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# Nurses experience on modern technologies and patient safety within Gerontology Care in Finland

## Literature Review

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Description

Gerontology is a growing field of nursing especially with the rapid increase of aging population in most of the developed countries. This has made modern technology in gerontology also known as gerotechnology essential in taking care of elderly patients. The adoption of gerotechnology has rather been slow with most of the old generation showing low integration of technology mainly because of little knowledge on the same.

The aim of this research is to analyze the nurses' experience on modern technologies and patient safety within the Gerontology sector using the case of Finland. The specific objectives included analysis of the modern medical technology surrounding gerontology in Finland; find out nurses' experiences of modern technology within Finland and safety of modern technology regarding gerotechnology in Finland.

Data used for literature review of this study was collected from article databases such as: Elsevier, OnlineWiley Google Scholar, Cinahl, and other online manual searches. The manual online searches were done using different key words and phrases to unearth relevant articles which contained adequate data on the topic of research. On the findings, the study identified that regarding the introduction of modern technology in gerontology care, the number of healthcare professionals was reduced thus needing only few nurses with the skills to operate the devices.

Keywords: Gerontology, modern technology, Patient Safety

# Content

# 1 INTRODUCTION

Technology from the nursing and health care sectors refers to the devices, drugs and the clinical procedures usually imported into daily clinical practices which can be transferred and transformed depending on the time and the purpose of its use (Sandelowski 1999). Gerontology on the other hand integrates technology, applications and nursing care in providing the best elderly care while minimizing accidents, time, and cost (Burdick and Kwon 2004).

Existing literature studies did not fully explore issues of safety of the elderly when new devices were introduced, which is a significant aspect of the gerontology. The use of these devices requires safety and monitoring of their internal bodily functions so that it ensures that they exercise within their limits. Segev-Jacubovski et al. (2011), mentions that most reviews focused mostly on utilization of new technologies and how they have been met with new difficulties such as demographic aspects, levels of income, education and their physical disabilities caused by old age. Also, it focuses on introduction of technology to the hospitality industry and how nurses have integrated into their daily operations without focusing on specific departments. However, it does not mention about nurses' experiences when operating modern technologies within the gerontology sector.

The aim of the study is to find out previous research on the modern technology, nurses' experiences on modern technology and safety of modern technology within the gerontology nursing in Finland. The purpose of this study is to offer information on how nurses experience using new technologies and its safety aspects within gerontology care. This can be used to formulate guidelines in training of new nurses in using modern technologies within the gerontology care in Finland.

# 2 GERONTOLOGY

## 2.1 Gerontology in Finland

Gerontology is defined as the study of the social, psychological, biological, and cognitive aspects of individuals as they grow from middle age through old age (AGHE 2016). With a population of approximately 5.5 million people, the Finnish population with aged people (65 years and over) constitute 19% with the number predicted to rise to 26% by the 2030 (Central Intelligence Agency, 2013). The gerontology sector in Finland focuses its operations on taking care of the aging population. Finland's healthcare sector has embraced and adopted the use of modern technology in Gerontology ensuring that the elderly individual or patients are well taken care of in an efficient manner and prolong their lifespan.

With the increase in number of the elderly in Finland, need for quality and adequate healthcare services is required. According to Kelley et al. (2011), the adoption of using technology in treating and serving the aging population has since increased in Finland particularly because the number of nurses or individuals to look after the aged has not risen to meet demand. Therefore, integration of technology in providing care to the elderly patients has been an important and useful solution to the sector. Cornejo et al (2013) share a similar notion with Kelley et al.(2011) stating that since the beginning of the new millennium, there has been a growing shortage of medical staff in all sectors in Finland including the gerontology sector especially in the rural areas.

According to Blazun et al., (2013), the aging population has been a contributing factor to increase in the shortage of nurses. In addition, the image of working for the elderly has not been too attractive for the young generations who are opting for more competitive and enjoyable job opportunities located in the urban areas. Yeo (2014) further states that several solutions have been searched as a way of filling in the gaps such as the provision of incentives and attractive salaries but the success has been minimal.

For that reason, therefore, the integration of modern technologies into the sector has been considered one of the solutions aimed at enhancing service delivery especially in the Northern parts of the country with the adoption of information and telecommunication technologies. IT systems and services have ensured easier connections to rural setting and offering more services to the older people as alternative approaches towards enhancing services on the nursing homes and hospitalization of the older patients (Central Intelligence Agency, 2012).

## 2.2 Nurses experiences regarding technology within gerontology care in Finland

Nursing is defined as the practice or profession of taking care of individuals of all ages sick or well. It also includes promotion of health, prevention of diseases in a manner that enhances their quality of health and life (WHO 2016).

Finland has an approximately of 30% of the labor force being already employed in the public sector (Central Intelligence Agency, 2012) with problem of an aging population, Finland also faces an economic problem cause by increasing shortage of labors.

According to Kortteisto et al (2010), in addition to the increasing problem of the aging population, the nurses within the medical sector, the gerontology industry as well are also experiencing an increasing problem of dissatisfaction with their work with the main causal agent being increased workloads caused by high staff turnover due to increasing retirees and job switching on the rise.

Bonini (2002) mentions that, many methods are not only very much dependable on the innovations integrated into the medical field, but they can also be very much complex is not understood well. This has become a trending thing in the medical arena as the introduction of new technologies has forced the medical institutions to also require competent and freshly trained health professionals to handle the new acquired equipment and devices. The

introduction of the surgical android or robot is a precise example where health professional with competency have been needed to operate on it (Ward and Clarkson, 2004).

Nevertheless, even though the new technologies can be very much significant for the patients, the health professionals such as the nurses have often encounter difficulties during the utilization of the devices that are more technologically inclined. Kent et al. (2015) stated that the resultant effect can be increase in accidents because of non-exposure to effective use of the same. For example, accidents can occur during the utilization of the hand-eye coordination problems when using the long equipment inserted through small incisions or natural body openings. The degree of freedom and the haptical feedback are usually diminished as the scope is required to give an image on a screen from the hospital professional tasks.

Differently, according to Chan (2007), successful and effective implementation of computerized systems and other technologies is very much dependent on the nurses' attitudes towards its use. Wu et al. (2013) agree with Chan (2007) stating that the nurse's attitudes towards the use of the newly introduced technologies is also influenced by the two factors of perceived ease of use and perceived usefulness about their jobs. Wu et al. (2013) opines that if the introduced technologies is perceived to be more useful in terms of enhancing the nurses' jobs and their performance, the nurses will become even more willing to adopt the new technology and the difficulties that come with it, because the benefits that outweighs its disadvantages. Kent et al. (2015) supports Wu et al (2013) stating that the perceived usefulness has been found to be a greater determiner or influencing the nurses' attitudes towards adopting given technologies as compared to the perceived ease of use. Stayt et al. (2015) agrees with Kent (2015) stating that this is because, with the element of perceived ease of use, the nurses can gradually learn how to handle the machines on their daily routines.

Differently, Mclane (2005) stated that another of the aspects that has been found to influence the use adoption of computerization and other technological adoption by the

nurses includes the user satisfaction. Mclane (2005) opines that the user satisfaction in regards to the technology to be adopted refers to the usability of the system introduced and the usefulness and how it has been reported. A report published in the Netherland Health Care Inspectorate (IGZ) showed findings that the introduction of minimally invasive surgery led to increase risk complications for the patients being operated on (WHO, 2010).

## 2.3 Safety regulations of new technology in gerontology care in Finland

The introduction of technology into the gerontology field in Finland is conducted and carried out with legal perspective in the plan. First, the introduction of Information technology equipment and devices always consider confidentiality and privacy of the patients. To ensure ethics is not breached patient's personal information must seek consent. For example, a good technological tool being installed in the nursing and care homes is given to a professional organization known as Elsi Smart Floor systems, they are tasked with monitoring of the situations of the elderly without violating the patient's privacy (Tekes, 2013).

Additionally, several laws have been introduced in Finland to regulate nursing operations within the healthcare industry. For example, the Statute of Continuing Vocational Education (Caps 1194 of 2003) was implemented to support furthering of professional education for nurses to keep up with the changing working environmental, such as the introduction of new technologies. The same can be said with the Health Care Professional Act that supports nurses to improve the knowledge and skills through furthering their educations (Viitanen et al., 2011).

A report published in the Netherland Health Care Inspectorate (IGZ) showed findings that the introduction of minimally invasive surgery led to increased risk complications for patients being operated on (WHO, 2010). The occurrence of such risk factors as mentioned is mainly attributed to the incompetence of the medical staff. Even though physicians in the

hospitals are usually responsible for the utilization and treatment of patients, it is usually nurses that are in frequent contact and use of the new technologies in a day-to-day routine. In a research conducted by McConnell and Murphy (1995) to determine how the nurse could learn to use new technologies introduced and their consequence. From the 323 nurses registered by the national medical board, working in a 500-bed care hospital, it was found that a considerable number of nurses could find their way around the usage of the new technologies through self-learning and discoveries. It was identified that this method and procedure produces several technical errors.

Additionally, 90% of participants in the research said that it was during their first interaction with the technologies that they learnt the main purpose, operation utility, concepts and their functions. Furthermore, Yeo (2014) states that the most identified mode of self-learning among nurses was through reading of manuals that accompanied the machines. A higher percentage also claimed to have learnt to use the machines through being guided by another nurse, medical registrar, or medical member in the hospital.

Nevertheless, McConnell and Murphy (1995) point out that 75% of the nurse respondents claimed to experience more stress as a result of utilizing new technologies. The study findings therefore indicate that the introduction of new technologies did not guarantee improved efficiency in the medical operations nor reduce complications as it was all dependent on several contextual factors.

A study conducted by Kiekkas et al (2006) sought to determine the perception of nurses on introduction of new technologies and the positive and negative effect they have on their jobs. The main respondents included nurses in the gerontology and critical-care unit with the total of 120 nurses. The survey discovered that most of the nurses could identify the positive effects that the medical technologies had on their jobs. Even so, most of them also stated that the integration of such new devices had an element of negative consequence that led to increase in errors and risks caused by human errors at the time of learning their way to operating machines effectively.

# 3 MODERN TECHNOLOGY INTO THE GERONTOLOGY SECTOR IN FINLAND

## 3.1 Electronic health records

Modern technology is the collective use of new skills, crafts and tools towards the practical application of knowledge to a particular activity (WHO, 2016). Several technologies have been adopted in gerontology field in Finland as a possible means to streamline the operations, increase safety, and error reductions within the units.

First, the Electronic health records (EHRs) have been one of the major types of technologies adopted by the medical field. The EHRs is usually featured with digital record of a patient's health history. It can be a collection of records from other hospitals clinics and public health facilities. One of the advantages of the EHRS is that it is available to the nurses at all times at a press of a button yet safeguarded to ensure that patient's information is secure and confidential. The prime purpose of the integration of the EHRS into the field of gerontology is to try and ensure that the patient's outcomes are improved through monitoring and analyzing all the available data to come up with better medical decisions that can be used to enhance their performance and health.

Blazun et al., (2012) state that, with the increase of more tasks delegated, the introduction of electronic devices had to be introduced to lessen clumsiness, frustration and the workload experienced especially in the communication and documentation of the patients' records. This immigration from paper version to digital version was necessary so as to keep the patients' information safely in one place.

According to Hobbs (2002) information systems have been deemed fundamental innovations that are responsible in bringing up revaluation in reference to the clinical transformation. Oroviogoicoechea et al. (2010) agree by stating that one of the systems associated with this kind of revolution is the biomedical monitoring innovations which

mainly include the non-invasive blood pressure equipment or the wireless telemetry analysis machines that have been introduced into the gerontology field in Finland to help aid out in monitoring the bodily systems of the elderly in the home care systems or in hospitals acute care units (ibid). Additionally, with the use of less invasive and more precise devices for diagnosis, ailments such as heart diseases are more likely to be detected and diagnosed using new blood analysis which involves the elimination of hazardous and diagnostic angiograms.

## 3.2 Specialized tattoos

Other less invasive technologies that have been absorbed into the gerontological field include the use of specialized tattoos that have been created to monitor aspects such as sugar levels without necessarily taking out blood samples. This has been effective especially for the high blood pressure patients and diabetic patients as it only involves insertion of miniature chipped tattoos which contain sensor to monitor the conditions and give out indications when the sugar levels have dropped or increased. The systems work through detection and monitoring of the movements of the elderly in their homes and rooms and triggers an alarm directly to the nurse's mobile phones in case an emergency in required such in cases of stroke or heart attack scenarios (Tekes, 2013).

## 3.3 Computerized physician/provider order entry (CPOE)

There has been continued adoption of computerized physician/provider order entry (CPOE) systems being introduced into the gerontology field (Huston, 2014). These systems are normally designed specifically for the nurses to put down patient orders through electronic means rather than the conventional method seen of writing down instructions and orders on paper. With the utilization of CPOE by the doctors and high medical practitioners in writing down orders such as prescriptions and symptoms, the instances of medical errors usually witnessed due to inaccurate and unclear prescriptions are much lowered (HIMSS, 2012).

Additionally, the utilization of the CPOE gives nurses with clinical decisions support (CDS) through access of information tools within the medical information systems. This support aid the nurse in matter such as diagnostics, therapy and planning for care for the elderly or sick patients without much strain.

## 3.4 Use of robotics

The use of robotics has also been emerging in the gerontology field like all other medical units and departments. The continuous emergence and utilization of robotics has been driven by the growing number of aging individuals. This has led to shortage in nursing professionals and increasing need for high quality care that is not subjected to limitations especially from the human perspective (Haughom, et al., 2011).

In the gerontology sector, specific robotics has been used with specific categorization based on their functionality such as rehabilitation, or social robots. The rehabilitation robotics are usually used in physical activities and assistance which are not featured with communicative capabilities. Such include the smart wheelchairs. According to (Oshiro et al., 2008) about 20% of people aged seventy years and over and 50% of the people aged 85 years and over usually report difficulties in taking part in their normal physical activities. This means a reduction in their mobility and distance taken; muscle strengths which make them have difficulties in normal activities such as standing and balance. The physical impairment can also affect their cognitive performance (ibid).

The utilization of the robots can enhance the quality of life of the elderly patients. In different situations, the social robots are used for communication purposes with the elders and can either be categorized as serviced based robots or companion-robots. The social robots are primarily used for both assistive roles for the elders in addition to providing them with social interactions in the health care provision (Blazun et al., 2013).

One such type of a social robotic that will assist in provision of services such as eating or bathing, mobility and assistance helps in the cognitive decisions and operations. Wu et al (2013) support the notion that the decrease in the memory and increasing levels of forgetfulness might result in low level self-care will. Therefore, utilization of robots that will attend to the daily routines for the elderly patients that can be forgotten such as; taking medication, going for appointments, eating or drinking and other cognitive abilities comes in handy.

The utilization of service type robots has become helpful in regard to supporting the elderly for the daily routine operations. For instance, the utilization of robotics such as the Nurse-bot Peral, Nabaztag and iCat have been previous integrated into the nursing and healthcare fields in gerontology (Pineau et al., 2003). Examples of some of the service type robotics used in Finland for the elderly include the Beddit. Beddit ensures that the elder patients are able to give their family members their personal information as well as their nurses in reference to their well-being in a private and discreet manner by simply resting the patients on robotically and technologically integrated smart bed (Tekes, 2013). Therefore, the purpose of the Beddit is to evaluate their sleep and their normal physiological activities automatically. They are less invasive technologies. The integrated sensory chips placed on the beds relay information automatically directly to the Beddit servers which can then be transmitted to the other selected individuals (Tekes, 2013).

## 3.5 Social networks technology

Slightly different, other types of socially-oriented technologies have been the inclusion of computer based technologies that can be used to provide the elder users the opportunity to socializes and establish social discreet networks. Pichierri et al (2012) holds that the advantages of such technologies provide the user with the ability to communicate with other individuals such as relatives and close friends and the nursing personnel even with the long distances between them.

According to the empirical study conducted by Blazun et al. (2013) on the usage of information and communication technologies by the elderly, a direct correlation was found between usage of the same and the increased efficiency and life prolonging. He further states that with the increase usage of the social technologies, the users' level of loneliness decreased significantly. The same was also elevated when elders underwent few training courses on how to use the same devices. This can be attributed to the increased social connection and reduction in psychological stress on their part (ibid). This and the affordability of the technology can help to explain the increased integration and use of information and communication systems in gerontology sector.

## 3.6 Electroencephalography

Another of the particular robotic technologies that has been put to use is the use of electroencephalography (EEG) which is already been utilized in the field of gerontology in concepts such as brain-controlled ambulation to the paralyzed patients and moving of small automatic vehicles such as wheelchairs for the elderly. For example, the use of service robotics in Finland has been used in instances to enhance service delivery to the caregivers for the elderly. Such robots have been of help in giving nurses the much-needed help in washing or moving the patients from one point to another. Also robotic carriers have been used in searching and delivering hospital supplies and medications, equipment and so that nurses are given more time to spend with the patients rather than doing the search work such commodities needed (Millard, 2012).

## 3.7 3D printing technology

The integration of 3D printing technology has also been seen in the gerontology field. The application of such technology has been focused on generating body parts for patients which can be then be used to replace worn out of dysfunctional parts on the patients (Thompson, 2012). For example, in 2013, doctors and the medical engineers were able to bring the concept of printing prosthetic jaws and limbs which can be then implanted on

older women who suffer problems such as bone infections. Other human features that have been recreated include the generation of an ear printed through using moulds and geld with use of rat collagen (Cantor, 2013).

According to the use of technology to enhance and increase mobility, communication and foster relationship within the working environment is also increasing amongst the nurses. The use of health communication approaches and health and information technology to increase the population of health result and the quality of health care given to the patients in addition to attaining equity in the nursing departments is seen to increase in the gerontology fields. Banham (2013) agrees with Cantor (2013) stating that the utilization of IT and communication devices is seen as important steps towards increasing decision making of the nurses towards their patients' conditions. Additionally, the use of health IT also facilitates quick and easier decision making especially in risky and emergency situations with the ultimate results being better service to the patients.

In Finland, according to a study conducted by Wotten (2001), there has been an increased surge in the utilization of telemedicine. In such scenarios, the elderly and the older patients received care from the nurses via video phoning. According to Segev-Jacubovski et al. (2011), based on the research conducted, patients who received videophone services had fewer tendencies to the admitted to the hospital due to increased complications in their health due to late check-ups. Segev-Jacubovski et al. (2011) further expounds stating that, the adoption of such communication systems was highly welcomed by the nurses due to their advantage of cutting down the distances of travelling to the elderly homes for check-ups.

Similarly, Khatri et al., (2011) has conducted a research study on telemedicine in Finland's gerontology sector. Based on the research conducted, the research findings indicated a wide range of diagnostics has been perfumed which includes the radiology, psychiatric and dentistry with the use of such telemedicine systems on the elderly. Khatri et al. (2011)

research concluded that the telemedicine has been high accepted by the society inclusive of the nurses and the patients due to the safety, convenience and efficiency in their use.

# 4 NURSES' EXPERIENCES ON MODERN TECHNOLOGY AND PATIENT SAFETY

## 4.1 Nurses experience on modern technology

Locsin (2010) holds that the adoption of technology into the medical and health care sector has been of importance in reference to the positive impacts on the patients, nurses and the overall care in their health care industry. According to a study conducted by Whittaker et al (2010), technological usage for the purposes of documentation showed that most of the nurses having positive attitude towards their integration due to the ease of use and reduction of the workload.

Technology integrations have become a common phenomenon for medical practitioners but its use has nevertheless not become fully utilized. According to an empirical study conducted by Stayt et al., (2015) nurses believe that technology integration is very important in the nursing field as it aids in reducing issues and burdens normally associated with workflow routine such as documentation, administrative functions, and medication of the patients, communication and acquisition of medical supplies.

According to Weber et al. (2009) based on the number of studies conducted, majority of the nurses have identified the need to incorporate technology into the daily and normal operations as one of the ways of enhancing medical and patient care. For instance, some nurses have identified key technological inventions such as utilization of Radio frequency identification (RFID) chipped devices to track the equipment use and patient's status while other identified other desired and inclusive technologies such as voice communication equipment as technologies that can enhance their operations in the medical field (Rachas et al., 2015).

According to Lapum et al. (2010) nurses are usually needed near the bedside or in close proximity to the patients in order to monitor their conditions and any changes that occur on the patients. Their close presence is important in preventing any harm that can occur to the patients. According to a study conducted by Kongsuwan (2011), the presence of nurses close to the patients prevented approximately 86% of medical errors.

Nevertheless, based on the same study, the amount of time spent by the nurse on proximate watch on their patients is amounted to just 23-30% (Kongsuwan, 2011). The absence is usually contributed by other axillaries services such as searching for supplies, documentations, collection of items and information to provide care for the patients. Paley (2014) states that, dissatisfaction of nurses at work is resulted by confusion in the nursing environment not only in the gerontology sector but other nursing and medical units as well is usually a great contributor.

Shimizu and Suzuki (2015) suggest that the integration of technologies into the gerontogical field has improved the operations for the nurses. For instance, with through use of technology, it has enhanced the safety and autonomy of dementia patients. Supporting Shimizu and Suzuki (2015), Inglis et al., (2015) states that, technology that has been integrated to assist the nurses in their operations has been labeled as aids and the provisions of adaptations. Examples of technologies introduced in the gerontology include immersive technologies which refer to the computer-oriented equipment that allows for physical envelopment of an individual's attention. The application of such technologies has been seen to be efficient methods of increasing the life of elder patients.

Similarly, Rudge (2002) opines that the introduction of smart technologies into the nursing field has also increased safety for the patients. ACMHS (2014) supports Rudge (2002) stating that the inclusion of smart technologies has become fundamental to the nurses in reducing the errors associated with nurse carelessness due to fatigue or stress. For example, smart IV pumps, smart beds and cards have increased the level of efficiency for the nurses. Smart bed and chairs have been known to enhance the nurses operations through monitoring and

analyzing the patient's signs and mobility without the integration of electrodes. With such, the smart beds can therefore interface with the hospital information and analytical systems and pass on the information collected to alert the nurses on their wearable devices if the patients need care or attentions (ACMHS, 2014).

Additionally, Alexander and Kroposki (2001) holds that the utilization of biomedical systems has also been lauded as significant by the nurses in enhancing the efficiency in their operations. With adoption of biomedical systems, nurses can no longer worry about axillary issues such as remembering passwords in each equipment handled in the supplies unit or operations of the patients' equipment. This is because they are capable of storing physiological features of the nurses such as retinal or fingerprints that can be used directly without being worried of security drawbacks or delays when critical and quick interventions are needed on a particular patient.

Differently, Crockerand Timmons (2009) state that the integration of technology into nursing field in the gerontology can help eliminate wastes and also reduces the workload issues that are normally experienced. Chow et al., (2012) agree with Crockerand Timmons (2009) stating with the utilization of information and technological devices, they can be able to keep track of the patients performance at any given time and while at the same time performing other duties all other the same time. Chow et al., (2012) holds that this reduces time wastage and enhances work performance of the nurses. Similarly, Pobocik (2015) posits that nurses have in the past used a lot of time tracking supplies and equipment that are needed by the patients. Nevertheless, with the introduction of RFID chipped technologies into the medical supplies and equipment needed, time management have become easier and effective to the nurses as product or supplier location can be done with a click of a button.

The application of robotic equipment have also come in handy for the nurses especially in lifting or carrying heavy parts or patients from one section to another within the hospitals effortlessly. In addition, Yeo (2014) opines that with the adaptation of technological

inventions, the nurses have positively hailed some of the devices incorporated into their operations as the main causes of stress relievers during the daily operations. Yeo (2014) holds that the introduction of data collection instruments have massively saved the nurses from routine patient data collection and monitoring since the systems have also been incorporated with analytical tools to help map out the final results and preferred diagnostic solutions for the older patients such as analyzing of blood pressure and sugar levels. Rachas et al (2015) further states that devices that imitate the decision making procedures of the experts have been very helpful for the nurses in finding safer and much quicker decisions about what the patients need especially in situations when the high medical doctors are not present at the time when the quick decisions have to be made.

In particular, According to Alasad (2002), the introduction of technology allowed the nurses to become more involved with the patients and giving them of the much needed care due to the positive impact technology gives them in terms of decision making allowing them to become safe and in control of the stations with the patients. Aari et al. (2008) supports Alasad (2002) stating that the having prior and effective mastery of the introduced technology is very important to the critical care nursing for the older patients. McGrath (2008) similarly opines that technology incorporation and mastery will ensure that compassionate caring is further enhanced a notch higher. McGrath (2008) further states with the introduction of technology, such as IT, the nurses are able to know their patients better and therefore give them the specific and customized services they need much easily and effectively.

Additionally, according to Yeo (2014) the introduction of newer technologies especially information and telecommunication linked devices have been viewed as assets by the practicing nurses as it aids them in accumulating continuous knowledge on their field when administering and caring for the patients. Rachas et al., (2015) agree with Yeo (2015) stating that with enough information being presented by the devices, nurses can build their knowledge base in a continuous manner without necessarily having to attend extra or additional classes part time.

## 4.2 The impact of the technologies on the patients' safety

Patient safety is the prevention of accidental or preventable injuries produced by medical care errors. While health care has become more effective it has also become more complex, with greater use of new technologies, medicines and treatments (WHO 2016).

Previous research conducted by Hofhuis et al. (2008) suggested that the introduction of technology had a negative impact on the nurse in respect to the giving psychological care to the older patients. Price (2013) and McGrath (2008) assert that the nurses perceive the introduction of certain types of technologies to the nursing and care department have increased the demands of the nurses and their time, allowing the nurses to spend less time with the patients in an attempt to establish a nurse-patient relationship that was previously seen. According to a study conducted by Noh et al. (2010) on the nurses in Finland, the early results showed that a minority of the nurses who participated in the research indicated that the introduction of the technologies at some point distracted them from giving the patients the much-needed care. This phenomenon occurred especially when a new technology was introduced to them in hurry without being given prior knowledge and technical information and knowledge on how to operate on them.

Other similar studies conducted by Almerud et al. (2008) also suggested that that the introduction of technology also increased the level of dehumanization and impersonality due to less and infrequent contact the nurses give to their patients "lacking the human touch"; an aspect that is highly needed especially by the older patients who feel they are being disconnected from the rest of the society by being placed in care facilities. Aari et al. (2008) supports Almerud et al., (2008) warning that care should be given in respect to the increasing proliferation of technology which may hamper critical care nursing and strip them off of their main purpose to the gerontology sector. Crocker and Timmons (2009) agree asserting that with the introduction of technology, the nurses have diverted their attention

and cared much on the management of the introduced technology and other physical devices rather that concentrating on giving personal and psychological care to the patients.

Similarly, Barnard and Gerber (1999) assert that with the new systems and devices being introduced into the medical arena, most of the nurses usually experience a difficulty in using the devices as they do not possess up-to-date knowledge to handle the existing machines and this can results to a lot of errors on their part. Barnard (2002) agrees with Barnard and Gerber(1999) stating that when the new equipment are introduced to the hospitals, the nurses are not usually given the necessary training programs as a way of introducing them on how the machines should operate.

Barnard (2002) also blames the complexity of the manuals attached to the new equipment are too difficult for the nurses to comprehend on their own without the help of a qualified medical professional. Antilla et al. (2011) also agrees with stating that in most of the cases most of the imported new technologies are usually programed to function on other languages and this can cause a problem if the language in the machines or the manuals is not comprehended by the local. Supporting Antilla et al. (2011), Doh (2012) states that disparities in the working environment of the nursing caring for the aging patients in hospitals and homes in view with the use of newly introduced technology shows a sign of disconnect due to issues such as reliability, ease of use and the responsiveness to the technology even with the patients themselves (Doh 2012). Other issues that have been pointed to increase the difficulty in incorporating technologies into the nursing care is the need for safety and security reasons given by the patients (Doh, 2012).

Differently, Holden and Karsh (2010), states that the ever changing scene of technology causes a nursing environment to become dynamic with the introduction of new technologies and this keeps on changing the complexity of the nurses and their work. Holden and Karsh (2010) further expounds stating that even though specialty training practices are usually a common feature to enhance the nursing depth of knowledge, the continuous spread of new knowledge that comes with the introduction of new innovations

makes it hard for the nurses to become updated in terms of their competence given the fact that most of them do not have time to attend extra training classes.

Desai et al. (2011) opines that patient care within the intensive care units of the adult patients does not only imply the usage and application of technology. This is because with the older patients instance of increased psychological stress is usually experienced which are usually caused by aspects such as sensory alterations, hallucination and delusions (Griffiths and Jones, 2011).

Reade et al (2011) similarly state that with the older patients' instance of sleep deprivation and impaired communications are also other factors that make technology integration harder. Additionally, aspect of anxiety and tremor instances are usually reported with patients who are impaired sensory. Reade et al. (2011) further state that even though the aim of technology integration into the older patients' ICU is to ensure lives are save, the emotional and psychological perspectives of the patients and the wellbeing have to be considered and it is with that that nurses are required to be up to date with the utilization of the introduced technology in order to assure them with their safety after their operations.

## 4.3 Recommendation on improving nurse experience in reference to modern technology

According to Jennings et al. (2009) technology that is usually recommended to be used for the purpose of clinical and nursing needs should ensure that it meets all the nursing requirements. Nevertheless, designing and the development of technology that specifically meets the needs of the nurses has been somewhat hard and this can be attributed to a number of factors in during the initial phases of the design. Wolf and Nellis (2011) supports Jennings et al. (2009) stating that modern technology introduced to the nurses should be ensure that it provides flexibility with the design models that can be used easily by the nurses without prior training for the uses. Wolf and Nellis (2011) propose that during the

design of the technologies the research and development team assigned with the work of creating new models of technological machines should be directed and given the standard elements that are directly to the day-today operations and activities of the nurses. Kelley et al. (2011) opine that even though the previous technological equipment and systems have tried to address the nursing care needs especially in the gerontology sector, the designs have fallen short in supporting the full needs of not only the nurses in needs of such devices but the patients as well.

According to Cornell et al., (2010), based on the study conducted on the gerontological nursing unit, based on the observations conducted, it was found that the nurses were characterized in making significant decisions in view of the way they should deliver services in an quick and effective way. Nevertheless, their work environment which was incorporated with the introduction of new technologies did not allow them to do such due to the complex nature of operating new and complicated devices (Cornell et al., 2011).

Oroviogoicoechea et al. (2010) assert that reaching the nurses is very important in regards to introduction of technology before it becomes underused or misunderstood by the people that should be in charge of handling them. To achieve this objective therefore, the hospital, management should ensure that an effective and clear objective is developed with an efficient team with the right kind of expertise needed assembled. Additional the medical professionals in gerontology should put together mechanism and management strategies that could spur up motivation of the nurses with realistic and effective timetables created and resource put up to ensure innovation implementation or integrations is done smoothly to avoid future errors and misunderstandings.

Differently, Viitanen et al. (2011) opines that before the implementation of new technology to help out with the elder patients, the management should be keen in involving the nursing in system creation and implementation and analysis at the earliest time possible to ensure that the nurses' needs are represented in the system to be implemented. Cornejo et al. (2013) similarly agrees that before considering to introduce new or modern technologies to

the nurses not only in the gerontology sector but other medical fields as well, considerations of the nursing contribution towards how they want the technology to aid or be featured should be highly considered (Lau, et al. 2010).

Furthermore, to ensure that the development and implementation of the new technologies is done in an effective manner, it is essential that it is conducted based on the clinical operations and practices. This means that the innovation technologies being included to the nurses should be converged to the already existing skills and knowledge values and strategies. It should be equally significant that the nurses are able to get feedback on the results of the adoption. Supporting Viitanen et al. (2011), Stayt et al (2015) state that this is because nurses not only need systems that will enhance the delivery of service but will also be capable of reducing the nurses demands especially at certain hours of the day in addition to reducing (ibid). Additionally, inclusions of nurses into the development and innovation implementation will be a better chance of understanding the nurses' needs such as the need to include technologies that can reduce the burden of work and consequently influence their retention in their professional fields (ibid). This will be a better chance in reducing errors and issues such as inefficient work schedule and patterns, documentation errors and missing files and supplies.

Arrangement of regular meetings for the nurses should also be another approach that should be utilized as it will aid in disbursing support and help to those individuals who need support learning how to use the devices integrated into their environments. Differently, Wilkins (2009) holds that based on the clinical practices, nurse individuals need to be highly motivated and assured that the devices and innovations introduced are aimed at helping them achieve effectiveness in their operations rather than being a replacement for them. They should also be educated on the need to understand their functionality as most of the equipment are not assigned to be used by higher medical professionals alone but they are also included to utilize such equipment since they will be with the patients in most of the instances. De Veer and Francke (2009) supports Wilkins (2009) stating that involving the nurses as the main end-users of the technology in the earliest possible time will most

probably lead to better adoption of the technologies in addition to also being able to identify how such newer innovations can be utilized for other effective individual experiences.

Differently, the social inclinations can also be considering a mitigation measure to reduce the negative effect that can be caused by integration of technology in the nursing practices. To that respect therefore, Venkatesh and Davis (2000) opine that an effective corporate culture is needed for the implementation of an innovative approaches., This therefore means that good and active leadership that can be able provide training and supervisory support will be a positive step forward in ensuring that the integration of innovations are not met with negative implications. Wang et al. (2008) agree with Venkatesh and Davis (2000) stating that with innovation absorption requiring time in any sector in an organization, the environmental aspects of the medical institutions such as procedures and managerial approaches and systems need to be examined in order to ensure that the nursing staff in the gerontology unit have enough time to equally understand to use them appropriately.

Thirdly, Van de Castle et al. (2004) states that the practicing nurses also need material and support from their superiors in order to compared why integration of the much-needed technology is not only significant for the hospitals but the patients as well. Therefore, it is equally essential to educate them for them to understand and grasp the much-needed technical skills that will be required to operate the new devices introduced into their working environment (Weber et al., 2009).

# 5 AIM AND PURPOSE OF THE STUDY

The first objective will be to find out previous research on the modern technology surrounding gerontology in Finland. Secondly, the research aims to find out nurses' experiences of modern technology in gerontology within the Finland. Thirdly, the research also aims to find out previous studies on the safety of modern technology in regard to gerontology in Finland.

Research questions:

1. What are some of the nurses' experiences of modern technology within Finland?
2. What are the safety measures taken to enhance gerontology application in Finland?

# 6 RESEARCH METHODOLOGY AND IMPLEMENTATION OF THE STUDY

## 6.1 Literature review

The literature review ensures that the research is conceptualized from already existing research. A systematic literature review shows a study method that identifies, appraises and evaluates evidence from existing scientific studies effectively. That being said systematic literature review sticks to the principles of scientific studies based on a research plan and its objective is to reduce bias and other issues that can occur during a research study. Literature review is therefore an approach that is a follow up of planning via use of specific phases or concepts. The stages include making the research plan, define the study questions data search, study and evaluation to draw up meaningful conclusions and recommendations. The research plan is important for the research as it provides it with the appropriate plan a guideline for the study. Other research phases of the systematic literature review include inclusion criteria that are utilized to focus on the research participants, outcomes of the research designs used. Moreover, the significance of the literature review responds to the research questions effectively and critically with the most efficient objectivity and intelligence.

The research procedure is applied in this literature review. This analysis follows the overall approaches and guidelines of a systematic literature review and follows the systematic stages through previously planned research study stages.

## 6.2 Literature Search

The sources that were used for the literature review of this research studied were collected from article databases such as Elsevier, OnlineWiley Google Scholar and other online manual searches. The manual online searches were done through the use of different key words and phrases in order to unearth relevant articles which contained adequate data on the topic of research. The most effective mode of online search was mainly done through the use of a combination of words such as nurse, healthcare, aging population, innovation and modern technology. With the search being broad, the researcher was able to narrow down the search to the most relevant articles that could be used for the research. To achieve this objective, the research was able to briefly read through the given abstracts and given conclusions of the articles to determine the reliability and relevance of the articles that was to be used. After reading through articles identified, the selection on the final documents to be used was done using the inclusion criteria.

The inclusion criteria of the literature review included articles that were

- Written in English Language
- Scientific publications and journals, doctoral and master thesis was also included.
- Peer-reviewed research
- Most of the articles published between the years 2000-2016
- Articles that could be fully accessed
- Articles that could respond to the research objective and questions
- Articles that studies the inclusion of technology in the nursing and health care units in addition to the gerontology sector.

All the other articles that could not meet the specified criteria were omitted for this study.

The following table highlights the articles used in the research

Table 1 Data search

| **Database** | **Key terms** | **Results** | **Chosen on the basis of title** | **Relevant Studies** |
|---|---|---|---|---|

| | | | **and abstract** | |
|---|---|---|---|---|
| CINAHL | Modern technology in nursing and health care | 150 | 30 | Alasad (2002)<br>Antilla et al. (2011)<br>Barnard and Gerber (1999)<br>Burdick and Kwon (2004) |
| Bio Med Central | Nursing experience, patient safety and modern technology | 110 | 22 | Aari et al. (2008)<br>Alexander and Kroposki (2001)<br>Almerud et al. (2007)<br>Banks et al. (2008)<br>Barnard (1997)<br>Blazun et al. (2012)<br>Bonini et al. (2002) |
| Google Scholar | Patient experience and modern technology | 120 | 24 | De Veer and Francke (2009)<br>Desai et al. (2011)<br>Broekens et al. (2009)<br>Chiw et a. (2012)<br>Cornejo et al. (2013)<br>Cornell et al. (2010)<br>Croker and Timmons (2009)<br>De Bruins et al. |
| Science Direct | Nursing experience and modern technology | 90 | 18 | Holden and Karsh (2010)<br>Kiekkas et al (2006)<br>Locsin (2010) |

| | | | | |
|---|---|---|---|---|
| | | | | McGrath (2008)<br>Purkis (1999)<br>Reade et al. (2011) |

## 6.3 Data analysis

The selected sources from the online searcher are to be analyzed using content analysis technique. Content evaluation is normally used conventionally for the analysis of research data. With the use of content analysis, the researcher was able to evaluate different set of data at the same and be able to describe them effectively. Kankkunnen and Vehvilainen-Julkunen (2003) states that with the utilization of the content evaluation, the researcher is offered with an effective means of formulating research reports and findings through utilization of a systematic manner in terms of data categorization based on some of the key words and phrases.

Kankkunnen and Vehvilainen-Julkunen (2013) states, that content analysis can be in various forms such as inductive, deductive, that is originating from data collected from the research participants or use of data from theoretical angles borrowed from other researched. With the inductive content evaluation technique, the researcher usually moves from a move specific angle to a more generalized perspective in making research conclusions. This means specific or individual instances are usually examined separately and combined with other individual in distances to develop a more generalized research findings and conclusions. The researcher will utilize the inductive content evaluation techniques to analyze the data for this research on nurses' experience, patient safety and inclusion of modern technology into the gerontology sector in Finland.

Specifically, therefore, the inductive content evaluation will involve the researcher critically reading through all the chosen research, analyzing their data given and thereafter analyzing the data on the research question on the literature review. The feedback to the questions will then be analyzed based on the studies using similar to the original words or phrases.

Additionally, single words or phrases will be utilized as analytical concepts during the reducing stage. After all the articles have been critically read and the reduction process is done, the reduced articles and expressions will then be collected and grouped into listed based on the research questions. The similarities and difference between the reduced words and phrases will be compared in the clustering or the coding phase of the data evaluation. The coded phrases and words will further be sub-categorized and given specific names that will act as a representative of all the contents in each subgroup. The last stage of the content analysis will involve combining all the subcategories that have similarities into main groupings.

# 7 RESULTS

## 7.1 Modern technology surrounding gerontology

From the secondary sources such as that of some of the modern technologies that were identified as being used in various countries including Finland included using the research methodology that had been specified in the prior section. The following part shows the outcomes of the research based on the journals identified by the research.

According to Frisardi and Imbimbo (2011) smart homes is one of the technologies used in gerotechnology. The technology embraces technologies such as Assisted Smart Dwelling Technology (ASDT) that allows sensory monitoring of elderly patients to identify their behaviour movements and the needs to enable the nurses to respond to them quickly. Other technologies that come with this technology are sensors and radio frequency identification of patients.

Cohen, Kampel and Verloo (2016) research explored the acceptability of intelligent wireless sensor system technology that was being used in homes for the elderly to monitor and diagnose the patients. The technology was fitted in such a manner that it could identify the patients, memory; identify patients' confusion and depression levels remotely. This technology enhanced patient's safety and enhanced nursing experiencing by making it easy

for the nurses to monitor patients and provide appropriate and timely responses to patients.

Rodeschini (2011) study was an analysis of previous studies that have explored the relationship between older people and technology. The study noted that there is a poor relationship between use of technology and elderly people. As per the this study, most of the technologies were developed without involving elderly people or users, therefore this technologies had poor relations with elderly people as they do not know how to used them. It was noted that designers of this technology had nurses in mind and not the elderly people.

Telemedicine is one of the technologies that has enhanced the aspects of Gerotechnology. It is now possible to take care of elderly patients at the comfort of their homes. Telemedicine makes it possible for prescriptions to be made by doctors to patients online (Castle, Ferguson and Schulz, 2016).

Marchibroda (2015) study classified the technologies that are used in gerotechnology into three categories which were technologies that support social communication of elderly, technologies that enable the patients to manage their weight such as weight apps and blood pressure apps in smartphones. The other category of gerotechnology was the technologies that supported interaction with healthcare system such as telemedicine, electronic health records. This study mainly highlighted technologies such as telemedicine and electronic heath records as the most commonly used technologies in the gerotechnology.

Blake (2010) identified mobile phones as one of the major devices that is useful in health monitoring of elderly patients. The study indicated that the short messages can be sent by elderly patients to physicians to express symptoms that they have. It was noted that the mobile phone system has been successfully used to monitor patients with chronic illnesses such as cancer, diabetes and asthma.

## 7.2 Nurses experience on modern technology and patient safety

Meiner and Schnepp (2014) research found that there two viewpoints that nurses held in regard to the new technologies. Some indicated that the technologies made their work easier by eliminating tedious manual processes such as manual patient monitoring and record keeping. Others increased that the technologies complicated the nursing work and it made them more of information systems experts than nurses. Nurses who were interested in technology had a difficult experience with the modern technologies compared to those who had interest in technology.

Fairley, Coakley and Moss (2014) identified that nursing experience that emanate from technology contributed to the nursing effectiveness by enabling nurses to work for definite number of hours. It reduced the number of nurses required to monitors patient hence enabling nurses to rest and has work life balance. This improved nurses' motivation and effectiveness when working. The study also identified that the technology enhanced patient safety by reducing occurrence of serious incidences in the healthcare facilities. Also it reduced the concurrence of patients' infections in the facilities. It also reduced the patient's length of stay in the hospitals.

Zhou, et al. (2015) study identified that the safety climate in hospitals with technology was high compared to hospitals that did not have modern technologies. The main barriers to the use of the technology identify were feat of blame, Nurses feared being blamed for using the technology for negative incidences caused by technology.

Chang and Chang (2008) also found that gerotechnology had positive effect on nursing motivation since it reduced workload that the nurses had such as recording keeping, appointments and patients interactions as the above mentioned could be done online or virtually.

## 7.3 The impact of gerontology on patients' safety

Lassere, et al (2015) review identified that quality of care highly improved through the modern technologies. The technologies such as the robotics, electronic monitoring of patients and electronic health records reduced the constant between patients which reduced chances of patient infections. They also ensured that patients were treated in environments where they felt safe and comfortable.

The study by Wang et al (2014) indicated that patients felt comfortable when treated at home. Technologies such as telemedicine and electronic health records made it possible for doctors to make prescriptions and diagnose patients virtually.

Swinglehurst and Greenhalgh (2016) found the back office work of technology that includes electronic health records coding ensured that patients' records are intact and are secure. Electronic health records are crucial in monitoring patient safety as well as in tracking the patient's health performance. It is much valuable for patients with mental illnesses such as Alzheimers Disease and may have memory difficulties. Chang and Chang (2008) study further identified that the patients developed psychological trust on nurses who were well conversant with technology than those who were not. The table below shows the outcomes:

Table 2 Research outcomes

| **Research objective** | **Researcher** | **Findings** |
|---|---|---|
| Modern technology surrounding gerontology | According to Frisardi and Imbimbo (2011) | Smart homes technologies Assisted Smart Dwelling Technology (ASDT) |
| | Cohen, Kampel and Verloo (2016) | Intelligent wireless sensor system technology to monitor and diagnose the elderly patients. |

| | | |
|---|---|---|
| | Rodeschini (2011) | There is a poor relationship between use of technology and elderly people. |
| | Castle, Ferguson and Schulz (2016) | Telemedicine |
| | Blake (2010) | Mobile phone messaging technology |
| Nurses experience on modern technology and patient safety | Meiner and Schnepp (2014) | Technologies made their work easier by eliminating tedious manual processes such as manual patient monitoring and record keeping. |
| | Fairley, Coakley and Moss (2014) | Technologies reduced the number of nurses required to monitors patient hence enabling nurses to rest and have work life balance. This improved nurses' motivation and effectiveness when working. |
| | Chang and Chang (2008) | Gerotechnology had positive effect on nursing motivation since it reduced workload that the nurses had such as recording keeping |
| The impact of gerontology on patients' safety | Lassere, et al (2015) | The technologies such as the robotics, electronic monitoring of patients and electronic health records reduced the constant between patients which reduced chances of patient infections. |

| | | |
|---|---|---|
| | Wang et al (2014) | Technologies such as telemedicine it possible for doctors to make prescriptions and diagnose patients virtually |
| | Swinglehurst and Greenhalgh (2016) | Electronic health records are crucial in monitoring patient safety as well as in tracking the patient's health performance. It is much valuable for patients with mental illnesses. |

Source: Created by author

# 8 DISCUSSION

## 8.1 Analysis of modern technology surrounding gerontology in Finland

First, in the case of the gerontology sector in Finland, with the shortage of medical professionals becoming worse towards the start of the new millennium, many of the rural centers and other hospitals had to rely on a few professional practitioners to work around their tight schedule in order to meet the increasing demand from the older population and the older patients admitted (Wolf and Nellis, 2011). This has therefore means that more and more operations and tasks had to be directed to the nurses and this took place through their reception and in the contexts of activities such as telephone advices, documentation and communication with the patients both through mobile and electronic mail channels.

Nevertheless, with the existence of barriers that inhibit them from actively utilization such technologies other designs have been highly needed to increase the usability of the same. Some of the barriers in existence include technological complications with their usage due

to the complexity in their user interface, age related capabilities and lack of enough information and support knowledge to operate such mechanisms (Wilkins, 2009).

## 8.2 Nurses experience on modern technology and patient safety

The introduction of modern technologies has increased improved the operations for the nurses in the gerontology field by enhancing the safety and autonomy of dementia patients and assist the nurses in their operations has been labeled as aids and the provisions of adaptations. Similarly, the introduction of smart technologies into the nursing field has also increased safety for the patients which have become significant to the nurses in reducing the errors associated with nurse carelessness due to fatigue or stress. In addition, interaction of technology has also in the overall sense improved the quality of the older patients' lives by enhancing their physical, psychological and cognitive abilities.

Nevertheless, nurse practitioners perceive the introduction of certain types of technologies to the nursing and care department have increased the demands of the nurses and their time, allowing the nurses to spend less time with the patients in an attempt to establish a nurse-patient relationship that was previously seen. Likewise, in the patients' angle, the integration of such technologies also posed a risk of increasing the level of overdependence with technology due to the reduced time of fostering nurse patient's relationships.

Even with such negative implications of technology, some of the propose suggestion to enhance their integration into the gerontology nursing health care include involvement of the nurses before the design and introduction into their working environment and providing them with the much needed information and knowledge that would ensure increased ease of use on the devices introduced to reduce the difficulties experienced with their usage.

## 8.3 Impact of gerontology on patients' safety

before the introduction of the technologies to help the patients exercise to was difficult for them to take part in the physical activities (Studenski et al., 2010) further state that the introduction technologies have been significant in providing them with the needed safety and monitoring of their internal bodily functions to ensure that they exercise within their limited (Pichierri et al., 2012).

Also there has been has been the adoption of better and less invasive treatment procedures with the help of new medication innovations and techniques. For instance, the use of laparoscopic equipment during surgical operations in the patients' abdominal areas can now be done precisely with the use of small incisions on an individual skin. Treatment through the utilization of colonoscopies and catheters for both the bowels and blood vessels are other innovative and technological applications in the medical field. This has enhanced patients' safety and confidence in the new technologies for nursing.

## 8.4 Ethical considerations, validity and reliability

One of the first ethical considerations that was considered is to avoidance of instance of plagiarisms of the content in other research articles used. The collection and utilization of the secondary data will at times present less ethical considerations unlike the use of data collected directly from the research participants. Furthermore, another of the ethical angle to be highly considered is to ensure that only credible information and research articles were adopted for this research. To ensure this all he research articles that were used had to be verified and critically analyzed before use.

Additionally, the research reliability was also carefully considered through ensuring that instance of data bias and research errors were eliminated. Moreover, the research validity was also reached through using relevant previous research articles are used in regards to the

research topic being studied. Additionally, well structure methods of collecting relevant previous articles were used to reduce instances of bias and ambiguity of the data used.

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