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# BENEFITS OF TECHNOLOGY IN DIABETES MANAGEMENT IN PATIENTS' POINT OF VIEW

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# BENEFITS OF TECHNOLOGY IN DIABETES MANAGEMENT IN PATIENTS' POINT OF VIEW

Diabetes remains one of the most healthcare challenges in the world today(Egede et al. 2011). An estimated 347 million people are diabetic and number is projected to double in next 18-20 years (World Health Organization 2013). As the disease continue to affect the world population, so does, the improvement in its care and management by use of modern technology (Bu et. 2007).

The main aim of this thesis is to find out the effect of technology in diabetes management. The thesis is under the E-medic project, which belongs to Central Baltic INTERREG IV A program. It is aimed at improving healthcare by use of technology. (E-medic 2013.) The task of this thesis is to create WebPages to help teach diabetic patients about how technology can help them.

As the diabetes continues to affect more people, there is still need for more research in diabetes management that will not only improve care but also reduce costs incurred by patients and government. This study aims at informing diabetic patients about possibilities of use of technology in their care. (Egede et al. 2011.)

KEYWORDS: Diabetes, diabetes management, Information technology, gadgets, Monitoring devices, Diabetes type1, Diabetes type 2, self care

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**APPENDICES**

# LIST OF ABBREVIATIONS (OR) SYMBOLS

| | |
|---|---|
| ADA | American Diabetes Association |
| AMA | American Medical Association |
| AADE | American Association of Diabetes Educators |
| AAFP | American Academy of Family Physicians |
| E-medic | A project funded by Central Baltic INTERREG IV A program |
| FDA | Finnish Diabetes Association |
| HDM | Healthcare Financial Management |
| NLM | National Library of Medicine |
| NEI | National Eye Institute |
| NDEP | National Diabetes Education Program |
| WHO | World Health Organization |

# 1 INTRODUCTION

During the last twenty to thirty years, the prevalence of diabetes has increased drastically among the world population and a reason for concern by all countries worldwide (National Library of Medicine 2012). It affects the quality of life of those who have disease causes complications and increase mortality (World Health Organization 2013). With the coming of technology in the care of diabetes, we expect an improvement in people's lives as well as reduction in costs (Fisher & Dickinson 2011, 2). This topic therefore is important in finding out how diabetes patients can be helped by the new technology.

According to World Health Organization (World Health Organization 2013), it is estimated that 347 million people are diabetic, 80% of which live in low and middle-income countries and projected diabetes deaths will double by 2030. In Finland, like any other country, diabetes is regarded as a major public problem (Finnish Diabetes Association 2013). While diabetes has no cure, new technologies have been developed to help in the management of the disease as well as numerous education programs to help those developing it to afford self-care (American Association of Diabetes Educators 2013). From improvements in insulin pumps and infusion sets to the implementation of continuous glucose monitors, technology is helping deal with diabetes easier than ever before (Tamborlane et al. 2008, 2).

Much as the world has embraced the coming of technology in day-to-day living, few diabetes patients, nurses and other service providers know about the role of technology in diabetic care (Klonoff 2009). And well as some may know, there is still limited knowledge on how to effectively use it in diabetic care. There is also still limited literature on the role of technology and cost-benefit and cost-effectiveness measures of diabetes management has been limited. (Perez 2010.) Shortcomings in the literature include brief study durations, a lack of generalizability of results to external settings and populations, and failure to account for factors such as costs, remoteness and patient education. Many institutions like hospitals and individual patients are still using traditional methods of care and management. (Bu et al. 2007, 2.)

This thesis is under the E-medic project, which belongs to Central Baltic INTERREG IV program. Central Baltic INTERREG IV program is playing a vital role in battle against diabetes mellitus with the help of project known as e Medic. The main aim of e medic project is improving healthcare by use of technology. E Medic is to build up new practices for the treatment of diabetes mellitus by providing effective consultation in medicine especially for diabetes mellitus and children. E-medic will create new scientific applications and monitoring devices to raise understanding of needs and importance of e health services. (E-medic 2013.)

This thesis is going to help highlight different ways how technology can enhance diabetic management by introducing to them the new innovations in information technology which allows for effective information flow between patients and their caregivers. Because there is limited literature in this topic, this thesis will add to the existing literature in highlighting the importance of information technology to better manage diabetes.

The aim of the thesis is to find out the effects of technology in diabetes care and management. The task of the project is to create WebPages to help teach diabetic patients about how technology can help improve their wellbeing.

# 2 DIABETES DISEASE

Diabetes mellitus or simply diabetes is a group of diseases characterized by high blood glucose levels that result from defects in the body's ability to produce and/or use insulin (American Diabetes Association 2013). Glucose is vital to your health because it's an important source of energy for the cells that make up your muscles and tissues and our brain's main source of fuel. Insulin is a hormone that is needed to convert sugar, starches and other food into energy needed for daily life. Inability either to make or to use insulin results in high sugar levels in blood leading to diabetes. (Mayo Clinic 2013.)

Type 1 diabetes usually diagnosed in children and young adults, also previously known as juvenile diabetes, is a type of diabetes where the body does not produce insulin. It is an auto-immune disease where the body's immune system destroys the insulin-producing beta cells in the pancreas leading to increase in blood sugar levels in the body. (Allison 2011.) With help of insulin therapy, where man-made insulin is injected to the patient, many young and youth diabetic patients are able to manage well with their condition and live a longer happier life. An estimated 350,000 people in the United States use insulin pumps today, and about 30,000 of those are believed to have Type 2 diabetes. (Jan 2013.)

Type 2 diabetes on the other hand, is a lifelong (chronic) disease in which there are high levels of sugar in the blood. Also known as late-onset diabetes, Type 2 diabetes is characterized by insulin resistance and relative insulin deficiency. ( Riethof et al. 2012.) This condition develops because your fat, liver, and muscle cells do not respond correctly to insulin (insulin resistance). As a result, blood sugar does not get into these cells to be stored for energy. (American Diabetes Association 2013.)

Gestational diabetes mainly affecting pregnant women, where pregnancy hormones block the work of insulin to breakdown starch in energy leading to increased sugar levels in blood. This lasts for the entire pregnancy periods, after which the blood levels go back to normal. (World Health Organization 2013.)

## 2.1 Risk factors and Prevalence

The main risk factors are genetics and family history, Injury or diseases of the pancreas can inhibit its ability to produce insulin and lead to type 1 diabetes, obesity/overweight

also increases the chances of getting diabetes. Hispanic/Latino Americans, African-Americans, Native Americans, Asian-Americans, Pacific Islanders, and Alaska natives have a high risks and prone to diabetes. Lifestyles involving less exercise and activity and consumption of high sugar foods/drinks and also ages of 45 and above are in high risk for type 2 diabetes. Pregnant women have a high risk for gestational diabetes. (World Health Organization 2013.)

Other risk factors include: Giving birth to a baby weighing more than 9 pounds, HDL cholesterol under 35 mg/dl, high blood levels of triglycerides (250 mg/dl or more), high blood pressure (greater than or equal to 140/90 mmHg), Impaired glucose tolerance, Metabolic syndrome as well as Polycystic ovarian syndrome-A condition called acanthosis nigricans, which causes dark, thickened skin around the neck or armpits. (Medline plus 2013.)

It is estimated that 347 million people worldwide are diabetic , 80% of which live in low and middle-income countries and projected diabetes deaths will double by 2030 (World Health Organization 2013). There are about 40 000 people with type 1 diabetes and about 250 000 people with type 2 diabetes in Finland and 4 000 children under the age of 15 have diabetes. The number of undiagnosed cases of type 2 diabetes is estimated at 200 000. Type 1 diabetes' incidence peaks are at the ages of 4-6 and 10-14 years, perhaps due to alterations in the pattern of infections or increases in insulin resistance but generally diabetes is a common disease for people 45 years and above. (Finnish Diabetes Association 2013.)

## 2.2 Diagnosis and treatment

Fasting Plasma Glucose (FPG) is a test that measures blood glucose levels to detect diabetes and pre-diabetes. It is done with a person who has not eaten anything for at least 8 hours. Prolonged fasting triggers a hormone called glucagon, which is produced by the pancreas. This causes the liver to release glucose into the bloodstream. If a person doesn't have diabetes, his or her body reacts by producing insulin, which prevents hyperglycemia. (Mayo clinic 2013.)

The American Diabetes Association suggests the following targets for most non-pregnant adults with diabetes. More or less stringent glycemic goals may be appropriate for each individual: A1C-7%, Pre-prandial plasma glucose (before a meal)-70-130 mg/dl and Postprandial plasma glucose (after a meal) at <180 mg/dl. The oral glucose tolerance test is also used to measure amount of sugar in urine. Diabetes is

diagnosed if glucose level is higher than 200 mg/dl after 2 hours of drinking glucose drink. (Martha et al. 2012.)

Urinalysis is a urine test that is often given to people with diabetes to check for diabetic related kidney disease (Reithof et al. 2012). A urine glucose test determines whether or not glucose is present in the urine. Glucose will overflow into the urine only when the blood glucose level is high, that is, too high for the kidneys to stop it spilling over into the urine. In most people, blood glucose levels above 10 mol of glucose per litre of plasma will cause glucose to appear in the urine. This level is called the 'renal threshold' for glucose. However, the renal threshold for glucose can be lower in some people who are otherwise healthy, during pregnancy, and in people who have a kidney disorder. (National Eye Institute 2013.)

A study in Finland demonstrated that lifestyle changes reduced the incidence of diabetes among overweight individuals. Specific dietary goals were given and a target of at least 30 minutes of exercise per day was set. Compared to the control group who lost 0.8 Kg over a 2 year period, the intervention group lost 3.5Kg after an average of 3.2 years; the incidence of diabetes in the lifestyle intervention group was 58% lower than in the control group (Tuomilehto et al. 2001.) In another research by Malkawi (2012), physical activity is deemed important in reducing effects of diabetes.

# 3 TECHNOLOGY AND DIABETES CARE

Technology facilitates the overall efficiency in managed care, thereby having the potential for reducing error, improving outcomes, and controlling costs amongst users and all concerned parties (Shea et al. 2013). Some of the commonly used technologies in the care of diabetes are telemedicine, self care technology and continuous glucose monitoring systems (Berger & Stenstrom 2008).

## 3.1 Telemedicine

One aspect common in the care of diabetes now day is telemedicine. Telemedicine is the use of medical information exchanged from one site to another via electronic communications to improve a patient's clinical health status. The use of teleservices has come to save time and money as well as improving quality of life for diabetic patients. (Gomez 2001.) Telemedicine allows nurses or doctors to collect, manage analyses and give feedback for those patients connected (Jersey et al 2007). It is a IT protocol that allows communication between patients and their carers in terms concerning: planned or extra visits, changes in care/treatment plans, teleconsultations, referral to other specialists, if any and new complications (Robert et al. 2010).

Telemedicine as a tool for intensive management of diabetes: the DIABTel experience. The DIABTel architecture is based on two main components: The Medical Workstation (MW) and the Patient Unit (PU). MW is PC-based application used by nurse and Doctors while PU is used by patients. Patient Units are connected to Medical workstations and patient help is accessed 24 hours a day. Telemedicine is designed to complement the daily care and monitoring related to glucose level fluctuations, diet, insulin, physical activity and other related issues. (Gomez 2001.) Telemedicine is important because it promotes patients' independence and ability to make their own decisions (Rieth 2012,15).

Diabetic retinopathy is one of the leading causes of blindness in America. The use teleophthalmology, which is a form of telemedicine, has helped a lot people in rural areas for instance in India to receive care. Teleophthalmology is the use of telecommunication for electronic transfer of health-related data from remote places, which allows them to communicate with specialists for instance in urban centers. (Vijayaraghavan & Mohan 2011.)

This method makes use of images/pictures that are taken on all the quadrants of the retina including the macula and optic disc after dilatation of the pupils at designated venues. The images are then interpreted by ophthalmologists and this offers urgent results and feedback. 'Telephthamology screening for diabetes retinopathy through mobile imaging units with Canada', Image capture of both eyes 3505 known diabetics was performed in 5 provinces in Canada: Quebec, British Columbia, Alberta, Saskatchewan and Manitoba. The use of telephthamology loweres barriers to screening and created new screening opportunities for a large number of diabetics with diabetic retinopathy who were still using traditional system. (Boucher et al. 2008.)

### 3.2 Self care

One other big role played by technology is enhancing self care in diabetes management. Self-care has been defined as "the right and responsibility to take care of your physical, emotional and spiritual well-being" (Hayes & Aspray 2010). Patient self-care technologies have been in use for a while in diabetes care. These technologies use educational resources data gathering systems to improve patients' own care (Ragnhild & Stan 2011, 145).

One of the examples of these technologies include high-tech automated phone systems that provide reminders to patients, electronic diary tools used in collecting information needed for the visit and online resources like peer support groups(Bu et al. 2007). ITDM technologies are for instance also being used to promote self-management. This is possible through promoting strict dietary compliance which improves blood sugar levels and reduces the damage to small blood vessels throughout the body (Bundesmann & kaplowitz 2011).

Patients' quality of life improves because complications like blindness, lower extreme amputations and a like, are lowered. This benefits both the patient on health terms as well resource utilization thus providing a low cost-effective care (William et al. 2008). Furthermore, ITDM provide more care compliance guideline such as Eye and foot exams and laboratory tests which leads to improves hemoglobin levels, blood pressure as well as cholesterol levels. This lowers possibilities of vascular and coronary diseases lessen possible end stage conditions such as mortality, myocardial infarction, blindness and lower extremity amputations. (Martha et al. 2012.)

### 3.3 Continuous glucose monitoring

Continuous glucose monitoring (CGM) systems have been useful in monitoring glucose levels among patients (David et al 2008). CGM systems use a tiny sensor inserted under the skin to check glucose levels in tissue fluid. The sensor stays in place for several days to a week and then must be replaced. A transmitter sends information about glucose levels via radio waves from the sensor to a pager like wireless monitor. (William et al. 2008.)

A two-phased study to monitor continuous glucose levels among nine participants was conducted. The study was aimed at developing a role model intervention to motivate non-exercising individuals with type 2 diabetes to engage in regular exercise. Under 72 hours of monitoring, the use of Continuous Glucose Monitoring System (CGMS) and Accelerometer Technology resulted in low glucose levels among all participants. Participants also realized that the visual glucose monitoring data reinforced routine self-management experiences such as exercise, diet as well as stress.

In another study 'Continuous Glucose Monitoring and Intensive Treatment of Type1 diabetes' (Tamborlane et al. 2008), By use of a randomized controlled trial, a study was conducted on 322 adults and children who were already receiving intensive therapy for type 1 diabetes and had a glycated hemoglobin level between 7-10%. The primary objective was to reduce this glycated hemoglobin level to less than 7%. These patients were divided into two groups i.e. the continuous monitoring group and the control group. Based on age i.e. 8-14, 15-24 and 25 and above. The results showed a substantial decrease in glycated hemoglobin levels with low possibilities of severe hypoglycemia to the patients who were 25 and above.

# 5 HEALTH EDUCATION IN INTERNET

Health education is any combination of learning experiences designed to help individuals and communities improve their health, by increasing their knowledge or influencing their attitudes (World Health Organization 2013). Effective patient education entails providing patients with health information that will improve their overall health status. As the healthcare practice becomes increasingly patient-centered, patient involvement in their medical decision-making process through patient education is central to improving overall health outcomes and patient satisfaction. (American Academy of Family Physicians 2013.)

Providing diabetic patients with complete, first-hand and current information helps create an atmosphere of patient-nurse, patient-doctor trust, it also enhances the doctor-patient relationship and empowers patients to actively participate in their own care and management. Effective patient education also ensures that patients have a sufficient level of knowledge and understanding, which allows them to make informed decisions regarding their own care. (Veronica et al 2012, 29.) Through use of links, diabetic patients are able to access more websites, contact more physicians, also patients are able to assess their learning goals and achievements as well as reminders to overall management of diabetes including: monitoring blood glucose levels, preparing and eating healthy foods, having regular physical activity, reading nutrition labels, take medications or inject insulin as well as adjusting medication or insulin according to blood glucose, diet, activity and during times of illness. (Martha 2008, 98-99.)

As healthcare sector becomes more demanding, so the need to devise more avenues to reach patients. It is now more evident that physicians, patient educators, researchers are making use of internet to teach patients through making well organized websites, where patients are taught about the disease. (Ali & Neal 2011.) and different possible treatments and the care of diabetes are no exception. Indeed, by providing diabetic patients access to care processes, medical information, medical advice, and online support groups. Hayes & Apray (2010) further stesses a patient-centered kind of care which paves way for patients to assume much greater responsibility for their care and management. Traditionally, the relationship between the physician and the patient is

out of balance, as the physician had better access to information and more experience than the patient. But these WebPages are changing this dynamic and this means more diabetes patients can know more about their disease as well as modern treatments and care available. (Davis et al. 2010, 2.)

Internet offers a lot advantages in patient education. It offer a range of information from diabetic patient-centered articles to medical research, interactive tools to assess health risks or make decisions about treatment options, links that enable people to access support groups and health care professionals like nurses, doctors (Neale 2010), also offers a chance to patients in remote places to access information, access for people with disabilities to information is also made possible (Klonoff 2009). It goes ahead to provide a more interactive media of learning and educative texts, audio, video, pictures and animation. Internet also provides the opportunity for patients to learn at their own pace, convenient time, in privacy or with other people. (Lindsay et al. 2008.)

For effective use of internet for patient education, patients and families need to choose websites that provide relevant health information to the patients' needs, encourage patients and families to take an active part in the patients' care, reflect current clinical practice and known evidence from up-to-date sources and research also need to be written in plain language and clear layout, so that most patients can understand and easily learn from them. The educators therefore should ensure that the materials they put on their websites is incorporated in the patients' care plan, develop and revise what they post, know what they post and most importantly materials that are relevant to patients' care needs. (Davis et al. 2010, 2-4.)

During the course of patient education, patients may get a different view on how their care should be handled. Patients may favor a certain treatment based on what they've read and then doctors need to provide additional information and education on the options and implications of the alternative treatment options by explaining the benefits, risks, and appropriateness of different treatments. (Riethof et al 2012.) Therefore responding to patients' health-related inquiries becomes a sensitive issue where physicians should be careful not to dismiss or disregard any information that patients gather. Instead, they should commend patients for trying to learn about their medical conditions, allow patients time to share or question what they've found, and respond to the information without overreacting, even if the information is flawed. (Tufts Managed Care Institute 2012.)

Internet is proving so useful in patient education but also has a few limitations. The main problem is mainly illiteracy where many patients, especially in developing countries can't use computers in order to access information (Silow-Carrol 2012). Lack of computer skills combined with lack of literacy skills( including numeracy, reading and problem solving ), make it different for patients to read, understand and sort information useful to their diseases and care other patients likely to have the same problem may include children, old people as well as disabled people (Schillinger 2007).

Additionally, remote places find it difficult to get reliable and fast information, some people can't access internet due to poverty. The American Medical Association's "Guidelines for medical and health information sites on the Internet" summarizes the barriers to realizing the potential of the Internet in patient care; inequitable access, imbalance between the reading level of the material and the reading skills of most patients, extreme variability in the quality of the content, potential for commercial interests to influence content in their WebPages, uncertain preservation of patients' personal privacy. (Lindsay et al. 2008.)

# 6 EMPIRICAL IMPLICATIONS

## 6.1 E-medic

This thesis is under the E-medic project, which belongs to Central Baltic INTERREG IV program. Central Baltic INTERREG IV program plays a vital role in battle against diabetes mellitus with the help of e Medic project. The main aim of e medic project is improving healthcare by use of technology in addressing the needs of diabetic patients. The needs of diabetic patients will be best illustrated in this thesis by the creation of WebPages that will guide the diabetic patients in their self care. (Emedic 2013.)

E Medic is to build up new practices for the treatment of diabetes mellitus by providing effective consultation in medicine especially for diabetes mellitus and children. E Medic will create new scientific applications and monitoring devices to raise understanding of needs and importance of e health services. With e medic then we anticipate to meet the goals of addressing the huge needs of diabetic patients.

## 6.2 Search for articles

The process of searching for articles begun by use of reliable databases such as; Science direct, Cinahl and Pub med. The search words used were technology, patients, diabetes type 1, and diabetes type 2. Out of the many articles we got from these sites we choose to re-size them by choosing the relevant articles which addressed the topic of our thesis. We opted to use 8 articles.

We used a few other articles and websites in our search for information. We were mainly interested in material that is less than 5 years. But also concentrating on the current technology across the globe. We also based our thesis on a few support organizations like WHO, Diabetes support associations like FDA, AADE to mention but a few.

## 6.3 Creating WebPages

The advent of internet has made education and access of information easier than before and it is not an exception to the care of diabetes. By using WebPages, several patients can be reached and educated about self-care, monitoring their blood sugar levels as well as communicating with specialists involved in the care of diabetes. In this

work, we created web pages that will educate diabetic patients about the disease, use of new technology including information technology as well as new gadgets in the care of their disease and complications. (Silow-Carrol 2012.)

The World Wide Web is a vast and rapidly growing repository of information, and various kinds of valuable semantic information are embedded in WebPages. According the HONcode, websites are expected to be transparent by avoiding giving misleading and deceitful information. In this work, we identified important information that patients can use to get the best of new technological advances. For instance, telemedicine that can help patients report any complications, nurses and doctors can also give immediate feedback (Yi & Liu 2003). We also included in several links where other important information regarding new care methods can be accessed.

WebPages need to be authoritative. As a guideline to good quality information on websites, those who build them are required to state their names and their specialties. This is to avoid non-specialist to post information that is misleading for the readers and offer accountability for those who post them. In our work, we give names of the authors, their education background and contacts including phone numbers and e-mail addresses in the Contacts link. (HONcode 2006.)

Privacy of views and information for the readers/patients is paramount in healthcare sector, so does specifically to health information on websites. Guideline of privacy, websites are obliged to keep readers' privacy. The Website owners undertake to honor or exceed the legal requirements of medical/health information privacy that apply in the country and state where the Web site and mirror sites are located. In our work we uphold that by keeping readers' identities secret and respect any reader's comments. We do this by keeping information, identities and inquiries to those who may call for more information private and no other reader/user should know or access unless there is confirmed permission. (HONcode 2006.)

According to e Result research and consulting, webpages need to be conformable to the users and should be made a priority at the back of any author's mind. Now days, the internet is widely known as the most common medium of accessing information, because of its accessibility at any location. In this context the reason for creating a webpage for a study becomes Important in order to reach out to the target population

who may not find it Comfortable to access the main thesis in the library. (Elske & Ludwig 2004.)

In this work, we make our webpage available on the net and intend to make it available for all readers regardless of age, location, ethnicity or culture In this work, we targeted patients who can understand English and used simple language that is understandable and can efficiently, effectively and satisfactorily be operated by the our target patients. This information may also in the future be translated into various languages including Finnish in order cater for a wider range of readers here in Finland.

Webpages need to be accessible and easy to navigate. This significantly improves people's browsing and searching experience. In this work, we made navigation buttons and bars easy to understand and use. These buttons and bars appear by the left side of the home page and a few on other pages. We also formulated anchor links that lead our patients to other pages to enable them get new information if need arises for instance the Gadgets bar lead to another page that lists and explains different new gadgets in the use of diabetes. In this we hope patients can learn more how to use the gadgets. (Bu et al. 2007.)

In creating a webpage, content of the webpage is well structured and the hierarchy of information is perfectly clear for clarity purpose to the reader (Sue 2004, 16). Websites need to be justifiable. Justifiability guides websites on stating their intent by backing up claims related to benefit and performance. In this work, we make our intent to teach patients clear and no financial gain is aimed. We formulated our headings to include the main topics of our webpage including information technology, gadgets used in diabetes care as well as other links containing useful websites. We chose our background color to be white and black for the texts for clarity reasons and further create encouragement for the patients to continue navigating without getting bored (HONcode 2006.)

The explosive growth of information on the Web makes it critical to develop techniques to distinguish importance information from unimportant one. Patients need an information portal that is well connected and quickly lead them to what they need. (Sue 2004, 15.) In our Webpages, we endeavored to connect different aspects of technology to each other and how well they are helpful to the patients. For instance the use of

information technology in educating about the use the gadgets, patients' questions portal to their care (Ruihua et al. 2004, 3-5).

The content for websites needs to be reliable and ethical. In conforming to reliability, websites need to uphold the principle of Attribution by referencing any information accessed, read or copied from a given source (HONcode 2006). In our work, we gave references to make our website reliable, update-to-date and also reward the different authors for their good work. The source of the content in our work is based on our thesis and articles from reliable sources like CINHAL, Science Direct and Mediscape. Several more links are put for readers to access the referenced sources in the website In order to avoid violating rights; most of the pictures we posted on our website were the ones we took ourselves.

Many will people judge Webpages by the quality of the writing, spelling and grammar errors, therefore, it is important to review different texts and sentences in order to give real meanings intended for the target readers. In this website, we reviewed all the our texts several times, checked for mistakes, in fact the spelling tool bar was very useful in this case. This was intended to make the information true and reliable. (HONcode 2006.)

Websites need to clearly disclose their financial sources (HONcode 2006). Websites are obliged to mention any help financially or otherwise they get during the website building process. In our work, we clearly show that that this project is supported by European Union commission (Emedic) and Turku University of applied sciences. More support services and material support are provided by the teachers/thesis supervisors in form advice, guidelines.

Any webpage's aim is to help patients improve on what they know. Websites are required to compliment what doctors do by providing more information but not to underrate or jeopardize the relationship existing between the readers/ patients and their doctors. The patient doctor relationship should be kept and upheld. (HONcode.2006.) In our work, we give information to patients to widen their knowledge on what they know, get to realize better ways/methods for their care and management of diabetes. We intend to complement that information that doctors have given to the readers and also try encourage them to do more consultations from them to know

better. It is also a guide to the patients to know what they didn't know about their disease for a better care plan and management between themselves and their care.

### 6.4 Ethical consideration

Ethics refers to doing what is morally and legally right in the conducting of research. This requires the researcher to be knowledgeable about what is done; to use reasoning when making decisions; to be both intellectual and truthful in approach and reporting; and to consider the consequences, in particular, to be sure that the outcome of the research outweighs any negatives that might occur. Using this approach, ethical decisions are much easier. Nurses as consumers of research must acknowledge legal and ethical issues of research study to evaluate whether the researcher is adhered to the basic human rights standards of an individual addressed in the study. (Neale 2009.)

In order to guide Internet users, HONcode helps them by highlighting reliable, understandable, relevant and trustworthy sources of online health and medical information. It demonstrates the intent of a website to publish transparent information. The transparency of the website will improve the usefulness and objectivity of the information and the publishment of correct data. HONcode has the following principles/guidelines; Authoritative principle allows for the author to post reliable information. Internet information's should be complimentary to other information on the website, keep privacy of users, rewarding of other others with citation. (HONcode 2006.)

At the beginning of this thesis project the two authors of this literature work informed the supervisors at Turku University of Applied Science their concern with research aim and tasks about the study and sought permission to carry out the study; the supervisors granted the permission. The ethical considerations that were considered during the writing of this thesis and the literature review process consisted mostly of the assumption that the articles that were selected and used in the analysis of the thesis were to follow a systemic process of ethical guidelines. It assured that the participant's anonymity and confidentiality was maintained and informed consent was obtained. Nevertheless there was also a presumption that the in due process, the method that was used in searching out and writing analyzing the articles was strictly followed.

The references for the data used are acknowledged and documented in the reference page. The study findings in the process were based on the scientific articles and the writers' views were not included. Therefore, the authors ensured that the process of the methodology was duly followed during the study and compilation of this document. Legal rights and ethical aspects were considered in this research. Researchers in nursing apply the principles that protect participants in the research from harm or risk and follow professional and legal rules which are laid down in the code of conduct and research guidelines.(HONcode 2006.)

Therefore, ethical guidelines of Turku University of applied Sciences, were fully adhered and maintained when drafting this thesis material and since the method in which the thesis study was done did not include interviews, questionnaires or observations, in which human beings were part of the data collection process, the need for consent and privacy were not considered in this thesis. Fortunately, there were no risks of harm to anyone. Nonetheless, ethical considerations played a part in the process of collecting information and analyzing the articles in this literature review. The data that was collected from the most trusted websites were disseminated accurately by proper referencing.

# 7 CONCLUSION

As researchers and scientists continue to look for better methods in the field of diabetes care, the role of technology cannot be overlooked. With the more organized computer programs, phone applications and ever growing number of different gadgets, the future is really bright (Wyne 2008). Technology has been useful in the management, control and monitoring glucose levels, exercise activity, diet, medication as well as self care, which form the basis of diabetes care and management. More diabetic patients by use of telemedicine can be reached regardless of time and location. (Veronica et al 2012.)

The more use of this technology will improve wellbeing for those with diabetes as well as reducing costs in medication, insurance coverages and overall care and management. More diabetic patients are able to control their sugar level and manage medications without travelling and using a lot of energy. We are looking at the future of technology to make care and management a lot more possible and easier to prolong people's lives. (Devaka & George 2013.)

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