

Perceptions of nurses about the use of technology in nursing

Literature review

Haikkala, Jenni

Ruotsi, Otto

Rutanen, Olli

Bachelor's thesis

April 2019

Social services, Health and Sports

Degree Programme in Nursing

Author(s) Haikkala, Jenni Ruotsi, Otto Rutanen, Olli	Type of publication Bachelor's thesis	April 2019
	Number of pages 37	Language of publication: English
		Permission for web publication: Yes
Title of publication Perceptions of nurses about the use of technology in nursing A literature review		
Degree Programme in Nursing		
Supervisor(s) Palovaara, Marjo & Jalonen, Anu		
Assigned by -		
<p>Abstract</p> <p>Technological development and adoption of new technology in healthcare have greatly affected the work of a nurse. Increased use of technology has created a constant demand for nurses to develop new skills and competencies. Technology is expected to improve the quality of care and ease the work of healthcare professionals.</p> <p>The aim of this literature review was to conduct a research on perceptions of nurses about the use of technology. The purpose of the study is to provide information for further studies regarding the implications of technology to nursing practice.</p> <p>Literature review was implemented by collecting articles from two databases; Cinahl and PubMed. 10 studies were selected for the study. Finally, articles were analyzed and evaluated by the Hawker grading system.</p> <p>Results of this literature review showed that majority of nurses perceive that the development of technology is positive and essential part of the profession in the future. Adaptation of new technology was seen to enhance job satisfaction, work performance, efficiency and reduce stress and anxiety. Further research is recommended to clarify risks and benefits of implementing new technologies and how it affects both patient centered care, and nurses' job satisfaction.</p>		
Keywords (subjects) Perceptions, nurse, technology		
Miscellaneous -		

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1 Introduction

Nursing is a profession that is constantly progressing. Job of a today's nurse has gone through metamorphosis from a profession it was a few decades ago (Dingwall, Rafferty, Webster 2002, 1). Advances in care technology have had a major impact to the typical work of a healthcare professional, completely altering the way of practice. Digital enhanced cordless telecommunications in hospitals, patient lifting devices, electronic patient information and automated drug distribution are good examples of technology that is here to stay and which many nurses must be able to use in their daily jobs. (Huston 2013.)

Use of technology is increasing in healthcare, with a goal to improve the quality of care and ease the work of healthcare professionals. Nurses are the largest segment of health care professionals. It is predicted that nurse's responsibility is going to be an advisor of technological tools, information systems and act as an interpreter for co-workers and patient. (Institute of Medicine Committee on the Robert Wood Johnson Foundation Initiative on the Future of Nursing, at the Institute of Medicine 2011.)

General belief is that the technology can improve the efficiency in clinical nursing, increase in patient safety and make time for better quality patient care and communication (Huston 2013). Although, in this scale, technology related problems and adverse functioning are inevitable (Powel-Cope et al. 2008; Van de castle et al. 2004).

The aim of this thesis is to conduct literature review about perceptions of nurses about the use of technology. The purpose of the study is to provide information for further studies about the implications of technology to nursing practice. This information could be used to provide further information about nurses' experiences in the use of technology in nursing.

2 Healthcare & Technology

2.1 Technology in nursing profession

Nursing is a profession that requires knowledge from physical-, social and human sciences, as well a set of well-trained clinical skills. Basic core values have always been to meet the needs of the patient's health and to develop better practices to face daily challenges and needs of society (Potter, Perry, Stockert, & Hall, 1).

Healthcare technology plays a major role in nursing globally, which have created a demand for the nurses to develop new skills and competencies (Jelec, Sukalic, & Friganovic 2016). Several organizations, such as, American nurse association (2010), have started recommending all nurses to have competencies in information technology (IT) and research shows that majority of nurses recognize a need of improvement in their IT-skills. (Hughes, Livingston, Semler & Hughes 2014.)

Development of modern technologies have dramatically altered the work of all healthcare professionals and forced them to adapt into it daily. During the time before technological breakthrough, a nurse monitored vital signs and the overall wellbeing of their patients mostly by their senses. By detecting visual changes in patient's skin color, smell or mental functioning, the nurse could conclude the current state of a patient and the need for the care (Jelec, Sukalic, & Friganovic 2016).

Even though, certain conditions still require the nurse to use their physical senses (Potter, Perry, Stockert, & Hall, 528), the development of technology has greatly affected the monitoring and diagnosing health issues. Pulse oximeter is a good example of revolutionary technological solution; it enabled accurate and real-time measurement of blood oxygenation, which was not possible before (Carlson & Jahr 1993). New inventions in health care are predicted to focus especially in a gene technology, robotics, digitalization, and nanotechnology. (Kaivo-oja 2016).

2.2 Medical devices, assistive technology and nursing informatics

Assistive devices or assistive technology are used for aiding a person to maintain or improve his/her ability to function and participate. They support the individual's independence, enhance their well-being and increase the quality of life. Medical devices are used for preventing, diagnosing and treating diseases. They are bound by the purpose of use and they are needed widely in clinical practice. They can be instruments, apparatuses, implements, machines, appliances, implants, reagents for in vitro use, software or materials. (WHO 2017; Garçon, Khasnabis, Walker, Nakatani, Lapitan, Borg, Ross & Velazquez Berumen 2016.)

Different electric patient data-systems are used for recording and processing the information about the patient's health, care and condition. Before 19th century, it wasn't common to document different information about the patient or the treatment. When the health care was developing, nurses and doctors started to record in a sort of diaries, the information about the medication and treatment, that patient had received. Today the amount of information, which is gathered about the patient, is enormous and it is recorded in computer-based data-systems. Using these electronic data-systems is more efficient than recording the information on paper, and it enables the nurses to use more time with the patient care, instead of documenting. (Bosman et. al. 2002; Mäkelä 2006, 34-37.)

Additionally, informatics in nursing is used for different administrative systems, imaging systems and separate data-systems. Administrative systems contain different forms related to appointments, invitations, statistics and background data. Forms for billings, referrals and lists of patients are examples of administrative systems. Imaging system is used for saving and processing medical images. System can record digital images that are taken, for example, by computer tomography or X-ray machines. Other data-systems that are related to diagnostics and monitoring and caring of the patient are part of the separate data-systems. (Mäkelä 2006, 35-46.)

2.3 Ethical issues related to nursing technology

In a client-centered care, the clients are seen as individuals their personal needs and wishes are considered when planning the care. They should be given a chance to take part on the decision making of their care. The services must be accessible to all the patients, and every patient should be treated in an equal way. The safety of the treatment, medication and technological devices is also part of the quality of care. The emphasis is on the learning from the previous hazardous situations and preventing new ones. Professional competence means using evidence-based knowledge on the treatment of the patient. Also, the ethics, values and appropriate encountering with the patient are part of the competence. The actions of social and health care services are influencing on the health of people. (Pekurinen, Rääkkönen & Leinonen 2008.)

Improvement in technology have not come without risks and ethical dilemmas. Rapidly increasing amount of healthcare technology creates a new set of problems and adverse functioning (Powel-Cope et al. 2008; Van de castle et al. 2004). Especially electronic services cause worries in nursing. Main fear is of losing the face-to-face contact with patients or dealing with the fact that nurse must acquire new skills along the new technology (Helkiö, Kautonen, Riippa, & Rönkkö, 2016, 46-51). New inventions have many benefits for the patient and nurses, but if the nurse doesn't have the skills to use them, or they are not suitable for the purpose, it may jeopardize the patient safety (Mieronkoski, Salanter, Suhonen, & Terävä 2016, 91-98). Furthermore, there are situations when the responsibilities are not clear. In robotics, there are many safety-related matters to consider, for instance, a robot may be hacked, or the connection can be cut off (Kataja 2016, 57-71).

The reasons to use technology in nursing care may not be ethical (Leino-Kilpi & Stolt 2016). One big issue is maintaining privacy, when using electronic documentation and transferring patient information between different health care services.

Everyone using the electronic information about patients must be aware of the norms related to them, so the privacy of the patient won't be violated. Additionally, the health care service providers must have a plan for monitoring the realization of privacy in their own domain (Konttinen & Mykkänen 2016, 133-146). Technology in nursing might cause inequality in care. For example, in different municipalities, there are different kinds of services available for residents (Helkiö et al. 2016, 35), thus some patients may not be able to use the same technology, because of lack of competence or required equipment (Leino-Kilpi & Stolt 2016).

3 Aim, purpose & research question

The aim of this thesis is to conduct literature review on nurses' perceptions towards development and the use of technology in nursing. The purpose of the study is to provide educational material for nurses by gathering possible positive and negative aspects and technological development in nursing. This information could be used in educational purposes when introducing new technology in nursing.

Research question:

- What are the perceptions of nurses about the use of technology in nursing?

4 Methodology & implementation of the study

4.1. Literature review

A methodology used for the current study is review of literature. It is to be effectuated by thorough documented process, to answer; what is the impact of technological development to the work of a nurse. The entire process of making a literature review consists of six individual steps. First step is choosing a topic and defining and realizing a problem around it. Then comes a phase in which researchers develop and argument based on searching and analyzing literature about the topic. After argument is set, researchers criticize the literature and conclusions found. After all of the previous steps, a review was written. (Machi & McEvoy 2016.)

Literature review as a method is favorable, because it renders researchers to study current literature about certain topic. Aim and purpose of this literature review is to summarize the perceptions of nurses about technological development and provide readers up to date information about current literature of the topic. (Williams & Vogt 2011.) Because so immense amount of literature is available, it is not possible for the reader to assimilate and study all of them in a reasonable amount of time. Especially for health care workers, who have a duty to have current and up to date knowledge about vast amount of information, it is essential to have reviews of literature available. This cuts out a possibility of misleading the reader, if only one small piece of information in single articles' evidence is read. (Machi & McEvoy 2016.)

4.2. Literature search

The preliminary search of the topic showed multiple promising results from three different academic databases. However, large part of the studies and reviews focused on using technology in teaching nursing to students. To exclude articles from our search and to minimize bias, four inclusion criteria were decided in which articles chosen should fall (Figure 1).

Article focuses on perceptions of nurses about technology used in healthcare
Article is published in English
Full text of the Article is available to JAMK students
Article is published between 2007-2018

Figure 1. Inclusion criteria

Articles that did not fall under inclusion criteria were automatically excluded from the search. Databases used to search articles were CINAHL and PubMed. These databases were used because they provide high quality and reliable articles for medical and nursing field research recommended by JAMK library (Shields, 2013). The following terms in searching were used in CINAHL: nurs* OR nurses OR nursing AND nursing technology OR healthcare technology AND perceptions OR attitudes OR opinion OR experience OR view OR reflection OR beliefs and in PubMed: nurs* OR nurses OR nursing AND nursing technology OR healthcare technology AND perceptions OR attitudes OR opinion OR experience OR view OR reflection OR beliefs AND “use of technology”. The terms were chosen because they provide the best and the most relevant articles so that none of the important articles were missed.

Next three steps were made by researchers as a group. First step, record screening was done by analyzing articles available for free to JAMK students (n=130). After this, duplicate articles were examined, and copies removed (n=38). Third step was to analyze articles by titles and abstracts. 60 studies were excluded. Next step was to read all remaining articles (n=26) individually and assess eligibility. After reading the articles, researchers gathered their findings and 16 were found to be unsuitable for the study and excluded. Final 10 articles were chosen for the study in agreement with the group. The chosen database results were extracted using and utilizing PRISMA flow diagram (Moher, Liberati, Tetzlaff, Altman & The PRISMA Group 2009). Figure 2 shows how the research process was performed.

4.3. Data Analysis

Purpose behind data analysis is to combine findings made from chosen reviewed articles and to build a wider and more detailed perception of the topic in question. Articles chosen were familiarized profoundly before more detailed critical appraisal. To evaluate the strength or frailty of an article, research group examined the relevancy, contents limitation and how broad studies or surveys were. (Aveyard 2014.)

During the next step scientific articles from Cinahl and Pubmed were reviewed by Hawker's grading system to assess the quality for bachelor thesis. First, all three researchers scored each article separately, following the part where individual scores were combined and counted average from all three researchers. During this phase, cut point of 21 points was chosen. The average scores varied between 23 and 29. Individual scores for articles were found to be within 5 points among researchers. No articles were excluded. (Hawker, Payne, Kerr, Hardey, Powell 2002.) Completing these steps researchers had enough scientific articles suitable for the thesis. Following part for current step was to read articles chosen multiple times to find essential phrases and sentences that held important information about thesis' topics.

Information from previous steps was then highlighted by each researcher individually and read again focusing around the highlighted parts. Then a table was made with Microsoft word to assemble information from all articles chosen. Final part was to read assembled information from the Microsoft word document and remove all irrelevant and at the same time gathering the most relevant themes from the articles. Results were then compared with the group and three main themes and five sub-categories were found (Figure 3).

At the stage when articles for data analysis were gathered, articles were read, and an Excel spreadsheet was carried out to accumulate the information from the articles. Information as author, year of publication, title, methodology of the study and main

findings within the article. List of detailed information is found in Appendix 1 in the last section of this paper. (Cronin, Ryan, & Coughlan 2008.)

The studies chosen to be reviewed (n=10) were published from 2007 to 2016. The studies were published in 2007 (1), 2008 (1), 2010 (1), 2011 (1), 2013 (2), 2014 (2), 2016 (2). Qualitative studies were from The United States (n=3), Australia (n=1), Swaziland (n=1), Canada (n=1), Egypt (n=1), Iran (n=1), South Korea (n=1) and New Zealand (n=1). The findings included studies that utilized different research methods: Structural questionnaire (n=1), Questionnaire analysis (n=1) Qualitative (n=3), Exploratory study (n=1), cross-sectional (n=1), Semi-Structured interview (n=1) and Mixed methods that collected both quantitative and qualitative data (n=2).

From every article chosen, information and result were summarized to address the research question. Aim of this review is to provide up to date information from different studies gathered that is more substantial than from one individual research. (Aveyard 2014.)

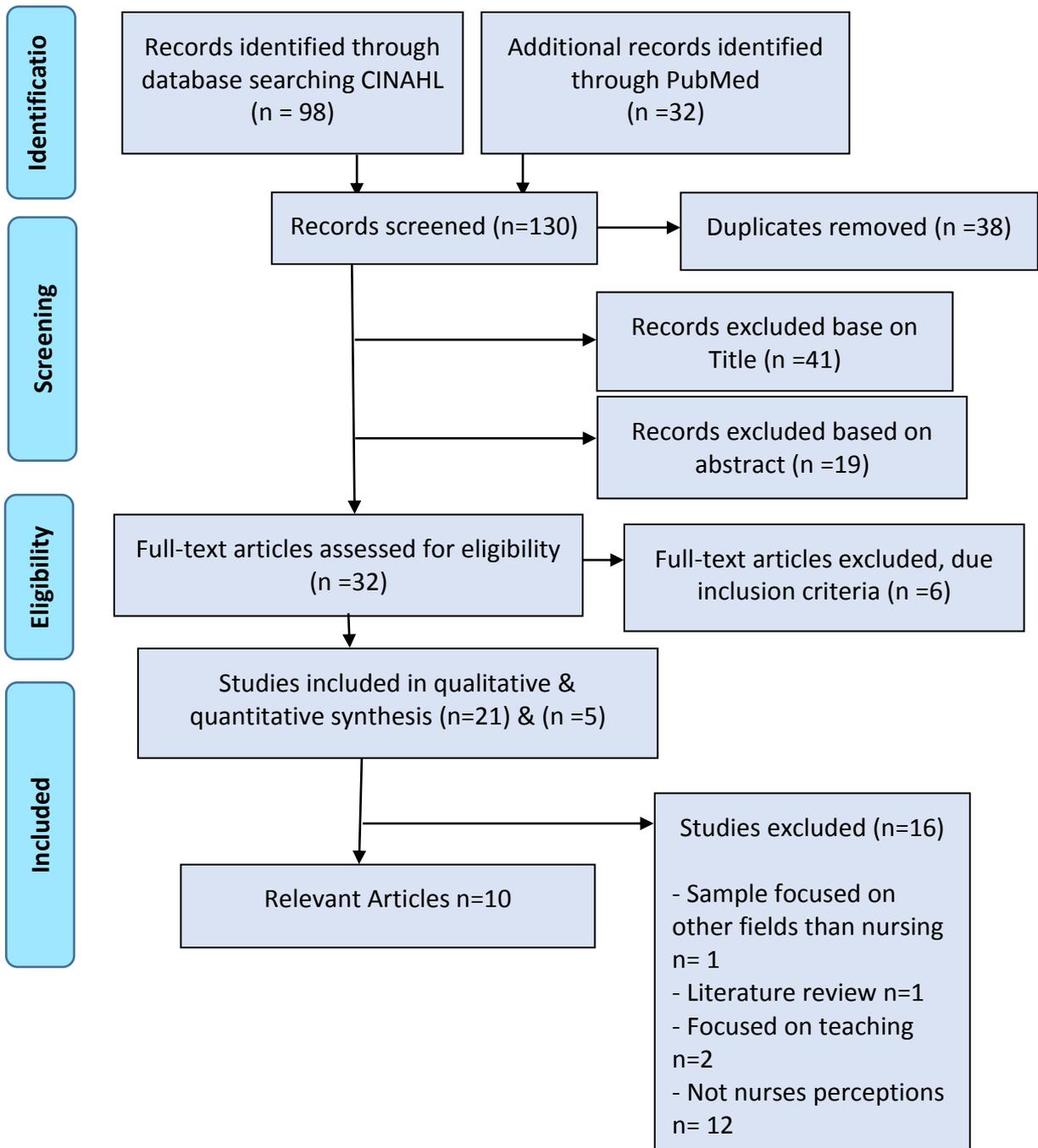
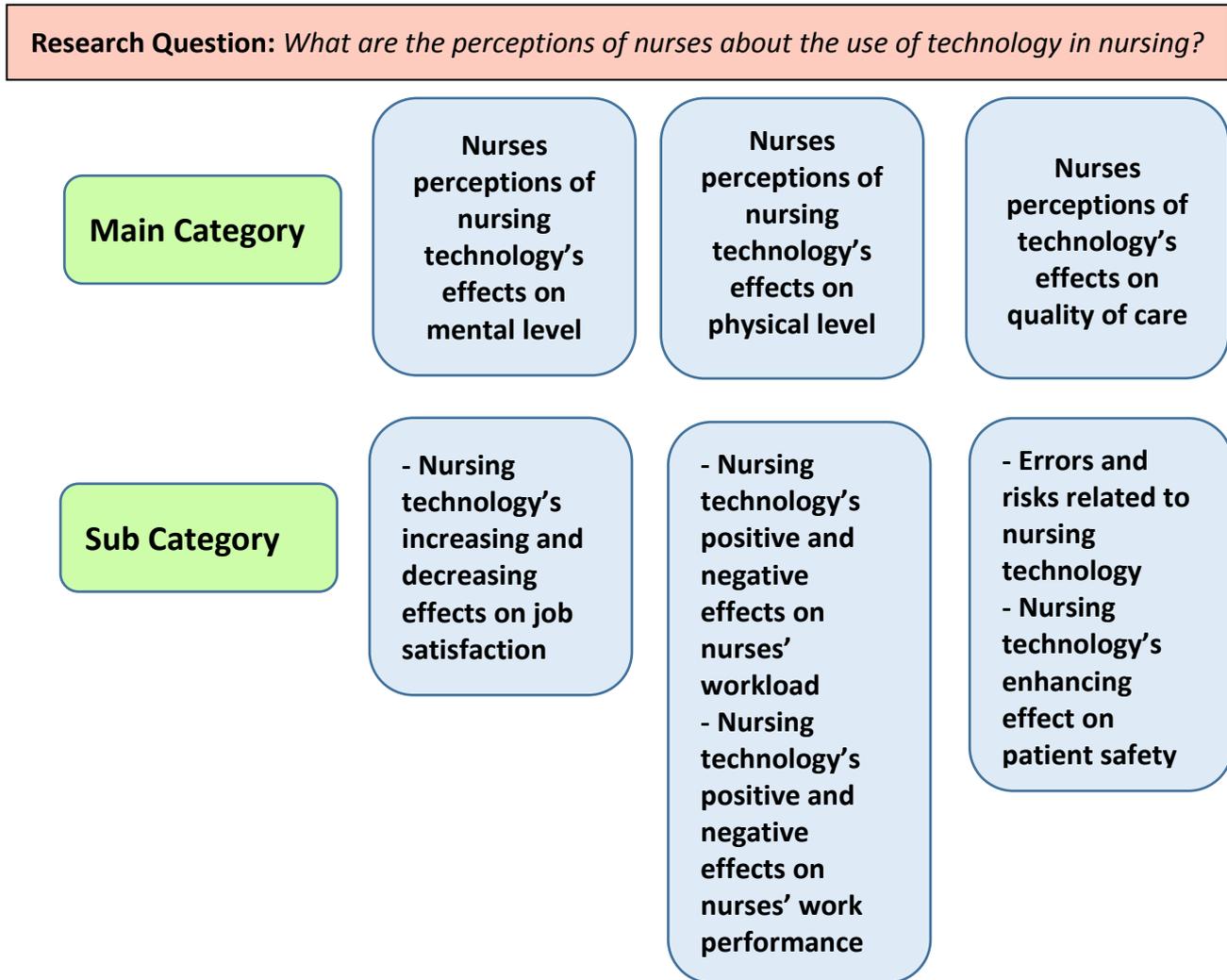


Figure 2. Flow chart for article selection process

Figure 3. Classification of data gathered



5 Results

5.1. Nurses perceptions of nursing technology's effects on physical level

Nursing technology's positive and negative effects on nurses' workload

The reduction of nurse's workload was a common finding in researches chosen for the literature review. Study done by Kim, Lee, Hwang and Yoo (2016, 6-10) found that the introduction of electronic medical records improved the access to the health information of their patients, and therefore reduced take-over times. Other study conducted by Adel, Mohamed, Ali and Sobh (2014, 11-18) showed that technological devices accelerate the completion of nursing duties, which was seen decreasing the fatigue and workload of nurses.

Sibandze and Mallinson (2017, 5-7) found out in their study that nurses felt that computer technology makes nurses work easier. Especially, it affects on time management, documenting, having less paperwork and editing patient's health records. Introduction of computer technology was seen to reduce stress, enhance work satisfaction and increase motivation. Holtz and Krein (2011, 247-262) found that implementation of new medical records system would simplify their work processes.

Rosenkoetter, Bowcutt, Khasanshina, Chernecky and Wall (2008, 60-69) studied the impact of smart pump technology in nursing. Main perceptions of the nurses were that the work load did not increase. Additionally, the new technology improved nurses' confidence about their work, eased daily nursing routine and helped to support independent work without the need to rely to other health care professionals. Correspondingly, anxiety in making medication errors decreased.

Wright and Honey (2016, 30) argued that implementing teleconsultation technologies reduced pressure and helped to make clinical decisions. However, in this care the implementation of new technology was seen expanding the workload by increasing the need for accurate documenting. Other theme affecting the positive

aspects of introducing technology was the lack of training. Sibandze & Mallinson (2017, 7-10) found that the nursing education did not prepare nurses about technology skills and/or there was no orientation to these in the workplace. Additionally, the lack of adequate technology and unreliable computer systems were seen disturbing the work of a nurse.

Nursing technology's positive and negative effects on nurses' work performance

Using nursing technology in work environment can raise the work performance of nurses and make working more efficient and less time consuming. Sharifian, Askarian, Nematollahi and Farhadi (2014) found out in their study, that one of the major factors why nurses use information systems in their work is because nurses experience that information technology increases their work performance.

Other studies also inflict that information technology acts as helpful tool and as a major factor effecting nurses and other health care professional's workflow, practices and flow of information in clinical settings (Nazi, 2013). However, the study also found some difficulties in use of IT. Because of secure messaging, patient information sharing between patient/provider relationships was found challenging in some cases and therefore brought more encumbrance to their performance.

In New Zealand nurses use tele-consultation as part of their practice to provide information and advice between nurses who work in specialist services and nurses who work in remote areas. Wright & Honey (2016, 30-38) studied the effects of use of tele-consultation in nursing from a distance and found out that it connected healthcare teams and enhanced further trust between patient relationships. This acted as a tool to provide quality healthcare even for the patients from afar. .

Nurses felt that they had a broad range of responsibilities requiring complex skills in their practice. Studies showed that it was necessary to have a high level of trust between consultants and to keep working performance at high level.

5.2. Nurses perceptions of nursing technology's effects on mental level

Nursing technology's increasing and decreasing effects on job satisfaction

Using technology in health care settings can influence nurses' job satisfaction. In ideal situation the technology can help increasing nurses' satisfaction in work. Rosenkoetter et al. (2008, 64-67) found out in their study, that when using a smart pump for administering medications, nearly half of the respondents felt less anxious about making medication errors. Many nurses felt that the smart pump technology is increasing their satisfaction of work and of the nursing care they provide.

Similar findings were also revealed in other studies. Sibandze and Mallinson (2017, 5-6) discovered that using computer technology can enhance work satisfaction, relieve nurses' stress and make them more motivated. Adel et al. (2008, 16-18) found out that only 25,8% of the participants thought that using technology in critical care unit is causing the nurses experience stress and burnout. Furthermore, according to Sirois, Fournier, Lebouthilier, Guerette-Daigle, Robichaud, Leblanc-Cormier, Molyneaux, O'Donnell and Mather (2013, 43-46) most nurses have a positive attitude towards new technology, and they consider it as an essential part of the nursing profession in the future.

Using technology in nursing profession may also cause negative feelings in nurses. Sibandze and Mallinson (2017, 7-10) highlights that the lack of training is causing the nurses to feel incompetent and uncomfortable. Insufficient technical support may cause the nurses to become demotivated. Inadequate amount of equipment and co-workers misusing the existing devices also decreases the satisfaction of nurses at work. Friction among the staff can emerge if all members of the staff don't have the same norms for using the technology (Holz & Krein 2011, 256)

Eley, Fallon, Soar, Buikstra and Hegney (2007, 26-32) discovered in their study that the level of confidence is often in line with the level of experience in the use of the technical application in question. In addition to this, they found out that the higher the educational level is, the higher the confidence to use the technical applications

will be. According to the study conducted by Sirois et al. (2013, 44-46) the different level of expertise in the use of technological equipment might cause tension in the working community. Training and technical support is important when introducing new technology.

5.3. Nurses perceptions of technology's effects on quality of care

Errors and risks related to nursing technology

The studies showed that in many nurses' opinion, there are problems and risks related to the use of technology. Poor availability of needed equipment or facilities and insufficient equipment cause problems (Wright & Honey 2013, 35; Sibandze & Mallinson 2017, 7-10). The lack of appropriate equipment may lead to situations where nursing duties are delayed, or they can't be performed at all (Sibandze & Mallinson 2017, 7-10).

According to the study conducted by Sibandze and Mallinson (2017, 7-10) lack of training to use the technology and lack of technical support hinders the nurses' use of technology. Technical support and a proper training to use the equipment was seen important also in the studies made by Sirois et al. (2013, 45-46) and Adel et al. (2014, 13, 17-18). Use of technology can increase risks for patients if the handling of the technological devices is inappropriate or if the staff is not interpreting the data in the machines correctly (Adel et al. 2014, 17).

Nursing technology's enhancing effect on patient safety

The articles revealed that nurses see the use of technology in health care to offer many advantages. Adel et al. (2014, 13, 16-18) discovered in their research that majority of the participants thought that using technological devices in a critical care unit increases patient safety, for example by making the treatment more secure and helping the nurses to recognize adverse effects faster. Similarly, Sibandze and Mallinson (2017, 5-7) found out in their research that nurses' opinion was that computer technology has increased the quality of care. Documentation is more convenient and safer, and the possibility to use internet provides the nurses a chance to seek information and update their knowledge. In addition, the privacy of the patient is secured better with computers.

According to some researches, many nurses think that technology can increase the safety of medication distribution. Sirois et al. (2013, 44-46) showed in their research that nurses have a positive attitude about new technology in medication distribution. The presupposition of nurses is that new technology will heighten the security level of medication distribution. Rosenkoetter et al. (2008, 64-67) discovered in their study that majority of the participants think that technology is promoting safe administration of medicine and it makes nursing practice safer and more effective. The nurses are not concerned that technology would cause more errors.

6 Discussion

In this chapter, research question of the thesis will be answered based on results found through analysis of used literature. Also, ethical consideration, validity and reliability aspects during the whole thesis process will be considered. Finally, summary of conclusions is made and based on the results found, ideas for future and further studies are contemplated.

6.1 Discussion about main results

The aim of this study was to obtain information on nurses' perceptions towards development and the use of technology in nursing through existing literature. This was to provide information for nurses to acknowledge the possible positive and negative aspects of development of technology in the field of nursing.

In this literature review, we have been researching the perceptions of nurses towards nursing technology. There were several themes found, and both positive and negative perceptions emerged. Nurses see technology in their work as a helping factor that is making the nursing care more efficient, making them feel more satisfied with their work and increasing the patient safety. In the other hand using nursing technology can cause them more work, more stress and cause technology related risks.

Initially researchers assumed that registered nurses might feel that development of technology adds workload, because of change in working methods and thus have more negative than positive perceptions towards technological development in the field of nursing but the results were the opposite. The study shows that nurses mainly feel that use of developed technology in their working environment decreased workload, improved their working performance and reduced risks and errors when treating patients (Kim, Lee, Hwang and Yoo 2016, 6-10; Adel, Mohamed, Ali and Sobh 2014, 11-18; Sibandze and Mallinson 2017, 5-7; Holtz and Krein 2011, 247-262; Rosenkoetter, Bowcutt, Khasanshina, Chernecky and Wall 2008, 60-69; Sharifian, Askarian, Nematolahi and Farhadi 2014; Nazi, 2013; Wright & Honey 2016,

30-38; Rosenkoetter et al. 2008, 64-67; Sirois et al. 2013, 44-46). However, there also are nurses who have many negative aspects on the subject (Wright and Honey 2016, 30-38; Sibandze & Mallinson 2017, 7-10; Nazi, 2013; Sirois et al. 2013, 44-46; Holz & Krein 2011, 256; Adel et al. 2014, 17).

It emerged, that nurses feel development of technology used in nursing care affecting a great deal when it comes to working performance and overall workload. Kim, Lee, Hwang and Yoo (2016) found out in their study that using electronic medical records was less time consuming. Sibandze and Mallinson (2017) supported this claim by also finding in their study that nurses felt that technology especially effects in time management in nurses work and not having to do so much paperwork, thus editing patient's health records and documenting was made much faster. One major field of technology that nurses benefit from, is using electronic medical records in their work. Mohammed, Ali and Sobh (2014) showed in their study that technological devices accelerated the completion of nursing duties, therefore decreasing fatigue and workload of nurses. This study also indicates that in nurses' opinion, using new technology in their work is an essential part of nursing profession in the future (Sirois et al. 2013).

Development of technology used in nursing care also enhances nurses' ability to work in variety of psychological manners. Use of technology enhances work satisfaction, thus decreases stress level while working and makes nurses more motivated. Possibility to use computer technology is giving the nurses a tool to update their knowledge and to upgrade their competence. Adel et al. (2008) and Sibandze and Mallinson (2017) support and found similar claims in their study, finding that nurses felt that using computer technology simplified their work, and therefore reduced stress and increased level of motivation when providing nursing care.

Many nurses feel that nursing technology can help nurses to provide high quality care if the equipment is proper and the nurses have skills to use it. Patient safety can be increased by using nursing technology that is making the care more secure and

accurate. Adel et al. (2014) and Sibandze & Mallinson (2017) support the claim with their findings that nurses felt treatment of the patients to be more secure, thus enhancing patient safety. Sirois et al. (2013) and Rosenkoetter et al. (2008) found similar aspects in their study where nurses felt technology improving safety in medical distribution and administration.

Even though nurses find there to be many benefits in nursing technology, they acknowledge that nursing technology can have its disadvantages. One major negative aspect found in this study was the lack of proper training nurses felt towards using technological devices in their work. Nurses felt incompetent and uncomfortable not knowing how to properly use some devices. Sibandze and Mallinson (2017) found out that misusing some devices decreased nurses' job satisfaction. When nurses are not well trained for using necessary technology in their work, it may lead to situations that endangers the safety of patients. Nurses feel that the incompetence with nursing technology may cause harms for patients. The patient safety is endangered if the nurse does not know how to use the equipment correctly. Sirois et al. (2013) and Eley et al. (2007) discovered that some nurses didn't feel confident enough to use new technology because there was a lack of education and proper training when nurses were introduced to it. Additionally, there may not be adequate amount of equipment or the existing equipment may be inoperable. Nurses are of the opinion that using equipment in nursing practice has many chances for risks and errors. (Wright & Honey 2013, 35; Sibandze & Mallinson 2017, 7-10).

6.2 Ethical considerations

In order to ensure that literature review is reliable and ethically acceptable, the researchers have followed guidelines set by Finnish Advisory Board on Research Ethics and ethical principles of JAMK University of Applied Sciences.

Finnish Advisory Board on Research Ethics have guiding principles for ethically acceptable and credible research. According to these, literature review is ethically accepted and reliable, if it is done following responsible conduct of research. Other

principles are the following; the research has been done with integrity and meticulousness, and data acquisition follows scientific criteria that is ethically sustainable. (Finnish Advisory Board on Research Integrity 2012).

Ethical Principles of JAMK University of Applied Sciences promote impartiality and truthfulness in academic community. Guidelines of ethical conduct of research act in accordance with previous Finnish Advisory guidelines, although defining them from the University of Applied Sciences point of view. (JAMK University of Applied Sciences 2018.)

All the articles chosen for literature review were analyzed with Hawker grading system (Hawker et al. 2002), which evaluated the bias and ethics of the research. During data analysis, results were discussed by researchers and all the articles were proven to be ethically acceptable for literature review.

6.3 Validity and reliability

Replicability was ensured by using matching search words in all trustworthy databases and carefully planning and documenting the process of literature search. Referencing when presenting other researchers' material was done respectfully and adequately following JAMK project reporting instructions (Liukko & Perttula 2017).

Due the fact that research has not been funded, the researchers had to use material available free and unrestricted for JAMK students. Therefore, researchers were limited to articles provided free of charge, in English language and/or offered from JAMK library resources. As the researchers are not native English speakers, there might be chance of misinterpretation. Additionally, this being the first literature review conducted by authors, its effect to research should be noted. Consequently, the restrictions mentioned above, and availability of previously defined articles might have affected the validity and reliability of the research.

Research misconduct means fabrication, falsification, plagiarism or misappropriation of research data (Finnish Advisory Board on Research Integrity 2012). To address misconduct, the research articles were carefully analyzed, referred and documented. In addition to this, three authors constantly crosschecked each other's material. Finally, finished version of the literature review was scanned by the Urkund plagiarism detection system.

7 Conclusion

Results of this literature review answered the question of how nurses perceived technological development in nursing. Majority of nurses have positive attitude towards developing technology and see it as an essential part of the profession in the future. Increased use of technology in nursing was seen to enhance job satisfaction and reducing stress and anxiety. Other positive effects were found in work performance and efficiency. Furthermore, technological advantages relating to medication distribution, information security, documentation and information seeking are seen as key elements of ensuring patient safety and facilitating the demanding work of a nurse.

Technology is an indispensable part of nursing profession now and to an increasing extent in the future. Thus, issues relating the uncertainty and incompetence regarding to it, should be addressed early. To deal with the reported negative outcomes of technological development, a proper training, support and guidelines with new technological appliances should be provided for every nurse according to their individual needs. In addition to this, guaranteeing availability of appropriate and up to date technology can decrease negative impacts. Therefore, organizations providing social and health care services have a big responsibility to offer resources and ensure seamless introduction of new technology in to nursing work.

Endlessly evolving technology creates a constant need for continuous research about the technological adaptation in nursing. Further research is needed to clarify risks and benefits of implementing new technologies and how it affects both patient centered care, and nurses' job satisfaction.

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Appendix 1. List of articles chosen

Author, year, journal	Title	Aim	Research method	Sample	Main results	Hawker's critical appraisal average score
Adel et al. 2014, Journal of Nursing and Health Science	Nurses' perception regarding the use of technological devices in critical care units	The aim of the study was to assess the nurses' perception regarding the use of technological devices in the critical care units	Structural questionnaire	n=89	The results revealed that almost of nurses were had high perception of positive aspects, while almost of them were had low perception of negative aspects regarding the use of technology. The result revealed that statistically significant relation between nurses' positive perception of using technology and their training and there was no statistically significant relation between nurses' positive and negative perception of using technological devices	26,6
Bree, Holz & Sarah, Krein. 2011. Journal of technology in human services	Understanding Nurse Perceptions of a Newly Implemented Electronic Medical Record system	This research utilized the unified theory of acceptance and use of technology model to understand how hospital nurses perceived the	Mixed methods design that included surveys and semi-structured interviews. Combination of both quantitative	n=113	The survey responses indicated that social influence, as defined by the UTAUT model, was the construct that most strongly predicted the nurses' intention to use the EMR system.	26,6

		implementati on of a new electronic medical records system	and qualitative researches.			
Rosenkoett er et al. 2008. Journal of the Association for Vascular Access	Perceptions of the impact of "smart pumps" on nurses and nursing care provided	The study reported here is a part of a three- phase study and focused on the perceptions of nurses (n=512) in a tertiary care hospital regarding the impact of the implementati on of "smart pump" technology and its impact on nursing care provided, medication errors, and job satisfaction.	Qualitative research	n=512	The use of smart pumps increased nurse job satisfaction by increasing self-confidence, increasing ease of daily nursing care and decreasing anxiety of making IV medication errors.	28

Wright J, & Honey M. 2016. Nursing Praxis in New Zealand	New Zealand nurses' experience of teleconsultation Within secondary and tertiary services to provide care at a distance	This study describes how NZ nurses use teleconsultation on within their practice and demonstrates the shift of some aspects of more complex healthcare back into local communities, supported by ICT.	Exploratory study	n=9	Teleconsultation offers a solution to socioeconomic difficulties encountered for patients when they travel long distances for healthcare. This is aligned to NZ's strategic plan to provide more care for patients closer to home therefore attending to the healthcare challenges and inequities for those in remote areas.	24
Eley et al. 2007. Australian journal of advanced nursing	Nurses' condense and experience in using information technology	In order to support policy planning for health, nurses in Australia were surveyed to determine their current use of information technology and barriers to that use.	Mixed- method approach to collect both quantitative and qualitative data	n=4330	For most of Australia's nurses, experience and confidence in use of information technology is confined to basic computer and common applications. In order to use information technology to support health delivery, action to increase access for nurses and remove barriers to use is urgently required. Employers and policy makers at all levels of government must work with nurses to adopt strategies to increase their access to and use of information technology.	28

Sharifan et al. 2014. Health information management journal	Factors influencing nurses' acceptance of hospital information systems in Iran: application of the Unified Theory of Acceptance and Use of Technology New Zealand, Australia, Iran	The aim of the present study was to explore factors affecting nurse-user acceptance of hospital information systems (HIS) in the Shiraz University of Medical Sciences teaching hospitals, based on the Unified Theory of Acceptance and Use of Technology (UTAUT).	A cross-sectional survey	n=350	The current research provided a useful tool for hospital managers in need of assessing the probability of success of new technology and helped the nurses to understand the benefits of acceptance in order to focus on the aspects of performance expectancy, effort expectancy, facilitating conditions, and social influence. Moreover, considering the importance of the patients' information and its centrality to high quality clinical nursing decisions, the nurse take-up of an efficient system could prevent risks to the hospitals and their stakeholders, especially the patients.	23,3
Bongani, T & Mallinson, K. 2010. Africa Journal of Nursing and	Experiences of professional nurses using computer technology in the intensive care unit	The purpose of this qualitative study was to explore the experiences of professional	Qualitative, descriptive study	n=13	Two themes emerged from the data analysis: practice values benefit and computer utilization challenges. The narrative data revealed that the nurses valued the technology, but experienced challenges when using computers to perform their daily nursing activities. Nurses perceived that computers made work easier and contributed to	27

Midwifery	setting in Swaziland	nurses using computer technology in ICU settings in the Swazi context.			quality improvement and resource utilization.	
Kim et al. 2016. BMC Medical Informatics and Decision Making	Analysis of the factors influencing healthcare professionals' adoption of mobile electronic medical record (EMR) using the unified theory of acceptance and use of technology (UTAUT) in a tertiary hospital	This study aimed to identify and verify the factors related to the adoption of a mobile EMR system by healthcare professionals by using the SEM analysis of questionnaire survey data and an analysis of system log data that reflected the actual usage by the end-users.	Questionnaire analysis	n=942	This study suggested a new model for the intentions of healthcare professionals to use a mobile EMR system and revealed that the end-users exhibit positive intentions to use and positive attitudes toward a system if it helps their work performance	28
Nazi, K.	The personal	The purpose	Qualitative	n=30	Study findings revealed a variety of factors that	31

2013. Journal of Medical Internet Research	health record paradox: Health care professionals perspectives and the information ecology of personal health record systems in organizational and clinical settings	of this study was to examine the experiences of physicians, nurses, and pharmacists at the Department of Veteran Affairs using an organizational ly sponsored PHR to develop insights into the interaction of technology and processes of health care delivery.	research		have facilitated or inhibited PHR adoption, use, and endorsement of patient use by health care professionals. Health care professionals' accounts and analysis of organizational documents revealed a multidimensional dynamic between the trajectory of secure messaging implementation and its impact on organizational actors and their use of technology, influencing workflow, practices, and the flow of information. In effect, secure messaging was the missing element of complex information ecology and its implementation acted as a catalyst for change. Secure messaging was found to have important consequences for access, communication, patient self-report and patient/provider relationships.	
Sirois et al. 2013. Technology and Health Care	Nurses' perceptions and attitudes towards new ADU technology and use	This research aimed to explore nurses' perceptions and attitudes towards current	Semi-structured interview	n=17	Findings in this study highlight the fact that missing medications (i.e., doses not available in cart) are inherently related to the completion of nursing staff's medication distribution routine. Missing doses cause delays in medication delivery which may increase the occurrence of medication errors. Participants described current technology use as an intricate part of their routine. The latter is mainly	24,3

		technology use on their units and towards the introduction of ADU technology and use with nursing staff in two different hospitals in South-East New-Brunswick, Canada.			utilized for patient monitoring and information retrieval. Overall, interview data indicated that ADU technology introduction is positively perceived by nursing staff particularly if the technology reduces missing doses events.	
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Appendix 2. Summary of critical appraisal scores

Author; Article	Jenni Haikkala	Olli Rutanen	Otto Ruotsi	Average
Adel et al.; <i>Nurses` perception regarding the use of technological devices in critical care units</i>	27	27	26	26,6
Bree, Holz & Sarah, Krein.; <i>Understanding Nurse Perceptions of a Newly Implemented Electronic Medical Record system</i>	27	27	26	26,6
Rosenkoetter et al.; <i>Perceptions of the impact of "smart pumps" on nurses and nursing care provided</i>	29	28	27	28
Wright J, & Honey M.; <i>New Zealand nurses` experience of teleconsultation Within secondary and tertiary services to provide care at a distance</i>	24	24	24	24
Eley et al.; <i>Nurses` confidense and experience in using information technology</i>	25	31	28	28
Sharifan et al.; <i>Factors influencing nurses` acceptance of hospital information systems in Iran: application of the Unifed Theory of Acceptance and Use of Technology</i>	25	22	23	23,3
Bongani, T & Mallinson, K.; <i>Experiences of</i>	26	28	27	27

<i>professional nurses using computer technology in the intensive care unit setting in Swaziland</i>				
<i>Kim et al.; Analysis of the factors influencing healthcare professionals' adoption of mobile electronic medical record (EMR) using the unified theory of acceptance and use of technology (UTAUT) in a tertiary hospital</i>	30	27	27	28
<i>Nazi, K.; The personal health record paradox: Health care professionals' perspectives and the information ecology of personal health record systems in organizational and clinical settings</i>	33	29	31	31
<i>Sirois et al.; Nurses' perceptions and attitudes towards new ADU technology and use</i>	23	24	26	24,3