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Individual and Team Factors Influencing the Adoption of Information and Communication Technology by Nurses

A Systematic Review

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The aim of this review was to explore which factors influence nurses' adoption of information and communication technology. A systematic review was conducted using qualitative and quantitative studies. The authors performed the search strategy in the databases of PubMed, CINAHL, and IEEE and included articles published between January 2011 and July 2021. This review explores the following factors: collaboration, leadership, and individual and team factors—that, according to qualitative and quantitative research, seem to influence nurses' adoption of information and communication technology. A gradual implementation process of the information and communication technology, involvement from care professionals in the implementation process, and team functioning are important factors to consider when adopting information and communication technology. In addition to these, individual factors such as age, experience, attitude, and knowledge are also influencing factors. The review suggests that collaboration is important within the implementation of information and communication technology in care and that it positively influences nurses' adoption of it. Individual factors are researched more extensively than collaboration, leadership, and team factors. Although they also appear to influence the adoption of information and communication technology, there is insufficient evidence to convincingly substantiate this.

KEY WORDS: Adoption, Collaboration, ICT, Nursing team, Systematic review

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The use of information and communication technology (ICT) is one of the responses to the challenges faced by healthcare: an aging population, the increase of chronic diseases, and the desire for quality of life, independence, and autonomy.[1,2] Additionally, with the emergence of the coronavirus (COVID-19), the delivery of care must urgently change. Infection prevention requires social distancing and quarantine. Thus, caregivers are recommended to use ICT such as telemedicine and e-consultation.[3] In addition to that, with an increasing number of older people wanting to live in their own home for as long as possible, quality of life and patient empowerment are becoming more important.[4] Information and communication technology has the possibility to signal diseases at an early stage and can be used for medical rehabilitation at home.[2] It can enable individuals to monitor their vital signs with the use of activity trackers or other wearable sensors, for instance, fall detection systems, lifestyle monitoring, or GPS trackers.[5] This enables vulnerable older people so that they can remain in their own homes longer and do not have to be institutionalized.

From the perspective of efficiency and cost effectiveness and in order to compensate for the expected shortages of nursing and care professionals, the implementation of ICT is necessary and urgent. Its use can improve efficiency in care,[5,6] for example, in the use of telecare in home care or for patients experiencing heart failure. Policymakers from countries such as the Netherlands,[1] the United States,[2] and the United Kingdom[7] state that the use of ICT in care is essential for increasing efficiency and quality of life; however, it has not yet achieved the possibilities that it offers. The aim of this review is to explore the following factors that may influence the adoption of ICT by nurses: collaboration, leadership, team factors, and individual factors.

In this review, the authors use the definition of ICT to describe the broader use of technology in healthcare. In this review, we describe it as "technologies used to support and deliver healthcare services."[8] Examples include the remote delivery of healthcare services and medical information with the use of electronic technology (telemedicine),[9] the electronic collection of patients' clinical data (EHRs),[10] and the use of Bar Code Medication Administration (BCMA) systems that are utilized to reduce medication

errors through electronically administrating medication for patients at their bedside.[11]

However, the adoption rate of ICT applications is minimal among professionals such as nurses, and not adopting them appears to be quite common.[12] This seems to be one of the primary reasons why ICT implementation is generally failing[3]; however, it is unclear what comprises the success and failure factors. Straub[13] refers to adoption as the decision an individual makes to either accept or reject an innovation and whether to integrate this innovation into their life. This process is not a single event; the decision of whether to adopt an innovation is formed by beliefs and attitudes of an individual that evolve over time. It is something different than solely using one, for example, because it is an organizational directive. Adopting an innovation means that an individual is willing to integrate it into their daily life and that they want to delve into using it and take ownership of it. In order for an individual to integrate the innovation into their work, it is necessary that other team members make a behavioral change and also adopt it. This is what makes technology adoption a complex and social process,[13] and many theories have been developed to explain behavioral change.

Various factors influence the adoption process—not only the innovator himself but also other elements such as characteristics of the innovation and the context of the individual. Rogers[14] states in the diffusion of innovation theory that technology adoption is therefore influenced by the functioning of social networks and, for example, peers, organizational pressure, and societal norms.[14] According to Lewin's[15] theory of change, the behavior of an individual is influenced by group behavior and interactions in the group. Forces in the group prevent the individual from embracing changes. This is why, according to Lewin, the environment of the group must be taken into consideration during an organizational change process, which must occur in three phases: unfreezing, moving, and (re)freezing. Sharing information, training, and leadership are also mentioned as important factors in the change process. This indicates that a broader view is necessary in order to understand the adoption process. One that is successful is not solely an individual process and will occur due to the influence of different factors.[15]

Nurses always work in teams and reflect preferences in the way they work within it. This is necessary to provide continuity of care for patients. According to Wensing et al,[16] the functioning of the team depends, among other things, on mutual trust, the composition of the team, and the presence of a team leader. Formal and informal leaders, such as nurses, could significantly influence changes.[16] Therefore, to increase the acceptance of ICT innovations in care delivery, not only individual factors but also other factors such as team factors, leadership factors, and the way nurses collaborate may influence how nurses adopt ICT into their professional life. Yet, no overview of factors regarding the influence of specifically collaboration, leadership, individuals, and teams on the adoption of ICT innovations was provided in literature. We strongly suspected that the four outcome variables we selected would have a strong influence on the degree of technology adoption in nursing.[16,17] However, a clear and focused overview on this was not yet available. Such an overview can provide new insights into the influencing factors on the adoption of ICT by nurses working in patient care. This systematic review identifies a number of them: collaboration, leadership, team factors, and individual factors.

Literature provides a broad range of factors that influence the acceptance and adoption of ICT innovations. Several adoption theories have been used to examine the concept of the implementation of innovations in healthcare. The Technology Acceptance Model[18] and the Universal Technology Adoption and Use Theory[19] are models that have been applied to assist in understanding the factors that influence an individual's decision to adopt an innovation.[13,20] When adoption theories are used to examine what choices an individual makes in accepting or rejecting an innovation, diffusion theories describe how an innovation is dispersed throughout the population.[13] However, as technologies and organizations become more complex, not only individual but also organizational and social dimensions must be taken into account.[20]

Several implementation models and strategies on introducing innovations into healthcare practice have been developed and researched.[10,12,16,21] These models have assumptions such as the introduction of the innovation should be performed systematically in order to have the most success. Additionally, when planning the innovation strategy, the determinants that facilitate or impede the innovation process must be considered, although an overly complicated plan will negatively impact the implementation process.[21]

Nurses always work in teams and often collaborate in an interdisciplinary context as it is necessary to share information and interprofessional knowledge to provide quality of care. Interdisciplinary collaboration is also becoming more important for healthcare. In 2010, the World Health Organization published the "Framework for Action on Interprofessional Education and Collaborative Practice."[22] According to the World Health Organization, interdisciplinary collaboration is "an innovative strategy that will play an important role in mitigating the global health workforce crisis."[22] For this reason, this review focuses on the nursing profession and collaboration among nurses; however, other aspects and the nature of collaboration between nurses and other disciplines are also involved. Various studies focus on the organizational factors of the implementation of innovations, whereas others focused on team characteristics, leadership, collaboration, or group climate that contributes to the adoption of ICT

innovations.[23,24] It appears that a combination of factors such as individual factors, the manner in which a team collaborates, leadership, and interdisciplinary collaboration have an important influence on the adoption of ICT by nurses. This review presents collaboration, leadership, and individual and team factors that, according to qualitative and quantitative research, seem to influence this behavior.

METHODS

Aims

The aim of this review was to explore the following factors that may influence the adoption of ICT by nurses: collaboration, leadership, team factors, and individual factors.

Design

A systematic review was performed using qualitative and quantitative studies. The EQUATOR resources were used for selecting the critical appraisal instruments; the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (the PRISMA statement) was used in the systematic review.[25] The resources developed by the Joanne Briggs Institute including the Checklist for Analytical Cross Sectional Studies[26] and the Checklist for Qualitative Research[27] were also used.

Search Methods

We began the systematic review with the hypothesis prompted by different knowledge sources that individual factors, team factors, and organizational factors have a significant influence on technology adoption.[10,12–17,20,21] To determine a scientific basis for this hypothesis, a fairly broad search strategy was initiated to ensure that no literature was missing that described one or more of these factors and thus offered new scientific insights. This was despite the fact that the studies in question may not have primarily had the same focus compared with our study. A team of four researchers was involved in the design of the systematic literature search. The search strategy and database selection were formulated in consultation with two independent librarians who are experienced in systematic reviews. The search strategy was performed in the databases of PubMed, CINAHL, and IEEE and included articles published between January 2011 and July 2021.

A combination of Medical Subject Heading terms and keywords that were relevant to ICT, nursing, adoption, collaboration, leadership, and teams were used to construct the search strategy. The search strategy is presented in Table 1. The search was performed in the period from January 2011 until July 2021. Around 2011, e-health became an important subject on the agenda of governments internationally.[28] It appears that it had been developed for a longer period of time but that the adoption and implementation was disappointing. According to the eHealth Strategies Report in 2011, "Europe is experiencing a strong political momentum to advance eHealth solutions for the benefit of both its citizens and health systems."[28] The inclusion criteria were limited to academic journals, peer-reviewed articles in the English language addressing ICT adoption by nurses and nursing teams, articles about ICT adoption addressing collaboration in teams and interdisciplinary collaboration in ICT (ie, telehealth, EHRs, telecommunications, videophones), leadership, team factors, and individual factors. Due to the focus of this review on interdisciplinary collaboration, besides the studies focusing on the nursing profession, studies focusing on an interdisciplinary context were also included. Studies addressing the implementation of technology itself and pilot studies, studies addressing the adoption of e-learning, perceptions of patients and students, and those regarding the use of, for example, social robotics or virtual reality were excluded.

Search Outcomes

The initial search retrieved 3339 articles for the period of January 2011 to July 2021. All references were imported into a data management system (Rayyan QCRI). Duplicates were excluded, which left 2771 articles. After the exclusion of articles based on the title, 280 articles were screened on title and abstract by two independent researchers. This excluded 228 articles. Each of the two researchers separately reviewed 52 articles in full text. Finally, 17 articles satisfied the inclusion criteria. Figure 1 summarizes the process.

Quality Appraisal

Two researchers screened each article independently. The quality of the evidence of the studies was assessed by using two of the Joanne Briggs Institute's critical appraisal instruments: the Checklist for Analytical Cross Sectional Studies[26] and the Checklist for Qualitative Research.[27] The choice of instruments depended on the type of study. To calculate the scores, the authors used an approach similar to Yasin et al.[29] The score obtained by each study was divided by the maximum possible score. This result was multiplied by 10 to obtain a score between 1 and 10. With this final outcome, the studies could be assigned to the following methodological quality categories: weak (1-5.9), moderate (6-7.9), and strong (8-10). Supplemental Digital Content 1 (see Supplemental Digital Content 1, http://links.lww.com/CIN/A180) presents the Joanne Briggs Institute scores. In order to categorize each article to the level of evidence, the Oxford Levels of Evidence published by the Centre for Evidence Based Medicine was used.[30] Slight adaptations were made on the categories for research in nursing and qualitative research methods based on Paans et al.[31] To determine the level of evidence, the following categories were used:

Level 1. Randomized trials

Table 1. Search Strategy

Database	Search Terms
PubMed	("Technology"[Mesh] OR "Diffusion of Innovation"[Mesh] OR "Nursing Informatics"[Mesh] OR "Electronic Health Records"[Mesh] OR "Medical Order Entry Systems"[Mesh] OR "Telemedicine"[Mesh] OR technol*[tiab] OR invention*[tiab] OR innovat*[tiab] OR ehealth [tiab] OR e-health[tiab] OR "electronic health"[tiab] OR telehealth[tiab] OR tele-health[tiab] OR telemedicine[tiab] OR telemonitor* [tiab] OR "medical information"[tiab] OR "medical order"[tiab] OR "nursing informatics"[tiab]) AND ("Nursing Staff"[Mesh] OR "Nursing Homes"[Mesh] OR "Nurses"[Mesh] OR "Nursing"[Mesh] OR nurse[tiab] OR nurses[tiab] OR nursing[tiab]) AND ("Motivation"[Mesh] OR "Attitude"[Mesh] OR "Attitude to Computers"[Mesh] OR adopt*[tiab] OR accept*[tiab] OR belie*[tiab] OR motivat*[tiab] OR assimil*[tiab] OR percept*[tiab] OR attitude*[tiab] OR readiness[tiab]) AND ("Nursing, Team"[Mesh] OR "Leadership"[Mesh] OR nursing team*[tiab] OR leadership*[tiab] OR "team climate"[tiab] OR team*[tiab] OR collaborat*[tiab] OR partnership*[tiab])
CINAHL	((MH "Technology+") OR (MH "Diffusion of Innovation+") OR (MH "Nursing Informatics") OR (MH "Electronic Health Records+") OR (MH "Electronic Order Entry") OR (MH "Telemedicine+") OR (MH "Clinical Information Systems+") OR (MH "Nursing Orders") OR TI (technol* OR invention* OR innovat* OR ehealth OR e-health OR "electronic health" OR telehealth OR tele-health OR telemedicine OR telemonitor* OR "medical information" OR "medical order" OR "nursing informatics") OR AB (technol* OR invention* OR innovat* OR ehealth OR e-health OR "electronic health" OR telehealth OR tele-health OR telemedicine OR telemonitor* OR "medical information" OR "medical order" OR "nursing informatics")) AND ((MH "Nursing Staff, Hospital") OR (MH "Nursing Homes+") OR (MH "Nursing Home Personnel") OR (MH "Nurses+") OR TI (nurse OR nurses OR nursing) OR AB (nurse OR nurses OR nursing)) AND ((MH "Motivation+") OR (MH "Attitude+") OR TI (adopt* OR accept* OR belie* OR motivat* OR assimil* OR percept* OR attitude* OR readiness) OR AB (adopt* OR accept* OR belie* OR motivat* OR assimil* OR percept* OR attitude* OR readiness)) AND ((MH "Team Nursing") OR (MH "Leadership") OR (MH "Collaboration") OR TI (nursing team* OR leadership* OR "team climate" OR team* OR collaborat* OR partnership*) OR AB (nursing team* OR leadership* OR "team climate" OR team* OR collaborat* OR partnership*))
IEEE	((((innovation OR technol*) AND nurs* OR "nursing team") AND adoption OR accept*) AND collaboration)

Level 2. Cohort studies, cross-sectional designs, pre-test/post-test designs, quasi-experimental designs, record reviews
Level 3. Case-controlled studies
Level 4. Database research, observational studies, qualitative interviews, systematic analyses of qualitative studies
Level 5. Expert opinions

Level 5 studies were excluded. The outcomes are presented in Supplemental Digital Content 1 (see Supplemental Digital Content 1, http://links.lww.com/CIN/A180). Bibliometric and network analyses were used to gain insight into the impact of the included studies. Bibliometric analysis showed us that five studies scored above average, of which one study[32] was strong: 75 citations with a field-weighted citation impact of 13.6. According to the network analysis, there has been no collaboration between the authors of the included articles; the studies were conducted independently of each other.

Data Abstraction

Data were extracted by three researchers (EC, JZ, WP). All of the studies were obtained by two separate researchers: one researcher compiled all of the included studies (EC), whereas two others each extracted half of the studies (JZ, WP). A table was used to aggregate the data containing the following elements: bibliographic elements (authors, year of publication, title), key findings, research design, level of evidence, quality score, data collection, sample size, type of technology, and the factors that influence adoption (collaboration, leadership, team factors, and individual factors; related to adoption and related to team membership). The results are presented in Supplemental Digital Content 1 (see Supplemental Digital Content 1, http://links.lww.com/CIN/A180).

Synthesis

A thematic analysis and narrative reviews were used to synthesize the data. The qualitative nature of nearly all of the studies meant that statistical methods could not be utilized. The data synthesis was conducted by the first author and discussed biweekly with the review team.

RESULTS

Characteristics of Studies

Publication dates were between 2011 and 2021. The studies originated from the United States (n = 8), the United Kingdom (n = 3), Canada (n = 1), Hong Kong (n = 1), South Korea (n = 1), Sweden (n = 1), Denmark (n = 1), and the Netherlands (n = 1). Seventeen studies were included with a total of 2.753 respondents, of which 2.481 were nurses. Nurses were involved in all of the 17 studies. Seven articles focused on EHRs, two concerned BCMA systems, five concentrated on telemedicine, and three related to both the EHR and BCMA, as presented in Table 2. Qualitative studies were the most common (n = 11). The other articles had a cross-sectional survey design (n = 6). All of the studies with a cross-sectional design were either of weak (n = 5) or moderate (n = 1) quality. The qualitative studies were either of strong (n = 8) or moderate (n = 3) quality. The characteristics of the studies will be outlined followed by discussing

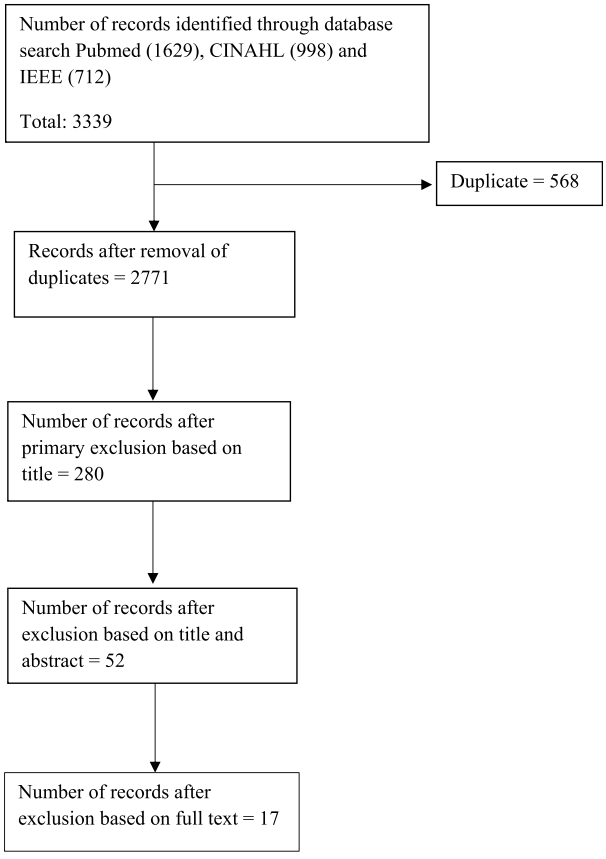

FIGURE 1. PRISMA flowchart of systematic review process (January 2011 to July 2021).

the factors that influence the adoption of ICT by nurses according to the studies.

Collaboration Factors

Thirteen of the studies included in this review[32–44] reported collaboration factors that influence nurses' adoption of different forms of ICT use. Actively involving care professionals in the implementation process and collaboration between care providers are influencing factors on the adoption process. The involvement of end users in the process of developing or implementing ICT enhanced their acceptance. According to nine of the studies, an important factor for successful implementation is collaboration between nurses and the information technology (IT) team.[33–41] Rasmussen et al[37] state that cooperation between all levels involved from the beginning increases a sense of ownership. According to Spetz et al,[39] nursing involvement in the implementation process and a partnership between nurses, pharmacy, and IT staff are necessary for the process. The studies do not describe the nature of the collaboration that is necessary for the successful implementation of ICT. According to five studies, interdisciplinary collaboration enhanced the adoption process; this was specifically the collaboration between health professionals and the IT team[34,35,39,42,43] and especially involvement of nurses from the early stage of development of ICT. Taylor et al,[32] Asiedu et al,[33] Rasmussen et al,[37] and Sockolow et al[44] state that collective training with a mixture of participants positively influences the implementation and adoption process.

In another context, the use of ICT also affects collaboration. According to five studies, the use of telemedicine, the EHR, and BCMA has an impact on collaboration due to new types of communication and time pressure.[33,37,40,41,44] According to these studies, utilizing ICT (ie, telemedicine, EHR, BCMA) influenced collaboration in a way that made it possible to collaborate more actively, and it caused new types of communication. The use of telemedicine facilitated a more direct way of communication, which enhanced confidence and a feeling of security. According to Asiedu et al,[33] one of the advantages of "teleneonatology" is that it facilitates collaboration that is more active between the neonatologist and remote care providers. Additionally, using technology improved nurses' confidence and provided the physicians with a sense of relief as it streamlined the care processes. Nurses reported that communication among interdisciplinary healthcare providers was improved since the implementation of the EHR as it made communication between care providers more transparent.[41] Moreover, it was easier for nurses to follow what was done by other disciplines.[44] On the other hand, the use of ICT could increase the feeling of time pressure and perceived stress for nurses as they needed additional time for documentation, which could influence collaboration in the team.[41]

Leadership Factors

Ten of the included studies[32–34,37–40,43,45,46] reported leadership factors that influence the adoption of ICT by nurses. Six studies found that support from leaders and (strong) nurse leadership aid in the implementation of telemedicine, the EHR, and BCMA.[33,34,37,39,43,45] According to one study,[34] strong nurse leadership especially aids in the implementation of the EHR. Management support from different levels[37,39] as well as leadership engagement and championing of the integration by supervisors and nurse managers promote the integration of the instrument that is involved.[33] Studies ascertained that support from different levels of leadership,[37] active communication, and feedback about errors,[45] flexibility, and a gradual implementation process[39] are influencing factors. Awareness among managers of the difficulties that nurses experience in developing digital skills was also considered as an influencing factor.[46]

Three studies determined that local champions and leadership shared by the team are the key enablers for a successful implementation of telemedicine and the EHR.[32,40,43] Local champions are defined as the individuals who enable

Table 2. Categories of ICT in Included Studies

Category (No. Studies)	Definition	Included Studies
EHRs (n = 7)	The electronic collection of patients' clinical data [14]	[34, 35, 40, 42, 44, 46, 48]
BCMA (n = 2)	Systems that are used to reduce medication errors by electronically administrating medication for patients at their bedside [15]	[36, 38]
Telemedicine (n = 5)	The distribution of healthcare services and medical information via communication networks [13]	[32, 33, 37, 45, 47]
EHRs and BCMA (n = 3)		[39, 41, 43]

adoption in the organization through promotion of telemedicine and the provision of support for colleagues.[32] Often, the nurses who are recognized as "early adopters" are selected as local champions. The presence of a "go-to-expert" colleague is an important factor in the adoption process. It is often seen that having an expert of the innovation as a member of a nursing team is beneficiary for the adoption process. Furthermore, a bottom-up approach in which the EHR is developed from the needs of the (nursing) team is beneficial.[40]

Team Factors

Eight studies[32,37,39–41,45–47] determined team factors that influence the adoption of telemedicine, the EHR, and BCMA. The culture in the organization and in the team is one of the main factors that influence the adoption of technology. According to Shah et al,[45] innovative organizations support staff to be ready for changes, and cultural change is required for organizations to implement telemedicine. Resistance to change[47] and working in a changing environment are barriers[32] for organizations to implement it. According to Taylor et al,[32] staff described the many changes they experienced in their work as overwhelming. Other developments were sometimes considered as having more priority than the use of telemedicine and led to an increased workload.

Five studies researched the importance of communication and collaboration within the team. According to Taylor et al,[32] one of the factors that contribute to enabling the implementation of telehealth is that personnel work closely in multi-disciplinary teams consisting of clinicians and technical personnel. According to Dunford et al,[47] nurses approach coworkers instead of their leaders for assistance, which emphasizes the importance of teamwork. Taylor et al[32] found that sharing of knowledge and success establishes trust between team members. Vedel et al[40] state that positive feedback and support from colleagues contributes to the adoption process. De Leeuw et al[46] emphasize the importance of encouraging working in a team culture, peer support, collegial learning, and helping each other in developing digital skills. Two studies determined how the implementation of the EHR, BCMA, and telemedicine influences the functioning of the team; work routines lead to task shifting,[37] and the ability for team members to assist each other depends on staffing and time pressure.[41]

Individual Factors

All 17 studies included in this review[32–48] ascertained individual factors that influence the adoption of telemedicine, the EHR, and BCMA. Six of the included studies concluded that the experience staff has with an ICT system (positive and negative) influences the adoption process.[32,33,35,38,40,45] Initial negative experiences are caused by, for example, uncertainty and lack of understanding about patient suitability[32] and can lead to resistance to using a system.[35] On the other hand, the perceived usefulness and perceived ease of use as described in the Technology Acceptance Model that nurses experience when utilizing one helps in the adoption process.[33,40] Staff attitudes and satisfaction with the system, evaluation of its quality, and the expectations for it[34,35,45,48] influence whether staff is self-motivated to use it. According to three studies,[32,40,44] an understanding of the value and goals of the system and the perceived benefits influences the adoption process.

Individual demographic characteristics such as age, gender, or computer skills had an impact on the evaluation of the usefulness of the system and satisfaction.[38,42,48] According to Moreland et al,[42] higher satisfaction scores were associated with staff members who had fewer years of experience working as a nurse and had greater comfort with using computers. According to Song et al,[38] nurses at advanced ages and with more experience have less behavioral intent to use BCMA. This is caused possibly because they already have a certain workflow without using technology compared with those who are younger and less experienced and can learn a workflow with using a computer. In addition, voluntariness in using the system has a positive influence on the adoption of the EHR by nurses.[48] Those who have less computer knowledge and fewer IT skills struggle more with the adoption of the EHR, BCMA, and telemedicine,[32,34,39,40] which indicates that offering training and support staff, as well as sufficient time to learn and repeat skills, contributes to a higher adoption rate.[32,39,43,46] A gradual implementation encourages nurses' adoption of the EHR.[40] Using BCMA has an impact on the knowledge that nurses have; nurses were

better prepared to have discussions with physicians.[36] On the other hand, workload challenges arising from the implementation of telemedicine contribute to workarounds that can be problematic when they influence the safety of the intervention and could create medical errors.[47] Moreover, nurses are concerned about how patients view nurses' performance when they spend more time on a computer due to the implementation of the EHR and BCMA.[41,44] This influences the adoption level of nurses or can be considered as a form of resistance.

DISCUSSION

The authors' objective of this review was to locate empirical evidence of collaboration, leadership, and team and individual factors regarding nurses' adoption rate of ICT that remains low while the necessity to use ICT in care increases.[49] The findings suggest that collaboration between nurses in the team and with other disciplines has an influence on the adoption of ICT in the realm of care.

Review limitations include the relatively small number of studies that were included and the level of evidence provided. The impact factor of five studies was above average, with one study that scored high.[32] The other studies scored on an average to a low level. A narrative review was used for the knowledge synthesis. A minimal number of studies were retrieved with generally weak study designs, providing moderate to inadequate scientific evidence to estimate significant factors influencing ICT adoption. The sample size of most of the studies was rather small, and most studies were from the Western perspective (North American, European); therefore, the results cannot be generalized globally. Most of the reviews were of a qualitative nature (11 studies). Altogether, according to the results presented in the included studies, we presume that future research is needed using a multifactorial design to be able to estimate influences that are more specific on nurses' ICT adoption. Nevertheless, the results implicate that a gradual implementation process, involvement from care professionals with the development and implementation process, and the functioning of the team are important factors to consider before implementing an ICT innovation. Nurses approach their colleagues for assistance, and it appears to be an important factor that a "go-to-expert" or "champion" is present.[10,11,40] Possibly, this has to do with the fact that, as is stated by Byrd et al,[20] an individual will utilize a resource if they have the perception that peers also use it. However, this can also go in the opposite direction when those who have a negative attitude influence are unsupportive of their colleagues and impede the adoption process.[49] In addition to this, individual factors such as age, experience, attitude, and ICT knowledge are influencing factors for the adoption process and are often related.[10,21]

Ingebrigtsen et al[17] state that mutual partnerships with IT positively influence adoption. If the composition of a nursing team is diverse with one or more team members who are go-to experts and there is collaboration with the IT team involved, this could have a positive effect on the adoption of ICT by the individuals who must use it. Additionally, nurses with advanced user skills could be selected by their managers as so called "super-users" to support the team with the adoption of ICT.[21,44] Findings show that the focus on collaboration and team functioning in this area has recently been scientifically explored using different types of methods. However, the studies still provide somewhat limited theoretical support and evidence. This is partly because the sample size in many studies was relatively small, the focus of the research in some cases was very broad on technology adoption factors, and the studies were qualitative in nature. There is only minimal research into an overview and a combination of these influencing factors. Compared with the other influencing factors, individual factors seem to be researched more extensively. Considering the fact that individual factors influencing adoption are researched more in depth compared with collaboration and team factors indicates that the importance of collaboration is not acknowledged when ICT is implemented. According to Mair et al,[49] these weaknesses in literature are the factors that promote user engagement and the emphasis on "top-down" approaches instead of collective action. It seems that the influencing collaboration factors, leadership factors, and team factors are not yet researched in depth as most findings refer to general factors influencing the adoption of innovation. In regard to leadership, "strong leadership" and leadership shared by the team appear to be important.[23] According to Ingebrigtsen et al,[17] proactive clinical leadership is associated with IT adoption; however, they did find insufficient evidence of which specific behaviors are appropriate for leaders. Regarding leadership in terms of motivating a team of nurses to act toward achieving a common goal in adopting ICT or the way leadership is performed, the authors must conclude that there is no significant evidence or substantial information available based on best practices.

Most of the studies provide general information about the adoption of innovations; however, there is no information specifically related on how the factors influence the adoption process (ie, that collaboration matters but not in what way). No research was found providing information about a combined approach by collectively taking collaboration, leadership, team, and individual factors into account. This might be caused by the fact that there is no comprehensive overview of the influencing factors nor is there a substantial theoretical background to use as the fundament for such a research design. Overall, although the scientific evidence of the studies is questionable, this review provides insight into the importance of collaboration, teamwork, and leadership.

The latest development of when a worldwide pandemic changes the world increases the urgency for the use of ICT in care.[50] In this period of time, especially when taking the recovering of the COVID-19 pandemic crises into account, knowledge about how nurses and their patients and families can be supported by ICT and how care organizations can organize their teams is most urgent. External factors, such as a pandemic, could have an additional impact on the adoption level in addition to the influencing factors such as collaboration, leadership, and team or individual factors. The urgency to use technology could be a stronger factor than any other factor, and this could be positive stimulation for the use of ICT.[50] Nonetheless, there is a need for a greater amount of empirical evidence of the relation between the influencing factors of collaboration, leadership, team, and individual as well as nurses' adoption of ICT.

Limitations

This review may include potential limitations. First, only publications in English and peer-reviewed literature were included. Non-scientific studies were not included, and gray literature was not retrieved. The authors only searched certain databases (PubMed, CINAHL, and IEEE), which may exclude potentially important sources of information, and certain information may have been disregarded. There was no focus on the theory development before conducting the systematic review. There might be some more scientific background, for example, from academic resources (ie, study books), that may have been missed. We chose to investigate technology adoption with a specific scientific focus. This has the limitation that other, related factors such as accessibility of (organizational) systems, the culture of an organization, and the availability of technological support were not included in our study but that these factors can play a role in the adoption of technology. We therefore recommend examining these factors in more detail in follow-up studies. Furthermore, the methodological quality of the included studies was low to moderate. Most of the studies had a minimal level of evidence or had a weak to moderate quality. This may influence the quality of the evidence that was discovered.

CONCLUSION

This review is the first in which the relation between ICT adoption by nurses and the factors of leadership, collaboration, and team and individual factors is researched. The review suggests that collaboration matters concerning the implementation of ICT in care and that it positively influences the adoption by nurses. What can be learned from this review is that collaboration has a positive influence on this. Active involvement of care professionals and interdisciplinary collaboration between nurses and the IT team have a positive influence on the adoption of ICT. Furthermore, collaboration in the team with a sharing of knowledge and successes and strong nurse leadership may be beneficial for it. Individual factors such as age, attitude, and ICT experience also have an influence. Collective training appears to have a positive effect on the adoption of innovations.

This review demonstrates that, when implementing ICT in care, various factors should be taken into account. Individual factors are researched more extensively than collaboration as well as leadership and team factors. Although these factors also seem to have an influence on the adoption of ICT, evidence is inadequate to substantially support this. Especially, collaboration, leadership factors, and team factors have been researched in general; however, a combination of these factors has not been studied. Future research into the combination of the influencing factors can provide additional insights into how the adoption process functions. Recommendations for further research include the use of (mixed methods and multifactorial) designs and sample sizes with the estimation that in-depth knowledge can be gained on what combination of factors influence the adoption of ICT with substantial levels of evidence.

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