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FACULTY OF BUSINESS ECONOMICS
Master of Management

Master's thesis

Healthcare Information System Management Challenges: The curious Case of the 'Cool Apps' that No One Likes

Supervisor :
Prof. dr. Benoit DEPAIRE

Martial Ayah Ndifor

Thesis presented in fulfillment of the requirements for the degree of Master of Management

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ABSTRACT

In past two decades, the advancements made in the domain of ICT are impressive, and a quick look into one's personal life and social interactions serves as a constant reminder of the change that these ICT advancements have brought about. People are increasingly seeking for convenience while establishing a connection to the world, and mobile communication technologies, and most recently, Mobile Apps, satisfy this quite well. Simultaneously, there is an increasing concern for personal and public health, especially with the rising aging population of the most developed economies; signalling even more future increase in health care demands. The amalgamation of these factors (increase ICT and health concerns) have led to increase prospects of using ICT as a magic wand to cast away and eradicate the ailments of poor health. This opinion is not only shared by individuals or end-users, but more-so by (public) health institutions/organisations, and several nations' government; backed by huge investments being made in an effort ascertaining a top-notch health care via IT. However, this has not translated into higher adoption of Medical or Health Apps, as one would theoretically assume. This research seeks to understand and expound what the discrepancies or challenges are, that prevent the usage of health apps irrespective of the increasing concerns in personal and public health, increase IT development and general increase in other mobile apps adoption (such as those meant for gaming and social interaction). To effectively investigate this phenomenon, this study sought to answer the main research question: *Why do health/medical Apps have a low adoption and retention rate, in contrast of the increase in health concerns and information technology proliferation?* It was broken down to facilitate comprehension (of the identified challenges to Health App adoption) into the following sub-research questions: *SQ1. How does a patient's attitude towards (personal) data influence their adoption of health Apps?; SQ2. What is/are the implication(s) of patient-centrism in adopting Health (care) Apps?; SQ3. How do health care Apps alter patients' daily routine?; SQ4: How does health professionals' tech-savviness alter patients' adoption of health Apps?; SQ5. What is the effect of unregulated medical Apps on patients' attitude to use?* To answer these questions, an explorative qualitative research approach was used in conjunction with existing scientific articles that were reviewed to identify major adoption challenges. These challenges were backed by an interview and responses from questionnaires that were randomly distributed. Also, the Sociotechnical System Concept, Technology Acceptance Model 2 (TAM 2), and Patient-centrism were the main conceptual frameworks in this study. The major findings that were identified to have a negative effect on patients' adoption of Health Apps are; Data security concerns, lack of patient-centrism in App development, low tech savviness of patients' health professionals, lack of regulation of Health Apps, and errors from such apps.

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2016, Hasselt (Belgium)

Martial Ayah Ndifor

Chapter 1: Introduction

In this chapter, the background of the research topic is discussed, followed by the problem statement that leads to the formulation of the research questions. Thereafter, the rationale of this study is explained, and this is proceeded by the scope of the entire study, the research design and the study outline.

1.1 Background

Over the past two decades there has been a massive global increase in information and communication technologies. This constitutes a broad range of hardware (from mobile devices; wearables, to drones) and software (smart phone, desktop and web-based applications), that are being used in everyday activities, and at organisational or corporate level. The use of ICT greatly facilitates communication and collaboration amongst colleagues; provides a convenient and cost effective means for team work—especially in cases of remote collaboration. Such communications are done via various IT enabled channels; video conferencing, double robotics, intranet/extranet social media, emails, VoIP (Voice over Internet Protocol), and more. Information communicated via such channels range from regularly operational processes and reports, to more sensitive customer (personal) information, executive strategic files and other IPs[1]. All of the aforementioned communication channels and information are applicable to the healthcare and pharmaceutical sectors too. However, patients are the main clients or customers, in healthcare, and any interaction that they have with a healthcare professional[2] often leads to the collection of very personal information. Every contact that a patient has with a healthcare professional—from consultation to laboratory sample provision, to doctor's prescription of medication—involves collection and analysis of patients' data or information. Such information constitutes the patient's medical history—records about previous illnesses, their current health status, diagnoses, medications and in some cases their financial information (such as Credit Card numbers). If a patient's information is mistaken for another, this could lead to drastic consequences. Such unwanted outcomes could be, wrong/over/under dose prescription, neglect, poor treatment, and all these outcomes may lead to patients' demise—in worst case scenarios.

[1] IP: Intellectual Properties
[2] Such as Doctors, Nurses, Laboratory Technicians, Consultants, Pharmacists

Modern day IT solutions—Patient Care Information Systems (PCIS), help to prevent patients' information mismatch and medical errors, but it also presents its own challenges that need to be effectively managed (Ash, Berg, & Coiera, 2004). It has been reported that the global awareness of personal health is at its highest rate, and the desire for individuals and/or patients to be actively involved in monitoring their health status is on the rise. Patient Care Information systems have been, and are being designed to enable this (Ash et al., 2004). Healthcare professionals do not have the sole responsibility to utilise these IT solutions in collecting and analysing patients' information, but patients themselves are getting involved in collecting and interpreting—still to a lesser extent—this information. There are scholars who denounce such practices, that is, patients interpreting their own medical data and/or information, while others do not see the harm in doing so, especially in minor illness. However, it has been investigated that this gives patients a feeling of empowerment when using ICT to monitor their health (Asoh & Rivers, 2010; Baldwin, Clarke, Eldabi, & Jones, 2002; Andreassen, 2012). The *feeling of empowerment* plays a crucial role in the treatment and healing process; as it gives assurance, provides security and comfort—especially to chronically ill persons who have to receive medications for extensive periods (if not for the rest of their lives). Also, this enhances trust in a patient-doctor relationship (Andreassen, 2012). Trust in patient-doctor relationships can be said to arise when patients become more knowledgeable about what is happening to and in their bodies, and the changes they are going through; hence they become less sceptical towards doctors' prescription and other medical information/advice.

The aforementioned outcomes of using ICT in healthcare is particularly common in eHealth. E-Health refers to the utilization of electronic processes and communication in executing operations that are related to healthcare. This term dates back to the late 90s, and its popularity or adoption has been on the rise (Andreassen, 2012)—alongside a general rise in Information Technologies. More interesting is the fact that patients are playing a great role in this. That is, they are actively involved in monitoring their health by using modern technologies, and these technologies range from mobile devices (smart phones, tablets and other wearable devices) to software (mobile applications, web-based platforms and other SaaS[3]). This is especially the case with chronically ill persons and the elderly (Kapadia, Ariani, Li, & Ray, 2015), as it provides them with flexibility, and

[3] Software as a service

empowerment (as mentioned earlier) over their health (Asoh & Rivers, 2010; Baldwin et al., 2002; Andreassen, 2012), and it is has been reported to be cost effective (Baldwin et al., 2002).

Talks about patients monitoring their health may sound abstract and often it may be difficult to visualize the rationale and motivation behind this. In this regard, an example of how patients can get involved in monitoring their health is by a company known as Proteus Digital Health.[4] Proteus Digital Health is a medical device company with its headquarters in the USA. They have developed a patient care information system that tracks patients' prescription drug adsorption and provide recommendations and/or feedbacks to the patients, their family, friends and doctors via mobile communication devices (phones and tablets). Essentially it provides the patient's data or information to those who were granted access by the patient to their platform or system.
In such a case and several other eHealth systems—patients are not only acting as consumers, but as producers of health knowledge (Hardey, 2001). They are actively taking part in providing healthcare to themselves with the help of ICT.

In regards to patients' ability and involvement in providing healthcare to themselves, information generated via such channels have been questioned. Most of the sceptical questions are geared towards patients' perceived lack of medical expertise in effectively utilizing technology to generate and communicate health-related information (Hardey, 2001). In addition, it has been reported in a study by Ash *et al.*,2004, that Patient Care Information systems (PCISs) increases errors rather than reduce them (Ash et al., 2004). This study was done by examining cases (health situations) in the United States, The Netherlands and Australia, and the errors were said to fall into two main categories: Those made in the process of *entering* and *retrieving information*, and those made in the *communication* and *coordination process* that is supposed to be supported by the PCIS (Ash et al., 2004).

In the 'pre-mobile devices and Apps era', doctor-patient relationships were obliged to be face-to-face; requiring the physical presence of both the doctor and his patient. Patients who needed monitoring would always have to be admitted in a healthcare facility, until regular monitoring by doctors/nurses is deemed to be of a lesser priority; then, and only then, can patients be discharged. Regardless, patients would still be required to make several appointments with doctors, and often,

[4] A digital healthcare company with its headquarter in California, USA.

such appointments are meant for patients to be informed about their health status. In addition, doctor patient relationships have been said to be based on a paternalistic model; where patients would seek a doctor's help, and the doctor's decisions were silently being complied to by patients (Kaba & Sooriakumaran, 2007). That is, whatever decision the doctors made was final, and was not disputed. These interactions were largely asymmetrical, and this has been challenged in the last two decades. This has led to the patient-centric interaction that is on the rise in recent years.

With an increase in (personal and public) health concerns and the increase in the usage/adoption of mobile apps (in general), one would expect this phenomenon to *translate* into an increase in the adoption of Health Apps, but this is argued to not be the case due to certain adoption challenges.

1.2 Problem statement and Research Questions

To investigate the challenges that prevent the adoption of Health Apps, the following research question was designed:

Why do health/medical Apps have a low adoption and retention rate, irrespective of the increase in health concerns and information technology proliferation?

Due to the broad nature of this research question, it has been divided into sub-research questions, so as to effectively tackle the issues and provide a clear understanding of the challenges that prevents (even the believed to be cool) high tech Health Apps from being utilized by end-users—patients.

To begin, data security concerns have been a pertinent issue in most businesses' ICT adoption (Tan *et al.*, 2009). Healthcare establishments deal directly with very personal information from their clients—patients, who often explicitly raise their concerns about the privacy or rather secrecy of their medical statues. This therefore increases healthcare professionals' prudence in handling patients' information—via IT communication channels—with a risk of database hacks. Given that a primary functionality of Health Apps is to collect patients' personal health data or information is argued to pose a major challenge in patients' use of such means to obtain health care. In this regard, it would be worthy to investigate this claim further by answering the sub-research question (denoted by SQ, and a number, for easy comprehensive and *follow-through*):

SQ1. How does a patient's attitude towards (personal) data influence their adoption of health Apps?

In addition to the challenges presented by data security and privacy concerns, ICT implementation in healthcare systems have been reported to lay focus on the technical aspects while ignoring the human inputs necessary for effective ICT implementation, adoption and performance (Waring & Wainwright, 2013). Patient-centrism in a broad sense refers to making the patient the ultimate *point of reference* when health care is provided (Kaba & Sooriakumaran, 2007). That is, health professionals do not only engage in a one-way interaction or communication, but a two way interaction is now being encouraged. Although, health professionals have increasingly been assuming patient-centric processes of interactions with patients in the past two decades (Kaba & Sooriakumaran, 2007); implementation of IT solutions for patients is still limiting. Failure of making patients the centre of every health IT solution that is developed, Health Apps inclusive, is argued to lead to a poor IT need determination and prioritization. Further exploration of this phenomenon would be vital in determining if this poses a valid challenge in capturing and satisfying patients' IT needs. This leads to the next sub-research question of this study:

SQ2. What is/are the implication(s) of patient-centrism in adopting Health (care) Apps?

Similar to the failure of assuming a patient-centric approach in Health App development, is the failure to consider the alterations of end-users' or patients' daily routines (by their use of such IT solutions). This issue is said to affect personal Health Information Systems (HIS) solution adoption in an article by Andreassen, 2012. It indicates that the effort to enable patients to have access to their health information may limit them and provide them with new obligations that they may not be able to sustain. This may act as a pertinent issue encouraging patients to reject Healthcare Apps/solutions. Irrespective of the time, effort, novelty, ease of use, enjoyable experience of the newly developed App or solution, if end-users feel their specific needs are not met, but realize it adds a new routine to their personal daily schedule, the App or solution is most likely to be rejected by them or have a low utilization/retention rate. Hence the next sub-question was designed, so as to investigate this phenomenon:

SQ3. How do health care Apps alter patients' daily routine?

Another major threat to Information System adoption and retention is the lack of experience in computing (Mantzana, Themistocleous, & Morabito, 2010), especially among older health care employees and patients. Such a claim may be regarded and/or labelled as a gross generalization or stereotyping, especially with age being a factor. However, the research by Mantzana *et al.*, is comparative in nature—between healthcare employees and employees of other industries—thus, the aforementioned (age stereotype) bias perspective can be claimed to be checked or controlled. With employees not being knowledgeable (enough) in computing, it can be said that the likelihood of technology adoption will be lesser (in comparison) to 'tech savvy' employees (of other industrial sectors). It can be argued that a low technology adoption level by health personnel would negatively alter patients' technology adoption because of a lower tendency (for such personnel) to recommend and/or motivate patients to use a (any) digital platform/App to monitor their health. This translates to a low score in the 'perceived usefulness' of Health Apps, and in some cases a low 'perceived ease of use' of a given system and/or technology. A new technology may have a higher/steeper learning curve to non-tech savvy employees, and a feeling of intimidation may lead to rejection of new or proposed systems. The same situation can be claimed to apply to non-tech savvy patients. However, an increase in health professionals' 'tech savviness' would mean an increase in their level of comfort and familiarity with a Health IT solutions, which could be argued to lead to a higher tendency to trust health IT solutions and hence more likely to recommend/prescribe them to her/his patients. On other hand, if a health professional is (simply) not willing or does not engaged in the utilization of Health IT solutions (for whatever reason), their patients' tendency and attitude to use such means in obtaining healthcare is argued to be low.

This has an indirect effect on patients' adoption of health IT solutions, and answering the proceeding question would shed more light unto Health App adoption challenges:

SQ4: How does health professionals' tech-savviness alter patients' adoption of health Apps?

The pharmaceutical and healthcare industry is heavily regulated (Sherer, Meyerhoefer, & Peng, 2016), but unlike prescription drugs, regulations that govern the development, licensing or recommendation of Medical Apps is very limited (Scher, 2015). The FDA only recently (in 2013) published a ruling in this regard, stating the conditions that will qualify a Medical App to undergo regulation procedures. It stated that, for a Medical App to undergo regulatory procedures it has to;

1. Function as medical device

2. Transform a device into a medical device
3. Perform patient-specific analyses and provide diagnoses or treatment on these bases (Scher, 2015).

Given these otherwise strict criteria, many Medical Apps *will go* and *have gone* into the market and/or (online) App stores unregulated. Health professionals may worry about recommending (most) medical apps to their patients due to their uncertainty in their efficacy or due to fears of being a defaulter to an organisational or country specific regulation. When a doctor prescribes a specific medication, there is a certain level of responsibility he/she is assuming with respect to any repercussions that may arise from patient's consumption of these medication. The same goes for Medical Apps *prescription*. In this regard, the dissatisfaction of a patient in utilizing a *prescribed* Medical App can be said to compromise the doctor's reputation, from that particular patient's perspective. Coupling this with the large number of unregulated Medical Apps—without sound legal quality approval—it can be argued that doctors' tendency to recommend or prescribe Medical App solutions to their patients will be low. When doctors do not prescribe or recommend health IT solutions to patients, there is a less likelihood for patients to commence utilization. Extrapolating from the TAM 2[5] (refer to Chapter 2; theoretical framework, for detailed explanation) there is a lack in an *authority figure*—the doctor—to act as a *Subjective Norm* to motivate or influence the *Perceived Usefulness* and/or *Intention to Use* of a given health IT solution. Hence reducing the patient's adoption of Medical Apps (Health IT solutions). In order to serve as a *starting point* to overcome this issue, it is worth finding an answer to the next sub-question:

SQ5. What is the effect of unregulated medical Apps on patients' attitude to use?

Having elaborated on the problems that this study investigates, it is worth knowing the reason why this is important. The next section of this chapter captures that.

1.3 The Relevance of the Study/Rationale

Healthcare is projected to be one of the most sought after industry in the near future. On a global level, individuals are becoming increasingly aware of their health status and wellbeing. This is especially observed in European Union countries, with a rising population of seniors, who on average have been said to be in need of more healthcare monitoring (Van Der Gaag & de Beer,

[5] Modified Technology Acceptance Model

2015; European Commision, 2005). To add, the Healthcare sector is said to be information intensive (Baldwin et al., 2002). That is, large amounts of data are collected from patients ('clients') every single day. This information (medical records) is critical as they portray patients' history and relationships with a healthcare institution, and is an essential part in diagnoses, treatment and/or medication.

Such large amount of data would require the assistance of cutting-edge IT infrastructures for proper management. While there are already existing technologies that are being used by hospitals to collect information, there are few existing solutions (software) that can effectively analyse/manage these data or information **with a high user retention rate**, and although mobile apps are very popular, health apps still face adoption challenges. In addition, developing such solutions are expensive, and require a significant amount of resources to maintain. If they are rejected by the end-users they do not serve their intended purposes.

Hence, this study seeks to identify the challenges that prevents the adoption of Health/Medical Apps, and this is done by answering the aforementioned sub-research questions.

The findings of this study will go a long way to provide a deeper understanding on patients' IT needs, in conjunction with their desire to take charge of their health. To a System Developer, the findings of this study would help them to have a more effective and patient-centric solution development process—having the end-users in-mind at every development process—by being able to obtain more realistic IT needs or demands from both healthcare personnel and patients. In addition, the findings of this study would contribute to existing knowledge on ICT challenges and adoption in the health sector (Waring & Wainwright, 2013).

1.4 The Scope of the study

This study took into account the human perspective or element involved in developing healthcare IT solutions—Health care Apps. That is, how healthcare personnel and end-users—the patients, perceive Health care Apps.

Due to the perceived *global nature* of healthcare solutions, there was no geographical limitation to this study. This means that a global audience' perspective was assumed while conducting this study. To add, the technical aspects—computer programming and code writing—involved in developing IT solutions or Apps (software) was not covered in this study.

Demographic elements such as age, gender, education, marital status, and cultural perspective are not considered as well, as they are more suitable for a quantitative study. Although these are certainly interesting directions to take with respect to the subject matter of this study, it was left out of this study in a bid to avoid over complexity that may prevent effective comprehension of the challenges that this study seeks to investigate. Also, limited resources, and time being one of them, did not provide a favourable ground for the scope of this study to encompass the aforementioned elements.

1.5 Research Design and Methodology

In this section, the general plan of action that is assumed in ensuring that the research questions for this study are answered, are covered. Also, the research time horizon, the rationale for the chosen research design and method, and the suitability to this entire study is clarified.

Introducing the research design; it is a cross-sectional study, and it is both exploratory and descriptive in nature. A cross-sectional study was chosen because: it allowed the research to capture the current situation of healthcare IT adoption; due to the limited timeframe for the study to be completed; and it is cost effective (Levin, 2006), relative to a longitudinal study.

1.5.1 Purpose of the Study

This study is Exploratory in nature. It tackles the 'Why' of Medical/Health Applications usage, with the human perspective as a factor. That is, there is an emphasis on patients' interaction with Health Apps. Although there is an increasing concern in personal healthcare and healthcare IT solutions, studies that are geared towards understanding the 'why' in Health (care) App Adoption is relatively limited.

1.5.2 Extent of Research Interference

The extent of the research interference was Minimal and Non-contrived (Saunders, Lewis, & Thornhill, 2009). Minimal research interference means that events are studied as they normally/naturally occur. No special conditions were provided or altered. There was no 'laboratory setup', control or observatory environment designed when this study was being conducted. In addition, respondents were not pre-conditioned or placed in special environments, neither were they incentivised prior to the interviews.

Since this a Cross-sectional study, in order to get the true nature of the existing situation and perspective on adoption challenges of health (care) Apps, a minimal interference was more appropriate. Hence the motivation to employ such a research interference.

1.5.3 Research Strategies

The human perspective in Health App adoption is a *core element* in this study, and there are different perspectives in this *core element* that are interrelated—all affecting the IT adoption/usage by end-users. In order to get a (deep) understanding of the underlying challenges faced in this domain, a health care professionals' and patient's perspective were taken into consideration. This means that open-ended questions were asked in an interview and questionnaires, respectively.

1.5.4 Time Horizon

Due to the fact that this research seeks to address current challenges encountered in patients' adoption of IT solutions, this study will be Cross-sectional or Horizontal. Cross-Sectional studies provides a snapshot of the current situation, and it is time limited (Saunders et al., 2009). A Cross-sectional study is also suitable for this study because, this study is in partial fulfilment of a Master's study program that has a fixed limited time-frame to be completed.

1.5.5 Data Collection Method/Research Instrument

Qualitative primary data is collected for this study from interviews and questionnaires, as well as secondary data from existing scientific articles—to put together a comprehensive study that is geared towards Med/Health App adoption challenges. Due to the cross-sectional nature of this study, using secondary data to answer the research questions for this study, may fail to evaluate the current (existing) situation or challenges in health IT adoption. The utilization of only secondary data is rather (more) suitable for Longitudinal studies (studies carried over a long period of time). In this regard, Primary data was collected not only because that suits the needs of this study better than only existing secondary data, but also because the researcher has a relatively higher control over the quality of primary data (Saunders et al., 2009).

1.5.6 Interviews and Questionnaire

Interviews are defined purposeful conversations between two or more parties (Anderson, 2010; Saunders et al., 2009), often characterised by a series of questions and answers. In order to answer

research questions that are open-ended and complex in nature, it is worth carrying-out an interview and asking open-ended questions in questionnaires (Frauendorf, 2007).

The interviews with health professionals were face-to-face on a one-to-one communication setting. This is to minimise distraction and to prevent respondents from expressing biased perceptions from other interviewees' presence or to prevent respondents' views/responses from being altered by other respondents' presence or views—such as the case may be in focused groups or group interviews (Saunders et al., 2009).

Predetermined themes (from the literature review) were used to collect qualitative data, although room was made to explore other important points that may be presented and deemed relevant to this study.

Assuming an Interpretivist Epistemology, such interviews made it possible to highlight certain points or answers that respondents made. Interpretivist Epistemology is the combination of two philosophical terms; Interpretivism and Epistemology. Interpretivism assumes a subjective perspective to events; for instance, cultural and environmental, and Epistemology refers to one's view with respect to what is considered valid knowledge and its limits (Saunders et al., 2009). This implies that the study was carried out with a focus on details, the reality behind the details, and the subjective meanings of the findings. This is beneficial as the understanding or interpretation of certain terms, challenges and/or situations surrounding end-user adoption of Health Apps.

1.5.7 Sampling

A *Sample* was used in this study, as opposed to an entire population. Sampling refers to identifying or considering a portion of a population to take part in a research or study. Studies where an entire population is considered or interview are known as Census (Saunders et al., 2009). Often such studies are time consuming, as the researcher(s) would have a much higher number of people/respondents to interview. This also leads to higher cost being incurred (in comparison to sampling), especially in situations where the researcher would need to employee research assistants or provide monetary incentives as a bait to attract the entire population.

Time, budget constraints and collecting data from an entire population was simply unrealistic—due to the nature of this study—having a sample is a more appropriate approach.

To add, Henry, 1990, in Sauders et al., 2009, argues that sampling provides a more accurate result in comparison to a census. A possible explanation to this could be as a result of the possibility for

respondents to freely express their opinions as opposed to a 'yes/no' answer—as common in most census studies.

There are two main sampling techniques; Probability or Representing Sampling and Non-probability or Judgemental sampling (Saunders et al., 2009).
In Probability sampling, the chances of sample (from a population) to be part of the study is known, and this is true for all other samples—when a sampling technique is used. Such a sampling technique is most suitable for experiments and surveys, especially when statistical inferences need to be made about the population, from the samples. The opposite of this sampling technique is Non-probability sampling; where chances of occurrence of a sample from a population is not known.
A Non-probability sampling techniques was used in this study. To be more precise the Purposive Non-probability sampling technique was used in getting questionnaire respondents. This technique is most appropriate for this study because; statistical inferences from the sample were not required; the purpose of the study is exploratory in nature; individual cases are not difficult to identify; a large sample size is not necessary, rather personal opinions that are cantered around key themes, are used in answering the main and sub-research questions for this study (Saunders et al., 2009), and this is the approach the is employed in this study.

1.5.8 Data Quality

The quality of a datum refers to its suitability to its intended purposes (Saunders et al., 2009). In other words, the degree to which data meets their intended purposes is directly proportional to their quality. Reliability and Validity of data is used to portray data quality.

I. Reliability

Reliability of this study refers to the ability for other researchers to repeat it (Saunders et al., 2009; Vaus & Vaus, 2001). This study addresses a complex and dynamic situation in health care and IT, and it utilizes the flexibility that qualitative data presents—in helping to tackle the research problem from various angles. Also, given that this research seeks to determine the current situation of health care IT applications adoption that has a very probable change of this situation/*status quo* (in the he future), future researches of such a calibre are best suited for a Vertical Research Approach. If a

researcher would want to repeat this study, he/she would have to take into consideration the existing situation (of Health App adoption) at that time.

Although it may be argued that this compromises the reliability of this study, it actually does not; rather it require a little more resources to repeat this exact same study, due to the effects of time on human behaviour, social interactions and societal norms, to name a few, but nonetheless the results are expected to be valid.

II. Validity

The validity of a research is directly proportional to the accuracy of the research findings in measuring or representing an event or occurrence (Anderson, 2010). That is, the closer a research findings illustrates an actual event, occurrence or situation, the higher the validity of the research. Certain factors such as respondents' and interviewers' personal biases, fear of disclosure of what may be perceived or considered sensitive information or data, and inappropriate research environment, to name a few, can significantly reduce the validity of a research. To ensure that the validity of this study remains at a higher level, the following measures were set in place:

A. The Interview

Respondents were not extensively briefed on the research study prior to answering the questionnaire—but had an introductory statement in the questionnaire. This helps to ensure that respondents did not feel the need to *over prepare* and *give formulate*d responses, and this is said to increase the credibility of the interviewer (Saunders et al., 2009), hence positively altering the respondents' responses.

B. Mortality

This refers to participants in the study dropping-out before the end of the study. This was prevented by designing this study as a cross-sectional research.

1.5.9 Unit of Observation and Unit of Analysis

Unit of observation can be said to refer to the view point from which data was collected. That is, from an individual, departmental, class or organisational level. In this study, the unit of observation is the individual, as questionnaires were issued on a 'one-to-one non-contrived setting'. However, the Unit of Analysis mainly based on the perspective of the end-user or patient End-users, and an

interview from a health care professional with experience in managing and directing Health App development processes.

The Unit of Analysis is differs from the unit of observation. A Unit of Analysis of a study refers to the '*who'* or the '*what'* that is being studied (Vaus & Vaus, 2001). In this study, the End-user's or patients' adoption of Health/Med Apps are the unit of analysis. This was motivated by the sub-research problem of this study, which is focused on patients/end-users. However, it would be interesting to take into consideration the perspective of all the parties (IT developers, doctors, nurses, pharmacists, IT project managers, to name a few) into account, but the complexity that may result from this could overshadow the actual problem that this research seeks to elaborate on.

With knowledge of the research design for this study, it is worth knowing what the general structure of this study looks like, and this leads to the next section, *Outline of the study.*

1.6 Outline of the study

Chapter 1: Introduction; this chapter covers the general introduction, background, problem statement/research questions, the relevance of the study/rationale, the scope of the study, and an overview of the methodology and outline of the study**.**

Chapter 2: This chapter consists of the formulation of the theoretical framework, which is followed by the literature review—a critical and analytical review of existing scientific articles, journals, conference proceedings, books, and other credible information sources.

Chapter 3: Findings from interviews and questionnaires

Chapter 4: Discussions

Chapter 5: Conclusion

Now that the background, research statement, research questions, research design, the scope and outline of this research has been expounded, the next chapter—chapter 2—provides explanations on the theoretical framework, and existing scholastic material in relation to adoption challenges to healthcare or medical ICT, or more specifically Health/Medical Apps.

CHAPTER 2: Theoretical Framework and Literature Review

2.0 Introduction

Information Systems (IS) are the amalgamation of different components such as hardware and software, people (users) and data or information. Information Systems are typically used for collecting, creating, analysing, storing and sharing data or information. Often, the term Information System is used interchangeably with Information Technology (IT). However, they do not quite have the same meaning.

Information Technology is a part of an *Information System*. It does not take into consideration the *people/user* component of an information system and (to some extent) the data or information. Rather, Information Technology constitutes the hardware and software components of an Information System.

To avoid confusion and to simplify comprehension of this review, the term *'patient'* is used in this study to refer to *'individuals'*. This is based on the assumption that at one point in time almost every individual has been sick—hence has been a patient. On a similar note, the terms and abbreviations; '*IS-Information System'*, *'IT-Information Technology',* and '*ICT-Information and Communication Technology'*, are used interchangeably. To add, the terms *Health Apps*, *Health care Apps*, and *Medical Apps*, are used interchangeably—with the same implied meaning—to refer to Mobile device applications that are intended to be used for health purposes.

Before commencing with the literature review, it is worth knowing the major theoretical framework or concepts that are employed throughout this study.

2.1 Theoretical Framework

This section of the chapter explains the main scientific models that were used as a building ground for the research design, and the formulation of a new or adapted framework for Health App adoption challenges.

2.1.1 Technology Acceptance Model 2 (TAM2) and Health App Adoption Challenge Model

The TAM2 is modified from the TAM by Venkatesh et al., 2003, and in this study, the Technology Acceptance Model 2 is used as a major framework in answering the sub-research question, which leads to answering the main research question. In order to understand TAM2, TAM needs to be explained.

Technology Acceptance Model (TAM) illustrates how users adopt and use a (new) technology. This model is based on the influence of two main factors on the adoption of a system—*Perceived Usefulness* and *Perceived Ease of Use.*

Perceived Usefulness (PU) is referred to as the level to which a user regards a given technology to positively improve their state of being or to add value to his/her life or job (Venkatesh et al., 2003; Wu, Chou, Weng, & Huang, 2011). It states that higher the PU of a Medical App, the higher the attitude to towards usage by patients.

Perceived Ease of Use is the extent to which a user or potential user thinks they can use an IT system with ease. The ***attitude to use*** a system is positively influenced by a high perceived ease of use (Jimoh, Pate, Lin, & Schulman, 2012; Park, 2009; Wu et al., 2011).

Both aforementioned factors do not directly influence end-users adoption of a system, rather, this is done via other factors;

Attitude toward Using: This defines a user's tendency to use or not to use an IT system. It is influenced in unison by *Perceived Usefulness* and *Perceived Ease of Use* (Schepers & Wetzels, 2007; Venkatesh et al., 2003; Wu et al., 2011).

Behavioural Intention to Use: This is influenced by a user's *attitude towards using* and *perceived usefulness* of the system (Venkatesh et al., 2003; Wu et al., 2011).

The final factor in the TAM is;

Actual Use: This depicts the adoption of new technology or an IT system (Venkatesh et al., 2003; Wu et al., 2011).

As mentioned earlier, TAM was modified into TAM2 by Venkatesh et al., 2003, and the reason for using TAM2 as oppose to simply TAM is because of its more detailed illustration of adoption challenges that are not elaborated in TAM. That is, it incorporate the effects of *social influences*—*subjective norms, voluntariness*—the willingness of a user to use an App, and *image*--'social status' of an

App. It also takes into account *cognitive instrumental processes* such as *job relevance*—how important is the App to the user, *output quality*—how effective and efficient are the results from an App, and *result demonstrability*—how tangible are the results.

These factors are illustrated in the figure below.

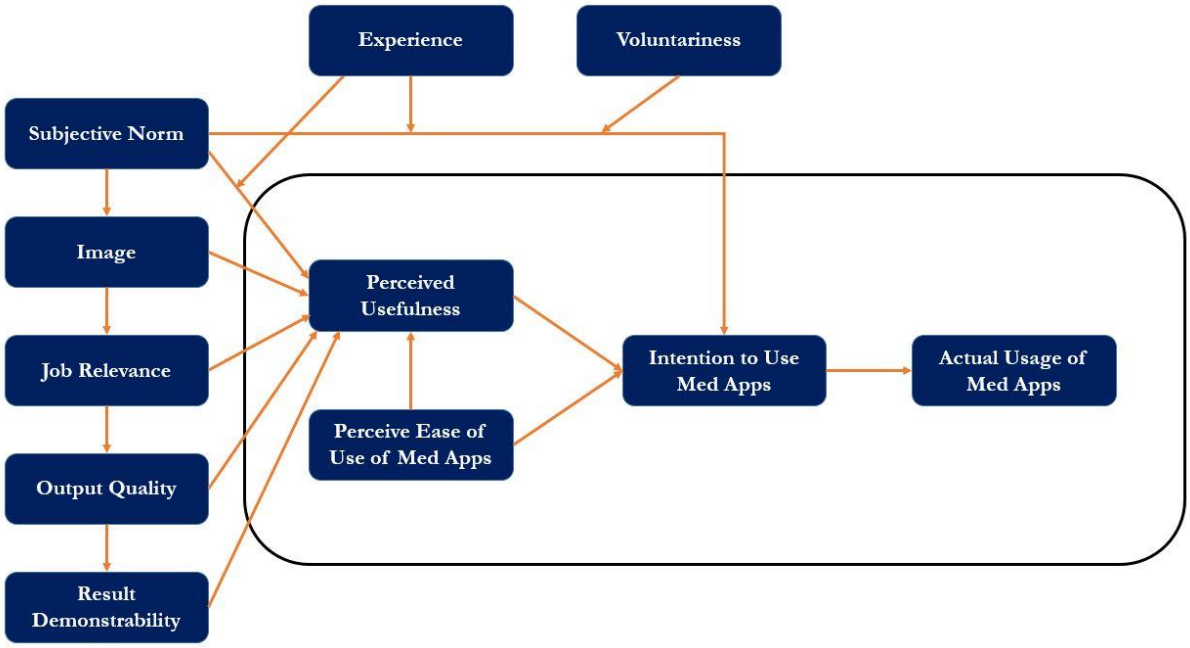

Figure 1: Technology Acceptance Model 2 (TAM 2) (Adapted from Venkatesh et al., 2003)

The factors affect the adoption of IT solutions (mentioned above) are used in this model as factors that influence or encourages the adoption of IT solutions. However, in this study these factors are looked at from an opposite point of view. That is, they are perceived as challenges that limit the adoption of Health Apps, and is represented as a model, which the researcher named (to ease understanding); *Health App Adoption Challenge Model* . This is illustrated in the figure below.

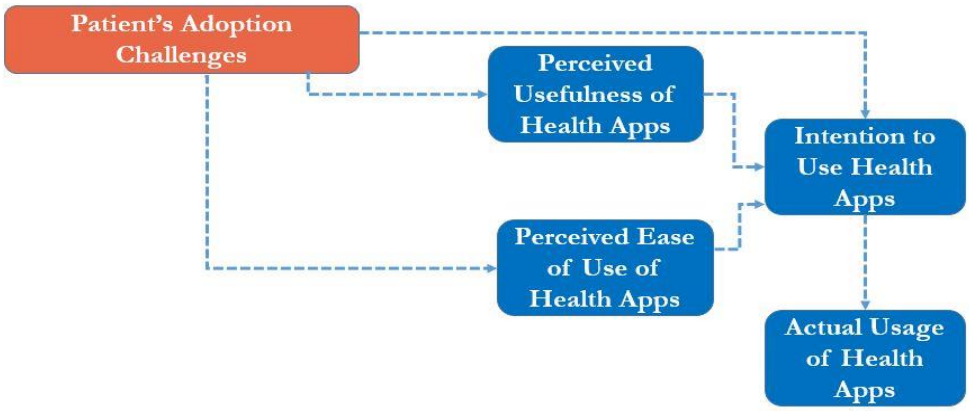

Figure 2: Health App Adoption Challenge Model (Adapted from Venkatesh et al., 2003)

The modified model (above) is utilized in conjunction with Sociotechnical System concept that also incorporates Patient-centrism. The newly developed theoretical framework is used to provide a scientific validation to identified Health App adoption challenges. That is, this framework is used to explain the challenges that affect the adoption of Health/Medical Apps. However, it is worth understanding what Sociotechnical System concept is, and this is explained in the proceeding sections.

2.1.2 Sociotechnical Systems

Humans have developed a very close interaction with their mobile communication devices. Such an interaction that individuals or society has with technical systems (mobile devices) is termed Sociotechnical Systems. This concept was coined in the 60s of the 20th century. Long before its creation, and even after its revelation to the industrial world (industrial psychology and labour studies), technical systems were always regarded as a standard with respect to its users. That is, technology was perceived as a variable that is not dependent on human interactions—users' interaction. Users of technology were required to socio-psychologically adapt to the developed or existing technology (Ropohl, 1999). The concept of Sociotechnical System illustrates that there is a reciprocal influence between human and machine, as opposed to the unidirectional notion that humans have to adapt to technology. To add, assuming a Sociotechnical Approach in developing an organisational system would involve taking into consideration the human/individual, social,

organisational and technical factors. A representation of a system and sociotechnical system is illustrate in the figure below.

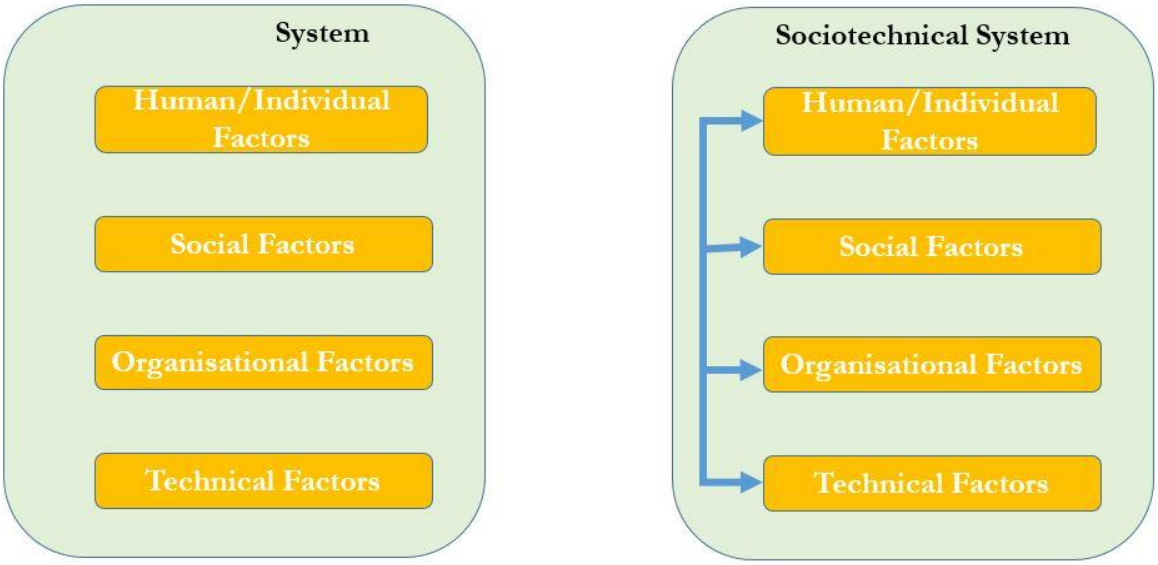

Figure 3: System vs Sociotechnical System

This builds on the fact that, designing a system—and with regards this study—a health IT solution or App development, without taking into consideration the human, social, organisational and technical factors that affects the system's functionality and usage, would lead to a failure in meeting end-users' and health professionals' expectations (Baxter & Sommerville, 2011). It is mentioned in Baxter & Sommerville, 2011, that, systems often meet their technical expectations, especially when a Techno-centric Approach is assumed in the development a process. A **Techno-centric approach** of system development refers to the paramount focus on technical issues of a system, with little to no incorporation of (end)-users' perspectives or opinion(s) in the process. Based on this, it could be argued that most IT developers would be pleased with the final product, as they would rate the success of a system based on its technical functionality. Such an approach is in contrast with the *Sociotechnical Approach*.

Based on the aforementioned argument on Sociotechnical system's positive impact in technology development, it can be said that a Sociotechnical approach would be vital in developing health Apps, especially given the current state in which humans interact with their mobile devices (as mentioned in the preceding paragraphs). Monitoring one's health, especially for chronically ill

persons, often requires an alteration or creation of daily routines, and such unforeseen alterations in patients' personal life may pose as a challenge to adoption Health Apps.

On order to reduce the complexity and to maintain the scope of this study, the *Human/Individual factors* and *Technical factors* are considered, are modified into *People (patients)* and T*echnology (Health Apps)*, respectively.

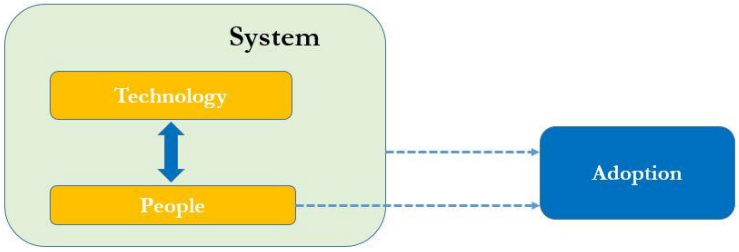

Figure 4: Sociotechnical System Adoption Model

Closely related to the Sociotechnical System Concept is Patient-centrism. Patient-centrism refers to development and provision of health care from a patient's point of view or perspective (Kaba & Sooriakumaran, 2007). It assumes that every health related care or solution starts and ends with the patient; involving the patient in the system development cycle. This is not limited to development of Health IT solutions or Apps, but also to doctor-patient relationships (Kaba & Sooriakumaran, 2007). The similarity between Patient-centrism and Sociotechnical systems is that they all take into account the human aspects of a system. However, the main difference is that Patient-centrism regards the patient's perspective to be of a superior standing in comparison to components in the system, while Sociotechnical System considers all the system components to equally *influence each other*.

2.1.3 Patient-Centrism

Patient-centrism refers to the perception of a patient as the focal point for doctor-patient relationships and provision of healthcare. That is, when health care is solely directed towards patients' needs—as it should be—and healthcare professionals seek for patients' input in medical diagnosing and treatment. Such an interaction has been reported to foster doctor-patient relationships, hence leading to superior health care (Andreassen, 2012; Baldwin et al., 2002; Kaba

& Sooriakumaran, 2007). This could be argued to transient into health IT solutions development (Martikainen et al., 2014). However, the implementation of a patient-centric approach in developing health IT solutions could be said to be too skewed to one end—the patient's—so much so that it undermines the technology component of a system. This leads to a dilemma; Techno-centrism or Patient-centrism.

The aforementioned concepts/theories, served as fundamental scholastic fortification in answering the main research question of why health Apps have a low adoption rate, from a challenge identification perspective, and were used as foundation pillars upon which the research design for this study was constructed—in reference to the themes for this study.

Referring to Figure 4, 'adoption' is a representation of Figure 2: Health App Adoption Challenge Model. This leads to the formation of a new adoption framework for this study, and is represented as the figure below.

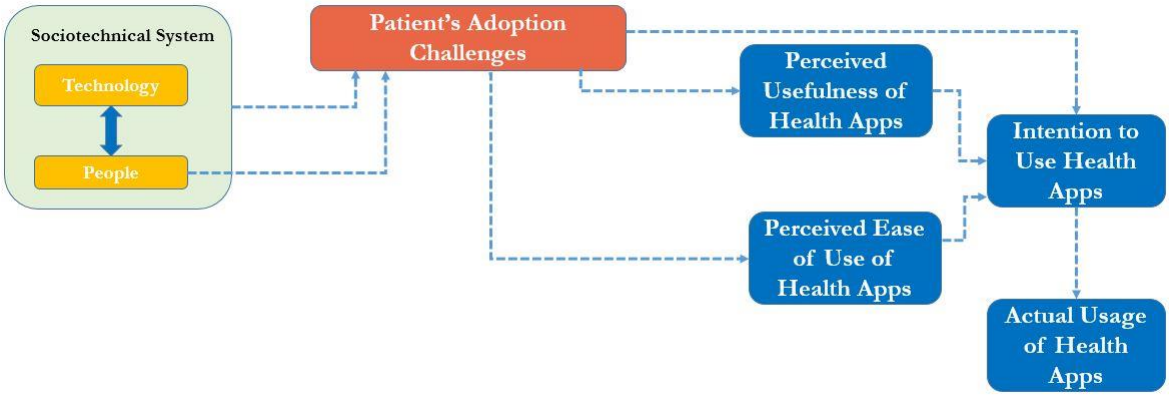

Figure 5: Sociotechnical System Adoption Framework

This framework takes into account that the entire status of a sociotechnical system, and the people perspective in the system, alters the adoption of an IT solution via challenges, and in this study it is patients' adoption challenges of Health Apps.
In the discussion chapter, this framework is further developed to incorporate all the identified patient adoption challenges.

In light of research design elucidation, the proceeding section of this chapter is the review of existing literature that contributes in answering the main research question via the sub-research questions.

2.2 Literature Review Introduction

In the mist of rising and cutting-edge technology, is the growing concern for individual and public health (Fichman et al., 2011; Mantzana et al., 2010; Zakaria, Affendi, & Zakaria, 2010). More now than ever, people want to know more about themselves, what their current health status is, and the future health consequences of their current life style.

There is a limited number of empirical studies that explicitly address this shift or change in mentality, however, certain factors such as global increase in literacy rates (UNESCO, 2014) and increase in the population of the elderly have been indicated to play a role in this phenomenon (Heart & Kalderon, 2013; Kapadia et al., 2015; Van Der Gaag & de Beer, 2015). Everything being equal; being educated often gives an individual an *upper-hand* in comprehending medical reports, and to engage in a deeper 'medical' conversation or dialogue with health personnel. Meanwhile, a growing aging population is indicative of a population that would require more health care (Kapadia et al., 2015; Van Der Gaag & de Beer, 2015). Irrespective of the root cause of the *rising concerns* in personal and public health, there is a need to align health care provision and reception, with current life style. That is, the need to ensure that a developed, provided or recommended health solution suits the way of life of the End-users.

At this moment, 2016, when this study is being carried-out, taking a snap observation of commuters in a public transport scenario—although not empirically supported—one would notice that there is a disproportionately high number of individuals whose attention is geared towards a mobile electronic device. This is a small example of how IT has, and continues to altering modern day life style. Social interactions; online social platforms and media—Facebook, Twitter, YouTube, Instagram and Snapchat, are some of the most adopted IT solutions, and could be labelled 'game changers', based on their popularity/subscribers and influence on how people interact with each other (today).

An amalgamation of *rising IT development* and *increasing health concerns* has evolved into *growth in Health IT*. However, Health IT/Apps do not 'enjoy' the same high adoption rate as other IT solutions

(especially Social Media Apps—Facebook, Instagram, Twitter, etcetera). This phenomenon portrays a disconnection; a missing puzzle; as one would expect the rise in IT and health concerns to lead to increase adoption in Health IT solutions, but this is not the case (Bristol, 2012). The health industry still lags behind in terms of implementing IT/ICT innovations or solutions, when compared to other industries (Gagnon et al., 2016).

However, there are other health aspects that have been reported to be aided by health IT solutions or medical Apps such as doctor-patient relationship, well-being, health monitoring and disease prevention. Applications that measure healthy activities have been indicated to have a higher retention rate than those that measure the current health status of users (Tamura et al., 2014). Examples of such IT solutions are illustrated in Figure below.

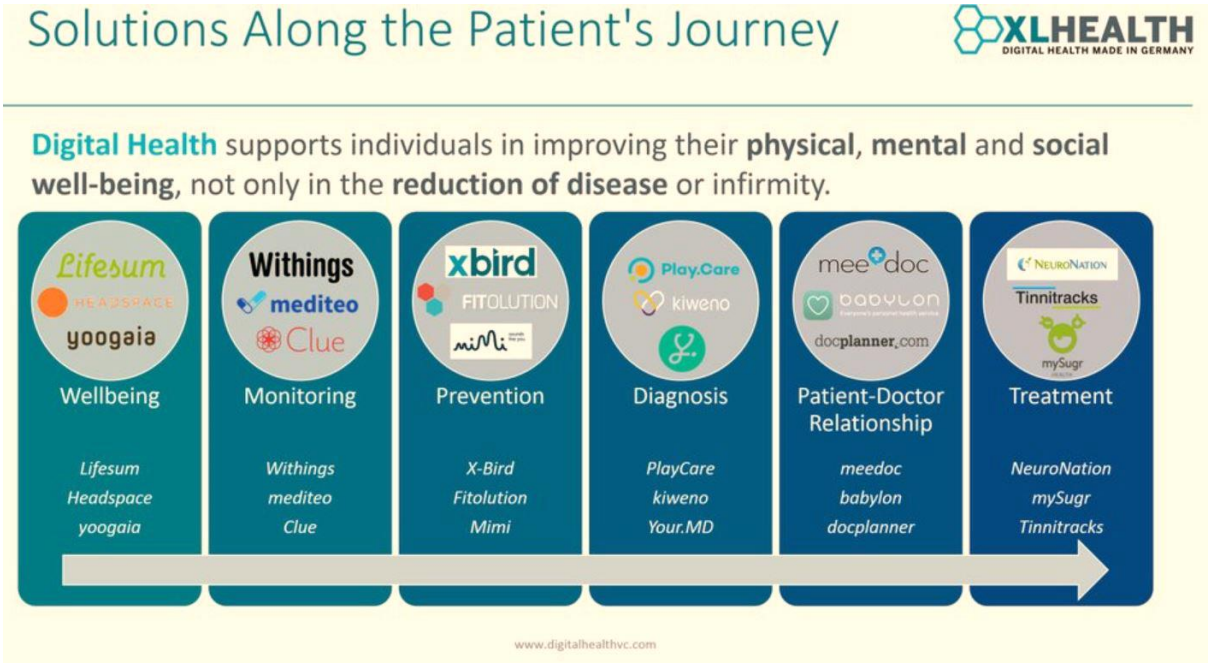

Figure 6: Example of Health Care Applications (Picture from XLHealth)

Irrespective of the benefits that HIS has on health institutions, this review will focus on its adoption by patients. Particularly, the challenges that present themselves or encourage patients to be apprehensive in commencing and retaining their use of medical applications—regardless of the benefits to their health (Chetley et al., 2006; Kay, 2011; Martikainen, Korpela, & Tiihonen, 2014). Notwithstanding, this review also takes into consideration how health care professionals' attitude towards IT, affects patients' adoption of medical applications. The technical challenges that are

faced by developers (that also affect the adoption of healthcare applications) are not considered in this review because this falls out of the scope of this study.
This leads the first health App adoption challenge.

2.2.1 Patients' Attitude Towards (personal) Data Collection and Distribution as an Influencing Factor in Medical App Adoption, and in relation to Hofstede's Cultural Dimension (Uncertainty Avoidance)

Paper-based records are bulky, take up a great deal of physical space and are less flexible in finding specific information. However, it has been reported that such records are less 'exposed' and liable to changes when compared to electronic records (Box & Pottas, 2014). That is, they are less likely to be altered. Depending on a given context or situation, this could be regarded as positive or negative. The ability to easily make changes would be relevant in situations where errors where committed. In contrast, changes to a patient's medical record could easily lead to faulty diagnoses and wrong prescription of medications. In addition, web-based health-knowledge (information) platforms do not automatically garner a 100 percent trust from visitors (While & Dewsbury, 2011). A possible explanation to this could lie in the defaced nature of online health platforms. That is, users often may not be aware of the 'mastermind' behind such online platforms, and what happens to their collected information. Such uncertainties may ignite a negative perception (scepticism) in adoption of healthcare online platforms via mobile Apps.
Such online healthcare IT platforms are often referred to, by the umbrella terms; eHealth and mHealth. Although similar, they do describe different IT processes or are different health IT solutions. It is necessary to explain these health IT solutions with data security and end-user scepticism as a factor.

Sharing medical records depends on the type of information, the purpose of the information and the stakeholder requesting the information (Fichman, Kohli, & Krishnan, 2011). In other words, the person asking for patients' information and the purpose or reason for asking to possess this information are important when patients are deciding to share them. Also the emotional state of a patient towards his or her health condition can affect his or her willingness to give access to their Electronic Health Information. Patients (or end-users) who are sad, angry, or anxious about their present health status, will be less likely to share their health information (Fichman et al., 2011).

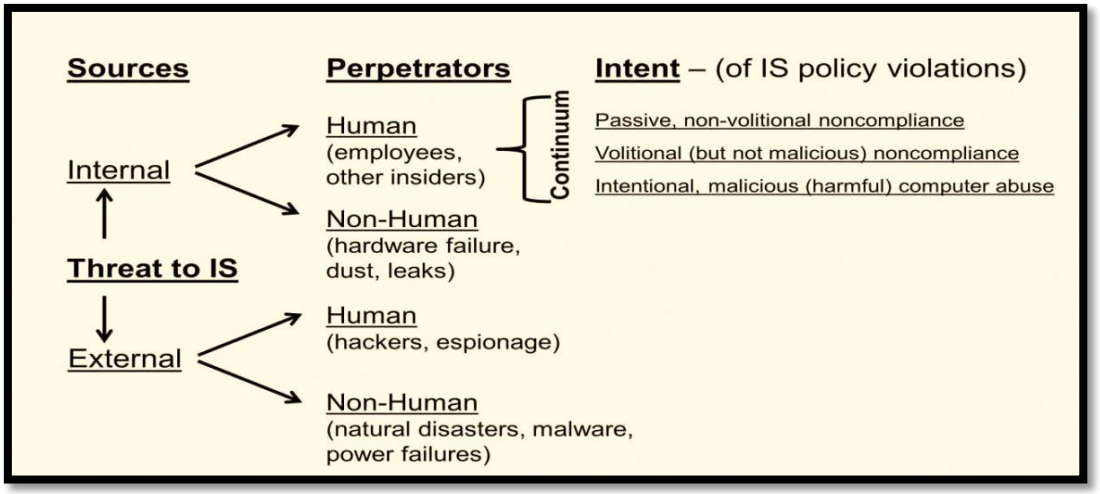

Figure 7: Information Security Threat Vector Taxonomy Abridged – Adapted from Box & Pottas, 2014

Apart from patients' emotional state—being altered by their health status—patients in general are more sceptical about providing personal information to corporate organizations—government institutions (Fichman et al., 2011; While & Dewsbury, 2011). In addition, government owned and for-profit hospitals have been reported to have less trusting by patients than non-profit hospitals or institutions (Fichman et al., 2011). Although non-governmental and non-profit health institutions have been reported to receive less scepticism from patients with respect to data sharing and handling, such institutions have still been noted for lower data sharing relative to other industries (Fichman et al., 2011). The nature of the information being synthesized via health IT is rather very personal, as it often measures conditions of the human/a person's system functionality. This is argued to be the reason for a higher scepticism towards data sharing and security in healthcare, especially with the social stigmas that are tagged with certain medical conditions.

There is *perceive risk* and *actual risk* in personal information leakage. A higher probability of occurrence and rationality of *actual risk* over *perceived risk* sets them apart (Shrader-Frechette, 1990). Both electronic and paper records can be made equally secure, but electronic records have been perceived to have a higher probability of being leaked (Fichman et al., 2011). This articles adds that, media attention to such issues can be held accountable for fuelling this perceived fear in electronic data storage. What this means is that; there are no actual dramatic or additional risks involved in eHealth or mHealth with data/information sharing as a factor, than there was when

eHealth and mHealth were non-existent or not well-developed. However, it has been reported that if patients are convinced that their health information would be beneficial to other individuals, they will be more likely to share it (Fichman et al., 2011).
It is possible that, if patients are more willing to share or give their approval for their health information to be shared when they are informed on how such information will be used, then it can be claimed that the distribution of that given piece of information does not possess a real risk to the patients or owners. This could simply be regarded as an irrational fear.

When taking into consideration the Sociotechnical systems and/or patient-centrism approach in developing or analysing Health App adoption, the complexity of human nature is worth being examined. However, it would be impractical to touch on every single aspect of human-kind and its effect on health App adoption in a single study. However, the cultural difference in terms of *uncertainty avoidance* is worth reviewing. The rationale for this is due to the important influence that such a cultural dimension has on one of the most challenging issues of every technology that records its users' (person) data, and this challenge is (personal) data security/protection. This is especially critical in health care information systems.

Hofstede's cultural dimension of Uncertainty Avoidance explains the difference in nations based on their level of risk taking. Nations with a high uncertainty avoidance ranking low on risk taking, and nations with low uncertainty avoidance, ranking high on risk taking. This particular cultural dimension comes in play when data security and health care Apps converge. Several articles of highlighted that, data security is a huge concern to patients when they engage in using IT for health reasons (Chetley et al., 2006; Fichman et al., 2011; Ghinita et al., 2007; Kay, 2011; Kushagra Sharma, Aditi Jayashankar, K. Sharmila Banu, 2016; Sherer et al., 2016; Wang et al., 2016). Based on this concept, patients' in/from cultures that have a high uncertainty avoidance are more likely to reject Health Apps. To empirically valid this, a quantitative study would be necessary, but because this is qualitative study, it is worth mentioning this challenge.

As mentioned in the theoretical framework section, the Sociotechnical systems philosophy seeks to establish a 'symbiotic relationship' between man and machine without compromising efficiency. On a larger scale this 'symbiotic relationship' is relational to a given society's interrelation with

technology. In this regard, it can be assumed that societies that are more progressive and more willing to accept change, are more likely to adopt new technology—health IT. Meanwhile, conservative societies or those with high uncertainty avoidance can be said to have a higher preference to maintain the status quo in terms of technology. Careful consideration of socio-technical factors is relevant for implementation and adoption of new health information systems. As such, a lower adoption of health technology is said to be unrelated to the technology itself, but to the sociotechnical influences (Lluch, 2011) of a system. This study further claims that, allocating more attention to socio-technical factors will improve the adoption of new health IT solutions. Based on this claim, it would be more rational to allocate more resources to (physiologically) prepare patients before proposing a given health IT solution, rather than on the development of the solution itself. Regardless, the implementation of a new ICT in a healthcare institution can be viewed as a political structuration for organizational change (Berg, 1999). A process which in itself needs the employment and/or execution of strategic plans. Often such organizational changes require careful thought out processes to optimize the utilization of implemented IT applications, by ensuring a diligent interrelation between the system(s) and healthcare professionals (Berg, 1999) and more importantly patients—end users.

In relation to Uncertainty Avoidance, effect of health care professionals' tech savviness on patients' adoption of health/medical Apps is paramount to this study. This builds on the *Innovation Diffusion Curve or Theory*, also known as *Multi-Step Flow Theory*. It seeks to explain the motivation behind the spread of new technology among members of a given social system, with *time* as a factor (Mahajan & Peterson, 1985). Based on this theory, members of a given social system are divided into sub-groups: Innovators (2.5%), Early Adopters (13.5%), Early Majority (34%), Late Majority (34%) and Laggards (16%) (Rogers, 1995).

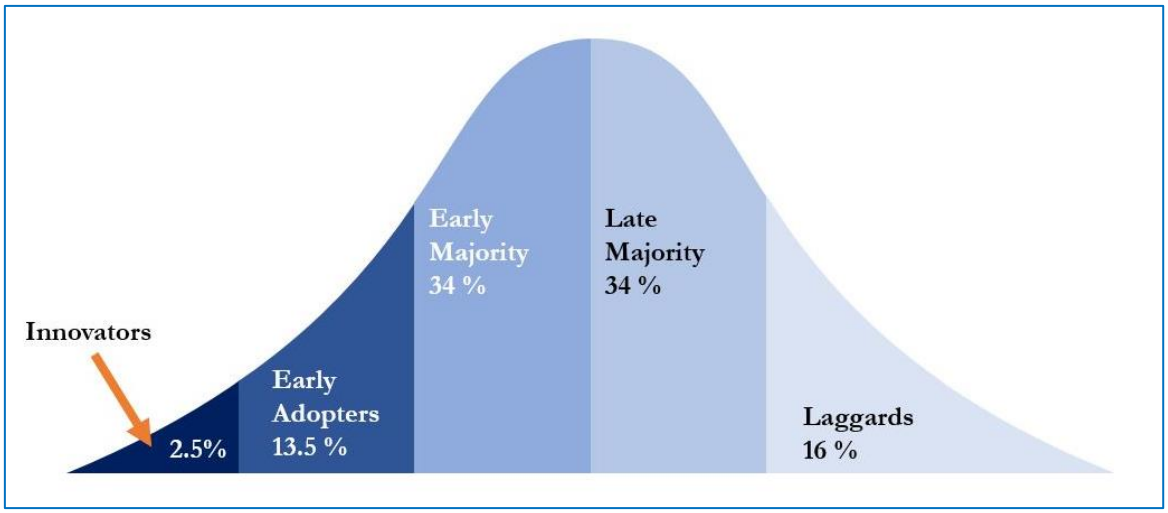

Figure 8: Innovation Diffusion Curve (Adapter from Rogers, 1995)

It based on the idea that, a patient whose doctor is part of the Laggards group, is most likely going to have a low adoption of Medical/Health Apps. This claim can be justified by the *Subjective Norm effect* of the TAM2 model. Subjective Norm explains the influence that a figure, entity or person at a position of authority or power, has on the adoption of new technology by End-users. Subjective Norm has been indicated to have a significant effect on end-users' *perceived usefulness of health apps* and b*ehavioural intention to use health apps* (Schepers & Wetzels, 2007). This is illustrated in the theoretical framework figure—Figure 5.

To help remedy this situation, a technique referred to as Anonymization has been developed, and is being improved progressively. This is a computational process where public or personal data is distorted to prevent identification of the 'original owner' or source (Kushagra et al., 2016). De-anonymization is the opposite of anonymization, where anonymized data are reallocated their original attributes so the source/owner of the data can be identified (with ease) (Wang et al., 2016). Loss of portions of the data have been reported in the course of anonymization, and this may compromise the integrity of the data, especially given that data are often subjective and/dependent on other variables to give an adequate or intended interpretation (Ghinita et al., 2007). This is especially the case with large data sets (Memon et al., 2015), and for big data analytics (Jang & Ko, 2015). Also this process is inaccurate, as developments and research are still being made in this domain (Ghinita et al., 2007).

Anonymization still does not provide the ultimate solution to data privacy issues, but it is a good step forward in ensuring a sense of 'comfort' (to patients) in sharing information that are considered to be personal. In this regards, it could be argued that medical application developers or providers who employ anonymization techniques on collected data (from their Health Apps), are more likely going to experience a higher patient download/signup/retention level, hence, will experience higher user-adoption level. However, such solutions provider would have to ensure that the anonymization processes/technique(s) are effectively communicated to their stakeholders—end-users/patients, else they are still faced with the challenge of patients' scepticism to third-party data possession and sharing.

2.3 The role played by Patient-centrism in influencing end-user's adoption of medical/health Apps

A general increase in literacy rates can be accountable for patients' desire to understand their medical results. It could also be argued to be a result of patients' increasing concern on their health status; leading to a heightened curiosity and desire to know as much as possible, what is happening in their body.

Medical professions such a medical doctor require years of specialized studies, and a huge devotion to self-development. Couple this to the complex nature of the human (biological) systems, it was a career path many were motivated to pursue nor had the capacity to endure until completion. This give the profession an element of prestige. As the old saying goes, "knowledge is power", doctors were deemed to be at a position of power, and their medical findings or conclusions were taken by patients with less dispute; whatever the doctor said was final. The doctor-patient relationship was paternalistic. The *paternalistic approach* of the doctor-patient relationship is being replaced (Kaba & Sooriakumaran, 2007) by a more patient-centric relationship. That is, the doctors are much more receptive to a patient's opinion about their own health. Such a relationship also allows a doctor to look at a patients illness from the patient's point of view (Kaba & Sooriakumaran, 2007).

ICT has been said to be positively correlated with trust in patient-doctor relationship (Andreassen, 2012). Health aids this by ensure that this process is executed by giving patients a platform to remotely and conveniently record data, information or knowledge about their health, and send to health professionals.

With patients interested in being part of their the process of developing and providing health care to themselves, a lack of involvement of patients or at least developing health apps that do not centre around patients presents an adoption challenge. This phenomenon is illustrated in the Sociotechnical System Adoption Framework, Figure 5, and as explained in theoretical framework section of this study. That is, a lack in patient-centrism in a health App development process will lead to a system that ignores the patient component, and this in turn projects a negative effect on the *ease of use* and *perceived usefulness*.

2.4 Alteration of end-users' daily routine and Medical/Health (care) App Adoption

"Are you a morning or an evening/night person?" This is common or *folk question* [6]that one get asks in social interactions or events. The inquirer is often interested in knowing if the respondent prefers or works better or best in the early or later hours of the day. An exemplary responds would be; "I'm a morning person"—meaning he/she is more productive in the morning. This is to portray the tendency that humans have in regards to developing daily routines. Such daily routines greatly varies with each individual and in the situations they find themselves. Some individuals may have assumed or developed rather strict daily routines to accommodate the life style they desire or are compelled to do so due to work or other social situations. Irrespective of the situation surrounding the motivation of a given daily routine, altering them after their 'consolidation' could be argued to be rather challenging.

IT developers have been reported to prefer not to deal with end-users/patients directly (Martikainen et al., 2014), but would rather have a direct interaction with IT project leads. That is, they would prefer to have a third-party to play an intermediate role between them and the end-users. This can be argued to prevent patients from actively taking part in system development life cycles. Based on this argument, patients are deemed powerless in system development processes, however, their personal lives do not stay unaltered—as mentioned before—upon adoption of a new health IT system—Health App. This may also present patients with new responsibilities in their daily routine (Andreassen, 2012), and HIS failures have often been reported when newly implemented information system alters the people and the environment in which the system is being implemented (Foshay & Kuziemsky, 2014). When such a phenomenon opposes the

[6] A layman's question

sociotechnical system concept, as there is no two way interaction among the components in a system, rather the patients are obliged to adapt to the technology—health app, and presents a challenge in the adoption of Health Apps.

2.5 The Relationship between Health Professionals' Tech Savviness and Medical/Health App Adoption

Healthcare establishments have been reported to have a hierarchical leadership or managerial structure (Hasvold & Scholl, 2011)—with medical doctors at the top. In most healthcare institution the 'commander in-chief' is often the medical doctor. It can be said he/she assumes a CEO role of the entire establishment—hospitals. In an establishment where the medical doctor is not an early adopter or evade health ICT advances, such establishment can be argued to experience a poor adoption of technology (to support its processes). The *Subjective Norm* could be accountable for such a situation (Heart & Kalderon, 2013).

On personal *levels*, determining a significant person is absolutely relative, but in professional or corporate *levels*, a significant person is often someone in a position of power—an authoritative figure—who can alter the current situation. In the case of healthcare institutions, which has been reported to have hierarchical managerial structure, it can be said the medical doctor will be regarded by many other (subordinates-) professionals as a 'significant person'/person of significance. This means that his or her behaviour towards health technology is most likely to resonate through the entire staff. Based on this argument, a doctor who is inclined in adopt (new) technologies in providing care to patients, is more likely to head a more tech savvy staff (and establishment). Tech savvy staff members' adoption of new technology is most likely higher than non-tech savvy staff members', since tech savvy tech savvy members' *perceived ease of use (of a given technology)* will be higher, hence, positively altering their attitude towards using a given technology, and eventually leading to increasing their actual usage (of a given technology or system). Most importantly, it can be argued that the attitude of health professionals towards technology gets transferred to their patients/clients. This is argued to be the case because of—again—Subjective Norm. Patients look up to health care professionals for medical advice and guidance, and health professional who is not motivated in using a Medical App to provide care to his/her patients would most likely refrain from recommending patients to use them.

2.6 Health App Regulations and Medical/Health (care) App Adoption

Many manufactured products require an examination, quality control and/or scrutiny before they can be sold or introduced into a market, legally. This ranges from fast moving consumer goods to certain high-end luxury items. This is not simply limited to products, but encompasses services as well. In the health industry this is also the case, especially given that most clients'/patients' lives are dependent on the quality of product and service they receive. In this light, regulatory hurdles in bringing healthcare branded products to the market is said to be among the most challenging. However, the FDA has been reported to be adamant in regulating software/Apps that are branded as 'Medical/Health Care Apps or Systems'. This is said to partially account for the large number of such Apps in Online App Stores. In the USA for instance, the FDA published its ruling on what it will regulate with respect to Medical Apps. The document stated that the FDA (Food and Drug Administration) will only regulate Apps that; 1) Function as medical devices, 2) Transforms a device into a medical device, 3) Perform patient-specific analyses, and provide diagnoses or treatment on these bases (Scher, 2015). Based on these criteria, most Medical Apps designed for Smartphones and tablets do not undergo any regulatory assessment, yet are released in to the market for download and usage.

Regulatory bodies ensure that the quality of medical solutions are guaranteed. In order for a product to get an approval from the FDA, the producers or developers would have to ensure and allocate more or extra resources to assure the quality of their end-product(s). When there is a lack of incentives to allocate extra resources in assuring the quality of an IT solution, the end-product is most likely bound to be sub-quality or mediocre. The credentials of health professionals who prescribe such 'unregulated Apps or IT solutions' that may turn out to be of a lower quality, can be argued to be at risk. This is so because such Apps/IT solutions when prescribed or recommended to patients are being perceived by patients as a form of medication. When these prescribed 'medications' fail to provide or deliver the intended or expect health benefits, it may translate into *competence insufficiency* with the health personnel being a victim.

In order to avoid being *afflicted* by incompetence perception from clients/patients, it is argued that some medical professionals would rather refrain from using medical applications as part of their medical prescription or patient care process. This intern reduces the usage, hence adoption, of Applications that are intended of medical purposes.

This challenge is an exception from being a derivative of lack sociotechnical systems, but its validity in this study is not compromising, rather serves as an additional point to be noted for further investigations.

2.7 Patient Care Information System (PCIS) Errors

The dark side of PCIS has been reported to take form in medical results errors; a problematic occurrence that may by itself undermine the milestones and potentials of ICT utilization in providing and receiving healthcare (Basilico, Marceglia, Bonacina, & Pinciroli, 2016; Foshay & Kuziemsky, 2014). Healthcare errors have serious adverse effects on individuals' lives—wrong medical diagnoses, under or over dose medication prescription, increase patients' hospital stay, and may lead to demise in extreme cases (Ash et al., 2004; Robert G. Fichman, Rajiv Kohli, 2011).
Ash *et al.*, 2004, reported PCIS errors to fall into two main categories: 1) Errors in entering and retrieving information and 2) errors in the communication and coordination process. These errors can be claimed to be user-based, without direct accountability to the effectiveness and/or functionality of the technology being used.

The key phrases from the two error categories—'*entering and retrieving information'*, and, *'communication and coordination process'*—are human-based. That is, the probability of their occurrence is dependent on the person executing the system (or the person's state of being at that given moment). These are subjective in this regard; depending upon the users' input and not directly related to the capabilities or integrity of the infrastructure of the other information system components that were implemented—software and hardware. Such situations could be termed as a GIGO[7]—'garbage in, garbage out'. The statement crudely translates, "if you give the system a wrong command, the system would give you a wrong result". This is also in-line with the claim made by Hardey, 2001, and he highlighted that PCIS leads to errors due to lack of expertise of the patients who are engaged in using such systems. In addition, a research by Oudshoorn, 2008, indicated that the adoption of such technologies is dependent on end-users' personal motivation, and their socio-technical network/system[8] of a given healthcare IT solution. Also, this raises the question about health

[7] A concept common to computer science and mathematics: the quality of output is determined by the quality of the input.
[8] Relationship between one's society and the technical (technological) infrastructure at their disposal.

professionals' and patients' proficiency in ICT ('their level of tech savviness'), and how that impacts the adoption and utilization of IS and Healthcare Apps in particular (for medical processes).

Another categorisation of PCIS errors was reported by Fichman et al., 2011. In this article the errors where placed into, 1) Procedural errors, and 2) Interpretive errors (Fichman et al., 2011). Procedural errors in this case refer to the protocols and/steps that are required to execute a diagnoses/examination/analyses or synthesis health data. Interpretive errors are encountered when the data has already been synthesized. They are made in the conversion process from data to information to knowledge. This is said to be the case because such is a '*conversion process'* by itself is interpretation (Zins, 2007).

In order to minimise errors—as an effort to encourage retention rates of healthcare IT solutions—some developers have resulted to automation of processes that may be redundant, considered too technical and/or regarded as boring. Interestingly, automation has been reported to influence users' behaviour by acting as a *record*. This encourages users of a given system to be more cautious and to ensure that the execution of such systems are in-line with the required protocol (Fichman et al., 2011). Automation however, as explained by Fichman *et al*., 2011, helps to resolve *interpretive errors*, but not *procedural errors*, but this result is achieved when combined with user training. It can be argued that is indeed the training offered to the users that helps to eliminate the interpretive errors, as they have an increased comprehension on what the system's output. Meanwhile procedural errors in an automated systems could be accounted for by the design of system, which fails to accurately measure the intended parameters. That is, a poorly designed system or technology would still produce procedural errors irrespective of the automation of its processes and/or the limitation of intermediate human input.
Based on this claim, one can say his reference to automation of a PCIS is at the level of result interpretation and/or reporting.

In contrast of Fichman et al., 2011's claim on mitigating PCIS errors, a study by Box and Pottas, 2014, reported that automation of such systems bring upon their own fails—that may compromise the integrity of the final results. The study further highlights the reason why automation processes are not the 'holy grail' of PCIS. It states that;

- Neglect of obligatory controls due to personal judgement as a less significant threat factor.

- Lack of *on-premise* expertise to manage the automated (automation) system.
- When processes that are not suitable for automation are automated, regardless.

2.8 Conclusion

Irrespective of the current changes that IT/ICT has made to the way people interact with their environment, there are still lots of changes and/or potentials to be unveiled. The health industry is said to be one of the areas with great potential for more IT revolution. This is also slightly owing to the fact that there has been a noticeable global increase in the awareness of personal and public health issues. In conjunction, there is a rise in the aging population, with Europe on the lead (European Commision, 2005; Heart & Kalderon, 2013; Van Der Gaag & de Beer, 2015). What this means is that; there is also an increased need to provide health care, especially to the chronically ill. Healthcare provision and reception comes in varying forms; from uploading detailed/disease specific information, to creating online-patient support forums and 24/7 live support centers, to using mobile applications from whatever location with a network that is connected to the internet. All these processes are made possible by the implementation of ICT/IT/IS (Chetley et al., 2006; While & Dewsbury, 2011); Baldwin, Clarke, Eldabi, & Jones, 2002; Oudshoorn, 2008). The benefits of ICT to health care is not geared to patients only, but to health professionals as well (Johnson, 2011). Irrespective of the impact and/or potential that IT plays/can play in providing superior health care, there are some challenges that need to be addressed.

Ensuring that patients adopt a given health IT is one of such challenges, this study dwells on this challenge by answering question—Why do health/medical Apps have a low adoption and retention rate, irrespective of the increase in health concerns and information technology proliferation? This entails shedding light on the socio-technical factors—from the perspective of patients. Bearing in mind the change in doctor-patient relationship from a paternalistic approach to a patient-centric approach. Other challenges that have been tackled in this chapter is the impact that health professionals' tech savviness have on patients' adoption of IT for health purposes. Health professionals have been reported to be (relatively) less likely to embrace new technology (Fichman et al., 2011). Some medical applications can be perceived in a similar way as medications, as they can both be prescribed by health professionals (to patients). In a situation where a given health care professional is not tech savvy, it is most likely that he/she would be reluctant in recommending or approval patients' use of an IT solution.

As IT usage increases, so does the generation of data/information. In health care this information are often very personal, and this raises the question of data security and protection. Although online information has been reported to be more liable to alterations in comparison to paper-based records, most of data security issues can be solved if users of a platform are informed about the whereabouts of their information. That is, patients are more likely to provide the very same information that they would not otherwise share, if they are informed that their information will be used to help other patients (who will be in possession of their information) and the time frame of possessing this information (Fichman et al., 2011). Also, some techniques such as Data Anonymization is gaining popularity in overcoming patients' fear in their data/information misuse. The lack of proper consideration of end-users'/patients' perspective in health system development process, is highlighted as one of the possible obstacles that prevent patients' IT adoption. This is so because without the end-users' (full) perspective in developing an app, there is most likely going to be a disconnection between user experience and perceived usefulness.

In the next chapters, to validate the identified challenges, interviews and questionnaires were issued to collect qualitative data, and these data are analysed with the Sociotechnical System Adoption Framework as a base.

Chapter 3: Findings

3.0 Introduction

In this Chapter, the responses from the interview and questionnaires are reported in themes that were identified in chapter 2—Literature Review section.

3.1 Description of interviewees and respondents

The respondents of the questionnaire chose to remain anonymous when asked if they would like their identity to be disclosed, in-case of a follow-up study. However, it would be important for the readers to have a picture of these respondents even without compromising their wish to be anonymous, and to understand why their responses matter to this study.

The interviewees for this study:

1. Dr. Antje Strohmaier is Director of Business Technology for Patient Support Services in the European Union region for a major and oldest multinational Pharmaceutical and Healthcare company, Merck KGaA. She is responsible for managing and directing IT projects, and one of her current projects is to the development of health app designed to support patients with a chronic disease known as Multiple Sclerosis.
2. Mark Thristan is a director of Advanced Analytics for Merck KGaA, with more than 10 years of end-user requirement specification for IT solutions development.

Their extensive experience in software development and end-user IT requirement determination and analysis leverages their opinion to prime importance, for this study.

Questionnaire respondents:

The questionnaire respondents, were not chosen based on any predefined characteristics, as mentioned in the research design. However, they are the researcher's colleagues and as it was easier to get access to them. These respondents were assuming the perspective of 'the patient or end-user', so a detail or further description of their profession is not relevant for this study. However, they are both male and females, between the ages of 23 – 38, and with an international background—Africa, Europe, Asia and South-America. An age group with a high probability of its members being smartphone and mobile app users. So they understand quite well, in general, what

mobile apps/health mobile apps are and how they can be used; making them the perfect candidates for this study.

For referencing, a summary of the interviews and responses from the questionnaire are available in the appendix. Also, a sample of the questionnaire is available in the appendix section. However, the proceeding sections describes the questions and their rationale.

3.2 Description of the questionnaire and interview questions

Although there is no particular rationale in the order of the questions in the questionnaire, the first three questions were designed to determine the general usage of Med Apps, and to get an understanding of the respondents' knowledge on such Apps.

3.3 Findings

In this section the results from the interview and questionnaire are described, and the findings are grouped into the same themes as in the literature review chapter.

Before commencing with the actual challenges, the first two questions asked respondents' if they have used a Med App in monitoring an illness, and if they are currently using one—at the time of their response. Most of the respondents indicated they have not. However, their participation in this study was not stopped, as their opinions as (potential) patients is valid and with the assumption they may likely use a Health App in future.

A follow-up question (3b) asked them why this was the case, and they had different reasons. Some said they have "no time to check the results everyday", and another mentioned, "Some information shown in the app might not have sufficient scientific evidence and therefore is not reliable". The annoyance in recording health data via such Apps was mentioned by one respondent.

The proceeding sections each targets the findings with respect to the identified challenges.

3.3.1 Patients' worries about third-person possession and handling of their personal data

Data security concerns have been indicated to play a role on how people utilize IT solutions (Memon et al., 2015; Wang et al., 2016) and this embodies Med Apps too. Upon review of the

existing articles that address this issue, the sub-research question was formulated; *How does a patient's attitude towards (personal) data influence their adoption of health Apps?*
To address this sub-question and to determine the opinions that *(potential) users* have on Med App, the forth question in the questionnaire was designed into two questions—4a and 4b.

Questions 4a asked respondents what their general opinion is, with respect to data security and handling of their personal data. The responses were mixed. They expressed both positive and negative attitude towards collection of their personal information. That is, some respondents were open to the idea of their personal data being collected by different IT applications, and others expressed scepticism towards this. However, other respondents highlighted the importance of health related data, and expressed their desire to be assured (by IT solutions providers) that their information will be *safe,* even though the question (4a) was not specifically geared towards personal health data security/protection.

When asked in question 4b about how they feel about their personal data being collected by Med Apps, they turned to be less enthusiastic about such data of theirs. Particularly, one respondent who answered questions 4a as "very open" to general data collection, now responded to collection of health data by simply stating "neutral". Another respondent said, "If I am the only one who can see the results then it is fine. Otherwise I won't use that Med App", and another respondent added that the lack of knowledge on who will be in possession of their health data, creates a negative feeling about such Apps. However, one interesting response was, "its fine with me since I won't type everything correctly".

3.3.2 Lack of Patient-centrism in the SDLC of Medical Apps

To address the next sub-research question—*what is/are the implication(s) of patient-centrism in adopting Health (care) Apps?*—a health care professionals' perspective was considered to have a better and deeper insight into the current situation. This is based on the ground that they (health professionals) play an important role in defining patients' needs and they usually act as *middle-men* between users/patients and IT developers. This is not claiming that patients are never (actively) included in health App development processes, but finding a patient who was involved in a health App development process is rather challenging.

In interview, the interviewer asked the interviewees to address the patient-centric concept, and to which it was expressed that the lack of profound involvement of patients in the SDLC of Med Apps, poses as an adoption challenge of Health Apps by users. To quote a response given with respect to development of a Multiple-sclerosis patients' health App:

> *"Yeah it was completely patient-centric. It was the main deference to other patient support programs. We in BioPharma*[9] *had another program called 'best in class patient support', but this always started from the department's point of view. But in this project they started really with interviewing patients, asking them what they have, want, need, what is the gab and how it can be filled. Also, what they would appreciate is, if we can deliver it to them to test, and basically this led to the employment of Design Thinking; it went a lot with many feedback sessions with patient's and testing and prototyping and re-prototyping and back again to the patients."*

3.3.3 Alteration of end-users' daily routine and Medical/Health (care) App Adoption

The 5th question in the questionnaire for patients was formulated to determine what impact an obstruction of their daily routine(s) by a Health App, would have on their adoption or retention of such an App. This is with regard to the sub-research question—*How do health care Apps alter patients' daily routine?*

A rather direct question was asked, "What impact does this/these Med App(s) have/had on you? And on your daily routine?" Most respondents' responses were passive, and did not actually articulate their opinion, but one respondent mentioned it would be stressful to use such an App on a daily basis, due to constant monitoring and input of data.

3.3.4 Low Health Professionals' Tech Savviness as a limiting factor to patients' Adoption

In the literate review chapter of this study, health professionals' tech savviness was indicated to indirectly affect their patients' adoption of Health IT solution—Health Apps, inclusive. To which the next sub-research question was developed: *How does health professionals' tech-savviness alter patients' adoption of health Apps?*

[9] A business unit of the respondent's company

To address this, a 'scenario-type' question was asked: "6. Given two Med Apps; App A and App B, and both Apps have the same functionalities. App A is used by your doctor and App B is not. Which App would you choose for yourself, if any? …And why?" Respondents all chose App A, expressing a rather strong opinion and confidence in their choice by mentioning "well, I am obviously affected by an advice of my doctor or even a friend…" and for "better collaboration with the doctor" "as it is used by a doctor; who knows or should know a lot about health.". Also the reliability of the information collected by an App that is being used by a health professional was perceived to be higher. To add, one respondent went further to write "I would be influenced by the authority of my doctor and would choose App A. However I might have read reviews online to get more opinions on the App."

3.3.5 Lack of Health App Regulations

A low approval rate of health Apps by the FDA (Fichman et al., 2011; Mandl et al., 2015) and similar authorities (Sherer et al., 2016) is being argued to have a detrimental effect on the adoption of unregulated Health Apps.

In this section, the question designed was geared to find an answer to the sub-research question: *What is the effect of unregulated medical Apps on patients' attitude to use?* To achieve this, another scenario-type question was asked, "7. Given two Med Apps; App C and App D, and both Apps have the same functionalities. App C has been regulated by the FDA and App D hasn't. Which App would you choose for yourself, if any? And why?"

The responses to this question were bi-directional. Some respondents expressing the lack of regulation of Med Apps as a discouraging quality to their usage of such Apps, saying: "App D, no trust in FDA"; "Probably App D to secure my personal data."

On the contrary other respondent expressed an opposite point of view, indicated that the regulation of Med Apps would rather serve as motivating tool for them to use an App.

Another group of respondents did not mention their choice Apps, rather they expressed that, checking to see if a Med App is regulated is not something they would do before downloading or using it.

3.3.6 The threat of Patient Care Information System (PCIS) Errors

The threat of patient care information systems, Med App inclusive, have been indicated to have errors in their output (Ash et al., 2004). Based this claim, errors resulting from Health Apps was indicated as another Health App adoption challenge. Although (a direct) sub-research question was not developed in this regard, it nevertheless did not diminish its significance in this study. This is confirmed when respondents indicated that they very much prefer Med App to accurately measure their health status and not otherwise. These responses were obtained when the respondents were asked to give their thoughts on the errors that result from Med Apps. Some respondents also proceeded to express the importance of collecting the right patient information, and the negative consequences patients may face when this is not the case.

Contrary to the 'patient-respondents" views on errors by Med Apps, one health professional mentioned that this has been an influencing factor in a positive response to the development of a Multiple Sclerosis (MS)App. However, these errors are not on the patients' actual health data, but on the process, and this was generated in the prototyping phase of a Design Thinking process of a Multiple Sclerosis App. There was a delay in response when the MS patients typed-in *an input*. The reason for this error was because the prototype was manually manipulated by a human (in the backend), and the patients liked that. Even though the patients were not aware they were interacting with a human via the prototype, they said they enjoyed the 'humanness' of the system.

It has been found in this chapter that, there is generally a low usage of Medical or Health (care) Apps and a description the qualitative findings from the interview and questionnaire was made. In order to make sound judgements and concluding statements to answer the research question taking into consideration the conceptual framework of this study, a discussion and conclusion chapter is designed for this, and this is done in the next chapter.

Chapter 4: Discussion

4. Introduction

In this chapter the findings of major challenges to Health App adoption in existing scientific articles and findings from interviews and questionnaires are discussed. Together, the primary data and the corresponding challenges (from existing articles) are used to answer the sub-research questions, which leads to answering the final research question for this study—*why do health/medical Apps have a low adoption and retention rate, irrespective of the increase in health concerns and information technology proliferation?*

The second section of this chapter is the general conclusion of this study and it also provide recommendations for future researches in this domain.

4.1 Discussion

In this section of the chapter, the findings are explained and the sub-research questions are answered, which leads to answering of the main research question.

4.1.1 Patients' worries about third-person possession and handling of their personal data

Under normal circumstances, without patients' health information, medical diagnoses and medication administration processes could be argued to be almost impossible—with regards to scientific principles—as there would most likely be lack of evidences, proofs or findings upon which a health professional can make solid concluding judgements on patients' health. As the level of medical technology development increases, especially with the increasing trend of wearables, the collection of end-users' personal information can be said to increasing too. Irrespective of the importance of patients' health or personal information in making medical diagnoses and/or administering treatment, as well as the increase in the trend to use wearables, patients have expressed their concerns about personal data collection, security/protection and sharing to third-parties. Data security is a major element to consider with respect to health Apps adoption (Box & Pottas, 2014; Jang & Ko, 2015; Kushagra Sharma, Aditi Jayashankar, K. Sharmila Banu, 2016; Wang et al., 2016). Hence, qualifying this as a major challenge to Health App adoption.

When a question was asked to respondents on their opinion(s) about their personal health data being collected by Apps, they generally highlighted this as an important issue to them. Also, they expressed an unwillingness to share such information to third-parties.

Referring to the theoretical framework developed in this study (Figure 5), building a health IT system that does not take into consideration it patients' perception of data that will be collected presents a challenge on the patient's intention to use such apps, and eventually reducing adoption.

These findings confirms the claim that patients are reluctant to adopt Med/Health Apps because of personal data collection, protection and sharing concerns (as in the articles in the preceding paragraph). To answer the sub-research question—*How does a patient's attitude towards (personal) data influence their adoption of health Apps?*: A patient with a low tolerance for personal (health) data collection and sharing, would have a low adoption of Health Apps, and another patient who does not perceive personal data collection and possession by third-parties to be of a major (negative) issue, would most likely have a high adoption rate for health Apps.

4.1.2 Lack of Patient-centrism in the SDLC[10] of Medical Apps

The Sociotechnical system concept, alongside the findings from this study are used to answer the sub-research question*: What is/are the implication(s) of patient-centrism in adopting Health (care) Apps?*

Sociotechnical system concept is based on the principle that, users of a technology and the actual technology (or system) have an interchangeable relation with each other (Baxter & Sommerville, 2011). In other words, the users of a technology do not necessarily have to modify *their processes* in order to meet the functionalities of a given technology or system, rather, a new technology or system is intended to improve or optimise (existing) processes. This indicates the consideration of users' involvement in the development of new technology or systems. Therefore, in order to achieve this, it is of importance to include the intended users at an early stage, if not at the start, of the technology development process.

[10] Software/system Development Life Cycle

The concept of Patient-centrism is similar to Sociotechnical system concept. This is so because, both concepts requires the involvement of the end-users of a given IT solution to be present in the solution development phases or processes. However, patient-centrism regards the patient (end-user) as the focus of the developed solutions. Patient-centrism has been referred to as a growing trend in health care (Kaba & Sooriakumaran, 2007), and this also transients to the development of health IT solutions. Taking into consideration how a patient would interact with a given Medical App is argued to lead to lower rejection of the Medical Apps as opposed to Med Apps that are developed without the intended patients' needs being considered (at every step of the development cycle). Failure to do so poses a pertinent challenge on end-users'/patients' adoption of Medical Apps.

The aforementioned claims is supported by the responses from the interview with a health professionals, who both stressed the importance in getting the end-users, in this case, patients, of a given health App to be involved actively in the Software/system Development Life Cycle (SDLC). The use of a Design Thinking approach and Agile processes in SDLC, starts with an initial collection of patients' needs, and permits constant development of prototyping and re-prototyping (of a health App) that are presented to the targeted patients to collect their feedback and evaluate their adoption—right in the middle of the solution development phase—and changes are made immediately (Dr. Strohmaier).
A poor patient-centric App development is most likely to lead to inefficient determination of patients' IT needs, and solutions developed in such processes are claimed to not meet end-users needs. When this happens the perceived usefulness is diminished, hence reducing the adoption of the IT solution—Health App (Figure 5).

4.1.3 Alteration of end-users' daily routine and Medical/Health (care) App Adoption

Some Medical Apps collect patients' information automatically while others require the patient to login into the App in order to record their health status. In the later situation, patients or users would have to alter their daily routine in order to accommodate the Medical App (functionalities). However, the responses from the questionnaire were rather passive in nature. Respondents generally do not have a strong opinion on this challenge, but it was mentioned that such health Apps could be quite stressful.

An explanation of the passiveness of the respondents with respect to their daily routines being obstructed by the utilization of a Health App could be as result of the intended purpose of the health App. These respondents have not had to monitor chronic health conditions that require frequent drug administration hence usage of the given Health App. In such a situation, the Sociotechnical Systems concept seeks to develop an IT system where the users would not have to make changes or disrupt their daily routines, but rather seamlessly incorporate the new IT solution (Medical App) into their daily lives.

Building up on this, Medical Apps that are liable to alter the routines of its users are most likely to face challenges in their adoption (by patients). To justify this claim, the respondents of the questionnaire did not express a positive attitude towards alteration of their daily routines, instead they are largely passive and one respondents used the words 'stressful' to describe this. Passivity towards Apps often may lead to a situation where one downloads an App, browses through it for a short while, and stops using it, without deleting it from their smart devices. This phenomenon is indicative of a negative attitude to use, leading to low actual usage.

So based on the respondents' responses, to answer the sub-research question; *how do health care Apps alter patients' daily routine?*—it can be marked as inconclusive. As the respondents fail to narrate how their daily routines are actually being affected by a health App. However, this does not take away from the fact that alterations in patients' daily routine does not present an adoption challenge.

4.1.4 Low Health Professionals' Tech Savviness as a limiting factor to patients' Medical/Health App Adoption

In this sub-section, scientific validation to this challenge is made by showing its relation in the theoretical framework of this study.

How healthcare professionals' tech savviness affect patients' usage of Health IT/Medical Apps is explained in the literature review section of this study, by mentioning that health professionals who do not or are not motivated in using medical Apps, negatively alter their patients' adoption.

When providing health care solutions to patients, health care providers are in a position of power over patients. In this regard, their actions towards technology transients to patients' attitude

towards such a technology. This claim is supported by the *Subjective Norm* effect of TAM2. Although the Subjective norm has been referred to as a social influence process—that is, people's perception to engage in an action is due to the social validation they may receive or not receive—in this case, it can be said to defer a little bit from a social effect stand point, but rather to the higher esteem that patients regard health professionals' opinions to be (with respect to health). This phenomenon is confirmed from responses collected from the questionnaire. Almost all respondents indicated that they would use a health App if their doctor uses it.

A low tech savvy health professional would mostly likely have a little experience with Medical IT/medical Apps, and experience with IT/ICT has been shown to indirectly affect the effect of Intention to Use via subjective norm (Venkatesh et al., 2003).
A similar phenomenon can be said to be observed when a health professional belongs to the first three categories of the Innovation Diffusion Curve. That is, Innovators, Early Adopters, and Early Majority. However, for health professional who fall in the Later Majority or worse in the Laggards group, their patients are argued to have a lower adoption or utilization of Med Apps. This is said to be the case due to such health professionals' reluctance in adopting technology, hence creating there is lack in positive motivation as their patients would perceive such IT solutions as not important—reducing the perceived usefulness—leading to low *Intention to Use*, hence poor adoption. However, in the case of self-medication, the low tech savviness of a health personnel could be said to serve little to no negative purpose on a patient's adoption of Medical Apps. This is argued to be so because a 'self-medicating patient' would not need a health professional as a third-party in interpreting his or her medical information—collected via a Medical App, and often would not value a health professional's opinion, hence their avoidance to seek for assistance.

Based on the aforementioned argument and evidence from primary research (interview), it can be said that health (care) professionals who are not tech savvy, negatively affect the adoption of health care Apps by patients, and how that comes about answers the sub-research question: *How does health professionals' tech-savviness alter patients' adoption of health Apps?*

4.1.5 Lack of Health App Regulations

The Health care and Pharmaceutical industry has its own fair share of regulatory hurdles to overcome, and Medical Apps are inclusive (Mandl et al., 2015). Strict rules by regulatory institutions

such as the FDA, translates to the existence of few regulated Medical Apps in the market. The regulation of an App and/or health IT system could be said to be perceived as a *stamp of approval* by a given regulatory body. This is argued to have a positive effect on the image of a regulated Medical App, and a negative effect on the image of an unregulated Medical App.
In TAM2, the *Image* of an IT system, alters the *Perceived Usefulness*, which in turn affects *Intention to Use*. In the case of Medical Apps regulation, an unregulated Medical App—lacking a stamp of approval—is argued to have a 'lower' image compared to regulated Medical Apps.

This relatively negative perception of unregulated Medical Apps' *Image* negatively alters *Perceived Usefulness*. A negative *Perceived Usefulness* would have a negative effect on *Intention to Use* and this negatively influence the *Actual Usage of Med Medical Apps*. This claim was confirmed by part of the respondents of the questionnaire, who indicated that an App that is regulated by the FDA would positively alter their intention to use. Interestingly, the other half expressed their lack in trust for the FDA and their main reason for this was due to fears with respect to data protection, as they indicated. These group of respondents perceived the FDA as an existing third-party in an approved Med App solution, hence expressed their concerns for data security. This is in accordance with their responses when asked about their opinion of personal data, where respondents said they would use a Med App if only the data is not shared.
It should be mindful that no claim has been made in this research that the FDA collects users' data from its approved Apps, rather these are the perceptions of the users. The validation of this claim does not full under the scope of this study, but the effect of such a perception on the adoption of Health/Med App is paramount to this study.

From a theoretical framework point of view it could be concluded that regulated Apps would have a higher adoption rate, and lack of regulations of Med Apps presents a challenge in their adoption. However, from the findings of this study, it can be concluded that, regulations of Apps by the FDA has both negative and positive impacts on adoption rates by end-users. Regardless, other respondents indicated that they are indifferent to an Apps approval by the FDA or other regulatory bodies when choosing a Med App.
The aforementioned findings gives answers to the sub-research question: *What is the effect of unregulated medical Apps on patients' attitude to use?*

4.1.6 The threat of Patient Care Information System (PCIS) Errors

In the preceding sections of this study, the importance of patients' information in making (correct) medical diagnoses and administration of medications has been expounded. A misdiagnosis may not only lead to sub-standard provision of medical assistance, but could result to drastic medical conditions, and in extreme cases it may result to a patient's demise. With this consequences in-mind, it is paramount that a medical App provides accurate information of a patient's health status.

Irrespective of the importance to obtain accurate patient data, errors have been reported in Patient Care Information Systems (PCIS) (Ash et al., 2004), and low efficacy has been reported to negatively affect adoption of Health IT (Heart & Kalderon, 2013).

In TAM2, *Output Quality* is correlated to *Perceived Usefulness*. That is, if the *Output Quality* (results) of an IT system/solution is low, the *Perceived Usefulness* would most likely be low, and this in turn *reduces* the *Intention to Use* (Park, 2009). This is argued to be a similar *course of events* with 'error-tagged results' from PCIS or Medical Apps. In order words, the occurrence of errors in information obtained by Medical/Health Apps, presents a challenge in the adoption of such Apps by patients/users. The findings from this study confirms this argument. The respondents on the questions expressed their desire for an error free Med App, and with some respondent proceeding to highlight the importance of collect the right health information providing health assistance.

For better understanding of the relationship between the identified challenges and the theoretical models and frameworks, adapted diagrammatic representations are presented as per the figure below.

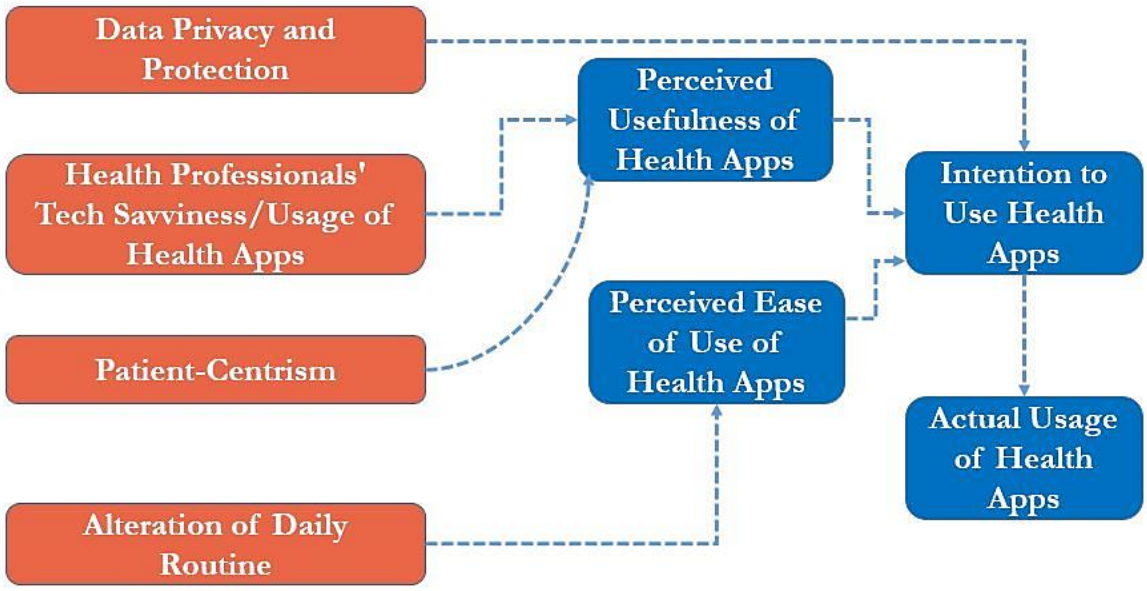

Figure 9: Health Adoption Challenge Framework

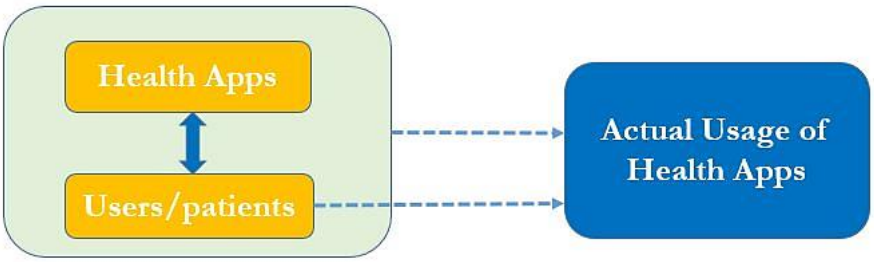

Figure 10: Sociotechnical System Adoption Model of Health Apps

An amalgamation of both Figure 10 and 11, leads to Figure 12 (below):

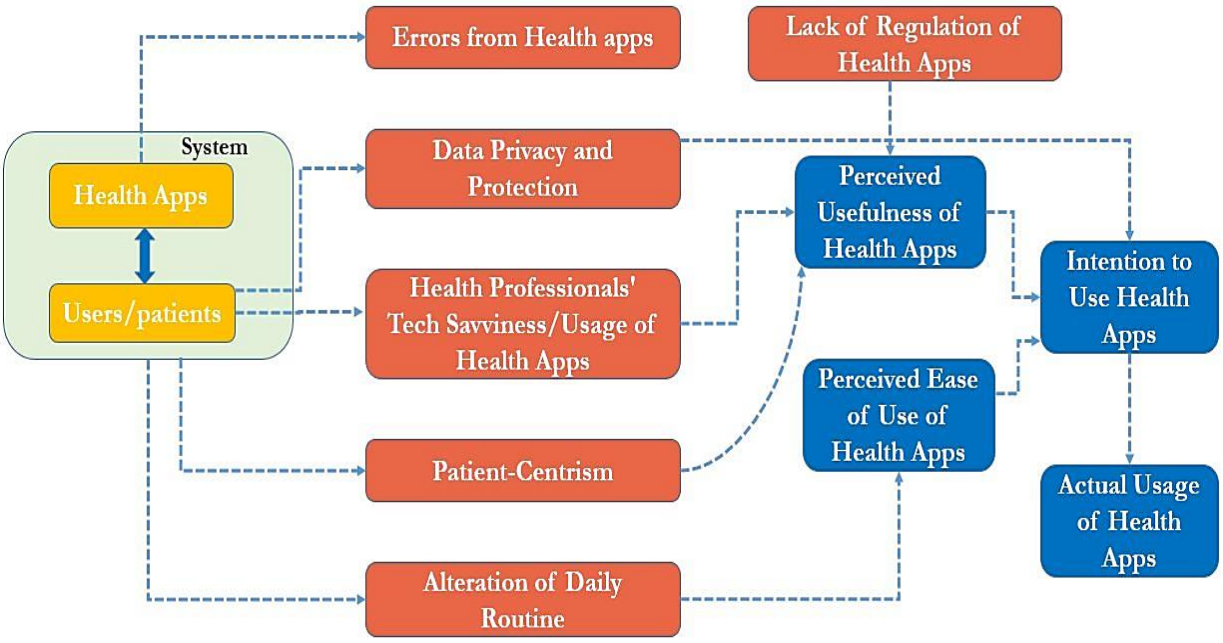

Figure 11: Health App Adoption Challenge Model

The next chapter gives a recap of the entire study, provides recommendation for further studies in this domain, as well as a concluding statement.

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Chapter 5: Conclusion

This chapter contains an overview of the entire study. It follows a similar chronology as the study, but with emphasis on the major findings, limitation of this study, and recommendations for future studies.

As mentioned in the preceding chapters, over the past two decades there has been a massive global increase in information and communication technologies, and this coincides with an increase in global awareness of personal health (Ash et al., 2004). ICT greatly facilitates, and has changed modern day interactions. This has especially led to cost effective means of team collaboration, on a corporate level—video conferencing, double robotics, intranet/extranet social media, emails, VoIP (Voice over Internet Protocol), to name a few. In a healthcare setting, these interactions are between healthcare professionals (doctors, nurses, insurance officers, pharmacist, to name a few) and patients. Each interaction between a health professional and a patient often leads to the collection of very personal and vital information that is particularly relevant to draw diagnostic conclusions on a given patient's health. As it is mentioned in the literature review chapter of this study, such information communication processes that were primarily limited to face-to-face interactions are now being complemented (if not replaced) by remote interactions via different health IT solutions that have been reported to help prevent patient information mismatch (Ash et al., 2004). When talking about remote access and/or connectivity, the utilization of mobile devices (smartphones, tablets, and other wearables) and their applications comes into mind.

Irrespective of the increasing concerns to personal health, the increase in IT solutions development in general and health IT solutions development in particular (Health Apps), it was argued in this study that the adoption rate of Health Apps is not proportional to the aforementioned trends. That is, one would expect just about the same increasing level of adoption of Health/Medical Apps by patients, just as the increase in health concerns, increase in advancement of (health) IT development, increase in mobile device usage and other non-health applications (such as mobile games and social media App), not forgetting corporate investments in this domain.

It was found and mentioned in the previous chapters that the health industry is said to be one of the most information intensive in the coming years, and the use of IT solutions to effectively

manage this information is paramount. However, the costs incurred and investments made in developing such high tech solutions would lead to little or no good if the final solutions are not adopted by the intended end-users—patients. This led to the formulation of the main research question: Why do health/medical Apps have a low adoption and retention rate, irrespective of the increase in health concerns and information technology proliferation? Upon review of existing articles, and to effectively answer the research question, it was divided into a few sub-research questions:

SQ1. How does a patient's attitude towards (personal) data influence their adoption of health Apps?

It was found out that patients do perceive their health data to be of prime importance, and they would prefer not to share them to third-parties. Medical or Health Apps function primarily by collecting patients' health information. This on itself presents a challenge to adoption. The second adoption challenge arises when third-parties can get hold of the information collected via Med Apps. However, the 'kind or type' of third-party in question does matter. A health care professional as third-party would not serve as a threat as much as an unknown third-party or some cases, large organisations or institutions such the FDA.

SQ2. What is/are the implication(s) of patient-centrism in adopting Health (care) Apps?

The role that patient-centrism was thought to play in patients' adoption of Med Apps was that; if there is a lack of effective determination and *collection* of patients' needs, then the final solution (Med App) would most likely be rejected, as it would not meet the needs of those it is intended for. The opinion of health professionals, as opposed to patients', indicated that, this was indeed true. It was found that, a lack of active patient involvement in the software development lifecycle can led to poor adoption of Med Apps.

SQ3. How do health care Apps alter patients' daily routine?

For this sub-research question, no concluding statements could be made because respondents failed to explicitly narrate how their daily routines are being altered by Med Apps. However, it was found out that it could be a stressful experience to constantly 'feed' information into a Med App; signally the advantage of *Automated Information Collection Health IT Solutions.*

SQ4: How does health professionals' tech-savviness alter patients' adoption of health Apps?

For this sub-question, the low tech-savviness of a health professional was found to have a negative influence on patients' adoption of health Apps. Patients with doctors who are not 'fans' of Med/Health Apps would tend to have a low adoption or will not be motivated to use such means of obtaining health care.

SQ5. What is the effect of unregulated medical Apps on patients' attitude to use?

This is the last sub-research question and it was found that, although some patients will not verify to see if a Health App has been regulated by the FDA or other health regulatory institutions before downloading and/or using, a regulated Health/Med App will be perceived as most reliable and accurate. So, a lack in regulation of health Apps was found to negatively alter their adoption.

Summing up; the main question of why Health Apps have a low adoption and retention rate has been answered. However, there are other dimensions that this study did not take into consideration but are just as relevant in investigating the adoption of Health Apps. Such as the design, price, Apps compatibility with personal smart device, aesthetics and signup/login procedures, to name a few. For future researches, this would surely be interesting areas for extensive statistical investigations, also taking into account the different cultural aspects that triggers or hinders patients' adoption of Health Apps, with Hofstede's Cultural Dimension as a factor. This would indeed be a great continuation in the pursuit for the reasons behind the curious case of the cool Health Apps that no one likes.

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Appendix

1. Questionnaire Sample

Dear Respondents,

These questions are intended for my master's thesis, and it is designed to investigate the adoption of Health Apps (for diagnoses, treatment, well-being/exercise, blood pressure, heart rate etc). In this regard, I would appreciate your participation.

Some questions require experience with Health Apps, in case this is not applicable to you, please still proceed in answering the question(s) to the best of your knowledge (as your opinion is highly valued). In addition, you could forward this link to those whom you belief could have an input.

Best,
Martial Ndifor

Questions

1. Have you used a medical or health App before?
2. Can you comment on the purpose for this App?
3a. Do you still use this App?
3b. Please explain the reason for your response in 3a?
4a. In general, what is your opinion with regards data security/personal data handling?
4b. How do you feel about collection of your personal data by Med Apps?
5. What impact does this/these Med App(s) have/had on you? And on your daily routine?
6. Given two Med Apps; App A and App B, and both Apps have the same functionalities. App A is used by your doctor and App B is not. Which App would you choose for yourself, if any? And why?
7. Given two Med Apps; App C and App D, and both Apps have the same functionalities. App C has been regulated by the FDA and App D hasn't. Which App would you choose for yourself, if any? And why?
8. What you think about errors from Med Apps?
9. Do you have any input with regards to usage of Health Apps, especially when compared to gaming or social media Apps?
10. Do you have any comments, or opinions you'd like to express?
11. Your Name (in order to be contacted for specific insights or clarification, if you'd want to)

2. Interview Summary

A. Antje Strohmaier

Interviewer: Do you have experience with healthcare application?
Antje: Yes I do. I've managed a couple for diabetes and currently one for Multiple Sclerosis (MS) patients.

Interviewer: Great. That's good. You actually covered most of the Apps that this research is based on. Where you involved in developing or writing codes for the apps?

Antje: No

Interviewer: So you were coordinating and serving as in a Business Analysis, IT manager role.

Antje: That is right. Especially in finding a use case for the Multiple Sclerosis App. The first approach was to ask patient what they would like in an App that would help them with their situation, and they found out that the patients really like it when Apps are not 'static', but you can be able to interact it, in a human-like manner. So in this regard artificial intelligence is important. Something like 'Alexia' of Amazon Echo with a female voice responding to your questions and carrying out actions for you.

Interviewer: Ok. In terms of the App's humanlike nature, was this done prior to developing the applications or after developing the applications?

Antje: Both. They first did the interviews with the patients and especially for the MS patients. Then the made a mock-up and tested with the patients to get their feedback and to get an understanding how the completed App will work. And this got quite good feedback and the positive thing always was that "it is so human". So the idea for this App was to give people support in doing exercises and they should be reminded at certain times to do their exercises. As it was an actual human behind the App, sometimes it was late for about 5 minutes or so, but there was an apology message that followed when this happens. Something like "oh sorry I'm a bit late. Here is your reminder". They liked it. They say it's so human. That you get the feeling you are talking to a human person.

Interviewer: And these patients did not know it was an actual human sending them a reply.
Antje: Exactly. They had no idea, and still do not know it was a human they were interacting with from the backend.

Interviewer: Even with the imperfection, the patients loved the test App or mock-up even more.
Antje: Exactly

Interviewer: Do you think if there was an exact and more accurate response from the App that would have affected the patients' relation to it?
Antje: Well, the results showed that the patients really liked this. Perhaps it's also because the MS patients are also socially isolated. As they cannot leave the house so easily. So for them it's nicer to have the ability to communicate with a person, and not with a machine. I personally, if I would use something like that, I would prefer to have it be more precise because in contrary I would like to have the feeling that it is exact and correct. Especially when it comes to medical advice. I would rather have it be unhuman and be precise, but this is my personal feeling. I'm not a patient.

Interviewer: For this specific MS App you just mentioned; how is the patient-centrism concept employed?
Antje: Yeah it was completely patient-centric. It was the main deference to other patient support programs. We in BioPharma (a department in the Antje's company) here was another program called 'best in class patient support', but this always started from the department's point of view. But this project they started really with interviewing patients, asking them what they have, want, need, what is the gab and how it can be filled. Also, what they would appreciate is if we can to deliver it to them, and basically this led to the employment of Design Thinking; it went a lot with many feedback sessions with patient's and testing and prototyping and re-prototyping and back again to the patients.

Interviewer: So Design Thinking makes acts as a huge factor in capturing the patients' perspective in the designing the App
Antje: Yes, yes. Exactly.

B. Interview summary: Mark Thristin

Interviewer: Do you have experience with Health Apps from a professional point of view?
Mark: Yes I do. For the past years I have been working together with IT developers on several projects to develop IT solutions or tools for patients. Some Apps are not necessarily designed for people with a particular disease, but just for anyone who is interested in monitoring their health.

Interviewer: What are the outcomes of some of the Apps you managed to develop?
Mark: It is difficult to effective measure their adoption, because these Apps are uploaded in the Merck App Store and after they are being downloaded, it get tricky to tract their usage by those who downloaded them.

Interviewer: How so?
Mark: I mean data privacy policies is an issue, and this prevents us from monitoring every single exchange that the user does with these Apps. In fact, we are not allowed to possess users' information in almost all the Apps.

Interviewer: How does this affect other App development initiatives?
Mark: To be honest; it could be better if we could effectively measure the success of the Apps we develop, rather simply knowing the number of downloads, but we have to respect the user's privacy. But some information such as user's location and age limit are often collected, just as with many Apps existing today.

Interviewer: How does the process of developing a Health App normally proceed?
Mark: This depends from App to App, but I always prefer to start with defining a user profile. That means, I start with identifying the intended end-user for this App, and a story telling approach works quite well. Talk to people, talk to the users, talk to does you belief may be users of this App. This process also requires a lot of empathy, because it requires you to put yourself in the patient's shoes, and think from their perspective. Finding answers to questions such as; what problem will this App solve? What benefits will this App present…a value proposition does help. It is important to always put the patients' needs first, else you are most likely not developing a solution for them.

Interviewer: So you act a mediator between the IT developers and the patients
Mark: Yes. You can say that.

Interviewer: The Healthcare and Pharmaceutical industry is quite regulated. What are your thoughts on this with respect to patients' adoption of medical app?
Mark: I can say there is a direct relationship, but the existence of strict regulations certainly limits the number of health apps developed and not simply 'fitness apps'.
Recently most Health Apps are developed for existing medical devices. To act as a connector for devices that existed as a standalone.

Interviewer: Have you heard of patient-centrism?
Mark: Yes. Making the patients' needs the central focus of health care provision. I believe this helps in capturing patients' needs.

Interviewer: So you endorse this concept.
Mark: Yeah.

Interviewer: Do you have any other comments with regards to Health Apps and their adoption by patients?
Mark: We could talk all day about this, but I'll cut it short. Make the users your central focus early on in the development process of a solution or App.

3. Summary of Responses from Questionnaire

Each bullet corresponds to a respondent, respectively for each question. That is, the first respondent is the same respondent for all first responses.

1. Have you used a medical or health App before?

- *No*
- *No, I mean there is an app in my iPhone but have never used it*
- *No*
- *Yes*
- *No I have not*
- *Yes*
- *Only for fitness*

2. Can you comment on the purpose for this App?

- *No*
- *Track health condition in real time as accurate as possible. Quick diagnosis for doctors, Overview for insurance companies*
- *To see how fit i am*
- *It might be designed for detecting the symptoms of potential diseases.*
- *N/A*
- *Tracking health related information*
- *For the gym and exercises*

3. a. Do you still use this App?

- *No*
- *No*
- *Sometimes*
- *N/A*
- *N/A*
- *Sometimes*

3. b. Please explain the reason for your response in 3a?

- *I have never used it, so that is why the response is ´no´*
- *No time to check the results everyday*
- *Some information shown in the app might not have sufficient scientific evidence and therefore is not reliable.*
- *N/A*
- *Annoying to enter the data.*
- *It depends my activity that week*

4. a. In general, what is your opinion with regards to data security/personal data handling?

- *I think it is an important thing*
- *Very open*
- *The data security has to be granted.*
- *I would probably fill out my real phone in the personal data since there might be the chance that you will get numerous cold calls from sales people once your personal data are disclosed.*
- *Data security/handling is an important issue in regards to health.*
- *Data security is often weak.*
- *I think about sometimes, but it depends on the type of data*

4. b. How do you feel about collection of your data by Med Apps?

- *Personally do no care*
- *Neutral*
- *If i am the only one who can see the results then it is fine. Otherwise I won't use that Med App.*
- *It's fine with me since I won't type everything correctly.*
- *I am fine if my health data are collected. Especially if this is of benefit for another people.*
- *Not good, because I do not know who has access to my data and medical data is especially sensitive!*
- *Again, it really depends, but if I'm sick I'll be careful with what I put into an App*

5. What impact does this/these ~~the~~ Med App(s) have/had on you? And on your daily routine?

- *Never used*
- -
- *Make it easier to control the health status.*
- *It might help me detect symptoms.*
- *N/A*
- *Thinking more about my health, but it is also stressful*
- *It could be a little demanding to constantly update*

6. Given two Med Apps; App A and App B, and both Apps have the same functionalities. App A is used by your doctor and App B is not. Which App would you choose for yourself, if any? …And why?

- *Well, I am obviously affected by an advice of my doctor or even a friend if he tells me that is a cool app*
- *App A, better collaboration with the doc*
- *Probably App A as it is used by a doctor who knows or should know a lot about health.*
- *App A since it is used by professionals which indicates the information reliability.*
- *I would be influenced by the authority of my doctor and would choose App A. However I might have read reviews online to get more opinions on the App.*
- *I would not care which one.*
- *App A. My doctor uses it, so I guess there is good reason behind that*

7. Given two Med Apps; App C and App D, and both Apps have the same functionalities. App C has been regulated by the FDA and App D hasn't. Which App would you choose for yourself, if any? …And why?

- *Can you actually sell apps not approved by FDA? I mean, i do not think I will check if it is approved by FDA before using it.*
- *App D, no trust in FDA*
- *Probably App D to secure my personal data.*
- *App C.*
- *I am not sure I would check if an App is regulated by FDA before using it.*
- *App C, because I would assume that it has higher security standards*
- *I don't care so much about this, but I'll think a regulated App would have more credibility to it*

8. What you think about errors from Med Apps?

- *Depends on what it actually measures. Everything has errors*
- *Happens*
- *The App should work proper.*
- *I think it depends on their functions. I need to get a more explicit information regarding the functions of Med Apps and the way how they work.*
- *Errors have a huge impact, as it might influence health directly*
- *I would not appreciate them, especially if I'm sick an expect to get guidance from such an App*

9. Do you have any input with regards to usage of Health Apps, especially when compared to gaming or social media Apps?

- *I am not a pro in this. I use only RMV, FB and What´s up apps actually*
- *No*
- *The health app is used less than the social media apps.*
- *Not yet since I never used it.*
- *No, I do not*
- *Health apps should have highest security standards as this data is highly sensitive as well as no errors should occur as it might directly have a negative impact on one's health.*
- *My previous response is still applicable in this case*

10. Any comments, or points omitted by the questions?

- *Some questions are quite wage I guess...*
- *No*
- *No.*
- *It would be great to know what the objective of this work is. Having known that I could think about adding questions. So far I found question 8 and 9 quite vague.*
- *If you haven't used this app before, please skip to the last question.*
- *Whether charges to download would influence the choice.*
- *Apps are good for purposes that are too 'serious', and you are not sure who will have access to this information*

Your name (in order to be contacted for specific insights or clarification, if you'd want to)

- …
- …
- …
- …
- …

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Ayah Ndifor, Martial

Datum: **21/08/2016**