



Edith Karjalainen
Diaconia University of Applied Sciences
Global Change and Community Development
Master of Health Care
Thesis, 2023

THE USE OF DIGITAL TECHNOLOGIES IN GERIATRIC CARE SETTINGS: A SYSTEMATIC LITERATURE REVIEW OF NURSES PERSPECTIVES





Diak

ABSTRACT

Edith Karjalainen

The use of digital technologies in geriatric care settings: A systematic literature review of the nurses perspectives

September 2023

Diaconia University of Applied Sciences

Degree Programme in Global Change and Community Development

Master of Health Care

This thesis aims to identify and summarize nurses' experiences and attitudes toward using digital technologies in geriatric care settings. The idea of the thesis centered around the rapidly increasing aging population, the increased use of digital technology in delivering care to the elderly, and the scarcity of nurses who can fulfill the demand while providing high-quality care.

The data was collected from three major electronic databases: PubMed, MEDLINE, and PsycINFO. The Mixed Method Appraisal Tool was used for quality assessment and grading of the chosen studies.

The data was analyzed with Erlingsson and Brysiewicz's content analysis method. The major results can be summarized as nurses having both positive and negative experiences and attitudes concerning the use of digital technologies in geriatric care settings.

The conclusion is that for successful implementation of digital technology in geriatric care settings nurses need to be incorporated from the earliest stages of the technology development. Furthermore, before introducing new technology, appropriate education, digital training, and time for nurses to adapt to new digital technologies are crucial.

Keywords: Nurses, Digital technology, Geriatric care

CONTENTS

1 INTRODUCTION.....	3
2 BACKGROUND	Error! Bookmark not defined.
2.1 Geriatric care settings	4
2.2 Digital technologies	4
2.3 Nursing professionals.....	4
3 PURPOSE, AIM, RESEARCH QUESTIONS	5
4 METHOD	7
4.1 Systematic review as a method.....	6
4.2 Inclusion and Exclusion criteria	7
4.3 Data collection	8
4.4 Critical appraisal and Data analysis	12
5 RESULTS.....	17
5.1 Study characteristics.....	17
5.2 Nurses experiences.....	19
5.3 Nurse's attitudes.....	20
6 ETHICAL PERSPECTIVES.....	20
6.1 Ethical Perspectives	20
6.2 Reliability.....	21
6.3 Validity.....	22
7 DISCUSSION.....	23
8 CONCLUSION.....	26
SOURCES	31
APPENDIX 1. Quality Assessment	33
APPENDIX 2. Summary of Findings Table	35
APPENDIX 3. Content Analysis Table.....	36

1 INTRODUCTION

As the number of people in old age is growing rapidly, the use of health care and social services is increasing (United Nations [UN], 2017). According to the United Nations (UN) department, the global population is ageing, and 35% of the European population and 28% of the North American population are expected to be aged 60 years or older by 2050. The World Health Organization projects that the proportion of the world's population over 60 years will double from 12% to 22% by 2050 (WHO, 2018). As the world's population ages, there is an urgent need for quality and adequate healthcare services. The use of technology in providing care to the elderly has increased, owing to a shortage of nurses to meet the demand (Kelley et al, 2011). The integration of new technology has been an important solution to different healthcare settings. According to Blazun et al., (2013), the aging population has been a contributing factor to the increase in the shortage of nurses.

Previous literature review based on seniors' technology acceptance have not thoroughly investigated nurses' experiences and attitudes toward the use of digital technologies in geriatric care settings when new devices were introduced, which is important in caring for the elderly (Tsertsidis et al., 2019). Most previous review studies on this topic, according to Segev-Jacobovski et al. (2011), focus on the introduction of new technology to the hospitality industry rather than specific departments. Furthermore, Venkatesh and Davis (2000) revealed that it takes a long time for medical institutions to incorporate technology to have effective innovations (Venkatesh & Davis, 2000). Previous research has not addressed what nurses' experiences and attitudes are when using digital technologies to provide care in geriatric care settings (Tsertsidis et al., 2019).

With the rapid growth and spread of digital technologies, nurses will be more exposed to the digital environment. Different experiences and attitudes of nurses in digital technologies will be of utmost importance in providing healthcare for geriatric patients (Tsertsidis et al., 2019). The perspectives and experiences of nurses in using digital technologies to deliver care have not been fully incorporated (Chan, 2017). User-centered design is crucial when developing new technologies

because users interact with the technology and patients daily. Thus, it is imperative to conduct a systematic review of this subject in this area, which has received little attention, for both academic and practical reasons.

2 KEY CONCEPTS

2.1 Geriatric care settings

A geriatric care setting is an outpatient health facility that specializes in the care of aged individuals (Department of Health [DOH], 2019). Geriatric care is described as the support given to people over the age of 65, whether in geriatric wards such as hospitals or in their own homes or residential care facilities. The goal is to assist older adults in remaining safe, independent, and connected to society (DOH, 2019).

2.2 Digital technologies

Digital technology is a branch of science or engineering knowledge concerned with the development and practical application of digital or computerized devices, methods, and systems (Thimbleby, 2019). Due to the significant increase in the elderly population, digital technologies are utilized in geriatric settings to provide options to the elderly while maintaining their safety and assisting healthcare providers. The primary goal of technology is to maintain or improve an individual's functioning and independence in order to facilitate participation and improve overall well-being (WHO, 2018). Most older adults prefer to age in place and are favored by policymakers. Peek et al. (2016) also emphasized the importance of technology in remaining independent, active, and healthy. This systematic review will focus on the extent to which nurses are exposed to different types of digital technologies while delivering care in geriatric care settings. Additionally, nurses' attitudes and experiences with digital technologies in geriatric care settings will also be identified in this review.

2.3 Nursing professionals

Nurse professionals gain nursing education which consists of theoretical and practical training delivered to nurses with the goal of preparing them for their duties as nursing care professionals (WHO, 2023). Additionally, nurse professional education entails the promotion of health and the avoidance of diseases in a way that improves individuals' quality of life and health (WHO, 2023). A nurse is a person who has completed a program of basic, generalized nursing education and is authorized by the appropriate regulatory authority to practice nursing in his/her country (International Council Of Nurses [ICN], 2020). Nurses in this review are defined as healthcare workers who provide or deliver direct care to older adults in geriatric wards or other geriatric care settings like home or long-term care facilities e.g., residential homes (WHO, 2023).

Nonetheless, while new technology can be extremely beneficial to patients, health professionals such as nurses frequently find issues while utilizing more technologically advanced gadgets (Kent et al, 2015).

Digital technologies have been adopted in a variety of fields, demonstrating that they can be utilized to improve patient health outcomes while also lowering healthcare expenditures (Steinhub & Topol, 2015). The rapidly increasing elderly population means that public spending and demand for healthcare and social services will increase (Peek et al., 2016; Peek et al., 2019). Despite the natural preference of individuals to remain at home on their own, older adults require long-term care due to a deterioration in physical and cognitive abilities. Allowing older persons to remain at home is a significant challenge, and various digital technologies need to be implemented to deliver individualized care and assistance with everyday tasks (Damant, 2015).

3 THE PURPOSE AND OBJECTIVE OF THE THESIS

The purpose of this systematic review is to identify and summarize nurses' experiences and attitudes toward using digital technologies in geriatric care settings.

This systematic review focuses on geriatric nurses' perspectives towards the use of digital technologies to provide care to the elderly in geriatric care settings.

The challenges of providing high-quality care to older persons in geriatric care facilities are increasing as the population ages and expenditures rise. As a fresh strategy, digital technology can assist in addressing this issue. The objective of this study is to synthesize current evidence in order to have successive implementation of digital technologies in geriatric care settings, allowing nurses to easily adapt and provide high-quality care in geriatric care settings. Another objective is to decrease dependency and reduce expenditures associated with demographic shifts.

The research questions guiding this review are:

1. What are nurses' experiences towards using digital technologies in providing care to patients in geriatric care settings?
2. What are nurses' attitudes toward using digital technologies in providing care to patients in geriatric care settings?

4 Data collection, Data, and Analysis

4.1 The systematic review as a method

This study was designed as a systematic review of published evidence. A systematic review is research that identifies a specific review question, finds all relevant studies, evaluates their quality, and summarizes their findings using a scientific methodology (National Institute for Health Research [NIHR], 2010). There are two research questions in this systematic review. A literature search will be conducted, followed by a quality assessment of the studies and an analysis of the included studies. The general goal of systematic reviews, according to (Bettany-Saltikov, 2012), is to use the best available research evidence in healthcare decisions for individual people/patients and for public policy (Bettany-Saltikov, 2012). After reading and comparing a scoping review to a systematic review, I initially contemplated conducting one, but I ultimately opted against it since, for this topic, I want to address a specific research question rather than just identify any knowledge gaps. This method was chosen because, as the aim of this thesis suggests, a systematic review would be an appropriate and relevant method for identifying and compiling knowledge about nurses' perspectives on using digital technologies in delivering care to patients in geriatric wards and other geriatric care settings. To ensure high-quality reporting, this systematic review was carried out in accordance with PRISMA guidelines (Moher et al., 2009). Replicability is the key component of a systematic literature review (Linnenluecke et al., 2020).

4.2 Inclusion and Exclusion Criteria

The Population, Exposure, and Outcome (PEO) format or framework was used to develop our search strategy in this systematic review (Munn et al., 2018). The PEO framework is a popular format in prognostic studies (Munn et al., 2018). Because this systematic review focuses on nurses' perspectives, the study asserted and determined that the PEO framework would be best suited for this study in terms of developing search terms and strategy, as well as limiting the search strategy to be clearer and more specific (Bettany-Saltikov, 2012).

The study's inclusion criteria were empirical studies published in full text over a 15-year period (2007-2022), articles written in English, and sample studies in-

volving exposure to digital technologies in geriatric care settings. Exclusion criteria included studies written in languages other than English, outcomes not relevant to the aim of this study, studies involving digital technologies used for teaching or diagnostic purposes, and studies that were not published in full text. The criteria presented below were chosen because they were relevant to answering the research question and the primary aim of this study.

Table 1

Inclusion criteria	Exclusion criteria
Empirical studies	Studies which are not empirical
Published in full text	Studies not published in full-text
Fifteen years publication 2007-2022	Studies published before 2007
Language (English)	Studies written in other languages than English
The studies must have investigated the extent to which nurses are exposed to different types of digital technologies while delivering care. Nurses' attitudes and experiences related to the use of digital technologies in geriatric care settings. Examples of digital technologies in this systematic review are communication technologies, wearable devices, and internet-based application	Nurses' exposure to digital technologies in non-geriatric care settings. Digital technologies used by nurses for education purposes in geriatric care settings. Other outcomes apart from attitudes and experiences resulting from the search
Participants, nurses	Other professionals than nurses

Participants: Nurses

Exposure: For inclusion, the study must have investigated the extent to which nurses are exposed to different types of digital technologies while delivering care to geriatric patients e.g., communication technologies, wearable devices, and internet-based applications.

Outcome measures: experiences and attitudes of nurses should be measured in the studies, any other outcome resulting from the search will be taken into consideration.

4.3 Data collection

The search was performed in two phases. First, a literature search guided by the information specialist was conducted between 9th June 2022 and 28th June 2022, and in the second phase, the search was updated between December 2022 and January 2023. In the second phase, no studies were found to be eligible for the final review. A literature search was conducted using the following keywords: nurses, digital technology, and geriatric care as well as their synonyms. The search terms used for each database are presented in Tables 2-4 below. Several electronic databases were used to collect data. PubMed, which includes MeSH terms, Medline (Medical Literature Analysis and Retrieval System Online) which includes Medline MeSH, PsycINFO (APA Thesaurus of Psychological Index Terms), and Google Scholar. These electronic databases were chosen for their extensive coverage of studies in healthcare services and clinical practice. The three electronic databases were chosen based on their relevance to this topic. Furthermore, these databases are trustworthy and specific to nursing research, as well as excellent sources for medical research. The reporting items PRISMA provide a guide for reporting evaluation of exposure, in this systematic review, it is exposure to different types of digital technologies which is the primary goal for this study (Moher et al., 2009).

The search strategy, study selection, and data collection procedures were presented in accordance with the Prisma guidelines and checklist (Moher et al., 2009). The flow diagram depicting the article selection process (literature search) and search tables from the three electronic databases were included. Figure 1 below depicts the PRISMA flow diagram and the study selection. The figure depicts the number of articles identified, screened, and assessed for eligibility, as well as the number of studies included in the final review. Tables 2-4 below show the search terms for each database.

Table 2 shows the search terms for PubMed

Table2. Search strategy in PubMed for the use of digital technologies in geriatric care settings, from nurses' perspectives

Date	Search terms
9/6/2022 *Search update December 2022	Search 1: ("Nurses"[MeSH Terms] OR "nurse s"[All Fields] OR "Nurses"[MeSH Terms] OR "Nurses"[All Fields] OR "nurse"[All Fields] OR "nurses s"[All Fields]) (n=425,904)
	Search 2: (((digital technology) OR (digital health)) OR ("Telemedicine"[Mesh]) (n=118,387)
	Search 3: (((elderly care) OR ("Long-Term Care"[Mesh])) OR (geriatric)) OR (aged care) (n=293,212)
	Search 1 AND Search 2 AND Search 3 (n=233) AND FILTERS (n=211)

Table 3 shows the search terms for MEDLINE

Table 3. Search strategy in MEDLINE for the use of digital technologies in geriatric care settings, from nurses' perspectives

Date	Search terms
17/6/2022 *Search update December 2022	Search 1: (MH "Nurses+") OR Nurse (n=473,743)
	Search 2: (MH "Digital Technology") OR digital health OR (telemedicine or telehealth) (n=62,842)
	Search 3: geriatric care OR ((MH "Long-Term Care") OR Elderly care OR aged care) (n=934,991)
	Search 1 AND Search 2 AND Search 3 (n=516) AND FILTERS (n=109)

Table 4 shows the search terms for PsycINFO

Table 4. Search strategy in PsycINFO for the use of digital technologies in geriatric care settings, from nurses' perspectives

Date	Search terms
28/6/2022 *Search update January 2023	Search 1: (MM "Nurses" OR nurse) (n=81,110)
	Search 2: (Digital technologies OR Digital health OR Telehealth) (n=32,921)
	Search 3: (geriatric care OR elderly care OR (long-term care or Aged care) (n=54,449)
	Search 1 AND Search 2 AND Search 3 (n=212) AND FILTERS (n=178)

Figure 1 displays the flow diagram of the article selection process according to the PRISMA guidelines (Moher et al., 2009).

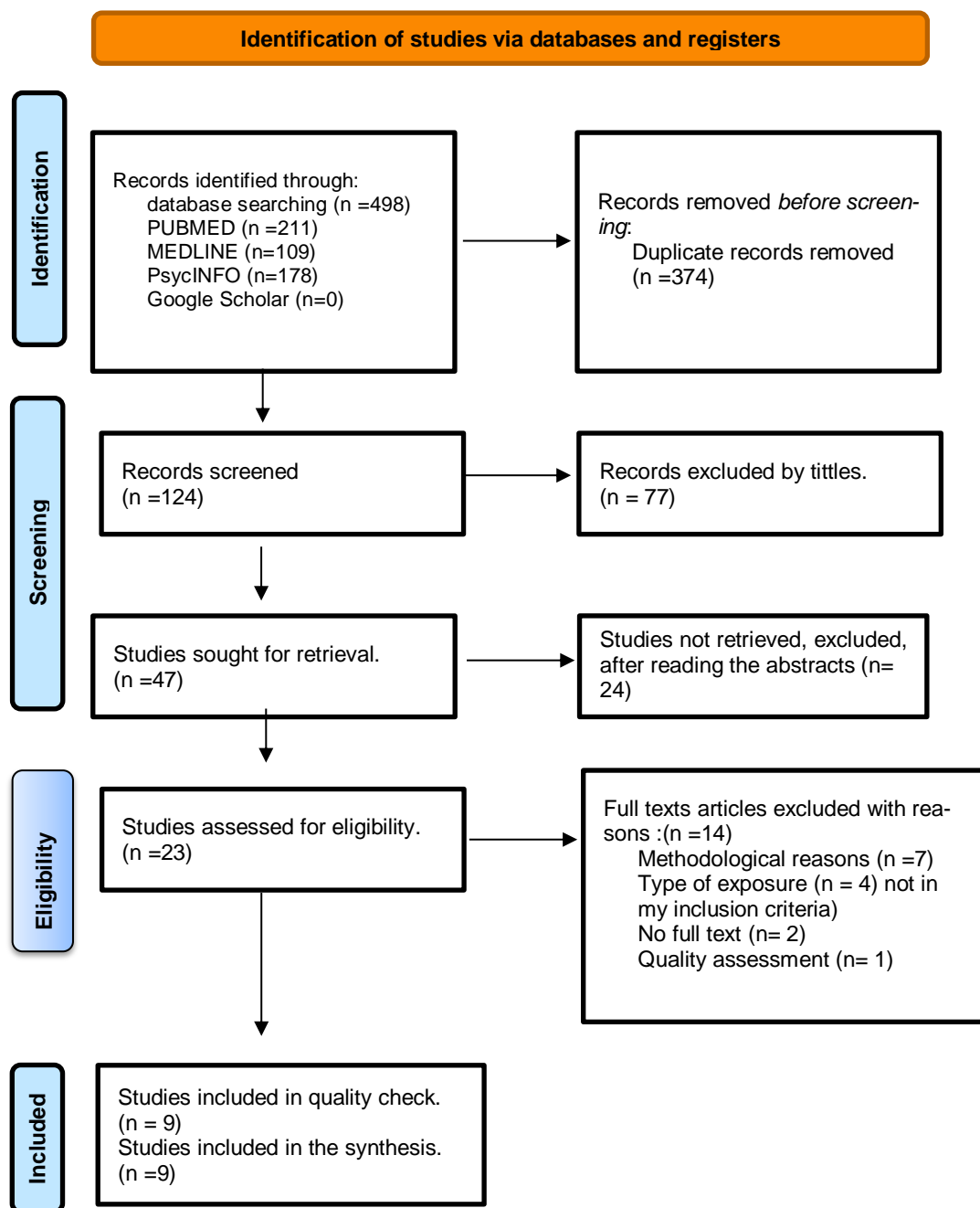


Figure 1. Search results flowchart

Search results

Following the literature search, the above-mentioned relevant articles were chosen, and the results were synthesized. Figure 1 depicts the search process and data information flow, as well as the reasons for study exclusion. After applying the limiters to all three databases, the search strategy yielded a total of 498 articles of which 374 were duplicates. Following identification, 124 articles were screened by title, with 77 articles being excluded, leaving 47 articles. After reading the abstracts, 24 of the 47 articles were eliminated because they did not relate to the purpose of this study. Articles that did not meet the inclusion criteria were excluded after screening by titles and abstracts, and some of the studies were not primary papers. Only 23 articles were considered eligible and were assessed for eligibility. After reading the full text of 23 articles, 14 were eliminated. Seven articles were eliminated for methodological reasons, and four articles were excluded because the type of exposure was not included in the inclusion criteria. Furthermore, two more articles were excluded due to lack of access to full text, and one article was removed due to methodological quality assessment. The search yielded 9 included articles, and the reference lists in those articles were manually searched to uncover additional studies not found in the electronic database searches.

Based on the study's inclusion criteria, the researcher did not find any studies from the reference lists that might have been included in the final review. The final review included 9 articles due to inclusion and exclusion criteria and was selected because they related to the purpose of this study. The articles were retrieved from three databases: PubMed (n=4), Medline (n=3), and PsycINFO (n=2). The researcher did not find any studies from Google Scholar which are relevant to be included in the final review.

4.4 Quality Assessment

To assess the scientific quality of the studies and the quality of the included articles for final review, the Mixed Method Appraisal Tool MMAT version 2018 was used (Hong et al., 2018). The MMAT tool was selected because it is designed to assess the appraisal phase of systematic mixed reviews (Hong et al., 2018).

The MMAT is a critical appraisal tool for systematic mixed studies reviews that include qualitative, quantitative, and mixed methods studies. It evaluates the methodological quality of studies from five categories: qualitative studies, randomized controlled trials, non-randomized studies, quantitative descriptive studies, and mixed method studies. The tool is divided into two parts: The first part is a checklist, and the second part is an explanation of the criteria. Part 1 consists of answering two screening questions for all types of study designs. S1. (Are there specific research questions? S.2 (Do the collected data allow us to answer the research questions?) (Hong et al., 2018).

The methodological quality standards are covered in Part 2 because each study design has a distinct domain and description. Depending on the type of study, methodological quality criteria include questions for each category. Each quantitative and qualitative study received a percentage score, which is calculated by dividing the number of Yes responses by the number of items assessed. Table 5 displays the total rating scores of the included studies in the most readable format. The number of asterisks (*) under each study in table 5 describes the level of quality assigned to that study. The included paper that met all five quality criteria is rated as a high-quality study (*****). The greater the number of asterisks, the higher the quality of the study (Hong et al., 2018). The four criteria for appraising quantitative and qualitative studies are represented by the numbers 1.1 to 1.4, 2.1 to 2.4, 3.1 to 3.4, and 4.1 to 4.4 in table 5. Appendix 1 contains a detailed explanation of the quality assessment of each included study as well as the numbers [1,2,3,4,5] in table 5.

Table 5: Quality assessment of chosen articles using the Mixed Methods Appraisal Tool (MMAT)

Zhang et al. (2010) Quantitative	MacNeill et al. (2014) Qualitative	Radhakrishnan et al. (2015) Qualitative	Vanhouwelingen et al. (2015)	Qian et al. (2019) Qualitative	Vander Cingel et al. (2021) Qualitative	Schmidt et al. (2021) Quantitative	Navarro et al. (2021) Quantitative	Author, (Year), Study category	Screening question		Methodological quality criteria
									1	2	
1	1	1	1	1	1	1	1	1	1	2	
1	1	1	1	1	1	1	1	1	1	2	
1	1	1	1	1	1	1	1	1	1	2	
0	1	1	0	1	1	1	1	3	1	3	
1	0	1	0	1	1	0	0	4	1	4	
0	1	1	1	1	1	1	1	5	1	5	
5/7The exposure time for mobile technology was short, this could affect the finding. Longer exposure time could enable participants to have more perceptions of using	6/7 The form of data collection, 4 sources, 4 out of 10 nurses were nursing administrators.	7/7 Appropriate methodology was used in this study.	5/7 Large number of dropouts, 14 nurses didn't complete the study. The findings cannot be generalized to men since the 95% respondents were women.	7/7 The methodology, the ethnographic approach was appropriate. Sample, collection of data, analysis and interpretation was clear and linked to the interpretation.	7/7 The chosen qualitative approach was appropriate. The sample represents the target population. The methodology was clear.	6/7 A pilot study with a very small sample size to evaluate the usability of digital devices.	6/7 This was a pilot study. Contradictions on the results due to one unclear setting.	Total score and comments			

Browning et al. (2009) Quantitative descriptive 4/****	1	1	1	1	1	0	1	6/7 1 nurse was a licence practical nurse, the rest were 38 registered nurses. The findings from this study cannot be generalise to a larger setting.
--	---	---	---	---	---	---	---	---

The level of quality given to each study is described under each study by the number of asterisks (*)

To ensure objectivity, at least two authors must evaluate study quality when using the MMAT tool (Hong et al., 2018). The other student and I worked together to evaluate the quality of the studies included in the final review. Disparities after appraisal were discussed in comparison to MMAT interpretation (Hong et al., 2018).

Finally, the criteria of the included studies' chosen categories were rated. Three out of nine studies were rated high-quality studies and given five asterisks (*****), indicating that they met all five quality criteria on the MMAT score tool; four studies were rated with four stars (****), indicating that they met 80% of the quality criteria; and two studies were rated with three stars (***), indicating that they met 60% of the quality criteria (Details can be found in Table 5). As a result, the greater the number of asterisks, the higher the quality of the study. Table 5 presents the appraisal results of the included studies. Appendix 1 provides an example of a detailed explanation.

4.4 Data synthesis and Data Analysis of the selected studies

The data from the included studies were extracted independently. A summary of Findings (SoF) table was designed for data synthesis (Higgins et al., 2019). The SoF table was mainly designed to focus on the primary aim of this study and consists of the summary of the characteristics of the included studies and key aspects like study design, study settings, type of data, data analysis method, out-

come measure, and the main findings of the studies. A data extraction spreadsheet was created to extract data from the included studies. The extraction spreadsheet was based on the data extraction template used by the Cochrane Consumers and Communication Review Groups (Ryan et al., 2016). The relevant information from the articles was extracted for data synthesis, and a Summary of Findings (SoF) table was created, as shown in Appendix 2.

Erlingsson and Brysiewicz's content analysis method was used to analyze the data (Erlingsson & Brysiewicz, 2017). The method of analysis by Erlingsson & Brysiewicz (2017) was chosen because there is a lack of knowledge about the phenomenon under study in this case, which is the use of digital technologies in geriatric care settings from nurses' perspectives. This method of analysis will compile knowledge to understand and comprehend the significance of nurses' experiences and attitudes toward using digital technologies in geriatric care settings (Erlingsson & Brysiewicz, 2017).

Additionally, the reason for selecting the content analysis method to analyze data for this systematic review is to categorize and arrange the information from these articles based on their relationship to create patterns (Vaismoradi et al., 2013). Furthermore, content analysis is the best data analysis method to use in this systematic review because it is typically recommended when no previous studies exist or previous knowledge is fragmented (Hsieh & Shannon, 2005). The knowledge in this systematic review of nurses' prior experiences and attitudes toward using digital technologies in geriatric care settings does not conform and is still dispersed.

The five-phase framework for content analysis is explained below, as well as how it was used step by step in this systematic review of the use of digital technologies in geriatric care settings from nurses' perspectives (Erlingsson & Brysiewicz, 2017).

The first step in the analysis was to gain a broad understanding of the articles selected for inclusion in the final review. This was accomplished by reading and re-reading full-text articles one by one to become acquainted with the data (Er-

lingsson & Brysiewicz, 2017). The second step was to create and produce meaning units based on the information gleaned from rereading all of the full-text articles. Throughout the process, the primary goal of this systematic review and both research questions guiding this review were in focus to facilitate text arrangement based on meaning units. Condensing meaning units was the third step in this framework analysis. Although the text was shortened, the core meaning of these articles was retained. This step was simply an updated shorter version of the previous step. The fourth step in this analysis was to create codes. The coding is a detailed explanation of the framework's previous step's condensed meaning unit. To represent code, raw data was condensed into short statements (Erlingsson & Brysiewicz, 2017). The final step was to group the codes to form categories. The codes were organized into groups based on their content, context, and relatedness to one another. The coding was based on the keywords that were developed and related to the primary goal of this study (Erlingsson & Brysiewicz, 2017). Tables 6 and 7 provide an example of data analysis results. Appendix 3 presents a detailed explanation of the content analysis method of the included studies.

The quotations listed in the table below are from full-text articles, which I read. The quotations were selected because they are nurses experiences and attitudes, specifically they are relevant quotations to answer the research questions.

Table 6: Data analysis results (Nurses' positive attitudes and experiences)

Example of quotations	Code	Subcategory	Categories	Main Category
"User friendly and less related to image". "Digital technology reduces workload and stress and makes the job easier". "Well, it's an easy and fast application".	Ease of use Simplifies daily work. User friendly Fast application Good clinical applicability	Digital technology simplifies nurses' workload.	Digital technology enhances nurses' performance while reducing their workload.	Positive attitudes and experiences of the use of digital technology for nurses in the geriatric care setting.
	Helpful tool High usability Usefulness Reduces workload Reduces stress	The usage of digital technology increases the efficiency of nurses and helps them perform better.		

<p>Usability of the app (System Usability Scale), very high usability, and good clinical applicability.</p> <p>“Easy comprehension, it simplifies everyday care”.</p> <p>“I would use Mini dental assessments in my daily routine. It’s a helpful tool”.</p> <p>“Simplify our work, also save time and inexpensive”.</p>	<p>Save time. Save costs</p>	<p>Using digital technology saves time and costs. Inexpensive</p>	<p>Efficient and beneficial</p>	
--	----------------------------------	---	---------------------------------	--

Example of quotations	Code	Subcategory	Category	Main Category
-----------------------	------	-------------	----------	---------------

<p>"I think there were a small number of people where it made them more anxious. We felt like a failure often". "Work is interrupted by technology failure".</p> <p>"The technology was a bit much for the generation of the folks that I usually took care of. , it isn't just as simple as pressing a button, You press a button, start, and then follow the prompts. But it doesn't always work that way."</p> <p>"There is a point where telehealth is quite stressful."</p> <p>"The actual use of the equipment sometimes can be a stumbling block for us".</p> <p>"I have to go back and double-check; I have no confidence". "High-stress work to deal with technology and frail population".</p>	<p>Anxious Fearful Failures Too complex Difficult Overwhelmed</p>	<p>Unpleasant emotions Emotional struggles</p>	<p>Nurses' perspectives on the effects of digital technologies on a mental level</p>	<p>Nurses' negative attitudes and experiences of using digital technology while providing care to the elderly.</p>
	<p>Stressful Major challenge Burden Confidence</p>	<p>Insecurity and demand on nurse's workload.</p>	<p>Nurses' perspectives on the effects of digital technologies on a physical level</p>	

Table 7: Data analysis (Nurses' negative attitudes and experiences)

5 Results

5.1 Study characteristics

This systematic review included nine empirical studies. The characteristics of all nine studies are presented in detail and described in Appendix 2. The studies in this review were conducted in various countries, with five from Europe, two from the United States of America, one from Australia, and one from Canada. The studies conducted in Europe came from Spain, Germany, the Netherlands, and the United Kingdom (Navarro et al., 2021; Schmidt et al., 2021; Van der Cingel et al., 2020; Van houwelingen et al., 2015; MacNeill et al., 2014). Two studies were conducted in the United States of America (Radhakrishnan et al., 2015; Browning et al., 2009). Furthermore, one of the other studies was conducted in Australia (Qian et al., 2019), and the other was conducted in Canada (Zhang et al., 2010).

These studies included registered nurses, (Navarro et al., 2021; Schmidt et al., 2021; Van der Cingel et al., 2021; Van houwelingen et al., 2015; Qian et al., 2019; Radhakrishnan et al., 2015; MacNeill et al., 2014; Zhang et al., 2010). Among these studies, one included 29 nurses of which 28 were registered nurses and one was a licensed practical nurse who was trained as a registered nurse (Browning et al., 2009). The nurses came from a variety of geriatric settings, including home care (Van der Cingel et al., 2020; Van houwelingen et al., 2015; Radhakrishnan et al., 2015; MacNeill et al., 2014; Browning et al., 2009; Zhang et al., 2010), long-term care facilities (Qian et al., 2019), and geriatric wards (Schmidt et al., 2021). The hospital setting environment was not specified in one study (Navarro et al., 2021). Aside from that, all the patients were elderly. The study was still included in the final review because the findings were based on data collected from geriatric care settings (Navarro et al., 2021).

Four qualitative studies (Van der Cingel et al., 2021; Qian et al., 2019; Radhakrishnan et al., 2015; MacNeill et al., 2014) and five quantitative studies were included in the final review (Navarro et al., 2021; Schmidt et al., 2021; Van houwelingen et al., 2015; Browning et al., 2009; Zhang et al., 2010). Three of the qualitative studies use a phenomenological approach (Van der Cingel et al., 2020; Radhakrishnan et al., 2015; MacNeill et al., 2014), and one uses an ethnographic

approach (Qian et al., 2019). All the quantitative studies were descriptive in nature (Schmidt et al., 2021; Van houwelingen et al., 2015; Browning et al., 2009; Zhang et al., 2010; Navarro et al., 2021).

Mobile technology was used in these studies as digital technology (Navarro et al., 2021; Schmidt et al., 2021; Van der Cingel et al., 2020; Zhang et al., 2010). Using digital mobile applications, digital tools for monitoring or communicating during the care process, monitoring blood sugar levels, monitoring patients, and digital personal assistance in nurses' daily activities are specific examples of these applications (Navarro et al., 2021; Schmidt et al., 2021; Van der Cingel et al., 2020; Zhang et al., 2010). In addition, home telehealth technology was used to help older adults age in place, as well as telehealth devices to monitor and administer medication to the elderly (Van houwelingen et al., 2015; Radhakrishnan et al., 2015; MacNeill et al., 2014; Qian et al., 2019; Browning et al., 2009).

5.2 Geriatric care nurses' attitudes and experiences towards using digital technologies.

Nurses' attitudes toward the use of digital technologies in geriatric care settings were reported in six studies (Navarro et al., 2021; Radhakrishnan, 2015; Schmidt, 2021; Van houwelingen, 2015; Van der Cingel, 2021; Zhang, 2010). Moreover the analysis table above, Table 6 explains in detail some of the positive experiences and attitudes expressed by nurses while providing care to elderly people in geriatric care settings. In the results section, the categories and subcategories from the results are in detail explained.

Technology enhances nurses' performance while reducing their workload

Nurses showed positive attitudes toward the use of digital technologies (Schmidt et al., 2021; Van houwelingen, 2015; Zhang, 2010). In addition to boosting nurses' confidence and performance at work digital technologies enable them to work independently. Additionally, the implementation of new digital technologies was significant to nurse's daily routines as these innovations simplified daily nursing

tasks at the same time reduced their workload (Schmidt et al., 2021; Van houwelingen, 2015; Zhang, 2010).

Digital technology minimizes nurses' workload. Nurses felt that using digital technologies reduced fatigue and workload by making nurses' jobs easier. Furthermore, nurses had positive attitudes because digital technology, allows them to have less paperwork, and increases nurses' motivation (Schmidt et al., 2021; Van houwelingen, 2015; Zhang, 2010). Furthermore, nurses reported positive attitudes due to the fast application of digital technologies which was adapted and accepted easily by nurses due to good clinical applicability (Schmidt et al., 2021; Van houwelingen, 2015; Zhang, 2010).

Additionally, the usage of digital technology increases the efficiency of nurses and helps them perform better. The results from this study also showed that the positive attitudes toward the utilization of digital technologies increase nurses' competence and due to that they achieve better outcomes and accomplish more. The high usability of digital technology and easy applicability were seen in nurses' daily work efficiency. The user-friendly tool encouraged nurses to adapt and apply digital technologies in their daily routines at work (Schmidt, 2021; Van houwelingen, 2015; Zhang, 2010).

Efficient and beneficial

Nurses had a positive attitude toward digital technology due to the fact that technology saves time, and it was inexpensive too. Nurses reported that using digital technologies in geriatric care settings simplifies daily care and work too. In addition to those, it was inexpensive to apply digital technologies since digital technologies can be operated by one nurse independently (Schmidt et al., 2021; Van houwelingen, 2015; Zhang, 2010).

5.3 Negative attitudes of the use of digital technology for nurses in geriatric care settings

Among these studies nurses have shown negative experiences and attitudes when using digital technologies while delivering care (Qian et al., 2019; MacNeill et al., 2014). The categories and subcategories from Table 7 above give detail explanation of the nurses perspectives.

Nurses' perspectives on the effects of digital technologies on a mental level

Additionally, nurses showed negative attitudes toward the use of digital technologies. The complexity of modern instruments, anxiety, fear, and a lack of self-confidence were all barriers to nurses' adoption of modern digital technologies. In addition, it was reported that nurses' attitudes toward the use of digital technologies included feelings of discomfort, being overwhelmed, and incompetence due to a lack of training. Nurses frequently reported errors during application processes due to a lack of training and experience with new digital technologies (Navarro et al., 2021; Radhakrishnan, 2015; Van der Cingel, 2021).

Unpleasant emotions and emotional struggles were reported across the studies, (Qian et al., 2019; MacNeill et al., 2014) nurses felt failures, anxious, fearful, and stressed when applying digital technologies in their daily routines. In addition to feeling that technology disrupts their work as is too complex and overwhelming, they also felt that technology at work has increased control over them (Qian et al., 2019).

Nurses' perspectives on the effects of digital technologies on a physical level

Insecurity and demand on nurse's workload as well as continuous disruption left nurses stressed and with a lack of confidence to perform their daily tasks. Nurses have had negative experiences such as feeling that technology is a huge burden and challenge in their daily routines. However (Qian et al., 2019) revealed that nurses reported having experienced several contradictions and interruptions/disruptions at the workplace while using technology to deliver care to their clients due to a lack of digital knowledge (Qian et al., 2019).

6 Ethical Perspectives and Reliability

6.1 Ethical Perspectives

The Finnish Advisory Board on Research Integrity's guidelines were followed throughout the research process for this study (Finnish Advisory Board on Research Integrity [TENK], 2012). This implies that when conducting research, the research community's standards of truthfulness, integrity, and awareness were obeyed (TENK, 2012).

Despite research permission was not needed for this study to be conducted, the required academic research ethics, which are important in the integrity of nursing professionals, were applied in this systematic review of the use of digital technologies in geriatric care settings from nurses' perspectives (Heale & Twycross, 2015).

The level of evidence and scientific quality of papers were appraised using the Mixed Method Appraisal Tool (MMAT), which also evaluated bias. All of the papers proved to be ethically acceptable for the literature review during data analysis (Hong et al., 2018). The methods used to conduct this systematic review are ethically sustainable and meet scientific standards. The results were openly discussed with scientific knowledge.

The work and accomplishments of other researchers were acknowledged and valued; in this systematic review, publications were properly cited and given due credit. The references are written in accordance with Diak's thesis paper writing

guidelines (TENK, 2012). Moreover, in performing this systematic review, I followed the scientific knowledge criteria for planning, conducting research, and reporting the research outcomes and data obtained throughout the research. To avoid plagiarism, the thesis must be written entirely in my own words, which I have done. Hence, writing in one's own words along with providing acknowledgment to the original authors is a key ethical principle. Moreover, the entire thesis procedure considered and implemented all of the supervisor's recommendations (Suri, 2019).

Since this is secondary research, literature reviews do not collect extremely private or confidential information from people like primary research does. Contrarily, a thorough study of the literature gathers data from papers and journals and gives due credit to the authors who originally wrote the work. Systematic literature reviews also serve a vital part in influencing public perception as well as guiding future research, practice, and policy. In light of this, it is now more crucial than ever to evaluate the ethical implications of how various stakeholders' interests are highlighted and portrayed in study evaluations (Suri, 2019.)

6.2 Reliability

The author searched three databases: PubMed, Medline, PsycINFO, and the search engine Google Scholar, this might have influenced the search results. These electronic databases were chosen for their comprehensive coverage of healthcare services and clinical practice studies. Furthermore, the databases were chosen specifically for their relevance and centrality to the topic. Moreover, bias in study selection due to the inclusion of only English-language articles, leaving out primary studies written in other languages. The concern of reliability also pertains to the replicability of the process and the outcome results. Figure 1 illustrates and describes the search terms in each database used, as well as the search strategy step by step, and this adds to the replicability of the search process. The search method in this systematic review can be repeated to achieve a consistent result (Leung, 2015).

The fact that four of the nine studies that were included in this study were published relatively recently (between 2019 and 2021) was one of the primary strengths of this systematic review. This finding suggests that the findings of

these studies contribute to the ongoing research and scientific knowledge in this field. To confirm that this systematic review was conducted in a structured format, the author adhered to all key procedures for conducting a valid systematic review. The author also double-checked the systematic review checklist to ensure that all relevant aspects are included (Bettany-Saltikov, 2012).

6.3 Validity

The appropriateness of the methods, data, and research questions in relation to the intended result are also considered to be aspects of research validity (Leung, 2015). The selection of methodology in this systematic review was suitable for addressing both research questions. The validity of the outcome findings depends on the design and data analysis technique. The data synthesis method was the best option and relevant in this systematic review because it allowed me to present a summary of the extracted data as well as a synthesis of the overall findings. The search was conducted in a trustworthy manner. The findings are credible because the method and analysis are transparent and systematic. This is also a means to build dependability, as the method should be repeatable as a result (Leung, 2015).

Clarity during data analysis and subsequent interpretations is required to ensure the credibility of the study results (Noble, & Smith, 2015). I adhered to each crucial step in the data collection and data analysis processes to keep the study validity of this systematic review. To improve the credibility of this systematic review, I re-read the nine full-text studies included in the final review several times for clarification. Throughout this research process, dependability, which alludes to the transparency of methodological choices, is clear and well-explained and presented with tables and a figure (Guba, 1994).

Another factor that could undermine the credibility of this thesis is the author's personal experience as a registered nurse dealing with the elderly in an orthogeriatric ward. The significance of having a reliable source and the experiences of other nurses. While conducting this research, it was critical for me as a nurse not to express my point of view in order to ensure that other nurses expressed their true value. Throughout this systematic review, I applied strategies that created

distance from the study to ensure that my prior knowledge and experiences did not interfere with other nurses (Noble & Smith, 2015).

As a result, for the validity of this thesis, appropriate and pertinent data were 9 studies, collected via reliable sources and Diaconia University of applied science search engines. More importantly, the systematic literature review method was used to answer research questions. Only relevant papers were selected for inclusion in the final review. Excluded articles were excluded from selected articles, as shown in Figure 1, the Flow diagram, which also provides an explanation as to why the articles were excluded. Furthermore, the Diaconia University of Applied Science template has been used.

This systematic review has some limitations. This study excluded editorials, book reviews, and systematic reviews. Despite the fact that this exclusion may have excluded some other facts, only empirical studies were included to ensure the findings' trustworthiness. This study's inclusion criteria were fulfilled by only nine studies. There is a methodological limitation regarding the selection of the studies because only one author selected them.

More research on nurses' experiences and attitudes in the future design and development of digital technologies is required, as their experiences are critical in ensuring the effective implementation of digital technologies in geriatric care settings.

7 Discussion

The purpose of this systematic review was to identify the current literature on nurses' experiences and attitudes toward using digital technologies in providing care to patients in geriatric care settings. The evidence indicates that the use of digital technologies improves nurses' performance while lowering their workload; it saves time and money; and digital technology reduces nurses' workload and stress. Furthermore, the use of digital technology boosts the efficiency and performance of nurses. Aside from these positive attitudes and experiences, the find-

ings included various nurses' viewpoints on the consequences of digital technologies on mental and physical levels. Specific examples of these applications e.g., mobile applications, digital tools for monitoring or communicating during the care process, monitoring blood sugar levels, home telehealth technology, and telehealth devices

The ~~research~~ findings of this systematic review contribute to our understanding of how significant it is to incorporate nurses from the initial stages of implementation of digital technologies. This is crucial because, in geriatric care settings, it is nurses who apply this digital technology daily to provide care to geriatric patients. Nurses view the use of digital technologies in relation to the technology's usability and the individual's prior technology experiences, both of which are most likely to have a positive influence on their willingness to use and adapt to digital technologies while providing care in geriatric care settings. The negative experiences and attitudes were more likely associated with the usability and adaptability of digital technology. Putting this into perspective, prior digital knowledge was seen as an advantage, as it allowed the smooth implementation and adaptation of digital technologies in geriatric care settings. These findings reflect those of Tsertsidis et al. (2019) who also found that nurses play an important role in care plan implementation, therefore, their perspectives and experiences in using digital technologies to deliver care have to be considered in the innovation of digital technologies. In accordance with the present finding, previous study by Yeo (2014) reported that nurses have praised some of the equipment they've adopted as a result of technological advancements as the primary reason of stress relief during the course of their daily operations (Yeo et al., 2014).

These findings will also aid in incorporating nurses' roles into inclusive innovation in the workplace, which is important since it enables the majority of people—if not all—citizens to engage in innovation and development, leaving no one behind. Additionally, having nurses with adequate knowledge of digital technologies can help empower the elderly to use more of these digital technologies and be more

independent in their daily lives. In the long term, this will decrease dependency, healthcare utilization, and nursing shortages while maintaining quality care .

These findings may also help us to understand that nurses' impressions of the usefulness of digital technology have a significant impact on their attitudes to use it. These findings suggest that for nurses to be motivated to accept digital technology in the workplace, they must trust in its value. A comparison of the findings with those of other studies confirms that the use of digital technology for the purpose of providing care revealed that the majority of nurses in geriatric care settings have a positive attitude towards their incorporation due to the fact that it is simple to use and reduces the amount of work that needs to be done (Whittaker et al., 2010).

Furthermore, the findings of this systematic review advance knowledge of the significance of nurses having the right education and training when dealing with new digital technologies. An organized and appropriate education program can help nurses obtain a comprehensive understanding of digital technologies, which will give them more confidence when implementing the new technology into their daily routines. This finding broadly supports the work of other studies in this area, a previous study by Venkatesh and Davis (2000), reported that technology incorporation in any sector of an organization takes a lot of time and the environmental features of medical institutions must be reviewed to guarantee that the nursing staff in the gerontology unit has sufficient time and education to comprehend and effectively use the innovations (Venkatesh & Davis, 2000; Chan, 2017).

An implication of these findings is the fact that the findings of the study encourage healthcare providers and other welfare experts in charge of geriatric nursing to concentrate more on interventions that consider nurses' perspectives on the use of digital technologies in relation to developing and implementing those technologies in geriatric care settings. As a result, it has a significant impact on older

people by promoting independent living, reducing relocation to nursing homes and most significantly reducing the shortage of nurses to fulfill demand. With this new knowledge, understanding nurses' experiences and attitudes, as well as how significant it is to include nurses' perspectives in the early stages of designing digital technologies, may facilitate aging in place, increase the quality of healthcare services, and minimizes the scarcity of nurses needed to meet demand.

8 Conclusion

This systematic research has shown that nurses had both positive and negative experiences and attitudes concerning the usage of digital technologies in geriatric care settings. Positive experiences and attitudes from nurses with prior digital knowledge have demonstrated that they are confident in their ability to use digital technology in the future. Stress, anxiety, discomfort, and fear, as well as the complexity of modern technologies, are impediments to the usability and adaptation of digital technologies in geriatric care settings. As the population ages, quality healthcare services must be maintained while nurses are in short supply to satisfy the demand. Appropriate education, specialized digital training, and time for nurses to fully comprehend and adopt new digital technology in geriatric care settings are required.

SOURCES

- Bettany-Saltikov, J. (2012) How to do a systematic literature review in nursing: a step-by-step guide. Maidenhead: McGraw-Hill/Open University Press.
- Browning, S. V., Tullai-McGuinness, S., Madigan, E., & Struk, C. (2009). Telehealth: is your staff ready to implement? A descriptive exploratory study of readiness for this technology in home health care. *Home healthcare nurse*, 27(4), 242–248.
- Blazun H, Saranto K, and Rissanen S (2012) 'Impact of computer training courses on reduction of loneliness of older people in Finland and Slovenia', *Comput Human Behav*, 28, pp. 1202– 1212.
- Cohen SS, Milone-Nuzzo P. Advancing health policy in nursing education through service learning. *ANS Adv Nurs Sci*. 2001; 23:28–4.
- Damant J, Knapp M. What are the likely changes in society and technology which will impact upon the ability of older adults to maintain social (extra-familial) networks of support now, in 2025, and in 2040? [Internet]. London: Government Office for Science; 2015. Future of ageing: evidence review. [cited 2023 July 18].
- der Cingel, M. V., Bulle-Smid, L., Holterman, S., Prins, H., Keuning, W., & Hettinga, M. (2021). From clinical reasoning to eHealth interventions, a study on how nurses assess care and eHealth in-home care. *Nurse education in practice*, 50, 102925.
- Erlingsson, C., & Brysiewicz, P. (2017). A hands-on guide to doing content analysis. *African journal of emergency medicine: Revue africaine de la medecine d'urgence*, 7(3), 93–99.
- Guba, E.G., & Lincoln, Y.S.(Eds.). (1994). Competing paradigms in qualitative research: Handbook of qualitative research. Thousand Oaks, CA: Sage.
- Heale, R., & Twycross, A. (2015). Validity and reliability in quantitative studies. *Evidence-based nursing*, 18(3), 66–67. <https://doi-org.ludwig.lub.lu.se/10.1136/eb-2015-102129>

Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, et al.

Cochrane Handbook for Systematic Reviews of Interventions version 6.0. (Editors).2019. (Updated July 2019). Cochrane. Retrieved from: www.training.cochrane.org/handbook

Hong QN, Fàbregues S, Bartlett G, Boardman F, Cargo M, Dagenais P, et al.

The mixed methods appraisal tool (MMAT) version 2018 for information professionals and researchers. *Educ Inf.* 2018; 34: 285–91.

Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative health research*, 15(9), 1277–1288.

International Council of Nurses ICN,2020

<https://www.icn.ch/>

Janine L. Wiles, Ph.D., Annette Leibing, Ph.D., Nancy Guberman, MSW,

Jeanne Reeve, Ph.D., Ruth E. S. Allen, Ph.D., The Meaning of “Aging in Place” to Older People, *The Gerontologist*, Volume 52, Issue 3, June 2012, Pages 357–

366.<https://doi.org/10.1093/geront/gnr098>

Kelley, T. F., Brandon, D. H., and Docherty, S. L. (2011) ‘Electronic nursing documentation as a strategy to improve quality of patient care’, *Journal of Nursing Scholarship*, 43(2), pp.154– 162.

Kent, B., Redley, B., Wickramasinghe, N. Nguyen, L., Taylor, N. J. Moghimi, H. and Bottin, M. (2015) ‘Exploring nurses reaction to a novel technology to support acute health care delivery,’ *Journal of clinical nursing*, 24(15/16), pp. 2340-2351

Leung, L., 2015. Validity, reliability, and generalizability in qualitative research. *Journal of Family Medicine and Primary Care*.

Linnenluecke, M. K., Marrone, M., & Singh, A. K. (2020). Conducting systematic literature reviews and bibliometric analyses. *Australian Journal of Management*, 45(2), 175–194.

Munn, Z., Stern, C., Aromataris, E., Lockwood, C., & Jordan, Z. (2018). What kind of systematic review should I conduct? A proposed typology and guidance for systematic reviewers in the medical and health sciences. *BMC medical research methodology*, 18(1), 5.

Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The

PRISMA Statement. *Int J Surg* 2009; doi:
10.1016/j.ijsu.2010.02.007

MacNeill, V., Sanders, C., Fitzpatrick, R., Hendy, J., Barlow, J., Knapp, M., Rogers, A., Bardsley, M., & Newman, S. P. (2014). Experiences of front-line health professionals in the delivery of telehealth: a qualitative study. *The British journal of general practice: the journal of the Royal College of General Practitioners*, 64(624), e401–e407.
<https://doi-org.ludwig.lub.lu.se/10.3399/bjgp14X680485>

National Institute for Health Research (NIHR) (2010) Systematic Reviews: Knowledge to Support Evidence-Informed Health and Social Care. London: NIHR. Available at <http://docplayer.net/6808443-Systematic-reviews-knowledge-to-support-evidence-informed-health-and-social-care.html> (accessed 16October 2021)

National Science and Technology Council. Emerging Technologies to Support an Aging Population [Internet]. United States of America: National Science and Technology Council. [cited 2020 Jan 14]. Available from: <https://www.whitehouse.gov/wp-content/uploads/2019/03/Emerging-Tech-to-Support-Aging-2019.pdf>

Navarro Martínez, O., Igual García, J., & Traver Salcedo, V. (2021). Estimating Patient Empowerment and Nurses' Use of Digital Strategies: eSurvey Study. *International journal of environmental research and public health*, 18(18), 9844.

Noble, H., & Smith, J. (2015). Issues of validity and reliability in qualitative research. *Evidence-based nursing*, 18(2), 34–35. <https://doi-org.ludwig.lub.lu.se/10.1136/eb-2015-102054>

Peek ST, Wouters EJ, van Hoof J, Luijkx KG, Boeije HR, Vrijhoef HJ. Factors influencing acceptance of technology for aging in place: a systematic review. *Int J Med Inform*. 2014 Apr;83(4):235-48.

Peek, S. T.M., Luijkx, K. G., Rijnaard, M. D., Nieboer, M. E., van der Voort, C. S., Aarts, S., van Hoof, J., Vrijhoef, H. J.M., & Wouters, E. J.M. (2016). Older adults' reasons for using technology while aging in place. *Gerontology*, 62(2), 226–237. <https://doi.org/10.1159/000430949>

- Peek, S. T. M., Luijkx, K. G., Vrijhoef, H. J. M., Nieboer, M. E., Aarts, S., van der Voort, C. S., Rijnaard, M. D., & Wouters, E. J. M. (2019). Understanding changes and stability in the long-term use of technologies by seniors who are aging in place: a dynamical framework. *BMC geriatrics*, 19(1), 236. <https://doi.org/10.1186/s12877-019-1241-9>
- Steinhubl, S. R., & Topol, E. J. (2015). Moving From Digitalization to Digitization in Cardiovascular Care: Why Is it Important, and What Could it Mean for Patients and Providers? *Journal of the American College of Cardiology*, 66(13), 1489–1496.
<https://doi.org/10.1016/j.jacc.2015.08.006>
- Qian, S., Yu, P., & Bhattacharjee, A. (2019). Contradictions in information technology-mediated work in long-term care: An activity theoretic ethnographic study. *International journal of nursing studies*, 98, 9–18.
- Ryan R, Synnot A, Pictor M, Hill S. Cochrane Consumers and Communication Group Data extraction template for included studies [Internet]. Melbourne: La Trobe University; November 2016. Available from <https://cccrq.cochrane.org/author-resources>
- Radhakrishnan, K., Xie, B., & Jacelon, C. S. (2016). Unsustainable Home Telehealth: A Texas Qualitative Study. *The Gerontologist*, 56(5), 830–840.
- Schmidt, A., Schlenz, M. A., Gäbler, C. S., Schlee, S., & Wöstmann, B. (2021). Development of a New Application-Based Chewing Efficiency Test (Mini Dental Assessment) and Its Evaluation by Nursing Staff in Geriatric Care: A Pilot Study. *International journal of environmental research and public health*, 18(22), 11889.
- Suri, H., 2019. Ethical Consideration of Conducting Systematic Review in Educational Research. PP-41-54 https://link.springer.com/chapter/10.1007/978-3-658-27602-7_3
- Tenk. (2012). Responsible conduct of research and procedures for handling allegations of misconduct in Finland. Guidelines of the Finnish Advisory Board on Research Integrity.
- Thimbleby, H. (2019). Three laws for paperlessness. *Digital Health*, 5, 2055207619827722.
- Tsertsidis A, Kolkowska E, Hedstrom K. Factors influencing seniors' acceptance

- of technology for ageing in place in the post-implementation stage: A literature review. 2019 Sep;129, p324-33.
- United Nations Department of Economic and Social Affairs Population Division. *World Population Ageing 2017-Highlights*. 2017.New York:ST/ESA/SER.A/397.
- United Nations Department of Economic and Social Affairs Population Division. *World Population Prospects: the 2017 Revision*. 2017.New York: ESA/P/WP/248 2017.
- van Houwelingen, C. T., Barakat, A., Best, R., Boot, W. R., Charness, N., & Kort, H. S. (2015). Dutch nurses' willingness to use home tele-health: implications for practice and education. *Journal of gerontological nursing*, 41(4), 47–56.
- Vaismoradi, M., Turunen, H., & Bondas, T. (2013). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing & health sciences*, 15(3), 398–405.
- Venkatesh V & Davis FD (2000) 'A theoretical extension of the technology acceptance model: four longitudinal field studies', *Management Science*, 46, pp. 186–204.
- Whittaker, A. A., Aufdenkamp, M., and Tinley, S. (2010) 'Barriers and facilitators to electronic documentation in a rural hospital', *Journal of Nursing Scholarship*, 41(3), pp.293– 300.
- WHO (2018), Technology, Health
https://www.who.int/health-topics/digital-health#tab=tab_1 Accessed 3rd February 2023
- WHO (2023), Nursing
https://www.who.int/health-topics/nursing#tab=tab_1 / Accessed 3rd March 2023
- Xiao, Y., & Watson, M. (2019). Guidance on Conducting a Systematic Literature Review. *Journal of Planning Education and Research*, 39(1), 93–112.
- Yeo, M. T. (2014) 'Implications of 21st century science for nursing care: interpretation and issues', *Nursing philosophy*, 15(4), pp. 238-249.
- Zhang, H., Cocosila, M., & Archer, N. (2010). Factors of adoption of mobile information technology by homecare nurses: a technology acceptance

model 2 approach. *Computers, informatics, nursing: CIN*, 28(1), 49–56.

APPENDIX 1. Quality assessment using the MMAT tool.

Quality appraisal of qualitative design study

First Author, Year	Van der Cingel et al. (2020)	Qian et al. (2019) Qualitative	MacNeill et al. (2014)	Radhakrishnan et al. (2015)
1.1. Is the qualitative approach appropriate to answer the research question?	Yes	Yes	Yes	Yes
1.2. Are the qualitative data collection methods adequate to address the research question?	Yes	Yes	No	Yes
1.3. Are the findings adequately derived from the data?	Yes	Yes	Yes	Yes
1.4. Is the interpretation of results sufficiently substantiated by data?	Yes	Yes	Yes	Yes
1.5. Is there coherence between qualitative data sources, collection, analysis, and interpretation?	Yes	Yes	Yes	Yes

Quality appraisal of quantitative descriptive study

First Author, Year	4.1. Is the sampling strategy relevant to address the research question?	4.2. Is the sample representative of the target population?	4.3. Are the measurements appropriate?	4.4. Is the risk of nonresponse bias low?	4.5. Is the statistical analysis appropriate to answer the research question?
Navarro et al., 2021	Yes	Yes	Yes	Not mentioned	Yes
Schmidt et al., 2021	Yes	Yes	Yes	0	Yes
Van houwelingen et al., 2015	Yes	Yes	0	0	Yes
Browning et al., 2009	Yes	Yes	Yes	0	Yes
MacNeill et al., 2014).	Yes	Yes	Yes	Not mentioned	Yes

APPENDIX 2. Summary of Findings, description of study characteristics, and the main findings

First author Year, Country	Aim	Data collection method(s)	Data analysis	Main findings Experiences	Main findings , attitudes
Navarro et al,2021 Spain	To assess and evaluate nurses' use of digital resources to reinforce information to their patients and assess the level of empowerment of their patients	Exploratory study N =850 nurses <u>Settings</u> 60 hospital environments 4 primary cares 7 nursing homes Questionnaire The survey,21 questions <u>Outcome measure</u> Chi-square test Kruskall -Walli's test and correlation	The conceptual model of patient empowerment		Negative attitudes due to a lack of understanding Nurses experience discomfort, fear, continuous complications, and difficulties to understand information on digital technologies. Communication channels like printed materials and oral communication were preferable to apps and mobile technology to monitor patients and provide extra information (P=0.85, Mann-Whitney U test), with no statistically significant difference (p =0.259, Chi-squared) their patients
Schmidt et al,2021 Germany	The aim of this study was to develop a digital application for mobile devices and to evaluate the usability of Mini Dental Assessment by nurses	Quantitative descriptive study, pilot study N=5 females Nurses 35 years and above <u>Settings</u> Geriatric care 10 applications were conducted 5 analogy and 5 digitals Questionnaire <u>Outcome measure</u> System Usability Scale Five-point Likert scale	IBM SPSS Statistics 26.0		Nurses reported positive attitudes towards ease of using the technology, which was related to usefulness, and acceptance in their daily routines regardless of prior knowledge - Usability of the app (System Usability Scale) 95.18± 4.26, very high usability and good clinical applicability.

Van der Cingel et al,2021, Netherlands	To determine how homecare nurses assess eHealth during the assessment of care in geriatric care settings	Qualitative study Registered nurses aged 30 and 65 N= 43 <u>Setting</u> 7 Homecare Interview sessions Focus group interview. Observation Field notes Focus group members check for clarification.	Thematic analysis (inductive approach)		Nurses reported negative attitudes due to unending challenges while applying digital technologies. Nurses reported feeling unsure, and unconfident to apply digital technologies.
Van houwelingen et al,2015 Netherlands	To examine Dutch nurses' willingness and attitudes to use home telehealth technology to help old adults age in place	Quantitative study N=67 nurses with home telehealth experience and 126 without home telehealth experience 95%were women <u>Setting</u> Homecare organizations Questionnaire, survey 5-point Likert scale PANAS scale (10positives and 10 negative emotions) Mann Whitney U test	Multiple regression analysis		Nurses with previous digital experiences reported significant positive attitudes towards the use of digital technologies as compared to nurses without digital experiences. Nurses with high technology experience reported increased motivation and confidence during the application of digital technologies. (10.14 vs11.63; p=0.014)
Qian et al,2019 Australia	To examine how nurses work, the role of information technology in their work, and what contradiction they face in their IT-mediated work	A qualitative study (ethnographic) N=11 nurses <u>Setting</u> 8 care units in two long-term care facilities	Activity theory	Nurses reported having negative experiences due to several contradictions and disruptions to their work while delivering care	

		Fields notes were created based on Observation data Informal interviews Document reviews		to their clients. Nurses reported experiencing insecure, failure, and high stress while using modern digital technologies in their daily routines.	
Radhakrishnan, 2015, USA	The aim was to understand the interdependency and interconnections of digital technologies from healthcare providers' perspectives	Qualitative study N=12 nurses <u>Setting</u> Home care Semi-structured interview	Content analysis		Negative attitudes were reported by nurses due to the lack of significant impact on patient outcomes and technical challenges as compared to the traditional way of delivering care. Nurses reported feeling powerless, fearful, and lacking the confidence to apply digital technologies.
MacNeill et al, 2014, United Kingdom	To investigate telehealth care for people with long-term conditions living at home from healthcare professional perspectives	Qualitative study, N=10 telehealth monitoring nurses <u>Setting</u> Homecare Semi-structured individual interviewed	Constant comparison analysis based on the Grounded theory	Nurses reported negative experiences. They felt that technology can be stressful and a huge burden to nurses and their clients too	
Browning et al, 2009, United States	To examine the perception of nurse's readiness to implement telehealth	Quantitative descriptive N =91 homecare nurses <u>Setting</u> Homecare Self-report survey PCI survey VAS scale 0-100 item indicator		Nurses reported positive experiences due to previous experiences using digital technologies. Over 65% (65.9%; n= 27) had a positive impact and identified features of improving quality care as significant benefits to the implementation of telehealth. (36.8%; n=14) identified that patient ability could be a barrier to	

				successful telehealth implementation. Nurses experienced the use of digital technology simplifies their work and allow them to save time in their daily routines.	
Zhang et al, 2010, Canada	To examine and discover what are the perceptions of nurses on mobile technology	Quantitative descriptive N =91 homecare nurses <u>Setting</u> Homecare Survey based on TAM2 model	Partial least squares analysis		Nurses reported positive attitudes based on the usefulness and ease of use determined by the acceptance of mobile technology. They also saw the usefulness of applying mobile technology in their daily activities if they perceive that people in their daily work think that they should also use technology. Nurses felt that acceptance of modern technology simplifies their work, and reduces workload fatigue and stress.(Path coefficient =0.261, P=.05)

APPENDIX 3. Erlingsson and Brysiewicz's content analysis method

Meaning Unit	Condensed Meaning Unit	Code	Category, Theme
<p>Navarro et al, 2021</p> <p>It was discovered that nurses of all ages used printed information equally ($p = 0.85$, Mann–Whitney U test), contrary to the notion that young nurses are more comfortable with a digital lifestyle and would apply this to their professional life. When classified by age, 70.60% and 74.20% were similar ($p = 0.259$, Chi-squared). Verbal communication was used by 38.22% under 40 and 41.20% above 40 ($p = 0.39$), suggesting that all age groups employed traditional routes.</p> <p>In their practice, nurses perceived that they had a wide variety of responsibilities requiring complex skills. Likewise, they felt overwhelmed and devastated. In addition, nurses felt discomfort and fear due to continuous errors during the application of digital technologies. In some instances, the sharing of patient information between patient/provider relationships was deemed difficult and thus hindered their performance.</p>	<p>Age and scarce knowledge are the major challenges to applying digital technologies.</p> <p>Digital communication channels were too complex, difficult, and time-consuming to implement.</p> <p>Nurses felt that they had extra responsibilities requiring complex skills and felt overwhelmed and fearful due to lack of training.</p>	<p>Devastated and fear were reported among nurses.</p> <p>Nurses felt overwhelmed while delivering care.</p> <p>Nurses felt discomfort during the application.</p>	<p>Fearful</p> <p>Overwhelmed</p> <p>Incompetence</p> <p>Discomfort</p>
<p>Schmidt et al, 2021</p> <p>The results of this pilot study revealed that every single nurse who took part in it claimed that they preferred utilizing the digital MDA rather than the analog one. Two of the nurses, however, are able to conceptualize incorporating either analog or digital MDAs into their everyday work, in contrast to the other three nurses, who exclusively desired to employ digital MDAs. In addition, each nurse agreed that MDA was beneficial, particularly in its ability to identify cases of malnutrition. Usability of the app (System Usability Scale) 95.18 ± 4.26, very high usability and good clinical applicability.</p> <p>Easy comprehension, it simplifies everyday care.</p> <p>Well, it's an easy and fast application.</p> <p>I would use Mini dental assessments in my daily routine.</p> <p>It's a helpful tool.</p>	<p>Nurses' positive attitudes toward digital MDA over analogy MDA were due to the technology's ease of use and usefulness.</p> <p>The application of modern technology simplifies nurses' daily work, fast application</p> <p>Accepted in their daily routines regardless of prior knowledge due to good clinical applicability.</p> <p>Helpful tool</p>	<p>Nurses felt their job was easier due to User-friendly technology.</p> <p>Nurses felt technology simplifies their daily work.</p> <p>Acceptance of new technology boosted nurses' confidence and increase their motivation.</p>	<p>Simplify their work.</p> <p>Boosted confidence. Increase motivation</p>

<p>Van der Cingel et al, 2021</p> <p>"It's a really nice one for clients, but I don't know if this is eHealth as well?"</p> <p>"We need to be well informed about the product that you want to introduce to your client because if I'm insecure I'll never get my client to trust it.....I think it is very important to be well instructed before we use it in daily practice."</p> <p>"We decided to add an extra visit, in order to check whether everything is okay"</p> <p>"I have to go back and double-check; I have no confidence".</p> <p>According to nurses, information is fragmented and thus difficult to keep track of. Almost all nurses emphasize that knowing about eHealth is one thing, but actually using it and discussing it with clients is an entirely different matter. They also emphasize the importance of tool usability and having them available to show clients.</p> <p>"Well, eHealth only suits those who have an interest in ICT. So, it can be the 95-old person who really likes a tablet."</p>	<p>Lack of information and training was a major challenge for nurses in applying technology in daily practice.</p> <p>Unending challenges while applying digital technologies, left nurses feeling insecure, unconfident, and discomfort.</p> <p>Nurses reported that clients' interests were a factor in the acceptability of digital technology</p>	<p>Nurses felt insecure and unsure.</p> <p>Lack of confidence was also felt among nurses</p>	<p>Insecure, lack of confidence,</p>
<p>Van houwelingen et al,2015</p> <p>Nurses with extensive technology experience (e.g., computers, micro-waves, Skype, tablets) (n = 41) had a significantly lower negative affect score related to HT use (mean = 10.14, SD = 0.36) than nurses with limited technology experience (n = 14; mean = 11.63, SD = 3.51; p = 0.014). As a result, general technology experience was associated with greater comfort with the use of HT. Home Telehealth Attitudes: A Comparison of Nurses with and without Home Telehealth Experience</p> <p>Nurses with HT experience reported significantly more positive attitudes, secure and facilitating conditions than non-HT nurses. Five items were used to compare attitudes. Significant differences were measured statistically using p values (p 0.05). All of the differences (p < 0.001) were statistically significant.</p>	<p>Technology experience was a challenge to apply digital technology. Nurses with high technology experience reported feeling comfortable and confident.</p> <p>High technology experience was associated with nurses being secure, positive attitudes toward using digital technology</p>	<p>Technology experience boosted nurses' confidence.</p> <p>Nurses with technology experience reported increased motivation</p>	<p>Self-confident</p> <p>Motivation</p>
<p>Qian et al,2019</p> <p>The field observations identified two instances of primary contradiction, three instances of secondary contradiction, one instance of tertiary contradiction, and one instance of quaternary contradiction. These contradictions were either introduced or resolved by IT.</p> <p>To create a useful EHR system for nurses and care workers, system designers should examine what they do in their work, what information</p>	<p>Nurses experienced several contradictions and disruptions at the workplace was a major challenge while using digital technology.</p> <p>Nurses felt like failures due to interruptions by technology.</p>	<p>Nurses felt insecure.</p> <p>Nurses felt like failures.</p> <p>Nurses' experiences and feedback are necessary for system development.</p> <p>Nurses experienced high stress in their daily routines</p>	<p>Insecure, lack of confidence</p> <p>Failure</p> <p>High stress</p>

<p>they require for their work, and what rules and conventions they follow when performing their work. It may not be sufficient to include only a few frontline nurses and care workers in the requirements analysis phase of system development to provide isolated and disconnected feedback.</p> <p>We felt like a failure often".</p> <p>"Work is interrupted by technology failure".</p> <p>"High-stress work to deal with technology and frail population".</p> <p>"System designers should experience a day in nurses' life, observe routines".</p> <p>"Observe what we do".</p> <p>"Involve frontline nurses from any system development".</p>	<p>Nurses should be incorporated into the analysis phase of system development.</p> <p>Nurses experienced high stress to incorporate technology into their daily routine.</p>		
<p>Radhakrishnan, 2015</p> <p>Nurses reported negative attitudes due to the lack of a significant impact on patient outcomes and technical challenges when compared to the traditional way of providing care. "Telemonitoring is an exciting, fast-moving, and sometimes difficult development in healthcare delivery". Nurses reported feeling powerless, fearful, and less confident during the application of digital technologies.</p> <p>"The technology was a bit much for the generation of the folks that I usually took care of. The technology, it isn't just as simple as pressing a button, and that's what we demonstrated.</p> <p>You press a button, start, and then follow the prompts. But it doesn't always work that way."</p> <p>"We are going to get new machines." And then boom, suddenly, "Oh, did we tell you?"</p>	<p>The application of digital technology was a major challenge for nurses.</p> <p>Adaptation to the new technology was hindered by fear and lack of confidence among nurses.</p> <p>The complexity of new technology and the lack of information needed for training</p>	<p>Nurses reported feeling powerless, and fearful.</p> <p>Nurses felt they lack the confidence to apply new digital technologies.</p>	<p>Fearful</p> <p>Incompetence</p> <p>Lack of confidence</p>
<p>MacNeill et al, 2014,</p> <p>Nurses reported negative experiences. They felt that technology can be stressful and a huge burden to nurses and their clients too.</p> <p>"I think there were a small number of people where it made them more anxious.</p> <p>"There is a point where telehealth is quite stressful."</p> <p>"The actual use of the equipment sometimes can be a stumbling block for us".</p> <p>So, you know, there is a point where telehealth is quite stressful, if you're at that end</p>	<p>Overcontrol of technology in the workplace was a challenge to nurses.</p> <p>The application of modern digital technology was also a challenge, burden, and stress for nurses</p> <p>The complexity of technology was a challenge for nurses to implement and adapt to.</p>	<p>Nurses reported technology is stressful and a huge burden.</p> <p>Made nurses anxious.</p>	<p>Stressful</p> <p>Overwhelmed</p> <p>Anxious</p>

<p>'It may be that the equipment is difficult for somebody to use at times, perhaps if they've had, you know, a stroke or something that makes it difficult to actually have, fit the cuff. So, the actual use of the equipment sometimes can be a stumbling block for patients.' (Nurse)</p>			
<p>Browning et al,2009 "Implementation of telehealth resulted in a reduced number of rehospitalization, Urgent and emergency care were decreased. "User friendly and less related to image". Nurses reported positive experiences due to previous experiences using digital technologies. Nurses' experiences included that modern technologies simplify their work, improve work efficiency, also save time. Over 65% (65.9%; n= 27) had a positive impact and identified features of improving quality care as significant benefits to the implementation of telehealth. (36.8%; n=14) identified that patient ability could be a barrier to successful telehealth implementation</p>	<p>The adoption of digital technologies was easy because it was user-friendly. Accepted by nurses because it simplifies their work. Previous experiences with digital technology improve work efficiency and save time</p>	<p>Nurses experienced that modern technology was user-friendly. Technology simplifies their work. Improve work efficiency and save time</p>	<p>User friendly Simplifies work. Work efficiency Save time</p>
<p>Zhang et al, 2010 This study found that homecare nursing staff's intention to utilize the wireless mobile system is influenced by perceived utility and simplicity of use. Most IS adoption studies rank perceived usefulness above perceived ease of use. Thus, homecare nurses will accept wireless mobile support if they sense its value. They also value easy-to-use technology. Subjective norm and image were the only TAM2 theoretical model antecedents of perceived utility. Thus, homecare nursing staff are more likely to adopt mobile ICT if they think their co-workers think they should. Nurses reported that the adaptation of digital technology reduces workload and stress and makes their job easier.</p>	<p>Nurses' positive attitudes towards digital technologies were influenced by simplicity and ease of use. The adoption and acceptance of the technology were also influenced by easy-to-use technology. Acceptance of digital technology reduces stress and fatigue among nurses</p>	<p>Nurses reported modern technology was simple and easy to use. Nurses reported that technology makes their job easier. Technology acceptance reduced workload. Fatigue, stress</p>	<p>Easy to use. Reduced workload. Fatigue Stress</p>