A SYSTEMATIC LITERATURE REVIEW ON USE OF TECHNOLOGY IN DIABETES MANAGEMENT AMONG NURSES – BENEFITS AND BARRIERS

The origin of the use of technology in diabetes care began in the early years as soon as diabetes became epidemic. Newly developed technological devices over the time have facilitated integration of electronic health record, improved diagnostic examination and contributed immensely to the overall quality of care (Belazzi 2008).

This research is commissioned by eMedic, which is a project funded by Central Baltic INTERREG IV A programme. The purpose is to provide relevant information about the use of e-Health technological devices in diabetes for nurses' education. The aim is to critically examine and produce evidence based material to be published in eMedic about the benefits, barriers and future of e-Health technology in diabetes management among nurses. In order to provide for nurses and healthcare workers evidence based information about e-Health in diabetes management.

A systematic literature review was used as a study method. A total of Twenty one (21) articles and five (5) books were reviewed, by three authors, which were Final year Nursing students of the Turku University of Applied Sciences as their Bachelors thesis and finally 16 articles selected for final review and appraisal process. Results were analyzed using the PRISMA flow chart followed by the CASP appraisal tool for assessing research articles. All the articles were retrieved from the academic databases such as Elsevier Science Direct, Medline, CINAHL and Ovid.

Though, present and future of diabetes technology are faced with few challenges such as patients' acceptance and illiteracy, financial issues and need to train and re-educate nurses on the use and handling of ever changing technological devices. It is however realized from this research study that use of technology and e-Health in diabetes management has impacted diabetes care in a positive direction right from the past until now the present and its continuity also has a brighter future.

The future of e-Health technology in diabetes management is promising if there is a considerable commitment efforts from government, patients and healthcare wo rkers. Area of research is also suggested for future researchers in the field of diabetes.

KEYWORDS: diabetes technology, nurses, benefits, barriers, future

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LIST OF ABBREVIATIONS (OR) SYMBOLS

BG	Blood Glucose.
CASP	Critical Appraisal Skills Program
CGM	Constant Glucose Monitoring
CINAHL	Cumulative Index to Nursing and Allied Health Literature
CSII	Constant Subcutaneous Insulin Infusion
DARTS	Diabetes Audit and Research in Tayside Scotland
DM	Diabetes Mellitus
E-Health	Electronic Health
E-Medic	E-Medic is a project funded by Central Baltic INTERREG IV A programe
EMRs	Electronic Medical Recording System.
EPR	Electronic Patient Record
HIT	Health Information Technology.
ICT	Information and Communication Technology
IT	Information Technology
NPH	Neutral Protamine Hagedorn
PDA	Personal Digital Assistant
PEO	Population, Exposure, Outcome
PHP	Personalized Health Plan
PHR	Personal Health Record
PICO	Population, Intervention, Comparison, Outcome
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta–Analysis
PZI	Protamine Zinc Insulin
SMBG	Self-Monitoring of Blood Glucose
WHO	World Health Organization

1 INTRODUCTION

This research is sponsored by eMedic, which is a project funded by Central Baltic INTERREG IV A programme. The target of the project is to devevelop new practices for virtual consultation in medicine. The focus is on diabetes and pediatric (eMedicproject.eu. 2012).

Diabetes was first described by the Ancient Greek physician Aretaeus of Cappadocia, who first coined the term “diabetes”. In Ancient India, diabetes was called “sweet urine disease”; they had observed that ants were attracted to the patients’ urine, and this became a positive test for the disease. Later, European physicians would taste urine samples to identify whether or not it had a “sweet” taste. (Ratheau et al. 2011, 57-64.) These brought about the use of technology in diabetes care. Electronic health-record technology using Internet-based strategies is believed to improve diabetes patient outcomes through enhanced education and patient support, and through reduced clinical inertia on the part of the healthcare provider. (Benhamou 2011, 53-56.)

Many more trials have been conducted with aim to improve and modify diabetes management and to achieve this goal new tools were developed and more are being constructed to bring about patients as well as health care practitioners a very reliable diabetes management system. Technology has helped diabetes management to become easier and patients have now a more exact diagnosis, care plan and follow up care. The number of people suffering from diabetes is getting more and more worldwide. The task of preserving desired glucose level is challenging for both patients and their families. (Moshe & Tadej 2012, 225.) Successful diabetes control relays on strict patient adherence to regimen of blood glucose monitoring, use of medication, skin care, diet besides exercise (Zielinski et al, 2006, 261). If diabetes is not treated correctly it will cause more serious problems in other body functions e.g. kidneys, nerves, feet, and eyes (Topiwala 2011).

Diabetes care has improved as many technological advances have been made in the field. Improvement included insulin pumps and infusion sets besides

implementations of continuous glucose monitoring. Furthermore, different applications are now being used by healthcare professionals and diabetes patients in order to provide best method in diabetes care (Diabetes Technology 2012).

In this thesis work, a review of diabetes technologies is examined to explore the development in these technologies. Moreover, this work will concentrate on ”Use of Technology and E-Health services in diabetes care in general and benefits and barriers to E-Health services among nurses”.

The purpose is to provide relevant information about the use of technological devices in diabetes for nurses’ education. The aim is to produce evidence based material in eMedic about the benefits and barriers of technology in diabetes care among nurses.

2 BACKGROUND

Diabetes remains a disease that demonstrates a preference for tribal and cultural groups. It remains common among Native Americans, Alaska Natives, African Americans, Hispanics, and Asians compare to its rate among Caucasians. (Kapustin 2008, 643.)

The International Diabetes Foundation's evaluation indicates that 366 million adults aged 20 – 79 are living with diabetes worldwide in 2011 and it is deemed to increase to 552 million before run out of the year 2030. Larger part of this rise is predicted to be associated with developing countries. (Moser et al. 2012, 1.) Diabetes has attained its peak in this present society as a life disease despite the full attention being supplied by various health professionals (Sönksen & Williams 1996, 67-68).

Patients with diabetes usually require a complex set of services and support ranging from glucose monitoring, insulin and other medication management, psychotherapy and social support, to physical activity promotion, nutrition counseling and more. In order to be successful, patients must understand very well their condition, and also strive to obtain the skills and attitudes to set goals, solve problems, monitor outcomes and overcome barriers to action. (Kaufman 2012, 40.)

To date, limitations in the area of diabetic technology have compromised provision of a first-rate service and this has created a huge interest in the introduction of newer technological devices for diabetes care (Sönksen & Williams 1996, 67-68). Health information technology is assumed to enable providers to improve quality of care and target interventions to patients, especially those with chronic conditions. For this reason, the use of electronic medical records (EMRs) has been encouraged in the management of diabetic patients according to the Saint-Vincent Declaration for quality assurance in diabetes in 1991. Since then, the widespread use of EMRs for the follow-up of patients has become a fact in all developed countries. (Varroud-Vial 2011, 49.)

TeleMedicine has significantly contributed in the right direction to the care of diabetes, it is noted to have created advancement and scientific changes in the diagnosis, examining and healing of diabetic patients. TeleMedicine services have capacity to automatically record diabetes monitoring values, such as Blood Glucose (BG) levels and vital signs. (García-Sáez et al 2009, 391-392.)

Integrated health information technology (HIT) system could be described as a significant tool when it comes to care delivery. The HIT system in KP comprises of electronic health record including point-of-care decision supports which is made accessible to concerned providers. (Schiotz et al 2012, 3.) Nonetheless, there are also conditions that generate doubts when diabetes technology is brought forward, these doubts could be linked to barriers to bigger scale execution of diabetic technological tools that involves patient computer skills, getting used to the technology, architectural and technical design, and the reason to fund the implementers for their care (Azar & Gabbay 2009, 9).

Diabetologists normally exercise certain fears for any newly introduced technology, most importantly when in the aspect of trustworthiness and protection, which happen to be two compulsory characteristics of any tool known to be daily medical practice. The diabetes consultant needs to see beyond the tool itself, all of the possible aftermath of its bigger scale application and distribution, and also the possible impact of the tool on cordial relationship or interaction already existing in-between patient-physician relationship. (Leroy 2011, 79.) Although, there are less computer-based diabetes management systems applied regularly in the health centers or general practice and even smaller number of systems which are employed interactively by clinicians during patient-doctors meeting session (Sönksen & Williams 1996, 67-68).

Meanwhile, diabetologists can simply expect that newly introduced technologies will better their know-how and examination of the metabolic state and, thus, assist in arriving at satisfactory solutions (Leroy 2011, 79). The new use of information technology to medical records has the capability to better the value, protection and results of diabetes care (Varroud-Vial 2011, 51). Regarding the ideas of many healthcare officers, diabetologists are happy about the introduction of latest technologies, believing these could be a medium of

achieving better appreciation for diabetes care consultants. Besides their appreciated capabilities in diabetes education, it is possible for diabetologists to take the advantage of the latest technologies to upgrade their potentials and, ultimately, their specificity. Hopefully, the latest technologies are expected to offer valuable solutions and better the relationship between patient and physicians. (Leroy 2011, 79.)

THE PAST AND THE PRESENT OF TECHNOLOGY IN DIABETES MANAGEMENT

Decades away, lots of efforts were made on a daily basis to bring in technology into the care of diabetes. Insulin was first found in 1923 and, within a century, it has been refined, humanized and now synthesized by genetically made microorganisms (Ratheau et al. 2011, 57-64). In 1977, insulin contained animal-sourced, relatively impure regular insulin and NPH (neutral protamine Hagedorn), Lente, or PZI (protamine zinc insulin) (Larry & Deeb 2008, 78).

Years before, serious results of short-term hyperglycemia in acute care have attracted attention. Organizations are observing closely the recommendation for arriving at a more reliable glycemic control. (Peeples and Seley 2007, 17.) Usual patients around 1980s still depended upon normal and long-acting insulin, but it possible it was human insulin rather than animal-sourced insulin in the United States. The most important development during that period was the arrival of self-monitoring of blood glucose (SMBG). (Larry & Deeb 2008, 78.)

Remarkable efforts have changed diabetes management from pure clinical diagnosis and the detection of insulin to constant subcutaneous insulin infusion (CSII) coupled with constant glucose monitoring (CGM) to give patients an opportunity to apply insulin delivery to glycaemia on a practically “real-time” basis (Ratheau et al. 2011,57-64).

Right from late 1970s, a tough attention has been dedicated to the plan and execution of information and communication technology (ICT) systems targeted at sustaining the care of diabetes mellitus (DM). Basically, in the fields of electronic patient records, decision support systems, and teleMedicine. Majorly diabetes management is possibly one of the areas where teleMedicine, e-

Health, and consumer-health solutions have been intensively practicalised. (Bellazzi 2008, 98.)

During 1980s, A1c tests became widely used which saves laboratory visits and venipuncture. The A1c test (also known as HbA1c, glycated hemoglobin or glycosylated hemoglobin) is a blood test that correlates with a person's average blood glucose level over a span of a few months. The A1c test measures how much glucose is stuck to your hemoglobin, or more specifically, what percent of hemoglobin proteins are attached to glucose. (Larry & Deeb 2008, 80.)

The treatment and follow-up of diabetes have dramatically improved over the past century, more so, changes have tended to improve glucose management towards achieving near-normal glycaemia while avoiding chronic complications, and have also tended to improve patients' quality of life (Ratheau et al. 2011, 57-64). Glucose monitoring was with urine, mostly Clinitest tablets that boiled urine, along with some glucose monitoring tapes. Ketones were measured with tablets that changed colors. Dipsticks for urine were just being introduced (Larry & Deeb 2008).

In France, hospital diabetes departments introduced electronic diabetes databases for inpatients as early as 1985. Their goals were to structure the clinical management of diabetic patients improve communication with general practitioners and promote regular quality-assurance processes. While hospitals with automated notes; records; order entry and clinical-decision support systems probably have fewer complications and lower costs, the true impact of these EMRs in French hospitals has not been evaluated. (Varroud-Vial 2011, 49.)

Research shows that most of the past efforts have been devoted to the design of systems for insulin management. However, the present research frontier is associated to citizen and patient emancipation through user modeling and context alertness. The severe condition of the disease and the reason to give power to patients make DM a "natural" circumstance to experiment ICT as a medium to keep home care. (Bellazzi 2008, 98-100.)

Latest growth in diabetes technologies have really helped diabetes control when it is compared to the situation in the earlier period, but it was linked to the necessity to attach or put on gadgets with more mind concentration on the disease. (Liberman et al 2012, 79). The present technologies being used in diabetes care of today have really brought in new and latest medical devices. Such continuous insulin infusion pumps and continuous glucose monitoring device are to better the health condition of the patients and the decision-making procedures that are acting as barriers to insulin-dependent diabetic patients. The introduction of the technologies into teleMedicine systems could step up the patients' abilities in caring for their sickness, helpful in the reception of these newly introduced medical devices. (García-Sáez et al 2009, 391.)

According to the studies carried out on persons with diabetes, the results suggest improved patient compliance with guidelines for managing diabetes coupled with improved way of life and attitudinal changes when care is given with the use of electronic communication medium and tele-Health systems. Mobile phones are common these days—over 2.7 billion people worldwide possess mobile phones. (Quinn et al. 2009, 334-335.) The establishment of information technologies and the approval in clinical practice of latest medical devices pave way for a new situation that permits dealing with the difficult crisis of diabetes care through varying control tactics modified to individual patient's features, including the artificial pancreas as one of the possible automated control strategies (García-Sáez et al 2009, 392).

Considering the United States alone, the sales of mobile phones has jumped from 34 million owners in 1995 to 230 million in 2006. The availability of mobile phones, across socioeconomic, gender, and age groups, coupled with their distinct capability to process and interchange data in real-time, make them a suitable ground to build easy, efficient, and real-time diabetes care programs that can be propagated as a whole. (Quinn et al. 2009, 334-335.) Previous healthcare hard work towards teleMedicine management focused on increasing the quality of communication and collaboration among the patients and doctors. Some of these were only restricted to non-electronic transmission of BG data while others coupled automatic processes for data transmission, used in a

bigger scale, experiences a major equipment for home care and diabetes education. (García-Sáez et al 2009, 391-392.)

Series of unequaled advantages are now accessible to carry out disease care and prevention programs on the ground of the current advances of ICT research. Importantly, the fields of user-centered design, mobile communication, context awareness, and wearable systems look very promising for the subsequent teleMedicine systems accomplishment. (Bellazzi 2008, 99.) A quiet number of therapies compare to the past are now accessible to treat diabetes and some of the results proved that there has been considerable outcomes have shown progress in the recent years (Peeples and Seley 2007, 13).

The general implementation of ICT on a daily basis, including, significantly, the Internet and mobile phones, is offering a great advantage to improve the organization of DM management delivery through upgrading and optimizing interaction among patients, health care providers, and health care systems. It is very significant to observe that while teleMedicine can aid transformation, promote communication and more reliable treatments, yet it does not cure people by itself. Empowering the healthcare officers who are meant to implement teleMedicine is very important. (Bellazzi 2008, 102.)

In France nowadays, the use of hi-tech tools have been implemented for diabetes care such as EMRs (electronic medical recording systems) and web-based personal health records (PHR) systems. These present a suitable structure such as electronic summaries of health information, personalized health plans (PHPs), and standardized and structured hospital-discharge forms which are needed for carrying out and distributing the information required to better standardize diabetes management. (Varroud-Vial 2011, 59.) In 2006, the Food and Drug Administration permitted a number of continuous glucose monitoring systems for use by the grown-ups suffering from diabetes. Each of these systems comprises of a glucose sensor, a portable electrode worn subcutaneously and connected to a transmitter that transmits information to a monitor that is so portable enough to be moving around in a pocket. (Peeples and Seley 2007, 16.)

As at the moment, in some parts of the world, therapies are now faced with automated systems, automated dialog systems working with natural language processing and generation seem very promising for DM care, most importantly Diabetes Mellitus type 2 (Bellazzi 2008, 100-101). Electronic medical records (EMRs) are observed to have offered considerable improvement in the accomplishment of the prescribed standards of diabetes management and midway results. The application of technological tools such as electronic reminders, e-Health technology and sending of emails to patients integrated into the EMR have also been documented and recognized to have a valuable effect on diabetes management. (Varroud-Vial 2011, 59.)

An interesting aspect of about an integrated system is the Diabetes Audit and Research in Tayside Scotland (DARTS), which is an updated population-based diabetes information system that retrieve data from varied sources, including hospital admissions, diabetes clinic visits, and diabetes medication (Bellazzi 2008, 100-101).

Most primary-care physicians have introduced EMRs for the management of patients in ambulatory care. This has paved way for possibility to record patients' demographics, historical background, information about care received recently and up-to-date challenges and active medication regimen, as well as prescribed medications. All these afore-mentioned features have significant effects in the management of severe diseases such as diabetes mellitus. Indeed, lots of randomized trials of evidence-based electronic reminders that were integrated into EMRs have shown useful impacts when it is compared with the normal common care. (Varroud-Vial 2011, 49.)

Traditionally, automated systems have been categorized as visit-by-visit systems and day-by-day systems, with the first being focused at helping physicians and the second coming to the aid of DM patients in their individual-management programs. The accessibility of teleMedicine therapies has modified this kind of pattern, potentially offering related type of information as regards self-monitoring to the patients and physicians, although with diverse roles and responsibilities. (Bellazzi 2008, 99.) More so, Game-based diabetes care therapies are also coming up as an efficient technique to assist patients

having diabetes to take up and maintain healthy character. The remodified system is highly decodable and permits researchers to put up games for the system in a comfortable way and make the game works with various kinds of actions. (Kaufman 2012, 43.)

2.1 Introduction of e-Health

E-Health is the use of information and communication technology (ICT) for health. Examples of e-Health uses include treating patient, conducting research, educating the health workforce, tracking diseases and monitoring public health (WHO 2012). Change in societal structure, increasing complexity in healthcare knowledge and increasing nursing shortage has led to healthcare system redesign. Included in most recommendations is the use of technology to make nursing practice more efficient. However, information technology has the potential to go further than simply increasing efficiency in healthcare (Ahren et al 2009).

E-Health can help improve the quality, capacity and efficiency of healthcare systems and it has the potential of improving access to healthcare system for underserved population and to increase the capacity to provide tailored and customization for individual patient and customers.

Currently healthcare systems are information intense domains where reliable and timely information is an important resource for planning and monitoring services besides health information systems can be a useful tool to make healthcare delivery effective and efficient. (Hernandez 2009)

Today nursing staff everywhere recognize the importance of evidence-based practice, where every care decision is informed by updated knowledge. It is not only nurses who benefit from increased access to patient data, patients also can now obtain health information relevant and tailored to their need (Royal College of Nursing 2009).

E-HEALTH HISTORY

In 1999, e-Health emerged as a popular term that refers to internet-based healthcare delivery. E-Health differs from telehealth and teleMedicine by not being professional-centric (Maheu et al 2001).

Healthcare computing can be tracked to early 1950s as mainframes were available only in the major hospitals of the G7 countries could afford to house and use these machines.

From early 1960s through the 1970s, new age of computing in healthcare emerged and major hospitals in the US and Europe began to agree on the need to advance patient information management. In the light of new technology and big infusion of investment money provided by corporate businesses and venture capitalist in late 1990s besides in the process of protecting healthcare assets from the Y2K threat, attention was shifted to internet connectivity. (Allen et al 2001, 4.)

IMPORTANCE OF E-HEALTH IN NURSING

According to the UK e-Health nurses' network, e-Health has been defined as the promotion and facilitation of health and well-being with the families and the enhancement of professional practice by use of information and communication technology (E-health highlights 2009).

E-Health is regarded as the most important revolution in healthcare since the advent of modern medicine and public health measures such as sanitation and clean water. Today nursing staff everywhere recognize the importance of evidence practice where every care decision is informed by updated knowledge Furthermore, it is not only nurses who benefit from increased access to patient data, patient also can obtain health information relevant and tailored to their need.(Putting information at the heart of nursing care 2012, 4)

Nurses form the largest group of health care professionals, and because of the particular role they play in coordinating as well as delivering care to patients, they are major generators and users of information besides, high-quality patient

care and nursing practice have always relied on the effective management of information (eHealth the future of healthcare 2012, 2).

BENEFITS OF INFORMATION TECHNOLOGY IN NURSING PRACTICE

The Table 1 below gives an overview of the benefits of information technology in nursing practice.

Table 1. Benefits of e-Health

Patient safety	Patients' demographic and clinical information is more legible, accessible and shareable, thereby giving clinicians more accurate, timely and complete data on which to base decisions.
Effectiveness	Clinical pathways and decision support systems can be embedded in electronic patient systems to give easy access to best practice evidence
Efficiency	More efficient work processes due to increased availability of clinical information, for example electronic transmission of prescriptions direct to the pharmacy
Patient centred and timeliness	Information about patient's preferences more easily available and access to up-to-date information on which to base clinical
Equitable	Ensuring that all people have the same level of access to services.

The key application areas of e-Health are electronic Medical Records (including patient records, clinical administration systems, digital imaging & archiving systems, e-prescribing, e-booking), teleMedicine and telecare services, health information networks, decision support tools and internet-based technologies and services (Pagliari, 2005).

2.2 Barriers of e-Health among nurses

The chapter “barriers in e-Health among nurses” is dealing with the problems that occur for nurses when working with e-Health services and programs. When researching through articles dealing with e-Health and their barriers among nurses, several identify the same problems. These problems can be categorized in following groups: Knowledge and IT-skill; time and accessibility; money, E-Health services and programs; memory aid and awareness; Trust and security; and workflow.

There are several e-Health services and programs which are all having different way of working. So a lot of nurses and other health care professionals are not having enough information technology (IT) skills to know how to work with the e-Health programs and feel unsecure to use them. (Saleem et al. 2009, 622.) It can also occur that nurses are more focusing on the electronic medical record than on the real living patient. The article “Are Electronic Health Records a Barrier to Nurse Practitioner Student Learning?” mentioned that e-Health can also become a problem for future nurses that they might not learn how to do right written documentation and write prescriptions. (Woodruff et al. 2010 ,280.)

It is very difficult to find time for use e-Health. From morning to evening people don’t have too much time for using the computer because also others might need it and also patients need their attention. During nightshifts it is easier to going and check on e-Health services when everything is calm. Nursing students who were doing their practical and had to use e-Health services rather used them at home than in work, because it was easier to find time for it and also supervisors and other work colleagues didn’t like to see them sitting on the computer. (Bogossian et al. 2010, 770.) The time also plays an important role in learning how to use these programs. Health care professionals are not having that much time and also a lack of interest in learning about e-Health services and programs (Anderson 2007, 481).

It is also not that easy gaining accessibility to e-Health services because there are a limited number of computers in every ward or they are not in close range.

Also other working staff members might need them. Also an account might be needed which not everyone has. (Bogossian et al. 2010, 70)

Several places also have the problem that they are not having enough money to fund e-Health services for their hospitals. Another barrier that was mentioned by health care professionals is that the vendors are not able to offer good products. (Anderson 2007, 481.) Some E-Health service programs were not well organized. Also site notes were not that easy to make on the programs' data sheets.

Nurses mentioned that e-Health services and programs are not a good memory aid. It is easier to remember information or other important messages that were written on paper. Health care professionals are also not that easy aware of new information of patients treatment, medication and other information. (Saleem et al. 2009, 622 – 623.)

Also it was found that health care professional are believing that notes and other information written on paper is more trustworthy than when it is written in an e-Health program (Saleem et al. 2009, 623 – 624).

That workflow of a ward is also getting affected by e-Health services and programs. Paper chards of patients are easily able to take with and make notes and are able to give then immediately further to the next health care professional. While when using e-Health program, the information need to be put into the program first and then it is visible for others to read. (Saleem et al. 2009, 622.)

2.3 Future expectation

Diabetes is a well-known regular medical condition that has to do with public health issues mainly relating to severe long-term complications (Barnett 2008, 60). Considering the future of diabetes management through e-Health, there is possibility to develop medical tools that run on a constant operation and communication capabilities. Some of the most highly advanced tools are the OmniPod system, an insulin pump that gives insulin in accordance to the programmed directions transmitted wirelessly from a handheld personal

diabetes manager, and new constant glucose adjusting devices, which has the ability to communicate the glucose readings with the hand-held receiver on the other end without a physical link. (García-Sáez et al 2009, 392.)

To lower the future proportion of attrition from complications (which indicates 80% of the total expenditures spent on diabetes) then concentration to glyceamic control (as well as other significant risk associated factors) is highly essential and healthcare experts require a broad range of management options from which to select the most appropriate for individual patient (Barnett 2008, 60).

Promising future way-forward comprises wearable computers, individual digital assistants, and mobile phones as grounds for health attitudinal change involvements. Wearable computers are electronic gadgets attached to the body. Normally, wearable computer facilitate the possibility of a continuous interactions between the attached computer and the patient wearing and permits multi-parameter checking, including vital signs, biological signals, and movements. (Bellazzi 2008, 100.) Though, the future of application of the newly growing technological approaches but major barriers ahead cannot be overlooked (Barnett 2008, 60).

Examples of wearable devices are intelligent biomedical clothes that integrate electronic devices into functional clothes. Intelligent clothes, in combination with devices that has capability to return feedbacks, could give a complete system. (Bellazzi 2008,100.) The rate at which technology in diabetes is moving, it is believed to aid distant exchange of information. More so, the execution of these individual and remote control approaches needs the establishment of a robust system (in terms of hardware and software) provided with bi-directional real-time communication to facilitate distant communication with the electronic devices of the concerned patient. Nonetheless, it is important that the system itself should be capable of functioning without the aid of or interference of the public communication network. (García-Sáez et al 2009, 392.)

Though, the positive prospect of technology in diabetes continue alleviating the concerns of lots of people but despite this, lots of questions still need to be

provided answers to. Regardless of the evaluation pointing that electronic communication behavioral health change involvements can be efficient, the concerns that bother is whether these new technological idea can perfectly replace the previously used system. (Glagow et al. 2012, 81.) The undenying remains that the latest technological invention in diabetes will be majorly more costly compared to traditional insulin injections; to a lot of patients basal insulin being given by injection will still be demanded; and no amount of safety information that is prepared, it will not be parallel to the lots of decades for which these products could be prescribed (Barnett 2008, 60).

Even though teleMedicine is still swinging in-between “fading” and “future,” ICT is anticipated to come up with latest very strong tools for the execution of novel DM management programs enabled by technology (Bellazzi 2008, 102). Moreover, patients and clinicians do really need to come together as one for the purpose of empowering the patients with diabetes to take up and maintain adopt and sustain habits of health-promotion that are important to guarantee better results (Kaufman 2012, 40).

The future study in ICT for DM should focus more on coming up with latest advanced technological devices and instruments to improve the standard of teleMedicine solutions, while at the same time structuring telecommunication models capable of sustaining the health care delivery procedures more efficiently (Bellazzi 2008, 102). Looking at it from ecological angle on health attitude change, it is still not clear whether internet use and results are determined by factors such as individual features, most importantly computer literacy and health literacy and numeracy; social network/social support; and community/environmental influences (Glagow et al. 2012, 81).

In the future, it is possible to achieve context awareness through other less advanced electronic breakthrough, which would be of utmost interest in order to wirelessly incorporate sustenance into the users’ everyday lives and also to activate communication with the user, such as short message service. The accessibility of such electronic tools can make it possible to better explain the “context” in which the interaction between the patient and the health officer application occurs. (Bellazzi 2008, 100.)

INTERESTS AND CONCERNS OVER EVOLUTION OF DIABETES TECHNOLOGY

The commitment of maintaining the desired glucose control still remains a big issue to battle with for both type 1 patients and their relatives (Liberman et al 2012, 79). There are lots of worries related to the discovery of e-Health in diabetes care. From the patients' perspective, Personal Health Records (PHR) systems run jointly with healthcare providers have been backed up as a way of standardizing diabetes management and a growing subset of PHRs has also brought about the possibility of involving the patients in their individual care by encouraging self-management of the difficult behavior associated with their diabetes disease. (Benhamou 2011, 53-56.)

In most cases, patients believe they should be the master deciding their wish about their diabetes care. Lots of patients prefer a small-sized, everlasting tool. Patients suffering from diabetes prefer and anticipate "closing the loop" with a diabetes tool that will, without human intervention, supply insulin in proportion to their CGM values. (Leroy 2011, 79.) Unfortunately, diabetes management has become the master over the patient himself. Going through a severe disease that really demands careful treatment regimen indicates that the affected patient has to sustain high level of interest and devotion without even considering breaking the care half-way. (Liberman et al 2012, 79.)

It is observed that most patients do not have interest in constant active tool; they like to personally maintain the control over their diabetes problem. Their preference is a kind of tool that could be relied upon if they wish to. This may make their mind off the fact that they are diabetes patients. (Leroy 2011, 79.) Meanwhile, at this present time, adopting the latest technological devises still demands treatment decision which is still the main duty of the patient. In other words, the area of the 'human factor' in diabetes advancement remains compulsory and be handled as a matter of importance. (Liberman et al 2012, 79-80.)

The ongoing interest in diabetes technology is aimed at management of DM type II within a "specialist–GP–patient" model. The latest style is to incorporate

guiding principles and decision support systems as reminders within electronic patient records (EPR) to maintain difficult basic care interventions. (Bellazzi 2008,101.) From another angle, the ‘human factor’ is not a single issue; it combines physical, emotional and intellectual phases, comprehending non-familiar information, as well as the ‘hassle factor’ of the different devices (Liberman et al 2012, 79-80).

To most patients, having the idea that the pump is supplying insulin at bedtime is important. Hyperglycemia at bedtime needs to be corrected and knowledge that the pump is working and the site is sufficient is important skill that cannot be overstressed. (Larry & Deeb 2008, 81.) As regards insulin infusions, patients anticipate a more discreet and easy-to-use system, they normally choose a pump that is almost invisible, without tubes, but with the likelihood of working independently on the reservoir, battery or infusion set. (Leroy 2011, 78).

In addition, there is a growing interest in giving patients a direct link to their EMRs via the Internet. A randomized controlled study of 244 patients allowed the pre-visit use of online personal health records (PHRs) linked to EMRs, enabling patients to author a “diabetes care plan” for electronic submission to their physician. (Varroud-Vial 2011, 49.)

Meanwhile, the greatest expectations are naturally related to constant blood glucose monitoring (CGM) tools. However, patients’ wishes often remain unclear, simply because few numbers of them have had the chance to use the latest available tools. (Leroy 2011, 78-79.)

3 THE PURPOSE AND AIM OF THE RESEARCH

The purpose is to provide relevant information about the use of technological devices in diabetes for nurses' education .The aim is to produce evidence based material in eMedic about the benefits and barriers of technology in diabetes care among nurses.

RESEARCH QUESTIONS :

1 What are the benefits of e-Health to nurses?
2 What are the barriers of e-Health to nurses?
3 What is the future of e-Health in diabetes care?

4 EMPIRICAL RESEARCH IMPLICATION AND METHOD

E-Health is concerned with promoting the health and wellbeing of individuals, families and communities, and improving professional practice through the use of information management and information and communication technology (ICT), which is a powerful tool that enables data to be shared as never before among health care workers: providing support for clinician to be able to share and exchange information to improve outcomes, patient safety and improve service efficiency (Wallis 2011, 14).

This research is commissioned by eMedic (see appendix), which is a project funded by Central Baltic INTERREG IV A programme. The target of the project is to develop new practices for virtual consultation in medicine. The focus is on diabetes and pediatric. E-Health is expected to provide answers to the treatment of diabetes and other diseases. However, challenge is to anchor new working procedures to daily routines. E-Medic develops new technological applications and monitoring tools to increase understanding of needs and requirements of e-Health services. eMedic project has started in 2011 and it will continue until the end of 2013.(eMedicproject.eu. 2012)

According to Wallis in an article published in 2011, electronic records enable information to be shared with colleagues and patients, but staffs also need awareness of e-developments, understand the benefits of computer technology, as well as their computer literacy skills. Furthermore E-Health is involving patients to participate more actively in the decision making about their care. (Wallis 2011, 14.)

Looking at the future of e-Health, Kaufman (2012) stated that as far as e-Health is concerned, the priority is to achieve a better healthcare result. E-Health is providing a suitable ground to build easy, efficient, and real-time diabetes care programs with the accessibility of teleMedicine and cheap mobile phones which are now available across socioeconomic, gender, and age groups. (Quinn et al. 2009).

The result of this research will be published in eMedic web pages for health care Professionals (see appendix).

Literature was searched through the Turku University of Applied Sciences online Databases of CINAHL, Cochrane Library and Elsevier: Science Direct. Key words for the search were based on the PICO method for qualitative where P stands for patients/population, I for intervention, C for comparism, O for outcome. (Cochrane Library Tutorial. 2012.) Key words were diabetes, technology, or e-Health, devices or uses, nurses.

Systematic review and met-Analysis or PRISMA was adopted and used as the methodoligal framework. The PRISMA protocol was adopted based on its competence or we can say reliability of its results as it is sanctioned by an international group that included experienced authors and methodologists which developed PRISMA (preferred reporting items for systematic reviews and meta-analyses) as an evolution of the original QUOROM guideline for systematic reviews and meta-analyses of evaluations of health care interventions, and also by the Cochrane library. (Liberati et al. 2009, 1.)

A comprehensive search strategy-including three electronic databases of CINAHL, Cochrane Library and Elsevier: Science Direct was undertaken by three researchers in this context researchers were third year nursing students of Turku University of Applied sciences as their final bachelors thesis project under the supervision of Turku AMK Researchers.

At the beginning of the research topic chosen was very broad (Use of Technology and E-Health services in diabetes care in general and benefits and barriers to E-Health services among nurses) and this led to all three researchers dividing topic into three different parts from which to search for data information respectively. All three researchers had used similar methods of search and research methodology and arrived at different results respectively. Results of work done so far was later combined and screened by Turku AMK researchers which were their supervisors. Feedback was given by their supervisors based on results and work done so far amongst which a new topic was selected (use of technology in diabetes care among nurses; benefits and

barriers) and research questions were formulated. The researchers proceeded with new data search and more information on the related topic adding and summing up all new data with old ones to reach a more reliable and validated result. Finally a combination of the result from all the data found was done by the researchers and screened thoroughly under reliability and validity methodological process and a final conclusion was made after discussions which included answers to the research questions and the future of e-Health and diabetes care.

The research method used to review and select articles was systematic literature review. A systematic review method was important in the context of this study because it aims to find as much as possible of the research relevant to the particular research questions, and use explicit methods to identify what can reliably be said on the basis of these studies. Systematic reviews retrieve, appraise and summaries all the available evidence on a specific health question. They are designed to reduce the effect of the reviewers' own bias, and a full protocol should be written to define and guide the process. The appropriate resources should be in place before undertaking a review. The steps of the review are: frame the question and choose appropriate methods; identify relevant work; extract relevant data on outcomes and quality; summarize the evidence; and, interpret the evidence. Reviews that combine valid, homogeneous studies of treatments that are relevant to health care, in patients who are typical, can provide good evidence to guide health care decisions. (White & Schmidt 2005, 54.)

4.1 Search Terms

BENEFITS

A search was conducted in the CINAHL and Medline databases accessed through the portal of Turku University of Applied Sciences on the 14th and 15th October 2012 respectively. Three searches were carried using search terms e-Health, e-Health AND benefits and e-Health AND nursing. Searches were results were restricted from 2000 CINAHL and MEDLINE and both databases were searched for results until recent days search were done. At the beginning

of the search complete text yielded big amount of material which covered topics beyond the range of this thesis work.

Table 2. Search terms for benefits of e-Health

Population	Exposure	Outcome
1 nurs*	2 e-Health	5 benefits
	3 nursing benefit	
	4 e-Health benefit	
	6 combine 2,1 and 2, 5 using AND	

The search question was formed utilizing the PICO method. The PICO method is a method to formulate a good research question and was developed in Oxford (Faridi van Etten et al 2009, 95). The PICO abbreviation stands for patient or population - Intervention - Comparison – Outcomes. The PICO method is a useful mean to divide a question into searchable components. These components are searched separately and later combined. (Faridi van Etten et al 2009, 95.) In this study the question was formulated using the PEO anagram, Table 2 above shows search question formulation.

Table 3. PEO question formation

Population	Exposure	Outcome
nurse	e-Health	benefit

BARRIERS

For the search the databases CINAHL and MEDLINE were used. Both of these databases are supported by Turku University of Applied sciences. The search was carried out by using PEO anagram which is another form of using the PICO method. The word PEO is a combination of the words population as P, exposure as E and outcomes as O. (Bettany-Saltikov 2010, 51.) The keywords used for this research were nurse, e-Health and barriers.

The search was done on the 19th of October 2012 at the databases CINAHL and MEDLINE through the portal of Turku University of Applied Sciences. The years of the search were restricted from 2002 until 2012 at the CINAHL database and the year 2012 was used for search at the MEDLINE database. An open search was done for nurs*, nurse, care taker, E- healt*, E-Health, electronic health, barrier, barri* and problem. The Table 4 below shows how the search was made and categorized.

Table 4. PEO anagram for barriers.

Population	Exposure	Outcome
1 nurs*	5 e-healt*	9 barrier
2 nurse	6 e-Health	10 barri*
3 care taker	7 electronic health	11 problem
4 combine 1 + 2 + 3 using OR	8 combine 5 + 6 + 7 using OR	12 combine 9 + 10 + 11 using OR
	combine 4 + 8 + 12 using AND	

Using the PEO method helped to get a structure into the search for articles. Step 1, 2 and 3 were to make an open search with of the words nurs*, nurse and care taker which were then leading to the next step 4 what was to combine the searches by using OR. The Table 4 above clearly shows which step number is also associated with which search word. Also the option all text was used to get every possible article which contains one of the words. Step 5, 6 and 7 was to make an open search for the words e-healt*, e-Health and electronic health which also included the all text option and were combined by using OR which was step 8. The step 9, 10 and 11 was to search for barrier, barri* and problem in all text format and combining them with OR then in the 12th step. Step 13 was to combine the steps 4, 8 and 12 by using AND. After step 13 every search was then limited to the years. For CINAHL it was from 2002 until 2012 and for the

MEDLINE database only the year 2012 was used. Every step was done the same way in both databases.

FUTURE EXPECTATIONS

A search was carried out in CINAHL and Elsevier: Science Direct databases through the Turku University of Applied Sciences portal and the end of January (25), (26), (27) 2012 respectively using open ended terms nurse", diabetes, technology, or e-Health, devices or uses, nurses". Searches were made randomly on a general level and then later restricted by dates from 2008 - 2012 in both CINAHL and Elsevier: Science Direct. Table 5 shows the search stream.

Table 5. PICO anagram for future of e-Health (Cochrane Library Tutorial 2012).

Population	Intervention	Comparism	Outcomes
1 Nurses*	2 Diabetes	3 Technology	4 Uses
General overview		5 e-Health	6 Devices
			7 education
5 combine 1+2+3+4+e-Health using OR.			
6 combine 1+2+3+4+5+devices+education using OR.			
7 combine 1+2+3+4+6+7 using AND.			

The terms for the strategy were formulated using the PICO diagram for qualitative research (Cochrane Library Tutorial, 2012) and the following free-text terms or MeSH terms and their combinations:

Database search: refined phase 2

Step 1 identified all text using the search term nurse* as the main target population of the research, and "general overview" to gather a wider range of information about the min target and main subject. Step 2 searched the for the term "diabetes" as the main subject pertinent to the study. Step 3 searched the

term “technology and e-Health” as focus of the subject matter, both terms were used as it is now widely seen that they both refer to same issues but by different names. Step 4 searched the terms “uses end devices” as a means to get general knowledge on the main subject issue and target group of the research. Step 5 combined steps 1, 2, 3 and 4 with the integer OR. Step 6 included the open ended word “education” as part of search to signify the outcome and arrive at result to research question. Finally all steps were combined using the integer AND. Results are show in Table 10, Data base search results.

4.2 Selection of articles

BENEFITS

CINAHL database search returned 63 articles for the search term e-Health, 18 articles included the e-Health benefits but in different domains beyond the range of this research, 5 articles were specifically covering the question of this research but 2 were included as they were full text. The same search term was used in MEDLINE database yielded 62 articles with 37 included e-Health applications in several different areas, 1 article was chosen.

In the third search the search the term e-Health AND benefits searched in CINAHL and it returned 5 articles, 1 was chosen as full text and covering the research question. Furthermore, a fourth search term e-Health AND nursing was utilized in CINAHL and it returned 12 articles, 1 full text were chosen. The Table 6 below shows the search results

Table 6. Database search results for Benefits

Database with dates	Date of search	Number of search results	Number of Duplicates	Number of articles eligible by primary inclusion criteria	Number of articles eligible by secondary inclusion criteria	Number of full content articles available
CINAHL (2000-2012)	13.10. 2012	80	18	18	8	4
MEDLINE (2000-2012)	14.10. 2012	62	9	37	3	1

Screening mechanism was designed to determine whether the article was eligible under criteria made to determine the suitability to answer the research question. Eligibility inclusion criteria were based on the PEO search anagram to report the exposure reported by the population of nurses concerning exposure of e-Health. Inclusion and exclusion criteria are outlined in the Table 7 below.

Table 7. Inclusion and exclusion criteria for benefits search

Inclusion criteria	Exclusion criteria
I. Academic journal	I. Title
II. Reference availability	II. Abstract
III. Full text	III. Discussion
IV. E-Health benefit in nursing work	IV. Articles of e-Health benefit in other domains than nursing

BARRIERS

Table 8. Database search results for barriers

Database with dates	Date of search	Number of search results	Number of Duplicates	Number of articles eligible by primary inclusion criteria	Number of articles eligible by secondary inclusion criteria	Number of full content articles available
cinahl (2002-2012)	19.10.2012	27	0	7	5	1
medline (2012)	19.10.2012	262	41	44	14	4

The Table 8 above gives information about the database search results. All together in the search for the barriers, there were 289 articles found. For finding most relevant and useful articles for this review there were primary and secondary inclusion criteria. After putting duplicates away, there were 248

articles left. Through the primary exclusion criteria which were English language, used from school database, the limitation of years and title being related to search the articles left were 51. Then the secondary inclusion criteria were that articles were qualitative and quantitative articles, latest released articles and abstract was available and contain relevant information according to the research question. After applying these criteria 19 articles were left. The last point was to control which of these articles had the option full text available. After checking that point, only 5 articles were left which are able to answer the research question.

Table 9. Inclusion and exclusion criteria for barriers search

Inclusion criteria	Exclusion criteria
I. Articles should be provided from school database II. Articles language should be English III. Articles should be published IV. between 2002 – 2012 V. Latest released articles were preferred, oldest release year 2009 VI. Qualitative and quantitative VII. Articles related to research question VIII. Full text	I. No full text or abstract available II. Duplicates III. No information related to research question IV. Older released articles were excluded V. Articles not from school databases

FUTURE EXPECTATION

Table 10. Database search future of e-Health

Database with dates	Date of search	Number of search results	Number of Duplicates	Number of articles eligible by primary inclusion criteria	Number of articles eligible by secondary inclusion criteria	Number of full content articles available
CINAHL (2008-2012)	27.01. 2012	650	176	72	20	9
ELSEVIER:SCIENCE DIRECT. (2008-2012)	28.01. 2012	510	149	90	20	11

The search yielded 1160 results (Figure 1), from both CINAHL and Elsevier Science direct databases and it was decided to further limit the search in the following way: review papers in English from 2005–2012 and full-text articles, which was the criteria for inclusion. The repeat search yielded 810 articles in total after which 350 articles which were duplicates were excluded and the search were further limited to review articles: 648 results. Of these, 162 papers were selected by title, of which 20 papers were included by abstract, and the full text and a final 6 articles which were most relevant in providing answers to the research question were selected each paper was examined and screened in a two stage process by one of the student researchers or reviewer. This is illustrated above in Table 10. Data collection criteria Table 11 and Figure 3 the PRISMA flow chart.

Table 11. Inclusion and exclusion criteria for future of e-Health search

Inclusion criteria	Exclusion criteria
I. Must be extracted from authorized Turku AMK academic databases e.g. CINAHL and Elsevier: Science direct	I. Articles be based on biased analysis
II. Literatures' objective must be related with the objective of the study	II. Articles with publication year below 2004 except for Sönksen, P. & Williams, C. 1996.
III. Articles with full texts and abstract	III. Articles without abstract and full text
IV. Data publication year should be from 2005-2012	IV. Articles not from academic database
V. Most of articles used are peered reviewed.	V. Articles from centralized search engines e.g. Google search
VI. Text must be in English language	VI. Articles with benefits and barriers of e-Health
VII. Qualitative and quantitative research articles.	

4.3 PRISMA flow chart

BENEFITS

According to (Aveyard 2010, 71) researcher needs to develop a strategy for managing literature to enable quick identification of literature that is related to research question (Aveyard 2010, 70). This method was utilized in finding relevant material. The titles and abstracts of the search were screened in tow stage process explained in the PRISMA flow chart below in Figure 1.

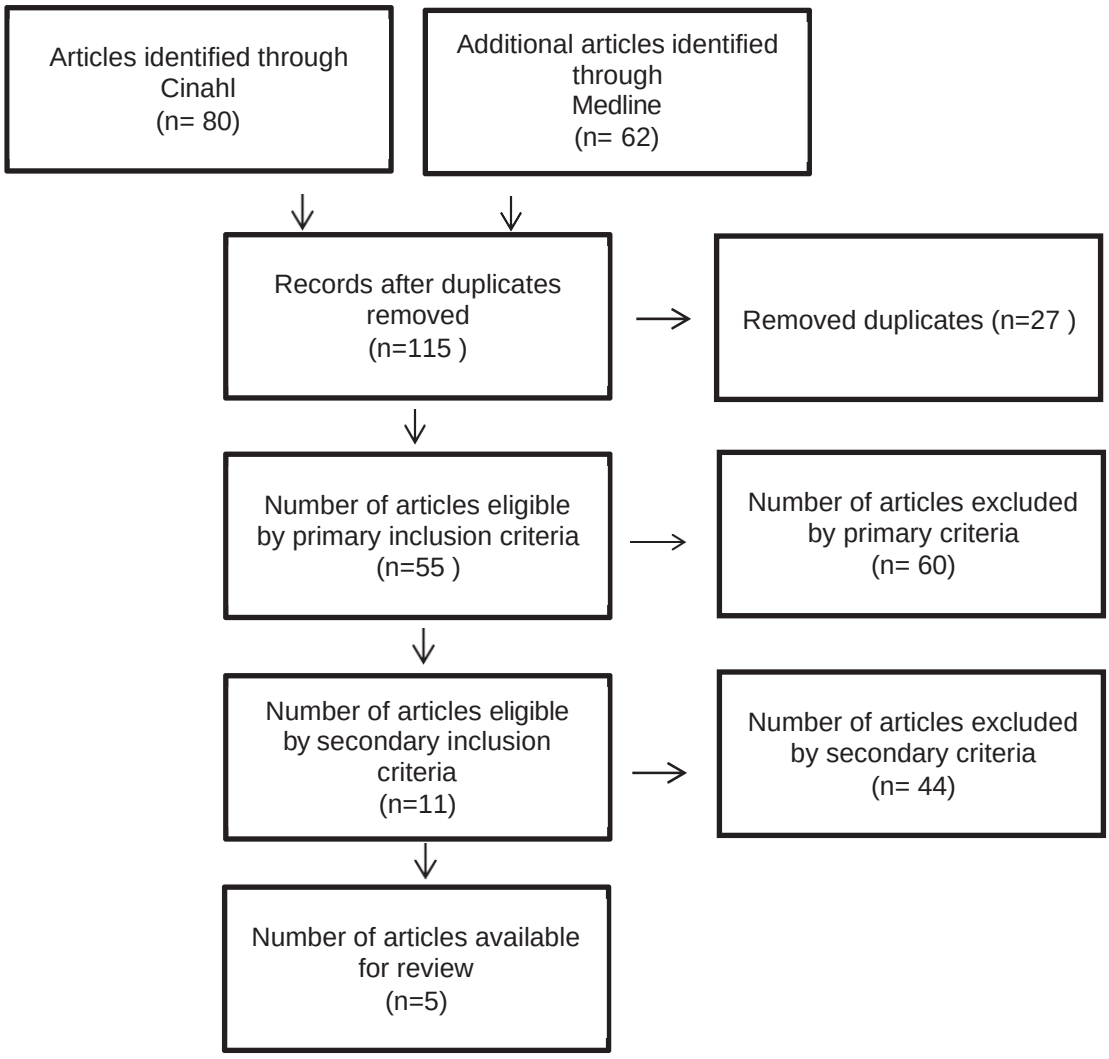

Figure 1. PRISMA Flow chart about the benefits (Móher 2009).

BARRIERS

After the articles have been limited to the right years the total amount at CINAHL database were 27 articles which didn't contain any duplicates. At MEDLINE 262 articles were found but 41 duplicates were also contained in that search. After removing all the duplicates a total amount of 248 articles were then screened by title and abstract in a 2 step progress. The figure below of the Prisma flow chart gives a clear overview of selected and excluded articles visible to see above in Figure 2. At the first step progress, it was screened for that the articles would be in English and that the title of the article would fit according to the research question. In total 51 articles where selected while 197 were excluded because they didn't fulfill the criteria. The second step was then

to screen through the abstract of those 51 articles which were left. If they contained information which was relevant to help to answer the research question, they were selected. Out of 51 articles there were 19 which got selected and 32 were excluded. It was carefully reviewed that articles would have to deal with nurses, e-Health and barriers.

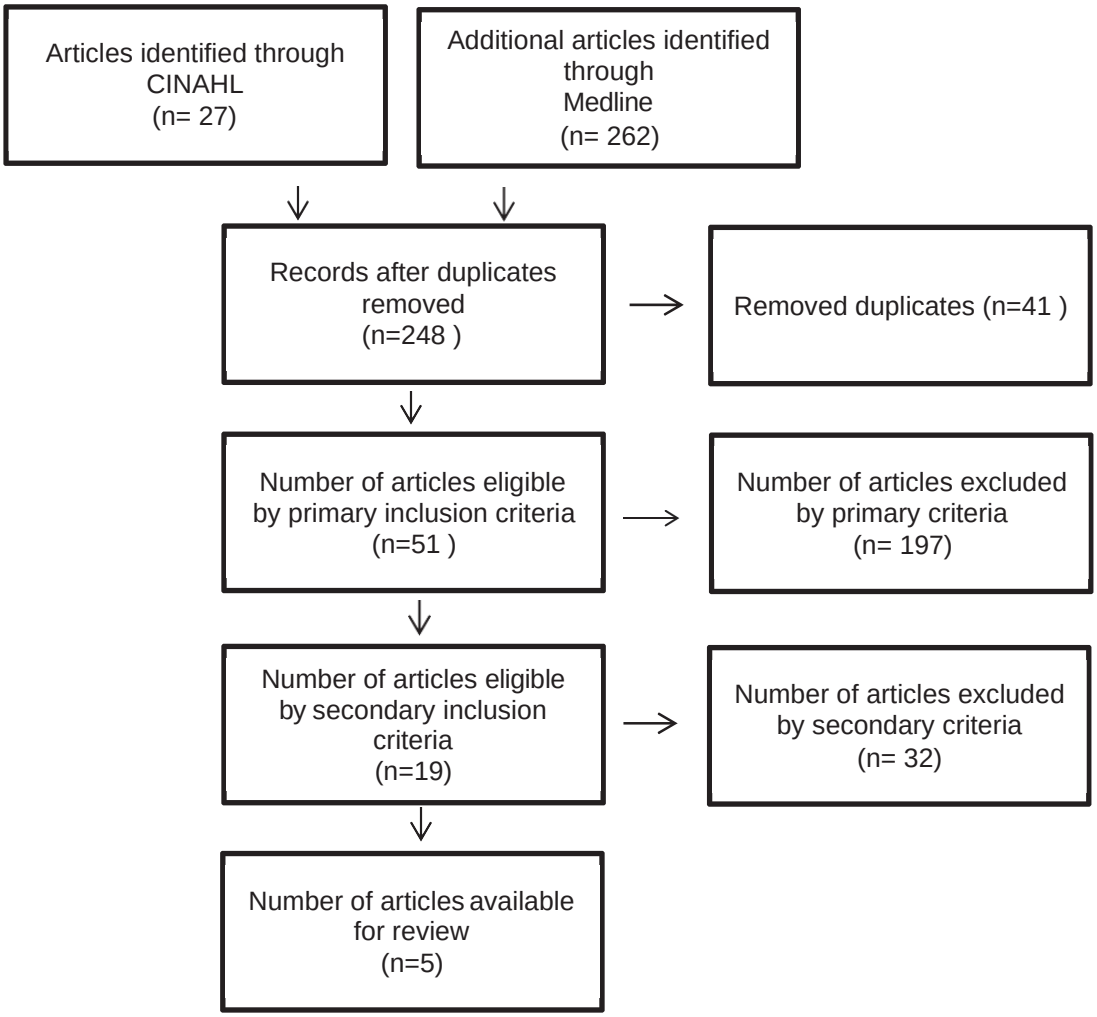

Figure 2. PRISMA Flow chart about the barriers (Mòher 2009).

FUTURE EXPECTATIONS

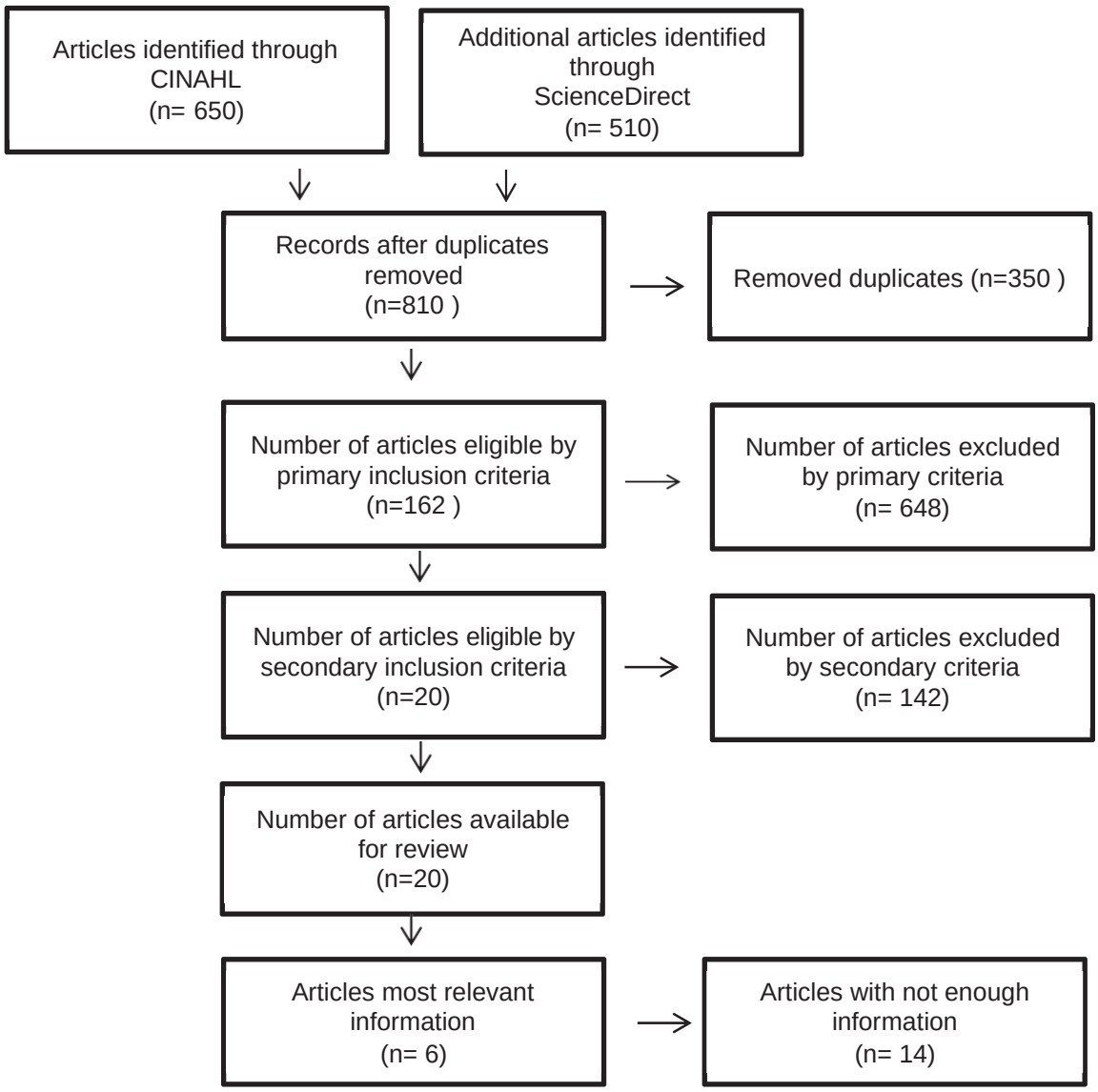

Figure 3. PRISMA flow chart about the future of e-Health (Oermann et al 2010, 351).

The first round of screening determined whether the articles were eligible for the project were under the criteria designed to determine the suitability of the methodology to answer the research question. The research articles that were empirical and peer reviewed were eligible by primary inclusion. Primary exclusion articles included those that were not published in English, theoretical, or position papers and systematic literature reviews. Systematic literature reviews were excluded because it was considered important to access primary,

raw data that was unsynthesized in order to adequately provide the right answers to the research question.

The first round of screening also reduced the CINAHL pool of articles to 72 and that of Elsevier: Science direct pool of articles to 90. The second criteria for screening concerned the research content and whether it was likely to contain information pertinent to the research question and provide adequate answers. The eligibility inclusion was based on the PICO search anagram that the results was likely to report the details of the search words and how they were interrelated in order to provide the answers needed for the research question. Secondary exclusion criteria included those articles containing the benefits and barriers of e-Health to nurses since the autonomy of the topic has already been limited to a particular search framework and those part of articles were already been reviewed by two other reviewers for this same project, therefore it was important to concentrate on the subject issue and target population on what were the outcomes of the comparisms Figure 3 above gives a good overview how the screening was done.

5 RESULTS OF THE REVIEWS

A total of 16 data were available for the final review for all the research questions. For benefits of e-Health five articles were available for the research and they were put into preliminary analysis. Articles are summarized in the Table 12 below

For barriers of e-Health 5 data got selected which were screened by the criteria and had relevant information for answering the research question. Main information about the articles will be given in the Table 13 below.

Finally for the future expectations of e-Health a total of 20 data (in this case the data were the articles) were available for the research which was later reduced to 6 data with the most relevant answers to the research question and underwent a review process all of which were subject to a preliminary analysis. The Table 14 below summarizes the results.

Table 12. Overview of the results for articles about benefits of e-Health

Author(s)	Year	Title	Method	Sample	Results/ Conclusion
Ann Casey et al	2011	Effective communication: principle of nursing practice	Qualitative study. Nursing standard	n=23	Information that is accessible, accurate and acceptable should be shared actively and consistently
Hucklave et al	2010	Information technology for patient safety	Qualitative study. investigative report	n= 37	Data completeness is an important safety issue in its own right
Judy, M et al	2011	Nursing Informatics. Engaging Patients and Families in e-Health.	Qualitative study. E-Health	n=7	Utilize the information health IT provides to improve the quality, safety and cost effectiveness of health care in the United States.
Pauline, J et al	2011	Experience of using a personal digital assistant in nursing practice - a single case study.	Qualitative study case study, open-ended interview	n=26	The incorporation of multifunctional PDA is an important issue for nursing management
Ruth Kidd	2011	Benefit of mobile working for community nurse prescribers	Qualitative study. Exploratory purpose sampling	n=6	For nurse prescribers in particular, several specific and interlinked benefits have emerged

Table 13. Overview of the results for articles about barriers of e-Health

Author(s)	Year	Title	Method	Sample	Results/ Conclusion
Edirippulige, S. et al	2009	Pre-registration nurses: an investigation of knowledge, experience and comprehension of e-Health	cross-sectional survey questionnaire	n = 56	Majority uses computer, but the awareness of and knowledge with regard to e-health care was limited.
Ersher-Kohle, A. et al	2012	Evaluating the Barriers to Point-of-care documentation for nursing staff	questionnaire, workflow survey	n = 24	Nurses don't recognize the Point-of-Care documentation as valuable.
Laramee, A. S. et al	2012	A comparison of nurse attitudes before implementation and 6 and 18 months after implementation of an electronic health record	pre-survey and post-survey design	pre-survey: n = 312, 6 months: n = 410, 18 months: n = 262	Nurses' attitude towards e-Health services didn't change much.
Leblanc, G. et al	2012	Determinants of primary care nurses' intention to adopt an electronic health record in their clinical practice	questionnaire	n = 102	Training and practice places should be available for nurses and they should also get encourage by supervisors.
Wallis, A.	2012	Survey explores nurses' use of e-Health tools	survey	n = 1313	Progress in overcoming barriers but there should be still more progress done.

Table 14. Overview of the results for articles about future of e-Health

Author(s) & year	Titles	Aims of the study	Method of data collection	Samples	Results/ Conclusion
Belazzi. R. 2008	TeleMedicine and Diabetes Management: current challenges and future research directions	To discuss current problems due to adoption of teleMedicine and possible IT solution	Review and observation	None	Low adoption of teleMedicine, low clinical outcomes of teleMedicine and high need for more research into teleMedicine
Benhamou. P. Y. 2011	Improving diabetes management with electronic health records and patients' health records	To examine how patient engagement and clinical inertia improves diabetes care	Review and observation	None	Electronic health records improve diabetes outcome with enhanced education, patient support and reduced clinical inertia
Garcia-Saez. G. et al. 2008.	Architecture of a wireless personal assistant for teleMedical diabetes care	To describe architecture, functionality and implementation of latest diabetes tools	Questionnaires	Questionnaires	It is perfect for personal assistant's usability & utility and will be more appreciated in the future as patients have more trust in it.
Leroy. R. 2011	What do patients with diabetes and diabetologists expect from the new technology	To examine both patients diabetologists and suggest what to be expected	Review and observation	None	Patients should expect better care while diabetologists should hope for positive evolution in their work

Table 14. Overview of the results for articles about future of e-Health (continuation)

Author(s) & year	Titles	Aims of the study	Method of data collection	Samples	Results/ Conclusion
Liberman A. et al. 2012	Technology and the human factor	To examine how human problems affect use of technology	Electronic record analysis	N=1622	Human factors, adherence, lack of motivation, low quality of life affect technological evolution.
Varroud-Vial. M. 2011	Improving diabetes management with electronic medical records	To look into how EMRs can impact diabetes care compare to manual system	Review and observation	None	e-Health has potentials to improve quality, safety & outcome of diabetes care

5.1 Review process Content/Data analysis)

In other to make valid references, strategies were used to identify the relevant ideas in the articles which are in line with the research questions. Providing answers to research questions majorly depends on the analytical approach used in drawing valid conclusion from the selected articles or text (Krippendorff 2004, 18). In reviewing the content of data, content analysis as a research methodology were used as it that enhances arriving at replicable and reliable conclusions from data to their context, with the aim of giving knowledge, latest insights, presentation of facts and a practical guide to action. Main objective of it is to arrive at a collective and wider view of the phenomenon while the result of it is the idea or classes explaining the phenomenon. (Elo & Kyngäs 2007, 108.)

BENEFITS

The remaining review articles were put to through content analysis in order to extract the data from the text. Articles were read and reread carefully, codes highlighted to identify themes and sub-themes. Furthermore, all identified data were summarized in categories (O'Hara et al 2011, 220). For this research the data unit of analysis were groups, objects and individuals and the common relationship between these units was the experience of benefits from e-Health tools and applications. Five articles were coded to organize data into categories (Klenke 2008, 92). As been presented in the background of this research there are various benefits associated with the introduction of e-Health tools in nursing. For the purpose of identifying these benefits from the articles these benefits are reported by nurses and nursing field experts.

Table 15. Articles coding

Author & year	Code
Casey et al 2001 (1)	The National Patient Safety Agency identified communication difficulties as a major factor affecting patient outcomes. Particular concerns included unclear documentation and nurses not being clear and confident in their reporting. Information that is accessible, acceptable and accurate, and that meets patients' and clients' needs, should be shared actively and consistently. Staff should communicate effectively with each other to ensure continuity, safety and quality of health care for all.
Johansson 2011	The recent radical increase in the availability of health-related knowledge implies that nurses handle large amounts of information, thus generating the need for useful information communication technology (ICT).
Judy, M 2011 (3)	One way we can do that is to encourage our patients to actively use technology to manage their own health care and to share information with their health care providers.IT systems can enable software that puts patients and their families at the centre of their own care, empowering and engaging them in reaching their health goals.
Ruth Kidd 2011 (4)	Potential benefits of mobile solutions, ranging from improved work-life balance, as a result of increased flexibility in working hours and locations.
Christopher et al 2010 (5)	One of the aims of the EPR is to tackle issues of data completeness. Data completeness is an important safety issue in its own right.

Table 16. Themes and Sub-Themes

Unit of analysis	Sub categories	Categories
1) Nurses and nursing staff are at the heart of the communication process: they assess, record and report on treatment and care, **handle information sensitively and confidentially, deal with complaints effectively, and are conscientious in reporting the things they are concerned about.** **1) Nurses are required to maintain up-to-date and accurate records of assessments.** **5) There are good theoretical reasons to believe that Computerized Decision Support Systems (CDSS) can contribute to patient safety**	Contributors to safe practice	Patient safety
2) A device that is easy to have at hand is a Personal digital assistant (PDA). **A PDA can contain the information nurses need in their daily work and is up-to-date with current information.** **Nurses improved their skills and awareness of research evidence when accessing information resources via a PDA. PDA requires improved content and more functions.** **Nurses improved their skills and awareness of research-evidence when accessing information resources via a PDA.** **4) For nurse prescribers in particular, several specific and interlinked benefits have emerged.** **4) Devices have greatly increased the speed at which nurse prescriber can complete administrative tasks related to the care they give.**	Improved service level	Efficiency
4) devices has had a significant effect on the ability of service teams to work together and co-ordinate care provision **The devices have helped clinician change their working patterns in many ways.** **4) Since information is accessible wherever a network connection can be made, many mobile practitioners can now begin and end shifts at home**	Cost effective	Cost

BARRIERS

The 5 remaining articles from the search were then going to be analyzed for relevant information to answer the research question. All of them are giving information on barriers of e-Health among nurses. The articles were read several times and beneficial information was marked and later the given information was made up into categories to give an overview about the barriers in e-Health among nurses. 2 articles were talking about nurses' attitude and skill in e-Health services and programs while the other 3 articles also had already specific barrier groups of e-Health. All together 6 groups of barriers were found, which were general knowledge about E-Health; accessibility; Information Technology (IT) skills; nurses' age and work experience; security and patients' reaction.

FUTUR EXPECTATIONS

In total, twenty articles were given priority in the whole study, but eleven of them have links with the third research question while only six articles specifically answered the question. The rest of the articles played better roles in background information and discussion part which is equally important to the study. How these articles are eliminated in stages is further discussed. The articles of

During the analysis of the contents, three classes evolved 'the past', 'the present' and 'the future'. Evolution of these classes was as a result of the contextual format adopted in the background of the study. Three articles (Deeb. L.C. 2008; Sonksen. P & Williams. C. 1996 & Ratheau.L. et al. 2011) discussed the past of e-Health technology. Garcia-Saez. G. et al. 2008; Peeples. M & Seley. J. 2007; Azar, M & Gabbay, R. 2008, accessed present situation while Liberman A. et al. 2012, Barnett, A. 2008; Leroy, R. 2011; Varroud-Vial, M. 2011; Belazzi, R. 2008; Benhamou. P. 2011 & Garcia-Saez, G. et al. 2008, concentrate their study on the e-Health today in relation to its future prospect.

To further minimize the articles that fall into these three classes, the reviewer decided to use content analysis as an analytical tool. In content analysis, themes need to be derived to serve as a point around which all the relevant or needed points would revolve. According to Methodology manual (2012, 2),

quality of content analysis is favored by the nature of the developed themes and direction in which questionnaire will take has a lot to do with the formation of the questions.

Answering the third question of the research “what is the future of e-Health in diabetes care?”, two themes that were developed are: ’growth trend’ and ’the future forecast for e-Health’ in diabetes management.

The reason for choosing these themes is that both of them have strong connection with the e-Health in diabetes management as regards the content of the selected articles. Also, the two themes form a kind of link between the three classes that were previously evolved. Growth trend describes the rate at which a technology develops, spreads grows or accepted by the people over a period of time, while future forecast is the prediction of the level that e-Health would possibly attain in the future, considering the level it has attained from the past till the present.

While analyzing the contents, the focus was majorly to extract the facts from the body, results and conclusions reached in every article as regards the future of e-Health. It was revealed that Deeb, L. (2008) only studied how e-Health technology grew in the last 30 years. Likewise, Sonksen. P & Williams. C. (1996) assessed the use of computer-based record for diabetes in the last 23 years. These two researches were not purposely carried out to predict the future of e-Health, they were therefore removed in the process. The study of Ratheau. L. et al. (2011) was also removed from the analysis, on the ground that, the survey studied how technology has changed diabetes management. It analyzed how technology has revolutionized diabetes management with more emphasis only on glucose management techniques but not on communication techniques and futuristic aspect of it. This seems to be too narrow and hereby eliminated.

One out of the three articles that discussed the present state of e-Health was included in the process. The included study is the work of Garcia-Saez. G. et al. (2008), that gave extensive details about the architectural design of a wireless personal assistant for tele-medical diabetes care and its possibility to influence

diabetes management in the future. The other two studies: Peeples. M & Seley. J. (2007); Azar, M & Gabbay, R. (2008) were taken out. The reason is that, their main discussions are found as minors in some other included articles. The former only expatiated on people's access to coordinated care while the latter discussed how a web-based management care failed to achieve the required objectives.

The other five articles that were considered to have provided answers to the third research question are: Belazzi, R.(2008); Liberman, A. et al.(2012); Varroud-Vial, M. (2011); Benhamou, P. (2011); Leroy, R. (2011). The content of these articles were more focused on what e-Health has to offer in the future based on the observation derived from the past and the present available facts. They considered the impact that e-Health has already made in relation to its growth trend to predict what e-Health technology has in the future.

5.2 Appraisal process

Analysis of data involves a number of critical stages, right from selection of relevant literatures to analytical process of their contents. After using content analysis to pin down the salient points in the relevant articles used in this research work, it was also essential to subject the most six relevant articles into scrutiny of CASP appraisal questions process. In appraising the rigor of research students may follow an evaluative framework such as CASP (2006) which was generated in the United kingdom to develop an evidence-based approach in health and social care, to analyze the value of the research in relation to the methodological rigor and strength of the evidence (Knowles & Gray 2011, 390.) CASP appraisal is not a criteria for inclusion or exclusion process and does not necessitate formation of classes and themes, it is only meant to further explore the relationship that exist between the features of each of the most six relevant articles with the objective of the research work.

In a CASP appraisal screening process, already made questions were tabulated against the most relevant six articles to quantitatively measure their qualitative values in relation to the direction of the study. Value of each article is rated on a scale of one to eleven (1 - 11) and one to ten (1-10) respectively as appraisal

score, which is derived from the number of question used by reviewers. The result of this appraisal score can then be figuratively interpreted. Table 4 below shows questions listed for appraisal and each article was graded a value score to signify its relevance to the criteria.

Table 17. CASP appraisal questions and results for benefits

Question	Casey 2001	Pauline 2001	Judy 2011	Kidd 2011	Christopher 2010
Was there a clear statement of the aims of the research?	Y	Y	Y	Y	**Y**
Is the qualitative methodology appropriate?	Y	Y	Y	Y	**Y**
Was the research design appropriate to address the aims of the research?	Y	Y	Y	Y	**Y**
Was the recruitment strategy appropriate to the aims of the research?	Y	Y	Y	Y	**Y**
Were the data collected in a way that addressed the research issue?	Y	Y	N	Y	**Y**
Has the relationship between the research and participant been adequately considered?	Y	Y	Y	Y	**Y**
Have ethical issues been taken into consideration?	Y	Y	Y	Y	**Y**
Was the data analysis sufficiently rigorous?	Y	Y	Y	Y	**Y**
Is there a clear statement of findings?	Y	Y	N	Y	**Y**
How valuable is the research	Y	Y	Y	Y	**Y**
Appraisal scores	**10/10**	**10**	**8/10**	**10/10**	**10/10**

Table 18. CASP appraisal questions and results for barriers

Questions	Edirippulige S. et al	Kohle-Ersher, A. et al	Laramee, A. S. et al	Leblanc, G. et al	Wallis, A.
Is the study relevant to your research question	Y	Y	Y	Y	Y
Does the paper address a clearly focused issue	Y	Y	Y	Y	Y
Is the choice of a qualitative method appropriate	Quantitative method	Quantitative method	Quantitative method	Quantitative method	Quantitative method
Was the author's position clearly stated	Y	Y	Y	Y	Y
Was the sampling strategy clearly described and justified	N	Y	Y	Y	N
Was there an adequate description of the method of the data collection given	Y	Y	Y	Y	N
Were the procedures for data analysis/ representation described and justified	Y	Y	Y	Y	N
Are the results credible	Y	Y	Y	Y	Y
Can the results be applied to the local situation	Y	Y	Y	Y	Y
Were all important outcomes/results considered	Y	Y	Y	Y	Y
Accept for further use as qualitative study evidence	N	N	N	N	N
Appraisal score	8/11	9/11	9/11	9/11	6/11

Table 19. CASP appraisal questions and results for future of e-Health

Questions	Belazzi. R. 2008	Garcia-Saez. G. et al. 2008.	Liberman A. et al. 2012	Varroud-Vial. M. 2011	Benhamou. P. Y. 2011	Leroy. R. 2011
Is the study relevant to your research question	Y	Y	Y	Y	Y	Y
Does the paper address a clearly focused issue	Y	Y	Y	Y	Y	Y
Is the choice of a qualitative method appropriate	Y	Quantitative method used	Quantitative method used	Y	Y	Y
Was the author's position clearly stated	Y	Y	Y	Y	Y	Y
Was the sampling strategy clearly described and justified	N	Y	Y	Y	Y	N
Was there an adequate description of the method of the data collection given	N	Y	Y	N	Y	Y
Were the procedures for data analysis/ representation described and justified	Y	Y	Y	Y	Y	Y
Are the results credible	Y	Y	Y	Y	Y	Y
Can the results be applied to the local situation	Y	N	Y	Y	Y	Y
Were all important outcomes/results considered	Y	Y	Y	Y	Y	N
Accept for further use as qualitative study evidence	Y	N	N	Y	Y	Y
Appraisal score	**9/11**	**8/11**	**10/11**	**10/11**	**11/11**	**9/11**

keys: Y = Yes N = No C = Can't tell

6 RESULTS TO RESEARCH QUESTION

BENEFITS

In the present time healthcare institutions are information rich institution in which timely information is voluble resource for planning and monitoring services besides healthcare information systems are useful tool to make In the present time healthcare institutions are information rich institution in which timely information is voluble resource for planning and monitoring services besides healthcare information systems are useful tool to make healthcare delivery effective and efficient(Hernandez 2009).

Patient safety in care setting requires effective communications. Information that is accurate and acceptable besides meet client and patient demands must be shared actively and consistently. Staffs have to communicate effectively between themselves to ensure safety, quality and continuity of healthcare for patient and clients. (Casey et al 2011, 35.)

Patients and clients perceptions of safety are important for several reasons. First, health-care policy leaders have been encouraging patients and families to take a proactive role in ensuring patient safety therefore, an understanding of how patients define safety is needed. Second, consumer perceptions of safety could influence outcomes such as trust and satisfaction or compliance with treatment protocols. Finally, consumer perspectives could be an additional lens for viewing complex systems and processes for quality improvement efforts (Rathert at al 2012, 23).

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BARRIERS

By reading carefully through each of the chosen articles; factors that affecting nurses and other health care staff member of using E-Health services and programs were identified. The major barriers of E-Health services and programs are the general knowledge about E-Health; accessibility; Information Technology (IT) skills; nurses' age and work experience; security and patients' reaction.

In several articles it was mentioned that nurses wouldn't have gotten enough information on Information and communication technology (ICT) would become an important tool in health care (Wallis 2012, 14). Nurses note that they should get enough information about ICT and also get consulted when new systems are being used at their work place, but they feel they still would be gotten informed too little (see Wallis 2012, 16). Also in the article "Pre-registration nurses: an investigation of knowledge, experience and comprehension of e-Health" results showed that most of nursing students are not having enough knowledge about the term E-Health in general, but they knew the terms "online health" and "electronic health records". They also mentioned that their knowledge is so low because not enough practice and training was done in that area and so they were not aware of how important E-Health as tool can be for work. (Edirippulige et al. 2009, 80.)

lso the accessibility was a major barrier for several nurses. Nurse students mentioned that the access to E-Health services and programs are easier at home and at university (Edirippulige et al. 2009, 80). Nurses note that they daily use the computer, but the accessibility is a major problem. Most have to share a computer with several colleagues, which lead also to the problem that they even

have to wait to gain access. Nurses may also experience an unequal level for getting access to computers. (Wallis 2012, 17.)

Also the lack of IT skills was a barrier that affected nurses to work with electronic health services and programs. Nurses noted in a survey that was done in Australia by Eley et al that their poor IT skills also affect their quality of work (Wallis 2010, 16).

Nurses' age and work experience also have been a major impact on nurses' attitude for using computer and other technology devices. It is affecting specially those nurses which are already older than 50 years and those who have already working experience of more than 5 years. Additional training would be needed for those nurses to ensure a positive adoption of E-Health services and programs. (Laramee et al 2012, 528.)

Nurses are also aware how secure it is to use those E-Health services and programs. Other nurses also might easily get access to information of patients with whom they are not dealing. The staff should be educated by employer about the patient's confidential requirements. (Wallis 2010, 18.) Nurses should also put patients' responses into consideration when using electronic documentation in patient's room. The patient might feel upset. (Kohle-Ersher 2012, 129.)

FUTURE EXPECTATIONS

After thorough review process of the articles, considering lots of criteria, the researcher reached the following conclusions and the opinions which in this context has emerged as the results or answers to the research question "what is the future of e-Health in diabetes management?"

With the immeasurable improvement and care e-Health is offering in the world of diabetes management, it is crystal clear that it has further potentials to improve quality, safety & outcome of diabetes care in the future as well (Varroud-Vial, M. 2011). Application of electronic health records has been successful and the rate at which it is being utilized among the health care officers to save time, protect data and facilitate easy and fast data sharing is

tremendous. It is as well believed that electronic health records still have a more responsible role to play as experts continue to add more features to the software, with enhanced education of the healthcare officers, patient support and reduced clinical inertia (Benhamou, P. 2011)

According to Garcia-Saez, G. et al. (2008), with the architectural design of the wireless personal assistant teleMedical diabetes tool, more of its advantage will be known by the time patients and health workers get exposed to it. Health workers would appreciate it even more in the nearest future as new technology comes with new faces that could definitely bring out the hidden potentials of the health workers. Belazzi, R. (2008) identified low level of teleMedicine adoption, low clinical outcomes but emphasized the need to start adopting it now in our system in other to secure a better future in the diabetes care advancement.

The suspected barriers to adequate future realization of e-Health are observed by Liberman, A. et al. (2012). It was noted that human factor such as adherence to old system, lack of motivation and low quality of life could possibly hinder technology evolution but with education, motivation and assurance, it can be overcome. Likewise Leroy. R. (2011) in his work rooted in ‘what do patients with diabetes and diabetologists expect from the new technology’. He however offered suggestion that patients in their own capacity should expect better care as the evolution of latest technology is mostly to their advantage while diabetologists should also hope for positive changes in their work.

7 DISCUSSION

This research is sponsored by eMedic, which funds projects with focus on environmental health care and diabetes management “eMedic is a project co-financed by the Central Baltic INTERREG IV A Programme 2007-2013. Programme funds cross-border cooperation projects with a focus on environment, economic growth as well as attractive and dynamic societies”(eMedicproject.eu. 2012).

Throughout this study researching the benefits of e-Health tools and applications in nursing work was evident and outlined in different areas of within the nursing practice. There is a considerable interest in exploiting the potential of digital solution to enhance the quality and safety of health care (Ashly et al 2001, 2). E-Health has been described as the single most important revolution in health care since the advent of modern medicine and public health measures (Silber 2003).

Furthermore, e-Health is concerned more with empowering, facilitating and promoting health and well-being of individuals and communities besides enhancement of professional practice through the use of information management and information and communication technology (rcn.org.uk). Patient safety in different care settings in particular has received tremendous enhancement by the introduction of e-Health tools and applications.

E-Health services and programs are becoming more and more important in health care. By reading through several significant and informative researches for this study a lot of barriers were found and most of the researches mentioned the same. Wallis notes that barriers are still the same and that nurses’ IT skills, knowledge and accessibility are still the main concerns in applying e-Health services to hospitals. (Wallis 2012, 19).

Also the absence of appropriate education of e-Health services in universities and hospitals is affecting the attitude of nurses and student nurses. Edirippulige, S. et al note that the lack of education about e-Health is a serious topic and that

nursing students are not aware that e-Health will play in important role in their life in the future as nurse. (Edirippulige, S. et al 2009,81.)

The objective behind development of e-Health in diabetes management is to better health care management and to guarantee longer and healthy lives, which is one of the major aims of eMedic project. In the process, the efforts to arrive at this objective faced some challenges and criticism on its way. Though, it is established in the study carried out by Ratheau et al. (2011) that e-Health development in diabetes care have gone a long way in achieving near normal glycaemia and also prevents severe complications which might arise as a result of suffering from diabetes, yet, Bellazzi (2008) sees e-heath swinging in-between ‘’fading and future’’ considering the criticism and attack e-Health is receiving from some patients and health workers.

Diabetologists normally show certain fears whenever a latest technology is introduced, especially in the aspect of trustworthiness and protection, the reason being that diabetologists are compelled to see beyond the importance of that tools. The future of this technology and how it could affect some other aspects of health such as patient-health care workers interaction need to be taken into consideration. Leroy (2011)

Regarding the relationship between patient and healthcare workers, Liberman et al (2012) and Varroud-Vial (2011) in their analysis agreed that latest information technology has contributed immensely to the welfare and control of diabetes, but did not explain how it has impacted the relationship between the patients and the nurses. Liberman et al (2012) lamented that the necessity of carrying or moving around with the technological tools attached to the body is constantly reminding the patients that something serious is wrong with the body system.

Bellazzi’s research (2008) objected this view by pointing out that past effort on diabetes management was all about regulating insulin in the body system, which remain vague to the concerned patients. Meanwhile, latest technology makes it possible for patients to personally read the values of the body insulin status from the attached electronic devices and be able to communicate the

message with their health workers. Bellazzi (2008) however concluded that latest technology incorporates the patient more into the care plan and hold them responsible for their own health on a daily basis.

Garcia-Saez et al. (2009) hold the same opinion with belazzi (2008) that introduction of teleMedicine would possibly involve patients more in their care plan by empowering them to communicate the state of their health with the nurses. Nevertheless, what concerns Barnett (2008) a lot are the future barriers that could possible come up while implementing newly growing technologies, though, he could not really establish those possible future challenges.

Despite ease brought about by the introduction of latest technology, Liberman et al. (2012) pointed at 'human factor' as important because adopting the latest technological devices still demands treatment decision which is still the main duty of the patient. In other words, the aspect of human factor in diabetes management is highly important and should be treated as a matter of necessity.

Bellazzi (2008) furthermore supported up the opinion of Liberman et al. (2012) by proceeding further that though teleMedicine can aid changes in diabetes care, promote communication and facilitate reliable treatments, but we should know that it does not cure people by itself. Therefore, empowering the healthcare workers who are the ones to implement teleMedicine is an important issue. In the same vein, Leroy (2011) even consider introduction of latest technologies as another educational tools in diabetes care, Leroy stated that introduction of latest technology makes diabetologists to be happy simply because, these tools can possibly boost their unused potentials and increase specificity in their results.

According to Varroud-Vial (2011), it is noted that French hospital has implemented electronic diabetes database since 1985. This is to structure the clinical management of DM patients, perfect the communication between the practitioners and the patients and to promote quality assurance processes. Implementation of automated notes, records, order entry and clinical-decision support systems are noted to have less complexity and not expensive. Though, the impact of these tools in France have not really evaluated by research works.

However, acceptance of diabetes management devices faced lots of challenges from the patients as well. Leroy (2011) observed that patients do not really like having the mindset that there is an instrument working with the body system or constant active tool, especially a bigger device. They prefer a pump that is almost invisible while attached to the body, possibly without tubes, but with the likelihood of working independently on the reservoir, battery or infusion set.

Among the issues that brought up differences and concerns about latest technologies was cost of implementation and patients' skills in coping with the use of these electronic devices. Azar & Gabbay (2009) see large scale implementation of diabetes management tools as too expensive to come about. Also, they were highly concerned that some patients have low computer skills to handle these tools, coupled with the difficulty they might go through in getting used to the architectural and technical design of it. Barnett (2008) claims that huge sum of money that is involved in installation and maintenance of these tools is not a fact to deny. However, affirmed that, considering the cost, most patients would even prefer basal insulin being given by injection.

Meanwhile, in the study carried out by Quinn et al. (2009), latest technology is going through a refined process and it is constantly changing on a daily basis, large scale execution is being brought down to mobile phone level, patients and health workers are now using portable gadgets that look like mobile phones. It is established that nowadays, mobile phones are cheap to afford. Considering United State alone, affordability of mobile phones increased from 34 million in 1995 to 230 million in 2006.

Despite all these challenges, the future of e-Health in diabetes management remains promising. According to Belazzi (2008), lots of unmatched benefits are available and promising considering the evolution of ICT in diabetes care especially in the area of user-centered design, mobile communication, context awareness and wearable devices.

Leroy (2011) established that diabetologists should anticipate that newly introduced technologies will surely better their knowledge, understanding and examination of the metabolic state and, thus, help them in arriving at near

normal solutions. Garcial-Saez (2009) also advised that it is important that the future system itself, if not presently fully achieved, should be made capable of functioning independently without the aid of or interference of the public communication network.

Looking at the future of e-Health from the accessibility of cheap mobile phones, Quinn et al. (2009) affirmed that cheap mobile phones are now available across socioeconomic, gender, and age groups, coupled with their distinct feature to process and interchange data in real-time, make them a suitable ground for e-Health to build easy, efficient, and real-time diabetes care programs. Kaufman (2012) re-stated that as far as e-Health is concerned, the priority is to achieve a better healthcare result. Therefore patients and clinicians do really need to come together as one for the purpose of empowering the patients with diabetes to take up, maintain, adopt and sustain habits of health-promotion that are important to guarantee better results.

7.1 Reliability and Validity

Meanwhile, the topic was certified by my supervisors before proceeding and continuous check are done on it until the final stage to make sure it is close to perfection

This study is based on reviewing the pre-existing works on e-Health technology in diabetes care. The methodological approach employed to handle the data in this study is systematic literature review. According to Neal (2009, 51), systematic literature review is the use of articles that are already existing to process data, it is carried out by formulating themes and arrive at results that share common ground with provision valid and reliable evidence based facts for policy making and practice (Neale 2009, p. 51).

In carrying out a research work at any level, one of the important factors to be put into consideration is how valid and reliable the study is. In the beginning of a study, some limitations would be identified which could affect the validity and reliability of a study. In this study, some limitations are identified by prediction made in the beginning of the study and they were taken care of by setting out

some criteria that will govern the research work. Though, in the process, some limitations also emerged and the direction and research questions of the study were slightly re-modified in other to preserve the main objective of the study.

At every stage of this work, a lot of efforts were applied to a reasonable degree mainly to avoid errors. In the first instance, the topic was certified to be alright before proceeding. Use of reliable and authorised academic databases such as Cinahl Ovid Medline and Sciencedirect make the authors to have a belief that the contents of the used literatures are close to actuality. Efforts were also made to give priority to studies based its data collection procedures on real life contact or through access to official electronic records of reputable organisations. The objectives of the chosen articles are also made sure to be in tune with the objective of the study.

The results of this study showed consistency with findings showed in the background of this study. furthermore this study has also showed consistency with previous findings and corresponded current situation in which e-Health tools and applications are involved.

One of the features of a reliable study is to be able to give the same results if carried out by different researcher in the absence of the previous author's agreement. To maintain this stand, most of the articles considered are those that used statistical tools such as Chi-square, t-tests etc and arrived at the same results with the other writers in the same field of study. Though large volume of data are involved in this study and to avoid repetition of facts or piling up of unnecessary facts, only bit of every article is considered in the study. Walliman (2001, 25) affirmed that every research work contributes only a fractional part of a bigger body of knowledge.

This study made use of systematic literature as a review tool so as to be able to handle the overwhelming emergence of large volume of literatures. Step by step approach was adopted in the process such as consideration recent studies ranging from 2005-2012; avoidance of articles without full texts and consideration of articles written by scholars. In the result analysis, three classes were formed to reduce the number of articles in the classes; themes were also

developed based on careful scrutiny which led to critically analyzed results. Through critical analysis students learn not to apply research to practice until it is shown to have been rigorously undertaken, robust in its findings and relevant for application to their own work (Knowles & Gray 2011, 391.) Differences in opinions and the way things are viewed cannot be perfectly same but these aspects were critically analyzed in the discussion parts of the study.

7.2 Limitations

In any research study, limitations are normal barriers but efforts should be put in place to minimize them to a reasonable extent in which little or no negative impact or bias would be reflected on the validity and reliability of the study. It is almost impossible to minimize limitations to zero level in a research study like this, conflicts of ideas were generated from various authors. Limitations emerged at every stage of the research, in the beginning of this study, some limitations are predicted and taken care of.

In the study, any identified biased opinion of the author was not given a priority over facts, the reviewers also tried to avoid allowing personal bias to supersede the objective of the research or influence the research direction. All evolved points were processed with equity based on the set criteria and evidence based practice that are meant to benefit the outcome of the study. Lots of efforts were put in to come up with a work with standard within the limited time frame which was quite small considering the level of the reviewers as undergraduates and first timers in this kind of review process, for example the depth of critical appraisal of the research articles was limited to the skills and ability of the researchers. Though the work meets up with the requirement, it is still believed that if there was enough time, more materials and facts would have been possibly sorted for which could as well benefited the study.

Another identified limitation is the inexperience of the writers. The research is a bachelor’s thesis and this work is the first research study being carried out by the writers. Therefore, the writers were faced with some tough challenges that really demanded for previously acquired skills. Though, all these challenges played some negative roles in the outcome of the work but with the support of

their supervisors and some other experienced school colleagues, the situation was later put under control.

As regards financing of the research, there was no provision made for any form of financial aid for the execution of this project, some essential literatures that could have also contributed positively to the study were not free and the reviewers could not afford to purchase them for the purpose of the study

Another limitation faced in this project was the fact that this project as done as a group work and researchers were restricted to only a particular search term even though some articles that were related to the subject were found they could not be used as it will be interfering on the co-researchers work.

7.3 Ethical Considerations

Violation of ethics and right, be it organization, institution or individual, is now a serious offence in this present world. Therefore, an academic research work must avoid ethic violation. According to Robley (1995, 48) ethics is an essential research tool and it can be viewed from various angles, ethical reports outlined by the ethic committee of a recognized body can be used as a guide and support during a study review process.

The topic was presented to the supervisor in charge before data search to see if there is any likelihood of the thesis going against public interest or any organization. All the reviewed literatures were retrieved free of charge from the official academic databases e.g. CINAHL and Science direct which the author has genuine right to access. It is believed that such literatures from academic database have been critically examined for ethical violation, therefore, using such articles further justify the ethical consideration in this study.

The content and structure of the study are well-managed to avoid using unacceptable language, obscene comment, real picture or misrepresentation of facts of any author. Parahoo (1991, 36) states that research content and structure are controlled by research ethic in other to avoid losing grip of the objective of the study.

Plagiarism in academic writings is a serious crime as it is widely known. All the quoted quotes in this work are not directly quoted or copied to avoid plagiarism. All the employed quotes are referenced accordingly at the reference page, in truth standing and honesty to the best of the author's ethical knowledge. Information about the participants of any used article are revealed to maintain privacy protection.

The study is devoid of bias justification by the author. Author's emotion is not allowed to over-ride the facts in the literatures and any of the quoted ideas is not re-modified to suit the objective of the study, the direction of the study itself is rather re-modified to soothe the quotes.

7.4 Conclusions

The use of e-Health tools and applications has doubtlessly benefited and positively affected many areas in nursing work. Although IT solutions do have considerable potential to improve nursing work and patient outcomes, there is currently a gap between the theoretical and empirically demonstrated benefits (Hucklave et al 2010, 31).

While e-Health applications typically have the technical capability to help nurses in the delivery of healthcare, inadequate attention to the socio-technical dimensions of their use can result in new avoidable risks to patients (Hucklave et al 2010, 3). Patient safety information could be integrated in nursing training in all levels (Rhay 2012, 5).

Several researches have been done already according the barriers of e-Health services and programs. Still main barriers are IT-skills and education. School and hospital should provide educational training to improve nurses' skills when handling e-Health services and programs. But the problem in school could be that they have fixed educational courses which they have to follow and there probably won't be that much time for dealing with. At Turku AMK nursing programs are explained and practiced with, but they should be used much more so that students are aware of them in their future career.

For future studies it would be necessary to find more information on education in universities about e-Health service and also what would be the financial cost for offering educational trainings and for nurses in hospitals.

As established in a number of literatures, e-Health has impacted diabetes care positively over the years. The benefit of e-Health technology has only contributed to the care, support and improvement in patients, but also, tapped the potential in the health care personnel as well. According to Belazzi (2008) in a research study carried out in France, widespread adoption of ICT in all daily activities, especially in the area of internet and mobile phones, has had a huge success in standardizing the organization of DM care delivery and the level of smooth and faster exchange of information among the health care service users, service providers and health care system itself, has achieved a greater level. Though, it is essential to realize that teleMedicine can aid progress, solidify communication and offer more reliable treatments, it does not cure the patients itself.

For this reason the education and proper training of the health professionals must be emphasized and taken seriously in other to be able to deliver diabetes health care services with the use of the latest e-Health technologies. A very good example of the use of e-Health can be seen from the Finnish nurses association which is a pioneer in offering e-Health and electronic services, which provide tools to carry out evidence-based nursing and has improved through e-Health diabetes management as well as other health care areas. Members have access to various professional information services online, such as Ovid Essential Nursing Collection or various databases. Nurses also have a unique opportunity to evaluate their own expertise by maintaining a personal electronic portfolio through the career gate.

Apart from education and training, it is also important that all the newly introduced technologies should be regularly made available at affordable prices so that the value of the technology would not undermine the value of health professionalism.

In any study, limitation and challenges that emerged during the review automatically expose the author to some other research areas that need to be explored but which the objective of this study cannot incorporate. These areas are meant to be recommended for the future researchers in the area of e-Health technology and diabetes care. Considering the level of this research work, being bachelors' level, the authors understand that recommendation cannot be made, therefore, suggestion is offered. The only notable area is 'Impact of e-Health technology dependence on the relationship between diabetes patients and health care professionals?

A research investigation into this topic by future researchers could shed more light on the growing dependence on e-Health technology among some diabetes patient and its negative impact on patients' therapeutic relationship with the health professionals.

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