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Digital technologies supporting towards nursing care: a brief review

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Abstract: There is a wide range of digital technologies being developed or used in nursing care. According to this scoping review, the findings on the good or negative impacts on people in need of care, careers, and facilities that provide care are available, and the reliability of these data will be assessed. Using a scoping review methodology, researchers have identified papers focusing on the efficacy of digital technology in nursing care for patients, careers, and care facilities. A total of 19,510 scholarly papers from nine databases were screened for inclusion in the study. A total of 123 individual papers and 31 reviews were analyzed for this research project. For example, aides for the disabled and information and communication technologies are among the technologies that are included in the category of nursing and health information technology. There are numerous studies that suggest good outcomes, but the quality of evidence is usually poor and the research sizes are often tiny. Few technologies have been studied in depth enough to provide solid results. There aren't many high-quality research studies (RCTs) in most technical fields. Heterogeneous outcomes suggest that the impact of new technologies may be substantially influenced by the way they are introduced and the unique environment in which they are placed. It's understandable that care facilities are wary of using new technology because of the lack of proof of their usefulness in nursing care. The scoping assessment identifies technological areas in need of further in-depth investigation in the future. It is imperative that more research be done on outpatient, informal, and cross-sectoral care in order to fully use and benefit from the possibilities of digital technology in order to help patients become more self-sufficient and relieve stress on both formal and informal caregivers alike.

Keywords: innovative technology, care-dependent, caregivers, nurses, patients.

I. Introduction

Many countries are conducting research into digital technologies for nursing care in the hopes that these technologies will facilitate or even substitute some aspects of human nursing work and thus help to mitigate the rapidly rising costs of care and shortages of skilled workers. These technologies. 1–4 Many nations currently have nursing care personnel shortages, which are anticipated to worsen as the population ages. 5 Despite the availability of digital technology for nursing care, many nurses do not use them. 6 "Nursing Care Innovation Center" is part of the German Federal Ministry of Education and Research's (BMBF) "Future of Nursing Care" research cluster, which has received funding from the BMBF. It aims to create new technologies, evaluate promising ones, and encourage their use. The project team has been given the goal of compiling a list of technologies that have been shown to have positive impacts on people in need of care, such as patients in hospitals, their carers, or the environments in which they are offered care.

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These new technologies have the potential to have far-reaching consequences. Care recipients' quality of life (QoL) may be increased, and the freedom of those who may need care may be enhanced by the use of technology, allowing them to remain at home with little or no nursing assistance while their QoL improves. 13–16 Formal carers' health may benefit from psychological or physical assistance. As a result, individuals may be able to work longer, or their informal carers may be relieved to the point that they no longer need official care assistance. 19–23 Nursing personnel in hospitals and long-term care facilities may be aided in their efforts to work more efficiently, improve patient care, or enhance patient safety. 24–27 Direct care assistance or an enhanced, digitally enabled structure of care procedures might accomplish these results. It is also possible to make nursing job easier by streamlining the handover procedure or cooperating with other institutions. 28,29

There is a wide range of digital technologies being developed or currently being used to assist in nursing care. 30 This scoping study focuses on technology that aids caregivers or those in need of care, whether they are official or informal. There are several ways to aid someone in need of care: social, mental, and/or physical. For the purposes of this scoping study, we want to get a broad picture of how various technologies affect people who are in need of care, the people who deliver that care, and institutions. Additionally, the quality of these outcomes is a consideration. Specifically, we looked at the sorts of research included in our review to answer this issue. Due to the vast number of studies included, a detailed evaluation of each study's quality could not be completed. The degree of evidence that may be obtained is strongly influenced by the study types that are utilised as a proxy.

Several key research topics underlie this assessment: When it comes to evaluating the efficiency of digital technologies used in nursing care, which ones have previously been tested? Which medical technology have been scientifically shown to have positive or bad impacts on the quality of treatment received or the length of time it takes to get it? Which kind of care facilities and patient populations has been studied so far?

II. Methods

Based on Arksey and O'Malley's scoping review approach, this study used a wide variety of study types in order to offer a comprehensive overview of the area of research. – 31 The iterative selection of studies was made easier by following the processual suggestions described in Levac et al32. Starting with a broad research topic, the scoping review began the process. During the study phase, the question was revised in order to allow for more extensive evaluations of the efficacy outcomes. We began by looking for areas of digital technology that have received the greatest attention in terms of acceptability, effectiveness, and efficiency in support of informal and formal care settings.

For this inquiry, we were trying to get an overall picture on what is currently being researched in the subject of digital technology in nursing care. Krick et al. have published an analysis relevant to this subject. 30 An further part of the review focused on studies of efficacy, enabling not only the identification of locations in which these studies are carried out but also the identification of technologies that are successful or not.

III. Methodology

Medline, Scopus, CINAHL, Cochrane Library, ACM Digital Library, IEEE Xplore, the Collection of Computer Science Bibliographies, GeroLit, and CareLit were the nine electronic databases we utilised for our search. To round up the research, we conducted a manual search of related initiatives in German-speaking nations. Scientific articles published between 2011 and 2018 that comprised empirical investigations (abstracts accessible in German or English) were included in the search. In March of 2018, all databases were searched. It was decided that a seven-year term would be sufficient to keep the scope reasonable and concentrate on the most cutting-edge advancements.

Kricket et al.30 provides a detailed description of the initial search approach, research identification, and data extraction method. A total of 19,510 scholarly papers were screened throughout the research selection process. The following key phrases were entered into the search engine:

The terms "care" and "nursing" are often used interchangeably, but the terms "robot" and "intelligent" are both used interchangeably, as are the terms "assistive" and "decision support system." The terms "ambient assisted living" and "sensor" are both used interchangeably, as are the terms "virtual reality" and "mixed reality." The terms "tagging" and "tracking" are both used interchangeably, as are the terms "remote (Effectiveness OR Efficacy OR Effect OR Efficiency OR Acceptance OR Adoption OR Acceptability HTA OR Health Technology Assessment OR Evaluation OR Evaluations OR Cost- Benefit Analysis OR Cost Benefit OR Cost Effectiveness OR Cost Utility OR Cost Analysis OR Cost Analyses OR Cost Consequence OR Economic Evaluation OR Economic Evaluations OR Economic Analysis OR Economic Analyses OR Costs and Benefits OR Benefits and Costs OR Costs and Outcomes OR Marginal Analysis).

- **Selection of Studies**

A total of 715 papers were found after a thorough search and selection procedure based on the original research topic. 30 Studies that only looked at acceptance or efficiency results (e.g. economic modelling studies), targeted educational settings or were situated solely in laboratories were excluded from the analysis in order to concentrate on effectiveness results that are relevant for people in need of care, formal or informal caregivers, or care institutions. On the basis of these limitations, data from 212 studies and 48 reviews were extracted in further detail in order to concentrate on the kind, intended audience, and substance of the reported results. Anness-outcomes with direct benefits for a patient, caregiver, or an institution were only included in the final analysis and presentation of data from single quantitative and qualitative research. We excluded studies that solely looked at technical or usability aspects of efficacy.

Studies included in meta-analyses and systematic reviews have to have at least a minimum level of systematic quality evaluation. Since the significance of the given findings could not be assessed without taking into account the study's overall quality into account, this judgement was necessary to make. Even if they claimed to be systematic or integrative reviews, they were removed from the analysis if they did not offer at least a basic quality evaluation of the included papers. No studies were included in this evaluation that met the eligibility requirements or where it could not be determined to which particular technical application the findings related. Systematic reviews were also omitted.

Figure 1 depicts the whole research selection process, including the exclusion of studies for various reasons.

To begin with, we gathered information on the studies' technology categories, research types, study settings, nation, number of study participants, target audience demographics, study settings, support fields, and the problems they were meant to solve. 30 Results from individual investigations were analysed in detail, focusing on their tiveness. People in need of care, caregivers, institutions, or the technology's usefulness were all grouped into one of four categories. It was determined if the reported impact was positive, tive, neutral, or ambivalent for each of these categories (ie, positive or neutral effects that were accompanied by some negative effects). Each category's influence was described in great detail. The first phase's data extraction was double-checked in terms of technology categories, research types, study settings, and the number of study participants. Effectiveness and acceptability results were included in certain dies. In cases where alternative methodologies or sample sizes were used to analyse these outcome dimensions, only the information relevant to the efficacy findings is shown or reported in this study.

Assisted living, assistive devices, ICT, monitoring/sensors, robotics, and virtual reality were among the technology areas in which the research were grouped together. Each technology-specific result section includes a list of category descriptions.

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Review types, primary topics and/or relevant technologies, search period, study count, and key findings regarding efficacy as stated by authors were all taken into consideration when extracting data for a more in-depth analysis. A brief summary of study methodological quality and/or study limitations was also included in the data extraction process.

A single researcher extracted the data for the individual investigations, which was then double-checked by a second researcher.

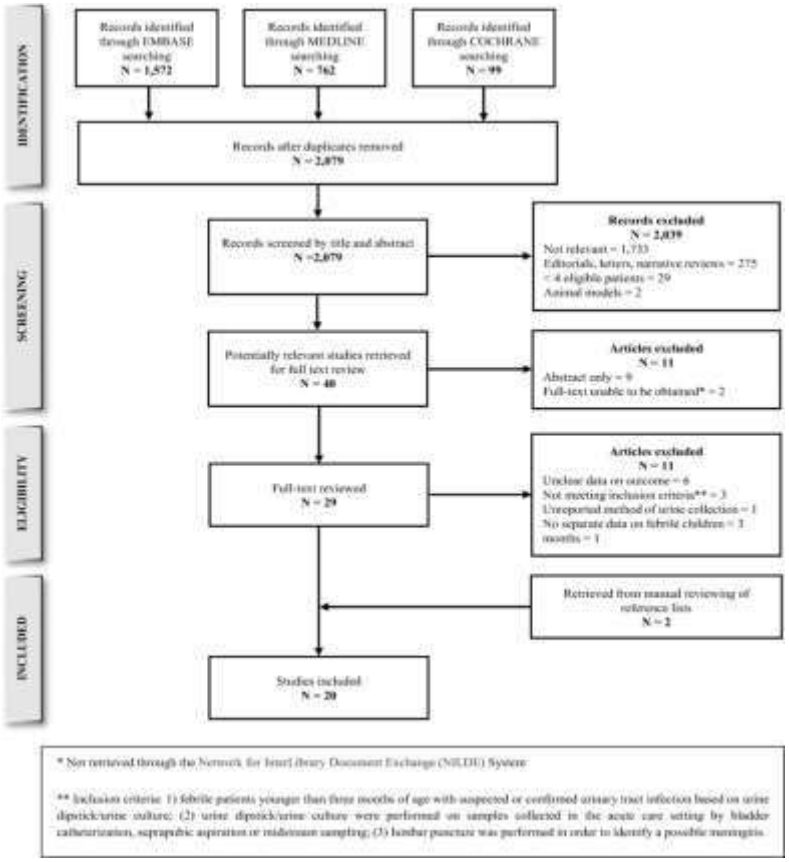

Figure 1 Flowchart: Documentation of study selection process.

Results were discussed between the two researchers if there was a dispute, and a compromise was reached. A single researcher extracted the data for the systematic reviews, and reviews that were omitted due to a lack of a quality assessment were reviewed a second time.

Table 1 shows the evidence level allocated to each research design based on standard evidence-based nursing and evidence-based medicine guidelines33,34, in order to offer the best possible indication of the reliability of the findings. Because we were unable to evaluate the quality of each research, we have included the category of "well-designed" studies in parenthesis in this table. It is under this category that study designs are classified that are not often seen in nursing or health research, but instead are more commonly found in technological research. These studies often include a small number of people and are conducted at an early stage in the creation of an ogy. A study with a control group is included in this category if there are fewer than 10 participants in the intervention group and the study does not offer sample size estimates (power calculations) or test data. The highest quality papers included in systematic reviews are used to provide a score to the review.

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IV. Results

The results of a search:

The complete analysis of research findings (direction of results and kind of outcomes), target groups and set parameters, study type (degree of evidence) and study size comprised 123 single studies and 31 reviews in total.

Table 1 Level of Evidence Scale

Level of Evidence	Study Type
Ia	Systematic reviews and meta-analyses that include more than one (well-designed) randomized controlled trial (RCT)
Ib	(Well-designed) RCT
2	(Well-designed) controlled studies, without randomisation, ie quasi-experiments; or pilot RCTs (self-designated)
3	(Well-designed) case-control or cohort studies, (preferably from more than one centre or research group)
4	Findings obtained from descriptive, other observational and/or qualitative research designs (including case studies), cross-sectional studies, user studies

General Results:

For the most part, this study aims to identify digital technologies that have previously been tested for their impact on individuals in need of care, official or informal caregivers, or care institutions, and to identify technologies for which credible empirical evidence of beneficial benefits is available. Prior to going into depth about the technologies featured and their unique efficacy outcomes, below are the research kinds and study sizes that have been used to determine the reliability of the findings. Additional File 1 provides a comprehensive summary of the findings from each individual research (including information on study type and size, target setting, target group, direction and type of effect). Additional File 2 provides an overview of systematic reviews and their key features.

Direction of Results:

The goal of this study is to identify technologies that demonstrate promising positive results in terms of outcomes that directly influence people in need of care, formal or informal carers, or the efficacy of a care facility. In all, 74% of the included studies found favourable outcomes, whereas 15% revealed equivocal outcomes, i.e., the research provided positive and negative findings for various outcome aspects. Of the research, 11 percent couldn't find any statistically significant effects, and no study found pure negative effects. Table 2 shows the direction of the results of the various research, broken down by kind. Studies with greater evidence levels had a smaller percentage of positive findings, and this is worth noting. The RCTs included had only 60% positive findings and 30% neutral results, however the user studies have favourable results for 92% of the studies included in the dataset. Mixed-methods studies are an exception, with 50 percent reporting ambiguous findings.

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Study Results in Detail by Technology Categories:

More information on the technologies that make up this review and the overall direction of its findings are offered in the following sections. Short descriptions of each category will be provided in the introduction. There is a comprehensive summary of all the findings from each study in Additional File 1.

For certain technical areas, relevant systematic reviews are stated if they exist in the appropriate sections. Many systematic reviews contain a broad variety of gies, while some of them concentrate on particular care issues and include just a small number of research using digital technologies. This paper's breadth prohibits the inclusion of a focused synthesis of all systematic reviews. This scoping review includes all systematic studies or meta-analyses that are included in Additional File 2. Most systematic reviews contain or mention that the quality of the studies included is moderate or low and that high-quality evidence is absent. A large number of them claim that the studies are essentially unrepresentative of each other. These studies, however, assist to highlight the scope of the analysed nologies, which is important. High-quality outcomes can only be achieved using a limited number of techniques.

Information and Communication Technologies (ICT):

A broad range of technologies are included under ICT. In general, they may be described as tools for gathering, storing, providing, managing, and/or improving interpersonal communication between people. They are all of these things. The following subcategories are used to categorise the mentioned technologies:

Table 2 Direction of Results by Study Type in Percent

Study Type	Level of Evidence	Number of Studies	In Percent	Direction of the Results		
				Positive	Neutral	Ambivalent
RCT	1b	20	16.3	60.0	30.0	10.0
Pilot RCT	2	4	3.3	75.0		25.0
Quasi-experiment	2	34	27.6	76.4	14.7	8.8
Case-control study	3	1	0.8	100.0		
Cohort study	3	1	0.8	100.0		
Mixed methods	4	6	4.1	33.3	16.7	50.0
Cross-sectional study	4	8	6.5	75.0	12.5	12.5
Case study	4	23	18.7	78.3	4.3	17.4
Qualitative study	4	13	10.6	76.9		23.1
User study	4	13	10.6	92.3		7.7
Total		**123**	**100.0**	**74.0**	**11.4**	**14.6**

(1). Hospital (or care institution) information systems (HIS)
(2). Electronic health (EHR)/electronic medical records (EMR)
(3). Computerized decision support systems (CDSS)
(4). Telecare
(5). General communication support
(6). Systems to support process planning and/or data exchange
(7). Specific Apps
(8). Target group specific interfaces

The category "Specific Apps" covers apps that don't fit into any of the other categories; it includes software solutions that help professionals, informal caregivers, or care-dependents in a variety of ways. Computerized decision support systems, for example, are often found in HIS and EHR/EMR systems because of their high level of integration.

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Patients' electronic medical records (EMRs) are a part of many hospital/care institution information systems (HIS). HIS collects, stores, manages and transmits patient data in hospitals and other care institutions.

V. Discussion

In general, a wide number of technologies are being investigated in connection to assisting nursing care, although almost no technology has been thoroughly examined to provide solid outcomes. In general, there aren't many research with a high degree of proof.

There are few randomised controlled trials (RCTs) among the papers included in this scoping review, which focuses on information and communications technology (ICT). Robotics and sensors/monitoring technologies are also heavily featured in this analysis. Two-thirds of the studies and all RCTs in the robotics category centre on the robotic seal Paro, therefore this is one of the few technologies that is thoroughly explored; nonetheless, most of the studies are fairly tiny. Only two of the four RCTs in the monitoring/sensors category indicate favourable outcomes, one on pressure ulcer prevention and the other on behaviour analysis for care decision support. 133 In spite of this, there are still a number of studies that generate favourable findings, indicating prospective study fields in the future. Scoping evaluations on sensor or monitoring applications that include studies on technological efficacy demonstrate that development in this subject is thriving. 30,156 10 different sensor systems were discovered in 118 investigations on enabling fall detection in a recent scoping review. 156 In most cases, they were just familiar with technology, and their degree of technical preparedness was typically poor. Nevertheless, this suggests that new applications may be developed if the technology's dependability is improved.

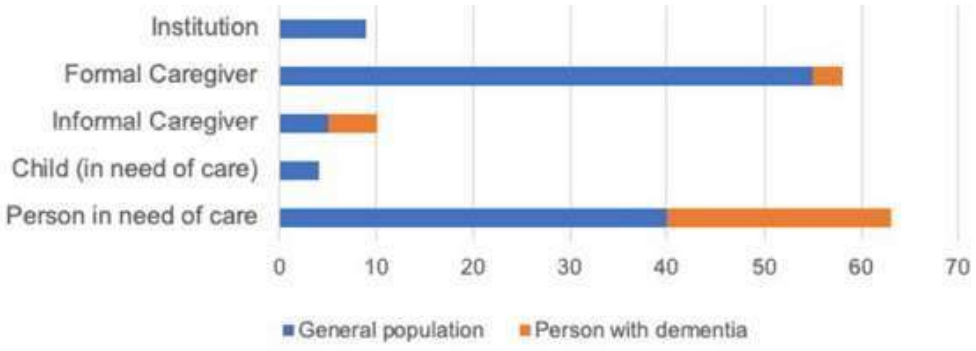

Figure 2 Number of studies by target group.

Due to the generally poor quality of the studies included in this scoping review in terms of evidence level, it is difficult to extrapolate much from what has been reported. It is consistent with the summaries of several of the systematic reviews that were included in this study. According to the majority of them, there was a wide range in quality amongst the included studies, the stated outcomes were frequently inconsistent, and the results could only be extrapolated so far. 1,4,23,25,92,93,112,113,157 Many systematic studies are older than this one, yet it can be inferred from this evaluation of the literature that this issue has not altered in recent years.

However, computerised decision support is an exception: a systematic review conducted by Bright et al. in 2010 had 148 RCTs66 and another meta-analysis conducted by Roshanov et al. in 2010 included 162 RCTs68; hence, this kind of system has a strong evidence basis. However, most of the included research pertains to medical treatment, and the number of papers that exclusively refer to nursing care remains unclear.

Settings and Target Groups:

There are strong hopes that digital technology will enable persons in need of care keep their freedom and support both official and informal carers. 1–3,158

In many industrial nations, the fast rise in the need for competent nursing care personnel brought on by population shifts is a primary motivation for technological research in health care.

158 To far, most research on technology care assistance have focused on hospital and inpatient long-term care settings, which is surprising given these issues. Only a few studies have been done on long-term care in the home, as this review indicates. Cross-sectoral care assistance, in particular, is substantially understudied. This may be owing to the fact that conducting scientific research studies in inpatient settings is considerably simpler than doing so in the outside world. Digital technology may play a part in lowering the need for professional care help, but it is necessary to support persons in need of care so that they can remain in their home surroundings, as many of them want. 159 Of course, research that relieves hospital and long-term care facility caregivers must also be encouraged. As a result, more attention should be paid to study into the use of technology to postpone or assist outpatient care arrangements. 30 As a result of a limited number of research, we may conclude that informal caregivers need help. There may be untapped opportunities to better incorporate informal carers into formal care systems, or lessen their care load, since just a few research have focused on this population.

VI. Conclusion

There have been several studies in the last few years looking at how new technologies may help those in need of assistance, as well as those who offer care and organisations. Also included in this analysis is information on the evidence levels at which the research were conducted, which reveals that high-quality studies are still lacking in the vast majority of technological fields.

It's clear that digital technologies may have a big impact on efficiency, but it's also important to consider how they're implemented in a certain environment. Potential advantages may not be realised if for example, nurses do not feel at ease with the system.

There is relatively little evidence of beneficial impacts for many technologies. As a result, it is understandable that healthcare organisations are hesitant to adopt cutting-edge technical solutions. According to this in-depth evaluation, there are a number of emerging technologies that need further study in the form of high-quality research.

The goal of relieving caregivers and addressing the nursing care deficit is commonly expressed, yet there is surprisingly few research that prove that it is possible to achieve this goal. The fact that so many researches are aimed at improving the quality of care or providing positive benefits for individuals in need is heartening. Research on outpatient long-term care and informal providers, in particular, should be supported more actively, as should research on gical solutions that allow older persons to stay at home (with a restricted amount of professional help). Cross-sectoral care research is also lacking at this point.

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