Physicians Behavioral Approach on Health Informatics Procedure: Hypothetical Perspectives

Abanti Cyrus Makori

Department of Information Technology, School of Computing and Informatics, Mount Kenya University

Abstract- This paper presents the critical review of the literature starting from a Global Perspective of Health Informatics, the Health Informatics situations in Kenya, factors Influencing Health Informatics Adoption, Health Informatics Privacy and Security, Biometric Feature in Wireless Body Area Network. The paper also addresses Health Informatics Ethical Issues, ethical concern with Information Technology Performance, health Workers Personality Traits, theoretical models, comparison of Theories used in this Research. Ethical issues Associated with Adoption of Health Information System and then the Conceptual Model.

Index Terms- Physician, Health, Informatics, Behavior, Hypothetical

I. Introduction

Public health informatics is defined as the systematic application of information technology in public health practices, research and learning (William *et al.*, 2009). This included the conceptualization, design, development, deployment, refinement, maintenance, and evaluation of communication, surveillance, and information systems relevant to the health sector. H*ealth informatics* is used to enhance this process by booking appointments and carrying out necessary tests, and get the correct prescription for best treatments (Andre, 2012).

According to Abul (2011) E-health has a system such as patient administration; laboratory information; electronic messaging; and, telemedicine, teleconsultations, tele pathology, tele dermatology among others. Electronic Health Record can act as a fundamental building block of all these applications. According to Kathrin *et al.* (2010) and Manuel (1999) global use of use of IT in healthcare was on the increase, requiring theoretically informed investigations to maximize the effectiveness of implementation. However, Sebastian *et al.* (2005) to effective use health informatics require picking the right software, managing implementation, providing on-going support and maintenance, and technology-enabled reality.

This confirmed the basic competencies as shown in Figure 2: Competencies of Informatics Work Force (Hersh, 2010) of the informatics work force (Hersh, 2010), needed for efficient exploitation of information technology in the health sector.

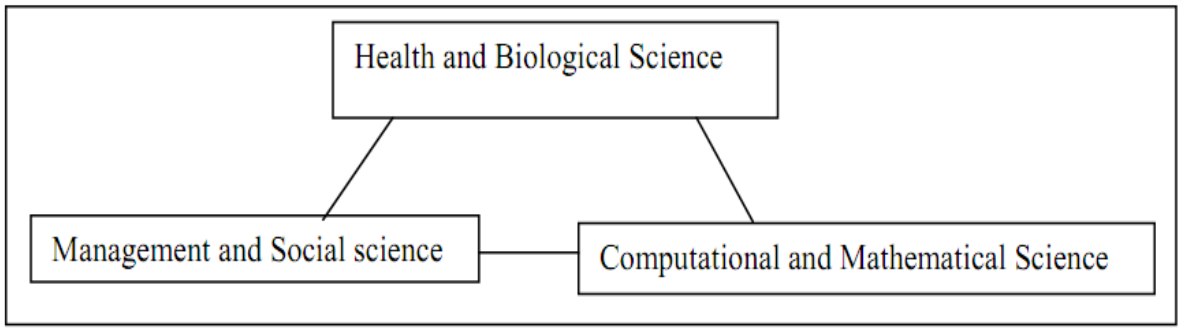

Figure 1: Competencies of Informatics Work Force (Hersh, 2010)

The health worker needs some competencies for them to adopt informatics systems. These competencies as presented on Figure 2: Competencies of Informatics Work Force (Hersh, 2010) background in health or biological science, management, computational and or mathematical science.

The adoption of health informatics has a number of challenges, according to Mantzana *et al.*, (2008) and Andre (2012), a) information quality, b) information availability, c) medical errors and d) health information system integration. e) Weak communication infrastructure delays the exchange and transfer of health information and, others are f) health information is partially available, g) clinical employees' resistance to the adoption and use of HIS, h) privacy, security and confidentiality of data, i) three out of four preventable errors in care hospitals are caused by system failure, j) the healthcare system still suffers, as a result of medical errors occurring, k). Health Information Systems are fragmented and h) high integration cost.

These challenges are summarized in Table 1: Challenges with Health Informatics Use (Mantzana *et al.*, 2008) as put forward by Mantzana *et al*. (2008). They are grouped into thematic areas such as information quality, information availability, IT integration and Medical errors.

Table 1: Challenges with Health Informatics Use (Mantzana *et al.*, 2008)

Thematic areas	Health informatics' potential	Health informatics, current challenges
Information quality	Improve quality of information	Weak communication infrastructure delays in transfer of information
Information availability	Improve availability of information	Health information partially available Health workers' resistance
IT integration	Improved integration	Fragmented health informatics solutions High cost of integration.
Medical errors	Reduce medical errors	Preventable errors are caused by system failures Unauthorised alteration of health record

These challenges facing the use of health informatics shown in Table 1: Challenges with Health Informatics Use (Mantzana *et al*., 2008) may be overcome by the existing potentials such as improved quality information, improved availability of information and reduction of medical errors.

1.1. GLOBAL PERSPECTIVES OF HEALTH INFORMATICS

In China Most hospitals have integrated Information Technology into clinical systems for good health (Andre, 2012). In America electronic medical health is gathering pace towards the 2014 deadline, hence easy monitoring of diseases (Idowu, 2010). However, this was not possible due to increased complexity, need to improve efficiency, quality, cost effectiveness and security of healthcare services (Vogt *et al.*, 2010).

In Pakistan, 88.0% of health workers have adopted health informatics as their career (Muzaffar *et al.* 2008). Other researchers such as Ozumba (2008) and Asangasi *et al.*, (2008) had observed that 0.5% of doctors in Nigeria used the Internet in searching for health information. However, Idowu (2010) maintained that the use of high quality real time health information would be available to the health care providers, researchers, decision makers and all health stakeholders. This could be possible if technology can be implemented effectively. This argument was supported by Muzaffar *et al*. (2008) who also argued that user needs should be addressed by health informatics as the best strategy. Kenya is also not left behind when it comes to the adoption of health informatics as discussed here next.

1.2. THE HEALTH INFORMATICS SITUATIONS IN KENYA

In Kenya, hospitals are organised in hierarchical order. Top of the hierarch is the National Hospitals, followed by County referral hospitals, then county hospitals, sub county hospitals and dispensaries respectively. The use of Information Communication Technology (ICT) in the Kenya Health System is on the increase (Salesio, 2007 and Ouma, 2008). These include electronic health records, hospital information systems, telemedicine and the internet, especially through the Internet solutions, up-to-date information, dissemination, and online library.

In 1994, the Republic of Kenya (RoK) approved the Kenya Health Policy Framework (KHPF) whose operation was the development the Kenya Health Policy Framework Implementation Action Plan. This led to the establishment of the Health Sector Reform Secretariat (HSRS) (Muga *et al.*, 2004 and Asangasi *et al.*, 2008). The major trend of e-health services in Kenya and the rest of the world as given by Andressen (2007) are pure access to health information on the internet, decision support, support for lifestyle changes (exercise), open public sites (for example, mental health, Social support), self-help groups, psycho-educational services (individual or group), question-answer services, online doctor services with health professionals, e-therapy or audio-visual conferencing, web-based discussion forums and then electronic mailing lists.

1.3. FACTORS INFLUENCING HEALTH INFORMATICS ADOPTION

According to Keri *et al.* (2006), Zahir & Peter (2008) and Morton, (2008) the factors affecting the adoption of health informatics are: cost, benefits & Perceived Value, IT support & Ease of use, Internal pressures, External pressures, IT infrastructure & Discretionary use, IT sophistication & Autonomy, Organisational size & leadership, Patient satisfaction, Security &confidentiality, Health workers & administrators relationship, and Education & training.

1.4. HEALTH INFORMATICS PRIVACY AND SECURITY

The increased use health informatics in the health sector, have led to an increased theft of patient records (Nicole, 2010 & Fredrick *et al*., 2004). Of these, identity theft is the fastest growing crimes. In 2009 there were more than 27500 cases of medical information theft in the USA. Statistically, fraud of electronic medical records has increased to112. 0% in one year (Nicole 2010). In 2003 internet hijackers stole 65000 web addresses belong to the county of Loss Angeles and sold them (Fredrick *et al*, 2004 and Harold *et al* 2004). The sale of patients' health information is a multibillion venture. The reason being people, corporations, and government are active in trading personal information for their own gain.

According to Scambusters (2012) eighteen million medical records were lost, stolen or otherwise put at risk of falling into the wrong hands. This means that our health records and privacy are in the hands of others. In 2011 there were more than three hundred and eighty (380) breaches involving 18 million medical health records. Thousands of health workers who handle billing data can also access at least some parts of patient's electronic medical records. At the Johns Hopkins Hospital, insecurity of health informatics is high (Eli, 2012).

However, with these factors as the fore-mentioned, it was possible that commercial entities might have a strong desire to access medical information (Mirza, 2012). This information includes patient histories, along with procedures and treatments performed, that would allow them to direct resources to profitable health care areas and target patients who require the medications and treatments they market. This is a reasonable

desire, but it will compromise patient privacy. Besides challenging society's privacy values, gaining access to full medical information for malicious purposes could result in a potential threat to the society. Medical information is valuable and its value continues to grow as the health care costs skyrocket.

1.5. INTEROPERABILITY OF ENTERPRISE INFORMATICS APPLICATIONS

According to Mantzana *et al.* (2008) Enterprise Application Integration (EAI) has emerged to support organisations overcoming their integration problems. It has been adopted by many organisations in various sectors. Despite its importance, the healthcare domain develops EAI solutions are slow, requiring further investigation. The lack of common institution-wide health informatics infrastructure has resulted in individual health sectors developing diverse health information systems.

The limitations of this approach include Enterprise resource planning system failure, Sharing and integration, Limited management support and decision making process, Back/front office operations and function, Security and privacy issues, Financial issues and Business process reengineering (Mustafa *et al*. 2008 and Zahir & Peter, 2010). Other limitations are high maintenance cost, data redundancy & inconsistence, and overlapping data. These limitations of health informatics infrastructure may be looked at from three areas such as people, hardware and software.

Interoperability is a state which exists between application entities where one application entity can accept and understand data from the other. Hence perform tasks in an appropriate and satisfactory manner. This could be without the need for extra operator intervention (Antonio, 2005). According to IEEE (1990) interoperability is the ability of two or more systems to exchange data and mutually use the information that has been exchanged. It is critical to recognise the complexity of the processes that surround health care when aiming towards interoperability of healthcare information, in which various categories of players are directly or indirectly involved.

When driving towards interoperability to support E-Health strategies successfully, health players have to be fully involved (Garner, 2009). This is due to their work environment which may be directly or indirectly impacted. These impacts are, by standards and technologies to support the workflow in their daily practice. It was advisable that before considering mandating the use of a particular technology or standards through any official certified body, their consent has to be achieved through a collaborative process.

Interoperability in E-health systems was important for delivering quality healthcare and reducing cost of health care. The important use of this included chronic patient coordination using different E-health systems. These E-health systems are Electronic Health Record Systems (EHRs), Personal Health Record Systems (PHRs) and wireless medical sensor devices (Garth, 2012). All these enable secondary use and share EHRs among different health care providers. To successively achieve full interoperability, it is important to involve all players such as health companies, health providers, IT managers, health administrators, health authorities and Governments.

Communication and cooperation among healthcare establishments demand different frameworks. According to Comyn (2006) these operate at various levels within the context of a clinical application. They include legal, ethical-cultural, administrative and technical interoperability framework. Any obstacles at any of these levels may cause the whole communication to falter. Each level needs to be addressed in order to achieve effective communication.

1.6. HEALTH INFORMATICS AND ETHICAL ISSUES

The Webster Dictionary defines ethics as conforming to accepted professional standards of conduct. This can be supported by Dean, (1992) and Lantos (1987). For example, people tend to rationalise unethical behaviour by saying, it is a business and does not believe in an unethical way of running a business. According to Horner (2007) four ethical issues that relate to health informatics are care standards, appropriate use, appropriate users, and professional relationships.

In spite of all the benefits that information technology has brought, it has also given rise to a number of troubling social problems particularly in the healthcare providers (Carol *et al.*, 2004). These social problems include loss of privacy, intellectual property issues, identity theft, spam, and sexual exploitation of children, obsolescence of workers' skills, global outsourcing of jobs and deteriorating of working condition. According to Davis (1991) and Bryn & Janice (2003) medical professional must remember the oath of ethics and code of conduct in the practice of their profession. According to Robinson (1991) safety is a critical factor in health care services considering the health nature of the individual.

According to Moor (1995) computer ethics proposed the policies to guide individuals and collective action in the use of information technology. Applying moral theory is only part of computer ethics. To act ethically requires that we take responsibility for our actions. We need to clearly understand that the technology itself is not to blame for the any harm that results from its use. One of the most frequent complaints from the internet users is an endless flood of unwanted email (spam) (Edward 2004). Experts agree that spam is here to stay hence need for a constitutionally acceptable method of reducing unsolicited email, especially when theft, fraud or abusive conduct is involved. Ketrina (2009) posed a question if the people not different from the objects in an actor network?

To answer this question we consult the Actors Network Theory (ANT). Saying that the computer won't let me do that is equivalent to saying our organisational policy won't let me do that. Information Technology is now used universally to support critical business decisions. According to (John 2004) it has evolved beyond the basic application such as billing, an inventory to a point where it directly supports customers and manufacturing process. Ketrina (2009) argued that ANT can be used to inform ethical questions of the human effect's special character Actors are heterogeneous networks, too, hence actor's networks. However, as Moor (1985) had argued that changing settings and practices emerge with new computer technology may yield new values as well as require the reconsideration of old values. A New moral dilemma may also be brought along. Physica (2010) on the other hand, advocated for awareness, policy formation and enactment of necessary legislation in all countries for the prevention of computer related crimes. In the

recent past dozens of ethics centers and programs devoted to business ethics, legal ethics, bioethics, medical ethics and computer ethics have sprung up. Physica (2010) continues to argue that these centers are designed to examine the implication and practices in all spheres of human activities on our lives.

Computer based performance monitoring ethics have been discussed by Ball (2001) in the work place. The argument was ethical monitoring practice is inadequate if simply applied to indicate whether the practice is on balance, ethical or not (Alder, 1998). Software piracy is on the increase (Roxanne, 2004). The reputation for integrity is crucial to success. According to Graig *et al.* (2003), current studies on adoption of technology in commerce have included all corporate aspects of technology, organizations, environments and individuals. These four influenced the adoption of framework generated from many trade studies.

The goal of the E-Health Code of Ethics is to ensure that all people worldwide can confidently, and without risk, realize the full benefits of the Internet to improve their health Tengku (2003). These are honesty, quality, informed Consent, privacy and professionalism. IT use is now considered a basic right of all human beings (Tengku, 2003). Several of the ethical issues related to access were observed and found to exist in a paper-record based world. These were brought back into view in relation to privacy concerns concerning the EMR (Ellen *et al*., 2011). For example, in one instance, a computer terminal froze during a clinical encounter in a consultation room. The clinician, frustrated, left the consultation room to seek help, and, because the system was non-responsive, remained signed onto the system (leaving the potential for the patient who remained in the room to access the system, if it began working again). In contrast to leaving a paper file in a room, this left access to the entire clinic's patient population potentially exposed.

Today we are connected to one another through electronic media such as cell phones, email, instant messaging, twitter, and Facebook. These connections enable us to stay in close contact with and share information with more and more individuals than ever before. Software piracy represents both ethical and business challenges to individuals and organization (Roxanne, 2004). All over the world the rights legally recognized are violated daily in the name of economic advancement, political stability, religious causes, terrorism, personal greed and Personal interest.

Development of effective health information systems requires understanding Health Informatics (HI), the systematic application of information and computer science and technology to health practice, research, and learning. Identity theft and the resulting financial crimes have become an increasing problem in our everyday lives (Patrick, 2005, earlier, health workers focused on the collecting and giving information for better treatment of diseases (William *et al*., 2011). Security was locking files in the rooms or file cabinets. However, computers increased the efficiency, keeping of health record and security. Computer based records management took health data from manageable few and opened opportunities for leakages with open data theft.

It is particularly offensive that these defendants stole the victims' identities from local hospitals and doctors' offices. People have enough to worry about when they go to a doctor. They should not have to worry about losing their identity to recover their health. According to Changrui & Arthur, (2009) the attempts to establish electronic medical records face challenges such as privacy, old records, and budget constraints. They propose the development of personal portable healthcare record smart cards and a corresponding framework to simplify maintenance and transfer of patient records as an incremental step towards a nationalized electronic records system.

The Federal Trade Commission (FTC) issued a set of regulations, known as the Red Flags Rule, requiring that certain entities, including health care providers, develop and implement written identity theft prevention and detection programs to protect consumers. Health identity theft is a fast-growing crime, and steps must be taken to defend against it. HIPAA and HITECH are the government's way of ensuring that all hospitals meet a minimum level of security. This baseline should be maintained and improved upon in an on-going basis (Michelle, 2008). By adhering to HIPAA and HITECH, the hospital is not only remaining compliant, but also ensuring its patients that it is constantly improving its security in a dangerous environment.

Among the potential benefits of EHRs are (Janine *et al*., 2011): (1) significant reduction in health care costs, (2) reduction of medical errors, and (3) improved quality of care. Examination of the data by some health care cost experts suggests that the exchange of health information contained in EHRs and other related HIT activity will have a substantial impact on the health care system's costs, saving approximately 80 billion dollars annually. A significant part of the savings could be achieved through the exchange of health information. Laura (2008) suggested measures to improve patient identification as checking and verifying the identity of patients; Use two verifiers on transfer of data to a facility; Standardized approach to the patient record; training on verification procedures to privacy among others.

There are serious potential consequences for victims whose information is compromised (Kathryn, 2011). As the nation moves toward the increased use of electronic health records, industry experts anticipate that occurrences of identity theft will rise dramatically.

In healthcare applications, the move toward developing electronic medical records (EMRs) and linking them to affiliated health care databases over a public network also brings an urgent issue of patient-identity theft (Chao *et al*., 2004). This is because eavesdroppers can intercept the transfer data via a public network at any place at any time, thereby resulting in an increased possibility of improper disclosure of patients' sensitive information and potential abuses of EMRs. Consequently, a patient may acquire a bad reputation due to improper disclosure of his/her EMR, thus requiring extra money and time of effort to recover their reputation and credit.

II. BIOMETRIC TECHNOLOGIES IN HEALTH SECTOR

The term biometrics is of Greek origin that literally means the measurement of life (Stephen, 2004). In more practical usage, it is argued, biometrics is the science of measuring and analyzing biological information. Biometrics is used to identify and authenticate individuals and is rapidly becoming a popular approach for imposing control over access to information.

The need for biometric-based authentication in the health sector would be attributed to the inefficiencies of other authentication techniques. According to Douglas (1997), some of the security strategies to protect e-record includes a health workers' request access for patients, health workers become patient fiduciaries and grant secondary access, coexistence of health workers, granting an exception for emergency access, simplify health workers access, execute a confidentiality agreement periodically and the enforce security policy vigorously & uniformly. Although these strategies are acceptable to some extent they fail to meet the privacy and security thresholds.

The biometric systems use human traits (Stephen, 2004). These traits are 1) genotypic traits (facial geometry, hand geometry, and DNA patterns), 2) rando-typical traits (fingerprints, iris patterns, and hand-vein patterns), and 3) behavioral traits (signature dynamics and keyboard typing patterns). All these will provide the ability to positively identify health worker by their personal attributes. The biometrics are gaining acceptance in the health sector because of the limitation of password authentication. According to Mogli (2011) 60.0% to 80.0 % of workers disclose their passwords to a colleague if asked. Many people actually write passwords on Post-it notes and stick them to their computer screens or keep under their keyboards. On the other hand, passwords, personal identification number (PIN), smart cards can be easily obtained or even shared. The same security breach can happen with patient confidentiality and patient medical records.

In a recent survey, it was estimated that by the end of 2012 half of the health workers were to be using personal mobile devices to access the computer system (Rifat *et al*, 2009). This was known as Bring Your Own Devices (BYOD). This, however, presents a number of challenges associated with security and privacy. To overcome this, mobile biometric has been recommended. According to Bill (2012) mobile biometrics offers a highly secure way to access personal computer, application and files containing health information. According to Howard (2011), if you were to make health workers to remember their passwords, they would wind up writing them down and that will be inherently less secure. The use of biometrics in the healthcare is anticipated to increase, especially with the need to accommodate multiple users on a shared E-health systems access. On the other hand Frank (2009) suggested that security and privacy was of value in healthcare that any other field. However, if this security system is seen to waste doctors' time and causes distraction then better none at all. In support for the use of biometrics, Frank (2009) also suggested use of biometric system instead of cryptic passwords. Biometric systems enhance detection of user's unique physical characteristics that would make the doctor's life easier in small clinics.

1.1. BIOMETRIC FEATURE IN WIRELESS BODY AREA NETWORK

Wireless Body Area Network (WBAN) is a small, intelligent device that may be implanted in one's body. According to Benoit *et al.,* (2010) WBAN is capable of establishing wireless communication. These devices monitor health status and gives back responses the user of medical personnel and can record the measurements over a longer period of time, hence improving the quality of the measured data. In their description Benoit *et al.* (2010) identified sensors and actuators as WBAN devices. The sensors measure some internal and external human body parameters such as the heartbeat, body temperature among others. On the other hand actuator acts on data they from sensors such as a pump administering the correct dose of insulin based on glucose amount. Interaction with the user or other persons is usually handled by a personal device. One example was sinking of data by smart phone as wireless devices.

The WBAN may be placed in the various parts of the human body as illustrated in Figure 3: Patient Body Monitoring Areas (Drude, 2007). Furthermore, the data obtained offers the doctors a clearer view than data obtained when admitted at the hospital.

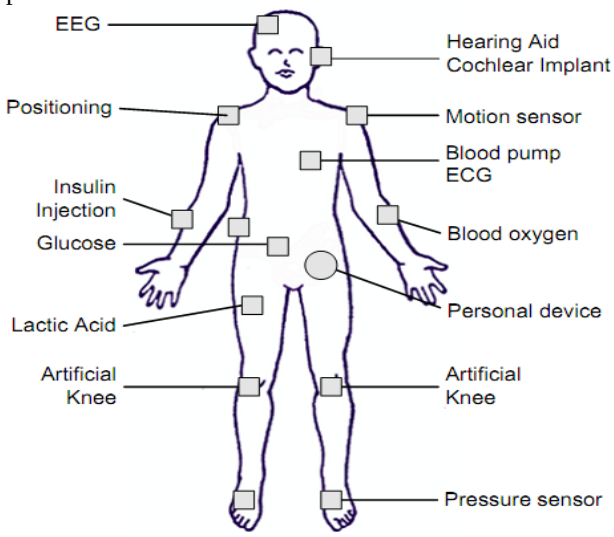

Figure 2: Patient Body Monitoring Areas (Drude, 2007)

Wireless Body Area Networks (Figure 3: Patient Body Monitoring Areas (Drude, 2007)) are an enabling technology for mobile healthcare service delivery. These systems reduce the enormous costs associated with patients in hospitals as monitoring can take place even at home in real-time and over a longer period of time (Dave *et al*., 2010).

According to Drude (2007) it is necessary for continuous monitoring patients. The usefulness of WBANs has been facilitated by the increased deaths resulting from disease that otherwise can be prevented. WBAN technology could provide the connectivity to support the elderly in managing their daily life and medical conditions (Drude, 2007). A WBAN allows continuous monitoring of the physiological parameters without limiting the patient movements in the hospital and at home.

III. HEALTH WORKERS' PERSONALITY TRAITS

Personality determines the unique thinking and behaving patterns of an individual (Wang *et al*., 2005).Traits, however, are the degree of this emerged uniqueness when an individual is observed from different angles or dimensions. According to Esther *et al.,* (2010) and Alan *et al.* (2011) The Big Five was originally derived in the 1970's by two independent research teams who took slightly different routes but arrived at similar

results. Most human personality traits can be boiled down to five broad dimensions of personality, regardless of language or culture. Personality is the enduring emotional, interpersonal, experiential, attitudinal and motivational style that explains the individual's behavior in different situations (Tan *et al*., 2012). However, personality can be a difficult and expensive construct to measure. Most personality inventories designed to measure traits or type combinations of traits (for example the Minnesota Multiphasic Personality Inventory, California Psychological Inventory, 16 Personality Factors, and NEO Personality Inventory) are proprietary instruments, whose items are copyrighted (Susan *et al*., 2010).

According to Wilburn & Chris (2012) personality is a stable set of characteristics and tendencies that determine peoples' commonalities and differences in thoughts, feelings, and actions. Males (53.0%) are more likely to have a Smartphone than females (47.0%). This study focused on the personal characteristic, commonly referred as Big Five personality factors (agreeableness, conscientiousness, extraversion, neuroticism, and openness to experience) (Wilburn & Chris, 2012 and Tan *et al*., 2012). A better understanding of the effects of personal traits of web-based decision will help web-based decision support system designers to provide more personalized designs for web-based decision systems (Linwu *et al*., 2009). It would be interesting to know what individual characteristics really contribute to the acceptance of biometric based health informatics.

1.1. AGREEABLENESS

Agreeable workers value getting along with others in the workplace and are therefore considerate, friendly, generous, and helpful. According to Wilburn & Chris (2011) people who scores high on agreeableness are sympathetic, good natured, cooperative and forgiving. They help others and expect help in return. They do well in jobs that involve considerable interpersonal interaction and teamwork. They are positively associated with beliefs about the perceived usefulness of technology (Susan *et al*., 2010).

The agreeableness dimensions that can be measured are shown in Table 2: Agreeableness Dimension (Tan *et al*., 2012). These agreeable dimensions have the scale as trust, genuine, consideration and unassuming.

Table 2: Agreeableness Dimension (Tan *et al*., 2012)

Scale	High Score Meaning
Trusting	Believes that people have good intentions, trust people to be honest
Genuine	Behaves straightforwardly, does not manipulate or use people
Considerate	Shows concern, listens well, makes people feel welcome
Unassuming	Keeps quiet about achievements, avoids talking about self

The dimensions of agreeableness (Table 2: Agreeableness Dimension (Tan *et al*., 2012)) have various high scores such as trust people, straightforward people, concern people who avoid talking about self.

1.2. CONSCIENTIOUSNESS

Conscientiousness concerns the way in which we control, regulate, and direct our impulses. Impulses are not inherently bad; occasionally time constraints require a snap decision, and acting on our first impulse can be an effective response so in certain occupations this is seen as an advantageous personality trait. Conscientiousness can be measured using the dimensions in Table 3: Conscientious Dimensions (Tan *et al*., 2012).

Table 3: Conscientious Dimensions (Tan *et al*., 2012)

Scale	High Score Meaning
Competent	Completes tasks, excels at work, gets things done efficiently
Organized	Likes to be organized, keeps things tidy, do things according to a plan
Achieving	Works hard, sets high standards, does more than is expected of him or her
Proactive	Gets down to work quickly, initiates activities, prepares in advance

The hallmark of the conscientious personality is self-control, reflected in a need for achievement, order, and persistence (Tan *et al*., 2012). They are more likely to carefully consider ways in which the use of technology would allow them to be more efficient and perform at a higher level at work (Susan *et al*., 2010).

1.3. EXTRAVERSION

Extraverts are described as being sociable, gregarious, and ambitious. The desire to gain social status is one of the most important motivations for individuals in deciding to adopt an innovation (Wilburn & Chris 2012 and Yoram *et al*., 2012). Extraversion is marked by pronouncing engagement with the external world. The dimensions to measure about the extraversion are shown in Table 4: Extraversion Dimensions (Yoram *et al*., 2012).

Table 4: Extraversion Dimensions (Yoram *et al*., 2012)

Scale	High Score Meaning
Friendly	Gets to know people quickly, cheers people up, enjoys contact
Outgoing	Likes to be surrounded by people, talks a lot, enjoys social occasions
Assertive	Communicates views and ideas, seeks to influence people, takes control
Energetic	Keeps busy, reacts quickly, is always on the go, fills spare time with activity

The extraversion dimensions shown in Table 4: Extraversion Dimensions (Yoram *et* al., 2012) demonstrate why the extraversion is an important personality trait. The extraversion moderated the relationship between subjective norms and intentions to use technology such that the relationship is stronger for individuals with higher extraversion (Susan *et al*., 2010).

1.4. NEUROTICISM

Neurotic personalities are likely to view technological advances in their work as threatening and stressful, and to have generally negative thought processes when considering the technological advances (Tan e*t al.,* 2012 and Susan *et al.,* 2010). The neuroticism dimensions that can be measured are shown in Table **5**: Neuroticism Dimension (Tan *et al*., 2012)

Table 5: Neuroticism Dimension (Tan *et al*., 2012)

Scale	High Score Meaning
Relaxed	Has fewer worries than most people, finds it easy to unwind
Contented	Comfortable with self, happy with life, positive about future
Self-assured	Confident in unfamiliar surroundings and with new people
Resilient	Calm under pressure, copes with problems, overcomes setbacks quickly

Neuroticism refers to the tendency to experience negative feelings. Neurotic people tend to be anxious, self-conscious and paranoid (Yoram *et al*., 2012).

1.5. OPENNESS TO THE EXPERIENCE

According to Yoram *et al*., (2012) Openness to experience measures a person's imagination, curiosity, seeking of new experiences and interest in culture, ideas, and aesthetics. It is related to emotional sensitivity, tolerance and political liberalism. People high on Openness tend to have a high appreciation for art, adventure, and new or unusual ideas (Susan *et al*., 2010). Those with low Openness tend to be more conventional, less creative, and more authoritarian. They tend to avoid changes and are usually more conservative and close-minded. Those who score high in openness have flexibility of thought and tolerance of new ideas. They actively seek out new and varied experiences and value change. Openness is consistently associated with training proficiency and engaging in learning experiences (Wilburn & Chris, 2012 and Tan *et al.,* 2012). They are more likely to hold positive attitudes and cognitions toward accepting the job-related technology in part because of their predisposition to embrace new approaches to work; they are less threatened by change implied in adopting technology. The dimension in openness to change can be summarized as shown in Table 6: Openness to Dimension (Tan et al., 2012).

Table 6: Openness to Dimension (Tan et al., 2012)

Scale	High Score Meaning
Imaginative	Has strong imagination, sets aside time for thinking, enjoys daydreaming
Innovative	Generates original solutions to problems, has lots of ideas for change
Rule Breaking	Prepared to bend the rules and take risks to achieve change
Adaptable	Tries new ways of working, adapts quickly to change

The theory behind the openness to change factor is that all people have creative ability, but individuals express it differently according to their thinking style. Thinking style influences where people look for information, the sort of information they prefer dealing with, and the type of environment they prefer working in. When solving problems in order to make decisions, there are usually two camps, adaptors and innovators.

IV. THEORETICAL MODELS

A theory is a supposition or a system of ideas explaining something (Oxford English dictionary). Theoretical model on the other hand is a collection of theories and models from the literature which underpins a positivistic research study. In other words, it is a conceptual model of how the researcher theorizes or makes logical sense of the relationships among the several factors that have been identified as important to the problem (Napaporn, 2007). Developing the theoretical model helps the researcher to propose and test certain associations. Thus improve the understanding of the situational dynamics. In whole, the theoretical model discusses the interrelationships among the variables that are considered important to the study.

Studying Information Technology in healthcare is considered as trying to hit a moving target. It requires different social theories than were present before its rise. Hence need to simplify reality, but the flip side of this is that this simplification should not be to the extent that this masks the fine nuances that characterize this complexity (Kathrin *et al.,* 2010). This study, therefore will consider the following theories.

1.5.1. DIFFUSION OF INNOVATION (DOI) THEORY

According to Napaporn (2008) diffusion is the process by which an innovation is communicated through certain channels over time, among the members of a social system (Figure 4: Factors Affecting Health Informatics Adoption (Graig, 2003).

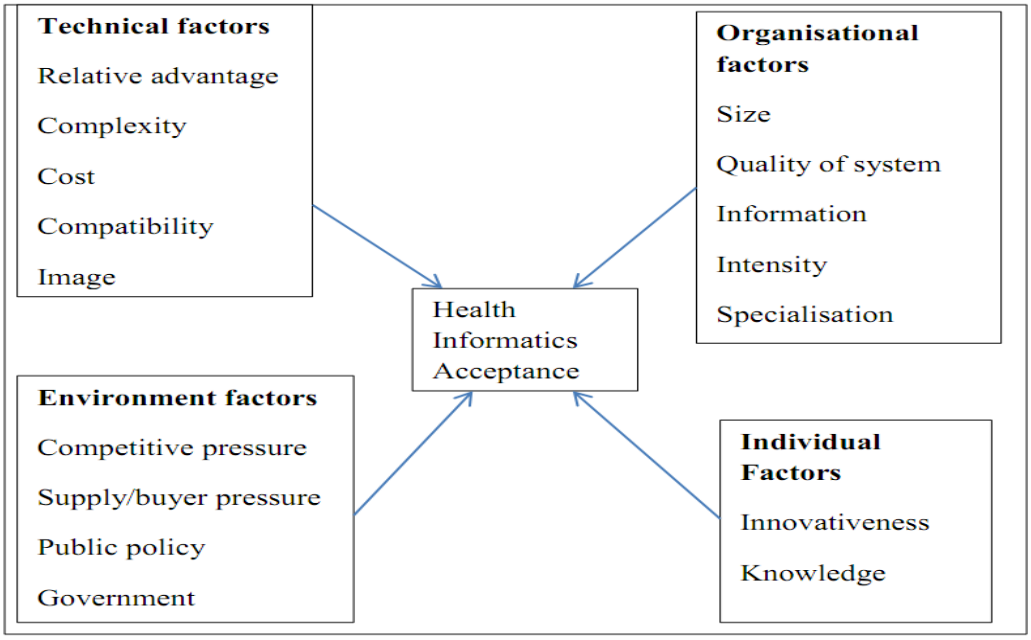

Figure 3: Factors Affecting Health Informatics Adoption (Graig, 2003)

An innovation is an idea, practice, or object that is perceived as new by an individual or other unit of adoption. According to Fred *et al.*, (1989), one of the most challenging issues in information systems (IS) is to understand why people accept or reject to use of it. The illustration in Figure 4: Factors Affecting Health Informatics Adoption (Graig, 2003) shows the factors have contributed to ICT adoption. However, Figure 5: Diffusion of Innovation Model (Rogers, 1985) shows the characteristics of an innovation, as perceived by the members of a social system, which determine its rate of adoption.

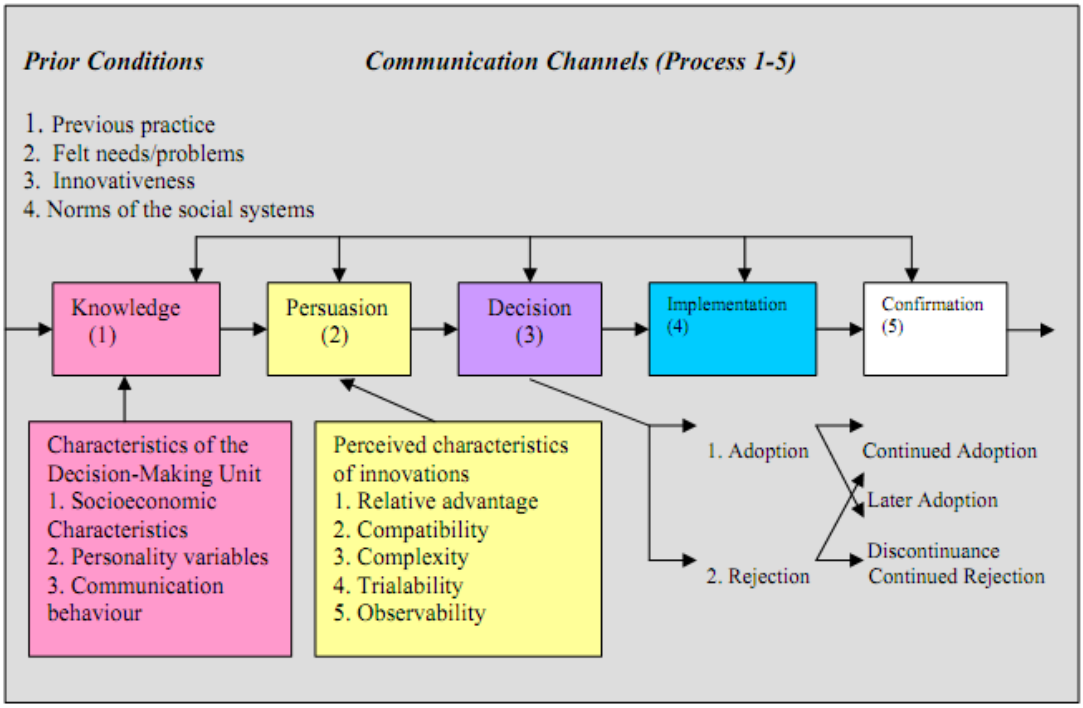

Figure 4: Diffusion of Innovation Model (Rogers, 1985)

The innovation-decision process is one through which an individual passes (1) from first knowledge of an innovation, (2) to forming an attitude toward the innovation, (3) to a decision to adopt or reject, (4) to implementation of the new idea, and (5) to confirmation of this decision.

1.5.2. Technology Acceptance Model (TAM)

According to Yogesh & Dennis (1999) and Fred (1989) the Technology Acceptance Model (TAM) (Figure 6: Technology acceptance Model (Davis *et al.*, 1989)) is an important theoretical contribution toward understanding IT acceptable

behaviors and usage. According to Manon (2008) the perceived usefulness seems to be the only significant predictor of intention of use. Basic factors such as attitude, perceived cost and perceived ease of use have no direct effect on intention to use virtual reality. However, noted by several information systems researchers TAM is incomplete in that it does not account for social influence in the adoption new information systems. Davis (1986) and Davis *et al*., (1989) noted that it is important to account for subjective norm (SN), the construct denoting social influence. They observed that it is difficult to identify if usage behaviors are caused by the influence of referents on one's intent or attitude as illustrated in the following Figure 6: Technology acceptance Model (Davis *et al*., 1989).

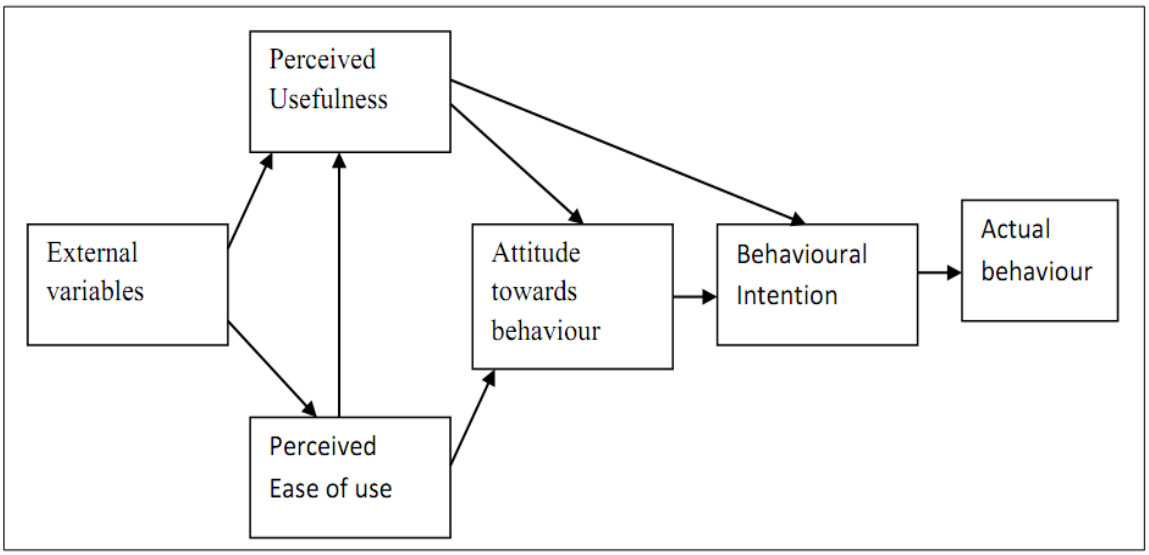

Figure 5: Technology acceptance Model (Davis *et al*., 1989)

This theory in Figure 6: Technology acceptance Model (Davis *et al*., 1989) suggested the problem may be due to the using of an alternative theoretical basis for conceptualizing subjective norm, specifically in terms of processes of social influence (compliance, identification and internalization).

1.5.3. Actors Network Theory (ANT)

The Actor-Network as a concept was developed by Michel Callon, Bruno Latour, and John Law during the course of the 1980s as a recognition that actors build networks combining technical and social elements and that the elements of these networks. Actors Network Theory (ANT) is an approach to social theory originating from Science Studies. It's a material-semiotic method that explores how relations between objects, people, and concepts are formed, rather than why they are formed (Katrina, 2009). ANT declares that the world is full of hybrid entities (Tatnall, 1999) containing both human and non-human elements. According to Kathrin *et al* (2010) it's difficult to differentiate a computer program's technical aspects of the influence exerted by the socio-cultural background of the software development team. An actor is a source of an action, regardless of its status as a human or non-human according to Carolyne (2007) and Kethrin *et al*., (2010). According to Richie (2011) studying the multiple agents is important in adopting health informatics as is a dramatic change in the health sector.

In agreement with Carolyne (2007), ANT has been selected for this study for a number of reasons. First, it is well established and there is an important hinterland of work explaining, critiquing, developing, and applying the theory. Second, it has been comparatively stable, with later presentations, building on the original theory, probably because the theory is owned by a relatively small group of writers. Third, it overcomes some important limitations of the technologically deterministic ICT as an enabler perspective taken by some management literature.

1.5.4. Theory of Reasoned Action (TRA)

This theory (Figure 7: Theory of Reason Action (Ajzen & Fishbein, 1980)) postulates that beliefs influence attitude and social norms which in turn shape a behavioral intention guiding, or even dictating an individual's behavior Ajzen & Fishbein (1980) as shown in Figure 7 and Napaporn (2007).

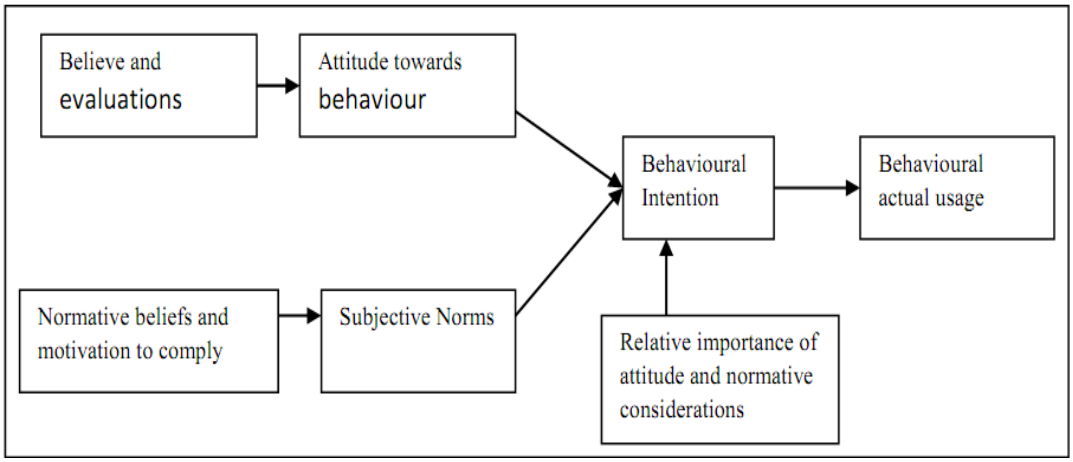

Figure 6: Theory of Reason Action (Ajzen & Fishbein, 1980)

Intention is the cognitive representation of a person's readiness to perform a given behavior, and it is considered to be the immediate antecedent of behavior. Napaporn (2007) also argues that Subject Norm (SN) illustrated in Figure 7: Theory of Reason Action (Ajzen & Fishbein, 1980) is an individual's perception about what other people think of his or her behavior in question.

1.5.5. Theory of Planned Behavior (TPB)

According to Ajzen (1991) and supported by Napapron (2007), Theory of Planned Behavior (TPB) incorporates an additional construct in order to account for situations where an individual lacks the control or resources necessary for carrying out the targeted behavior freely. TPB is a theory that predicts deliberate behavior, because behavior can be deliberate and planned. This is the case for TPB as shown in Figure 8: Theory of Planned Behavior (Adopted from Ajzen, 1991).

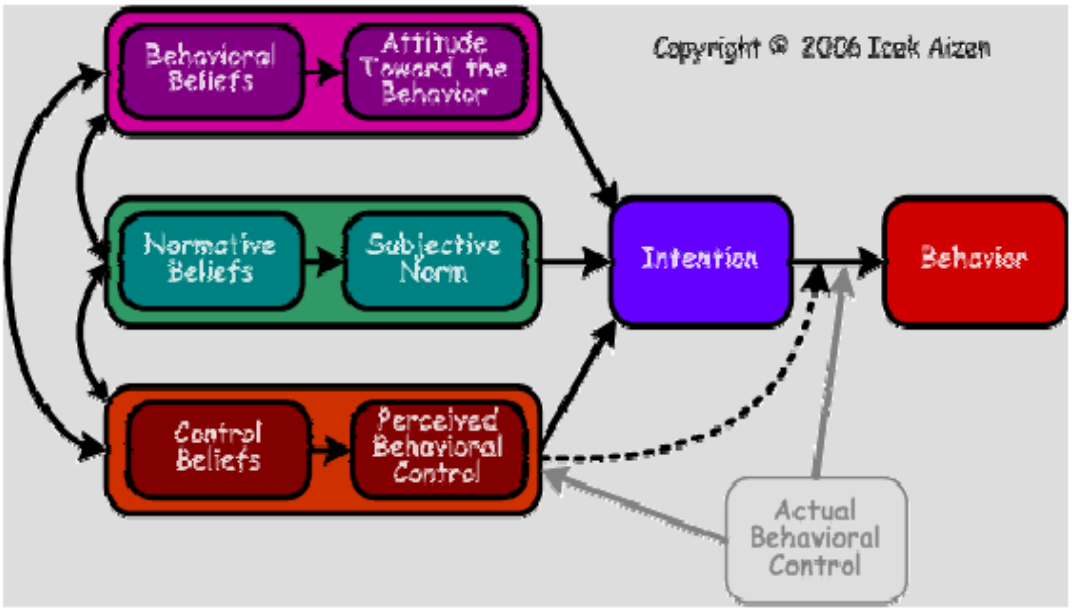

Figure 7: Theory of Planned Behavior (Adopted from Ajzen, 1991)

The intention of this theory was to determine by one attitude toward the specific behavior, two subjective norms (SN) and three perceived behavioral control (PCB) (Ajzen, 1991).

1.5.6. Comparison of Theories used in this Research

Technology is a dictator because it does not request or wait for anybody for it to be used. The prevailing condition dictates that one option is to use technology. The Table **7**: Summary of Theories and their Attributes shows the attributes of each of these theories.

Table 7: Summary of Theories and their Attributes

Theory	Summary of its Feature
Diffusion Innovation Theory (DOI)	Five attributes of an innovation that influence the adoption and acceptance behavior: relative advantage, complexity, compatibility, trialability, and observability (Napaporn, 2008).
Technology Acceptance Model (TAM	Perceived usefulness and perceived ease of use are the two most important individual beliefs about using an information technology.

	They lead to individual behavior intention and actual behavior (Yogesh & Dennis, 1999; Fred, 1989 and Manon, 2008).
Actors Network Theory (ANT)	Declares that the world is full of hybrid entities, containing both human and non-human elements, and was developed to analyses situations, where separation of these elements is difficult (Carolyne, 2007 and Kethrin *et al*., 2010).
Theory of Reasoned Action (TRA)	An individual's behavior intentions determine his or her actual behavior. Behavior intention is in turn determined by the individual's attitude toward this behavior and subjective norms individuals are rational. Decision makers who constantly calculate and evaluate the relevant behavior, beliefs in the process of forming their attitude toward the behavior (Ajzen & Fishbein, 1980 and Napaporn, 2007)
Theory of Planned Behavior (TPB)	Used to predict an individual's behavior only in a real voluntary situation, not in a mandatory context, consider the mandatory situation, adds new constructs of perceived behavioral control in TPB. Perceived behavioral control, perceptions of internal and external constraints on behavior (Janzen, 1991 and Nap apron, 2007)

However, as much as the technology is dictating, a number of theories have tried to explain why technology adoption in hospitals is slow. These theories have been discussed.

4.1 THE CONCEPTUAL MODEL

The proposed research model (the conceptual Model) comprised three important types of variables:

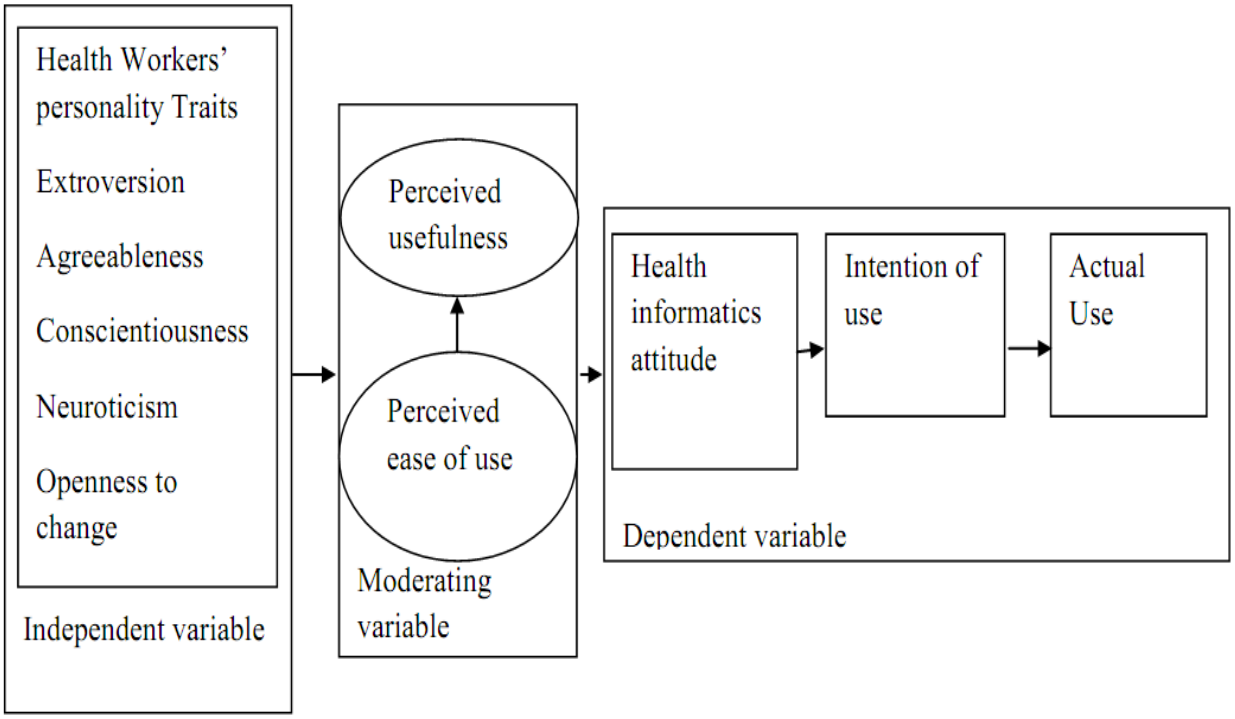

Figure 8: Proposed Conceptual Path Model of Biometric Based Informatics

Based on the previous researches, a theoretical model was developed. Figure 9: Proposed Conceptual Path Model of Biometric Based Informatics represents a conceptual model that the research tested and analyzed in this study. The arrows linking constructs (latent variables) specify hypothesized causal relationships in the direction of the arrows. The arrows between constructs and indicators (observed variables) symbolize measurement validity.

1) The moderating variables are perceived usefulness and perceived ease of use. According to Sebastian *et al.* (2005), the three macro roles to identify competencies are applied health informatics, research and development of health informatics, and Clinician health information. The research employed these to define the acceptance of Health Informatics by health workers in the selected level 5 hospitals in Nyanza Region, Kenya.

2) The dependent variables are usage behavior, behavioral intention, and technical (actual) usage. The attitude influenced behavior and technical usage of health informatics

3) The independent variables were the health worker personality traits (Extroversion, Agreeableness, Conscientiousness, Neuroticism and Openness to change).

4) The related study by Morton (2008) that determined the individual characteristics and socio-technical factors that contributed to physician acceptance of an Electronic Health

Record. Morton's study used a hypothesized causal model grounded in Diffusion of Innovations theory. Morton developed Technology Acceptance Model was using case study and survey methods tested using structural equation modelling (SEM). An online survey was distributed to 802 faculty, fellow and resident physicians in an acute care teaching institution in the southeastern United States with the overall response rate was 29.8%.

According to Sung *et al.* (2006) they identified a number of variables that emphasize the larger social fiber beyond individual characteristics that are relevant to the acceptance of computer technology. Sung *et al.* (2006) also suggested these individual characteristics have been shown to positively affect acceptance.

V. CONCLUSION

The literature review points to lack of a model to evaluate the physicians' behavioral approach influence on the acceptance or rejection of newly introduced health informatics in health sector in Kenya. Five theories TAM, TRA, ANT, TPB and ANT were reviewed. This was on the basis of the support ingredient for acceptance and ethical usage of patient records. This pointed to the need for an integrated theoretical approach. The approach was to help understand the technology acceptance by physicians. From the literature review, it is postulated that evaluation of health workers' traits may be conducted against biometric based health informatics. Such a model supported by the theories representing technology acceptance may be developed.

This paper identified several areas pointing towards the need to enhance technology acceptance in relation to the user traits attributed to the degree of acceptance of technologies. The next paper presents the approach to be used to provide data for investigating the research questions in order to achieve the specific objectives of this proposed research study.

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AUTHORS

First Author – Makori Cyrus Abanti (PhD), Acting Dean School of computing and Informatics, Mount Kenya University, Kenya, Email: abantima@gmail.com