

**ACCEPTANCE AND BARRIERS TO PHARMACISTS'  
ADOPTION OF SMARTPHONE MEDICAL APPS**



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**FACULTY OF MEDICINE AND HEALTH SCIENCES  
UNIVERSITI MALAYSIA SABAH  
2015**

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ADOPTION OF SMARTPHONE MEDICAL APPS**

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**THESIS SUBMITTED IN PARTIAL FULFILLMENT  
FOR THE DEGREE OF MASTER OF SCIENCE**

**FACULTY OF MEDICINE AND HEALTH SCIENCES  
UNIVERSITI MALAYSIA SABAH  
2015**

## DECLARATION

I hereby acknowledge that I have stated the source of each extraction, summary and reference in this study and that this thesis comprises no material available elsewhere or extracted in whole or partially from others theses presented for any universities degree or diploma programs.

In addition, I also declare that I have never submitted this thesis for the award of any degree or diploma in any other tertiary institutions.

12 October 2015

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## CERTIFICATION

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Firstly I would like to express my love and respect to my father and deceased mother for teaching me determination and the value of education, nothing would have happened without their auspices in my endeavours.

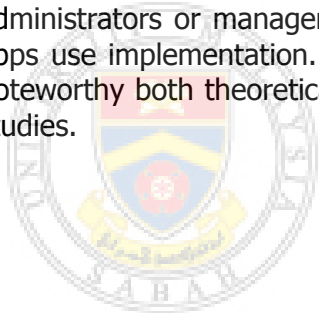
I would like to take this opportunity to acknowledge the contribution of all three supervisors, who have been very helpful and supportive in sharing their expertise and providing helpful feedbacks to me throughout the years. I thank all the pharmacists around the world who have participated honestly in the focus groups and questionnaire survey of this research project. Special thanks go to Emiliah Talib, Roger Balakan, Nor Surayah Bt Osman and Maurice Liaw, who acted as focus group facilitators, and have dedicated their valuable time in conducting the group discussion at various venues. Not to forget also to express my gratitude to the pharmacists of my acquaintance who have volunteered themselves in helping me to administer questionnaires at various institutions from around the world.

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## ABSTRACT

With the recent blooming and revolutionizing effect of mobile technologies and its related applications (apps), it is not uncommon that medical apps have seen to play a role in decision support within the health system including pharmacy practice. It is of great importance to learn about healthcare professionals' views towards the adoption of this new health information technology (HIT) in their practices prior to any mandatory implementation of the system. The goal of this study is to investigate pharmacists' perception towards mobile medical apps use in pharmacy practice and to explore the enabling and inhibiting factors that govern the adoption of this HIT. This study has undertaken a mixed-mode research methodology, combining focus group and survey questionnaire studies to examine the relationships between key constructs in the proposed model. Multinational pharmacists from various fields of practice have participated in the studies. Survey data was analyzed using partial least squares (PLS) modeling statistical technique. The findings provided strong empirical support for six positive (i.e. perceived usefulness, perceived ease of use, result demonstrability, subjective norm, compatibility, facilitating conditions) and two negative determinants (i.e. security, resistance to change) of intention to use medical apps. Predictive relevance of the proposed model was evaluated and was found promising in generalizing actual medical apps usage. Results of this study are able to assist healthcare administrators or managers in their decision making during early stage of medical apps use implementation. In short, contribution and implications of this study are noteworthy both theoretically and practically, and serves as the baseline for future studies.



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## **ABSTRAK**

### **FAKTOR KEBOLEHAN DAN HALANGAN PENERIMAAN APLIKASI MOBIL PERUBATAN OLEH PEGAWAI FARMASI**

*Dengan perkembangan terkini dan kesan revolusi teknologi mobil dan aplikasi yang berkaitandengannya, ia satu kebiasaan yang mana aplikasi perubatan dilihat memainkan peranan dalam menyokong keputusan di dalam sistem kesihatan termasuklah perkhidmatan farmasi. Ia satu kepentingan besar untuk mengkaji tentang pandangan para pakar penjagaan kesihatan terhadap penerimaan Teknologi Maklumat Kesihatan (TMK) yang baru ke dalam perkhidmatan mereka sebelum sebarang mandatori sistem diimplimentasikan. Matlamat kajian ini adalah untuk mengkaji persepsi pegawai farmasi terhadap penggunaan aplikasi mobil perubatan dalam perkhidmatan farmasi dan untuk meneroka faktor kebolehan dan halangan yang mempengaruhi penerimaan itu dalam Teknologi Maklumat Kesihatan. Kajian ini telah melalui metodologi penyelidikan secara mod-campuran menggabungkan kumpulan sasaran dan kajian soalan tinjauan untuk memeriksa hubungan antara faktor utama dalam model penyelidikan yang dicadangkan. Pegawai farmasi dari pelbagai bidang praktis dan negara telah mengambil bahagian dalam kajian ini. Data kualitatif telah dianalisis dengan menggunakan teknik partial least squares. Hasil penemuan menunjukkan sokongan empirikal yang kuat bagi enam penanda positif (perceived usefulness, perceived ease of use, result demonstrability, subjective norm, compatibility, facilitating conditions) dan dua penanda negatif (security, resistance to change) untuk menggunakan aplikasi perubatan. Ramalan relevan model yang dicadangkan telah dinilai dan mendapati cerah dalam menentular TMK sebenar. Hasil kajian ini dapat membantu pentadbir dan pengurus farmasi dalam process membuat keputusan tentang pelaksanaan awal aplikasi perubatan. Kesimpulannya, sumbangan dan implikasi kajian ini perlu diberi perhatian secara teori dan praktikal, seterusnya menjadi garis panduan untuk kajian pada masa akan datang.*

## TABLE OF CONTENTS

	Page
<b>TITLE</b>	i
<b>DECLARATION</b>	ii
<b>CERTIFICATION</b>	iii
<b>ACKNOWLEDGEMENT</b>	iv
<b>ABSTRACT</b>	v
<b><i>ABSTRAK</i></b>	vi
<b>TABLE OF CONTENTS</b>	vii
<b>LIST OF TABLES</b>	xi
<b>LIST OF FIGURES</b>	xiii
<b>LIST OF ABBREVIATIONS</b>	xv
<b>LIST OF APPENDIX</b>	xvi
<b>CHAPTER 1: INTRODUCTION</b>	1
1.1 Overview	1
1.2 Study Impetus and Rationale	3
1.2.1 Background of The Study	3
1.2.3 Problem Statement	13
1.2.4 Research Questions	14
1.2.5 Aim and Objectives of Study	14
1.2.6 Significance of Study	15
1.3 Research Design	15
1.3.1 Phase I: Qualitative Approach	16
1.3.2 Phase II: Quantitative Approach	17
1.4 Terminology	17
1.5 Thesis Structure	19
1.6 Summary	19



<b>CHAPTER 2: LITERATURE REVIEW</b>	21
2.1 Overview	21
2.2 Health Information Technology (HIT)	21
2.2.1 HIT in Malaysia	26
2.2.2 IT in Pharmacy Practice	27
2.3 Mobile Devices and Applications (Apps)	31
2.3.1 Mobile Health (mHealth) Applications	33
2.3.2 Medical Apps for Pharmacists	38
2.3.3 Quality and Regulation of Medical Apps	39
2.4 Technology Adoption Theories	42
2.4.1 Technology Acceptance Model (TAM)	45
2.4.2 Innovation Diffusion Theory (IDT)	50
2.4.3 Theory of User Resistance	52
2.5 HIT Adoption Studies in Pharmacy Practice	54
2.5.1 Acceptance Factors	54
2.5.2 Resistance Factors	60
2.6 Summary	62
<b>CHAPTER 3: RESEARCH METHODOLOGY</b>	64
3.1 Overview	64
3.2 A Mixed Method Design Paradigm	64
3.3 Conceptual Framework	66
3.3.1 Identification of Variables	67
3.3.2 Definition of Variables	69
3.3.3 Hypotheses	71
3.4 Data Collection	72
3.4.1 Qualitative Approach – Focus Group	72
3.4.2 Quantitative Approach - Questionnaire	73
3.5 Data Analysis	75
3.5.1 Qualitative Data Analysis	75
3.5.2 Quantitative Data Analysis	76
3.6 Validity and Reliability in Research	79
3.6.1 Quality in Qualitative Research	79
3.6.2 Validity and Reliability in Instruments Construction	80

3.7	Ethics and Research	81
3.8	Summary	85
<b>CHAPTER 4: STUDY 1 - THE FOCUS GROUP</b>		<b>87</b>
4.1	Overview	87
4.2	Method	88
	4.2.1 Planning for Focus Groups	89
	4.2.2 Conducting the Groups & Data Collection	95
	4.2.3 Data Analysis	100
4.3	Research Findings	102
	4.3.1 Participant Profiles	102
	4.3.2 Acceptance Factors	107
	4.3.3 Resistance Factors	110
4.4	Discussion	113
	4.4.1 Relationships between Key Constructs	115
	4.4.2 The Barriers	117
4.5	Limitation	119
4.6	Summary	120
<b>CHAPTER 5: STUDY 2 – THE QUESTIONNAIRE</b>		<b>121</b>
5.1	Overview	121
5.2	Method	122
	5.2.1 Defining Target Population and Sampling Method	122
	5.2.2 Development of Questionnaire Items	123
	5.2.3 Item Reliability and Validity	131
	5.2.4 Administration of Questionnaires	134
	5.2.5 Statistical Analysis	135
5.3	Results	137
	5.3.1 Demographic and Descriptive Analysis	137
	5.3.2 Measurement Model Analysis	144
	5.3.3 Hypotheses Testing	149
	5.3.4 Model Evaluation	152
5.4	Summary	155

<b>CHAPTER 6: DISCUSSION OF THESIS FINDINGS</b>	157
6.1 Overview	157
6.2 Discussion	157
6.2.1 Summary of Major Findings	157
6.2.2 Acceptance Factors to Adoption	159
6.2.2 Resistant Factors to Adoption	162
6.2.3 Research Implications	163
6.3 Research Limitations	165
6.4 Future Avenues for Research	167
6.5 Conclusion Remarks	167
<b>REFERENCES</b>	170
<b>APPENDICES</b>	190
<b>LIST OF PUBLICATIONS</b>	198

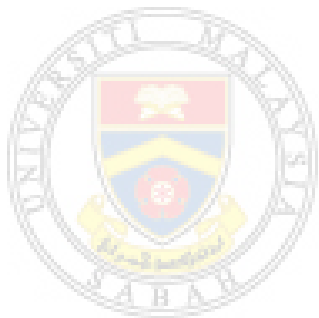


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## LIST OF TABLES

	Page
Table 1.1: Emerging health information technology use in pharmacy practice	9
Table 2.1: Common examples of health information technology	24
Table 2.2: Examples of applications used in the medicines use process in hospital settings	30
Table 2.3: Types of global mHealth initiatives	35
Table 2.4: Examples of medical apps that are relevant to pharmacy practice	41
Table 2.5: HIT adoption studies relevant to the field of pharmacy practice	58
Table 3.1: List of Identified Variables	69
Table 3.2: Definition of independent and dependent variables used in this study	70
Table 3.3: Summary description of various data collection method in quantitative research approach	74
Table 3.4: Types of validity and reliability used to produce credible instruments in quantitative research	83
Table 4.1: Criteria for focus group moderator selection	92
Table 4.2: Focus groups findings on medical apps adoption determinants and their relevant contributing factors	114
Table 5.1: Table of specification used for item pool generation	125
Table 5.2: Cronbach's alpha and item analysis of measurement items in pilot testing	132
Table 5.3: Item mean, standard deviation, composite reliability and average variance extracted	144
Table 5.4: Item loadings for each constructs	147
Table 5.5: Square root of AVE (diagonal element)	148

Table 5.6: Variance Explained ( $R^2$ ), Effect Size ( $f^2$ ), and Total Effect Size of the variables	150
Table 5.7: Path Coefficient Analysis using SmartPLS	151
Table 5.8: Results of cv-communality ( $H^2$ ) and cv-redundancy ( $F^2$ )	154
Table 5.9: Communality, redundancy and <i>GoF</i>	155



UMS  
UNIVERSITI MALAYSIA SABAH

## LIST OF FIGURES

	Page
Figure 1.1 : Global adoption of mHealth initiatives in 2011.	2
Figure 1.2 : Global Mobile Apps Download (all kind).	4
Figure 1.3 : Active Application Count by Category 2013.	5
Figure 1.4 : Percentage of Physicians Using Electronic Medical Records (EMR) in 2005, in US.	13
Figure 1.5: Thesis Structure.	19
Figure 2.1 : Proposed integrated IT interface in supporting pharmacy practice.	29
Figure 2.2 : Popular consumer applications in 2013.	33
Figure 2.3 : Illustration of the role of mobile handheld devices in submitting data collected from wearable sensors in chronic disease management.	36
Figure 2.4 : Conceptual model linking organizational and individual adoption decisions in the process of technology innovation assimilation.	43
Figure 2.5 : Technology Acceptance Model (TAM).	45
Figure 2.6 : Technology Acceptance Model 2.	47
Figure 2.7 : Unified Theory of Acceptance and Use of Technology (UTAUT).	48
Figure 2.8 : Technology Acceptance Model 3.	49
Figure 3.1 : Theoretical research framework.	66
Figure 3.2 : Relationship between behavioural intention, attitude and actual behaviour.	67
Figure 3.3 : Issues in selecting a statistic to use in quantitative data analysis.	78
Figure 3.4 : Data Collection Checklist.	85

Figure 4.1 : Overview of the focus group process flow.	100
Figure 4.2 : Focus Group 1, seven pharmacists (N=7) from mixed field of practice.	103
Figure 4.3 : Focus Group 2, five pharmacists (N=5) from community practice.	104
Figure 4.4 : Focus Group 3, four pharmacists (N=4) from mixed field of practice.	105
Figure 4.5 : Focus Group 4, six pharmacists (N=6) from hospital practice.	106
Figure 5.1 : Distribution of questionnaires collected via various methods.	135
Figure 5.2 : Gender distribution of 414 respondents.	137
Figure 5.3 : Age group distribution among 414 respondents.	138
Figure 5.4 : Nationality of respondents.	139
Figure 5.5 : Distribution of respondents from various fields of pharmacy practice.	140
Figure 5.6 : Distribution of mobile devices ownership among the respondents.	140
Figure 5.7 : Voluntariness of respondents to use medical apps in work.	141
Figure 5.8 : Mandatory use of medical apps in work places.	141
Figure 5.9 : Self-reported average weekly of medical apps by respondents.	142
Figure 5.10 : Commonly used medical apps by the respondents.	143
Figure 5.11: Intention to use medical apps by pharmacists.	143
Figure 5.12: Statistical significance of path coefficients.	152

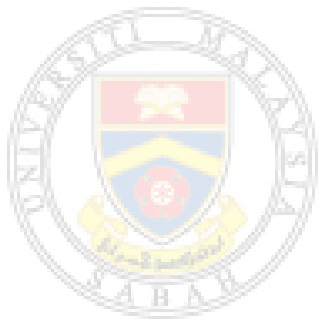
## LIST OF ABBREVIATIONS

<b>ADR</b>	-	Adverse Drug Reaction
<b>apps</b>	-	applications
<b>CPOE</b>	-	Computerized Prescriber Order Entry
<b>EHR</b>	-	Electronic Health Record
<b>EMR</b>	-	Electronic Medical Records
<b>FDA</b>	-	US Food and Drug Administration
<b>HIS</b>	-	Health Information System
<b>HIT</b>	-	Health Information Technology
<b>ICT</b>	-	Information and Communications Technology
<b>IDT</b>	-	Innovation Diffusion Theory
<b>IT</b>	-	Information Technology
<b>LHR</b>	-	Lifetime Health Record
<b>mHealth</b>	-	mobile health
<b>OS</b>	-	Operating System
<b>PEOU</b>	-	Perceived Ease of Use
<b>PLS</b>	-	Partial Least Squares
<b>PU</b>	-	Perceived Usefulness
<b>SEM</b>	-	Structural Equation Modeling
<b>SPSS</b>	-	Statistical Package for Social Sciences
<b>TAM</b>	-	Technology Acceptance Model
<b>TPB</b>	-	Theory of Planned Behaviour
<b>TRA</b>	-	Theory of Reasoned Action
<b>UTAUT</b>	-	Unified Theory of Acceptance and Use of Technology
<b>WHO</b>	-	World Health Organization



## LIST OF APPENDIX

	Page
Appendix A: Focus Group Guide For Moderator	190
Appendix B: Focus Group Consent Form	191
Appendix C: Topic Guide For Focus Group Participants	192
Appendix D: Demographic Survey Form	193
Appendix E: The Questionnaire	194
Appendix F: Questionnaire Design Checklist	197



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# CHAPTER 1

## INTRODUCTION

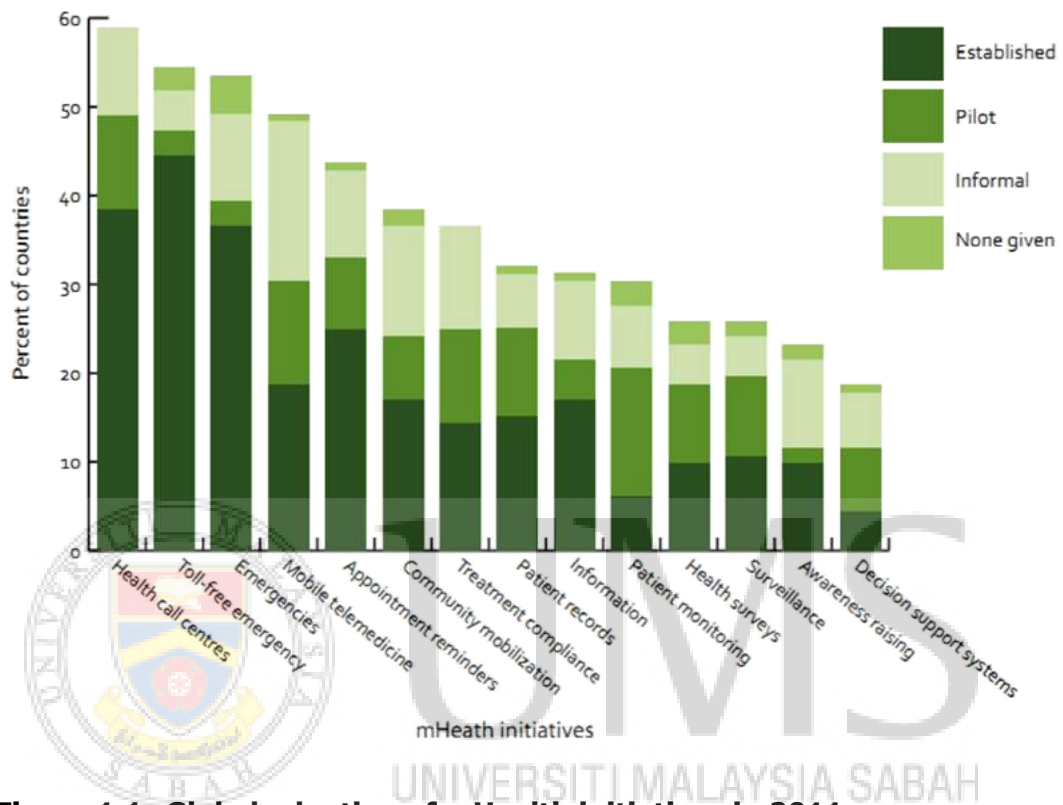
### 1.1 Overview

Mobile technology has proliferated into every single corner on earth and it is nothing less than astonishing. The utilization and adoption of mobile technology by end users has quietly transformed many fields such as communications, entertainment, finance, commerce and whatnot. Now this technology has reached its hand in healthcare environment to alter delivery of health services, quality of health services to patients as well as cost of healthcare.

Matching the rapid growth in mobile technology advancement is the explosion of mobile health (mHealth) initiatives around the world following a global survey undertaken by World Health Organization (Figure 1.1) (WHO, 2011). The growth of new generation of mHealth is substantiated due to the synergistic effect of combined smart device value-added abilities such as camera, GPS, video chat, Bluetooth connectivity to medical or home devices together with creative software applications. The value of medical applications (apps) as mHealth tools is undeniable and its development and adoption pose a great deal in various healthcare fields. Four characteristics of mobile devices has attributed to the development of quality medical apps: personal, ubiquitous, connected and increasingly intelligent (Modani & Eldrasi, 2012).

This chapter provides insights into the importance of pharmacists as main potential health information technology adopters. It is essential to note the impact of medical apps penetration within healthcare industry and its roles in the delivery of quality healthcare services. Hence, it is of great interests and benefits to

investigate the attitude of pharmacists towards the adoption of medical applications in their practice.



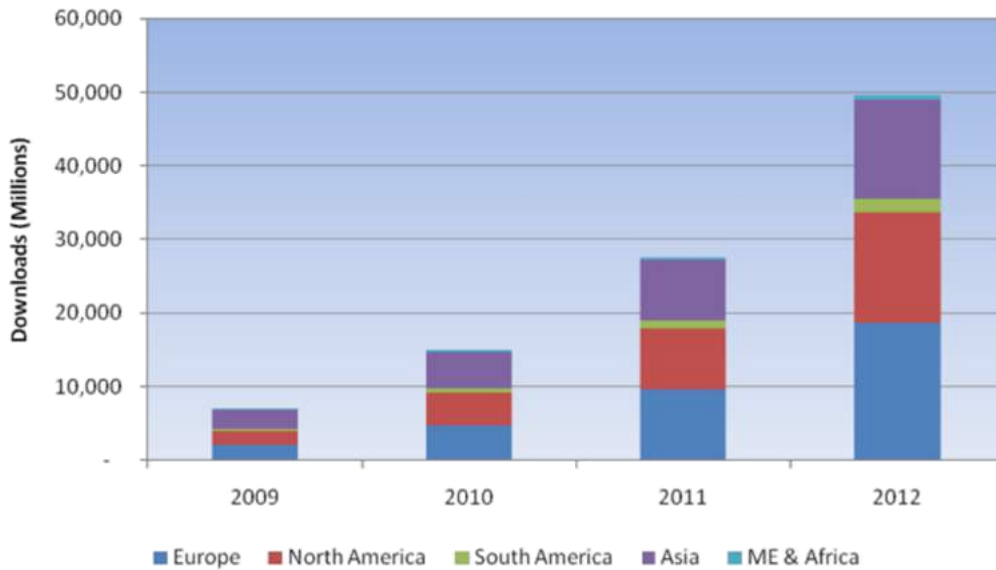
**Figure 1.1: Global adoption of mHealth initiatives in 2011.**  
 Source : WHO, 2011.

## **1.2 Study Impetus and Rationale**

### **1.2.1 Background of The Study**

Mobile phone is the single most pervasive technology ever invented – this statement is not over exaggerated at all. International Telecommunication Union has reported that there are now nearly 5 billion mobile phone subscriptions worldwide, with more than 85% of the population are now covered by at least a commercial wireless signal (WHO, 2011). Mobile technology is reshaping consumer spending pattern, be it in the housing, healthcare, entertainment and travel, or in the food, drinks, communication and transportation (Sharma, 2012). It is therefore anticipated that there will definitely be more changes in the next 10 years than in the previous 100 years on the effect of mobile technology innovations in our lives.

In a recent report released, unit sales as well as revenue of mobile devices and handheld computers are now exceeding traditional personal computers, with an expected total global mobile subscription to exceed 7 billion in early 2013 (Sharma, 2012). The growth is the most prominent in Asian countries such as China and India, hitting the record of 1 billion and 950 million subscription respectively. Consequently, it is not a surprise to see the development and sales of mobile applications (mobile apps) to surge exponentially boosted by expanding spread of smartphones and related devices such as tablets. It is forecasted that the mobile apps download (all kind) clicks across all devices will reach 50 billion by 2012, which is a tremendous increase from 7 million in 2009 (Na, 2011) (see Figure 1.2).



**Figure 1.2: Global Mobile Apps Download (all kind).**

Source : Chetan Sharma Consulting, 2010.

A mobile app is a software application designed to run on smartphones, tablet computers and other mobile computing devices. These devices allow users to self-install and use the application based on their own need and interests. The applications are classified into a full wide range of category from gaming, education, entertainment, lifestyle, utility tools, and book to finance, weather, sports and travel, as well as medical apps, and the list goes on (see Figure 1.3). The average healthcare app costs about US\$15, which is above the average costs of general app, and the apps are being developed mainly for health education, health management, data management, and other health workflow processes. These healthcare apps make up about 1%-2% of the entire market for apps, and is expected to grow 25% annually over the next 5 years (Anderson, 2012).



Just as the internet sparked the rise of e-health, so as the smartphone's popularity is revolutionizing healthcare industry. According to Savit *et al.* (2012), the five ways in which mobile apps will transform healthcare include: improved access to care, improved patient engagement, new provider business models, reduced Medicare fraud and improved patient safety. In this context, healthcare delivery is moving rapidly from a world of patient influx to a world of data influx, transforming how the patients are engaged by the healthcare system. One should not underestimate the impact of these new capabilities as to the way consumers practice and react on health information through the use of apps. For most healthcare organizations nowadays, the question is no longer whether they should involve but rather how quick they can become part of the market. Example of organizational innovations in taking the central in using medical apps to improve healthcare include: eVisits for patients, PineApp for patients, medication or patient care app for nurses, and mobile drug referencing tools for physicians and pharmacists (Jeni, 2012). Mobile technology holds a potential for more efficient and sustainable, more competent and cost effective in healthcare processes, pharmacy practice included.

Year 2011 has seen a huge leap forward in healthcare mobile computing industry when the US Food and Drug Administration (FDA) announced and issued a draft guidance document (FDA, 2013) in an attempt to regulate mobile medical apps to protect consumers from associated risks. The move did not surprise everyone because it has well been advocated that the use of mobile medical apps on smartphones and other mobile computing devices is revolutionizing delivery of healthcare from the point of care giver to another end of care receiver.

The extraordinary spread and penetration of mobile technologies, as well as encroachment in their innovative applications to address health precedency has evolved into a new era of e-health which is known as mHealth. Mobile health is fundamentally the practice of medicine and public health which are supported by mobile devices, including more specifically the apps-sophisticated programs. The use of mobile apps offers a highly accessible and cost-effective means of

implementing motivational and self-management programs, and hence delivering high quality healthcare that is going to benefit and empower the patients at the end of the day (Handel, 2011). It is believed that healthcare providers, as well as pharmaceutical industry, will supplant mobile phone industry as the primary distributors for mHealth apps (Larkin, 2011). The mHealth tools advocated do not intend to replace healthcare providers but rather is an important supportive tool for the provision of high quality healthcare services. As such, it is a common understanding that the effective implementation and adoption of information technology (IT) within mHealth entity enables the industry to overcome its three most pressing concerns: increasing medical errors, climbing costs, and the shattering of care delivery (DePhillips III, 2007).

Information systems have developed substantially over the years to support the infrastructure of medicine such as education, clinical decision making, communication and many other facets of health professional activities (Greenes & Shortliffe, 1990). These are now collectively known as Health Information Technology (HIT). Three distinctive types of HIT that are prominent and significant in day-to-day provision of healthcare services include: electronic health record (EHR), personal health record (PHR), and clinical data exchanges.

On the other hand, medical informatics or health informatics is now emerging as a distinctive academic entity. It can be regarded as an umbrella for medical informatics, bioinformatics, and pharmacoinformatics, reflecting that informatics plays a significant role in all parts of healthcare (Åstrand, 2007). In parallel with the rise of information technology over the years, the role of pharmacists has changed considerably. Despite the fact that pharmacists are no longer compounders of medicines, pharmacists are still responsible to ensure delivery of quality, effective and safe pharmaceutical care to patients. Pharmacy informatics focuses on the use, management and integration of data, related knowledge, information, and various technologies associated to medication use processes in order to improve pharmaceutical outcomes (M. Siska, 2007). Table below (Table 1.1) depicts some examples of emerging pharmacist activities