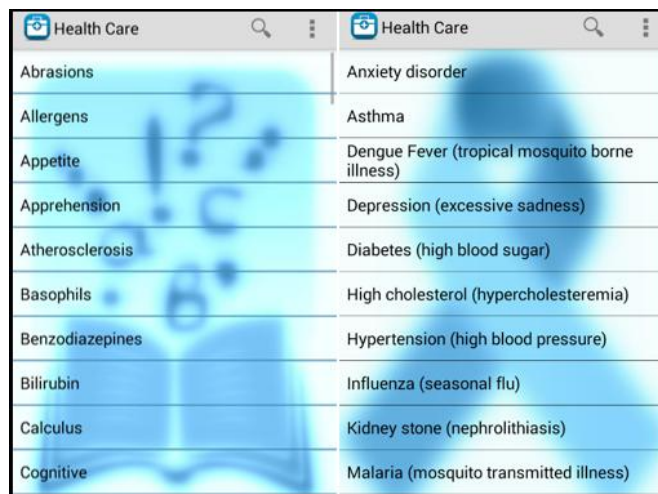


Fig. 12. Home screen of Health Care App

The main features of the app are stated below:

- A user can get awareness about different diseases, their causes, symptoms and treatment. A description of simple remedies and precautions to avoid or manage the disease is also included (see Fig. 11).
- A list of common medical terms / jargons has been included in the application. This feature will be beneficial for users, particularly medical students, to get instant knowledge about the term. Text to speech feature is also included for people who have trouble in reading text in cell phones (see Fig. 9).
- User can read about a number of medicines, their uses and possible side-effects. Details about chemical composition and structure has been included to help medical students in their study
- Health news feed has been included in the app from renowned health care website and services globally. The

feed is updated automatically as and when the internet connectivity is available.

The app was developed for Android® platform because it has proved to be a game changer for the developing countries. Being free and based on the solid Linux kernel, it has largely multiplied the use of smartphones in the developing world where wireless connectivity is cheaper and more accessible as compared to wired networks.

In future, we plan to enhance the scope of this application by adding information pertaining to more diseases, medical terminologies, drugs as well as disease surveillance and outbreak. Moreover, development of application for other mobile operating system like iOS® and Windows® Phone is also under consideration to increase the user base.

#### IV. CONCLUSION AND OUTCOMES

E-health and telemedicine offers a brilliant opportunity to improve the standard of healthcare services provided to patients round the globe, particularly to patients from developing countries. People from such countries can improve their access to these services using the exponential increase in ICT devices and usage throughout the world.

The DocsLab application can be extended to cover all parts of Karachi, in fact the application can be extended to cover entire country. Moreover, admin panel may be provided to participating physicians and hospitals to manage their information in a better way. Awareness apps like Drugs-Pharma and Health care app can be enhanced and made available on online markets like Play Store®, App Store®, Store® and App World® in order to benefit the general populace.

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