



LAUREA
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Health innovations in elderly care

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Health innovations in elderly care

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Degree Programme in Nursing
Bachelor's Thesis
May, 2016

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Year	2016	Pages	45
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Demographic transition has taken place in the world population and this has led to an increase in the number of older people in the world. Aging has been associated with chronic diseases and disabilities. This situation has increased with time and has significant challenges and implications to the administration, health and social services provisions etc. For this reason, there has been a need for health innovations that would ensure the continuity of quality elderly care and ensure healthy aging. To achieve health innovations, there is need to know the existing innovations. This study aimed at answering the question of “What health innovations are there in elderly care?”.

A systematic literature search was conducted through Laurea’s electronic databases . Three databases were used; CINAHL with fulltext (EBSCO), ProQuest Central and SAGE Premier 2012. With a suitable combination of search terms and limitation to articles published after January 2010 or before December 2016, the initial search yielded a total of 283,117 articles. These articles were finally reduced to 9 used in the study following a step by step application of the limitation criteria and a critical appraisal of the articles. The 9 articles were coded and analysed by qualitative analysis.

The findings showed that health innovations in elderly care have taken place in five main areas that included technological innovation, medical innovation, innovation in education and communication, environmental and economics innovation, managerial innovation. However, technological innovation is at the centre of most other health innovations.

Keywords: Health innovations, Elderly care, gerontology, geriatrics

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1 INTRODUCTION

The world human population undergoes a constant aging process. Demographic projections in several countries indicate the age structure of the elderly to increase significantly with the greatest part of the population consisting of the very old people. However the aging population is facing major health problems with chronic illnesses, disabilities, physical and moral impairments. In addition, the human population world-wide increased rapidly and death rate and fertility declined significantly due to improvements in health care systems and technology which lead to human life expectancy from birth increased since 1950 onwards by about 20 years on average enabling people to live well over 70-80years (Behr & Sciegaj, p.83, 2010).

Innovation is anything that creates new resources, processes or values or improves a company's existing resources, processes or values (Christensen, Anthony & Roth 2004 p 293). Applied to nursing, innovation in elderly care is the introduction of new ideas, methods or actions in order to improve on any of the following: the health of the population, the staff's skills, the satisfaction of both patient and care providers, the clinical outcome and the cost of the care. (Bub 2013).

The need for innovation in elderly care is permanent as technology and medicine change rapidly with time as well as human nature and habits. Nurses being at the center of the delivery of health care, any innovation inspired by the experiences, ideas or expectations would provide an optimized outcome. Therefore nurses should be encouraged to take active role in innovation processes.

According to Hughes (2006), many successful innovations worldwide have been developed and implemented by nurses. Nurses are at the forefront of nursing actions and constitute more than 80% of health care delivery team members, there is need for them to also be at the forefront of innovations. From the foregoing discussion, we can easily notice that many literature or background reviews have been done in order for innovation projects to be conducted. However, as innovation is continuous, a recent review needs to be done to assess the current situation prior to further innovations.

A qualitative literature review was conducted on professional articles in order to find out the types of health innovations that have been taking place in elderly care. The data were extracted from articles published between 2008 and 2016 and available through Laurea's library databases. And an inductive content analysis was used to reach conclusion of the study.

The purpose of this study is to serve as a background study for our technological idea to improve the existing nursing care for elderly people. As students, during study placements and partial work in different nursing environments, innovation ideas are developed aimed at improving the nursing profession. This study will then help to understand the limitations of the existing technological innovations in the nursing care of the elderly people for any further improvement.

2 Purpose statement and research question

The purpose of this thesis is to find out the types of health innovations that have taken place in elderly care. In other words this paper sort to answer the research question: “What kind of health innovations are there in elderly care?”

3 Definition of concepts

The concepts used in this study are wide with varying understandings and interpretations based on subjective backgrounds. However, for the purpose of this study, we are going to limit our definitions in order to share our focus points and avoid ambiguities. We will therefore define the two terms: health innovations and elderly care.

3.1 Health innovation

The aim of innovations in health care is to make the delivery of care more convenient, more effective, and at a low cost (Herzlinger 2006). Health innovations are therefore processes, actions, procedures and applications that enhance quality health care delivery, promotion and rehabilitation to the society at minimal cost. According to Herzlinger (2006), health innovation focuses on three aspects: technology, consumer, and business & policy.

By improving medical services, diagnostic methods, surgical procedures, drugs and drugs delivery systems as well as documentation systems, technology has been used as an innovation tool in health delivery. We therefore talk of technology focused health innovation (Goodman 2014).

On the consumer point of view, health innovation refers to the involvement of the consumer into the care delivery process in order to minimize costs and increase personal control over their health care spending (Herzlinger 2006). Getting consumer involved into their care plan would help achieve one of the purposes of innovation: enhancement of quality health care delivery. The efficiency of the health care delivery is also improved by making the services accessible to the patients and clients, for example; proper documentation system in the Finnish health care system makes it possible for the patient to access his or her file electronically regardless of his location and time. In this case, the patient can request renewal of prescriptions and follow up and take part in his medical guidelines or health care plan easily (Kanta 2015). In addition, health care delivery is improved as waiting times are reduced during doctors' appointments when the consumer is taken into account during care planning.

In the business and policy aspect, health innovations in this area would involve the implementation of policies that sort of make various services available at the same place. In this way, the patient would not need to move through various health institutions to get various needed health services. It makes it possible for a cardiac patient for example to receive X-ray, ultrasound or electrocardiogram and angiography services at the same hospital institution. This innovation

reduces movement of the patient and improves patients follow up. However, this innovation is not available in resource limited settings (WHO 2005). Also, health innovation in the business and policy aspect tend to harmonize the health care delivery by enforcing laws and ethical guidelines.

In this paper, health innovation encompasses all the above mentioned aspects. However, some points in the business and policy aspect such as laws and decisions would not be discussed as health innovations.

3.2 Elderly care

According to WHO (2001) an elderly person is a person aged 65 years and above. The care provided by health and allied health professionals to this group of people is what referred as elderly care. This care enable the elderly person or patient to live a longer, quality and healthy life. Therefore elderly care is the holistic care delivered to an elderly patient or client in home care premises, hospitals, health centers, home for elderly people and service house for elderly. This care includes personal care such as activities of daily living, medical care and care management, dental care (statistics Canada 2008)

Together with Canada and the United States of America, Finland uses high standard assessment instruments, such as the RAI (Residence Assessment Instrument), to plan quality elderly care (European Commission 2013). In Finland and other countries, the care professionals include, nurses, doctors, practical nurses, physiotherapists, nutritionist, social workers and care assistance (Teperi, Porter, Vuorenkoski & Baron p.54, 2009). Also elderly care is provided at four different settings as shown in the table bellow.

Elderly care setting	Type of health care provided
Home care	the care delivered at patient homes or at day-care centers
Sheltered housing	Care provided in apartment complexes for the elderly which include services such as meals delivery, nursing care, and assistance with activities of daily living.
Residential homes	Includes institutions for elderly with the higher degree of disability for independent living. 24 hours care is provided.
Health center	These include in-patient wards such as health center hospitals where the need of medical care is indicated

Table 1: Types of health care services available in elderly care

4 Systematic litterature review

The research methodology used in this paper is a systematic literature review focused on five processes defined by Siu & Comerasamy (2013, p46-49). The research was conducted with a

rigorous search in order to synthesize and summarize findings to answer the question: “what kind of health innovations are there in elderly care?” For this purpose, the study included a literature search using predefined databases, an assessment and appraisal of the validity of the study, assessment of the quality of the data, extraction and analysis of the data and presentation of the findings.

The aim of this research was to review and classify the different types of innovations that are present in elderly care. The demographic transition worldwide today is imposing a significant need for greater attention in elderly care as the aging process keeps progressing in the world (Linderman, Wang, Steinmetz & Redington 2010, Jännes, Hämäläinen, Hanski and Lanne 2015). Significant innovations in elderly care would thus help to overcome these challenges. With the importance we attached to this area of health care, a rigorous systematic review of relevant literature was conducted using three accessible databases from the nurses’ libguide of Laurea’s university databases as shown in the table 1.

In this study, the literature review was made in conformity with the approach defined by (Khan, Kunz, Kleijnen & Antes 2003) and the guidelines of the American Journal of Occupational Therapists (2015). According to these, a systematic review consists of:

- Stating clearly the problem to be addressed in the review,
- Searching and identifying relevant sources (studies) when keeping in track the reasons for inclusion and exclusion
- Assessing the quality of the sources selecting the sources with designed criteria (acceptable level of the design); in-depth assessment.
- Summarizing the evidences by synthesizing the data: subgrouping /meta-analysis...
- Interpreting the findings

To answer the study question of “what kind of health innovations are there in elderly care?” the above mentioned steps of a literature review in application to this study are discussed below.

4.1 Literature search

A systematic literature search is based on identifying and extracting the most relevant and available published evidence based research materials that answered a research question in the most understandable form (Khan & al. 2003). This search, in order to meet the standards and recommendations needs to be reproducible and must be objective and thoroughly done free of biases and within the limits of the available resources.

For the purposes of this paper and to achieve its objective, three databases from the Laurea’s library guide of nursing. The selection of those databases was based on recommendations

from the library staff of Laurea University of Applied sciences, Otaniemi about their reputations and relevance in this field of study. The available data bases at the start of the search were ten in number and a decision was made to use seven out of the ten for the search. However, after a couple of weeks spent on cumbersome searches and seemingly impossibility coupled with difficulties to restrict the results to the most relevant articles to this study, the assistance of the librarian was sorted. With the assistance of the library staffs, the databases were trimmed down to the three most relevant and most recommended evidence based ones: CINAHL with full text (EBSCO), ProQuest Central and SAGE Premier 2012.

The search of articles within the databases then selected was made with five combinations of the search terms: Innovations, elderly care, geriatrics, gerontology and aging. Because of the diversity of the meaning of the word “innovation” as applied in different fields, it was not easy to limit the relevant articles with the use of this key word alone to our nursing context. However, upon running the combinations of search terms through the search engines of the databases suitable relevant data sets were retrieved and table 1 was produced as result of the wide search without limitation.

	Health+ Innovation+ Elderly Care	Health + Innovation+ Geriatrics	Health + Innovation+ Gerontology	Health + Innovation+ Aging	(Health Inno- vations)+ (Elderly care OR Geriatrics OR Gerontol- ogy Or Aging)	Totals
CINAHL with full- text (EBSCO)	93	93	9	114	253	
ProQuest Central	45915	7368	7961	90757	120915	
SAGE Premier 2012	224	859	1187	7369	0	
Totals	46232	8320	9157	98240	121168	283117

Table 2. Recapitulation of the results of the search using combined search terms within the databases.

4.2 Exclusion and inclusion criteria

Exclusion and inclusion criteria are the criteria that are set before the review is conducted (Bettany-Saltikov 2012). For this review study, the selection of articles was made based on criteria that were discussed and agreed among the authors of the review. According to Meline's (2006) definition of inclusion criteria, for this study, the exclusion and inclusion criteria are as shown on the table below (table 3).

Inclusion	Exclusion
Be a full text article with abstract available.	Not free article
presence of relevant key word(s)	Not relevant to the study
Be published after January 2010 and before December 31, 2016	Studies done in Africa, Asia,
Be written in English language	Studies done in other fields than nursing / medicine.
Be sourced from either an academic journal, a conference paper/proceeding, a working paper, a book or a government / official publication.	Not found in the laura databases
Be a study conducted either in Europe. Canada or USA	Not relevant content Not Health related

Table 3: Inclusion and exclusion criteria

Also, to minimize bias in the selection process for the primary studies, a predefined protocol was also agreed upon by the researchers in conducting the search (Kitchenham, 2004). The protocols for this study were clearly defined as follows: the selected articles from each data basis were ranked according to relevance. Then the first 20 articles from each data base hits were recruited for examination, the articles selected out of the 20 had to meet the selection criteria which is defined in the table 3. The flowchart below is a step by step guide to how the articles were selected for this paper.

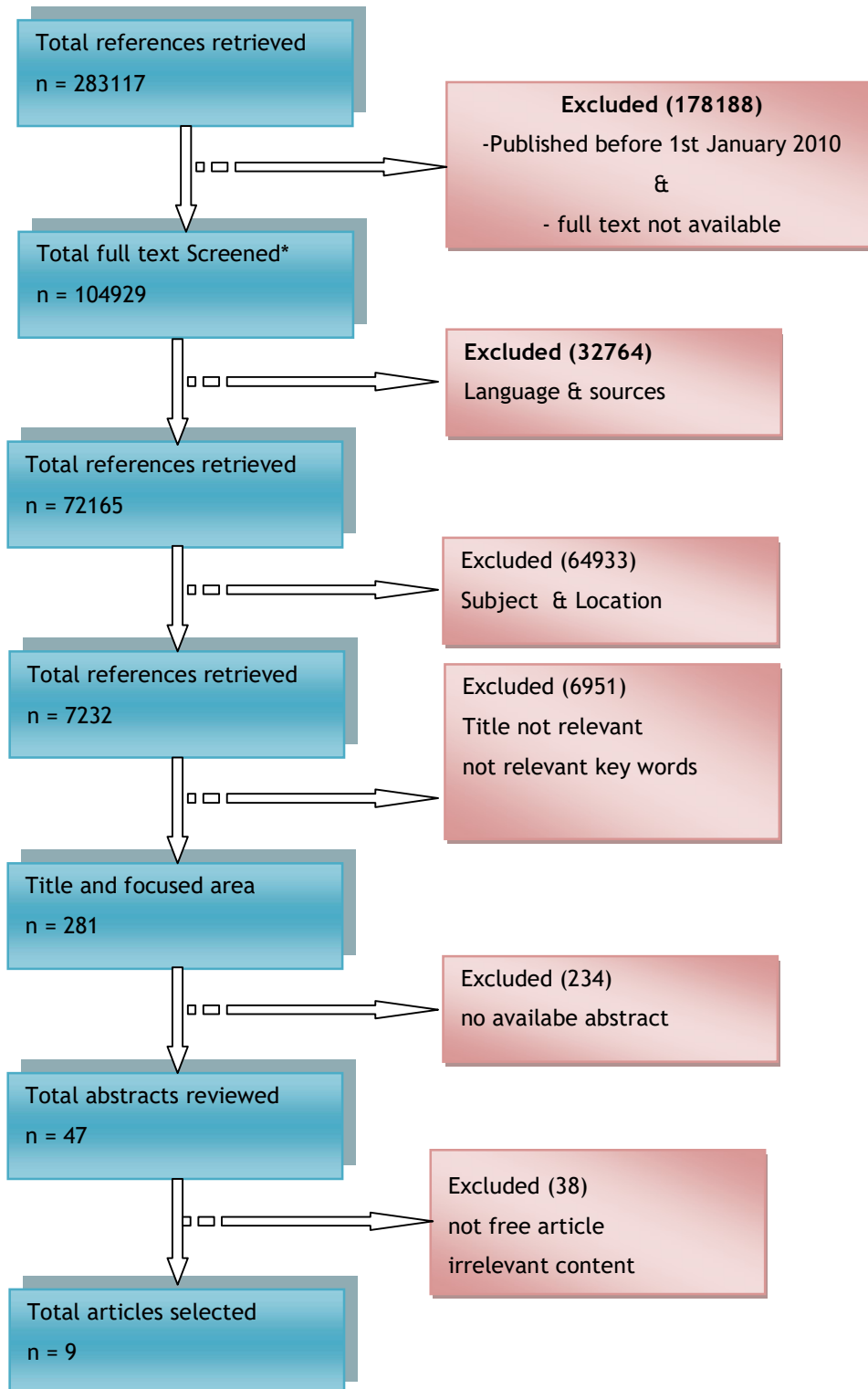


Figure 1. Flow chart of the data selection process.

4.3 Data extraction

Referring to Dykiert data extraction is the collection and recording of the relevant data from the selected articles to be reviewed. For relevance and reliability, the data extraction must be as precise as reported in the articles. Furthermore the data extraction is done independently by two authors. Data extraction is made using some predefined form that are adjusted according to the authors of the study. The form used for our data extraction is an updated form of the version used by Wallace and Wray adapted by the Cardiff Business School (Cardiff Business school, 2016). For the purpose of this paper, the protocol adopted for the form was to limited the form by only including the authors, the title, the year, the findings and the observations. The data extraction is adapted to suit the purpose of answering the specific research question.

The purpose of the data extraction is to to answer the research question by providing most logical evidence based answers that supports facts presented in the findings of the studies. For this purpose to be achieved, a critical reading of the selected studies is done in order to extract just the information that is relevant.

For this paper, the authors read the articles separately and recorded the data to the extraction table designed by mutual agreement between them, see Appendix 1 for the extracted data. The data extracted were coded in order to ease interpretation and presentation of the findings. The coding protocol was designed as follows:

.The first digits represent the articles used for the review, therefore, we had 1-9 for the first digits.

.The second digits represent the order of the data extracted by article ,example 1.2.x is the second data extracted from the first article

.The third digits represent the level of extraction of the data. The number 0 in the third digit represents the raw data (extracted individually by authors). Any other number represents the level of extraction (extracted by consensus by the authors). For example 1.2.0 is the second raw data from the first article whereas 1.2.1 represents the second level of extraction of the second data from the first article.

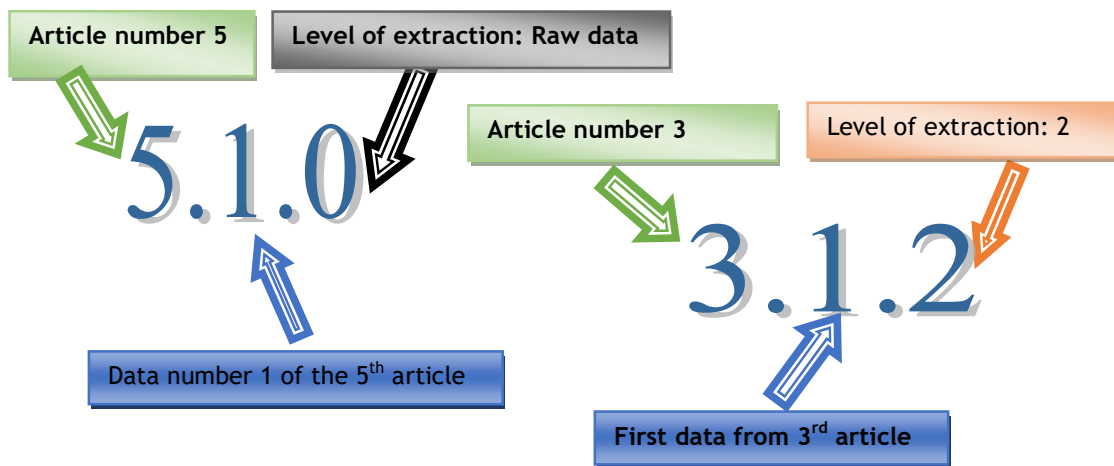


Figure 2: Illustration of data extraction coding

The table 4 bellow is a sample table of data extraction.

Article N°	Articles	Data extraction level 1 (Raw data)	Data extraction level 2	Data extraction level 3
1	Bailey, Foran, Scanaill & Dromey. 2011. Older adults, falls and technologies for independent living: a life space approach	Pedometer, daily activity log, Video-monitoring, remote health monitoring, fall detectors, door monitors, bed alerts, pressure mats, smoke and heat alarms, electronic sensors 1.1.0	Technological physical activities' monitoring of the patient 1.1.1	Technological innovation in patient safety 1.1.2
		Two dimensional house plan, smart homes with increased intelligence in home appliances 1.2.0	Housing innovation for independent living 1.2.1	Environmental Innovation for patient autonomy 1.2.2

Table 4: Sample table of data extraction

4.4 Data analysis

Data analysis begins after the data collection even though the process starts in the mind of the researcher(s) from when data collection begins (Speziale & Carpener, 2007). Together with the synthesis of the data, it is an important but complex part of the process of interpretation of the research (Sui and Comerasamy, 2013). Data analysis is the categorization of the findings set into patterns. According to Speziale and Carpenter, 2007, it requires the personal skills of the researcher including, intuitive, sensory intuitions, imaging and cognitive comparisons. It is therefore a sorting, grouping and synthesis of data.

In this paper the authors agreed on an inductive data analysis process which consist of moving from details to more general picture of the phenomenon (Speziale & Carpener, 2007).The authors independently extracted the data from the selected articles used in the review They jointly coded the extracted data as illustrated in table 2 in the appendix 1. The coded data are categorized in such a way that similar words, phrases and themes occur in the same area (field) of health innovation in elderly care.

The raw data extracted individually were sorted by consensus after comparison of data and discussion into 20 sub-categories. These by consensus between the authors after detailed discussions and consideration were further fused into 5 main categories which are technological innovations, medical innovations, innovations in communication and education, environmental and economics Innovations, and managerial innovatrions.

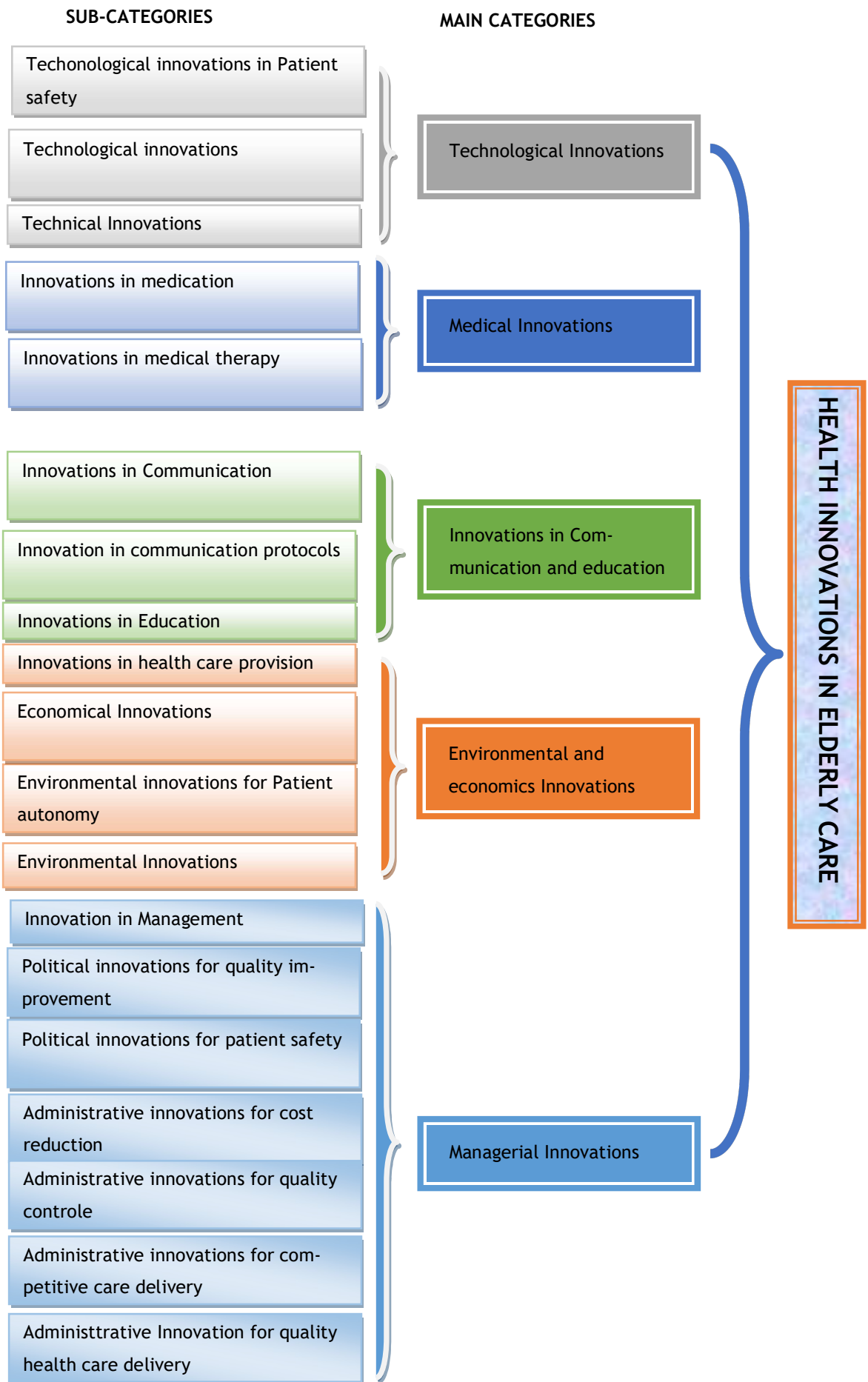


Figure 3. Flow chart of the mains and sub-categories.

5 Findings

Through an inductive data analysis of the articles selected, five main categories of innovation were produced from the data extraction and analysis in response to the research question. These categories are: technological innovations, medical innovations, innovations in communication and education, environmental and economics innovations, managerial innovations. Findings from this work are therefore going to be presented in these five main categories or themes. For the purpose of clarity and understanding, a critical appraisal table is included in the appendix 1.

5.1 Technological Innovations

Bailey, Foran, Scanaill and Dromey (2011) in their studies conducted a qualitative research on technology of independent living in Ireland (TRIL). They based their argument on 42 articles and 8 participants to highlight the use of new technology to monitor patient's activity of daily living through logs and video- monitorings, fall detectors, remote health monitorings, bed alerts, heat and smoke alarms electronic sensors... In their study, Bailey & al., referred to the technology of independent living as assistive technologies and defined them as systems that makes it easier and safer for a task to be performed by elderly, allowing them to perform a task they would otherwise be unable to do. In line with Bailey & al.(2011), Jannes, Hämäläinen, Hanski and Lane (2015), argued the important role of gerontechnology in supporting daily life as it compensates for the decline in functional ability in the elderly. They carried out their argument through a systematic review using 30 articles, 341 minutes of recordings and 68 pages of transcripts texts from interviews with specialists, services providers and public decision makers.

Siciliano, Redington, Lindeman, Housen & Enguidanos (2013) carried out a qualitative research in which 30 articles were used and 12 participants took part in a semi-structured questionnaires on a diffusion of technology aimed at reducing the high cost of health care for elderly people resulting from medication errors. Through out their study, Siciliano & al. (2013) focused on the use of technology such as telemedicine, electronic health records, electronic prescriptions, videoconferencings to contain the growth of medication errors within the health care of elderly people. Also Goldwater & Harris (2011) in a market analysis of existing technologies demonstrated that health technologies support health coordination and improve patient centered- care as well as empower nursing home residence. Goldwater and Harris named the health information technologies to be: electronic health records, telemedicine, technology for physical fitness, mobile health, cognitive stimulation game, smart phone...

Aenesen, Lotherington & Olsen (2011) in a qualitative literature review assessed the use of information and communication technology and smart house technology to improve the cost of health provision to elderly. A smart house technology is the installation of smart devices such as fall sensors, smoke detectors and global positioning systems (GPS) to enable independent, safe and long living of the elderly persons. Their study also point out the use of vid-

eo visits in home care and two- ways video camera to enhance communication between nurses and patients as innovations in technology.

Satariano, Scharlack & Lindeman (2014) carried out through a narrative review, studies on the importance of assistive devices, networking, mobile communication and remote monitoring to enhance healthy independent living for elderly people. During those studies, they found out that social networks, mobile communication and remote monitoring technologies increase the ability of elderly persons to live on their own at their home. They also showed care professionals can be linked to their patients through smart phones, tablets, and chronic diseases and medication management are enhance through electronic medical records. In addition the patient is effectively managed through mobile devices that are able to transmit vital data about the patient such as heart rates, hazardous movements associated with falls and injuries.

Nejat, Nies & Sexton (2010) in their paper, discussed the interdisciplinary team approach for the integration of assistive robots in health care applications. They argued that the introduction of robots is a technological innovation that would reduce constant labour shortage in the health care sector by providing monitoring, reminders, physical assistance as well as general companionship and for performance of selective repetitive time consuming nursing tasks.

5.2 Medical innovations

In this paper the authors describe medical innovations as innovations that have taken place in the area of appropriate use and administration and management of medication. These also include prescription, documentation, delivery of medication in medical care/therapy.

Siciliano & al. (2013) their above mentioned study pointed out electronic health records, computerized medication dispensers (telemedicine) and the use of electronic prescriptions by physicians, video conferencing, medication management software as well as medication dispensing machines as necessary innovations put in place for elderly care. They also demonstrated staff training and scope of practice on appropriate use of medication by older people as well as outreach activities to diffuse medication management as significant innovation in medication.

Brown, 2013 in his commentary paper aimed at describing the role of the affordable care act in facilitating health care systems changes and opportunities for pharmacists and other health care professionals developed the use of medication therapy management service as an innovation that could improve the quality of care and reduce the overall cost of care to patients with chronic diseases. In his study, Brown also supported the participation of pharmacists as part of a patient-centred medical home team and the increase in accessibility of medication to patients.

5.3 Innovations in communication and education

For the purposes of this paper, innovations in communication and education is defined by the authors as all aspects of innovations that involves communication and or education in enhancing and cordinating elderly care. Brown, 2013 highlighted in his study the importance of communication in elderly care. He defined the putting in place of a system that includes co-ordination of care programmes where hospitals, medical therapy management services and primary care providers communicate and coordinate the elderly care in order to avoid re-admission after discharge from the hospital.

Satariano & al. (2014) in their studies have shown different ways of patient and nurses interaction thereby enhancing elderly care. This is achieved by the use of new technologies of communication to allow the patient to cope at home when being attended to by the nurses and other health providers remotely. Also, they emphasized on the use of electronic medical record and electronic patient documentation as significant innovations in the patient health management and patient health care process that allows the continuity of care and patient follow up even at a distance and at any time by the health care provider such as a physician. In the same view, electronic health records is also identified by Goldwater & Haris (2011) as an innovation that supports health coordination by allowing information to be accessible to care givers on time and anywhere.

In the area of education, Satariano &al. (2014) indicated the importance and implications of education in the enhancement of elderly care. According to them, patients and health professionals should be sensitized about the use of innovative ideas and the delivery of quality health care in elderly settings. They emphasized on the diffusion of innovations that enhances elderly care to those providing the care. They indicated the importance of strategical staff training and development on the latest innovations such as in ergonomics and resource management for better use and mentainging of new technology in health care.

5.4 Environmental and Economics innovations

This would be referred to by the authors to mean those innovations in the area of the environment and finance. Bailey & al. (2011) in their study on older adults' falls and independent living clearly showed the importance and implications of the smart house technology as a way forward to improved elderly care. They showed that two deminsional house plan modifies the living environment of the elderly in order to permit for independent living.

Poland Lai (2015) in his review to illustrate how new governance shapes changes in the long term care sector in Ontario, found that laws need to be adjusted to meet changing circumstances in the outside world. He indicated that permitting global competition and privatization, advancement in communication as well as science and technology were necessary inno-

vations in elderly care. Emphasis on performance measurement as an innovation to improved elderly care were also highlighted.

Brown, (2013) discussed about the creation of the centre for medication and Medicaid innovation that could test payment and health service delivery model to a population where improvement in care and a decrease in avoidable health care expenditures are needed. This measure will reduce cost of health care in the elderly. He also found that the overall cost of care to patients with chronic diseases can be reduced by the participation of pharmacists in the medical therapy management services which he sees as a significant innovation.

Jännes & al. (2015) In their studies revealed that housing innovations are important health innovations in elderly care that re-organises the elderly patients' living environments based on the changing and future needs of the elderly. Also, the constant growth in technology improves the working, learning and leisure and social interaction of the elderly. Thus, creating a new environment for the elderly patient. Aenesen & al. (2011) supported the use of smart house technology including fall sensors, smoke detectors, GPS into modifying the patient's environment.

Satariano & al. (2014) described in their study an environmental innovation created by the use of assistive devices, social networks, mobile communications, home community, and remote monitoring. Assistive devices which are also environmentally based constitute an innovation that improves elderly care. The availability of financial resources for the end user to be able to purchase and use the technology such as assistive devices is an economic innovation that needs to be addressed by the economic stakeholders when planning to innovate elderly care.

5.5 Managerial innovation

Under this theme the authors are looking at those management aspects that seek to improve elderly care. These include aspects such as administration, law, politics, acts and decision making processes.

Poland Lai, 2015 emphasised on the adjustment of law in changing circumstances in order to allow competition and privatization as a means of quality health care insurance. According to him, great emphasis needs to be put on performance measurement as a means of ensuring the quality of health delivered to a population. The removal of administrative barriers which he termed administrative red tapes was an innovation that could encourage competitive care delivery thereby improving on the quality of health. Finally, Poland recommended the use of the "care for all act" to improve quality care by creating quality committees, quality improvement plan and satisfaction surveys.

Jännes & al.(2015) in their paper argued that a new approach should be adopted in the decision making process concerning the purchase of technology for the elderly patients. The approach they argued should be that which would optimize the outcome of the care. By this, it should be by involving experts and the uses of the technology in the purchasing technology or devices for elderly care.

6 Discussion

A lot of studies have revealed an increasing demographic transition in the world population leading to an increasing population of the old people. This demographic transition is associated with chronic diseases and disabilities. This situation creates challenges and costs for the provision of elderly care. This situation can be addressed in various ways and one of these ways is by innovations.

Many health innovations have been done in elderly care and literature on the area are numerous (the basic search for this work produced 283117). The purpose of this thesis was to find out the kinds of health innovations that exist in elderly care. After going through the steps of a literature review, the answer to the question: " what kind of health innovations are there in elderly care ?" was articulated on five points.

The process used in answering this question include the gathering of 30 raw data from nine selected articles out of an initial 283117. Those data were further summarized at a level 3 of extraction into 20 raw data which were merged or categorized into five main categories. However these major points overlap as illustrated in the figure 4 bellow:

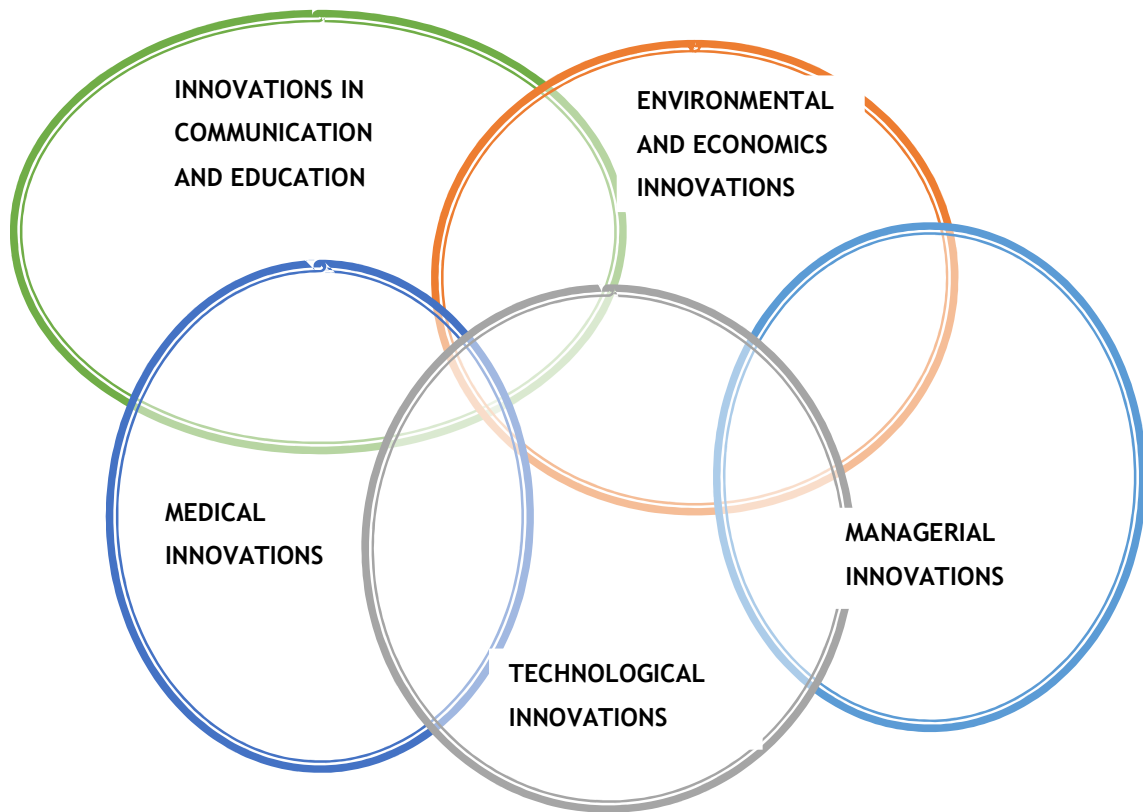


Figure 4: overlapping of main categories of innovations.

The five main categories of innovations found upon synthesis and analysis of the raw data seen in table 4:

Main categories	Examples found/ included
Technological innovations	Information and Communication Technology (ICT), Electronics technology(electronic devices), smart house technology, mobil technology, robotics, multimedia applications, intelligent home appliances, gerontechnology.
Medical innovations	Medication dispensing machines, Electronic prescriptions, electronic medication management, diffusion of medical technology, medical therapy management, telemedicine.
Innovations in communication and education	Video conferencing, video monitoring, electronic health documentation, e-learning, staff training on recent innovations, patient guiding and the use of new innovations, telemedicine and telehealth.
Environmental and economics innovations	Smart house technology, ICT, Video conferencing and monitoring, new ways of interactions.
Managerial innovations	Protocols, laws, health care acts, politics, management

Table 5. Main categories and given examples

The overlapping of main categories of innovations is actually a correlation between those categories. During the findings, we realized that the core of all these innovations in elderly care is the technological innovation. This means that technology was the basis of all the other innovations. For example, information and communication technology (ICT) innovation which is a technological innovation gave grounds to some medical innovations such as electronic health and medical records and electronic prescriptions. Another interpretation of this overlapping of main categories is the direct effects of one category on another. This can be seen in the area of the smart house technology which is an innovation in technology has an impact on innovations on the environment and economics. The electronic prescription as well as the patient management software are both technological innovations that are found also in medical innovation and also in communication innovations. In addition, as a third interpretation of the illustrated overlap, an innovation can be considered as belonging to more than one category depending on the way the technology is being used.

According to the results of this study, the health innovations in elderly care are grouped into five categories but four of the five categories emerge mostly from one of them; the technological innovation. This means that technological innovation is the mother of all innovations in elderly care.

6.1 Ethical considerations

The authors ensured a high standard of ethical consideration in the review by following the Laurea's guidelines and standards for ethical writing. These guidelines as well as the guidelines for systematic literature review (Carpenter & Speziale 2007, Comerasamy & Sui, 2013) were detailedly discussed among the authors before the start of the studies and strictly followed at every stage of the writing process. We would like to testify that the chosen theme of this study, the main categories, sub-categories and the data chosen were all our own creations resulting from conception of the initial study idea. Furthermore, there is no conflict of interest in this our final report. The Laurea's guidelines for referencing and citation (2013) was strictly followed as a guide to ensure the avoidance of any aspect of plagiarism in all stages of the writing process. Also, in consultation with the tutors and the librarians to ensure the reliability and relevance of the material used, the authors used only articles that were from the Laurea's NELLI database as an official trusted academic source. In addition, during the extraction and appraisal of the articles, the authors ensured that the process was done independently, objectively and without any bias or conflict of interest. During the whole process of the studies the authors have fully worked devotedly and committedly sticking to the objectives and laid down plans for the study. The shared tasks were equal and fully committed to and accomplished by the both authors working in collaboration throughout the process.

6.2 Trustworthiness

Being a qualitative study, the trustworthiness of this paper can be accessed from the reflection of the findings on the practical reality of the experience. Before the start of the study, the authors consulted the tutors and detailedly discussed and agreed on the qualitative methodology. The authors then kept track with the From the point of view of the commitments of the individual authors to the work, the purpose of the study, the data collection, the sources of the data synthesis and analysis, the trustworthiness of this study can be evaluated. The authors have also vividly shown at every stage of the study the step by step processes of each stage. This ensures that the reader understands every stage of the study very well so as to be able to understand the findings. The research question has been at the centre of the the whole research processes. The raw data was extracted as in the research articles reviewed and the sources of the data were reliable academic sources.

6.3 Limitations and recommendations

Numerous health innovations have been taking place in elderly care some such as technological innovations are tangible and others like reforms and laws are more abstract. This thesis is a literature review that based its argumentation on findings from 9 articles selected among 283117 articles. The research of articles was not only limited to laurea's library databases but to article that were free of charge. During the work, the authors of this paper found evidence that not all the health innovations were covered in the available literatures. So the findings and discussion were only based on the aspects of health innovations discussed in the literatures used for this review. Even though it is obvious that they have been some innovations in areas such as diagnosis methods, or treatment processes, this paper did not cover such innovations as no literature was available to support a discussion.

An other aspect of the findings that was not discussed in this work was level of implementation of the different findings. This work was limited in identifying the innovations and categorizing them without indicating how much that innovation has impacted the elderly care delivery. This paper did not mention how deeply the findings were implemented or to which extend they were developed already neither does it mention what need to be done regarding the five main categories of the findings. Finally this work did not identify the areas where more innovative idea could be developed.

Further study on this topic could evaluate the impact of the innovations on elderly care as well as conducting a semi-structured interview to elderly care providers that will consist on finding out how the five sub categories of innovations have shaped their care provision.

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Appendix 1

Table 5: articles selected for the review

Article N°	Author/ Year of Publication	Title	Purpose statement	Methodology	Conclusion
1	Bailey, Foran, Scanail & Dromey. 2011.	Older adults, falls and technologies for independent living: a life space approach	To draw attention to the need for further understanding of the fine details of routine and taken-for-granted daily activities and mobility if technologies designed to mitigate the negative impacts of falls and fear-of-falling are to provide unobtrusive support for independent living.	Qualitative exploratory, life-space diary study	How the negative impacts of a fall or fear-of-falling may be alleviated through technological or other assistive devices has to take into account an individual's familiar life space.
2	Poland Lai.2015.	How New Governance Shapes Changes in the Long-Term Care Sector in Ontario, Canada	this paper explains how law was used to promote innovations in health care governance in the Canadian province of Ontario between 2004 and 2012, it also examines how recent changes to the governance of the long-term care (LTC) home sector in Ontario	Review of literature interview and case study.	This paper examined potential governance innovations in the Ontario long-term care home sector, which is undergoing a transformation. While the formal legal and regulatory apparatus continue to operate in the background, New governance approaches represent additional processes and procedures to help problem-solve challenges in the

					sector.
3	Siciliano, Redington, Lindeman, Housen & Enguidanos 2013.	Lessons from the trenches: Adopting Medication technology within agencies serving Older adults	To determine factors that served as challenges and facilitators in implementing and adopting medication optimization technology by community-based programs serving older adults. - To gather information to inform grant makers of how their grant making structure could better support agencies	The use of semi structured questionnaire and qualitative analysis.	Challenges, included time, funding, staff, licensing, scope of practice, reimbursement, and technology issues.
4	Brown, Lawrence. 2013.	Emerging Opportunities for Pharmacists to improve Health care for the poor and underserved	To describe the role of the Affordable Care Act in facilitating these health care system changes and opportunities for pharmacists and other health care professionals to be a part of this change due to implementation of provisions within the Affordable Care Act.	Commentary	Affordable Care Act provides multiple opportunities for hospital pharmacists to improve patient health outcomes and reduce hospital readmissions by providing medication therapy management services as part of an accountable care organization or a patient-centered The two biggest challenges are staffing and funding.

5	Jännes, Hämäläinen, Han-ski & Lanne. 2015.	Homelike living for elderly people: A needs-based selection of technological solutions	Those who are responsible for purchasing solutions for the elderly do not always fully understand both the needs and limitations of the end user. -Technological solutions are not usually developed from the perspective of the elderly in the first place.	Applied and mixed method based on assistive technology review, in-depth and semi-structured interviews, and a questionnaire regarding the needs of the elderly and their views on technology.	Technology is not the answer to everything, it cannot replace human relationships, but the correct technological solutions can support social life.
6	Aenesen, Lotherington & Olsen. 2011.	Smarter elder care? A cost-effectiveness analysis of implementing technology in elder care	Quantitative assessment of the use of smart house technology and video visits in home care. Having identified healthcare providers, hospitals and relatives as the main affected groups, we show that smart house technology is cost-effective, even if only relatives gain from it. Video visits, which have higher implementation costs, demand effects on both relatives and health care providers in order to be a cost-effective tool in home care.	Literature review	Smart House Technology, has very low costs, may be cost-effective, even if we only assume effects on relatives. No reduction in (nursing) time costs to home care providers and to hospitals is needed. For video visits, which imply far higher costs, we show that significant reductions in the time costs for home care providers are needed to defend the effort costs. This is true independently of whether video visits substitute physical visits or are in addition.
7	Satariano, Scharlach & Lin-	Aging, Place and tech-	To review the range of	A narrative review of	Despite a wide range

	deman.2014.	nology: Toward improving Access and well-ness in Older Populations.	promising technologies (e.g., smart phones, remote monitoring devices) designed to enhance aging in place; identify challenges for implementation of those technologies; and recommend ways to improve access to technologies in older populations.	research, practice, and policies from multiple fields, including information science, gerontology, engineering, housing and social services, health care and public health.	of emerging and current technologies, there are significant challenges for implementation, including an uneven evidence base, economic barriers, and educational and ergonomic issues that adversely affect many older adults - Recommendations for future development and adoption include improving the evidence base through field-testing of “packages” of devices in diverse populations of older adults; development of innovative funding mechanisms involving multidisciplinary teams, older adults, and caregivers; and promotion of safety and security in the use of these technologies in older populations.
8	Nejat,G., Nies, Mary., & Sexton, Thomas. 2010.	An interdisciplinary team for the design and integration of assistive robots in health care applications			

9	Goldwater & Harris. 2011.	Using Technology to Enhance the Aging Experience: A Market Analysis of Existing technologies	To provide details on a wide array of available health technologies, their benefits, and how these tools will transform the way people age during the next decade.	Detailed Analysis of the existing technologies.	<p>As we begin to turn into a new decade, there is a tremendous opportunity to increase the understanding and awareness of the growing senior population and the technologies that can support them in a manner that preserves both their autonomy and dignity.</p> <ul style="list-style-type: none"> - The rise of health information technology is not simply limited to a clinical record of care, but also includes advances that can help a senior better understand and manage their own care. - In this way, they can continue to age gracefully within their home or a community, in which they can still be productive, and still live their lives unencumbered by the rigidity and isolation of a facility that is foreign and unnatural to them. - The next few years show tremendous promise in this area, and as new tech-
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					nologies are developed and introduced into the long-term care environment, future efforts will look not to develop a simple understanding of them, but will look to implement them broadly and eventually see both the intended and desired results.
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Bellow is the table of Appraisal of the articles selected

Article N°	REFERENCE	RESEARCH METHODOLOGY	SOURCE	SAMPLING SIZE/ NO OF ARTICLES REVIEWED	DATA COLLECTION METHOD	DATA ANALYSIS TECHNIQUE
1	Bailey, Foran, Scanail & Dromey. 2011. Older adults, falls and technologies for independent living: a life space approach	Qualitative exploratory, life-space diary study.	Journal of Ageing & Society (Qualitative research).	8 participants	Feed back interview	Qualitative analysis.
2	Poland Lai.2015. How New Governance Shapes Changes in the Long-Term Care Sector in Ontario, Canada. The Innovation Journal: The Public Sector Innovation Journal, Volume 20(1), 2015, article 4	Review of literature, Case study			Interviews	
3	Siciliano, Redington, Lin-	Qualitative re-	Aging international	12 participants	Interviews using	Qualitative

	deman, Housen & Enguidanos 2013. Lessons from the trenches: Adopting Medication technology within agencies serving Older adults.	search.	(online source).		semi-structured questionnaire	analysis.
4	Brown, Lawrence. 2013. Emerging Opportunities for Pharmacists to improve health care for the poor and underserved. Journal of Health Care for the Poor and Underserved 24 (2013): 6-14. Meharry Medical College	Commentary	Academic journal.			
5	Jännes, Hämäläinen, Hanski & Lanne. 2015. Homelike living for elderly people: A needs-based selection of technological solutions	Qualitative review using in-depth and semi-structured interviews, and a questionnaire	Journal of home health care management and practice.	30 articles and sources used.	Review of assistive technology, in-depth and semi-structured interviews, and a questionnaire.	Constructive research methodology.
6	Aenesen, Lotherington & Olsen. 2011. Smarter elder care? A cost-effectiveness analysis of implementing technology in elder care. Health Informatics Journal 17(3) 161-172. Sage. United Kingdom.	Literature review	Health informatics journal.	Not mentioned	Systematic search	qualitative
7	Satariano, Scharlach & Lindeman. 2014. Aging, Place and technology: Toward improving Access and well-ness in Older Populations	Literature review	Journal of aging and health.	not mentioned	Not mentioned	personal appraisal

8	Nejat, Nies & Sexton. 2010. An interdisciplinary team for the design and integration of assistive robots in health care applications	Experimental				
9	Goldwater & Harris. 2011. Using Technology to Enhance the Aging Experience: A Market Analysis of Existing technologies	Literature review	Ageing international.		Review	Personal Appraisal

Table 6. Table of Appraisal.

Table 7: Data extraction table

Article N°	Articles	Data extraction level 1 (Raw data)	Data extraction level 2	Data extraction level 3
1	Bailey, Foran, Scanaill & Dromey. 2011. Older adults, falls and technologies for independent living: a life space approach	Pedometer, daily activity log, Video-monitoring, remote health monitoring, fall detectors, door monitors, bed alerts, pressure mats, smoke and heat alarms, electronic sensors 1.1.0	Technological physical activities' monitoring of the patient 1.1.1	Technological innovation in patient safety 1.1.2
		Two dimensional house plan, smart homes with increased intelligence in home appliances 1.2.0	Housing innovation for independent living 1.2.1	Environmental Innovation for patient autonomy 1.2.2
2	Poland Lai.2015. How New Governance Shapes Changes in the Long-Term Care Sector in Ontario, Canada	law must adjust to changing circumstances in the outside world: increased global competition; privatization; fiscal crises; new production modes and patterns of employment; and advancements in communication, science, and technology. (2.1.0)	Political innovations for competitive care (2.1.1)	Political Innovations for quality improvement (2.1.2)
		The core ideas include great-	Policy Innovation for low	Administrative innovations

		er emphasis on performance measurement; preference for lean and disaggregated organizational forms; substitution of contracts for hierarchical relations; use of market-type mechanisms; emphasis on treating users as customers, and on the application of generic quality improvement techniques. (2.2.0)	cost quality health care delivery (2.2.1)	for cost reduction (2.2.2)
		removal of red tape, more autonomy for public agencies and employees, increased responsiveness to users, stimulation of public innovation, and more effective service delivery through contracting out. (2.3.0)	Administrative innovations that encourage competition (2.3.1)	Administrative innovations for competitive care delivery (2.3.2)
		The Excellent Care for All Act sets out a number of quality related requirements for health care organizations, such as quality committees, quality improvement plans and satisfaction surveys.	Quality assessment and control measures (2.4.1)	Administrative Innovations for quality control. (2.4.2)

		(2.4.0)		
		This increased reliance on social enforcement—the private action of detecting and reporting illegality—has created a need for legal mechanisms to protect and incentivize whistle-blowing (enforced self-regulation) (2.5.0)	Political Innovations for patients’ safety and health promotion (2.5.1)	Political innovation for patient safety (2.5.2)
3	Siciliano, Redington, Lindeman, Housen & Enguidanos 2013. Lessons from the trenches: Adopting Medication technology within agencies serving Older adults	Information technology, electronic health records, videoconferencing, computerized medication dispensers (telemedicine). Videoconferencing, medication management software, medication dispensing machines. (3.1.0)	Technological innovations Medication innovations (3.1.1)	Technological innovations Innovations in medication (3.1.2)
		Improvement of the use of medication by older people by appropriate medication management such as the use of electronic prescriptions by physicians using the computer. (3.2.0)	Innovations in medication management & prescription (3.2.1a) Innovation in technology applied to medication (3.2.1b)	Innovations in medication (3.2.2a) Technological innovations (3.2.2b)

		Staff training and scope of practice on appropriate use of medication by older people, outreach activities. Diffusion of medication management technology. (3.3.0)	Innovations in medication management and administration (3.3.1a) Innovation in technology applied to medication (3.3.1b)	Innovations in medication (3.3.2a) Technological innovations (3.3.2b)
4	Brown. 2013. Emerging Opportunities for Pharmacists to improve Health care for the poor and underserved	What this means for patients is that hospitals will need to implement programs that provide better care for patients during their hospital admission and also provide post discharge care for patients so that they are less likely to be readmitted. These programs are likely to include coordination of care programs where the hospital works to ensure patients have a primary care provider (PCP), ensures that a medication reconciliation and medication counseling is carried out before discharge, and ensures the patients discharge summary and discharge medication list is communicated to the PCP (4.1.0)	Innovations in patient and information management (4.1.1)	Innovations in communication protocols (4.1.2)

		<p>Finally, Section 3021 of the ACA outlines the creation of the Center for Medicare and Medicaid Innovation (CMMI). The purpose of this Center is to test payment and delivery models in populations where improvement in care and a decrease in avoidable health care expenditures are needed (4.2.0)</p>	<p>Innovations in cost management (4.2.1)</p>	<p>Economical innovations (4.2.2)</p>
		<p>support pharmacist participation as part of the patient-centered medical home team and broader access to pharmacist-provided patient medication therapy management (MTM) services. These medication therapy management services can improve the quality of care and reduce the overall cost of care to patients with chronic diseases (4.3.0)</p>	<p>Changes in health care team structure and introduction of MTM services (4.3.1a)</p> <p>Cost management (4.3.1b)</p> <p>Quality assurance. (4.3.1c)</p>	<p>Innovations in medical therapy (4.3.2a)</p> <p>Economical Innovation (4.3.2b)</p> <p>Quality Innovations (4.3.2c)</p>
		<p>providing medication adherence counseling, and providing the patient with an accurate list of the medications the patient will be taking</p>	<p>Communication, care coordination and team collaboration enhancement (4.4.1)</p>	<p>Innovations in communication (4.4.2)</p>

		<p>after discharge. These pharmacists could also coordinate care with the patient's primary care provider, by sending them a copy of the patient's discharge summary and discharge medication list. About two weeks postdischarge, the hospital-based pharmacists can contact patients to assess the effectiveness of medications, any noted side effects, and any problems with medication adherence (4.4.0)</p>		
		<p>Therefore, hospitals must now focus on appropriate transitions and coordination of care and on the care given to patients post discharge (4.5.0)</p>	<p>Ensurance of continuity of care (4.5.1)</p>	<p>Innovations in provision of care (4.5.2)</p>
5	<p>Jännes, Hämäläinen, Hanski & Lanne. 2015. Home-like living for elderly people: A needs-based selection of technological solutions</p>	<p>Assitive technology (gerontechnology) compensates for the decline in functional capacity in the elderly. Gerontechnology narrows the gap between the elderly and their environment enabling them to live independent lives in their homes (5.1.0)</p>	<p>Technological innovations for functional and physical capacity assistance (5.1.1)</p>	<p>Technological innovations (5.1.2)</p>

		<p>Apartments should be built with facilities to install devices based on the changing and future needs of elders ... Door steps and hand rails provided in buildings facilitates and secure movement (5.2.0)</p>	<p>Housing innovations (5.2.1)</p>	<p>Environmental innovations (5.2.2)</p>
		<p>Working, social interactions as well as learning and leisure are improved by technology. Elders are different, their needs are changing. (5.3.0)</p>	<p>Innovations in social interactions (5.3.1)</p>	<p>Environmental innovations (5.3.2)</p>
		<p>Those purchasing are not experts in elderly care. The users are rarely included in the purchasing process. Selection of technical solutions is made without proper knowledge and information. (5.4.0)</p>	<p>Innovations in decision making process (5.4.1)</p>	<p>Management innovations (5.4.2)</p>
6	Aenesen, Lotherington & Olsen. 2011. Smarter elder care? A cost-effectiveness analysis of implementing technology in elder care	<p>We quantitatively assess the use of smart house technology and video visits in home care. (6.1.0)</p>	<p>Technological innovations in health care provision (6.1.1)</p>	<p>Technological innovations (6.1.2)</p>
		<p>Smart House Technology (SHT) implies installing devices such as fall sensors,</p>	<p>Technological innovations</p>	<p>Technological innovations</p>

		global positioning system (GPS), and smoke detectors to enable elderly people to live longer in their homes (6.2.0)	in housing (6.2.1)	(6.2.2a) Environmental innovations (6.2.2b)
		A two-way video camera enables the nurse and the patient to communicate and see each other at the same time (6.3.0)	Enhancement of Nurses/patient communication (6.3.1)	Innovations in communication (6.3.2)
		Nurses can instruct patients via a two-way video to perform simple tests by themselves and thus the nurse saves travel time and costs... At the home care office, one nurse handles 20 apartments (patients) with SHT. Annual total labour (6.4.0)	Reduction of time and cost of the delivery of care (6.4.1a) New ways of guiding patients (6.4.1b) Resource allocation and management (6.4.1c)	Economical innovations (6.4.2a) Innovations in health provision (6.4.2b)
7	Satariano, Scharlach & Lindeman.2014. Aging, Place and technology: Toward improving Access and wellness in Older Populations.	Assistive devices, social networking, mobile communications, and remote monitoring can enhance aging in place (The ability to live in one's own home and community safely, independently, and comfortably, regardless of age, income, or ability level). Electronic medical records enhance chronic diseases and medication management,	Enhancement of holistic care (7.1.1a) Technological innovations (7.1.1b) Innovation in medication documentation (7.1.1c) Communication innovations	Innovations in health care provision (7.1.2a) Tecnological innovations (7.1.2b) Innovation in medication (7.1.2c) Environmental innovations

		<p>smart phones and tablets link the elderly with care givers, doctors, friends and other service personnel, assistive devices which are environmentally based devices, global positioning system(GPS) and self parking vehicles. Mobile devices fitted on the client transmits vital information such as heart rate and abrupt movements associated with falls and injuries (7.1.0)</p>	<p>(7.1.1d) Innovations in patient's monitoring and safety (7.1.1e) Environmental innovations (7.1.1f)</p>	<p>(7.1.2d) Innovations in communication (7.1.2e)</p>
		<p>Sensitization about availability of assistive devices improves their use... Improved knowledge of ergonomics and sensory issues make their use possible and better... Better education and financial resources makes it possible to purchase, use and maintains the technologies (7.2.0)</p>	<p>Enhancement of knowledge (7.2.1a) Resources management (7.2.1b)</p>	<p>Educational innovations (7.2.2a) Technical innovations (7.2.2b) Economical innovations (7.2.2c)</p>
8	<p>Nejat, Nies & Sexton. 2010. An interdisciplinary team for the design and integration of assistive robots in health care applications</p>	<p>The development of innovative social assistive robots can help to minimize threats and provide measurable improvements in an individual's health status via providing monitoring, reminders, and physical assistance as</p>	<p>Technological innovations (8.1.1)</p>	<p>Technological innovations (8.1.2a) Innovations in health care provision (8.1.2b)</p>

		well as general companionship... Design of human-like socially assistive robots capable of doing selective repetitive and time-consuming nursing assistant tasks. (8.1.0)		
		From a nursing perspective, the robots should be designed in a manner in which they will be acceptable, pleasing, and safe for the user in the setting of use. (8.2.0)	exclude (already mentioned several times)	
9	Goldwater & Harris. 2011. Using Technology to Enhance the Aging Experience: A Market Analysis of Existing technologies	Health information technology supports health coordination, improves access, empowers nursing home residents and serves as a means of delivering services to community and home based residents on a person-centered care basis. (9.1.0)	Innovations in health information technology (9.1.1)	Technological innovations (9.1.2)
		Electronic health records (Health IT) improves efficiency, care coordination and makes information accessible to care givers on time and anywhere. (9.2.0)	Technological innovations in patients' files management and care coordination (9.2.1)	Technological innovations (9.2.2)
		Health IT applicable in el-	Technological innovations	Technological innovations

		<p>derly care includes personal health records, mobil health, personal health, telemedicine/Telehealth (video consultation, remote monitoring devices, asynchronous transfer of medical images), using technology for physical fitness, cognitive stimulation games online:</p> <p>Mobil health (mHealth) downloadable health information such as chronic disease management provided by devices such as the cell phone.</p> <p>Telehealth technology is used in patient safety by providing remote sensors that can put off a stove left on for too long, detect falls and changes in behaviours, variations in vital signs, orientation of the client etc.</p> <p>Interactive games such as cross word puzzles, memory games, electronic quizzes provide for social interactions and enhances cognitive and physical activities especially in those with cognitive loss or limited communication ability as a result of stroke or dementia. (9.3.0)</p>	<p>in health documentation, medicine delivery, patient's monitoring and physical and cognitive stimulation. (9.3.1)</p>	<p>(9.3.2)</p>
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