TELEHEALTH COMPETENCE IN NURSING

ENHANCING SKILLS AND PRACTICE IN PROVIDING CARE REMOTELY

Thijs van Houwelingen

Colofon

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(met een samenvatting in het Nederlands)

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CHAPTER 1

INTRODUCTION

CHANGES IN SOCIETY AND HEALTH CARE

Our society and health care sector face a major challenge to deliver high-quality health care to an aging world population (United Nations, 2017) with a shortage of nurses; a shortage that will continue for years to come (Chan, Tam, Lung, Wong, & Chau, 2013). An additional change is the widespread integration and adoption of Internet technology. People are increasingly performing tasks online, including banking or government-related tasks, such as tax returns or passport applications, and the same applies to the health care sector.

The widespread adoption of Internet technology into our society has 'democratized' knowledge; the Internet makes information available to the masses. Increasingly, health care providers meet patients who have already searched for medical information online, prior to consulting with their nurse or doctor (Koch-Weser, Bradshaw, Gualtieri, & Gallagher, 2010). For example, in March 2012, the evidence-based website on health care usage (http://www.thuisarts.nl) was launched by the Dutch Minister of Health. This website now has 3 million unique page views each month (out of a total Dutch population of nearly 17 million people) (Spoelman et al., 2016); this amount of views illustrates the number of people that search for medical information on the Internet.

Today, however, not all health care professionals are comfortable with the new 'informed patient', as illustrated by a recent news article from the United Kingdom entitled "GPs threaten to refuse remove patients who visit 'Dr Google' first" (Gallagher, 2017). In contrast, other health care professionals encourage their patients to use the information available as a way to empower their patients (Pluut, 2017). Empowering patients by providing access to information can significantly increase the patients' independence; in the Netherlands, the number of GP consultations declined by 12% two years after the launch of the Dutch evidence-based health care website www.thuisarts.nl (Spoelman et al., 2016).

The abovementioned trends in society and health care are also observed in the Netherlands, a country with a strong health care system (according to the Euro Health Consumer Index (Björnberg, 2017)). To maintain the quality of care, the Netherlands face a number of major challenges. By 2040, 27% of the Dutch population is expected to be 65 years old or older, compared to 18% today. The increasing

elderly population coincides with an increasing demand for health care services. The Dutch Nurses' Association (2017) calculated that by 2025, in the Netherlands alone, 125,000 extra nursing administrators will be needed to keep pace with the health care demand.

In this context, i.e., the (a) increasing demand for care and (b) the increasing technological possibilities to improve patients' independence, policy makers, governments and researchers are thinking of ways to transform health care delivery. Below, we discuss how this transformation in health care, and especially the increasing involvement of technology, impacts the nursing profession.

FROM INPATIENT CARE TO COMMUNITY CARE AND 'AGING IN PLACE'

One significant part of the transformation in health care is the shift from institutionalized care to community care (Low, Yap, & Brodaty, 2011). Twenty-five years ago in the Netherlands, almost 30% of the older people lived in a nursing home, but by 2015, this percentage decreased to 13%. This trend is expected to continue through 2040 when only 8% of the older people will live in a nursing home (Centraal Bureau voor de Statistiek., 2015). On a global level, older people are encouraged to 'age in place' by living in their own home safely, independently and comfortably for as long as possible (World Health Organization, 2015). To support patients' independence, it is increasingly important that nurses should provide self-management support and help patients incorporate their disease in their lives (van Hooft, Dwarswaard, Jedeloo, Bal, & van Staa, 2015). Below, we discuss how technology can increase patients' independence.

ASSISTING PATIENTS TO AGE IN PLACE WITH TECHNOLOGY

Many health care technologies are developed to support patients' independence and for improving their self-management. Technological solutions in health care are rapidly emerging (e.g., electronic health records (Jha et al., 2009), mobile health care applications (Ventola, 2014), wearable health sensors (Patel, Park, Bonato, Chan, &

Rodgers, 2012), online therapy (Ruwaard, Lange, Schrieken, Dolan, & Emmelkamp, 2012), evidence-base health care websites (Spoelman et al., 2016)).

Among the technologies that could help patients age in place, telehealth is a growing interest. Telehealth is defined as providing health care remotely, instead of face-to-face, through the use of digital technology. Telehealth services could support community-dwelling patients to age in place by (a) replacing face-to-face visits with e-visits via the use of videoconferencing (Brunett et al., 2015), (b) monitoring vital signs such as blood pressure, blood glucose levels or heart rate via self-measuring devices (Barlow, Singh, Bayer, & Curry, 2007), (c) monitoring movements in and around the home via activity monitors (Shany, Redmond, Narayanan, & Lovell, 2012), or (d) responding to patients' personal alarms and alerting nurses or family members when necessary (Dewsbury & Ballard, 2012).

Telehealth

Providing health care remotely, instead of face-to-face, through the use of digital technology (e.g., videoconferencing).

Telehealth may also help provide care in rural areas by "eliminating distance barriers while improving equity of access to services that often would otherwise not be available in remote and rural communities" (Canada's Health Informatics Association., 2015, p. 13). In countries with large rural areas and therefore low availability of health care professionals, such as Canada and Australia, telehealth can enhance the nurses' ability to reach the rural populations (Effken & Abbott, 2009). Moffatt and Ely (2010) investigated the telehealth benefits for rural Australians and concluded that telehealth has the potential to reduce the inequitable access to health care services.

FURTHER SCALING UP OF TELEHEALTH SERVICES

Based on the theory that telehealth can support people to age in place and contribute to their self-management, several projects have begun with the goal of increasing the use of telehealth services. The European Union began the large-scale project titled 'United4Health: Transforming the patient experience with telehealth in Europe' (European Commission., 2016) with the goal of taking full advantage of telehealth services.

Also, on a national level, governments encourage telehealth upscaling, such as the Dutch Ministry of Health (Schippers & van Rijn, 2014), which created goals to increase the use of telehealth services (see the text box below).

The Dutch Ministry of Health telehealth goals by 2019:

1. 80% of chronically ill patients have direct access to (parts of) their medical record.
2. 75% of chronically ill patients and vulnerable older people who are willing and able to, perform self-measurements.
3. All community-dwelling patients have the possibility to communicate via videoconferencing with their health care providers.

Reaching these goals would entail a major shift in the Dutch health care system, where currently 93% of the care occurs face-to-face (Krijgsman et al., 2016). Fortunately, a high percentage of the elderly Dutch have Internet access. In 2017, >99% of Dutch adults had access to the Internet, and 88.3% of the older people (65 years or older) had access to the Internet (Centraal Bureau voor de Statistiek., 2017). However, whether patients and health care providers are ready to use the Internet for healthcare remains a question. The European Commission project United4Health concludes that to further upscale telehealth services, both patients and health care professionals should be empowered to take full advantage of telehealth, and to reach this, their IT literacy should be strengthened (United4Health., 2016). Telehealth solutions are only effective if the users (patients and nurses) know how to use the technology adequately (Jang-Jaccard, Nepal, Alem, & Li, 2014).

A LACK OF COMPETENCE HAMPERS THE USE OF TELEHEALTH

Competence

The ability to execute a task properly by possession the required knowledge, skills and attitudes.

Several goals pertaining to increasing telehealth use have been discussed. However, the conversion to telehealth remains slow due to various barriers (e.g., inappropriate technology design, inadequate business case, financial issues (Ariens et al., 2017; Kort & van Hoof, 2012)). Additionally, another barrier for telehealth use noted in the literature is the lack of adequately trained and competent health care professionals (Ariens et al., 2017; Kort & van Hoof, 2012; United4Health., 2016).

In this thesis, we focus on this barrier and, in particular, the lack of telehealth competence among nurses. Nurses' acceptance and use of telehealth services are hampered by feelings of insufficient competence (Brewster, Mountain, Wessels, Kelly, & Hawley, 2014; Giordano, Clark, & Goodwin, 2011; Sharma & Clarke, 2014). In many areas, including science (e.g., Brewster et al., 2014; Giordano et al., 2011; Sharma & Clarke, 2014), politics (e.g., European Commission, 2012) and education (e.g., Simpson, 1998; Steeringgroup Bachelor of Nursing 2020, 2015), adequate telehealth education development and the integration of telehealth in nursing curricula is described as an important strategy to overcome the existing barriers to telehealth use.

THE CURRENT STATUS OF TELEHEALTH EDUCATION IN NURSING CURRICULA

To explore the extent to which nursing schools teach telehealth, we investigated the status of telehealth education in nursing schools in Germany, Spain, the United Kingdom and the Netherlands (van Houwelingen, 2014). The results indicated that a minority of nursing schools offered telehealth education at that time. Many nursing schools, however, were planning to offer telehealth education in the near future. Of the Dutch nursing schools, 50% aimed to implement education on 'videoconferencing' into their curriculum, possibly encouraged by the latest Dutch nursing standard in which 'telehealth competence' is considered one of the core skills (Steeringgroup Bachelor of Nursing 2020, 2015).

On a global level, the importance of nurses' telehealth competence is emphasized in the Tuning Framework in Europe (Tuning Project, 2011), the Australia Qualification Framework (Australian Qualifications Framework, 2013), the American Nurses Association (American Nurses Association, 2010), and the World Health Organization (World Health Organization, 2009). These nursing standards may encourage nursing schools to implement telehealth into their curricula, but the standards lack concrete suggestions on what to implement and how to implement the content.

RESEARCH GAP: WHAT ADDITIONAL KNOWLEDGE IS NEEDED?

Although the importance of telehealth education is widely recognized (in science (e.g., Brewster et al., 2014; Giordano et al., 2011; Sharma & Clarke, 2014), politics (e.g., European Commission, 2012) and education (e.g., Simpson, 1998; Steeringgroup Bachelor of Nursing 2020, 2015)), the concrete characteristics of telehealth education are rarely described in the literature.

To understand how nurses should be trained in telehealth, we must first gain a better insight into nurses' ***intention*** to use telehealth. Several sources describe technology acceptance in general (Venkatesh & Davis, 2000; Venkatesh, Thong, & Xu, 2012), but less is known about the acceptance of health care technology, and even less is known about the acceptance of health care technology by nurses. What factors predict nurses' willingness to use telehealth?

Another topic without sufficient knowledge is the specific activities nurses can perform using telehealth and the specific ***competencies*** (knowledge, skills and attitudes) nurses need to execute these activities. Most nursing standards (e.g., American Nurses Association, 2010; Australian Qualifications Framework, 2013; Steeringgroup Bachelor of Nursing 2020, 2015) only emphasize the importance of telehealth competencies and lack examples of nursing telehealth practices. The examples, however, are needed to assist telehealth education development.

The lack of ***self-confidence*** in possessing the telehealth competencies is often described quite generally and raises the question of whether nurses lack 'all the required competencies' or perhaps a 'specific set of the competencies'. For educators, gaining insight into the specific educational needs of nurses is useful to develop tailored telehealth training programs. In the literature, little detail is provided on how much confidence nurses already have for each of the required telehealth knowledge, skills and attitudes.

Furthermore, today's applicants for nursing education are part of a generation of so-called 'digital natives' (Prensky, 2001). This generation of students is commonly characterized as experienced in using the Internet and communication technologies. Therefore, one may wonder whether the general lack of self-confidence in telehealth

would also be experienced by this generation of future nurses. So far, the extent to which this Internet-generation of nursing students needs telehealth education remains unknown.

The final research gap includes a lack of evidence on the ***training*** effectiveness for nurses' knowledge, self-efficacy and telehealth use. Many studies (e.g., Brewster et al., 2014; Giordano et al., 2011; Sharma & Clarke, 2014) assume that training is an adequate strategy to overcome telehealth barriers, but this assumption has, to our knowledge, not been examined in the literature thus far.

THESIS OUTLINE

Based on this background and the abovementioned research gaps, the following topics and related questions need to be addressed to understand how nurses could be better prepared for providing telehealth:

1. *Intention*: How can telehealth users, both nurses and patients, be motivated to use telehealth?
2. *Competencies*: How can nurses integrate telehealth services into their work, and what competencies are required?
3. *Self-confidence*: To what extent do nurses feel equipped to provide telehealth services?
4. *Training*: How can nurses be trained, and how does this training contribute to their practice?

These four topics will be addressed in chapters 2–7 of this thesis, are illustrated in Figure 1 and are outlined below.

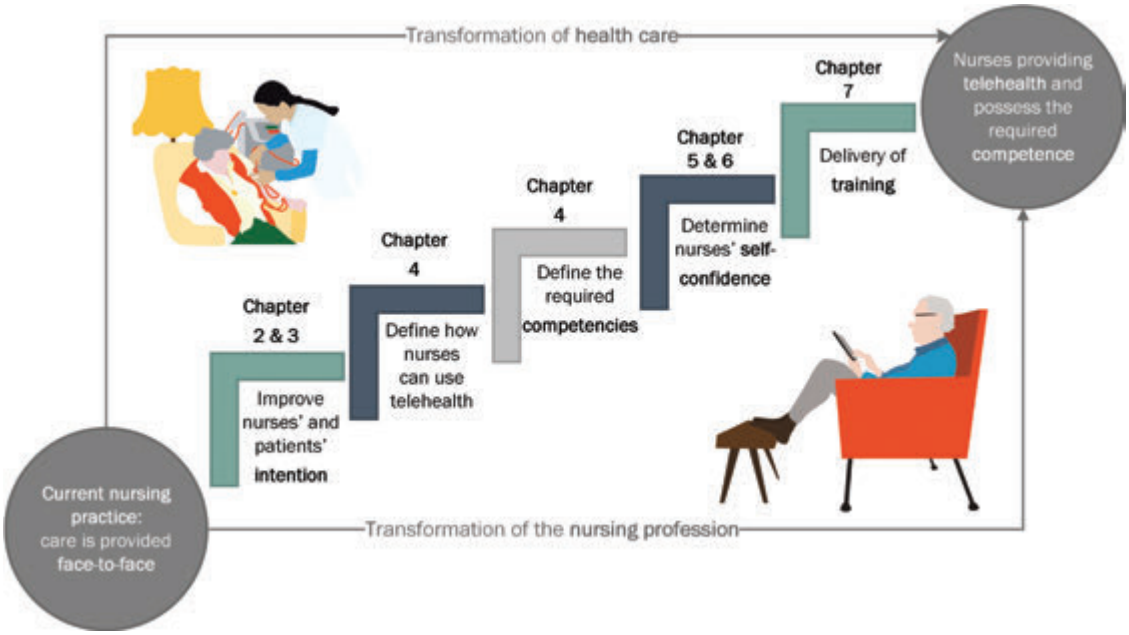

Figure 1. The thesis outline: preparing nurses to provide telehealth and the related research topics addressed in this thesis.

TOPIC 1: THE INTENTION TO USE TELEHEALTH

The first two chapters of this thesis focuses on nurses' and older people's intention to use telehealth. The theoretical framework of the technology acceptance model (TAM) (Venkatesh & Davis, 2000) and the extended version of this model, the unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2012), are used to gain insight into the willingness of nurses and the readiness of older people to use telehealth. In more detail, **Chapter 2** answers the question of what factors predict the Dutch nurses' willingness to use home telehealth and outlines the implications of the results for practice and education. **Chapter 3** addresses the same topic as in **Chapter 2** but focuses on older people by exploring their intention to use videoconferencing and their capacities to use digital technology.

TOPIC 2: THE COMPETENCIES REQUIRED FOR PROVIDING TELEHEALTH

In **Chapter 4,** we outline the 'nursing telehealth entrustable professional activities' nurses can perform to support community-dwelling patients. An important theory in this chapter is the concept of 'entrustable professional activities' (EPAs). EPAs are defined as "tasks or responsibilities to be entrusted to the unsupervised execution by a trainee once he or she has attained sufficient specific competence" (ten Cate, 2013, p. 157). The concept of EPAs, originally created to enhance physician training, was applied to nursing telehealth. **Chapter 4** describes the knowledge, attitudes and skills (competencies) nurses need before they can provide telehealth services.

TOPIC 3: SELF-CONFIDENCE IN TELEHEALTH COMPETENCE

Chapters 5 and 6 address whether future nurses (i.e., current nursing students) and hospital nurses feel confident in possessing the competencies required for providing telehealth. **Chapter 5** explores the question of how the current Internet-generation of nursing students perceives technology-based health care. Is it right to assume that the Internet-generation of nursing students naturally have a positive view of telehealth? **Chapter 6** describes hospital nurses' self-rated telehealth competence and the implications for developing nursing telehealth training programs.

EPAs

Tasks or responsibilities to be entrusted to the unsupervised execution by a trainee once he or she has attained sufficient specific competence.

TOPIC 4: TRAINING IN TELEHEALTH

In **Chapter 7,** the findings of the previous chapters are incorporated into a telehealth training program for nurses in primary care, homecare and hospital care. The chapter also evaluates the training's effectiveness on nurses' knowledge, self-efficacy and telehealth usage. The following two theories were utilized in this chapter: (1) The principles of the social cognitive theory to increase an individual's self-efficacy (Bandura, 1994) were used to develop the training and (2) Kirkpatrick's four-level evaluation model for training (Kirkpatrick, 1996) was applied to evaluate the training. The chapter examines the assumption that training is an adequate strategy to overcome barriers to telehealth use.

Finally, in **chapter 8**, the findings of the previous chapters are summarized and used to answer the following main question of this thesis: How should nurses be trained to provide care to patients remotely through digital technology? Chapter 8 ends with implications from the findings of this doctoral research for nursing practice, education and theory to contribute to the transformation of health care in which technology is increasingly involved.

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CHAPTER 2

DUTCH NURSES' WILLINGNESS TO USE HOME TELEHEALTH: IMPLICATIONS FOR PRACTICE AND EDUCATION

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CHAPTER 3

UNDERSTANDING OLDER PEOPLE'S READINESS FOR RECEIVING TELEHEALTH: MIXED METHOD STUDY

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ABSTRACT

Background

The Dutch Ministry of Health has formulated ambitious goals concerning the use of telehealth, leading to subsequent changes compared with the current health care situation, in which 93% of care is delivered face-to-face. Since most care is delivered to older people, the prospect of telehealth raises the question of whether this population is ready for this new way of receiving care. To study this, we created a theoretical framework consisting of 6 factors associated with older people's intention to use technology.

Objective

The objective of this study was to understand community-dwelling older people's readiness for receiving telehealth by studying their intention to use videoconferencing and capacities for using digital technology in daily life as indicators.

Methods

A mixed-method triangulation design was used. First, a cross-sectional survey study was performed to investigate older people's intention to use videoconferencing, by testing our theoretical framework with a multilevel path analysis (phase 1). Second, for deeper understanding of older people's actual use of digital technology, qualitative observations of older people executing technological tasks (e.g., on a computer, cell phone) were conducted at their homes (phase 2).

Results

In phase 1, a total of 256 people aged 65 years or older participated in the survey study (50.0% male; median age, 70 years; Q1-Q3: 67-76). Using a significance level of .05, we found seven significant associations regarding older people's perception of videoconferencing. Older people's (1) intention to use videoconferencing was predicted by their performance expectancy (odds ratio, OR, 1.26, 95% CI 1.13-1.39), effort expectancy (OR 1.23, 95% CI 1.07-1.39), and perceived privacy and security (OR 1.30, 95% CI 1.17-1.43); (2) their performance expectancy was predicted by their effort expectancy (OR, 1.38, 95% CI 1.24-1.52); and (3) their effort expectancy was predicted by their self-efficacy (OR, 1.55, 95% CI 1.42-1.68).

In phase 2, a total of 6 men and 9 women aged between 65 and 87 years participated in the qualitative observation study. Of the primary themes, 5 themes were identified

that could provide greater understanding of older people's capacities and incapacities in using digital technology: (1) "self-efficacy and digital literacy," (2) "obstacles to using technology," (3) "prior experience and frequency of use," (4) "sources of support and facilitating conditions," and (5) "performance expectancy." These 5 themes recurred in all 15 observations.

Conclusions

Performance expectancy, effort expectancy, and perceived privacy and security are direct predictors of older people's intention to use videoconferencing. Self-efficacy appeared to play a role in both older people's intention to use, as well as their actual use of technology. The path analysis revealed that self-efficacy was significantly associated with older people's effort expectancy. Furthermore, self-efficacy and digital literacy appeared to play a major role in older people's capacities to make use of digital technology.

Keywords: Older adults, videoconferencing, technology, path analysis, observations, community-dwelling people, UTAUT, TAM, self-efficacy, digital literacy

INTRODUCTION

Background

The increasing use of digital technology in society requires that all citizens, including older people, have digital literacy. In the Netherlands, people are gradually forced to regulate tasks online, for example, banking or government-related issues, such as tax returns or passport applications. The same applies for health care, in which digital technologies are increasingly integrated, for example, in telehealth, in which health care is delivered remotely through the use of digital technology such as videoconferencing.

On the basis of the belief that telehealth can offer a solution for the increasing number of older people with a (chronic) disease and the accompanying increasing demand for care, the Dutch Ministry of Health formulated in 2014, three ambitions with regard to the use of e-health to be achieved within 5 years: (1) 80% of chronically ill patients have direct access to (parts of) their medical record, (2) 75% of chronically ill patients and vulnerable older people who are willing and able to, actual perform self-measurements, and (3) all community-dwelling patients have the possibility to communicate via videoconferencing with their health care providers (Schippers & van Rijn, 2014). These ambitions require a major change to the current health care situation, in which 93% of the care occurs face-to-face according to a recent poll (Krijgsman et al., 2016). These ambitions are based on the technological possibilities of telehealth; however, they raise the question of whether patients, especially older patients, are ready for this new method of care delivery; do older people intend to use videoconferencing and what capacities do they have in using digital technology?

Olson and colleagues (2011) showed that there is limited evidence that older adults are averse to using technology, but their frequency and choice of the type of technology often differ from younger adults. Older people are part of another technology generation than younger people and consequently raised with different types of technology (e.g., television, radio, telephone) (Sackmann & Winkler, 2013) than the technologies that are currently used in health care (e.g., using the Internet via PCs, notebooks, tablets, including videoconferencing and apps). To facilitate the use of new technologies, Holden and Karsh (2010) emphasize the importance of end users receiving sufficient support to ensure that they feel confident in their ability to use these technologies. In health care, nurses have an important role in providing

this technological support to patients to enable older people to receive telehealth (van Houwelingen, Moerman, Ettema, Kort, & ten Cate, 2016).

Consequently, to support older people in the use of digital technology in health care, we must first understand their readiness to do so, by exploring the factors associated with older people's intention to use digital technologies, such as videconferencing (which is a part of telehealth). Furthermore, it is relevant to explore how older people address technology in their daily life. Several studies with regard to older people's acceptance of technology (e.g., de Veer et al., 2015; Heerink, Kröse, Wielinga, & Evers, 2008; Nayak, Priest, & White, 2010; Pan & Jordan-Marsh, 2010) are built on the Technology Acceptance Model (TAM) (Venkatesh & Davis, 2000) and the modified version of this model, the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Thong, & Xu, 2012). The TAM (Venkatesh & Davis, 2000) and UTAUT (Venkatesh et al., 2012), however, provide neither a deep understanding of the relations and interactions between factors and nor insight into the capacities of community-dwelling older adults to use digital technology. This insight, however, is needed to understand older people's readiness to receive telehealth.

Purpose of the Study

This study aims to obtain a deeper understanding of community-dwelling older people's readiness to receive telehealth by studying older people's intention to use videoconferencing and capacities or incapacities to use digital technology in daily life as indicators. Since individual's intention to use technology can substantially differ from their actual behavior (Bhattacherjee & Sanford, 2009), both intention and actual use of technology are examined in this study. This knowledge could benefit health care professionals' abilities to assist older people in using technology and enable older people to benefit more from novel technology that supports them in aging in place. To achieve this, the following steps were taken and reported in this study: (1) literature review to build a theoretical framework of intention to use technology, (2) testing the framework, (3) collection of data on older people's capacities or incapacities to use digital technology, (4) synthesis of all results, and (5) conclusions and implications for older people's readiness to use telehealth.

Literature Review—Older People's Intention to Use Technology and Associated Factors

In 2017, a literature search was performed to build a theoretical framework of older people's intention to use technology and associated factors. Therefore, the search terms "older people," "technology," "intention," and "factors," as well as alternative terms, such as "seniors" and "associations," were used for a search in CINAHL, Google Scholar, PsycINFO, MEDLINE/PubMed, ScienceDirect, Scopus, and Web of Science. To scope the literature review, inclusion criteria were as follows: (1) target group with a median or mean age of 65 or older, (2) publication date less than 10 years ago, (3) peer-reviewed original research, (4) quantitative studies in which "intention to use technology" was tested as a dependent variable, and (5) studies written in English. The process and results of the literature search, in terms of search strings, number of hits, and number of selected studies, are shown in the Multimedia Appendix 1.

Theoretical Framework of Intention to Use Technology

Of the 249 studies that were found in September 2017, only 29 studies met the criteria. After duplicate studies were filtered out, 11 studies remained (Braun, 2013; Cajita, Hodgson, Budhathoki, & Han, 2017; de Veer et al., 2015; Hoque & Sorwar, 2017; Shah, Barnett, Kuljis, Hone, & Kaczmarski, 2013; Sintonen & Immonen, 2013; Tsai, 2014; Tsai, Wong, Hsu, & Tseng, 2013; Tsai, Chang, Chen, & Chang, 2017; Wang, Rau, & Salvendy, 2011; Wang & Sun, 2016)], and these 11 studies were used to build the theoretical framework on older people's intention to use technology (see Figure 1). On the basis of the 11 included studies, the theoretical framework shows six predictors of older people's intention to use technology: performance expectancy, effort expectancy, self-efficacy, subjective health status, perceived privacy and security, and frequency of Internet use. Table 2 shows how these predictors were operationalized in this study. All hypotheses with regard to older people's intention to use technology and the related sources of evidence are illustrated in Figure 1.

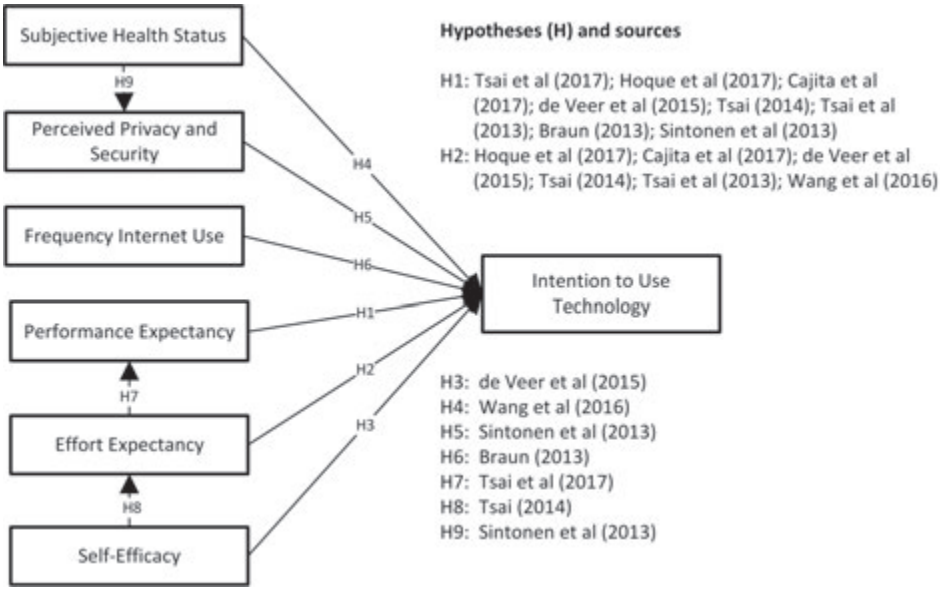

Figure 1. Theoretical framework. This framework displays the factors associated with older people's intention to use technology. Each hypothesis is based on prior research, as shown.

METHODS

Design

A mixed-method triangulation design (Greene, Caracelli, & Graham, 1989) was used, including a cross-sectional survey study (phase 1), generating quantitative data concerning older people's intention to use videoconferencing, and an observational study (phase 2), yielding qualitative data concerning their actual use, by observing their capacities in using technology in daily life. In phase 1, we focused on "videonferencing," a relatively new technology (in health care), that is often used in telehealth services. To observe a representative sample in phase 2, we focused in this phase on more traditional, commonly used technologies. If we adhered to videoconferencing, we could have observed only those older people who use videoconferencing, which might have introduced a selection bias. Both insights, intention to use and actual use of technology, are important to understand older people's readiness to receive telehealth.

Phase 1: Cross-Sectional Study on Older People's Intention to Use Videoconferencing

Setting and Participants

Participants were recruited in September 2012 for the cross-sectional study. Older people were invited to fill out a paper version of the survey through 2 patient advocacy organizations, 2 senior social clubs, 5 health care organizations, and a senior information day in Utrecht. Additionally, to reach a large group of potential participants, a Web-based panel of approximately 2000 clients was invited to fill out an online version of the survey.

Two inclusion criteria, (1) independently living at home and (2) being 65 years of age or older, were maintained. To estimate the required sample size, we followed the rule of thumb for multiple regression analysis, with the purpose of building a prediction framework: maintain a ratio of 10 positive cases in the dataset to 1 predictor variable in the full path analysis (Harrell, Lee, & Mark, 1996). Since the full path analysis contains 6 predictors, a sample with at least 60 positive cases was required. The dependent variable "intention to use" (measured on a 5-point scale, with 1=totally disagree, 2=disagree, 3=neutral, 4=agree, and 5=totally agree) was used to calculate the number of positive cases by labeling participants with a response from 1 to 3 as "non-cases" and participants with a response from 4 to 5 as "positive cases," resulting in 70 positive cases.

Cross-Sectional Survey

We collected data using a survey to test the hypotheses illustrated in the theoretical framework. The outcome measured was set as "intention to use videoconferencing," aligned with the ambitions of the Dutch ministry in which the use of videoconferencing is an important part of telehealth.

The survey included items covering the following topics: demographic questions (e.g., age, gender, and educational level); health-related questions (e.g., health status) based on Czaja et al. (2006b); technology experience in daily life (with, e.g., Internet, computer) based on Czaja et al. (2006a); and older people's perception of videoconferencing (e.g., performance expectancy, effort expectancy, and intention to use videoconferencing), based on Chang & Hsu (2012) and Gagnon et al. (2012).

All constructs regarding older people's perception of their health and perception of videoconferencing were measured with multiple statements.

The operationalization of these predictors is presented in Table 2 in the Results section. The survey items that were based on previously developed and used questionnaires were translated from English into Dutch and cross-translated. Subsequently, the content of the survey was discussed with experts in aging and technology who were selected from our network and pilot-tested among a representative group of older people to determine the readability and comprehensibility.

Statistical Analysis

Missing values were substituted using the 5-time multiple imputation method to reduce bias (Janssen et al., 2010). The results of the statistical analysis of each of the 5 imputed dataset were pooled using Rubin's rule (Rubin, 1996).

The internal consistency of the constructs (e.g., self-efficacy, performance expectancy) was assessed with Cronbach alpha, considering Cronbach alpha values between .70 and .95 to be "good" (Terwee et al., 2007). For our multilevel regression analysis, the variable "frequency of Internet use" was dichotomized, using a data-driven method to select an appropriate cut-off point. In the survey, participants were asked: "on average, how many hours per week do you use the Internet?," whereby, 0=not, 1=0 to 1 hours, 2=1 to 5 hours, 3=5 to 10 hours, 4≥10 hours. The cut-off point was set at 2, meaning 0=less than 5 hours a week and 1=5 or more hours per week.

All hypotheses, as illustrated in our theoretical framework (Figure 1), were tested using a path analysis approach (Duncan, 1966). In the full path analysis, 4 outcome variables, that were interconnected, were tested at once (see Figure 1): Outcome 1 "intention to use videoconferencing" predicted by (1) "performance expectancy," (2) "effort expectancy," (3) "self-efficacy," (4) "subjective health status," (5) "perceived privacy and security," and (6) "frequency of Internet use"; Outcome 2 "performance expectancy" predicted by "effort expectancy"; Outcome 3 "effort expectancy" predicted by "self-efficacy"; and Outcome 4 "perceived privacy and security" predicted by "perceived privacy and security." In this way, the effects of group-level predictors were deliberately confounded with the effects of the group variables, thus upholding the hierarchical structure. As such, the effects of both levels of variables could be estimated. All three outcome variables and accompanying predictors in the path

analysis were based on the literature mentioned in the introduction. A significance level of .05 was used to determine whether predictors had a significant association with the dependent variable.

Additionally, starting with the full path analysis (Figure 2), a backward selection procedure was performed; at each step, the variable with the highest P value was excluded first. Simultaneously, at each step, the goodness of fit of the framework was examined using the Akaike Information Criterion (AIC) (Akaike, 1974) to assess the performance of each model compared with the initial framework. Following this procedure, a final path analysis (Figure 3) was reached with only significant (significance level of .05) predictors and using the AIC as a threshold. In this final framework, the themes derived from the qualitative data were included.

We used the statistical package R (version 3.4.2; 2017-09-28; The R Foundation for Statistical Computing) for the path analysis. All other statistical analyses were performed using SPSS (IBM Corp Released 2016, IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM Corp).

Phase 2: Observations on Using Technology in Daily Life

Qualitative Approach and Research Paradigm

Given the relative lack of exploratory studies on community-dwelling older people's capacities or incapacities to use technology, we performed a conventional content analysis (Hsieh & Shannon, 2005) on the qualitative data obtained from observations of older people using digital technology at their home. Our approach was constructivist, using an interpretative phenomenological epistemology (Bunniss & Kelly, 2010) based on the notion that there is not one "truth" in regard to the phenomenon of technology use.

The observations were executed by the third author and by third-year bachelor's degree-level students with backgrounds in nursing, health care management and Cesar exercise therapy. Before their observations, these students received training from our research team on how to perform observations. None of the observers were known to the participants before the observations being performed. All observations were discussed by our multidisciplinary research team. As members of the research team, the first author of this paper (CvH) has a background in nursing, sociology,

and nursing education; the second author (RE), in nursing, nursing science, and epidemiology; the third author (MA), in human movement science and nursing education; and the fourth author, in medical biology, built environment, and gerontechnology (HK).

Context, Setting and Sampling

In 2012, between September and December, we conducted the study among community-dwelling older people (65 years of age or older). The sampling started in phase 1, along with the survey, and participants were informed about the opportunity to also volunteer in phase 2 (the observations). When the participants were willing to participate in phase 2, they filled out a form with contact details, which they returned to the research team together with their completed survey. For phase 2, the same inclusion criteria were held as in phase 1: (1) independently living at home and (2) being 65 years of age or older. However, we also selected based on both "experience with a computer" and "experience without a computer," with the aim of being able to observe participants with and without computer experience. After 15 cases were observed, theoretical saturation was reached; sufficient data were collected to understand the concepts of our study.

Data Collection and Processing

To facilitate consistency over different sets of observations, a list of day-to-day technological tasks was composed before the data collection. The tasks were developed by the third and last authors during a 2-day workshop with our American research partners (details described under "Acknowledgments"), which resulted in the following 8 categories: (1) computer basics (e.g., "create a new folder on your desktop"), (2) email (e.g., "send an email with an attachment"), (3) use of the Internet (e.g., "show a map of your town"), (4) television (e.g., "change the volume of your TV"), (5) mobile phone (e.g., "show how to save a contact in your contact list"), (6) household (e.g., "make popcorn in a microwave"), (7) health (e.g., "show how to use a digital scale"), and (8) videoconferencing (e.g., "show how to start videoconferencing with your nurse"). Without a specific time constraint, the observant followed this list of tasks and encouraged the older adult to accomplish the task independently. The older people could ask for a hint when they could not proceed with the task. The observant encouraged the older people to think aloud during the performance of their technological tasks. During the direct observations, notes were made using

a form with space for notes for each of the tasks and blank space for other possible remarkable occurrences. These notes were used during the iterative analysis process.

All observations were audio-recorded and lasted 1 hour on average. The audio-recordings were transcribed and anonymized. All transcripts were stored, coded, and analyzed in MAXQDA (software for qualitative data analysis, 1995-2016, VERBI Software—Consult—Sozialforschung GmbH, Version 12.2.1, Berlin, Germany).

Data Analysis

Data analysis followed the steps for conventional content analysis as outlined by Hsieh and Shannon (2005), a method to describe a phenomenon—in this case, the daily use of digital technology by older people. Through an iterative process of coding, by discussing findings in the light of the literature, the research team identified and described the most prevalent themes with regard to older people's day-to-day use of technology. The concepts derived from our theoretical framework in (Figure 1) were used as "sensitizing concepts," defined as "interpretive devices and as a starting point for qualitative research" (Bowen, 2006, p. 14). In addition to the concepts derived from Figure 1, the contextual factors in the use of technology, as described by McFarland and Hamilton (2006), were also used as a starting point for analysis (e.g., task structure, prior experience, other's use).

Although these 2 frameworks were used, we conducted an open, inductive analysis, starting with open coding. To enhance trustworthiness, CvH and MA coded the verbatim transcripts independently, with a focus on the sensitizing concepts and the main question: "How do older people struggle with digital technology use and what supports them?" The first round of coding by two of the authors (CvH and MA) resulted in 1022 coded text segments. Then, these open codes were discussed among all authors to organize and group the codes into meaningful clusters. After this discussion, 157 text segments were considered irrelevant. The remaining 881 text segments and related codes were clustered and categorized. We searched for themes that occurred in each observation with all participants. Eventually, we achieved consensus on the primary themes observed in the data.

In the last phase, definitions for each theme were developed and provided with illustrative examples or quotations from the data. Quotations in this study were translated from Dutch into English. During the whole analysis, we kept in mind that

we were looking for information that could eventually benefit nurses' in assisting older people to use technology in health care. To illustrate the qualitative results, the themes and subthemes were drawn in Figure 3.

Ethical Approval

This research was conducted following Dutch human subject regulations. Since the Dutch Medical Research Involving Human Subjects act did not apply to either phase 1 or phase 2 of this study, no official ethical approval was required. Nevertheless, all necessary precautions were taken to protect the anonymity and confidentiality of our participants. The Dutch Medical Research Involving Human Subjects act applies to medical research "if there is an infringement of the physical and/or psychological integrity of the subject" (Central Committee on Research Involving Human Subjects, 2016).

Cliëntenbelang Utrecht (an organization that defends the interest of health care clients) approved the study and provided access to the client panel. All participants were informed with a letter containing information about the purpose of the study. Participants were informed that their participation was voluntary, that they were free to decline or discontinue their participation at any time and that their responses were processed anonymously and only used for research purposes. No person identifying information was collected.

RESULTS

Phase 1: Cross-Sectional Study on Older People's Intention to Use Videoconferencing

Characteristics of Study Population

In total, 288 older people filled out the questionnaire on paper or online. Of these individuals, 22 were excluded since they were younger than 65 years of age. Of the 256 cases left, 50.0% (128/256) were male and 50.0% (128/256) were female, with a median of 71 years (Q1-Q3 67-76). A minority (13.7%, 35/256) of participants had experience with videoconferencing, of whom approximately half had less than 1 year of experience, while the other half had more than 1 year. The majority (71.1%, 182/256) completed an average or high level of education. Of the 256 cases,

21.1% (54/256) missed one or more questions that were used for this study. Their missing values were substituted using the 5-time multiple imputation method. All demographic details of the participating older people are listed in Table 1.

Table 1. Demographic Characteristics of Participating Older People (*N* = 256; Paper Participants [*n* = 70] and Online Participants [*n* = 186]).

Characteristics		n (%)
Gender		
	Male	128 (50.0)
	Female	128 (50.0)
Age by category (in years)		
	65-74	182 (71.1)
	75-84	67 (26.2)
	>85	7 (2.7)
Median age=71 (Q1-Q3=67-76)		N/A[a]
Experience with the use of video conferencing		
	Yes	35 (13.7)
	No	221 (86.3)
Highest completed educational level		
	Lowest (primary education)	10 (3.9)
	Low (lower secondary education)	57 (22.3)
	Average (general or vocational upper secondary education)	70 (27.3)
	High (postsecondary nontertiary education)	119 (46.5)

[a]N/A: not applicable.

Descriptive Results and Consistency of the Research Constructs

The internal consistency of the six constructs was "good," with a Cronbach's alpha of 0.70 (Terwee et al., 2007). All grouped items and accompanying median scores, 1st and 3rd quartile ranges, and Cronbach alphas are presented in Table 2.

Results of the Path Analysis

Using a significance level of .05, the multilevel path analysis revealed that 5 of the 9 hypotheses regarding older people's perception of videoconferencing were supported. On level 1, older people's intention to use videoconferencing was significantly predicted by their performance expectancy (odds ratio, OR, 1.26, 95% CI 1.13-1.39), effort expectancy (OR 1.23, 95% CI 1.07-1.39), and perceived privacy and security (OR 1.30, 95% CI 1.17-1.43). In our sample, self-efficacy (OR 1.09, 95% CI 0.94-1.23), subjective health status (OR 0.90, 95% CI 0.79-1.01), and frequency of Internet use (OR 1.03, 95% CI 1.42-1.68) were not significantly associated with older people's intention to use videoconferencing.

On level 2, older people's performance expectancy was predicted by their effort expectancy (OR 1.38, 95% CI 1.24-1.52). On level 3, their effort expectancy was predicted by their self-efficacy (OR 1.55, 95% CI 1.42-1.68). Our last hypothesis, on level 4, was not supported: older people's perceived privacy and security was nonsignificantly predicted by their subjective health status (OR 1.05, 95% CI 0.95-1.16). The complete path analysis and unstandardized regression coefficients, from which the ORs were derived, are illustrated in Figure 2, with intention to use videoconferencing as the main outcome variable.

Table 2. Constructs of the Path Analysis: Internal Consistency and Median Scores.

Construct and related items	Cronbach alphas[a]	Median (1st quartile – 3rd quartile)
Subjective Health Status (predictor variable)	**.87**	3.0 (2.3 – 3.3)
1. In general, I would say my health is[b]		3.0 (2.0 – 3.0)
2. Compared to other people of my age, I would say my health is[c]		3.0 (2.0 – 3.0)
3. How satisfied are you with your present health?[c]		4.0 (3.0 – 4.0)
Performance Expectancy (predictor and outcome variable)	**.72**	3.3 (3.0 – 4.0)
1. By using videoconferencing, I can live longer in my own home independently[d]		4.0 (3.0 – 4.0)
2. The use of videoconferencing will give me more freedom[d]		3.0 (3.0 – 4.0)
3. The use of videoconferencing will enhance my self-reliance[d]		3.0 (3.0 – 4.0)
Effort Expectancy (predictor and outcome variable)	**.85**	3.8 (3.0 – 4.0)
1. I think videoconferencing will be clear and easy to use[d]		4.0 (3.0 – 4.0)
2. Videoconferencing will be easy to operate and use[d]		4.0 (3.0 – 4.0)
3. Videoconferencing will be easy to learn[d]		4.0 (3.0 – 4.0)
4. Videoconferencing will have a clear guide for operation[d]		4.0 (3.0 – 4.0)
Self-Efficacy (predictor variable)	**.77**	4.0 (3.4 – 4.2)
1. I am confident enough to use videoconferencing[d]		4.0 (3.0 – 4.0)
2. Given an appropriate training, I will have the ability to use videoconferencing[d]		4.0 (3.0 – 4.0)
3. I possess the necessary skills to learn how to use videoconferencing[d]		4.0 (3.0 – 4.0)
4. I am afraid I will not learn how to use videoconferencing[e]		4.0 (4.0 – 5.0)
5. I think I will find it hard to acquire the necessary skills to use videoconferencing[e]		4.0 (3.0 – 5.0)
Perceived privacy and security (predictor and outcome variable)	**.79**	3.3 (2.8 – 3.7)
1. My feeling of security is higher with the use of videoconferencing[d]		3.0 (3.0 – 4.0)
2. With the use of videoconferencing my feeling of security will be higher[d]		3.0 (3.0 – 4.0)
3. The possibility of immediate contact with a health care professional will give me a safe feeling[d]		4.0 (3.0 – 4.0)
4. The use of videoconferencing is confidential[d]		3.6 (3.0 – 4.0)
5. I will have no problems with the idea that videoconferencing consultations are saved[d]		3.0 (2.0 – 4.0)
6. The use of videoconferencing will not influence my feeling of privacy[d]		3.0 (2.4 – 4.0)
Frequency of internet use[f] (predictor variable)	N/A[g]	N/A

Construct and related items	Cronbach alphas[a]	Median (1st quartile – 3rd quartile)
Intention to Use Videoconferencing (outcome variable)	**α = .76**	3.5 (2.8 – 4.0)
1. I am willing to use videoconferencing to complement my traditional care[d]		3.0 (2.4 – 4.0
2. I have the intention to use videoconferencing routinely to receive care[d]		3.0 (2.0 – 4.0)
3. I intend to use videoconferencing when this is necessary to receive care[d]		4.0 (3.0 – 4.0)
4. After an appropriate training, I am willing to use videoconferencing[d]		4.0 (3.0 – 4.0)

[a]Cronbach alpha between 0.70 and 0.95 is "good" (Terwee et al., 2007)
[b]Likert-scale ranging from 1 = "poor" to 5 = "excellent"
[c]Likert-scale ranging from 1 = "not satisfied at all" to 5 = "very satisfied"
[d]Likert-scale ranging from 1 = "totally disagree" to 5 = "totally agree"
[e]Likert-scale ranging from 1 = "totally agree" to 5 = "totally disagree"
[f]Participants were asked: "on average, how many hours per week do you the Internet?" 0: not, 1: 0-1 hours, 2: 1-5, 3: 5-10 hours, 4: >10 hours. For the path analysis, this variable was dichotomized, using a data driven method to select an appropriate cut-off point. The cut-off point was set at 2, meaning 0=less than 5 hours a week and 1=5 or more hours per week.
[g]N/A: not applicable

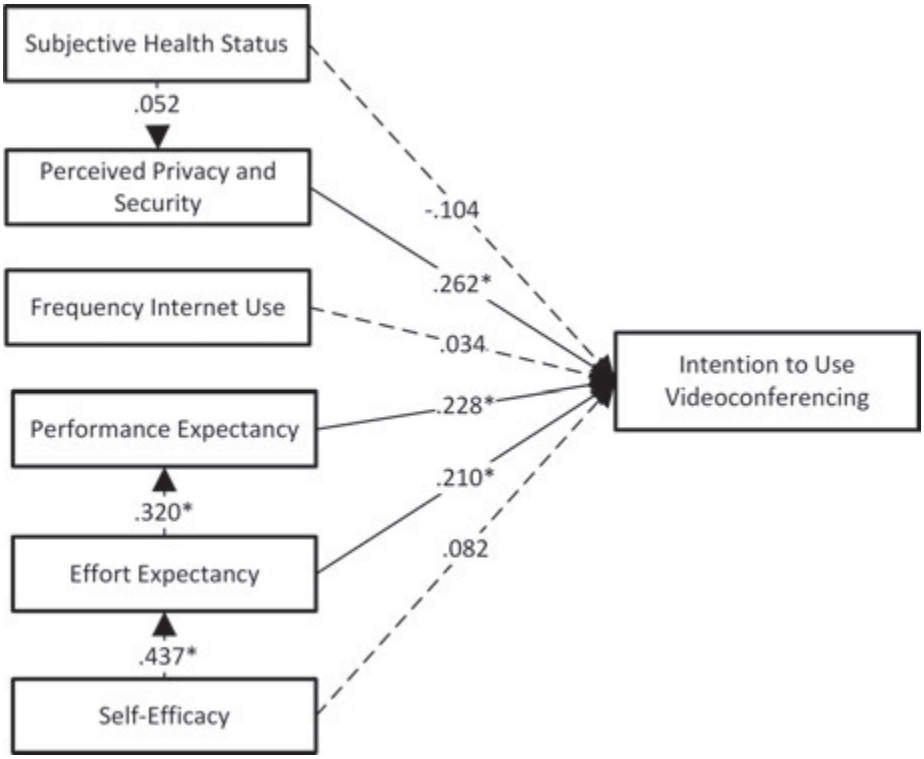

Figure 2. Older people's (*N* = 256) intention to use videoconferencing and associated factors. Unstandardized regression coefficients are shown, derived from the path analysis. Estimates were pooled from the results of the analysis of 5 imputed datasets using Rubin's rules. *Significant association, using a significance level of .05 (dotted line indicates nonsignificance).

Phase 2: Observations on Using Technology in Daily Life

Characteristics of Observed Older People

Of the survey population of 256 older people, 16 older people volunteered to take part in phase 2 of the study: with observations conducted at their homes while they executed technological tasks. The quality of one of the audio recordings was too poor to be able to create a verbatim transcription, leaving 15 observations suitable for qualitative analysis.

Among the observed older people were 6 men and 9 women. Their age ranged from 65 to 87 years (mean=73.21, SD=6.59, 1 missing value). Of the participants, 7 had low levels of education (lower secondary education), 2 received average-level education (general or vocational upper-secondary education), and 4 completed high-

level education (bachelor's degree or higher, 2 values missing). Approximately half of the participants did not have a computer (n =7), while the other half did use a computer (n =8).

Understanding Older People's Capacities to Use Technology

In all, 5 primary themes were identified that could help us understand older people's capacities and incapacities in using digital technology (ordered by frequency of occurrence): (1) "self-efficacy and digital literacy," (2) "obstacles to using technology," (3) "prior experience and frequency of use," (4) "sources of support and facilitating conditions," and (5) "performance expectancy." These 5 themes were observed among all 15 participating older people and included 865 of the 1022 coded text segments. Within these 5 primary themes, several subthemes were identified, which are described below and illustrated with exemplary quotations.

Theme 1: Self-Efficacy and Digital Literacy

In phase 2, "self-efficacy and digital literacy" was the most prevalent theme that appeared to play a role in the day-to-day use of technology by the older people we observed. "Self-efficacy" refers to an individual's belief in his or her ability to accomplish a certain task in a specific situation (Bandura, 1994). We observed many situations in which older people expressed low self-efficacy regarding technology use, but approximately the same number of situations occurred in which high self-efficacy was expressed. The following conversations between a man and his wife illustrate the low self-efficacy of the man and obstacles he experienced with his computer. The conversation between the man and his wife started after the participant (man) was asked to open his email, and to be able to use his email, the participants had to turn on his computer first:

> *Man: [With e-mails] I do nothing. I'm a "digital illiterate." [To his wife:] You always have a note attached, don't you? It's not there, so I know nothing.*
> *Wife: Can you turn it on, or not?*
> *Man: I don't know, something with green, whether it's the right or left button. Was it something green?*
> *Wife: Just try it.*
> *Man: Nothing happens.*
> *Wife: You have to push it longer. Do you hold it the other way around?*
> *Man: Nothing happens at all.*

Wife: You do have to hold it longer, the red button.
Man: There is nothing red at all.
Wife: No, it isn't red yet, you have to hold it longer. [Participant 2, male, 81 years]

The theme of self-efficacy occurred in a variety of ways during the observations; older people believed that they were not able to accomplish certain technological tasks (low self-efficacy), but discovered that they actually were able to do so or could do so after a small suggestion on how to proceed. Further, we observed older people who could explain very clearly how an application or device worked and were proud that they possessed the right skills, for example:

I think it's already good that I am able to open my e-mail and send e-mails back. [Participant 9, female, 72 years]

Another recurrent observation was older people who kept very strictly to the things that they had learned and stayed away from abilities outside of their knowledge. For example, one participant said the following about his email application:

I never look over there, I just do everything I have learned. [Participant 2, male, 81 years]

The same participant added:

Outside of that [email application], I become nervous. [Participant 2, male, 81 years]

"Digital literacy" refers to "a large variety of complex cognitive, motor, sociological, and emotional skills, which users need in order to function effectively in digital environments" (Eshet-Alkalai, 2004, p. 93). During the observations, while older people were executing technological tasks, almost all participants experienced their limited digital literacy. This limited "digital literacy" impacted their technology use in several ways: (1) the functionality of a device was only partially used since participants did not understand how to use several functions or how to use the required buttons and (2) when a new device was bought, everything had to be learned from the start, as exemplified by one of the participants:

> *But I notice that I'm not so good at electrical devices, so this [task] has to go very slow. [...] Yes, I remember, I was in the store and I touched it but I did not know how it worked anyway. I actually felt like a "dummy." And I was reluctant, but he [salesman] explained me how to put that thing on/off. He said, "try to do it." And there are also things that I could execute at that moment, but not anymore [once at home]. And then I have to ask again how it works.* [Participant 9, female, 72 years]

Task Structure. Within the theme of self-efficacy and digital literacy, two subthemes were identified: "task structure" and "effort expectancy." Regarding the task structure, which is referred to in the literature as the extent to which a task is nonroutine and varied (McFarland & Hamilton, 2006), we observed several older people who used the functionality of a device only partially and, as a result, did not benefit from all the possibilities the device offered. One male participant, for example, stated that he only reads emails but never responds:

> *In the past, I've had to type sometimes, but that's way too difficult, so I only read e-mails. As long as I have her [his wife], she does that.* [Participant 2, male, 66 years]

Another participant explained that she only uses her cell phone in specific situations:

> *I only use it [cell phone] when I visit my son. When I sit in the train, I call my son and ask him to pick me up. But besides that, I never take my phone outside.* [Participant 13, female, 70 years]

Effort Expectancy. We also gained insight into the role of "effort expectancy," defined in the literature as "the degree of ease associated with consumers' use of technology" (Venkatesh et al., 2012, p. 159). Several participants were complaining about the nonease of use of the technologies they used while executing the technological tasks. One woman, for example, talked about the difficulty of saving a number in the contact list of her cell phone:

> *[in order to save a contact] I have to search a lot, but I will get it done. Please wait, this is very illogical [...]. Very illogical. I hope future devices are smarter.* [Participant 11, female, 76 years]

Another example of how effort expectancy plays a role in the use of technology came from a participant who prepared himself for executing a task with his cell phone. Seemingly easy functions can already be difficult:

> *I first have to turn it [cell phone] on. That's always a bit tricky. Especially my wife has difficulties finding that on button.* [Participant 7, male, 74 years]

Theme 2: Hurdles to Using Technology

Obstacles. Older people experience all kinds of obstacles to using technology, also referred to in the literature as "barriers" (e.g., Gatto & Tak, 2008; Gitlow, 2014), which are elements that hamper their use of technology. We observed obstacles in diverse categories. At first, technical obstacles presented themselves, for example, the disruption of Internet service, a broken button, a slow-running computer, or a stuttering connection while videoconferencing. Furthermore, we observed obstacles in the category "limited digital literacy," for example, unable to find the cursor (of the mouse), getting confused after updates, or not knowing how to use the Internet. The third category included more personal use-related barriers, for example, prefers to read the news in the newspaper instead of on an iPad, forgets his or her password very often, or having resistance toward social media, as expressed by one participant:

> *Wearing a personal alarm around my neck is fine with me, but [...] Facebook and whatever else there is, is another reality beyond my sensory reality.* [Participant 11, female, 76 years]

Anxiety. Additionally, in 12 cases, the subtheme "anxiety" was identified as an obstacle to using technology. McFarland and Hamilton (2006) use a slightly different term, namely "computer anxiety," which they describe as "an individual's uneasiness or apprehension toward computers." During our observations, a variety of anxiety-inducing sources arose related to the use of technology, including (1) receiving spam, (2) experiencing system updates, (3) losing written text, (4) damaging a device, (5) fearing the use of technology in general, (6) fearing microwave radiation, (7) fearing inadequate privacy protection, (7) feeling unsafe using the Internet, and (8) fearing online scams or cyber criminals. Regarding the last 2 obstacles mentioned, one participant expressed her fear of online banking:

> *One hears so much…things that can go wrong with online banking. I dedicated myself to, if possible, only do online banking when one of my two children is with me.* [Participant 9, female, 72 years]

All anxiety sources mentioned above hampered the participants' use of technology.

Theme 3: Prior Experience and Frequency of Use

While executing technological tasks, the theme of prior experience and frequency of use was exhibited by all participants. We observed people with much experience and little experience, as well as participants who told to have a device but reported never using it (e.g., did not use their cell phone since they already had their landline telephone).

The capacities and incapacities regarding technology use seemed to be associated with older people's experience in the past and/or their frequency in use. Some participants said they were glad that they learned to work with computers during their working career. Others did not and had to learn everything from the start. Their limited experience hampered their capacity to accomplish technological tasks:

> *I really don't know how it works, I just have it [computer].* [Participant 14, female, 68 years]

In several cases, participants had forgotten how to accomplish a specific task since they reported only doing it once or twice in the past.

In contrast, more prior experience was clearly supportive:

> *This isn't really complicated, since I already have been working with that computer for 2 years now.* [Participant 6, male, 86 years]

According to the participants in this study, capacity in using technology is a matter of experience and practice.

Theme 4: Sources of Support and Facilitating Conditions

Facilitating Conditions. When participants had to overcome obstacles to technology use, they reached out to various sources of support. These sources of support are part

of the "facilitating conditions," defined as "consumers' perceptions of the resources and support available to perform a behavior" (Venkatesh et al., 2012, p. 159). A variety of sources of support came up, such as following a computer course via SeniorWeb, a very important Dutch forum according to one of the participants:

> *SeniorWeb is really important, but I wonder if people take that step. [...] For me, it's amazing to see that, myself included, my family, brothers and sisters encounter the same [obstacles].* [Participant 8, male, 65 years]

Further sources of support that were mentioned by our participants were manuals, helpdesks, installers, and persons, often including partners, friends, children, and grandchildren.

Significant Role of Children. Children and grandchildren play a significant and diverse role in the use of technology by older people; they appeared to function as a motive or incentive to start using technology, for example, since technology offers the ability to communicate more easily (and over distance). Subsequently, children help their parents in purchasing, installing, and using technology. The active support of children solves issues in the use of technology on the one hand while on the other hand, it might cause older people to maintain their lack of technology skills. When they struggle with technology, some older people wait for their children to solve it:

> *I'm not good at saving a number. My grandchildren always come to do that.* [Participant 14, female, 68 years]

Another example came from a woman who was asked to send an email to multiple persons:

> *My children once said, "just put all those names here" but I don't have a clue of the meaning of all this.* [Participant 13, female, 70 years]

Theme 5: Performance Expectancy

"Performance expectancy," a well-known construct in technology-acceptance theories, refers to "the degree to which using a technology will provide benefits to consumers in performing certain activities" (Venkatesh et al., 2012, p. 159). Our participants mentioned benefits in various categories: (1) leisure, for example,

playing games, reading books, and using street view; (2) increasing communication possibilities, for example, (also mentioned earlier) with family or nurses; and (3) aging in place, as illustrated by the following statement:

> *I'm already thinking of what do I need to have? What do I have to do, so in about 10 years...what do I need in order to be able to live at home as long as possible?* [Participant 8, male, 65 years]

Task-Technology Fit. Within the performance expectancy theme, a recurrent statement was that the technology must fulfill a need. This idea is close to the construct of "task-technology fit," which refers to the assumption that "performance impacts will result from task-technology fit—that is, when a technology provides features and support that 'fit' the requirements of a task" (Goodhue & Thompson, 1995, p. 214). Sometimes an event occurred in the lives of our participants that caused a certain technology to suddenly fit their needs, as illustrated in the following statement:

> *This tablet...I bought it because I like to read. And now, my eyes have become so bad that I can't read books anymore [from paper].* [Participant 9, female, 72 years]

The same participant explained her motivation to purchase a computer:

> *I had to do financial matters, and at that moment, I took a computer.*

DISCUSSION

Principal Findings

In this study, 7 significant associations regarding older people's perception of videoconferencing were found. Older people's (1) intention to use videoconferencing was predicted by their performance expectancy, effort expectancy, and perceived privacy or security; (2) their performance expectancy was predicted by their effort expectancy; and (3) their effort expectancy was predicted by their self-efficacy. In other words, whether older people intend to use videoconferencing depends on their expectations of the usefulness of this application, their expectations of how easy it is

to use videoconferencing, and their confidence whether their privacy and security is protected when using videoconferencing.

Self-efficacy did not appear to be a significant predictor of older people's intention to use videoconferencing. However, the multilevel regression analysis made it possible to identify multiple associations within the path analysis and showed us that self-efficacy significantly impacts older people's effort expectancy of technology, which in turn impacts older people's intention to use videoconferencing. Since self-efficacy and effort expectancy can be quite comparable (Venkatesh & Davis, 1996), we executed as a kind of sensitivity analysis the path analysis without effort expectancy, which showed a significant association between self-efficacy and intention to use technology.

Self-efficacy and digital literacy was also identified as the most prevalent theme during the observations in phase 2. Four additional themes were identified that could help us understand older people's readiness to receive telehealth: "obstacles to using technology," "prior experience and frequency in use," "sources of support and facilitating conditions," and "performance expectancy."

Two of the themes, self-efficacy and performance expectancy, were also part of our theoretical framework and path analysis on intention to use technology. Additionally, the construct effort expectancy was observed within the theme "self-efficacy and digital literacy." The qualitative results indicate that older people's use of technology is associated with the themes we found. It is interesting to test in future research whether these themes (e.g., facilitating conditions, prior experience, task structure) are also associated with older people's intention to use. In our path analysis, frequency of Internet use did not appear to be a significant predictor of intention to use, but perhaps (prior) experience with other types of technology does have a significant association with older people's intention to use. Figure 3 summarizes the findings of both the constructs of the path analysis (phase 1) and the themes and subthemes derived from the observations (phase 2).

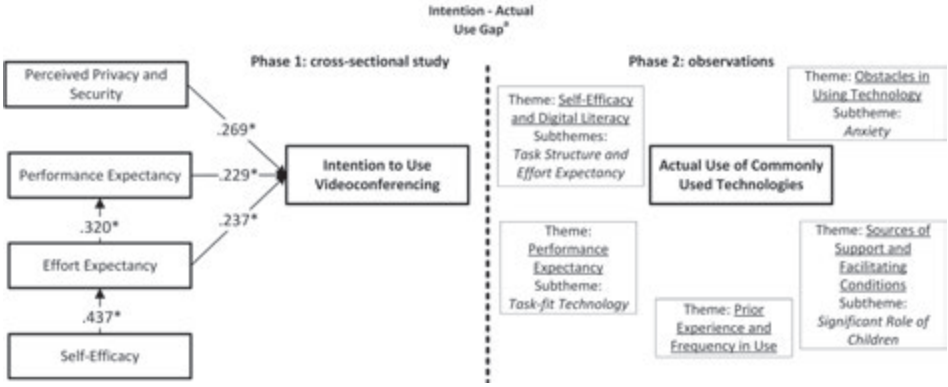

Figure 3. Understanding older people's intention to and actual use of technology. A mixed-method framework of a multilevel regression path analysis (*N* = 256) and qualitative observations (*N* = 15). *Significant (alpha .05) associations; unstandardized regression coefficients are shown. The letter "a" denotes that this "Internet—actual use gap" was based on prior research..

Integration with Prior Research

Figure 3 illustrates how the themes found in phase 2 are related with the subthemes. On the basis of prior research, one can argue that there are more interactions within this framework to explore. Sponselee (2013), for example, describes that family support positively impacts users' frequency of use. Subsequently, the frequency of use might positively impact older people's self-efficacy since performance accomplishments and successes that raise mastery expectations are seen as the strongest methods of increasing self-efficacy (Bandura, 1977). Another association that might be useful to explore in further research is that between facilitating conditions and obstacles. During observations, we learned that when participants had to overcome obstacles to technology use, they reached out to various sources of support, which differed from person to person depending on the level of the individuals' facilitating conditions.

Additionally, older people's motivation to start using or purchase technology can substantially differ, illustrated by one of our participant who explained her motivation to purchase a computer: "I had to do financial matters, and at that moment, I took a computer." This finding is in line with Peek (2017) who concludes that improving older people's acceptance of technology requires, among other things, an understanding of the specific needs and circumstances of the targeted individual. Peek (2017) also emphasizes that the acceptance of technology by older people is a dynamic process; specific events that occur in an individual's life can trigger the need of using technology.

Regarding the predictors we found, effort expectancy and performance expectancy were already known from the TAM (Venkatesh & Davis, 2000) and UTAUT (Venkatesh et al., 2012), as well as observed in other health care related studies (e.g., de Veer et al., 2015; Tsai, 2014) and from health care providers (van Houwelingen et al., 2015). What this study adds to the TAM (Venkatesh & Davis, 2000) and UTAUT (Venkatesh et al., 2012) is that older people's intention to use videoconferencing also can be predicted by their perceived privacy or security. Furthermore, the multilevel regression shows that effort expectancy was predicted by self-efficacy, and performance expectancy was predicted by effort expectancy. Our findings concur with those from other research studies (Berge, 2016) that emphasized the shortcomings of the common TAMs with regard to obtaining a deep understanding of older people's readiness for using technology. By using a mixed-method design, this study shows (in phase 2) how some of the constructs of the path analysis regarding older people's intention to use videoconferencing (i.e., performance expectancy, effort expectancy, and self-efficacy) also play a role in the day-to-day situation of older people when they are using technology.

Contrary to the findings of prior research (Bürmann genannt Siggemann, Mensing, Classen, Hornberg, & Terschüren, 2013; Chen & Chan, 2014; Peek et al., 2014), "subjective health status" in our study was not found to be a relevant theme for older people's technology use, neither in their intention to use videoconferencing, as shown in Figure 2, nor during the observations. Moreover, the performance of the path analysis model enhanced considerably (on the basis of the AIC) after we excluded subjective health status in Figure 2. Zimmer and Chappell (1999) drew a comparable conclusion. In their study, older people's self-assessed health was not significantly associated with their receptivity to new technology. Thus, caution is required when linking older people's subjective health status to their intention to use technology.

Within the theme "sources of support and facilitating conditions," the significant role of family members was identified. This observation is aligned with the prior research of Luijkx, Peek and Wouters (2015). In this interview-study, Luijkx and colleagues emphasized the importance of including family members when implementing technology into the lives of older people and described that especially grandchildren can positively influence the acceptance of technology. Peek and colleagues (Peek et al., 2014) added that older people sometimes are afraid to burden their children

with technology-related questions. This could also have played a part in one of our observations, in which an older person told us: "My children once said, 'just put all those names here' but I don't have a clue of the meaning of all this." When it comes to the role of family members, we observed an ambivalent mechanism; in accordance to prior research, family members can generate enthusiasm for using technology among older people, but at the same time, family members can also hamper the digital literacy of older people by taking over their technological tasks, which foregoes the opportunity for older people to become more skilled with using the technology.

Study Limitations and Strengths

Our sampling strategy might have been a study limitation. Since the total number of potential respondents was not known, we could not measure a response rate and may have thus missed this indicator of representativeness. Only for those respondents who were recruited via the e-panel (n =186) we could, resulting in a response rate 9.30% (186/2000), which is low (Fincham, 2008). In the Netherlands, only 5% of the community-dwelling older people uses videoconferencing, according to a poll in 2016 (Krijgsman et al., 2016). Perhaps, the lack of experience of the remaining 95% of the population hampered their enthusiasm to participate in the survey about videoconferencing.

The online respondents of our study represent the largest part of our sample (72.3%). As a result, our sample was biased by a higher percentage of Internet users compared with the general Dutch population of older people, in which 74% of the 65- to 75-year-old population and 34% of the population over 75 years of age occasionally used the Internet in 2012 (Centraal Bureau voor de Statistiek., 2013). In our sample, about 94% of the 65- to 75-year-old population and 89% of the population over 75 years of age had experience with using the Internet (at least) occasionally. Additionally, 46.5% of our sample completed higher education, which does not reflect the percentage of highly educated older people in Dutch society, namely 17% in 2012 (Centraal Bureau voor de Statistiek., 2017). We do not know whether the interactions we found in phase 1 would have also been found if the distribution of our sample was less skewed toward highly educated older people with a relatively high amount of technology experience. The sample skewness, however, only applies to phase 1. To observe both older people who possibly already had more digital skills or technology experience and those who did not, in phase 2, we carefully selected our participants,

resulting in a sample in which approximately half of the participants did not use a computer ($n = 7$) and the other half did use a computer ($n = 8$).

We believe that our study strength lies in the triangulation of two methods, which helped us to gain a deep understanding of the often-used constructs in technology-acceptance models. Moreover, we noted the added value of the observation method (instead of interviews) to gain an understanding of technology use. With 9 of the 15 participants, a situation occurred in which they misjudged their digital skills; they overestimated or underestimated their skills, and as a result, they could or could not complete a technology task in contrast to their prior expectations. Our method of observations was not hindered by this form of recall bias, whereas it might have spoiled our results if we had chosen a different method, such as interviews.

Implications for Practice, Education and Future Research

Education or Training

Older people's intention to use technology is directly predicted by their effort expectancy, performance expectancy, and perceived privacy or security. Furthermore, self-efficacy and digital literacy appeared to play an important role in the day-to-day use of technology by older people and increase their effort expectancy. Therefore, we recommend addressing these concepts in technology training for older people to be given by nurses or other educators. We believe that in starting with increasing older people's self-efficacy, their effort expectancy and intention to use will follow. In the literature, performance accomplishments, which are successes that raise mastery expectations, are seen as the strongest method of increasing self-efficacy (Bandura, 1977). As mentioned, during our observations, several participants discovered their ability to accomplish a technological task contrary to their prior expectations. In training, similar practices could be organized with the aim of giving older people the opportunity to achieve performance accomplishments. This practice will be the strongest intervention to raise their self-efficacy and as a result their intention and capacity to use technology.

The second strongest source of self-efficacy is vicarious experience, namely, seeing others accomplish difficult situations (Bandura, 1977). During training, older people's self-efficacy will most likely increase as technological tasks are repeatedly shown to be achievable by a variety of models. Although this modeling strategy is

less effective than personal accomplishment, it may be suited for training purposes by letting participants observe each other executing technological tasks.
A final thought for supporting older people in technology use comes from our observation that some of our participants kept very strictly to the skills that they had learned and became nervous about trying anything outside of their skill set. One can argue about the most appropriate way of learning: (1) providing very specific concrete instructions focused on specific applications or devices or (2) starting from more general technological competencies that could perhaps be applied to a variety of situations, applications, or devices. Hickman, Rogers and Fisk (2007) show that, if the goal is to support learning, "guided attention training" works better for older people than "guided action training," in which participants are told exactly what to do at every step. More research, similar to Hickman, Rogers and Fisk (2007), is needed to learn more about what approach may work best.

Above, we take the perspective that barriers to technology use are a result of a lack of self-efficacy among the end users, in this study of older people. However, the lack of self-efficacy can also be the result of an inappropriate design of the technology. Tsai and colleagues (2015) showed that when a new technology is easy to use, a lack of self-efficacy was not a strong barrier for older people to use this technology. So, besides developing adequate training programs for older people, it is useful to think of designing appropriate technology that is easy to use.

Future Research

To test the suggestions above, more research with regard to older people's technology use is required. Our overarching aim was to place older people in a better position to benefit from new ways of health care provision. In this study, we gained a deep understanding of older people's day-to-day use of technology, which can be used as a basis for training development. Research into older people's beliefs regarding their capacities in using health care technology using a pretest-posttest setup, before and after a training, might be a logical next step in research.

CONCLUSIONS

This study shows that older people's intention to use videoconferencing is directly predicted by their performance expectancy, effort expectancy, and perceived privacy or security. Additionally, self-efficacy significantly impacts older people's effort expectancy, which subsequently impacts older people's performance expectancy of videoconferencing. In the day-to-day situation, older people experience all kinds of obstacles when using digital technology. Self-efficacy and digital literacy appeared to be the most important theme that plays a role in their technology use and overcoming barriers. Overcoming barriers to technology use is necessary to be able to make use of the new ways of receiving health care involving digital technology.

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APPENDIX 1. LITERATURE REVIEW, SEARCH TERMS AND HITS

Source	Search terms	Hits	Selected for use
PubMed	((older adults[title/abstract] OR older people[title/abstract] OR seniors[title/abstract] OR elderly[title/abstract]) AND (technology[title/abstract])) AND intention[title/abstract]) AND (factors [title/abstract] OR determinants[title/abstract] OR associations[title/abstract])))	22	6 [1]
CINAHL	(AB older adults OR AB older people OR AB seniors OR AB elderly) AND (AB technology) AND (intention) AND (AB factors OR AB determinants OR AB associations)	8	1 [2]
ScienceDirect	TITLE-ABSTR-KEY("older adults") or TITLE-ABSTR-KEY(elderly) or TITLE-ABSTR-KEY("older people") or TITLE-ABSTR-KEY(seniors) and TITLE-ABSTR-KEY(technology) and TITLE-ABSTR-KEY(intention) and TITLE-ABSTR-KEY(factors) or TITLE-ABSTR-KEY(determinants) or TITLE-ABSTR-KEY(associations)	23	2 [3]
Google Scholar	allintitle: (older OR elderly OR seniors) AND technology AND (intention) AND (factors OR determinants OR associations)	0	0
Web of Science	TS=(older adults OR seniors OR elderly OR older people) AND TS=(technology) AND TS=(intention) AND TS=(factors OR determinants OR associations)	84	10 [4]
Scopus	(TITLE-ABS-KEY (older AND people) OR TITLE-ABS-KEY (older AND adults) OR TITLE-ABS-KEY (elderly) OR TITLE-ABS-KEY (seniors)) AND (TITLE-ABS-KEY (technology)) AND TITLE-ABS-KEY (intention) AND (TITLE-ABS-KEY (factors) OR TITLE-ABS-KEY (determinants) OR TITLE-ABS-KEY (associations)) AND PUBYEAR > 2006 AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (DOCTYPE , "ar"))	95	7 [5]
PsycINFO	((Older adults or Older people or Elderly or Seniors) and Technology and (Intention) and (Factors or Determinants or Associations)).tw.	17	2 [6]
	Selected		29
	Duplicates		18
	Finnaly included		11

1. Tsai et al. (2017); Hoque & Sorwar (2017); Cajita et al. (2017); de Veer et al. (2015); Tsai (2014); Tsai et al. (2013)
2. Hoque & Sorwar (2017); Wang et al. (2011)
3. Hoque & Sorwar (2017); Braun (2013)
4. Tsai et al. (2017); Hoque & Sorwar (2017); Wang & Sun (2016); de Veer et al. (2015); Tsai (2014); Sintonen & Immonen (2013); Braun (2013); Tsai et al. (2013); Shah et al. (2012); Wang et al. (2011)
5. Tsai et al. (2017); Hoque & Sorwar (2017); Wang & Sun (2016); de Veer et al. (2015); Tsai (2014); Braun (2013); Wang et al. (2011)
6. Braun (2013); Wang et al. (2011)

CHAPTER 4

COMPETENCIES REQUIRED FOR NURSING TELEHEALTH ACTIVITIES: A DELPHI-STUDY

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ABSTRACT

Background

Telehealth is viewed as a major strategy to address the increasing demand for care and a shrinking care professional population. However, most nurses are not trained or are insufficiently trained to use these technologies effectively. Therefore, the potential of telehealth fails to reach full utilization. A better understanding of nursing telehealth entrustable professional activities (NT-EPAs) and the required competencies can contribute to the development of nursing telehealth education.

Method

In a four-round Delphi-study, a panel of experts discussed which NT-EPAs are relevant for nurses and which competencies nurses need to possess to execute these activities effectively. The 51 experts, including nurses, nursing faculty, clients and technicians all familiar with telehealth, were asked to select items from a list of 52 competencies based on the literature and on a previous study. Additionally, the panelists could add competencies based on their experience in practice. The threshold used for consensus was set at 80%.

Results

Consensus was achieved on the importance of fourteen NT-EPAs, requiring one or more of the following core competencies; coaching skills, the ability to combine clinical experience with telehealth, communication skills, clinical knowledge, ethical awareness, and a supportive attitude. Each NT-EPA requires a specific set of competencies (at least ten). In total, 52 competencies were identified as essential in telehealth.

Discussion/conclusion

Many competencies for telehealth, including clinical knowledge and communication skills, are not novel competencies. They are fundamental to nursing care as a whole and therefore are also indispensable for telehealth. Additionally, the fourteen NT-EPAs appeared to require additional subject specific competencies, such as the ability to put patients at ease when they feel insecure about using technology. The NT-EPAs and related competencies presented in this study can be used by nursing schools that are considering including or expanding telehealth education in their curriculum.

Keywords: Education, eHealth, Home care, Technology competencies, Entrustable professional activities, Nursing informatics, eSkills, Healthcare technologies, Community-dwelling patients.

BACKGROUND

Using technology to provide healthcare remotely is seen as a major strategy to address the continuous increase in the demand for care. Due to the increasingly available communication technology, telehealth is attracting growing interest. Nurses can use telehealth technologies in the care of community-dwelling patients (Krijgsman et al., 2014), for example, by (a) replacing face-to-face visits with e-visits via the use of videoconferencing, (b) monitoring vital signs such as blood pressure, blood glucose levels or heart rate via devices for self-measurement, (c) monitoring movements in and around the home via activity monitors, or (d) responding to personal alarms by patients to let nurses or family members know when something goes wrong. Nurses can also use technologies for teleconsultation, for example to provide wound assessment at a distance. However, these telehealth solutions are only effective if users (patients and nurses) know how to use technology adequately (Jang-Jaccard, Nepal, Alem, & Li, 2014).

Education and training can bring technology and healthcare together (Gifford, Niles, Rivkin, Koverola, & Polaha, 2012). Training nurses how to integrate information technology into existing care pathways will also facilitate its acceptance (Brewster, Mountain, Wessels, Kelly, & Hawley, 2014). For many years, the importance of telehealth education and training has been recognized in science (e.g., Booth, 2006; Brewster et al., 2014; Giordano et al., 2011; Kort and van Hoof, 2012; Lamb and Shea, 2006; Maag, 2006; Sharma and Clarke, 2014; Simpson, 1998; van Houwelingen et al., 2015), politics (e.g., European Commission, 2012) and education (Simpson, 1998; e.g., Steering Group Bachelor of Nursing 2020, 2015). In addition, we have seen in an earlier study that the willingness of nurses to use telehealth will increase when they are more experienced with telehealth applications (van Houwelingen et al., 2015).

On a global level, the importance of telehealth competencies for nurses is emphasized in the different nursing standards: e.g., The Tuning Framework in Europe (Tuning Project, 2011), the Australian Qualifications Framework (2013), the American Nurses Association (2010), and also by the World Health Organization (2009). These standards however, limit themselves to emphasizing the importance of telehealth competencies, and lack in giving examples of concrete nursing telehealth practices. The current study aims to discuss this nursing telehealth practice in depth, by exploring the knowledge, skills and attitudes that nurses need for the execution

of professional telehealth activities in an attempt to facilitate the development of telehealth education and the acceptance of telehealth. In this study, we define competencies as the blend of knowledge, attitudes and skills. Some studies (Barakat et al., 2013; De Gagne et al., 2012; Gifford et al., 2012) have started to provide insight into what competencies and training nurses might need for the provision of telehealth and described a first overview of the most important basic telehealth competencies. Besides these studies, there are valuable reports available describing telehealth competencies in more detail (e.g., American Academy of Ambulatory Care Nursing, 2011; Australian Nursing Federation, 2013). Thus far no scientific studies have identified the specific telehealth activities nurses can perform to support community-dwelling patients and which specific set of competencies is required for each of the telehealth activities. Identifying these nursing telehealth activities and related competencies, is the aim of the current study.

A new approach to the frame of competencies in healthcare domains is the use of 'entrustable professional activities' (EPAs) (Mulder, ten Cate, Daalder, & Berkvens, 2010;; ten Cate, 2005; ten Cate, 2014). EPAs are defined as "tasks or responsibilities to be entrusted to the unsupervised execution by a trainee once he or she has attained sufficient specific competence" (ten Cate, 2013, p. 157). There is an important difference between EPAs and competencies: EPAs are tasks that can be distributed among health care team members at the beginning of a shift. Competencies are the required capacities that a team member should possess before he or she can be entrusted to perform the EPA independently. The concept of entrustable professional activities (EPAs) was designed to link competencies to clinical practice for curriculum development and teaching assessment (ten Cate and Scheele, 2007). One of the first applications of the concept was with physician assistants in training (Mulder et al., 2010). In our study the concept is used to explore all the competencies that nurses need to possess before they can be trusted to perform specific nursing telehealth EPAs.

The research questions posed in the current study were as follows: (1) Which nursing telehealth entrustable professional activities (NT-EPAs) can nurses perform to support community-dwelling patients?; and (2) What knowledge, attitudes and skills do nurses need to acquire before they can be entrusted with the telehealth activities derived from question 1? The findings might also provide insight into the question whether nurses need new, subject specific competencies (competencies that

were not relevant before the emergence of telehealth technologies), or that a range of common competencies (competencies of importance for nursing practice in general) is sufficient to be able to execute the nursing telehealth activities independently.

METHOD

This study had two phases: (1) the development of a survey with possible relevant nursing telehealth EPAs (NT-EPAs) and competencies and (2) a Delphi-study with experts in which the survey was used as an instrument to reach consensus on the most essential telehealth activities and competencies. The two phases are illustrated in Fig. 1 and are explained below.

Development for the proposal of Nursing Telehealth EPAs and Knowledge, Attitudes and Skills

The proposal of NT-EPAs and possible related knowledge, attitudes and skills that was presented in the survey was based on the following sources:

- Analysis of the Dutch nursing profile and 'body of knowledge and skills'
- Literature search
- Previous research
- Interviews
- Observations

Analysis of the Dutch Nursing Profile and 'Body of Knowledge and Skills'

The proposed 14 NT-EPAs were developed based on an analysis of the following sources: (a) the Dutch nursing profile (Schuurmans, Lambregts, Projectgroep V&V 2020, & Grotendorst, 2012; Steeringgroup Bachelor of Nursing 2020, 2015), (b) the Dutch nursing professional roles as described by Pool (2007), (c) the 'body of knowledge and skills'(Steeringgroup Bachelor of Nursing 2020, 2015), (d) the final attainment levels, in existence since 1996 (Commissie Kwalificatiestructuur, 1996) and (e) a study on the future of Dutch district nurses (Keurhorst, Kusters, & Laurant, 2011). The main question of the analysis of the content of these sources was which 'traditional' nursing activities can also be provided via telehealth. The proposal of NT-EPAs was composed with all authors in close collaboration with a nurse with more than eight years of experience in daily practice in telehealth, randomly selected via the network of the authors.

Literature Search and Previous Research

The list of competencies, consisting of 52 types of knowledge, attitudes and skills for telehealth, was partly based on literature sources and was retrieved and selected via correspondence with specialists from our network (Academy of Medical Royal Colleges, 2011; Barakat et al., 2013; Oudshoorn, 2008; Schuurmans et al., 2012; Scottish Centre for Telehealth and Telecare Development Programme, 2011; van Houwelingen et al., 2015).

In addition, input from previous research was used (van Houwelingen, 2014; van Houwelingen et al., 2015). In this study, 361 representatives of companies that provide telehealth services, educational institutions and health and social care organizations in the Netherlands, Germany, Spain and the United Kingdom described which competencies they consider essential for nurses to provide telehealth.

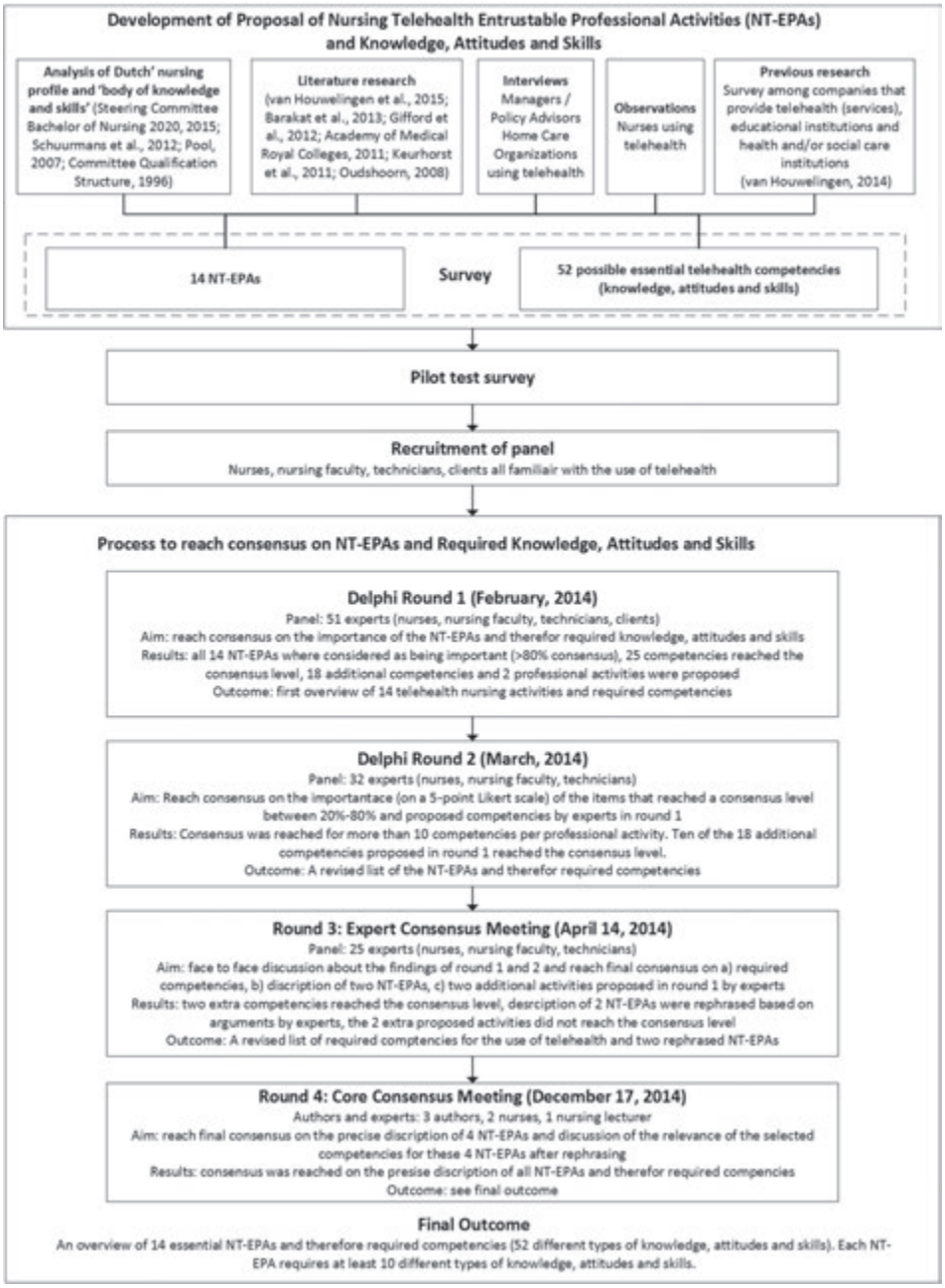

Figure 1. Study design of the development of essential nursing telehealth entrustable professional activities (NT-EPAs) and the required knowledge, attitudes and skills. Each step of the method is discussed in detail in the method section of this paper.

Observations and Interviews

Between October and December 2013, observations and structured interviews were conducted in two healthcare organizations where nurses have been working with telehealth for more than eight years. To gain insight into relevant telehealth activities and competencies, four telehealth-experienced nurses were observed based on the 'think-aloud method' Van Someren et al., 1994, in which the nurses were asked to think aloud while performing their telehealth activities. In addition to the observations, two team managers in these two healthcare organizations were asked what competencies they expect recruited nurses have when they apply for a function in which telehealth activities play an important role.

Compiling of Information

The memos written during the observations and interviews and the answers by representatives from previous research were coded and grouped into recurring themes (using MAXQDA software for qualitative data analysis, 1989–2015, VERBI Software – Consult – Sozialforschung GmbH, Berlin, Germany). The recurring themes and the findings from the literature review served as the basis for the list of 52 competencies that was proposed in the survey.

Structure and Pilot Testing of the Competencies List

To structure the list of 52 competencies (see Table 3), the competencies were categorized into fifteen knowledge competencies, nine attitude competencies and 28 skills competencies placed into five subcategories: general, technological, clinical, communication and implementation skills. To explore the readability and feasibility of the survey, the survey was pilot tested by four volunteering undergraduate nursing students who made notes and remarks and checked the completion time of the survey. The survey was restructured into a final version based on their feedback.

Recruitment of the Expert Panel Members

The recruitment of experts commenced in December 2013 via telephone. Eight nursing schools that provide bachelor's degree level education, two hospitals, eleven home care organizations and seven providers of technology were contacted. The organizations were selected based on the authors' network and individuals' earlier interest in the topic.

Snowball sampling was used to approach employees with a special interest in telehealth, and the employees were asked to propose other potential experts. Additional information was given by an e-mail information letter explaining the aim of the study, the relevance for practice and the dates of the consecutive research rounds. After general interest to participate was received from potential experts, the participants were informed about the study by telephone and screened to determine whether they met the inclusion criterion of at least six months of telehealth experience.

Patients were recruited by their nurses with the subsequent provision of an information letter. Thereafter, an eligibility telephone call was made to check if patients had at least six months of experience and whether they were able to read Dutch. If participants were not able to complete the survey online, a paper version was posted.

Ethical Approval

Because this study did not involve participants being required to perform actions or imposing certain behaviors upon them, the Dutch Medical Research Act did not apply to this study. Subsequently, all necessary precautions were taken to protect the anonymity and confidentially of our participants; in the patient information letter, participants were informed about their voluntary participation and informed that they were free to decline at any time. Furthermore, the participants were informed that their responses were processed anonymously and only used for research purposes. No identifying patient information was collected.

Process to Reach Consensus on Nursing Telehealth EPAs and Required Knowledge, Attitudes and Skills

The first Delphi round started with a survey consisting of the open question "Which competences are needed for the provision of telehealth?", and a proposed list of competencies and nursing telehealth EPAs derived from previous research, literature, observations and interviews (discussed below). The combination of an open question and proposed list of competencies was chosen for two reasons: (1) for the respondent it can be challenging to propose new competencies, and (2) for the aim of this study, it is important to have the opinion of an expert panel on findings of previous research and literature.

Delphi Round 1

The first Delphi round started with an online survey (using www.surveymonkey.com) presenting the fourteen NT-EPAs and the list of 52 types of knowledge, attitudes and skills and aimed for each panel member to select the items for each NT-EPA. To prevent missing essential competencies, the experts could propose additional knowledge, attitudes and skills.

The expert panel was asked to indicate – on a 5-point Likert scale - the relevance of each NT-EPA for the nursing profession. Subsequently, the panel members were asked to select what knowledge, attitudes and skills of the list they thought to be a prerequisite for nurses to perform the NT-EPA independently. To encourage the experts of the panel in selecting the competencies critically, a maximum of half of the 52 competencies needed to be selected per NT-EPA.

Delphi Round 2

Items from the first round that were selected by >80% of the expert panel were considered to be relevant competencies. These were not presented in round 2. Items with <20% consensus were excluded from round 2. Consequently, only competencies with an agreement level of 20%-80% in the first round were presented to the participants in round two. For each competency, the precise agreement level retrieved in round 1 was shown to the participant. Furthermore, new items proposed by respondents in round 1 were presented. This method was applied for each NT-EPA and the related knowledge, attitudes and skills.

Round 3: Expert Consensus Meeting

In round three, the experts came physically together in a three-hour meeting aimed at discussing the findings from previous rounds and at achieving final consensus on the telehealth activities and related competencies. This meeting was chaired by one of the authors (OtC) (see Figure 2, Appendix A). Participants gave permission for the meeting to be audio-recorded.

At the start of this meeting, each expert received a hand-out with all NT-EPAs and related competencies. All competencies deemed necessary for an NT-EPA with an agreement level of >80% were displayed in green, and the remaining items were depicted in red. Each activity was discussed with a focus on the red competencies. The experts were given the opportunity to bring in arguments for the importance

of competencies that did not already reach the consensus level of 80%. After a short discussion, opinions were collected using an electronic voting device (Xtol Messenger: http://www.xtol.co.uk/handsets.html). Experts could respond 'yes' or 'no' to the question "Do you consider this knowledge, attitude or skill as being required in order to be able to provide this nursing telehealth activity adequately?".

Round 4: Core Consensus Meeting

On four of the NT-EPAs, open discussions concerning the precise phrasing remained at the end of the third round. Subsequently, an extra expert consultation meeting was organized to reach a final consensus on precise definitions for these nursing telehealth EPAs. One lecturer, and two nurses of the expert panel of the previous rounds volunteered to participate in this final meeting, together with three of the authors. Transcriptions of the audio-recordings from round three were used as input for the discussion. After the revision of the nursing telehealth activities, the related competencies were discussed to verify if the competencies were still relevant, leading to choices to accept or withdraw the rephrasing of the four NT-EPAs that were discussed.

Statistical Analysis

The level of consensus within the expert panel was explored using frequencies of items: did more than 80% of the expert panel select an NT-EPA as an essential required competency? All data analyses were performed using SPSS (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp).

Qualitative analysis of the expert meeting

Aiming at identifying groups of items with a similar meaning, transcriptions of the audio-recordings and notes given by experts in round three were transformed into themes. Themes were transformed using MAXQDA via a process of axial coding by two of the authors (CvH and AM) independently.

RESULTS

Demographics of the Expert Panel

In total, 51 experts from six nursing schools that provide bachelor's degree level education, one hospital, eight home care organizations and six providers of technology consented to participate and took part in Delphi round 1. Most were nurses (62.7%); the remaining participants were nursing faculty, technicians or clients. One of the client experts indicated that the survey was too complicated and left the study in round 1. In rounds 2 and 3, there was a decline in response to 32 and 25, respectively. Thus, over 50% of the expert panel dropped out in the third round, the expert consensus meeting. Table 1 lists the demographic characteristics of the complete expert panel.

Table 1. Demographic Characteristics of the Expert Panel

Characteristics	**Expert panel round 1 (*n* = 51)**	**Expert panel round 2 (*n* = 32)**	**Expert panel round 3 (*n* = 25)**
Expertise, *n (*%)			
Nursing faculty	12 (23.5)	7 (21.8)	9 (36)
Nurse	32 (62.7)	20 (62.5)	13 (52)
Technician	5 (9.8)	3 (9.4)	3 (12)
Client	2 (3.9)	2 (6.3)	0
Gender, *n (*%)		*	*
Male	31.4 (16)		
Female	68.6 (35)		
Age, *n (*%)		*	*
23-32	14 (27.5)		
33-42	7 (13.7)		
43-52	11 (21.6)		
53-62	17 (33.3)		
63-79	2 (3.9)		
Telehealth experience, *n (*%)		*	*
Personal alarms	30 (58.8)		
Videoconferencing	43 (84.3)		
Activity monitors	10 (19.6)		
Telemedicine	17 (33.3)		
Telemonitoring	15 (29.4)		
Telehealth experience in years, *n (*%)*)*		*	*
1 year	10 (19.6)		
1-4 years	25 (49.0)		
4-10 years	11 (21.6)		
>10 years	5 (9.8)		
Educational level, *n (*%)		*	*
Lowest (primary education)	1 (2.0)		
Low (lower secondary education)	1 (2.0)		
Average (general or vocational upper secondary education)	7 (13.7)		
Above average (post-secondary non-tertiary education)	44 (86.2)		

* These demographic data were not asked in the third round

Professional Nursing Telehealth Entrustable Professional Activities (NT-EPAs)

Fourteen NT-EPAs were identified and considered to be relevant for nursing practice with consensus levels varying from 82% to 100% (see Table 2).

Table 2. Nursing Telehealth Entrustable Professional Activities (NT-EPAs)

***NT-EPA* - Title**	
1:	Supporting patients in the use of technology [a]
2:	Training patients in the use of technology as a way to strengthen their social network
3:	Providing health promotion remotely [b]
4:	Triaging incoming calls and alarms [c]
5:	Analyzing and interpreting incoming data derived from (automatic) devices for self-measurement [a]
6:	Monitoring body functions and lifestyle[1] [b]
7:	Providing psychosocial support[1] [b]
8:	Encouraging patients to undertake health promotion activities[1] [c]
9:	Instructing patients and family care givers in self-care[1] [b]
10:	Assessing patient capacity to use telehealth[b]
11:	Evaluating and adjusting the patient care plan[1] [b]
12:	Coordination of care with the use of telehealth technology [b]
13:	Independent double-check of high-risk medication[1] [b]
14:	Guidance and peer consultation[1] [b]

[1] Via the use of videoconferencing
[a] Consensus level on the relevance of the NT-EPA = 80-89%
[b] Consensus level on the relevance of the NT-EPA = 90-99%
[c] Consensus level on the relevance of the NT-EPA = 100%
Note. complete definitions of the NT-EPAs are listed in Appendix B

During the second Delphi round, two additional possible NT-EPAs were proposed by the experts: (1) "peer group supervision with regard to the use of telehealth" and (2) "the telehealth care professional being available twenty-four seven, working with a permanent team in order to support the client in getting to know the health care professionals remotely". After a discussion in round three, the expert panel concluded that these responsibilities were relevant but represented facilitating requirements and not NT-EPAs in their own right. As a result, no additional NT-EPAs were added, leaving 14 activities in which nurses can use telehealth to provide healthcare to community-dwelling patients remotely.

Competencies Required to Execute the NT-EPAs

For each of the nursing telehealth activities, a specific set of necessary competencies was selected by the expert panel. A complete overview of the 14 NT-EPAs and related required competencies is listed in Table 3 and will be discussed below.

Table 3. Required Knowledge, Attitudes and Skills for Each of the NT-EPAs

Required competencies[1]	Nursing telehealth entrustable professional activities[2]														
	1. Support patients	2. Train patients	3. Health promotion	4. Triaging	5. Data-analysis	6. Monitoring	7. Psychosocial support	8. Encouraging	9. Instructing	10. Assessing	11. Evaluating	12. Coordinating	13. Double check	14. Peer consultation	Total NT-EPAs
Knowledge															
Clinical knowledge	-	-	+	+	+	+	-	+	+	-	+	-	+	+	9
Knowledge of the procedure: what to do in case of an emergency*	+	-	-	+	+	+	-	-	-	-	-	-	+	-	5
Knowledge of policies, procedures and protocols of the organization concerning the deployment of telehealth technologies*	+	-	-	-	-	-	-	-	-	+	-	+	+	+	5
Knowledge of the (clinical) limitations of telehealth*	-	-	-	+	+	-	-	-	+	+	-	-	-	-	4
Knowledge of how telehealth can be deployed in existing pathways*	-	+	+	-	-	-	-	-	-	+	-	+	-	-	4
Knowledge of how technology can be used in sharing information with colleagues*	-	-	-	-	-	-	-	-	-	-	-	+	+	+	3
Knowledge of the laws and regulations concerning the protection and exchange of medical data, e.g., data protection, informed consent and confidentiality*	-	-	-	-	-	-	-	-	-	-	-	+	+	+	3
Knowledge of the potential benefits of telehealth*	-	+	-	-	-	-	-	-	-	+	-	-	-	-	2
Knowledge of how to collect health-related data for patient monitoring*	-	-	-	-	-	+	-	-	-	-	-	-	-	-	1
Insight into which sources patients like to use to find information about their disease	-	-	+	-	-	-	-	-	-	-	-	-	-	-	1
Insight into the reliability of health information on the web	-	-	+	-	-	-	-	-	-	-	-	-	-	-	1
Knowledge of relevant protocols[3]*	-	-	-	+	-	-	-	-	-	-	-	-	-	-	1
Knowledge about what to do if the technology does not work[3]*	+	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Attitudes															
Has an attitude aimed to support self-management / empowerment, encourages patients to play an active role in their treatment	+	+	+	-	-	+	+	+	+	+	+	-	-	-	9
Uses an ethically correct attitude during videoconferencing (honesty, confidentiality, personal and professional integrity) *	-	-	+	+	-	-	+	-	+	-	+	+	+	+	8

Required competencies[1]	Nursing telehealth entrustable professional activities[2]														
	1. Support patients	2. Train patients	3. Health promotion	4. Triaging	5. Data-analysis	6. Monitoring	7. Psychosocial support	8. Encouraging	9. Instructing	10. Assessing	11. Evaluating	12. Coordinating	13. Double check	14. Peer consultation	Total NT-EPAs
Attitudes															
Is patient	+	+	-	+	+	-	+	-	+	-	-	-	-	-	6
Can convey empathy through videoconferencing by facial expression and verbal communication*	+	-	+	+	-	-	+	-	+	-	-	-	-	-	5
Is able to promote privacy and confidentiality in videoconferencing*	-	+	+	-	-	-	+	-	-	-	-	-	-	+	4
Encourages the use of electronic measurement devices for the collection of detailed patient information*	-	-	-	-	+	+	-	-	-	-	-	-	-	-	2
Promotes the importance of a unified way of analyzing and sharing clinical information to improve the quality of data and the quality of care	-	-	-	-	-	-	-	-	-	-	-	+	-	-	1
Has confidence that telehealth technology is not difficult to use*	-	-	-	-	-	-	-	-	-	+	-	-	-	-	1
Is open-minded to innovations in ICT (taking into account the importance of protecting confidentiality)*	-	-	-	-	-	-	-	-	-	+	-	-	-	-	1
Motivational attitude[3]	-	+	-	-	-	-	-	-	-	-	-	-	-	-	1
Remains calm, friendly and analytic towards the patient when troubleshooting[3]	+	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Is able to enhance the confidence of the patient in the deployed technology[3]*	+	-	-	-	-	-	-	-	-	-	-	-	-	-	1
General skills															
Analytical skills: is able to think creatively to solve problems	+	-	-	+	+	+	-	+	+	-	+	+	+	+	10
Coaching skills	+	+	+	-	-	-	+	+	+	+	-	-	-	+	8
Is able to prioritize and switch quickly between different patients and different requests for help	-	-	-	+	-	-	-	-	-	-	-	+	+	-	3
Protects the privacy of self and the patient in the use of telehealth technologies (compliance to ethical, legal and regulatory considerations)*	-	-	-	-	-	-	+	-	-	-	-	-	+	-	2

Required competencies[1]	Nursing telehealth entrustable professional activities[2]														
	1. Support patients	2. Train patients	3. Health promotion	4. Triaging	5. Data-analysis	6. Monitoring	7. Psychosocial support	8. Encouraging	9. Instructing	10. Assessing	11. Evaluating	12. Coordinating	13. Double check	14. Peer consultation	Total NT-EPAs
Technological skills															
Is able to train the patient to use the equipment*	+	+	-	-	-	-	-	+	+	-	-	-	-	-	4
Basic ICT skills, such as the use of the Internet and a personal computer*	-	+	+	-	-	-	-	-	-	-	-	-	-	+	3
Is able to check equipment for functionality*	+	-	-	-	+	+	-	-	-	-	-	-	-	-	3
Technological skills in the field of new technology*	-	+	-	-	-	-	-	-	-	-	-	-	-	+	2
Is able to use electronic health records[3]*	-	-	-	-	-	-	-	-	-	-	+	-	-	-	1
Clinical skills															
Is able to combine clinical experience effectively with telehealth technology in decision-making*	-	-	-	+	+	+	-	+	-	-	-	+	+	+	7
Observation skills: interprets non-verbal and verbal expressions in the right way when videoconferencing	+	-	+	+	-	+	+	+	+	-	-	-	-	-	7
Is able to use health-related data effectively in patient care; (a) presents patient data clearly to colleagues	-	-	-	-	+	-	-	-	-	-	+	+	+	+	5
Is able to use health-related data effectively in patient care; (b) is able to measure, compare, group and interpret data	-	-	-	+	+	+	-	-	-	-	-	+	-	-	4
Is able to compose a risk prevention plan to support patients' safe independent living	-	-	-	-	-	-	-	+	-	-	+	-	-	-	2
Triage and clinical reasoning skills[3]	-	-	-	+	-	-	-	-	-	-	-	-	-	-	1
Communication skills															
Communication skills: is able to listen and ask focused questions to the patient, paraphrasing and summarizing at reluctant responses	+	+	+	+	+	+	+	+	+	+	+	+	-	+	13
Is focused in communication and able to reveal patients' problem through specific questions	+	-	-	+	+	+	-	-	-	-	+	+	+	+	8
Empathy: is able to recognize (at a distance) the needs of the patient and care situation*	-	-	+	+	-	+	+	+	+	-	+	-	-	-	7

Required competencies[1]	Nursing telehealth entrustable professional activities[2]														
	1. Support patients	2. Train patients	3. Health promotion	4. Triaging	5. Data-analysis	6. Monitoring	7. Psychosocial support	8. Encouraging	9. Instructing	10. Assessing	11. Evaluating	12. Coordinating	13. Double check	14. Peer consultation	Total NT-EPAs
Communication skills															
Is able to communicate clearly in videoconferencing and knows what to do to enhance contact (e.g., use of voice, light, background)*	-	-	+	-	-	+	+	-	+	-	-	-	-	+	5
Is able to put patients at ease when they feel insecure about using technology*	+	+	-	-	-	-	-	-	+	+	-	-	-	-	4
Is able to create a confidential environment and a pleasant atmosphere in video conferencing*	-	-	-	-	-	-	+	-	-	-	-	-	-		1
Is able to communicate across different disciplines[3]	-	-	-	-	-	-	-	-	-	-	-	+	-	-	1
Motivational techniques[3]	-	-	-	-	-	-	-	+	-	-	-	-	-	-	1
Implementation skills															
Is able to assess whether telehealth technology is convenient for the patient by the use of established criteria (for example, cognitive ability, technological skills)*	+	-	+	-	-	-	-	-	-	+	-	-	-	-	3
Is able to assess the needs and preferences of the patient with respect to telehealth*	-	+	-	-	-	-	-	+	-	+	-	-	-	-	3
Is able to communicate effectively the benefits of telehealth technologies*	-	+	-	-	-	-	-	-	-	+	-	-	-	-	2
Is able to provide advice about reliable health information on the internet; sites, medical care portals and mobile applications*	-	-	+	-	-	-	-	-	-	-	-	-	-	-	1
Total required competencies:	17	14	16	16	12	14	12	12	14	13	10	14	12	15	

* These 32 competencies are specifically required for the provision of telehealth, and would not have been relevant without the emergence of telehealth. The remaining 22 competencies are also important for several other traditional nursing activities.

[1] Competencies sorted by frequency within the category

[2] See Table 2 for a complete description of the 14 NT-EPAs

[3] These nine competencies were not part of the initial proposed list of 52 competencies in round one but were afterwards proposed by one the experts in round 2 or 3 and reached the 80% agreement level. All other competencies listed above were part of the proposed list and also reached the threshold of 80% for at least one of the NT-EPAs. Of the 52 competencies that were proposed in the survey in round one, the following nine competencies did not reach the 80% consensus level: (1) knowledge about the costs related to telehealth, (2) technological knowledge: is aware of the newest telehealth technologies, (3) knows that the patient is free to choose to not use telehealth, (4) knowledge about the risks of exchanging footage, (5) is able to discuss technological issues with the patient, (6) is able to implement new telehealth technologies in practice, (7) is able to assess patients' capacity to use telehealth based on standardized criteria (e.g., cognitive ability, technological skills, motivation), (8) ensures that the personal dignity of the patient is not compromised during videoconferencing, and (9) is able to identify patients via a protocol.

Required Knowledge for the Provision Telehealth

The expert panel acquired consensus on 13 different types of knowledge that are required for the provision of telehealth, represented in Table 3. All nursing telehealth activities – except for NT-EPA 7 and NT-EPA 8 – require multiple knowledge sources, ranging from two to four types. Clinical knowledge and procedural knowledge (what to do in case of an emergency) were the most frequently selected knowledge items (see Table 3).

Required Attitudes for the Provision Telehealth

The expert panel reached consensus on 12 different attitudes that are required for the provision of telehealth, illustrated in Table 3. 'An attitude to support self-management/empowerment' and 'the use of an ethically correct attitude during videoconferencing' were selected most frequently, nine and eight times, respectively. Another frequently selected attitude was 'patience'.

In addition to the selected attitudes, 'ethical awareness' arose from the qualitative analysis of the audio-recordings of the expert meeting. Nurses should pay attention to privacy in remote contact and to limitations in collecting patient data. During the expert meeting in round three, one of the experts emphasized the importance of an ethical awareness as follows: "The future nurse should be aware of the legal and ethical aspects of the use of those devices and the safety of open networks. Where are these data stored? Be aware of what I'm saying and write down with new technology".

Skills for the Provision Telehealth

The expert panel reached consensus on 27 different skills that are required for the provision of telehealth, presented in Table 3. Communication skills were selected for the provision of all fourteen activities, except for NT-EPA 13. Furthermore, coaching skills, analytical skills, and being able to combine clinical experience effectively with telehealth technology in decision-making were frequently selected; all three skills were selected for eight of the fourteen activities.

During the expert consensus meeting, the experts discussed the importance of 'being able to communicate clearly in videoconferencing and knows what to do to enhance contact (e.g., use of voice, light, background)'. In round two, 63% agreed on the relevance of this skill for NT-EPA 6 'monitoring body functions and lifestyle

via videoconferencing'. In round three, one of the experts argued that to monitor body functions, a nurse must be able to assess a patients' skin color, and distinguish whether an observed change in color indicates that the patient is sick or whether the change in skin color is caused by the light of the video screen. After hearing this argument, 86% of the expert panel agreed on this skill, which subsequently was included in the list of competencies related to NT-EPA 6.

In addition to the selected skills as presented in Table 3, a few themes arose from the qualitative analysis of the audio records of round three. For instance, 'lifelong learning' was brought up as a result of a discussion regarding the rapid development of new technologies. Nurses should have the competence to integrate current technologies in their care pathways. One of the experts mentioned the risk of being too focused on specific technologies: "The contemporary telehealth technique will be thrown away in two years' time. When it comes to new technologies in general, you should be aware of new developments".

DISCUSSION

Communication skills, coaching skills, the ability to combine clinical experience with telehealth, clinical knowledge, ethical awareness, and a supportive attitude were seen as the most important competencies for nurses that provide telehealth. These findings are consistent with findings from previous studies (e.g., Academy of Medical Royal Colleges, 2011; Barakat et al., 2013), in which comparable telehealth competencies were reported. In addition, the results of the current study emphasize the benefits of avoiding general statements about telehealth competencies. In the four rounds of the Delphi-study, the experts revealed that each of the fourteen nursing telehealth activities requires a specific and different set of competencies.

In discussing the 52 competencies found in this study, a distinction can be made between fundamental, more common competencies and 'new' or 'subject specific' competencies. Competencies such as clinical knowledge, communication skills or patience have always been fundamental, for nursing in general. Due to their wide importance, these competencies became generic and were also expected to be important for the provision of telehealth.

In addition to the 20 common competencies, this study discovered a set of 32 distinctive and new competencies; competencies that became relevant as a result of the emergence of telehealth. Based on the number of times they were selected, especially the competencies that were required for just a few activities, 'is able to communicate clearly in videoconferencing', 'knows what to do to enhance contact, e.g., use of voice, light, background', and 'knowledge about what to do if the technology does not work' were the most distinctive of the common competencies.

Regarding the list of competencies, one could argue that some competencies, such as the ethics-related ones, are indispensable. However, one might be surprised that not all of these ethics-related competencies are selected for all the NT-EPAs that involve videoconferencing. In the case of NT-EPA 9 for example ('instructing patients and family care givers in self-care via the use of videoconferencing'), only one ethics-related competency was selected ('uses an ethically correct attitude during videoconferencing (honesty, confidentiality, personal and professional integrity)'). One explanation might be that the experts have thought that the content of other ethics-related competencies (e.g., 'protects the privacy of self and the patient in the use of telehealth technologies') is already integrated in the competency that was selected, and therefore became less demanding.

During the expert meeting in round three, experts provided arguments to select additional competencies. Not all of these competencies reached the 80% agreement level. For example, one expert argued that clinical knowledge should be required for the provision of NT-EPA 7 'psychosocial support via videoconferencing'. The expert emphasized, "Imagine you have to deal with a psychiatric patient, then you need background information of the patient in order to decide what kind of psychosocial support you are going to provide". As 59% of the expert panel agreed and a threshold of 80% was used for consensus, this knowledge was not included in the final list of competencies that were considered to be essential for the provision of NT-EPA 7.

The selected nursing competencies in the current study were based on the opinion of an expert panel. In twelve cases, nurses achieved consensus on the importance of a specific knowledge, attitude or skill item, whereas faculty disagreed significantly (using a Mann–Whitney U test and $P = < 0.05$). For example, nurses achieved consensus (> 85%) on the importance of the ability to assess the needs and preferences of the patient with respect to (telehealth) technology for three of the activities in

NT-EPA 1, 7 and 11, whereas not even 35% of the faculty considered this skill to be important for these three nursing activities.

In the current study, we used the consensus levels of the total panel, including both nurses and nursing faculty. The examination of significant differences however, reveals that there are different opinions between subgroups with respect to the importance of telehealth competencies. The current study was not designed to reveal the reasons for these differences in opinion so we can only speculate. One possible explanation for this finding is that faculty filled out the survey more critically. Another possible explanation is that nursing faculty underestimate the importance of these competencies, perhaps caused by a lack of practical experience with telehealth.

Implications for Training in Practice and Education

The fourteen activities and related competencies that arose from this study can be used for training and assessment purposes. The description of the activities provides insight into how telehealth can be integrated in routine care. Before nurses can be trusted to perform one of the activities, they should demonstrate that they possess the required knowledge, attitudes and skills. The description of the fourteen NT-EPAs can also help design the curricula of nursing training by linking their education to practice.

There are several opportunities to relate our NT-EPAs to the international nursing frameworks mentioned in the introduction. For example, the NT-EPAs and required competencies can be added to the 'subject specific competences' section of the Tuning Framework (Tuning Project, 2011), or linked to the seven competency roles of the CanMEDS framework in the Netherlands (Steering Group Bachelor of Nursing 2020, 2015), since each NT-EPA will require different roles. The NT-EPAs can also be linked to the standards described in the American Scope and Standards of Practice (American Academy of Ambulatory Care Nursing, 2011). For example, NT-EPA 7 'Providing psychosocial support' can be linked to AAACN Standard 11 'Communication', NT-EPA 12 'Coordination of care with the use of telehealth technology' fit with Standard 5.1 'Coordination of Care', and NT-EPA 14 'Guidance and peer consultation' fit with Standard 5.3 'Consultation'. Linking the results of this study to a specific framework might be helpful in an attempt to translate the NT-EPAs to the curricula of a specific country.

Limitations and Future Research

In the original design, we aimed to increase the weight of the response of the nurses compared to the response of the nursing faculty, since we value their experience in practice with telehealth. However, as a result of drop-outs in the second and third round, the ratio of faculty and nurses that were represented in the expert panel, shifted from twelve faculty on 32 nurses, to nine faculty on thirteen nurses. Without this change in the group, perhaps more competencies would have been selected in round 3, following the thought that nurses voted less critically. Nevertheless, nurses were still in the majority. The fact that the nurses apparently did not manage to convince nursing faculty with arguments has to be taken into account when interpreting the results of our study.

Sequentially in this study, an opinion-based approach was used to collect data. The fact that this study is based on the opinion of Dutch experts only, could have had consequences for the generalizability of our results. However, in order to confine this limitation, the consensus discussion started with a list of knowledge, attitudes and skills based on findings of previous research and international literature.
The relative novelty of the topic of telehealth competencies and a lack of understanding of necessary competencies was the reason to first build a framework of telehealth competencies that subsequently can provide a base for future validation research. Further validation of the nursing telehealth EPAs and related competencies is recommended to investigate if the nursing competencies also enhance the quality of telehealth provided by nurses in practice.

CONCLUSION

This study yielded 14 NT-EPAs and 52 required types of knowledge, skills and attitudes (KSAs) that nurses should possess when executing telehealth activities. Thirty-two KSAs are 'new' competencies, specifically required for the provision of telehealth. Nurses can use technology in various ways to provide health care remotely, ranging from the provision of psychosocial support via videoconferencing to an independent double-check in the case of high-risk medication. All of these nursing telehealth EPAs appear to require a specific set of knowledge, attitudes and skills. This situation emphasizes the need to describe competencies in relation to specific telehealth activities, rather than a general overview of telehealth

competencies. Home care organizations or nursing schools can use the NT-EPAs and related competencies presented in this study as a starting point for the development of successful training and education.

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APPENDIX A – ROADMAP ROUND THREE: EXPERT CONSENSUS MEETING

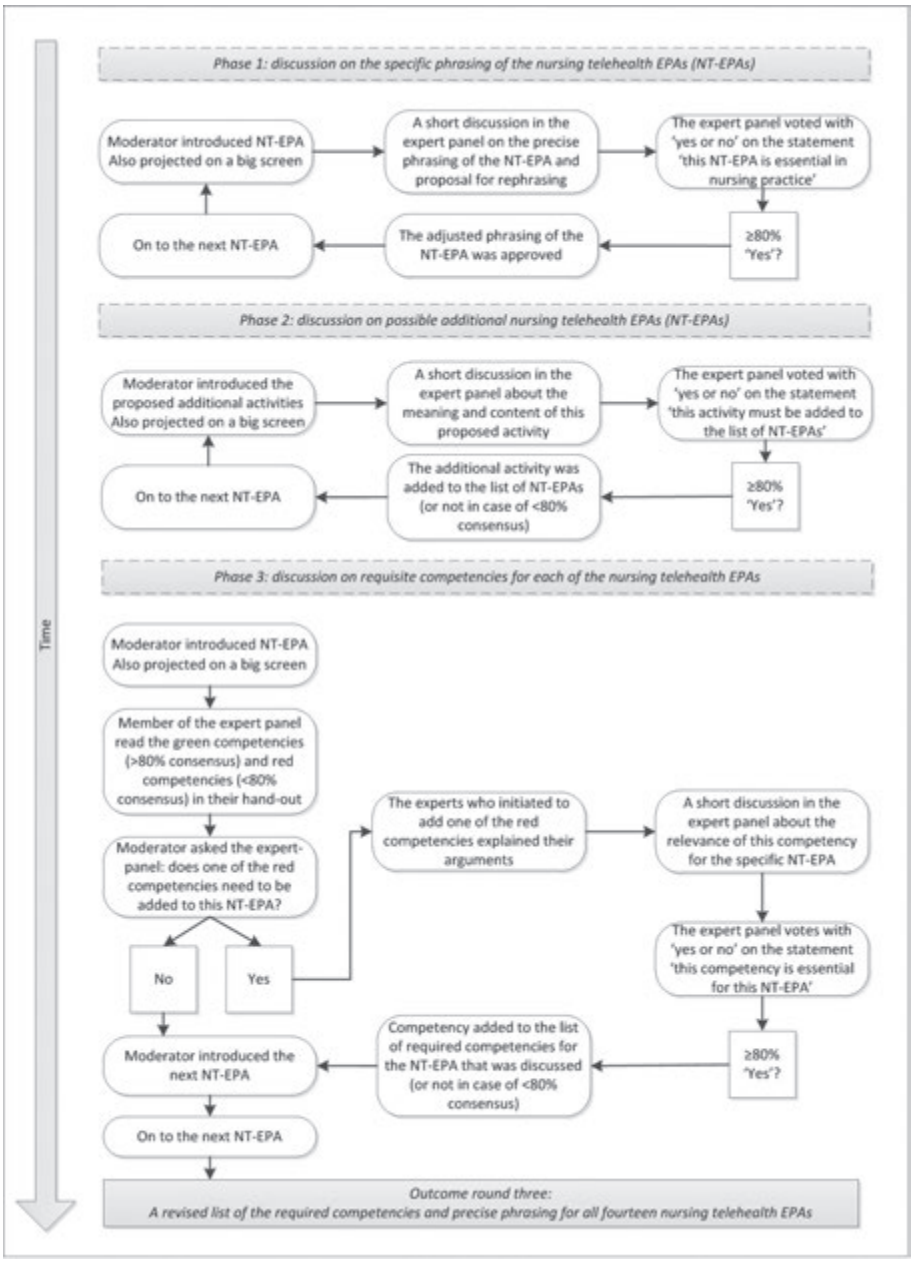

Figure 2. Roadmap expert consensus meeting from Delphi round three, consisting of three phases of discussion: 1) the precise phrasing of the NT-EPAs, 2) the possible additional NT-EPAs and 3) the required competencies.

APPENDIX B. NURSING TELEHEALTH ENTRUSTABLE PROFESSIONAL ACTIVITIES (NT-EPAS)

NT-EPA 1: **Supporting patients in the use of technology**
Definition: The nurse is the first port of call for community-dwelling patients in case they experience trouble in the use of technology. Nurses should support patients in finding a solution.

NT-EPA 2: **Training patients in the use of technology as a way to strengthen their social network**
Definition: Nurses are responsible for supporting patients in maintaining and strengthening their social network. Nurses should attempt to keep patients away from social isolation. Several technologies can be used to strengthen patients' social network. Social media websites, e-mail, or a smartphone can be used to keep in contact with family or relatives. Nurses should provide patients information about the possibility of these media.

NT-EPA 3: **Providing health promotion remotely**
Definition: The provision of health promotion is an important nursing responsibility. Besides providing health promotion face-to-face, health promotion can be offered remotely with the use of technology. As a result, nurses provide – in addition to face-to-face health promotion – health promotion with the use of videoconferencing, e-mail and internet. Depending on the situation, nurses decide which medium fits best. As a part of health promotion, nurses refer patients to trustworthy health websites.

NT-EPA 4: **Triaging incoming calls and alarms**
Definition: In case of incoming alarms via screens, video, telephone or incoming data, nurses assess the situation and problems of the patients remotely. Nurses use a two-way audio transmission or videoconferencing to collect information. In the case of a two-way transmission, no visual information is available. Nurses assess the gravity of the situation remotely and arrange a settlement in line with the protocol.

NT-EPA 5: **Analyzing and interpreting incoming data derived from (automatic) devices for self-measurement**

Definition: Diagnosing and monitoring vital functions is one core task of nurses. Today, in healthcare practice, several technologies are being used to automatically check and transport (body) functions of the patient, e.g.: heart rate monitors, motion detectors to monitor patients' activity, or medication dispensing services that sounds an alarm when medication has been forgotten. Furthermore, patients can use devices for self-measurement, e.g., measuring their blood pressure at home. Nurses analyze and interpret the incoming data from these devices. Nurses assess whether the incoming data are alarming and determine what action is required.

NT-EPA 6**: Monitoring body functions and lifestyle**[1]

Definition: Diagnosing and monitoring body functions and lifestyle is also possible remotely. Nurses monitor the health conditions, lifestyle and the circadian rhythm of patients by questions and observations through videoconferencing. When nurses observe signs of health hazards, they determine what action is required.

NT-EPA 7: **Providing psychosocial support**[1]

Definition: Nurses need to be alert to possible psychosocial problems of patients. The goal of psychosocial support is to treat patients humanely and support them to take their full place in society. Psychosocial support can be "unscheduled", when it is part of the daily somatic care, or "scheduled", when the psychosocial care is planned separately. Both types are – in addition to face-to-face meetings – provided by nurses remotely through videoconferencing.

NT-EPA 8: **Encouraging patients to undertake health promotion activities**[1]
Definition: Nurses have a responsibility to empower patients, referred to as 'empowerment'. By stimulating patients to undertake health promotion activities, nurses empower patients. This empowerment is also provided remotely through videoconferencing. Nurses stimulate patients to do breathing exercises, take medication (promote medication adherence), attend a day program. In addition, nurses stimulate patients to control their health and well-being as much as possible on their own, referred to as self-management. Nurses advise patients what medical applications, (automatic) devices for self-measurement, and health care portals (online platform for exchanging health and care information) they can use to have an active role in controlling their own health and well-being.

NT-EPA 9: **Instructing patients and family care givers in self-care**[1]
Definition: In the context of empowerment, nurses stimulate patients to take care of their own disease, referred to as self-care. To maintain safety, nurses inform and instruct patients and support family caregivers. This instruction can be provided remotely through videoconferencing. Although other self-care tasks exist, nurses instruct patients and their families the following self-care tasks at minimum: measuring blood glucose levels / blood pressure, administer insulin / intramuscular injection, ostomy and fistula management, wound care and catheter care.

NT-EPA 10: **Assessing patient capacity to use telehealth**
Definition: Nurses have a responsibility to recruit patients for telehealth. Thus, nurses assess patient capacity to use telehealth. Nurses assess patients' physical and cognitive abilities and motivation to use telehealth, e.g., during a visit at the patients' home. During the patient assessment for telehealth, nurses discuss how telehealth can support the patient in ageing in place through (a) more control, (b) greater autonomy and (c) more privacy and can (d) support them in getting in contact with people outdoors.

NT-EPA 11: **Evaluating and adjusting the patient care plan**[1]
Definition: Nurses actively involve patients and family caregivers to their patient care plan. Therefore, nurses evaluate the patient care plan in consultation with the patient. When a patient has access to videoconferencing, nurses evaluate the patient care plan remotely using this technology. When patients use telehealth services, 'the use of telehealth' is part of the evaluation because the use of telehealth is a part of their patient care plan. Furthermore, nurses organize video meetings and chair these meetings. The patient, family caregivers and all involved healthcare providers are invited to join these video meetings with the aim of increasing their involvement in the patient care plan.

NT-EPA 12: **Coordination of care with the use of telehealth technology**
Definition: Nurses have a responsibility in coordinating care with the aim of delivering care as a continuous and integrated process. In addition to consulting face-to-face, nurses coordinate care via electronic medical records, e-mail and videoconferencing.

NT-EPA 13: **Independent double-check of high-risk medication**[1]
Definition: An independent double check by another staff member is required for the administration of high-risk medication. The independent double-check process does not require physical presence and can be performed remotely via videoconferencing. Nurses provide and receive independent double-checks through videoconferencing, at least in the administration of insulin and intravenous medication.

NT-EPA 14: **Guidance and peer consultation**[1]
Definition: Nurses have the task of supervising (new) colleagues and other caregivers in the performance of established tasks and activities. Furthermore, when in doubt or in the absence of expertise, nurses ask and provide peer consultation via videoconferencing.

[1] Via the use of videoconferencing

CHAPTER 5

INTERNET-GENERATION NURSING STUDENTS' VIEW OF TECHNOLOGY-BASED HEALTH CARE

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ABSTRACT

Background

Today's nursing school applicants are considered "digital natives." This study investigated students' views of new health care technologies.

Method

In a cross-sectional survey among first-year nursing students, 23 common nursing activities and five telehealth nursing activities were presented along with three statements: "I consider this a core task of nursing," "I look forward to becoming trained in this task," and "I think I will do very well in performing this task."

Results

Internet-generation nursing students (n = 1,113) reported a significantly ($p \leqslant .001$) less positive view of telehealth activities than of common nursing activities. Median differences were 0.7 (effect size [ES], −0.54), 0.4 (ES, −0.48), and 0.3 (ES, −0.39), measured on a 7-point scale.

Conclusions

Internet-generation nursing students do not naturally have a positive view of technology-based health care provision. The results emphasize that adequate technology and telehealth education is still needed for nursing students.

Key words: Nursing students, telecare, technology confidence, telehealth, digital natives, nursing education, telenursing, eSkills, nursing telehealth activities

INTRODUCTION

Nursing curricula are regularly updated to respond to changes in society and health care practice. Current nurse educators must respond to an increasing use of health care technology in nursing practice. Health care technologies, such as telehealth care (i.e., the remote provision of health care using technologies such as videoconferencing or equipment to monitor vital signs), typically do not provide direct, face-to-face contact (Shea & Chamoff, 2012). This limits the possibility to observe patients and their environments directly and requires additional digital competencies for contact through technology. Inadequately trained professionals are considered a barrier to the effective provision of telehealth care (Brewster, Mountain, Wessels, Kelly, & Hawley, 2014; Kort & van Hoof, 2012; Sharma & Clarke, 2014; van Houwelingen et al., 2015).

An earlier study identified 14 distinct nursing telehealth activities (van Houwelingen, Moerman, Ettema, Kort, & ten Cate, 2016) or professional activities that can be performed by nurses to support patients using technologies (e.g., triaging incoming calls and alarms, or independently double-checking high-risk medication via videoconferencing). All of the telehealth activities required a specific set of knowledge, skills, and attitudes. Nurses cannot be entrusted with these activities without receiving adequate training in these additional required competencies.

Specific competencies for health care technologies have become a significant part of published nursing curriculum guides (e.g., American Nurses Association, 2010; Australian Qualifications Framework, 2013; Steeringgroup Bachelor of Nursing 2020, 2015; Tuning Project, 2011). These curricular adjustments contribute to overcoming barriers caused by inadequately trained nurses in telehealth care. Nurses currently working in this domain need additional skills to be able to integrate technology applications in practice. However, today's applicants for nursing education are part of a generation known as "digital natives" (Prensky, 2001). This generation, referred to as Generation Z by Glass (2007), knows no world without the Internet, and its members commonly are characterized by their wide experience with and skills in using the Internet and communication technologies. For these students, the use of health care technology may feel normal because they are already immersed in a world of technology through the use of smartphones, tablets, and social media, both privately and at primary and secondary schools. The question that is being asked by

schools of nursing is, "How much technology-based nursing education is necessary for the current new generation of future nurses to provide telehealth care?"

Aim

The aim of this study was to gain insight into today's Internet-generation nursing students' view of technology-based health care and to determine whether the Internet generation believes that technology-based health care should be a part of nursing. According to the generation rhetoric of Prensky (2001), today's nursing students already may be familiar with abundant technological opportunities, and special attention to telehealth provisions in the nursing curricula may not be as relevant. However, no studies have explored this assumption. The current study sought to answer the question of whether the current Internet generation of applicants for nursing education actually has a positive view of technology-based health care. This question was addressed through the following sub-questions:

- Do Generation Z nursing students consider nursing telehealth activities to be a core part of nursing, at least as much as common nursing activities?
- Do Generation Z nursing students want to become trained in nursing telehealth activities, at least as much as in common nursing activities?
- Are Generation Z nursing students confident that they will perform well in nursing telehealth activities, at least as much as in common nursing activities?
- Do Generation Z nursing students have a more positive view of nursing telehealth activities than students born in earlier generations?

METHODS

Design, Setting and Population

This cross-sectional study surveyed a convenience sample of new undergraduate nursing students in August 2015 from seven nursing schools across The Netherlands. Seven schools located throughout The Netherlands that provide bachelor's degree education in nursing were included in the study. The nursing schools volunteered to participate and were willing to recruit freshmen to respond to the survey. Within the first 2 weeks of school, all first-year nursing students ($N = 2{,}639$) from the seven nursing schools were sent an e-mail by their own school; the e-mail described the

study and asked the students to participate by filling out an online questionnaire (via SurveyMonkey®).

No specific inclusion or exclusion criteria were established as all new nursing students were approached. Year of birth was used as a criterion to divide the participating students into generations according to categorization by Glass (2007): Generation Z (born between 1992 and 2000), Generation Y (born between 1977 and 1992), Generation X (born between 1961 and 1977), and Baby Boomers (born between 1941 and 1961).

Ethics Statement

This study did not require participants to perform actions or impose certain behaviors on them; therefore, the Dutch Medical Research Act (abbreviated in Dutch as WMO [wet medisch wetenschappelijk onderzoek]) did not apply to this study. Nevertheless, all necessary precautions were taken to protect the anonymity and confidentially of the participating students. Students were informed in a letter about their voluntary participation and were told that they were free to decline at any time. Furthermore, students were informed that their responses would be processed anonymously, securely stored, and used for research purposes only. No identifying information was collected.

Survey Instrument

The survey began with four demographic questions regarding participants' age, gender, educational level, and technology experience in daily life. Students' technology experience in daily life was explored by asking how often per day they used a smartphone, the Internet, an iPad/tablet, e-mail, and a laptop or personal computer.

Table 1. List of Nursing Activities, Internal Consistency, and Median Scores of Generation Z Nursing Students (*n* = 1,113)

	Nursing Telehealth Activity	I Consider This To Be Core Activities of Nursing	I Look Forward Getting Trained in It	I Think I Will Perform Well in This Activity
		Median (1st quartile – 3rd quartile)		
	Nursing telehealth activities			
1.	Triaging incoming calls and alarms	6 (5 - 7)	6 (5 - 6)	6 (5 - 6)
2.	Analyzing and interpreting incoming data derived from (automatic) devices for self-measurement	6 (5 - 6)	6 (5 - 6)	6 (5 - 6)
3.	Encouraging patients to undertake health promotion activities via videoconferencing	5 (4 – 6)	5 (4 – 6)	5 (4 – 6)
4.	Instructing patients and family care givers in self-care via videoconferencing	5 (4 – 6)	6 (4 – 6)	6 (4 – 6)
5.	Independent double-check of high-risk medication via videoconferencing	6 (5 - 6)	6 (5 - 6)	6 (5 - 6)
	Cronbach's alpha:	α = .81	α = .84	α = .84
	Common nursing activities			
6.	Clinical reasoning	7 (6 - 7)	6 (6 - 7)	6 (6 - 6)
7.	Performing care	7 (6 - 7)	7 (6 - 7)	6 (6 - 7)
8.	Strengthening self-management	6 (5 - 7)	6 (5 - 7)	6 (5 - 6)
9.	Assessment of care needs	6 (6 - 7)	6 (6 - 7)	6 (5 - 6)
10.	Personalized communication	7 (6 - 7)	6 (6 - 7)	6 (6 - 7)
11.	Establishing and maintaining a nurse-patient relationship	6 (6 - 7)	6 (6 - 7)	6 (5 - 6)
12.	Shared decision making	6 (6 - 7)	6 (6 - 7)	6 (6 - 7)
13.	Multidisciplinary collaboration	7 (6 - 7)	6 (6 - 7)	6 (6 - 7)
14.	Ensuring continuity of care	6 (6 - 7)	6 (6 - 7)	6 (6 - 7)
15.	Investigative capacity	6 (6 - 7)	6 (6 - 7)	6 (5 - 6)
16.	Evidence based practice	6 (6 - 7)	6 (5 - 7)	6 (5 - 6)
17.	Professional development	6 (5 - 7)	6 (5 - 6)	6 (5 - 6)
18.	Professional reflection	6 (6 - 7)	6 (5 – 6)	6 (6 – 7)
19.	Moral sensitivity	6 (6 - 7)	6 (6 - 7)	6 (5 - 6)
20.	Prevention-oriented analyzing	6 (6 - 7)	6 (6 - 7)	6 (6 - 7)
21.	Health promotion activities	6 (6 - 7)	6 (6 - 7)	6 (5 - 6)
22.	Nursing leadership	6 (6 - 7)	6 (6 - 7)	6 (5 - 6)
23.	Coordination of care	6 (6 - 7)	6 (5 - 7)	6 (5 - 6)
	Common nursing activities			
24.	Improving safety	6 (6 - 7)	6 (6 - 7)	6 (5.5 - 6)
25.	Nursing entrepreneurship	5 (4 – 6)	5 (4 – 6)	5 (4 – 6)
26.	Providing quality of care	6 (6 - 7)	6 (5 - 7)	6 (5 - 6)

Nursing Telehealth Activity		I Consider This To Be Core Activities of Nursing	I Look Forward Getting Trained in It	I Think I Will Perform Well in This Activity
		Median (1st quartile – 3rd quartile)		
27.	Participate in quality assurance	6 (5 - 7)	6 (5 - 7)	6 (5 - 6)
28.	Professional behavior	7 (6 - 7)	6 (6 - 7)	6 (6 - 7)
	Cronbach's alpha:	α = .97	α = .97	α = .97

Note. The telehealth activities (1-5) are derived from our prior study (van Houwelingen et al., 2016). The 23 other activities (6-28) represent all core tasks as described in the Dutch nursing standard 'Bachelor Nursing 2020: a futureproofed training profile 4.0' (Steeringgroup Bachelor of Nursing 2020, 2015). All activities were presented along with three statements presented at the top of the table.

Subsequently, 28 nursing activities were presented with a short definition (Table 1). Of these, 23 activities were common nursing activities (e.g., clinical reasoning and monitoring lifestyle) that represented all of the core tasks described in the Dutch nursing standard (Steeringgroup Bachelor of Nursing 2020, 2015). To be able to compare the students' view of telehealth activities with their view of common activities, common activities were included in the survey. In addition, five activities were nursing telehealth activities (e.g., health promotion via videoconferencing) derived from a previous Delphi study (van Houwelingen et al., 2016). In that study, experts reached a consensus about 14 essential telehealth activities for nurses; five of the telehealth activities with the highest consensus were selected for the current study.

After each of the 28 nursing activities (Table 1), three items were included as statements: "I consider this a core task of nursing," "I look forward to becoming trained in this task," and "I think I will do very well in performing this task." Students answered these questions using a 7-point Likert scale ranging from totally disagree to totally agree.

The survey ended with an optional open-ended comment section for participants to include a comment. Because only 13 of 1,451 participants left relevant comments, which represented less than 1% of the sample, the comments were not included in the results section.

Data Analysis

The normal distribution of the data was explored visually using histograms and tested with Kolmogorov-Smirnov tests. Because the data were not normally distributed, nonparametric tests were used. Mann-Whitney U tests were performed to test differences (using $p \leqslant .05$ as a criterion) in demographic characteristics between the Generation Z nursing students (born between 1992–2000) and nursing students from other generations (born before 1992).

Furthermore, Generation Z nursing students' view of technology-based health care was explored with four subquestions. A Wilcoxon signed rank test was performed to explore the first three subquestions, which were concerned with Internet-generation students' view of telehealth activities compared with their view of other common nursing activities (using $p \leqslant .05$ as a criterion). The differences were explored using the three statements: "I consider this a core task of nursing," "I look forward to becoming trained in this task," and "I think I will do very well in performing this task." For each of the three statements, the average score was calculated for the 23 common (non-telehealth) activities (derived from the Dutch nursing standard) and the average score of the five telehealth activities (derived from the authors' prior research). Again, for each of the three statements on a sample level, the median of the average scores of these 23 common activities was compared with that of the five telehealth activities. The effect sizes (ES) for the three comparisons were calculated by dividing the Z score (Z) by the square root of the number of observations ($\sqrt{n}$), as suggested by Field, Miles, and Field (2012): ES = Z divided by $\sqrt{n}$.

The fourth subquestion was examined with Mann-Whitney U tests (using $p \leqslant .05$ as a criterion). The median of the average scores of the five telehealth activities of Generation Z students was compared with that of students born in earlier generations for each of the three statements: "I consider this a core task of nursing," "I look forward to becoming trained in this task," and "I think I will do very well in performing this task."

To avoid selection bias caused by a complete cases approach (Janssen et al., 2010), the missing values for those participants who partially completed the survey were imputed using a linear regression imputation method, which resulted in five imputed data sets. All five data sets showed comparable results. The results of the data analysis are based on one data set.

Data analyses were performed using SPSS® version 23.0 software and the statistical package R version 3.2.2 software.

Reliability and Validity of the Survey Instrument

In this study, students' views of 23 common nursing activities and their views of five nursing telehealth activities were explored with three statements: "I consider this a core task of nursing," "I look forward to becoming trained in this task," and "I think I will do very well in performing this task." For each of the three statements, the average scores were calculated across the 23 common activities and the five telehealth activities. To justify the merging of activities, the internal consistency of the 23 common nursing activities was analyzed for each of the three statements and the five nursing telehealth activities. The complete list of activities and accompanying median scores, first and third quartiles, and Cronbach's alpha are presented in Table 1.

Prior to data collection, validity evidence was collected for the survey instrument following the guidelines by Artino, La Rochelle, Dezee, and Gehlbach (2014) for the development of educational research questionnaires. To assess the clarity and relevance of the activities and accompanying statements in the survey, two experts (one lecturer and one nurse) from the authors' network were interviewed. Subsequently, to ensure that the study participants would interpret the items in the manner intended, two students who were about to begin attending the authors' nursing school were interviewed cognitively (Artino et al., 2014). These two students did not always interpret the survey's phrasing adequately, and the phrasing subsequently was changed to increase participants' understanding.

RESULTS

Student Characteristics

A total of 1,451 nursing students responded to the survey. The majority (n = 1,039) completed the entire survey. A group of 175 students responded only to the demographic questions and were excluded from further analyses. Students who completed the survey were compared with the students who responded only to the demographic questions; slight but significant ($p \leqslant .05$) differences were found in two of the demographic items: the educational level of the excluded students was slightly higher than that of the included students, and the frequency of Internet use among the excluded students was slightly lower.

Table 2. Demographic Characteristics of Nursing Students

Characteristics	Generation Z nursing students born after 1992 (*n* = 1,113)	Nursing students born before 1992 (*n* = 163)
Gender, % (n)		
Male	12.1 (135)	17.2 (28)
Female	87.9 (978)	82.8 (135)
Age[1], % (n)		
Generation Z (1992-2000)	100 (1,113)	...
Generation Y (1977-1992)	...	73.6 (120)
Generation X (1961-1977)	...	25.2 (41)
Baby boomers (1941-1961)	...	1.2 (2)
Daily use of technology[2], % (n)		
Smartphone*	99.6 (1,108)	96.3 (157)
Tablet or iPad*	22.4 (249)	40.5 (66)
Skype / Facetime	4.8 (53)	2.5 (4)
Internet	99.7 (1,110)	98.8 (161)
E-mail*	90.9 (1,012)	98.2 (160)
Computer / Notebook*	80.7 (898)	90.8 (148)
Highest completed educational level, % (n)*		
Lowest (primary education)	.1 (1)	0
Low (lower secondary education)	1.1 (12)	4.3 (7)
Average (general or vocational upper secondary education)	97.3 (1,083)	71.2 (116)
High (bachelor's degree or higher)	1.5 (17)	24.5 (40)

[1] Generations divided according to Glass (2007)
[2] Participants were asked how often they use these six technologies in their daily life, on a 4-point scale ranging from 1 = daily to 4 = hardly ever. This table presents the frequencies of participants who responded 'daily'
* The Mann-Whitney U test was performed to explore significant differences (using $P < 0.05$ as a criterion) between the characteristics of the nursing students from Generation Z and the students from other generations

The percentage of missing values for each variable of interest ranged from 0% to 18.6%, which was substituted using the five-times multiple imputation method. As a result, the findings presented in this article are based on 1,276 cases, which reflects a response rate of 48% (Figure 1). No significant differences were found with regard to demographic characteristics between students who completed the survey and those who partially completed the survey.

Of the 1,276 cases used for analysis, not every student automatically belonged to Generation Z; 163 students were born in earlier generations. The remaining 1,113 students were born after 1992 and therefore were considered part of Generation Z. The first three subquestions were based on the 1,113 Generation Z students. The fourth subquestion was answered by comparing the 1,113 Generation Z students with the 163 students born in earlier generations.

In some respects, the characteristics of the Generation Z nursing students differed significantly from the students born in earlier generations; Generation Z nursing students reported a higher use of smartphones but a significantly lower use of tablets/iPads, e-mail, and computers or laptops ($p \leqslant .05$). Students born in earlier generations were educated at a significantly higher level. The demographics of the participating students are listed in Table 2.

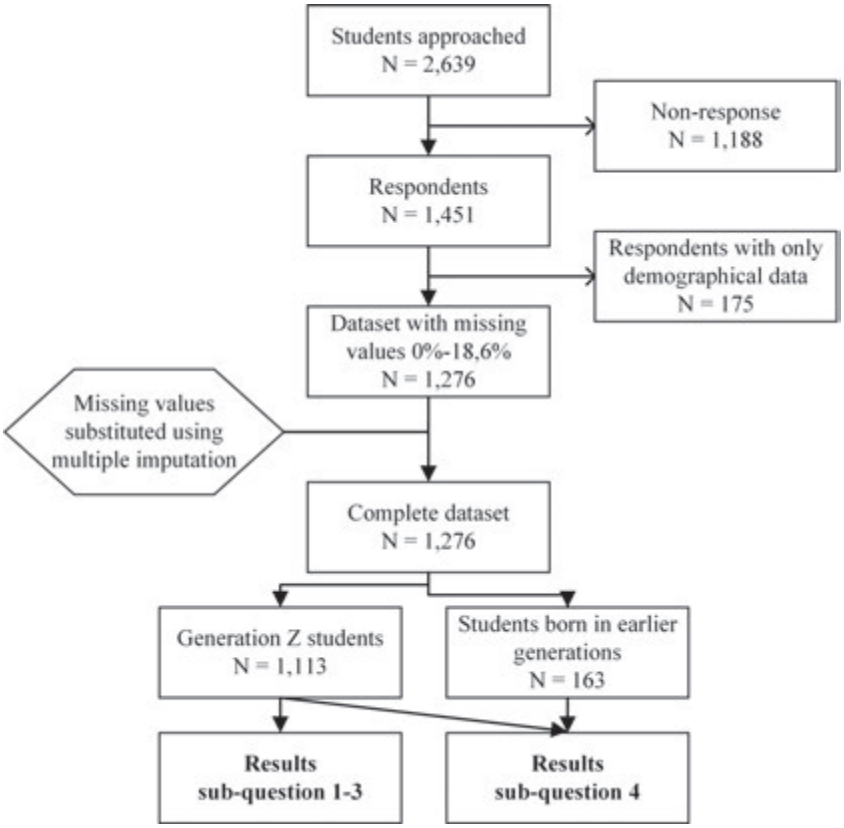

Figure 1. Flowchart showing responses.

Generation Z Nursing Students' View of Technology-Based Health Care

Figure 2 shows the median and interquartile range scores for nursing telehealth activities and common nursing activities, as reported by Generation Z nursing students. Generation Z nursing students' view of technology-based health care was explored with four comparisons, which were performed to answer the four subquestions of this study.

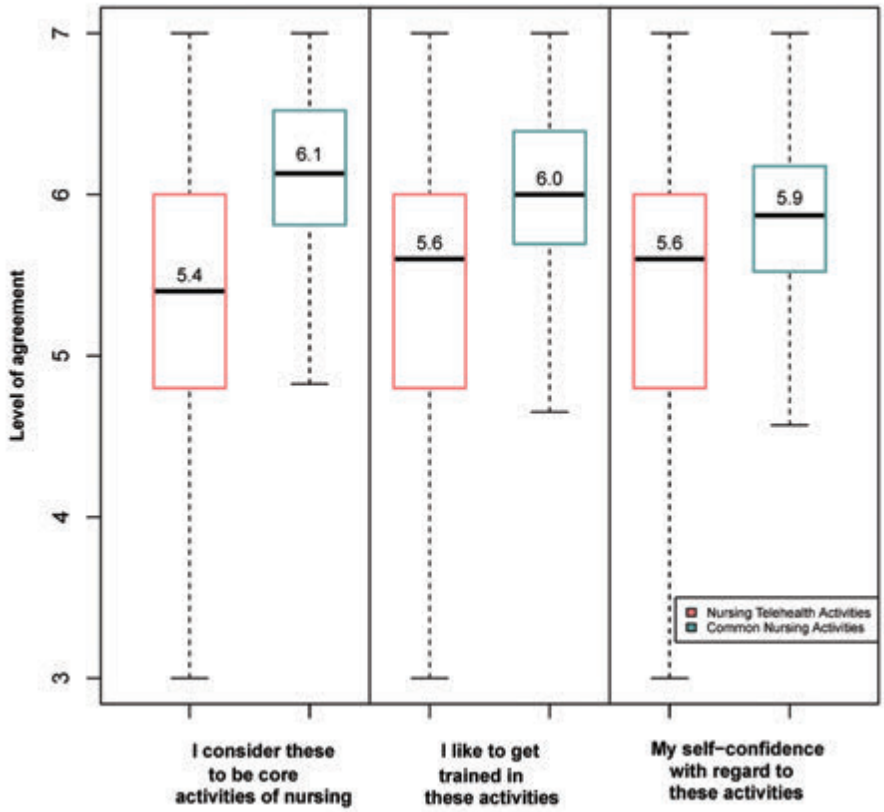

Figure 2. Generation Z nursing students' perceptions of telehealth activities (*n* = 1,113). Students reported significantly lower scores for nursing telehealth activities than for common nursing activities (using Wilcoxon signed rank test, $p \leqslant .001$; medium effect sizes for all three categories as measured on a 7-point scale. Outliers were excluded.

Do Students Consider Telehealth Activities to Be a Core Part of Nursing?

Generation Z nursing students did not consider nursing telehealth activities to be a core part of nursing equal in importance to common nursing activities. Moreover, they appeared to consider nursing telehealth activities a significantly smaller part

of nursing than common nursing activities (median, 5.4 versus 6.1 as measured on a 7-point scale, $p \leqslant .001$, ES = −0.54).

Do Students Want to Become Trained in Telehealth Activities?
Generation Z nursing students did not want to become trained in nursing telehealth activities as much as in common nursing activities. Furthermore, they appeared to be significantly less enthusiastic about becoming trained in nursing telehealth activities than in common nursing activities (median 5.6 versus 6.0 as measured on a 7-point scale, $p \leqslant .001$, ES = −0.48).

Confidence in Performing Telehealth Activities.
Generation Z nursing students' confidence in performing nursing telehealth activities was not equal to their confidence in performing common nursing activities. Moreover, they appeared to report significantly lower confidence in performing nursing telehealth activities than common nursing activities (median 5.6 versus 5.9 as measured on a 7-point scale, $p \leqslant .001$, ES = −0.39).

Generation Z Nursing Students' View Compared with Students Born in Earlier Generations. Students' view of the five nursing telehealth activities was measured on three levels: "I consider this a core task of nursing," "I look forward to becoming trained in this task," and "I think I will do very well in performing this task." No significant differences were found between the Generation Z nursing students and older generation nursing students in terms of their view of nursing telehealth activities (using $p \leqslant .05$ as a criterion).

DISCUSSION

This study aimed to explore Generation Z nursing students' view of technology-based health care. The study sought to determine whether Internet-generation nursing students actually have a positive view of technology-based health care, at least as positive as their view of common nursing activities. The results of this study indicate that the answer is they do not. Moreover, contrary to what was expected from the generation rhetoric, the 1,113 participating students in this study reported a significantly less positive view of telehealth activities than of common nursing activities, such as clinical reasoning. Another surprising result was that the Internet-

generation students (born between 1992 and 2000) did not have a more positive view of telehealth activities than their fellow students born in earlier generations (born before 1992).

Although the five telehealth activities received significantly lower values (Figure 2), the activities still had fairly high median scores, indicating that the students' valuation of telehealth activities was clearly not negative but ranged between *somewhat agree* and *agree*. In addition, when the activities were analyzed separately (Table 1), the results demonstrated that telehealth activities were not necessarily the least valued professional activity. For example, students reported an even lower median score (5.0) for "nursing entrepreneurship," described as "being aware of the economic and financial interest of the organization and ensuring this is embedded in your way of working."

Study Limitations and Strengths

To avoid selection bias caused by a complete cases approach, multiple imputation was used to impute the missing values for those participants who partially completed the survey. A group of 175 students completed only the demographic questions; thus, they provided too little information as a basis for imputing their missing values. Therefore, these students were excluded from further analyses. These excluded students had comparable demographic characteristics to the students who were included for analysis. However, there were slight, albeit significant, differences in their educational level and frequency of Internet use, which might reveal a selection bias.

Another limitation concerns the generalizability of these results to other countries. The data were collected only in The Netherlands. Thinyane (2010) found that digital natives can be considered a worldwide phenomenon; however, when focusing on specific types of technology, significant variances in usage patterns were found among students from different countries. This also might apply to health care technologies.

A strong point of this study is that all of the approached schools located throughout The Netherlands agreed to participate. In addition, a response rate of 48% is acceptable for a sampled survey population larger than 2,000 students, according to Nulty's (2008) guideline for surveys in higher education. The response rates differed

between the participating schools, ranging from 27% to 98%. As a kind of sensitivity analysis, the results of the school with the lowest response rate were compared with the results of the school with the highest response rate; no differences were found in outcomes related to the four subquestions of this study. Therefore, the selection bias due to non-response was negligible.

Integration With Prior Work

Prior studies (Jones, Ramanau, Cross, & Healing, 2010; Kennedy, Judd, Churchward, Gray, & Krause, 2008) have discovered considerable diversity with respect to the technological literacy of Generation Z individuals. The results of the current study confirm that researcher must be careful in making general statements about the technological literacy of a generation as a whole. The results show that one cannot say that students of Generation Z have a more positive view of telehealth care aspects of nursing than students of previous generations. In addition, the larger interquartile ranges of the telehealth activities in this study compared with the interquartile ranges of the three common nursing activities (Figure 2) imply a considerable variance within the study population with respect to their view of telehealth. Technology-based health care might require additional skills than the skills required for the use of common technologies, such as the Internet or a computer.

Although the survey approach does not allow causal inferences, it is suggested that emerging technology-based health care provision might be in contrast with students' expectations of their profession when they begin their nursing education. Dutch nurses feel valued when they take patients for a walk or help them out of bed (Nijhuis & van der Padt, 2003). The fear of losing this personal contact may impede their willingness to adopt telehealth (Brewster et al., 2014; Bürmann genannt Siggemann, Mensing, Classen, Hornberg, & Terschüren, 2013). These mechanisms also might play a role in the lower valuation of the telehealth activities compared with the valuation of common nursing activities reported by the current study population.

Implications for Nursing Education

Technology has become a core part of nursing curricula around the world (e.g., American Nurses Association, 2010; Australian Qualifications Framework, 2013; Steeringgroup Bachelor of Nursing 2020, 2015; Tuning Project, 2011). Educational institutes can play a key role in preparing future nurses for technology-based health care. Some suggestions are offered for improving the educational preparation of

future nurses in the three categories addressed by this study (i.e., "I consider this a core task of nursing," "I look forward to becoming trained in this task," and "I think I will do very well in performing this task").

How to Present Telehealth as a Core Activity of Nursing

The fact that health care technologies emerge at a fast rate and have become a core part of nursing still seems somewhat unreal to students. The rapidly growing market of health care technologies and the many examples of telehealth in current practice demonstrate the development of telehealth into a core part of nursing. Nursing students might fear that older adults lack the capacities to use new technologies. In this case, educators then can indicate that although in general it can be said older adults have poor digital literacy, there are examples from practice and research (e.g., Mitzner et al., 2010; Parker, Jessel, Richardson, & Reid, 2013) that demonstrate many older adults are willing and capable of using modern technologies.

How to Motivate Students to Become Trained in Telehealth

In anticipation of technological developments in health care, training in health professional–patient communication should include electronic communication (e.g., e-consultation and videoconferencing) (Frenkel, Chen, & ten Cate, 2016). As mentioned, however, nursing students might fear they will lose personal contact with patients, and as a result, they might be less interested in education with regard to telehealth. Educators then can respond by emphasizing the relevance of the technology, giving examples in which telehealth is integrated in routine care, and they can assuage the fear of losing personal contact by explaining that face-to-face contact will always continue to exist. This also might help inform students that the assumed negative impact on the staff–patient relationship is widely recognized in the literature but remarkably not experienced by nurses who already have experience with telehealth (Brewster et al., 2014).

How to Increase Nursing Students' Confidence That They Will Do Well in Performing Telehealth

Nursing schools can play a key role in helping students get used to telehealth and can increase their confidence that they will do well in performing telehealth. In general, strategies to increase self-confidence, which were suggested by Bandura (1977) many years ago, include verbal persuasion, vicarious experience, and performance accomplishments. Following this theory, nursing students' confidence can be

increased when nurse educators put them in a position where students are informed and encouraged to use telehealth, able to learn from role models (e.g., nurses who already work with telehealth in practice or patients who appreciate telehealth), and able to experience and practice with telehealth equipment (e.g., patient simulations). These educational interventions might support nursing students' confidence and encourage them to integrate health care technologies into their work.

Further Research

In further research, validity evidence must be collected to support these suggestions to improve nursing education. Mixed-method studies (experimental design and in-depth interviews) will increase the profession's understanding regarding what educational interventions support nurses' self-efficacy in providing technology-based health care.

CONCLUSION

Nurse educators must respond to the emergence of technology-based health care provision. According to generation rhetoric, one can argue that digital natives are already adequately equipped for this alternative type of care provision. However, this study shows the opposite and emphasizes the need for adequate telehealth technology education for all nurses, independent of their knowledge or lack of knowledge about the Internet. Educational institutions should play a key role in this transition of health care by integrating health care technology into their curricula.

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CHAPTER 6

HOSPITAL NURSES' SELF-REPORTED CONFIDENCE IN THEIR TELEHEALTH COMPETENCIES

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ABSTRACT

Background

The diffusion of telehealth into hospital care is still low, partially because of a lack of telehealth competence among nurses. In an earlier study, we reported on knowledge, skills and attitudes (KSAs) nurses require for the use of telehealth. In the current study, we shed light on hospital nurses' confidence in possessing these telehealth KSAs.

Methods

In a cross-sectional study, we invited 3,543 nurses from three hospitals in the Netherlands to rate their self-confidence in 31 telehealth KSAs on a 5-point Likert scale, using an online questionnaire.

Results

In total, 1,017 nurses responded to the survey. Nine KSAs were scored with a median value of 4.0, 19 KSAs with a median value of 3.0, and three KSAs with a median value of 2.0.

Conclusions

Since hospital nurses only have confidence in possessing 9 of the 31 essential telehealth KSAs, continuing education in additional KSAs is required to support hospital nurses in gaining confidence in using telehealth.

Keywords: Nursing telehealth activities, eHealth, training, competencies, telehealth self-efficacy

INTRODUCTION

Telehealth services are described as an important strategy and future direction for hospitals to, for example, reduce hospital readmission (Kripalani, Theobald, Anctil, & Vasilevskis, 2014). Unfortunately, the diffusion of telehealth is still slow, likely because of a lack of confidence among nurses in possessing essential telehealth competencies (Brewster, Mountain, Wessels, Kelly, & Hawley, 2014). Although training and education are often suggested as strategies to increase nurses' confidence (Giordano, Clark, & Goodwin, 2011; Kort & van Hoof, 2012; Sharma & Clarke, 2014; van Houwelingen et al., 2015), little detail is provided about what content should be included in nursing telehealth continuing education programs (Brewster et al., 2014).

To enhance hospital nurses' self-confidence in providing telehealth, they need to gain the appropriate competencies. This leads to the question "what competencies are necessary for nurses in order to use telehealth services?" This question was addressed in an earlier study (van Houwelingen, Moerman, Ettema, Kort, & ten Cate, 2016), in which we identified fourteen nursing telehealth care activities (e.g., 'providing health promotion remotely through videoconferencing'). For each activity a specific set of required knowledge, skills and attitudes (KSAs) was determined. In this study we concluded that, in total, nurses require 52 different KSAs for the provision of telehealth, including generic KSAs such as 'clinical knowledge' besides specific KSAs such as 'the ability to put patients at ease when they feel insecure about using technology'.

The 52 telehealth KSAs could serve to develop nursing telehealth care educational programs, which add to existing competencies. However, it is still unknown how much confidence nurses already have in possessing these KSAs. Our study aims to assess hospital nurses' self-rated confidence in possessing essential telehealth KSAs, summarized as telehealth care competence. This insight is needed for the development of nursing telehealth continuing education programs.

METHODS

Design

In a cross-sectional study in three hospitals in the Netherlands, a convenience sample of registered nurses was asked to rate their telehealth KSAs.

Setting and Population

Between October 2016 and March 2017, 3,543 registered hospital nurses were asked to join the survey by filling out an online questionnaire (using www.surveymonkey.com). No specific inclusion criteria were applied. All registered nurses in the Netherlands have completed senior secondary vocational nursing education or have a bachelor's degree in nursing education. The three hospitals that participated were located in the northern and central part of the Netherlands.

Survey Instrument

The survey began with seven sociodemographic questions: gender, age, educational degree, setting, inpatient or outpatient, experience with telehealth and daily use of digital technology. Subsequently, a list of 31 telehealth KSA items followed, derived from van Houwelingen et al. (2016) (all KSA items are listed in Table 2). For each item participants were asked to rate their confidence in possessing that KSA, e.g., 'I can communicate the benefits of telehealth technologies to patients', on a 5-point Likert scale including the labels: 1= totally disagree, 2= disagree, 3= neither agree, nor disagree, 4= agree, 5= totally agree.

Prior to our data collection, we collected validity evidence for the survey instrument, following the guidelines by Artino and colleagues (2014) for the development of educational research questionnaires. To assess the clarity and relevance of the KSAs in our survey, we interviewed three experts in telehealth who were selected from our network (all three were nurse specialists working on a daily basis with telehealth in the hospital setting).

As a result of the expert interviews, the number of KSAs items in the survey was reduced from 52 to 31 by excluding the 21 KSAs that were mentioned by van Houwelingen et al. (2016) as 'generic competencies' (e.g., clinical knowledge). We only included KSAs that were mentioned as 'subject specific competencies', i.e., the 32 KSAs that "are specifically required for the provision of telehealth, and would

not have been relevant without the emergence of telehealth" (van Houwelingen et al., 2016, p. 57).

To ensure that our participants would interpret the questionnaire items in the manner we intended, prior to survey administration we conducted cognitive interviews with six hospital nurses to understand their interpretation (Artino, La Rochelle, Dezee, & Gehlbach, 2014). Based on these interviews, some KSAs items were rephrased. For example, 'knowledge of the procedure: what to do in case of an emergency' was changed to 'knowledge of the procedure: what to do in case of an emergency during the use of telehealth'. Furthermore, in two knowledge items 'knowledge of relevant protocols' was addressed, which our participants found confusing. After a discussion with the experts, we decided to merge these two items, resulting in a survey with 31 telehealth KSAs.

To explore whether hospital nurses had additional thoughts about what should be included in continuing education in telehealth, the survey ended with one open-ended question: "Imagine that your organization will start or expand the use of telehealth, (e.g., 'Analyzing and interpreting incoming data derived from automatic devices for self-measurement', 'Providing health promotion remotely', 'Instructing patients and family care givers in self-care' or 'Guidance and peer consultation via videoconferencing'). In addition to the 31 competencies in this survey, you may still identify other needs for training. If so, please describe them in the textbox below".

Dealing With Missing Data

To avoid selection bias caused by only including the participants who had completed the survey (Janssen et al., 2010), missing values for those participants who partially completed the survey were imputed. We used a multiple-imputation technique, including logistic and linear regression (the default method in SPSS), to impute missing data, and generated five imputed datasets. The statistics reported in the results section are pooled statistics from the five imputed datasets.

Data Analysis

Normal Distribution

The distribution of the data was visually explored using histograms and tested with Kolmogorov-Smirnov tests. Because the data were not normally distributed, we could not use the typically used averages and standard deviations to report our

results. Therefore, for each of the 31 KSAs, the median value and related interquartile range (IQR) were calculated.

Nonparametric Mann-Whitney U Tests

Furthermore, since the data were not normally distributed, we used nonparametric tests to explore differences. Aiming to obtain a deeper understanding of a possible selection bias, Mann-Whitney U tests were performed in two ways. First, differences in demographic characteristics were tested between (a) participants who only responded to the demographic questions (and did not respond to the KSAs items) and (b) participants who fully or partially completed the survey including the KSAs items. Second, differences in self-rating scores on 'I'm open-minded to use new innovations in IT' were tested between (a) participants who directly responded to the first e-mail invitation to join the survey, and (b) those participants who joined the survey only after a reminder e-mail. This e-mail reminder included the phrasing: "to increase the reliability of the survey, nurses who do not have an affinity for telehealth are also invited to join the survey"). All statistical data analyses were performed using SPSS (IBM Corp. Released 2016. IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY).

Analysis of Responses to the Open-ended Question

The responses to the open-ended question on the survey were analyzed in accordance with the suggestions of O'Cathain and Thomas (2004) on how to handle open-ended questions on a survey in two steps. First, all answers were coded. These initial codes were discussed among the authors to organize and group the codes into meaningful categories/topics. Second, we searched for illustrative examples. The coding and analysis was performed in MAXQDA (software for qualitative data analysis, 1995-2016, VERBI Software – Consult – Sozialforschung GmbH, Version 12.2.1, Berlin, Germany). As a last phase of the data analysis, we tested whether those nurses who choose to answer the open-ended question differed from those who did not and compared these subgroups using Mann-Whitney U tests on age, gender, educational status, experience with telehealth and their self-rating scores on 'I'm open-minded to use new innovations in IT'.

Ethics Approval

The Ethical Review Board of the Netherlands Association for Medical Education (NVMO-ERB) approved this study. All nurses participated voluntarily in the survey.

Nurses were informed by a letter and told that they were free to decline to participate or to terminate participation at any time.

RESULTS

Sociodemographic Characteristics

Of the 3,543 nurses that were invited to participate, 1,040 nurses responded to the survey. Of them, 23 were excluded, since they only responded to the informed consent and not to any additional questions, leaving 1,017 participants.

Not all participants fully completed the survey. We compared the nurses who fully or partially completed the survey (n = 729) with those who responded only to the demographic questions (n = 288) and found slight, but significant ($P < 0.05$), differences between these two subgroups in three of the demographic items. Participants who only responded to the demographic questions (1) more often worked in inpatient (than outpatient) care, (2) more often had 'average' education (less often high), and (3) made less use of Skype or Facetime in their daily lives.

Of the 45 items in the survey, 32 had one or more missing values. The percentage of missing values for each variable varied from 0% to 28.3%. All missing values were imputed using a multiple imputation procedure. As a result, the findings presented in this paper are based on 1,017 cases, which reflects a response rate of 29%.

Most participants were female (88.5%, n = 900) and the majority had a bachelor's degree or higher (61.2%, n = 622) The median age of the participants was 41 years (IQR = 30-53). Approximately half of them (49.4%, n = 503) had experience with using telehealth. This experience was assessed by a close-ended yes/no question, so unfortunately, no insight could be gained about the length of experience. All sociodemographic characteristics are listed in Table 1.

Table 1. Sociodemographic Characteristics and Technology Experience of Participating Hospital Nurses (*N* = 1,017)

Characteristic	*n* %
Gender	
Female	900 (88.5)
Male	117 (11.5)
Age group (yrs)	
≤30	276 (27.1)
31-40	221 (21.7)
41-50	181 (17.8)
51-60	273 (26.8)
>60	66 (6.5)
Highest completed educational level	
Low (lower secondary education)	18 (1.8)
Average (general or vocational upper secondary education)	377 (37.1)
High (bachelor's degree or higher)	622 (61.2)
Setting	
Mental health hospital unit	56 (5.6)
Non-psychiatric hospital unit	961 (94.4)
Working inpatient/outpatient	
Inpatient	801 (78.8)
Outpatient	123 (12.1)
Both	93 (9.1)
Experience with telehealth[1]	
Yes	503 (49.5)
No	514 (50.5)
Daily use of technology[2]	
Smartphone	955 (93.9)
Tablet and/or iPad	541 (53.2)
Skype and/or Facetime	40 (3.9)
Internet	986 (97.0)
E-mail	966 (95.0)
Computer/Laptop	828 (81.4)

[1] Experience with, for example, electronic health records, videoconferencing, telemonitoring, falls detection.
[2] Participants were asked how often they used these six technologies in their daily life, which they answered on a 4-point scale ranging from 1 = daily to 4 = hardly ever. This table presents the frequencies of participants who responded 'daily'.

Self-reported Confidence in Telehealth Knowledge, Skills and Attitudes

Nine telehealth KSAs were scored with a median value of 4.0, 19 KSAs had a median value of 3.0, and three items had a median value of 2.0. All self-rating scores are listed in Table 2 Table 2 also displays for how many nursing telehealth activities each of the KSAs is required, which indicated their relevance. These numbers are based on a prior study (van Houwelingen et al., 2016). Of the KSAs categories, skills most frequently scored high (median of 4.0). Five of the 15 skills items were scored with a median value of 4.0, compared to two of the nine knowledge items and two of the

seven attitudes. Of the three KSAs that were scored with a 'low' median value (2.0), all were all knowledge items, e.g., 'what to do if the technology does not work' (see Table 2).

Most items (19 of 31) had a median score of 3.0, meaning 'I neither agree, nor disagree that I possess this KSA'. Nurses had the most confidence in possessing 'basic IT skills, such as use of the Internet and a personal computer' (*Median* 4.0, IQR 4.0-5.0) and they had the least confidence in having knowledge of 'the procedure: what to do in case of an emergency during the use of telehealth' (*Median* 2.0, IQR 1.0-3.0).

Nurses' Suggestions for Continuing Education in Telehealth

Of the 1,017 respondents, 132 left a response to our optional open-ended question 'you may still identify other needs for training. If so, please describe them in the textbox below'. These 132 nurses were significantly older than the nurses who did not respond to the open-ended question (*Median* age of 48.0 versus 40). We found no difference with regard to gender, educational status, experience with telehealth or their self-rating on 'I'm open-minded to using new innovations in IT'.

The initial coding process of the responses to the open-ended question resulted in 160 coded text segments, which could be divided into five topics. Remarkably, the most prevalent topic (45% of all 160 text segments) was not directly related to the topic of our question (acquiring telehealth competencies), but concerned general statements about telehealth, (e.g., "telehealth is a positive development" or "telehealth is not applicable to our work" or "telehealth is an undesirable development").

The second most prevalent topic (29%) was directly related to sour question and included all kinds of wishes, needs or suggestions related to continuing education in telehealth, which will be discussed below. The other three topics concerned '(technical) feedback on the survey' (14%) (e.g., a word missing in one item), 'statements on the importance of training' (9%) (e.g., "education is really important") or 'other' (3%) ("I'm retiring in a couple of months, so I didn't get into this"). Below, we only discuss the second category (acquiring telehealth competencies), since these comments are directly relevant to this study.

Table 2. Hospital Nurses (*N* = 1,017) Self-Reported Confidence in Their Telehealth Knowledge, Skills and Attitudes

	I have knowledge of...	Median (1st quartile – 3rd quartile)	Required for how many Activities[1] a
1.	the potential benefits of telehealth and social media	4.0 (3.0-4.0)	2
2.	how to collect health-related data for monitoring patient's healtht	4.0 (3.0-4.0)	1
3.	how telehealth can be deployed in existing pathways	3.0 (2.0-3.8)	4
4.	the limitations of telehealth in providing health care	3.0 (2.0-3.6)	4
5.	how technology can be used in sharing information with colleagues	3.0 (2.0-4.0)	3
6.	the laws and regulations concerning the protection and exchange of medical data, e.g., data protection, informed consent and confidentiality	3.0 (2.0-4.0)	3
7.	policies, procedures and protocols of the organization concerning the deployment of telehealth technologies	2.0 (2.0-3.0)	5
8.	what to do if the technology does not work	2.0 (2.0-3.0)	1
9.	the procedure: what to do in case of an emergency during the use of telehealth	2.0 (1.0-3.0)	5
	Skills: I...		
1.	have basic IT skills, such as the use of the Internet and a personal computer	4.0 (4.0-5.0)	3
2.	am able to use electronic health records	4.0 (3.4-5.0)	1
3.	am able to check IT equipment for functionality	4.0 (3.0-4.0)	3
4.	have skills in the field of contemporary technologies	4.0 (3.0-4.0)	2
5.	protect the privacy of self and the patient by taking into account ethical, legal and regulatory considerations during the use of telehealth technologies	4.0 (3.0-4.0)	2
6.	can train the patient in using IT equipment	3.0 (3.0-4.0)	4
7.	can combine my nursing knowledge and experience effectively when using telehealth technology and decision-making	3.0 (3.0-4.0)	7
8.	can communicate the benefits of telehealth technologies to patients	3.0 (2.7-4.0)	2
9.	can assess whether telehealth technology is convenient for the patient (for example based on their cognitive ability, technological skills)	3.0 (2.4-4.0)	3
10.	am able to create a confidential environment and a pleasant atmosphere in video conferencing	3.0 (3.0-4.0)	1
11.	can put patients at ease when they feel insecure about using technology	3.0 (3.0-4.0)	4
12.	can assess the needs and preferences of the patient with respect to telehealth	3.0 (2.0-4.0)	3
13.	can assess the reliability of health information on the Internet; websites, and mobile applications and advise patient about these apps and sites. I can also advise patients on how to use medical record portals in a safe way.	3.0 (2.0-4.0)	1
14.	am able to recognize (at a distance) the needs of the patient and determine the care situation	3.0 (2.0-4.0)	7
15.	can communicate clearly in videoconferencing and have knowledge of the key points (e.g., use of voice, light, background)	3.0 (2.0-4.0)	5

	Attitudes: I...	Median (1st quartile – 3rd quartile)	Required for how many Activities[1] a
1.	am open-minded about using new innovations in IT	4.0 (3.4-4.0)	1
2.	use an ethically correct attitude during videoconferencing (honesty, confidentiality, personal and professional integrity)	4.0 (3.0-4.0)	8
3.	can convey empathy through videoconferencing by facial expression and verbal communication	3.2 (3.0-4.0)	6
4.	encourage the use of electronic measurement devices for the collection of detailed patient information	3.0 (3.0-4.0)	2
5.	am able to promote a feeling of confidentiality and privacy in videoconferencing	3.0 (3.0-4.0)	4
6.	have confidence that telehealth technology is not difficult to use	3.0 (3.0-4.0)	1
7.	am able to convey confidence in the deployed technology to patients	3.0 (3.0-4.0)	1

Note. Measured on a 5-point scale, ranging from 1= totally disagree to 5= totally agree. Statistics were pooled from 5 imputed datasets. Items arranged from high to low based on the median values and interquartile range within each category (KSA). The items were derived from 'Competencies required for nursing telehealth activities: a Delphi-study' (van Houwelingen et al., 2016).

[1] Van Houwelingen et al., 2016 describe 14 Nursing Telehealth Entrustable Professional Activities (NT-EPAs). Some of the KSAs were required for several activities, some for only 1, which indicates the importance of the different KSAs for practice.

Table 3. Nurses' Suggestions of Additional Topics to Be Included in Continuing Education in Telehealth

	Suggested topics to be covered	Comments given	Frequency of similar comments
1.	Training in the following activities: • Analyzing and interpreting incoming data derived from (automatic) devices for self-measurement • Providing health promotion remotely • Instructing patients and family care givers in self-care • Guidance and peer consultation via videoconferencing	"I cannot think of any other additional components at this time." (#48, female, 31 years)	13
2.	Use of (new) devices: use, safety, practical aspects	"I think it's a good way to communicate remotely. However, this requires clear agreements regarding the use and security, both for the patient and clinic" (#528, female, 58 years)	12
3.	Providing health care remotely, e.g., medication check, video communication	"I have no experience in working like this, but it seems to me a challenge to learn. I understand that some training is needed to master this way of communicating." (#949, female, 64 years)	6
4.	Laws and regulations	"It's good to not only name the laws and legislation in protocols but also hear it during a training" (#71, female, 45 years)	2
5.	Informing/explaining to patients about the use of telehealth	"That it [telehealth] will be useful for a particular group, I agree, but not everyone will be able yet to use it. In explaining remote technology, I need training." (#252, female, 53 years)	2
6.	Good communication skills	""Advice on good communication / questioning about complaints" (#442, female, 27 years)	1
7.	Decision making on the basis of observations through video communication	"Making decisions based on video communication; when and how do you send someone and when can you make the decision yourself?" (#534, female, 45 years)	1
8.	Follow-up care through video communication	"Video communication and / or remote monitoring, for example in follow-up care of patients, or family members of patients. Perhaps this threshold is lower than if you need to make an appointment" (#89, female, 51 years)	1
9.	All options and possibilities	"I feel sorry if there are options that I do not discover and therefore, do not use. There must be training courses for this purpose" (#425, female, 25 years)	1
10.	Stimulating patients in the use of the electronic health record	"The electronic health record, where the patient can follow everything online. Train nurses how this works and how they can inform or stimulate the patient" (#589, female, 23 years)	1

Suggested topics to be covered	Comments given	Frequency of similar comments
11. Time to maximally benefit from the technology	"Time to use the technology optimally" (#545, female, 57 years)	1
12. The whole process	"I'm not very good with the latest IT gadgets, I would like to have training in the whole process" (#313, female, 31 years)	1
13. Good practice	"I think I only know what I cannot, if I start using it more, and then I know where I'm struggling with. Practicing on beforehand, seems desirable to me" (#316, female, 60 years)	1
14. Typing skills (keyboarding)	"Many colleagues cannot type quickly (especially the older colleagues). They never followed a typing course. I think it's crucial for them to process information quickly" (#425, female, 25 years).	1
15. Applicability of telehealth	""I would like to have explained the possibilities and applicability of this item [telehealth activities] (for me a fairly new area)." (#259, female, 50 years)	1
16. Developing a uniform way of using telehealth	"Training to develop a uniform way of working with each other and to be aware of the different protocols we use." (#584, female, 29 years)	1

Within the category of acquiring telehealth competencies, 16 different suggestions were identified. Four suggestions recurred in multiple answers, and the other 11 were mentioned only once ($n = 1$). The two most prevalent suggestions were (1) to obtain continuing education in the four examples of nursing telehealth activities that were given (see Table 3) and (2) continuing education in the practical use of devices, attention to, e.g., use, safety, video communication. All 16 suggestions are listed in Table 3 and provided with a related comment of a participant.

DISCUSSION

Hospital nurses' confidence in possessing essential telehealth care KSAs in 9 of 31 items was 'good' (*Median* 4.0 on a scale from 1-5, e.g., 'knowledge of the potential benefits of telehealth and social media'). In 19 KSAs nurses had 'moderate' confidence in possessing these (*Median* 3.0). Nurses appeared to have 'low' confidence in three KSAs (*Median* 2.0, e.g., 'knowledge of policies, procedures and protocols of the organization concerning the deployment of telehealth technologies').

Integration With Prior Research

In the current study, we illustrated nurses' limited confidence in possessing the required telehealth KSAs, but the slow diffusion of telehealth services into hospital care could also be explained by other factors. According to national policy plans, funding for telehealth services in hospital care will be further realized and regulated from 2018 onwards (Dutch Healthcare Authority [Nederlandse Zorgauthoriteit (NZa)], 2017). The limited (financial) possibilities of hospitals, until now, might have also limited nurses' chances to gain experience with the use of telehealth. We started our introduction by mentioning that nurses' lack of telehealth competence can hamper the use of telehealth, but it can also work the other way around. The limited availability of telehealth services in hospitals eliminates the opportunity for nurses to have successful experiences, which could improve nurses' self-confidence (Bandura, 1977).

In prior research, executed in Australia by Eley et al. (2008), the same general conclusion was drawn: nurses need additional education to improve their confidence in using IT. Eley et al. (2008) also studied nurses' confidence in using IT, but with a focus solely on possessing 'technical IT skills', e.g., Spreadsheets, Windows, Apple, Touch Screen. Our study adds to that literature, as we not only measured nurses' confidence in operating a certain IT device, but subsequently whether they felt able to integrate this device into healthcare, for example through the skill "able to create a confidential environment and a pleasant atmosphere in video conferencing".

Carter et al. (2010) explored the educational needs in 'telepractice' (i.e., the delivery of care provided via information and communication technologies) of nurses in Canada and mentioned that providers of telehealth education programs could include colleges, universities, nursing associations, telehealth organizations or hospitals. For

hospitals, the results of our study can be used as a starting point in the development of continuing education programs by considering which KSAs were scored as moderate or low (further discussed under 'implications for continuing education').

Study Limitations

Using a cross-sectional survey design brings the risk of a biased response (Levin, 2006), where individuals with a certain set of characteristics are more likely to respond. This might also apply to our survey, with a response rate of 29%. Therefore, we compared those who responded directly to the survey (n = 665) and those who only responded after a reminder e-mail was sent (n = 353) on their self-rating on 'I'm open-minded about using new innovations in IT'. Nurses who responded only after the reminder e-mail appeared to be significantly ($P < 0.01$) less open-minded about using new innovations in IT. Therefore, we argue that the sample selection bias, due to the initial non-response, was decreased by sending the reminder e-mail, which might have encouraged the 'less open-minded to IT nurses' to join our survey.

Another limitation concerns the generalizability of our study. Our results can be generalized to the three participating hospitals, but we do not know whether the confidence levels we found apply to nurses in general. Furthermore, our open-ended question, 'In addition to the 31 competencies in this survey, you may still identify other needs for training. If so, please describe them in the textbox below', was only answered by 132 participants. Non-responders (n = 885) may have thought that education on the 31 KSAs would be sufficient. The 132 participants who did respond reflect only 13% of our total study population. Moreover, the two suggestions were most frequently mentioned, 13 and 12 times, respectively, represented 1.3% and 1.2% of all participants. Therefore, we believe these examples might provide insight into *how* nurses *can* think of what components are essential for continuing education in telehealth, but they do not provide a reliable overview of what hospital nurses actually need for education. The results can provide a starting point for the design of continuing education programs.

Implications for Continuing Education / Staff Development

A positive self-perception of competence is associated with behavioral change (Bandura, 1977). This also applies to the context of nursing telehealth; more confidence in telehealth competence is positively associated with nurses' willingness to use telehealth services (Lam, Nguyen, Lowe, Nagarajan, & Lincoln, 2014; van

Houwelingen et al., 2015). Hence, the results of our can be used for the development of continuing education programs aimed at increasing nurses' willingness to use telehealth services.

In our earlier study (van Houwelingen et al., 2016), all 31 telehealth care KSAs of our survey were considered relevant to nursing practice. However, it was unclear whether all of these 31 KSAs should be included in continuing education in nursing telehealth . Our study revealed that hospital nurses' confidence in 22 of the 31 KSAs was moderate or low (see Table 2). Therefore, we consider these 22 KSAs relevant to be included in continuing education in nursing telehealth.

When hospitals seek to further narrow down components in their continuing education in telehealth, they could exclude some of the KSAs based on the frequency of nursing telehealth activities they are required for. For example, in our final recommendation for staff development (Table 4), we included only those KSAs that are required for at least four different nursing telehealth activities (according to van Houwelingen et al. (2016)). Seven of these KSAs were scored with a median of 2.0 or 3.0, and one attitude was scored with a median value of 4.0 (IQR 3.0-4.0), i.e., 'An ethically correct attitude during videoconferencing'. Although the majority our study population appeared to have 'good' confidence in possessing this attitude, we do recommend to educate hospital nurses in this attitude, as this attitude is required for eight different activities. In Table 4 we present eight highly recommended components to include in continuing education in telehealth, based on our results, including those from prior research (van Houwelingen et al., 2016).

Table 4. Highly Recommended Components for Continuing Education in Nursing Telehealth in Hospitals

	Essential training components	Based on[1]
1.	*Knowledge* of policies, procedures and protocols of the organization concerning the deployment of telehealth technologies	Low score + relevance
2.	*Knowledge* of what to do if the technology does not work	Low score
3.	*Knowledge* of the procedure: what to do in case of an emergency during the use of telehealth	Low score + relevance
4.	*Skills* to combine clinical experience effectively with telehealth care technology in decision-making	Medium score + relevance
5.	*Skills* to be able to recognize (at a distance) the needs of the patient and care situation (empathy)	Medium score + relevance
6.	*Skills* to communicate clearly in videoconferencing and know what to do to enhance contact (e.g., use of voice, light, background)	Medium score + relevance
7.	*Attitude*: conveying empathy through videoconferencing by facial expressions and verbal communication	Medium score + relevance
8.	*Attitude*: an ethically adequate attitude during videoconferencing (honesty, confidentiality, personal and professional integrity)	High relevance

[1] Nurses (*n* = 1,017) expressed their confidence in possessing 31 different telehealth knowledge, skills and attitudes (KSAs), on a scale from 1 (lowest) to 5 (highest). 'Low score': median of 2.0; 'medium score': median of 3.0. The KSAs are required for a different amount of nursing telehealth activities, which indicates their relevance for practice (van Houwelingen et al., 2016). 'Relevance' indicates: required for at least five different nursing telehealth activities. 'High relevance' indicates: required for 8 nursing telehealth care activities.

Table 4 provides insight into in which KSAs nurses should gain more confidence, for example via continuing education. When thinking of how to deliver continuing education in telehealth, Bandura's (1977) strategies to increase self-confidence might be useful. Hospital nurses' telehealth confidence might increase when they have successful experiences (performance accomplishments). Another possibility for continuing education is to have nurses learn by observing role models (vicarious experience) in clinical practice, e.g., those with experience in telehealth services. During continuing education, educators can encourage participants to share experiences in using telehealth services. Positive experiences of significant others, such as colleagues, might also help nurses in gaining self-confidence in their own telehealth competence.

Although facilitating training courses in telehealth can accelerate the process of acquiring competence, there are several other strategies for continuing professional development, among which a deliberate and thoughtful use of clinical experience (Pool, Poell, Berings, & ten Cate, 2015). As a kind of sensitivity analysis, we compared

the confidence levels of the nurses of our sample with (n = 503) and nurses without telehealth experience (n = 514). Nurses with telehealth experience reported significantly higher ($P < 0.01$) confidence levels for both telehealth knowledge, skills and attitudes, indicating that 'experience' is also an important factor to gain competence.

CONCLUSIONS

When hospitals consider increasing nurses' confidence in telehealth competence, they should be aware that the majority of the nurses in this study already have self-confidence in 9 of the 31 required telehealth care KSAs. At the same time, nurses' confidence in 19 of the 31 KSAs is moderate or low, and continuing education in additional KSAs for telehealth is highly recommended. In the current study, we specifically revealed 8 KSAs that we recommend be included in continuing education programs in nursing telehealth . Continuing education in these essential telehealth KSAs might support hospital nurses in using telehealth services and contribute to increasing the diffusion of telehealth services into hospitals.

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CHAPTER 7

TRAINING NURSES TO INCREASE THEIR KNOWLEDGE, SELF-EFFICACY AND USAGE OF TELEHEALTH: A MULTI-SETTING PRETEST-POSTTEST STUDY

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ABSTRACT

Background

Education is a major strategy to overcome the barriers associated with telehealth use by nurses. In an earlier study, fourteen core nursing telehealth activities and required competencies were described and proposed for the development of telehealth training programs for nurses. However, the nature and effectiveness of such training has not yet been specified and tested in practice.

Objectives

To establish the effectiveness of a training in essential telehealth competencies on nurses' subjective knowledge, self-efficacy and use of telehealth.

Methods

A two-day training in nursing telehealth activities (e.g., 'providing health promotion remotely') was evaluated in 1) primary care, 2) homecare and 3) hospital care settings. Outcome measures of the first three levels of Kirkpatrick's hierarchy were collected: 1) reaction; 2a) knowledge and self-efficacy regarding telehealth before, after and 6-10 weeks after the training, and 3) behavior effects, the number of remote consultations provided 6-10 weeks after the training compared to 6-10 weeks before training.

Results

Twelve primary care (PC), fourteen homecare (HC) and eleven hospital (H) nurses received training. They evaluated the training with median scores of 8.0 (PC), 9.0 (HC) and 8.0 (H) on a 10-point scale. In each team, telehealth knowledge during the training significantly increased ($P < 0.05$). In two teams (PC and HC), this effect was maintained at the follow-up. In each team, nurses' telehealth self-efficacy was significantly increased 6-10 weeks after the training. After the training, the number of remote consultations (Kirkpatrick level 3) increased from 2 to 12 in primary care and 12 to 35 in homecare and decreased from 28 to 17 in the hospital setting.

Conclusions

Training in telehealth activities contributes to subjective telehealth knowledge and self-efficacy of nurses. Further research that examines additional barriers to

full utilization is needed since the effect on telehealth usage among nurses differed depending on the setting.

Keywords (4-8): Nursing activities, eHealth, eSkills, telehealth, Kirkpatrick's hierarchy, training evaluation

INTRODUCTION

The use of telehealth, a way to provide care remotely with technology instead of face-to-face interactions, is hampered in part by a lack of adequate telehealth competencies among nurses (Ariens et al., 2017; Kort & van Hoof, 2012). Telehealth education is frequently suggested as a strategy to overcome barriers in telehealth use (e.g., Brewster et al., 2014; European Commission, 2012; Giordano et al., 2011; Sharma & Clarke, 2014; van Houwelingen et al., 2015), politics (e.g., European Commission, 2012). However, to our knowledge, this assumption has not been explored. The current study aims to address this research gap.

Earlier studies (e.g., Gifford et al., 2012; Stromberg, 2011) have explored the effectiveness of telehealth training based on Kirkpatrick's level 1 'reaction', i.e., nurses' *perception* of the usefulness of the training, but no studies have addressed a potential added value of training on nurses' perception of learning (level 2a according to Yardley & Dornan (2012) or behavior (level 3). These higher levels are relevant when considering how to increase the utilization of telehealth. Nurses' confidence in their telehealth competence appears to be positively associated with their willingness to use telehealth (Lam et al., 2014; van Houwelingen et al., 2015). Therefore, it is relevant to evaluate the impact of training on knowledge of telehealth and self-efficacy of nurses (Kirkpatrick level 2a: self-perception of learning). Furthermore, insight into the impact of training on telehealth use frequency by nurses (Kirkpatrick level 3: behavior) is required since many studies *assume* that training is an adequate strategy to overcome telehealth barriers, but this has not been established.

Therefore, the current study aims to evaluate the effectiveness of training in telehealth competencies not only on Kirkpatrick level 1 but also on levels 2a and 3. Prior to this evaluation, a course in nursing telehealth activities was developed. In an earlier study, a set of core nursing telehealth activities and required competencies were identified (van Houwelingen et al., 2016) and recommended for use in the development of nursing telehealth training programs. We followed this suggestion and used these activities and competencies as a framework for the development of a two-day telehealth training. Subsequently, the training was delivered to three nursing teams. In this study, we report the extent to which this training contributed to telehealth knowledge, self-efficacy and usage in nursing practice.

METHODS

Design

A multi-setting study was conducted using a pretest-posttest method during a nursing telehealth training among three nurse settings.

Sampling and setting

We approached a convenience sample of three nursing teams from our own network with the offer of providing a nursing telehealth training to integrate nursing telehealth in daily practice. All teams were already using telehealth. The teams were employed in primary care, homecare or hospital care in The Netherlands (see Table 1).

Table 1. Characteristics of Participating Settings

Characteristics	Setting 1	Setting 2	Setting 3
Type of setting	Primary care	Homecare	Hospital care
Number of nurses	15	14	15
Patients	Community-dwelling	Community-dwelling	Dermatology
Location	City of Utrecht	Region of Utrecht	City of Utrecht
Type of telehealth / remote consultations	Electronic consultation, a secure web-based platform for nurse-patient communications.	A tablet to provide home telehealth videoconferencing, screen-to-screen communication.	Electronic consultation, a secure web-based platform for nurse-patient communications, integrated into the patient portal.
Initiation of remote consultations	The patients initiate the consult by asking a question, and nurses respond. Nurses have a role in stimulating patients to make use of the electronic consultations function.	Both nurses and patients can initiate a consultation through videoconferencing.	The patients initiate the consult by asking a question, and nurses respond. Nurses have a role in stimulating patients to make use of the electronic consultations function.

Prior Telehealth Experience and Training

In the past, all three teams had received a short training or instruction for using the device offered by the provider of the device or application. All three teams expressed a lack of knowledge regarding the integration of telehealth in their work. At baseline

measurements of our study, all three teams had barely made use of telehealth (see Table 6).

Invitation to Participate

Nurses were invited by their manager or telehealth project leader to participate. The training was accredited by the Dutch Nurses and Carers Association, which encouraged nurses to participate since continuing education from time to time is required to maintain registration.

Educational Intervention: Training in Telehealth Activities and Educational Strategy

Nurses received two 2-3 hour trainings regarding how to integrate nursing telehealth activities in their daily work. The training sessions were delivered by the first or fourth author with a telehealth project leader or nurse specialist of their own organization.

The fourteen nursing telehealth activities (e.g., 'Assessing patient capacity to use telehealth', 'Monitoring body functions and lifestyle remotely using videoconferencing') derived from a prior study (van Houwelingen et al., 2016) were used as a framework in the development of the training. The goal of our educational intervention was that nurses would acquire these nursing telehealth activities and related knowledge, attitudes and skills.

In each setting, we first discussed which of the fourteen activities would be applicable. For example, since the primary care and the hospital team did not use a videoconferencing system, nursing telehealth activities involving videoconferencing were not applicable in these settings. This resulted in trainings of nine different telehealth activities in the homecare setting and three activities in the primary care and hospital settings (see Table 5). Nurses learned how to increase the use of telehealth by (1) initiating remote consultations and (2) encouraging patients to ask questions via the electronic consultation system.

Educational Strategy

The training aimed to increase nurses' knowledge and self-efficacy and, as a result, the use of telehealth in nursing practice. Therefore, Bandura's (1977) strategies to increase self-efficacy were used: (1) performance accomplishments by organizing

practices (starting with low complex videoconferencing practices), which gave the participants the opportunity to have successful experiences, (2) using vicarious experience by having participants see others accomplish difficult situations, and (3) verbal persuasion by acknowledging participant skills during telehealth practices.

A detailed description of our educational intervention is provided in appendix 1, written in accordance with the 'guideline for reporting evidence-based practice educational interventions and teaching (GREET)' (Phillips et al., 2016).

Data Collection

We collected data using questionnaires and user statistics on the first three levels of the Kirkpatrick hierarchy (Yardley & Dornan, 2012) at four time points: 6-10 weeks before the training (observation (O) 0), immediately before the training (O1), immediately after the training (O2) and six weeks after the training (O3) (see Figure 1). Below, we explain the method for collecting data in each level.

Figure 1. Outcome measures per observation moment and corresponding Kirkpatrick hierarchy levels (according to Yardley & Dornan (2012): 1=reaction, 2a=perception of learning, 3=behavior).

Sociodemographic Data

The survey began with five sociodemographic questions concerning gender, age, educational level, experience with telehealth, and daily use of technology (in private life).

Level 1, Reaction (Satisfaction and Perceived Usefulness With Regard to the Training)

In addition to measuring the effectiveness of the training, we evaluated nurses' satisfaction and perceived usefulness of the training to assess whether these findings in Kirkpatrick level 1 were in line with the findings in 2a and 3. Nurses expressed their satisfaction with regard to the training in two ways. First, defining satisfaction as the degree to which realistic expectations are met, one open-ended question

was asked: "What were your expectations of the training prior to the start?" This question was followed by a closed question to rate satisfaction on a 10-point scale (1-10) (higher scores indicating higher satisfaction).

Second, four items followed regarding the perceived usefulness of the training (e.g., 'I can apply the content of the training to my job'), derived from the 'Training Evaluation Inventory' (Ritzmann et al., 2014).

Level 2a, Perception of Learning (Subjective Knowledge About Telehealth)

Before and after the training, nurses rated their confidence in their knowledge about telehealth on a 5-point Likert scale (e.g., 'Knowledge of the potential benefits of telehealth'). These knowledge items were identified as essential to perform the nursing telehealth activities in which the nurses were trained (van Houwelingen et al., 2016). Since each activity required a specific set of knowledge items, the number of knowledge items that was part of the training differed among settings. We only measured nurses' confidence in those knowledge items that were part of the training. The primary care and hospital nurses responded to nine items, and the homecare nurses responded to twelve items (see Table 4).

Level 2a, Perception of Learning (Telehealth Self-Efficacy)

On level 2a, nurses also rated their confidence in acquiring the nursing telehealth activities in which they were trained before and after the training (see Table 5). We used Bandura's guide for constructing self-efficacy scales (Bandura, 2006). Accordingly, a 10-point scale was used, ranging from 1 = 'not at all able to' to 10 = 'totally able to'.

Level 3, Behavior: Number of Remote Consultations

In each setting, the number of remote consultations initiated by both nurses and patients was automatically registered. In homecare settings, remote consultations involved those using home telehealth videoconferencing with a tablet. In primary care and hospital care settings, electronic consultations were provided through a secure web-based platform for nurse-patient communications. We aimed to collect the number of consultations over a period of at least 12 weeks. In two settings, the project leaders of the participating organizations provided us with data over a longer period. Data were tracked over a period of 20 weeks (10 before, 10 after the training) in the primary care setting, 16 weeks in the homecare setting, and 12 weeks in

the hospital setting. To protect the anonymity of the participants, these data were collected and analyzed on a group level.

Data Analysis

The distribution of the data was visually explored for normality using histograms and tested with Kolmogorov-Smirnov tests. Since most data were not normally distributed, median and interquartile range scores were reported (with regard to training satisfaction, knowledge of telehealth and self-efficacy). Subsequently, nonparametric tests were performed to assess significant differences. First, differences in demographic characteristics among the three settings (primary care, homecare and hospital) were explored using Kruskal-Wallis tests for age, experience with telehealth, and daily use of technology. Chi-square tests were used for gender and education. Furthermore, the following analyses were performed on the three different Kirkpatrick levels.

For level 1, the median and interquartile scores of the items with regard to the satisfaction and perceived usefulness of the training were analyzed and reported for each nursing setting separately.

For level 2a, subjective knowledge of telehealth and self-efficacy in nurses was compared between the pre- and post-tests using Wilcoxon Signed-Rank Tests. For each setting, we explored whether the knowledge items and self-efficacy items were significantly different between observation 1 (pre-test) and observation 2 (directly after the training) as well as between observation 1 and observation 3 (six weeks after the training).

Additionally, to summarize the findings, we calculated the average score of the subjective knowledge items (for all three observation moments) for each respondent as well as the average score of the self-efficacy items. Again, these average scores were tested for differences between observation 1 and observation 2 and between observation 1 and observation 3 using Wilcoxon Signed-Rank Tests.

For level 3 (behavior), the user statistics (number of remote consultations) were analyzed with descriptive statistics. For each setting, we reported the total number of remote consultations in the 6-10 weeks before the training and the total number of remote consultations provided in the 6-10 weeks after the training.

A *P*-value of < 0.05 was defined as statistically significant. To increase the power of the Mann-Whitney U tests and Wilcoxon Signed-Rank Tests, we used the Monte Carlo simulation (with a confidence level of 99%) to assign *P*-values. Data analyses were performed using SPSS (IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp) and the statistical package R (version 3.2.3 (2017-03-06), The R Foundation for Statistical Computing).

Ethics Approval

The Dutch Ethics Review Board of Medical Education (NVMO-ERB) approved this study (NERB approval number 637). All nurses participated voluntarily in the training and accompanied research. Prior to the research and training, nurses were informed about the aim and amount of training and research by a letter and were told that they were free to participate or to terminate participation at any time.

RESULTS

Sociodemographic Characteristics

Twelve out of a team of fifteen primary care nurses, fourteen homecare nurses and eleven out of a team of fifteen hospital nurses volunteered to participate in the training. Due to conflicting calendars, two of the nurses in each setting missed the second training session.

There were two trainings, each lasting 2-3 hours, with one or two weeks between the two training sessions. In each setting, only one male participated. The length of experience with telehealth varied, though not significantly, between the primary care and hospital setting; hospital nurses had adequate experience (eight of eleven nurses >2 years), and most primary care nurses had 6-12 months experience or less. Most homecare nurses (twelve of fourteen) had just started using telehealth (1-6 months of experience). All other demographic details are listed in Table 2.

Table 2: Sociodemographic Characteristics of Participating Nurses

Characteristic	Primary care (*n*=12)	Homecare (*n*=14)	Hospital (*n*=11)
Gender, *n* (%)			
Female	11 (91.7)	13 (92.9)	10 (90.9)
Male	1 (8.3)	1 (7.1)	1 (9.1)
Age group (yr), *n* (%)			
≤30	3 (25)	0	2 (18.1)
31-40	2 (16.7)	2 (14.3)	1 (9.1)
41-50	3 (25)	6 (42.9)	2 (18.2)
51-60	4 (33.3)	5 (35.7)	3 (27.3)
>60	0	1 (7.1)	3 (27.3)
Highest completed educational level, *n* (%)			
Average (general or vocational upper secondary education)	1 (8.3)	1 (7.1)	0
High (bachelor's degree or higher)	11 (91.7)	13 (92.9)	11 (100)
Experience with telehealth, *n* (%)			
None	4 (33.3)[1]	0	3 (27.3)[1]
1-6 months	1 (8.3)[1]	12 (85.7)[2]	0
6-12 months	5 (41.7)[1]	1 (7.1)[2]	0
1 – 2 years	1 (8.3)[1]	0	0
>2 years	1 (8.3)[1]	1 (7.1)[2]	8 (72.7)[1]
Daily use of technology, *n* (%)**			
Smartphone	12 (100)	14 (100)	11 (100)
Tablet and/or iPad	6 (50)	11 (78.6)	7 (63.6)
Skype and/or FaceTime	0 (0)	0	0
Internet	12 (100)	13 (92.6)	10 (90.9)
E-mail	12 (100)	13 (92.6)	11 (100)
Computer/Laptop	9 (75)	12 (85.7)	9 (81.8)

[1] Experience with electronic consultations; nurse-to-patient communications within a secure web-based platform
[2] Experience with home telehealth videoconferencing
**) Participants were asked how often they used these six technologies in their daily life, which they answered on a 4-point scale ranging from 1 = daily to 4 = hardly ever. This table presents the frequencies of participants who responded 'daily'

Level 1: Reaction (Satisfaction and Perceived Usefulness of the Telehealth Training)

In each setting, the extent to which training expectations were met differed; a median value of 8.0 (scale 1-10) was found in the primary care and hospital setting, and a median value of 9.0 was found in the homecare setting. All items with regard to the perceived usefulness of the training were scored with a median value of 4.0 (5-point scale) (see Table 3).

Table 3. Satisfaction and Perceived Usefulness of the Training

	Primary care (*n* = 12) Median (Q1-Q3)	**Homecare (*n* = 14)** Median (Q1-Q3)	**Hospital (*n* = 11)** Median (Q1-Q3)
On a scale of 1-10, to what extent have these expectations been met?	8.0 (7.0 – 8.0)	9.0 (8.0 – 10.0)	8.0 (6.5 – 8.0)
I find the training useful for my job (scale 1-5)*	4.0 (4.0 – 4.0)	4.0 (4.0 – 4.8)	4.0 (4.0 – 4.0)
Investing time in this training was useful (scale 1-5)*	4.0 (3.0 – 4.0)	4.0 (4.0 – 5.0)	4.0 (3.5 – 4.0)
I can apply the content of this training in my job (scale 1-5)*	4.0 (3.8 – 4.0)	4.0 (4.0 – 5.0)	4.0 (3.5 – 4.5)
I derive personal use from this training (scale 1-5)*	4.0 (4.0 – 4.3)	4.0 (4.0 – 5.0)	4.0 (3.5 – 4.0)

Note. Measured directly after the training. Since the data were not normally distributed, median scores are reported.
*) Perceived usefulness items derived from the Training Evaluation Inventory (Ritzmann et al., 2014)

Level 2a: Knowledge About Telehealth Before and After the Telehealth Training

In each team, based on the total score of the knowledge items, nurses' knowledge about telehealth significantly (P <0.05) differed immediately after the training (see Figure 2). Between observations 1 and 2, the median values and corresponding first and third quartile (Q1-Q3), measured on a 5-point scale, shifted from 2.9 (Q1-Q3: 2.6-3.6) to 3.7 (Q1-Q3: 3.4-3.8) in the primary care setting, 3.0 Q1-Q3: 2.7-3.1) to 4.0 (Q1-Q3: 3.8-4.1) in the homecare setting, and 3.3 (Q1-Q3: 3.1-3.6) to 3.8 (Q1-Q3: 3.7-4.0) in the hospital setting.

Six to 10 weeks after the training, this increase was maintained in the primary and homecare settings, with median values of 3.7 (Q1-Q3: 3.4-4.1) in primary care and 4.0 (Q1-Q3: 3.8-4.3) in homecare. Hospital nurses' knowledge at observation 3 (median 3.8, Q1-Q3: 2.3-3.9) was also higher than knowledge at observation 1 (median 3.3, Q1-Q3: 3.1-3.6), but this difference was not significant (P >0.05).

In terms of item level, listed in Table 4, the data show that most differences between observations 1 and 2 were found in the homecare setting; 10 out of 11 items increased significantly (P <0.05) compared to only 1 out of 9 items in the primary care and hospital settings. A comparable pattern was observed between observations 1 and 3; 10 out of 11 items increased significantly in the homecare setting, 2 out of 9 in the primary care setting, and none in the hospital setting.

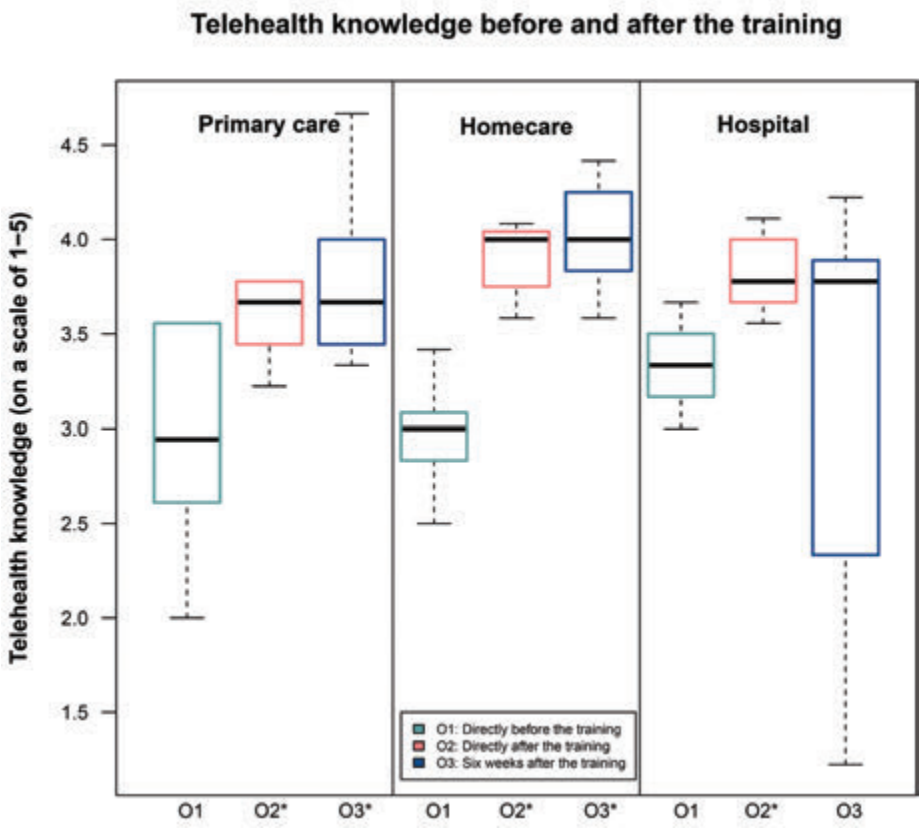

Figure 2. Nurses' knowledge about telehealth before and after the training, measured in primary care (*n* = 12), homecare (*n* = 14) and hospital (*n* = 11) settings. Box plot shows median, upper/lower quartile and extreme values. Maximum whiskers of O1 and O2 of primary care do not appear because the maximum values equal the third quartiles. Wilcoxon Signed-Rank Tests, using Monte Carlo simulation (confidence level of 99%) to assign *P*-values (2-tailed), were performed to assess significant differences between O1 and O2 and between O1 and O3.
*) Significantly higher ($P < 0.05$) than the pretest, observation 1 (O1).

Table 4. Nurses' Telehealth Knowledge Before and After the Training

		Primary care (*n* = 12)				
	Subjective knowledge of... (scale: 1-5)	**O1** Median (Q1-Q3)	**O2** Median (Q1-Q3)	**O3** Median (Q1-Q3)	**O1 vs O2** *P*-value	**O1 vs O3** *P*-value
1.	policies, procedures and protocols of the organization concerning the deployment of telehealth technologies	3.0 (2.0–3.8)	3.5 (2.0–4.0)	4.0 (2.5–4.0)	.189	.160
2.	the (clinical) limitations of telehealth	3.0 (2.0–4.0)	4.0 (4.0–4.0)	4.0 (4.0–4.0)	.063	.063
3.	how telehealth can be deployed in existing pathways	3.0 (2.0–3.8)	4.0 (4.0–4.3)	4.0 (4.0–4.5)	.009	.017
4.	the laws and regulations concerning the protection and exchange of medical data, e.g., data protection, informed consent and confidentiality	3.0 (2.0–3.0)	3.5 (2.0–4.3)	4.0 (3.0–4.0)	.569	.065
5.	the potential benefits of telehealth	4.0 (2.3–4.0)	4.0 (4.0–5.0)	4.0 (4.0–4.0)	.065	.066
6.	how to collect health-related data for patient monitoring	2.5 (2.0–3.8)	4.0 (3.0–4.0)	4.0 (4.0–4.0)	.083	.015
7.	which sources patients like to use to find information about their disease	3.5 (2.0–4.0)	4.0 (3.0–4.0)	4.0 (2.5–4.0)	.189	.249
8.	the reliability of health information on the web	3.5 (3.0–4.0)	4.0 (3.0–4.0)	4.0 (3.0–4.0)	.110	.563
9.	what to do if the technology does not work	3.0 (2.0–4.0)	3.0 (3.0–3.0)	4.0 (2.5–4.0)	.534	.063
10.	the procedure: what to do in case of an emergency					
11.	how technology can be used in sharing information with colleagues			NA		
12.	relevant protocols					
Total score on knowledge of telehealth[1]:		**2.9 (2.6-3.6)**	**3.0 (3.4-3.8)**	**3.7 (3.4-4.1)**	**.002**	**.003**

Note. Wilcoxon Signed-Rank Tests were performed to assess significant differences ($P < 0.05$) using Monte Carlo simulation (confidence level of 99%) to assign *P*-values (2-tailed); NA: Not Applicable, these items were not part of the training in this setting since they were not required for the activities in which the nurses were trained and therefore were not measured. [1]We calculated the average score of the subjective knowledge items (for all three observation moments) for each respondent, here above referred to as 'total score'. Again, these average scores were tested for differences. Measuring moments; O1: immediately before the training, O2: immediately after the training, O3: 6 weeks after the training. Items; Knowledge items derived from our prior study (van Houwelingen et al., 2016).

	Homecare (*n* = 14)					Hospital (*n* = 11)				
	O1 Median (Q1-Q3)	**O2** Median (Q1-Q3)	**O3** Median (Q1-Q3)	**O1 vs O2** *P*-value	**O1 vs O3** *P*-value	**O1** Median (Q1-Q3)	**O2** Median (Q1-Q3)	**O3** Median (Q1-Q3)	**O1 vs O2** *P*-value	**O1 vs O3** *P*-value
	2.0 (2.0–3.0)	4.0 (3.3–4.0)	4.0 (4.0–4.0)	.016	.004	3.0 (2.0–3.0)	4.0 (3.5–4.0)	4.0 (2.0–4.0)	.006	.114
	3.0 (3.0–3.0)	4.0 (4.0–4.0)	4.0 (4.0–4.0)	.003	.002	3.0 (3.0–4.0)	4.0 (4.0–4.0)	4.0 (2.0–4.0)	.126	.824
	3.0 (3.0–3.0)	4.0 (4.0–4.0)	4.0 (4.0–4.0)	.002	.004	4.0 (4.0–4.0)	4.0 (4.0–4.0)	4.0 (2.0–4.0)	.246	.623
	3.0 (2.5–4.0)	4.0 (4.0–4.0)	4.0 (4.0–4.0)	.061	.030	3.0 (2.0–4.0)	4.0 (3.0–4.0)	3.5 (2.0–4.0)	.189	.595
	3.0 (3.0–4.0)	4.0 (4.0–4.8)	4.0 (4.0–4.0)	.006	.030	4.0 (4.0–4.0)	4.0 (4.0–4.0)	4.0 (2.0–4.0)	.501	.501
	3.0 (2.0–3.0)	4.0 (4.0–4.0)	4.0 (3.0–4.0)	.003	.009	3.0 (3.0–4.0)	4.0 (3.0–4.0)	4.0 (2.0–4.0)	1.000	.623
	3.0 (3.0–4.0)	4.0 (3.3–4.8)	4.0 (4.0–4.0)	.032	.055	3.0 (3.0–4.0)	4.0 (3.0–4.0)	3.0 (3.0–4.0)	1.000	1.000
	3.0 (2.0– .0)	4.0 (3.0–4.0)	4.0 (4.0–4.0)	.009	.004	3.0 (2.0–4.0)	4.0 (3.5–4.0)	3.5 (2.8–4.0)	.350	1.000
	2.0 (2.0–3.0)	4.0 (4.0–4.0)	4.0 (4.0–4.0)	.001	.001	3.0 (3.0–3.0)	4.0 (3.0–4.0)	3.5 (2.8–4.0)	.060	.642
	3.0 (2.5–4.0)	4.0 (4.0–4.0)	4.0 (4.0–5.0)	.017	.007					
	3.0 (3.0–4.0)	4.0 (4.0–4.8)	4.0 (4.0–4.8)	.008	.008			NA		
	3.0 (2.0–4.0)	4.0 (4.0–4.0)	4.0 (4.0– .0)	.030	.017					
	3.0 (2.7-3.1)	**4.0 (3.8-4.1)**	**4.0 (3.8-4.3)**	**.000**	**.000**	**3.3 (3.1-3.6)**	**3.8 (3.7-4.0)**	**3.8 (2.3-3.9)**	**.016**	**.187**

Level 2a: Telehealth Self-Efficacy Before and After the Training

Figure 3 shows that only the telehealth self-efficacy of homecare nurses had significantly (P <0.05) increased immediately after the training based on the total score of the self-efficacy items. Self-efficacy shifted from a median value of 6.2 (Q1-Q3: 5.7-6.6) before the training to 7.8 (Q1-Q3: 7.2-8.5) immediately after the training (using a 10-point scale). The telehealth self-efficacy of the nurses working in the primary care and hospital setting also increased, but this difference was not significant.

However, six to 10 weeks after the training (O3), telehealth self-efficacy in each team of nurses was significantly increased compared to their self-efficacy prior to the training (O1). Between O1 and O3, nurses' telehealth self-efficacy shifted from median values of 6.3 (Q1-Q3: 6.0-7.0) to 7.0 (Q1-Q3: 6.5-8.2) in the primary care setting, 6.2 (Q1-Q3: 5.7-6.6) to 7.6 (I Q1-Q3: 7.3-8.2) in the homecare setting, and 7.0 (Q1-Q3: 6.3-7.7) to 7.8 (Q1-Q3: 7.2-8.4) in the hospital setting.

With regard to item level (Table 5), the data again show that most differences between observations 1 and 2 were found among the homecare nurses; 8 out of 9 self-efficacy items increased significantly (P <0.05), but self-efficacy with regard to 'Assessing patient capacity to use telehealth' did not improve. In the primary care setting, 1 out of 3 items significantly increased, and no items differed in the hospital setting. A comparable pattern was observed between observations 1 and 3; 7 of the 9 self-efficacy items increased significantly in the homecare setting, and only 1 out of 3 items increased in the primary care and hospital settings.

Figure 3. Telehealth self-efficacy before and after the training, measured on a 10-point scale in primary care (*n* = 12), homecare (*n* = 14) and hospital (*n* = 11) settings. Box plot shows median, upper/lower quartile and extreme values. Wilcoxon Signed-Rank Tests, using Monte Carlo simulation (confidence level of 99%) to assign *P*-values (2-tailed), were performed to assess significant differences between O1 and O2, and O1 and O3. *) Significantly higher (P < 0.05) than the pretest, observation 1 (O1).

Table 5. Nurses' Telehealth Self-Efficacy Before and After the Training

		Primary care (*n* = 12)				
	Self-efficacy with regard to nursing telehealth activities (scale: 1-10)	**O1** Median (Q1-Q3)	**O2** Median (Q1-Q3)	**O3** Median (Q1-Q3)	**O1 vs O2** *P*-value	**O1 vs O3** *P*-value
1.	Providing health promotion remotely	7.0 (6.0-7.0)	7.0 (6.8–8.0)	7.0 (6.5–8.0)	.403	.236
2.	Assessing patients' capacity to use telehealth	7.0 (6.0-8.0)	7.0 (6.0–8.0)	8.0 (7.0–8.0)	.939	0.96
3.	Supporting patients in the use of technology	6.0 (4.0-7.0)	7.0 (6.0–8.0)	7.0 (5.5–8.5)	.016	.030
4.	Instructing patients and family care givers in self-care[1]					
5.	Training patients in the use of technology as a way to strengthen their social network					
6.	Providing psychosocial support[1]					
7.	Guidance and peer consultation[1]			NA		
8.	Monitoring body functions and lifestyle[1]					
9.	Encouraging patients to undertake health promotion activities[1]					
	Total score on telehealth self-efficacy[2]:	**6.3 (6.0-7.0)**	**7.2 (5.9-8.0)**	**7.0 (6.5-8.2)**	**.171**	**.024**

Note. Wilcoxon Signed-Rank Tests were performed to assess significant differences ($P < 0.05$), using Monte Carlo simulation (confidence level of 99%) to assign *P*-values (2-tailed); NA: Not Applicable, these activities were not part of the training in this setting, since they were not applicable to their care provision. [1] Via videoconferencing. [2] We calculated the average score of the self-efficacy items (for all three observation moments) for each respondent, here above referred to as 'total score'. Again, these average scores were tested for differences. Measuring moments; O1: immediately before the training, O2: immediately after the training, O3: 6 weeks after the training. Items; self-efficacy items derived from our prior study (van Houwelingen et al., 2016).

	Homecare (*n* = 14)					Hospital (*n* = 11)				
	O1 Median (Q1-Q3)	**O2** Median (Q1-Q3)	**O3** Median (Q1-Q3)	**O1 vs O2** *P*-value	**O1 vs O3** *P*-value	**O1** Median (Q1-Q3)	**O2** Median (Q1-Q3)	**O3** Median (Q1-Q3)	**O1 vs O2** *P*-value	**O1 vs O3** *P*-value
	6.0 (6.0–7.5)	8.0 (7.0–8.0)	7.0 (7.0–8.0)	.020	.149	8.0 (7.0–8.0)	8.0 (6.5–8.0)	8.0 (7.8–9.0)	.685	.378
	7.0 (6.0–7.0)	8.0 (7.0–8.8)	8.0 (7.0–8.0)	.124	.089	8.0 (7.0–8.0)	8.0 (7.0–9.0)	8.0 (7.8–9.0)	.471	.170
	5.0 (3.5–6.0)	7.5 (7.0–8.0)	7.0 (7.0–8.0)	.002	.002	6.0 (5.0–8.0)	7.0 (5.5–8.0)	7.0 (6.0–8.3)	.054	.040
	6.0 (6.0–7.0)	8.0 (7.3–9.0)	7.5 (7.0–9.0)	.001	.005					
	5.0 (4.0–6.0)	7.0 (7.0–8.0)	7.5 (7.0–8.0)	.002	.003					
	7.0 (6.0–8.0)	8.0 (7.3–9.5)	8.0 (7.3–8.8)	.011	.007					
	6.0 (5.5–7.0)	8.0 (8.0–8.0)	8.0 (7.0–8.8)	.002	.002			NA		
	7.0 (6.0–7.0)	8.0 (7.3–8.8)	8.0 (7.3–8.0)	.004	.005					
	6.0 (6.0–7.0)	8.0 (7.3–8.8)	8.0 (7.0–8.0)	.003	.023					
	6.2 (5.7-6.6)	**7.8 (7.2-8.5)**	**7.6 (7.3-8.2)**	**.001**	**.002**	**7.0 (6.3-7.7)**	**7.7 (6.7-8.2)**	**7.8 (7.2-8.4)**	**.096**	**.034**

Level 3: Number of Remote Consultations Before and After the Telehealth Training

The number of remote consultations provided by nurses (Kirkpatrick level 3), observed 6-10 weeks before and after the training, increased from 2 to 12 in the primary care setting and 12 to 35 in the homecare setting and decreased from 28 to 17 in the hospital setting (Table 6).

Table 6. Number of Remote Consultations Before and After the Training

	Primary care (*n* = 12)		**Homecare (*n* = 14)**		**Hospital (*n* = 11)**	
	1-10 weeks before training	1-10 weeks after training	1-8 weeks before training	1-8 weeks after training	1-6 weeks before training	1-6 weeks after training
Number of remote consultations*	2	10	12	35	28	17

*) In homecare, home telehealth videoconferencing using a tablet; in primary care and hospital electronic consultations, a secure web-based platform for nurse-to-patient communications. Numbers apply to the whole group of nurses/nursing teams. Numbers of remote consultations were tracked over a period of 20 weeks in primary care (10 weeks before the training, and a period of 10 weeks after the training), 16 weeks in homecare (8 weeks before, 8 weeks after) and 12 weeks in hospital (6 weeks before, 6 weeks after) settings.

DISCUSSION

This multi-setting pretest-posttest study evaluated the effectiveness of a training in nursing telehealth activities and related competencies on knowledge, self-efficacy and use of telehealth in nurses. In each setting, nurses' knowledge was significantly increased immediately after the training. In the primary care and homecare settings, this increase was maintained 6-10 weeks after the training. Self-efficacy of homecare nurses increased during the training. Furthermore, 6-10 weeks after the training, telehealth self-efficacy was significantly higher than before the training among nurses from all three settings. With regard to Kirkpatrick's (1996) level 3 (behavior), we found that the number of remote consultations provided by nurses had increased in two of the three teams after receiving the training. However, in the third team, the number of consultations after the training was lower than before the training.

The number of knowledge and self-efficacy items that changed after the training differed among the settings (tables 4 and 5). Based on the number of items that improved significantly and the number of remote consultations before and after the training, most changes occurred in the homecare setting and the fewest

occurred in the hospital team. The fact that the training had the highest impact on homecare nurses corresponds with the findings in level 1, satisfaction of the training. Homecare nurses valued their satisfaction of the training with a median value of 9.0, whereas the two other settings valued the training with a median of 8.0, both on a 10-point scale. A possible explanation is that the homecare nurses were trained in nine different telehealth activities, whereas the primary care and hospital nurses received training in only three activities since the six other activities were not applicable to their organization.

The fact that the participating hospital nurses had more experience with telehealth prior to the training compared to the primary care nurses could provide another explanation for the finding that they appeared to benefit the least from the training. Perhaps this training is most suitable for nurses with relatively little (i.e., 1–6 months) experience in using telehealth. Additionally, the baseline scores of the hospital nurses on the self-efficacy items were already higher, and therefore less improvement was possible.

Strengths and Limitations

To the best of our knowledge, this is one of the first studies examining the effectiveness of a training in telehealth on the use of telehealth in nursing practice. Furthermore, the training was evaluated in multiple settings, which made it possible to discuss the differences.

Nonetheless, caution is required for several reasons when generalizing our findings. Our study included a small sample with ten to fourteen participants per setting. To increase the reliability of our findings, we improved the power of our analyses in level 2a by using Monte Carlo simulation to assign *P*-values. However, this was not possible for our findings on the number of remote consultations (level 3). Since these data were collected on a group level, we could not use Wilcoxon Signed-Rank Test to explore significant differences.

Another limitation in our statistical testing is that we performed multiple comparisons, which increased the likelihood of a type I error, i.e., 'concluding that a significance difference if present when it is not' (Armstrong, 2014, p. 502). Therefore, as a type of sensitivity analysis, we applied a post hoc Bonferroni test (Armstrong, 2014) to our results in Tables 4 and 5 (comparisons of scores on the knowledge

and self-efficacy items between observations 1 and 2, and observations 1 and 3). After dividing the *P*-value of 0.05 by the number of comparisons and using this adjusted *P*-value as a statistical significance threshold (Bonferroni correction), five of the 31 significant differences we found in nurses' knowledge (Table 4) remained significant. Four of these five differences were observed in the homecare setting. With regard to self-efficacy, we found 22 significant differences (Table 5). Eight of these differences remained statistically significant after applying the Bonferroni correction. All eight differences were observed in the homecare setting. This post hoc sensitivity analysis supported our conclusion that the training had the greatest impact on homecare nurses.

Furthermore, the quantitative approach of our study limited the ability to explain the results of the training. By using a pretest-posttest design, it cannot be proven that the findings observed after the training are actually a direct result of the training. These facts limit us in explaining the decrease in the number of remote consultations after the training in the hospital setting. Our findings indicate that training is an effective strategy to help nurses gain knowledge and self-efficacy with regard to telehealth. Therefore, we recommend repeating our approach in future research, preferably in an experimental design using a larger sample. A mixed-method sequential explanatory design might help to gain a deeper understanding of the working mechanisms of the effectiveness of training.

Integration With Prior Work

We found a significant increase in telehealth self-efficacy of nurses 6 to 10 weeks after the training. This result matches the study by Gifford and colleagues (2012), in which the perceived competence of health care professionals also improved significantly after training. In addition, our study collected objective data on Kirkpatrick level 3 (behavior), the number of remote consultations before and after the training.

The variance found in the effectiveness of the training on nurses' use of telehealth (level 3, behavior), emphasizes that acquiring (confidence in) competencies is no guarantee of success. A lack of adequate competencies is only one of the barriers to the implementation of telehealth (Ariens et al., 2017; Kort & van Hoof, 2012). Although the hospital nurses in the current study were satisfied with the training and their self-efficacy differed significantly 6 to 10 weeks after the training, the number of remote consultations decreased. Since the electronic consultations are

often initiated by patients, the frequency of use depends partially on factors beyond the control of nurses.

The frequency of telehealth use by nurses can be affected by several other barriers, such as the business case, commitment, or design of the device (Kort & van Hoof, 2012). Furthermore, financial aspects can play a role (Ariens et al., 2017). In the Netherlands, funding for telehealth services in hospital care will be further realized and regulated from 2018 onwards (Dutch Healthcare Authority [Nederlandse Zorgauthoriteit (NZa)], 2017). The limited (financial) possibilities of hospitals may also impede the use of telehealth by hospital nurses.

Implications for Practice and Training

The current study indicates that training helps to improve nurses' knowledge of telehealth and self-efficacy, which could support the further integration of telehealth services in daily work. When health care organizations seek ways to further implement the use of telehealth, they could consider delivering training comparable to the type described in this study. Since the homecare setting appeared to have benefited the most from our training, we believe that nursing settings with characteristics comparable to the homecare setting in our study (i.e., (a) relatively less experience in using telehealth and (b) a setting in which most nursing telehealth activities are applicable) could benefit from our training. Our training motivated homecare nurses to increase the number of remote consultations by changing work routines from traditional face-to-face care to a situation in which care is partially delivered remotely.

Today, executing nursing telehealth activities is still a new type of care provision for most nurses. Further research is necessary to explore whether similar training leads to comparable improvements in other organizations with different characteristics, such as culture, business case, and/or facilities. A key element of our training was the focus on the 'integration of telehealth' in daily practice. To achieve this, we recommend starting telehealth training programs with a focus on improving nurses' knowledge and self-efficacy since self-efficacy is an important predictor of behavioral change (Bandura, 1977). For most nurses, using telehealth is a new type of care provision and therefore requires behavioral change. Our study showed that training could motivate nurses to change behavior.

CONCLUSIONS

The changes in healthcare toward an ongoing increase in technology involvement requires additional competencies for nurses and a new way of working. After receiving training in nursing telehealth activities, the number of remote consultations increased in two of the three teams. Although further research on the barriers to full utilization is needed, we found that training in nursing telehealth activities contributes to subjective telehealth knowledge and self-efficacy of nurses, which are important factors for encouraging the use of telehealth.

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APPENDIX 1: DESCRIPTION OF THE EDUCATION INTERVENTION

Educational intervention, described in accordance with the guideline for reporting evidence-based practice educational interventions and teaching (GREET) (Phillips et al., 2016).

BRIEF NAME:

Integrating nursing telehealth activities in practice

1. INTERVENTION: A two partial-day training in which nurses learned how to integrate nursing telehealth activities in their daily practice was delivered. Day 1 focused on practicing, and on training day 2, nurses were examined in the same nursing telehealth activities. Afterwards, nurses received a certificate that stated the activities acquired by the nurses. The nursing telehealth activities were derived from a prior study (van Houwelingen et al., 2016). For each setting (primary care, homecare, hospital), we first discussed which activities were applicable in the specific organization, resulting in a training in 9 different telehealth activities for the homecare nurses (e.g., 'monitoring body functions and lifestyle remotely using videoconferencing') and 3 different activities for the nurses working in primary care or hospital settings (i.e., (1) providing health promotion remotely using remote consultations, (2) assessing patient capacity to use telehealth (make use of remote consultations), and (3) supporting patients in the use of technology.

WHY - THIS EDUCATIONAL PROCESS

2. THEORY: Our goal was to increase nurses' knowledge and self-efficacy and, as a result, their usage of telehealth. We used three strategies as described by Bandura (1977) to increase nurses' self-efficacy: (1) performance accomplishments by organizing practices (starting with low complex videoconferencing practices), which gave the participants the opportunity to achieve performance accomplishments, (2) using vicarious experience by letting participants see others accomplish difficult situations (e.g., one of the trainers who was a direct colleague of the participants),

and (3) verbal persuasion by acknowledging participants skills during their practices with telehealth.

3. LEARNING OBJECTIVES:
The learning objectives differed among the settings. The main goal of our educational intervention was that nurses acquired the following nursing telehealth activities and related knowledge, attitudes and skills:

- Providing health promotion remotely (all groups)
- Assessing patient capacity to use telehealth (all settings)
- Supporting patients in the use of technology (all settings)
- Instructing patients and family care givers in self-care via videoconferencing (homecare only)
- Training patients in the use of technology as a way to strengthen their social network (homecare only)
- Providing psychosocial support via videoconferencing (homecare only)
- Guidance and peer consultation via videoconferencing (homecare only)
- Monitoring body functions and lifestyle via videoconferencing (homecare only)
- Encouraging patients to undertake health promotion activities via videoconferencing (homecare only)

WHAT

4. MATERIALS:
Two materials were used: (1) a question and answer (Q&A) form about telehealth knowledge and (2) written real-life scenarios.

Nurses received a question and answer (Q&A) form with regard to the 12 knowledge items required for the telehealth activities that were the central part of their training. During the training, nurses were divided into pairs in which one nurse received the correct answers to the even items and the other received the answers to the odd items. By discussing the correct answers, nurses trained each other in telehealth knowledge.

A core element of the training was practicing real-life scenarios using role-playing. In each scenario, nurses practiced with one of the nursing telehealth activities.

Nurses were divided in teams of three, with three roles: 1) nurse, 2) patient, and 3) observer. The materials for the observer consisted of an observation form in which all required knowledge, skills and attitudes for the applicable nursing activity were listed. Additionally, two questions were posted for the observer: (1) what went well and (2) in what could the nurse make progress?

5. EDUCATIONAL STRATEGIES:
Since performance accomplishments are the strongest strategy to improve self-efficacy of nurses, our educational strategy was to activate the learners as much as possible and to avoid monologues by the instructors. We activated prior knowledge by asking questions and simultaneously motivated nurses to share experiences since vicarious experience is another important strategy to improve self-efficacy. The majority of the training sessions consisted of role-playing with real life scenarios. This process helped nurses accomplish the activities in which they were trained. In session 2, nurses performed the same activities, and their accomplishment was confirmed by receiving a certificate.

6. INCENTIVES:
The training was accredited by the the Dutch Nurses and Carers Association, which also encouraged nurses to participate since some are required to pursue continuing education from time to time for their nursing registration. Another incentive provided was a certificate (which stated activities the nurses acquired) that nurses received after completion of the training, showing that they acquired the nursing telehealth activities.

WHO PROVIDED

7. INSTRUCTORS:
The training was provided by the first author, fourth author, a nurse specialist and/or a telehealth project leader from their own organization. The first author has a background in nursing (education) and sociology and is currently a PhD Candidate in 'telehealth education' with five years of experience in teaching bachelor's degree nursing students. The fourth author has a background in nursing (science) and telehealth and is currently employed as a researcher and teacher at a university hospital center. The nurse specialist and telehealth project leaders were all educated

as health care providers, general practitioners or nurses. They were less experienced in teaching since this was not part of their core tasks. However, they did have experience with providing training sessions.

HOW

8. DELIVERY:
The training was delivered face-to-face with two instructors for 10-14 learners (nurses).

WHERE

9. ENVIRONMENT:
The training occurred in practice at the locations of the involved organizations.

WHEN AND HOW MUCH

10. SCHEDULE:
There were two sessions of 3 hours each with 1-2 weeks in between. The designated time for self-directed learning activities was limited to approximately 1 hour. At the end of session 1, nurses received a few exercises in preparation for session 2. For example, to be prepared for 'Instructing patients and family care givers in self-care via videoconferencing', nurses received the following exercise: 'Call a (female) family member or girlfriend via FaceTime or Skype. Get her to tie a tie in the right way, with a "double windsor". Help the person by presenting it yourself and take a good look at how she does. If you manage this, you're likely to be able to support a patient in various self-care tasks.'

PLANNED CHANGES

11.
For each setting (primary care, homecare, hospital), we first discussed which activities were applicable to the specific organization. Since the primary care and

hospital teams did not use a videoconferencing system, nursing telehealth activities involving videoconferencing were not applicable to their setting, resulting in training of nine different telehealth activities for the homecare nurses and three different activities for the nurses working in primary care or hospital settings (see Table 5).

UNPLANNED CHANGES

12.
In the primary care setting, the practice of two activities (i.e., 'Assessing patient capacity to use telehealth' and 'Supporting patients in the use of technology') were combined due to time constraints as well as the fact that the nurses noticed that the skills required for both activities were highly equivalent.

HOW WELL

13. ATTENDANCE:
To facilitate attendance, several strategies were used. These strategies were not applicable to, and therefore differed in, each setting. In the homecare setting, the training was offered at multiple times to give nurses the possibility to choose. In the primary care setting, drinks and food were arranged. Furthermore, as mentioned previously, the training was accredited by the Dutch Nurses and Carers Association. Attendance was required to receive the corresponding credits.

Further Information:
Please contact the first author if further information is desired.

CHAPTER 8

DISCUSSION

INTRODUCTION

Telehealth competence has become essential in the nursing profession due to changes in health care and global ambitions to increase telehealth use. Today, the acceptance and use of telehealth is hampered by several barriers, including nurses who lack the required competencies (Brewster, Mountain, Wessels, Kelly, & Hawley, 2014; Kort & van Hoof, 2012; Sharma & Clarke, 2014). Adequate telehealth education development is described as an important strategy to overcome this barrier (Brewster et al., 2014; European Commission, 2012; Giordano, Clark, & Goodwin, 2011; Sharma & Clarke, 2014). To address nurse training and preparation for providing telehealth, the following four topics and questions are addressed in this thesis:

1. *Intention*: How can telehealth users, both nurses and patients, be motivated to use telehealth?
2. *Competencies*: How can nurses integrate telehealth services into their work, and what competencies are required?
3. *Self-confidence*: To what extent do nurses feel equipped to provide telehealth services?
4. *Training*: How can nurses be trained, and how does this training contribute to practice?

KEY FINDINGS

Topic 1: The Intention to Use Telehealth

In **Chapter 2,** we identified the following four significant predictors of nurses' willingness to use telehealth: (1) the perceived usefulness to their patients, (2) the expected effort, (3) the social influence and (4) the expected cost. Based on these findings, the Chapter provides the following four recommendations to motivate nurses to use telehealth: (a) inform the nurses about the patient benefits of telehealth, (b) convince the nurses of telehealth's ease of use, (c) create an environment where the nurses can be innovative and (d) inform the nurses about the telehealth costs.

Most telehealth services consist of a two-way interaction between the health care provider (often nurses) and the patient (often older people). Both users need to be ready to use this new health care delivery method. **Chapter 3** outlines older people's readiness to receive telehealth care. Older people's intention to use videoconferencing

is predicted by their expectation of telehealth's usefulness, the expected effort and the perceived privacy/security. Self-efficacy and digital literacy play an important role in older people's technology use and in overcoming barriers. Therefore, we suggest organizing practices such that older people have the opportunity for successful experiences. This could enhance older people's readiness to receive telehealth care and consequently improve nurses' abilities to integrate telehealth services into their work.

Nursing Telehealth Entrustable Professional Activities (NT-EPAs)

1. Supporting patients in the use of technology
2. Training patients in the use of technology as a way to strengthen their social network
3. Providing health promotion remotely
4. Triaging incoming calls and alarms
5. Analyzing and interpreting incoming data derived from (automatic) devices for self-measurement
6. Monitoring body functions and lifestyle[1]
7. Providing psychosocial support[1]
8. Encouraging patients to undertake health promotion activities[1]
9. Instructing patients and family care givers in self-care[1]
10. Assessing patient capacity to use telehealth
11. Evaluating and adjusting the patient care plan[1]
12. Coordination of care with the use of telehealth technology
13. Independent double-check of high-risk medication[1]
14. Guidance and peer consultation[1]

[1]Via the use of videoconferencing

Topic 2: The Competencies Required for Providing Telehealth

To integrate telehealth into the nursing practice, **Chapter 4** describes fourteen nursing telehealth entrustable professional activities (NT-EPAs). A panel of telehealth experts discussed the NT-EPAs and reached a consensus on their relevance for the nursing practice. Subsequently, the chapter describes the essential knowledge, skills and attitudes that nurses need to execute these activities. In total, 52 competencies were identified as being essential, e.g., coaching skills, the ability to combine clinical experience with telehealth, communication skills, clinical knowledge, ethical awareness, and a supportive attitude.

Topic 3: Self-confidence in Telehealth Competence

In **Chapter 5,** we conclude that the current Internet-generation of nursing students does not naturally have a positive view of providing technology-based health care. The nursing students (n = 1,113) reported a significantly (P <0.001) less positive view of telehealth activities compared to common nursing activities (e.g., 'clinical reasoning' and 'monitoring lifestyle').

Chapter 6 examined hospital nurses' (*N* = 1,017) confidence in possessing the essential telehealth knowledge, skills and attitudes (KSAs). The nurses' confidence level in 9 of the 31 KSAs was 'good' (e.g., 'knowledge of the potential benefits of telehealth and social media'). In 19 of the KSAs, nurses had a 'moderate' confidence level. The nurses appeared to have a 'low' confidence level in three of the telehealth KSAs (e.g., 'knowledge of policies, procedures and protocols of the organization concerning the deployment of telehealth technologies'). Both chapters emphasize the importance of telehealth training.

Topic 4: Training in Telehealth

In the final study (**Chapter** 7), we found that a training session on nursing telehealth activities (NT-EPAs) contributes to the nurses' subjective telehealth knowledge and self-efficacy, which was evaluated using a multi-setting pretest-posttest study. The effect of the training on the nurses' telehealth use differed per the setting, and therefore, further research into additional barriers is needed.

CONSIDERING THE FINDINGS

When considering the findings of this thesis, one should consider the context in which this research occurred: a transforming health care landscape that includes an aging population (United Nations, 2017), a staff shortage (Chan, Tam, Lung, Wong, & Chau, 2013; Dutch Nurses' Association, 2017), a shift to community care (Low, Yap, & Brodaty, 2011), aging in place (World Health Organization, 2015), rapid technology innovations (Charness, 2008), and patients who are increasingly looking for health care online (Koch-Weser, Bradshaw, Gualtieri, & Gallagher, 2010; Spoelman et al., 2016). As part of this health care transformation, many governments have ambitions to scaling up telehealth services (European Commission., 2016). Telehealth use, however, is hampered by several barriers.

This thesis addressed the lack of telehealth competence among nurses, which is only one of the barriers to telehealth use. Other barriers that exist and were not addressed include an inappropriate design of technology (Tsai, Shillair, Cotten, Winstead, & Yost, 2015), an inappropriate business case (Kort & van Hoof, 2012), a lack of digital skills among the users (Giordano et al., 2011; Sponselee, 2013), limited evidence about telehealth (Inderwies, 2012), and the costs (Ariens et al., 2017; Ratan,

Lindeman, Redington, & Steinmetz, 2012). Therefore, only improving nurses' telehealth competence will not guarantee a successful diffusion of telehealth services. Recognizing the context of this study and the additional barriers, the following considerations may be useful.

Non-early Adopters Need Time to Adopt

Many researchers investigate telehealth adoption, both by staff (Brewster et al., 2014; Gagnon, Orruno, Asua, Abdeljelil, & Emparanza, 2012; Taylor et al., 2015) and by community-dwelling people (de Veer et al., 2015; Peek, 2017; Sponselee, 2013). Nonetheless, is the slow adoption of telehealth really surprising? A classical theory pertaining to adopting an innovation is Roger's (2010) theory of 'diffusion of innovation'. This theory explains that only 15% of the population belongs to the 'innovators' or 'early adopters' (i.e., people that adopt new innovations quickly). The majority of people need more time to adopt the innovation. Furthermore, technology acceptance is a dynamic process; specific events that occur in an individual's life can trigger the need for using technology (Peek, 2017). If the same applies to telehealth use, widespread telehealth adoption will likely occur in a matter of time. However, given the urgency, we do recommend searching for ways to accelerate the adoption process, similar to this study that addressed the barrier of nurses lacking telehealth competence.

Inadequate Telehealth Competence or Not Ready for a New Role?

In this thesis, we addressed the barrier of inadequate telehealth competence. However, also possible is that nurses avoid using telehealth services because they do not feel prepared to provide this new service. As discussed in Chapter 1, not all health care professionals are comfortable with the new 'informed patient': patients who increasingly use the Internet to find medical information. Using telehealth services also has implications for the nurse-patient relationship. By using telehealth services, patients can take control themselves instead of the nurse (Townsend et al., 2015), and nurses may need to adjust to these changing roles. Professionals need to be able to give the patient control (Ettema & de Kuiper, 2014).

Another concern of nurses regarding their changing role was discussed in Chapter 2. Dutch nurses feel valued when they help patients get out of bed, change the patients' clothes, help patients eat, or assist patients in taking a walk (Nijhuis & van der Padt, 2003). The fear of losing this interaction, and the related personal contact, might also

result in the reluctance of nurses to use telehealth (Bürmann genannt Siggemann et al., 2013). Therefore, addressing the changing role of nurses in telehealth training programs is recommended.

Competence Versus Self-efficacy: a Lack of Skills or a Lack of Confidence

Although many authors conclude that health care professionals lack the required telehealth competencies, most studies never assessed this lack in competence objectively. Their opinion is often based on nurses who say they lack the competencies, which raises the question of whether there is a true lack of competence or a lack of *self-perceived* competence (i.e., self-efficacy). An individual's self-perceived competence can substantially differ from their actual competence (Pajares, 1997). We also observed this mechanism during the training (Chapter 7). Some nurses were very convinced that they did not possess the required skills to execute telehealth activities. However, their opinion changed after the role playing where they practiced providing telehealth. The nurses discovered that they could perform these nursing telehealth activities quite well. They also realized that they already possessed many of the required skills, since these skills are important for the general nursing practice (e.g., communication skills and clinical reasoning).

Whether competence or self-efficacy (the self-perceived competence) is lacking, improving nurses' self-efficacy can accelerate the adoption of telehealth services, as a positive self-perception of competence is associated with behavioral change (Bandura, 1977). This behavioral change is required to transform the health care landscape in which telehealth services are increasingly embedded. Thus, this thesis provided several training suggestions to improve the telehealth self-efficacy of both nurses (Chapter 6 & 7), nursing students (Chapter 5) and older people (Chapter 3).

A Lack of Competence or an Inappropriate Technology Design?

In Chapter 6, the limited confidence pertaining to adequate telehealth competence (self-efficacy) of nurses is discussed. However, an individual's lack of self-efficacy can also be caused by inappropriate technology design (Tsai et al., 2015). Tsai and colleagues (2015) demonstrated that self-efficacy was not a significant barrier for technology use among older people when the new technology is easy to use. This raises the question of whether the lack of competence would be a barrier if the telehealth technology was better designed and easier and intuitive to use. We suggest that the lack of competence would still be a barrier based on the performance of the

participating nurses in Chapter 7 who knew how to use the device but lacked the knowledge and skills to integrate the technology into their daily work. Therefore, the training described in Chapter 7 focused on teaching nurses how to integrate telehealth activities into their daily practice (and not how to use the device). However, considering appropriate designs is relevant since nurses are more likely to start using the telehealth services when the system is perceived as easy to use (as discussed in Chapter 2).

Smartphones Are Widely Used Without Any Training

Most people have never received training on how to use a smartphone, yet the use of smartphones is widely adopted. This concept can be contemplated when considering the diffusion of healthcare technologies. In the Netherlands, approximately 95% of the working population (25–65 years old) uses a smartphone to access the Internet (Centraal Bureau voor de Statistiek., 2017). West and Mace (2010) studied the rapid success of Apple's iPhone and concluded that the widespread adoption of smartphones was strongly associated with an adjustments to its design; 'When given web browsing that was substantially similar to the browsing experience on a PC, mobile web usage went up dramatically' (West & Mace, 2010, p. 282). After improving this functionality, the device suited the users' wishes and needs (who wanted to have a *real* Internet experience), and subsequently, smartphone use increased.

This example emphasizes the importance of a technology fitting the wishes and needs of the user. When applied to nursing technology, developers should be aware of the desires and needs of nurses to successfully provide telehealth care. This idea is also presented in the task-fit technology theory (Furneaux, 2012) arguing that 'information system use and performance benefits are attained when an information system is well-suited to the tasks that must be performed' (idem, p. 87). Possibly, when nursing tasks are used as a starting point for health care technology development, the nurses will readily adopt these technologies.

Co-designing With Nurses

The importance of including health care professionals in the designing process of health care technologies was also outlined by Giordano and colleagues (2011). In their evaluation of the whole system demonstrator action network, one of the world's largest randomized control trials to date, Giordano et al. (2011) stated: 'The most

powerful strategy [to change clinical practice] was to include clinicians who could make good use of telecommunications technologies at the earliest stages of planning, and to encourage them to be actively engaged at the design stage of the project' (p. 14). As a result of the co-designing, the project outcomes fit better with the general practitioners' existing practice, and the outcomes were consequently better understood and trusted. Thus, including nurses at the earliest stage of telehealth projects may also accelerate telehealth adoption by nurses. Co-designing health care technologies with nurses provides the opportunity to discuss how an intended telehealth device fits into nursing tasks, which is a key factor for success (when following the task-fit technology theory).

A FIVE-STEP MODEL TO PREPARE NURSES FOR PROVIDING TELEHEALTH CARE

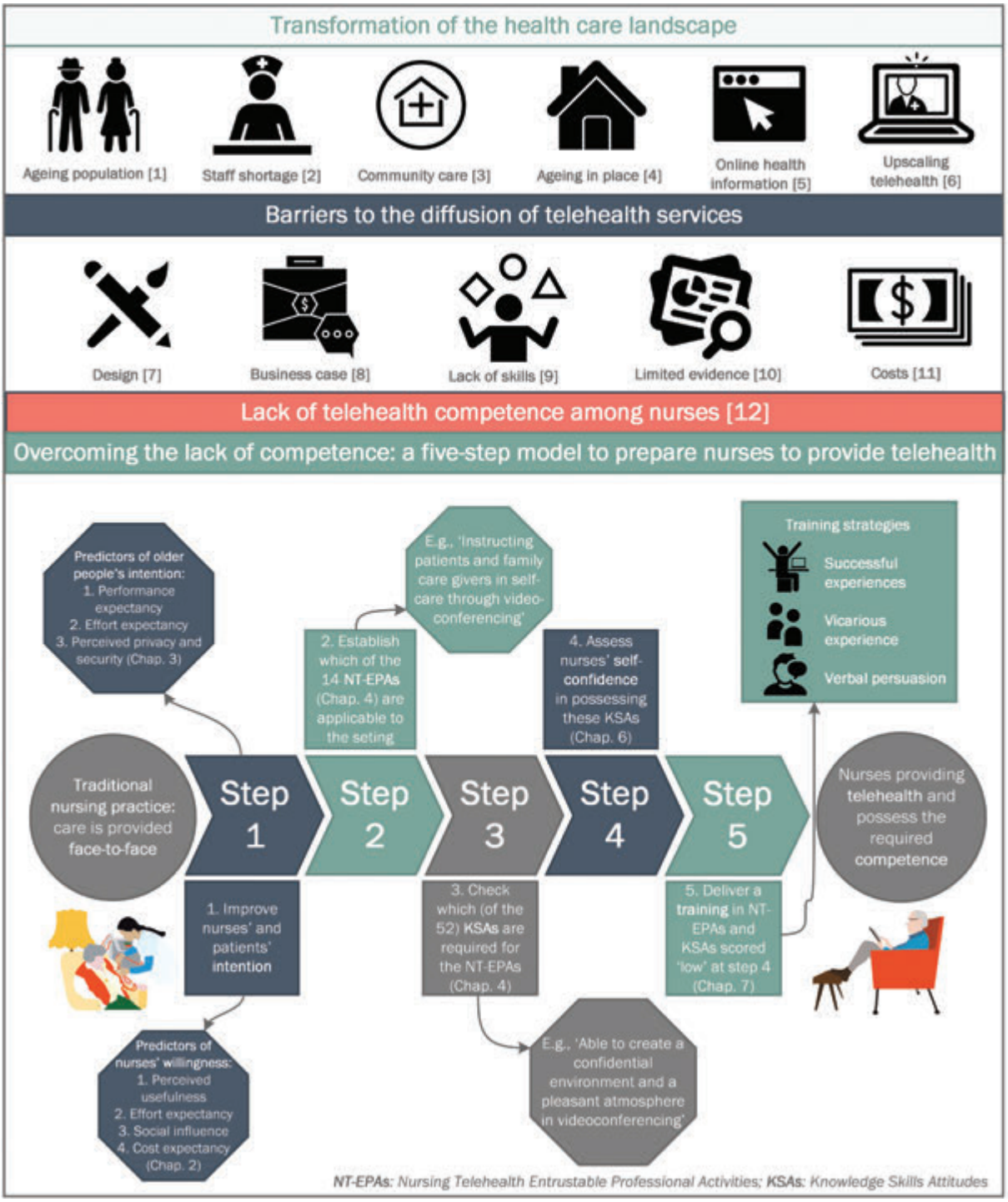
Based on the six studies discussed in this thesis, we propose a five-step model to prepare nurses for change in their profession, from the current face-to-face care to providing telehealth care. The five steps are illustrated in the infographic below, including the context in which this thesis exists (i.e., the transformation of the health care landscape and the several barriers that hamper the use of telehealth services). Each step is included in one or more chapters of this thesis. The five-step model will be further discussed under 'Implications for practice and education'.

STRENGTHS AND LIMITATIONS

Strengths

Relevance and Novelty

The first strength of this doctoral research is its relevance and novelty. We used a bottom-up approach by using a problem in the nursing practice as a starting point: the lack of telehealth competence among nurses. This enhanced the relevance for today's changing nursing profession. On a global level, nursing curricula have embraced the topic of telehealth competence, but most curricula lack a description of the specific telehealth activities and related competencies. The nursing telehealth activities and competencies provided in this thesis can be used for educational purposes to help educators adequately equip nurses.



Infographic. Five steps to prepare nurses to provide telehealth care, within the context of a transforming healthcare landscape and barriers to the diffusion of telehealth services.
Sources: [1] United Nations (2015); [2] Chan et al. (2013); Dutch Nurses Association (2017); [3] Low et al. (2011); Centraal Bureau voor Statistiek (2015); [4] World Health Organization, 2015; [5] Koch-Weser et al. (2010); Spoelman et al. (2016); [6] European Commission (2016); [7] Tsai et al. (2015); [8] Kort et al. (2012); [9] Sponselee (2013); Giordano et al. (2011) [10] Inderwies (2012) [11] Ariens et al. (2017); Ratan et al. (2012); [12] Brewster et al. (2014); Sharma et al. (2014); Kort et al. (2012)

Applicability to Education and Practice

A second strength, in line with the first one, is the applicability to education and practice. As a result, we provided concrete recommendations in each chapter. Further, as a part of this study, we trained professionals in practice and enhanced their knowledge, self-efficacy and usage of telehealth (Chapter 7). The applicability of this research for nursing education was demonstrated when some of these results were implemented into the nursing curriculum of our nursing school as described by Koster en van Houwelingen (2017) and Kort and colleagues (2015).

The applicability also enabled us to translate our findings into practice as outlined in various publications (e.g., van Houwelingen & Kort, 2013; van Houwelingen, Moerman, Kort, & ten Cate, 2015; van Houwelingen, 2016; van Houwelingen, Vroegindeweij, van der Meulen, & Glashouwer, 2017).

The Triangulation of Methods and Sources

A third strength is the triangulation of methods and sources. Telehealth competence in nursing was explored using multiple methods, including both inductive and deductive reasoning. We used (multi-level) regression techniques (Chapters 2 & 3), a review of the literature (Chapter 3), qualitative observations (Chapter 3), a Delphi-study (Chapter 4), cross-sectional studies including a descriptive and comparative analysis (Chapters 5 & 6), and finally, a multi-setting pretest-posttest study (Chapter 7). Additionally, multiple sources and perspectives were used including homecare nurses (Chapters 2 & 7), older people (Chapter 3), educators, technicians, patients and nurses (Chapter 4), nursing students (Chapter 5), hospital nurses (Chapters 6 & 7) and primary care nurses (Chapter 7). The triangulation of these perspectives and approaches helped gain a deeper understanding of the telehealth competence in nursing.

Limitations

Sensitive to Selection Bias

Using a cross-sectional survey design, as described in Chapters 2, 3, 5 & 6, brings the risk of a biased response (Levin, 2006). Likely, individuals with an affinity for telehealth were more likely to respond. In education and practice, we experience that students and nurses may have a strong opinion about telehealth, ranging from 'telehealth is a total disaster' to 'I love telehealth'. Our study sample is likely biased towards nurses who have a higher affinity for telehealth and who possibly have higher levels of self-confidence in possessing the required competence than the general nursing population. Another bias stems from only including respondents who completed the survey (Janssen et al., 2010). To avoid this type of bias in Chapters 3, 5 and 6, the missing values for those participants who partially completed the survey were inputted using a multiple imputation regression technique. In hindsight, the same could have been done to the missing values for the study described in Chapter 2, in which the current conclusions are based on only those respondents who were willing to complete the survey.

The Limited Power of the Training's Effectiveness

In Chapter 7, the conclusions drawn from the earlier Chapters were incorporated into a telehealth training program. Although, the results indicated that training contributes to nurses' knowledge, self-efficacy and telehealth usage, the power of our conclusions is limited due to the study design and sample size. Thus, caution is required when generalizing our findings. The question remains as to whether comparable results would be found when delivering the training to other nursing teams.

The Limitation of Scope

In this thesis, we studied how nurses can integrate *existing* telehealth services into practice. One could argue that nurses should have been actively engaged in the early stages of telehealth development. We have not addressed the potential role of nurses in telehealth development, and neither was it proposed by the experts in the Delphi-study (Chapter 4). Consequently, the question remains of whether additional competencies are required for nurses to be engaged in the designing processes.

CONTRIBUTION TO THEORY

The Field of Technology Acceptance Models

Many studies analyzing the acceptance of a new technology uses the technology acceptance model (TAM) (Venkatesh & Davis, 2000) and the modified version of this model, the unified theory of acceptance and use of technology (UTAUT) (Venkatesh, Thong, & Xu, 2012). We applied both models, in Chapters 2 and 3, to the nurses' and older people's intentions to use telehealth, and our findings are discussed in light of the UTAUT model. Prior to these studies, we explored whether or not the UTAUT model was an adequate framework to apply to nursing telehealth (van Houwelingen, Barakat, Antonietti, & Kort, 2013), and we concluded that the model was adequate. This thesis adds to the literature the following list of factors that significantly predicts Dutch nurses' willingness to use telehealth: perceived usefulness, expected effort, social influence, and expected cost. Previously, these factors were not established.

The Nursing Field's Telehealth Competencies

Chapter 1 outlined the research gaps in the nursing telehealth competencies. In previous studies, the topic of telehealth competencies was applied to health care professionals in general (Academy of Medical Royal Colleges, 2011; Barakat, Woolrych, Sixsmith, Kearns, & Kort, 2013). This thesis adds 52 essential telehealth knowledge, skills and attitudes (KSAs) that are specifically applicable to the nursing profession. Of these 52 KSAs, 20 of the KSAs were referred to as 'generic' KSAs and 32 were 'subject specific' KSAs (i.e., the KSAs that are specifically required for providing telehealth) otherwise not relevant without the emergence of telehealth (e.g., 'is able to communicate clearly in videoconferencing' and 'knowledge about what to do if the technology does not work'). This thesis showed how these KSAs can be used to assess the nurses' confidence in their own telehealth competence (Chapter 6) and to develop nursing telehealth training programs (Chapter 7).

The Field of Entrustable Professional Activities

To establish the required telehealth competencies, we used the framework of entrustable professional activities (EPAs) defined as "tasks or responsibilities to be entrusted to the unsupervised execution by a trainee once he or she has attained sufficient specific competence" (ten Cate, 2013, p. 157). The EPAs were originally developed as a framework for postgraduate medical education, but more and

more, they are used in undergraduate medical education and in other health care professions including physician assistants (Mulder, ten Cate, Daalder, & Berkvens, 2010; Wiersma, Berkvens, & ten Cate, 2017), nurse practitioners (Hoyt, Ramirez, & Proehl, 2017) and nurses (Wagner, Dolansky, & Englander, 2017). In this thesis, the EPAs framework was used to establish the activities nurses could perform using telehealth, and subsequently, the knowledge, skills and attitudes nurses need to perform these activities. Chapter 4 describes fourteen different nursing telehealth entrustable professional activities (e.g., 'analyzing and interpreting incoming data derived from (automatic) devices for self-measurement' and 'independent double-check of high-risk medication via videoconferening'). The fourteen nursing telehealth EPAs found in this thesis are an addition to the existing EPA literature and illustrates that the EPA framework is very applicable to *nursing telehealth* education and in practice.

IMPLICATIONS FOR NURSING PRACTICE AND EDUCATION

A Five-step Model to Train Nurses

In our infographic, we propose five steps to prepare nurses for providing telehealth and to achieve the required telehealth competencies. The **first step** is to improve the users' *intention* (based on Chapters 2 & 3). Based on the predictors of nurses' intention to use telehealth, we recommend informing nurses about the usefulness, expected effort, and costs related to telehealth. The next **step (2)** is to establish which of the fourteen nursing telehealth activities (NT-EPAs), as outlined in Chapter 4, are applicable to the nurse setting. The following **step (3)** is to check (as described in Chapter 4) what specific *competencies* are required for the selected NT-EPAs (from step 2). In **step 4**, the nurses' *self-confidence* in possessing the required competencies should be assessed to clarify their educational needs. The final **step (5)** is to deliver the telehealth *training* on the selected NT-EPAs (as described in Chapter 7), paying special attention to the KSAs scored low in step 4. This five-step model starts with improving the users' intention to use telehealth, which could motivate them to participate in the telehealth training programs. However, a greater intention to use telehealth could result from the training (step 5).

Improving Nurses' Self-efficacy

When delivering telehealth training programs, Bandura's (1977) strategies to increase self-efficacy can be used. In Chapter 7, we used the following three strategies to increase the nurses' telehealth self-efficacy. First, organize the practice (starting with less complicated videoconferencing practices) to give the participants a successful experience (*performance accomplishments*). Second, allow the nurses to learn by observing role models (*vicarious experience*) with telehealth experience. During the observation, the educators can encourage the participants to share their telehealth experiences. The positive experiences of the colleagues may help nurses gain confidence in their own telehealth competence. Third, acknowledge the participants' skills when practicing telehealth (*verbal persuasion*).

Integrating Telehealth Into the Nursing Curriculum

In addition to providing current nurses with training, the results of this thesis can also be used to train future nurses by integrating nursing telehealth activities into nursing schools' curricula. At our nursing school, the University of Applied Sciences Utrecht, telehealth education began in 2012. Comparable to the training in Chapter 7, our nursing school pays significant attention to the *integration* of telehealth into the nursing practice (van Houwelingen et al., 2017). As discussed, the technology device itself is not often difficult, but the difficulty lies in integrating telehealth into practice.

To clarify how telehealth can be a part of the healthcare pathways, we suggest incorporating the training as little as possible in separate courses on telehealth but seeking for ways to incorporate nursing telehealth activities into existing courses, as shown in the following three examples. First, during the education on medical safety, nursing students can practice executing the NT-EPA 'independent double-check on high-risk medication via videoconferencing'. Second, during the education on communication skills, nursing students can practice performing the NT-EPA 'providing psychosocial support via videoconferencing'. In addition, third, during the courses on triaging, nursing students can be trained in the NT-EPA 'analyzing and interpreting incoming data derived from (automatic) devices for self-measurement'.

The Simulated Monitoring Center

To give students the opportunity to practice real life scenarios, the Utrecht University of Applied Sciences created a simulated alarm and monitoring center

and a simulated home environment (as described by Koster & van Houwelingen (2017). In these settings, the students can test and experience healthcare technologies (e.g., Google Glass, devices for self-measurement, videoconferencing, and personal alarming). For example, within a special course on community care, the nursing students used Google Glass to instruct patients and family care givers remotely. They practiced instructing the family care givers how to provide stoma care. The aim of such practice was not to learn how Google Glass works, but rather the aim was to let the students reflect on how technology can be used to provide remote care and experience which skills (e.g., coaching skills) become important when supporting the patients in self-care.

The Patient's Perspective in Receiving Telehealth

In this thesis we studied how nurses can be trained to provide telehealth care. The overarching goal, however, is to help patients to benefit from technologies such as telehealth that could help them live independently in their homes for as long as they wish. Therefore, we also studied older people's readiness to receive telehealth care (Chapter 3) and provided recommendations on how older people can be supported.

Supporting Older People in Using Technology and Receiving Telehealth Care

Contrary to the stereotype that older people are unable or afraid to use technology, Mitzner and colleagues (2010) showed that older people clearly perceived many benefits from using technology. Nurses can play a key role in ensuring that older people benefit from telehealth services. Today, supporting older people in technology use remains a new professional activity for nurses. To support patients (and often elderly patients) in using technology, the nurses could use Chapter 3's conclusions on older people's readiness to receive telehealth services. During our observations of older people executing technological tasks, several people discovered their ability to accomplish a technological task contrary to their prior expectations. To support older people in using technology, nurses can organize technology practice session, with the goal of giving older people the opportunity to have successful experiences and subsequently increase their self-efficacy.

Furthermore, nurses should consider involving the family members as a strategy to support the older people in using technology. During our observations, the significant role of the family members was identified, which aligns with the previous research of Luijkx, Peek and Wouters (2015) who emphasized the importance of

including family members when implementing technology into the lives of older people.

FUTURE RESEARCH

The Effectiveness of Training

The quantitative approach on the effectiveness of the telehealth training in our study is limited by the ability to explain the results of the training. Our findings indicate that training is an effective strategy to help nurses gain knowledge and self-efficacy of telehealth. However, the impact of our conclusion is limited due to the study design and sample size. Further research is needed to establish whether our findings can be generalized to other nurse settings. Since our study indicated that the training helped nurses increase their knowledge and self-efficacy, portions of our approach could be repeated, such as the outcomes and training characteristics, although preferably in an experimental design using a larger sample size. Furthermore, using a mixed-method sequential explanatory design could help increase the understanding of the effectiveness.

Telehealth Competence 2.0

As discussed, the scope of this thesis was limited to the use of the *existing* telehealth services. However, nurses could also be involved in the health care technology design process, which could be a powerful strategy to successfully fit the technologies into the existing nursing practice. Further research is needed to explore this suggested role of nurses and to identify what competencies nurses need to reflect critically on their daily practice and to use this reflection to contribute to the health care technology design.

CONCLUSION

Our healthcare landscape is transforming in response to the aging population, staff shortages and increasing technological possibilities. Telehealth is seen as a solution to help patients live independently in their own home and community. Today, the diffusion of telehealth is still hampered by several barriers. This thesis addressed the barrier of nurses lacking the required telehealth competencies. Based on six

different studies, we propose the following five-step model to prepare nurses for providing telehealth care, which will subsequently transform their profession: 1) improve nurses' *intention*, 2) define what NT-EPAs are applicable to the nurse setting, 3) check what specific *competencies* are required, 4) assess nurses *self-confidence* in possessing these competencies, and 5) deliver *training* on the NT-EPAs. In the nurses' transformed profession, nurses can play a key role in supporting older people's technology use and enhance the elderly population's ability to receive telehealth services. Our future nurses can be trained in telehealth care by integrating the NT-EPAs into nursing schools' curricula. Although several other barriers remain, the results of this thesis can be used to train current and future nurses. Adequate nurse training can accelerate telehealth diffusion and consequently contribute to older peoples' opportunity to live independently in their own home.

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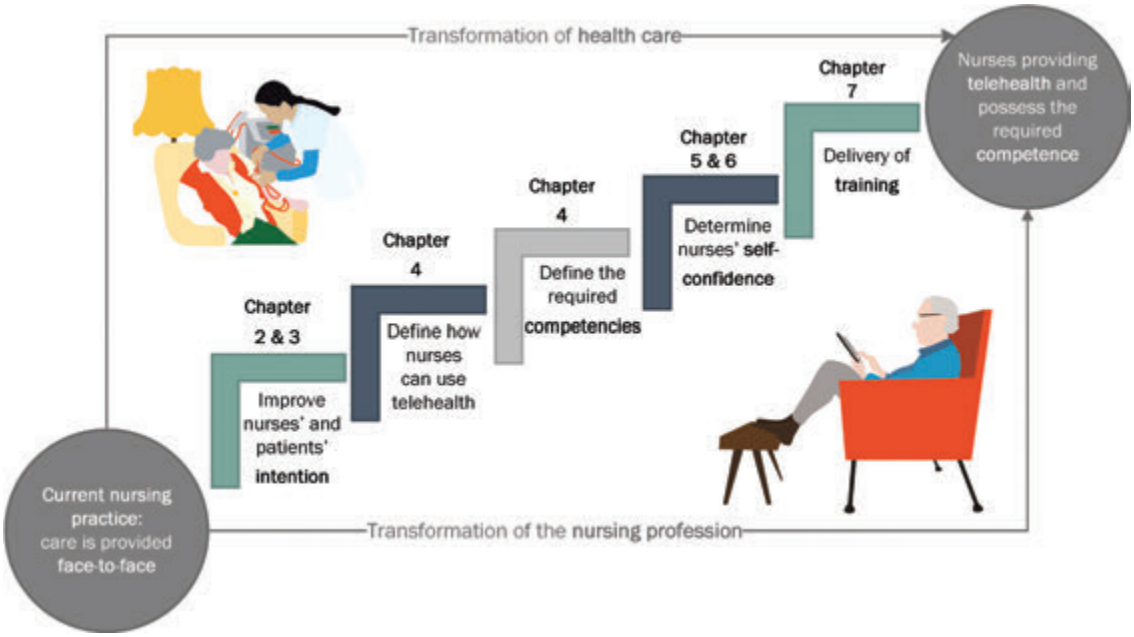
SUMMARY OF THESIS

This thesis describes how nurses could be prepared with training and education to acquire telehealth competence.

In **Chapter 1**, a general introduction is provided, explaining how the topic of 'telehealth competence in nursing' has become important in the nursing profession. 'Telehealth' is described as providing health care remotely, instead of face-to-face, through the use of digital technology, such as videoconferencing. 'Competence' is the ability to execute a task properly by possession the required knowledge, skills and attitudes. Changes in health care, such as (a) the increasing use of internet technologies in health care, (b) the shift from inpatient to community care, (c) more and more people ageing in place and (d) the global ambitions to increase telehealth use, requires nurses to be able to provide telehealth and possess telehealth competence. The Dutch government created goals to increase the use of telehealth. The conversion to telehealth care, however, remains slow due to various barriers. This thesis focuses on ways to overcome the barriers nurses experience in engaging in telehealth, partially caused by lacking the required competence. Four topics and questions were investigated to determine how nurses can be prepared with training and education to acquire telehealth competence (also illustrated in the Figure below):

1. *Intention*: How can telehealth users, both nurses and patients, be motivated to use telehealth? (Addressed in Chapter 2 & 3)
2. *Competencies*: How can nurses integrate telehealth services into their work, and what competencies are required? (Addressed in Chapter 4)
3. *Self-confidence*: To what extent do nurses feel equipped to provide telehealth services? (Addressed in Chapter 5 & 6)
4. *Training*: How can nurses be trained, and how does this training contribute to their practice? (Addressed in Chapter 7 & 8)



TOPIC 1: THE INTENTION TO USE TELEHEALTH

Most telehealth services consist of a two-way interaction between the health care provider (often nurses) and the patient (often older people). Both users need to be ready to use this new health care delivery method.

In **Chapter 2**, Dutch nurses' willingness to use telehealth was explored. Telehealth services can be used to provide care to patients remotely and can help older adults age in place. However, these technologies are unlikely to impact care unless health care providers are motivated to use them. To help guide the development of nursing education to facilitate adoption and use, Chapter 2 examined predictors of Dutch nurses' willingness to use telehealth, based on a survey of 67 Dutch community nurses with and 126 without telehealth experience. Nurses' willingness to use this telehealth was predicted by telehealth's (a) perceived usefulness to the client, (b) effort expectancy, (c) social influence, and (d) cost expectations. The results of the Chapter 2 illustrate the benefits of educating nurses about the potential usefulness of telehealth for their clients and training them to increase telehealth's perceived ease of use. Nurses become more willing to adopt telehealth when they are supported by coworkers and are aware of its potential usefulness, usability, and associated costs.

In **Chapter 3**, older people's readiness to receive telehealth was explored with a mixed-method study, including a survey to investigate their intention to use videoconferencing and qualitative observations of older people executing technological tasks. Performance expectancy, effort expectancy, and perceived privacy and security appeared to be direct predictors of older people's intention to use videoconferencing. Furthermore, the observations of older people executing technological tasks revealed that self-efficacy and digital literacy appeared to play a major role in older people's capacities to make use of digital technology. Four additional themes were identified that could provide greater understanding of older people's capacities and incapacities in using digital technology: (1) "obstacles to using technology," (2) "prior experience and frequency of use," (3) "sources of support and facilitating conditions," and (4) "performance expectancy." Chapter 3 ends with recommendations on how older people can be supported in the use of technology, for example by organizing training sessions in which they have successful experiences, which will improve their self-efficacy.

TOPIC 2: THE COMPETENCIES REQUIRED FOR PROVIDING TELEHEALTH

A better understanding of nursing telehealth entrustable professional activities (NT-EPAs) - professional tasks in which nurses can integrate digital technologies - and the required competencies, can contribute to the development of nursing telehealth education.

Chapter 4 describes the results of a four-round Delphi-study, in which a panel of 51 experts discussed which NT-EPAs are relevant for nurses and which competencies nurses need to possess to execute these activities effectively. The Chapter yielded 14 NT-EPAs. Nurses can use technology in various ways to provide health care remotely, ranging from the provision of psychosocial support via videoconferencing to an independent double-check in case of high-risk medication. All of these nursing telehealth EPAs appear to require a specific set of knowledge, attitudes and skills. In total, nurses should possess 52 types of knowledge, skills and attitudes (KSAs) when executing telehealth activities. Thirty-two KSAs were 'new' competencies, specifically required for the provision of telehealth. Chapter 4 recommends home care organizations or nursing schools to use the NT-EPAs and related competencies

presented in this Chapter as a starting point for the development of successful training and education.

TOPIC 3: SELF-CONFIDENCE IN TELEHEALTH COMPETENCE

According to the generation rhetoric, today's nursing students may already be familiar with abundant technological opportunities, and special attention to telehealth provisions in the nursing curricula may not be as relevant. **Chapter 5** answered the question whether the current Internet-generation of applicants for nursing education actually has a positive view of technology-based health care. A cross-sectional survey among 1,113 Internet-generation first-year nursing students, revealed that students of this generation do not naturally have a positive view of technology-based health care provision, contrary to what was expected from the generation rhetoric. The students reported a significantly less positive view of telehealth activities (e.g., 'Triaging incoming calls and alarms', or 'Independently double-checking high-risk medication via videoconferencing') than of common nursing activities (e.g., 'Clinical reasoning' or 'Monitoring lifestyle'). Consequently, Chapter 5 concludes that adequate telehealth technology education is needed for all nurses, independent of their knowledge or lack of knowledge about the Internet.
The diffusion of telehealth is still slow, likely because of a lack of confidence among nurses about their telehealth competencies. **Chapter 6** reports the results of a cross-sectional survey study among 1,017 nurses. Nurses from three hospitals in the Netherlands were asked to rate their self-confidence in 31 different types of telehealth knowledge, skills and attitudes (KSAs), derived from Chapter 4. The survey revealed that the majority of the nurses already have self-confidence in 9 of the 31 required telehealth KSAs. At the same time, nurses' confidence in 19 of the 31 KSAs was moderate or low, and therefore continuing education in KSAs required for telehealth is highly recommended. Chapter 6 specifically revealed 8 KSAs to be included in continuing education programs in nursing telehealth. Continuing education in these essential telehealth KSAs might support hospital nurses in using telehealth services and contribute to increasing the diffusion of telehealth services into hospitals.

TOPIC 4: TRAINING IN TELEHEALTH

In **Chapter** 7, the findings from the previous chapters were used for the development of a nursing telehealth training. Education is a major strategy to overcome the barriers associated with telehealth use by nurses. However, the nature and effectiveness of such education has not yet been specified and tested in practice. In Chapter 7, the effectiveness of a training in essential telehealth competencies on nurses' subjective knowledge, self-efficacy and use of telehealth was established. A two-day training in nursing telehealth activities (e.g., 'providing health promotion remotely') was evaluated. Twelve primary care (PC), fourteen homecare (HC) and eleven hospital (H) nurses rated the training with median scores of 8.0 (PC), 9.0 (HC) and 8.0 (H) on a 10-point scale. In each team, telehealth knowledge during the training significantly increased. In two teams (PC and HC), this effect was maintained at follow-up 6-10 weeks later. In each team, nurses' telehealth self-efficacy had significantly increased. After the training, the number of remote consultations (Kirkpatrick level 3) had increased from 2 to 12 in primary care, 12 to 35 in homecare and decreased from 28 to 17 in the hospital setting. The chapter concludes with the suggestion that training nurses in telehealth activities contributes to their knowledge and self-efficacy but further research that examines additional barriers to full utilization is needed.

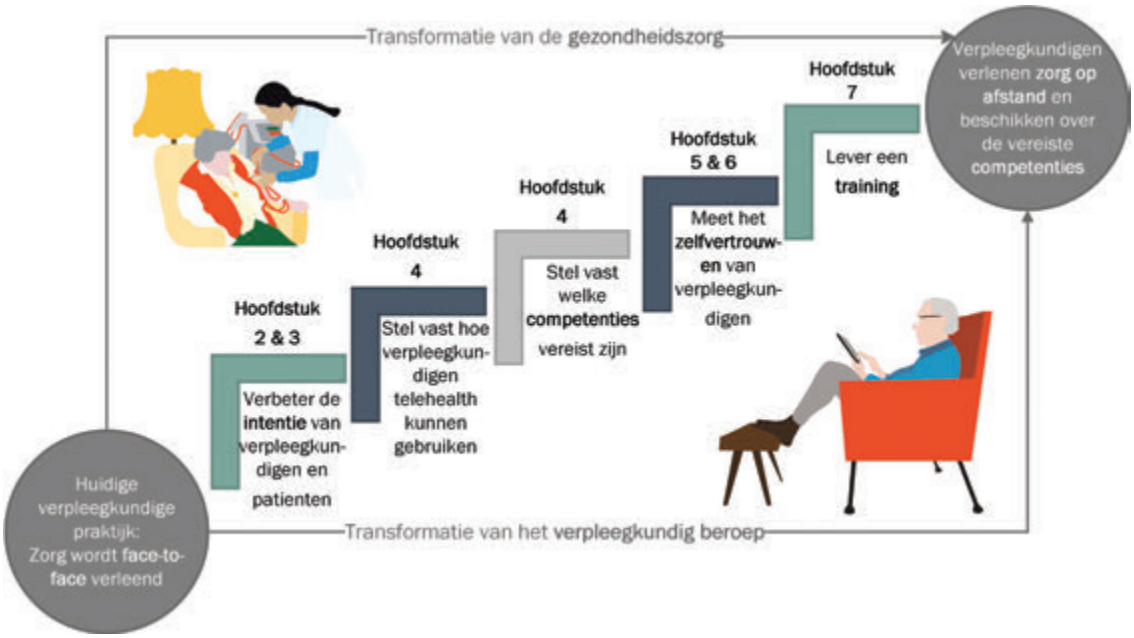
In **Chapter 8** all findings of the thesis are discussed, including the strengths (e.g., 'Applicability to education and practice') and limitations (e.g., 'The limited power of the training's effectiveness'). A five-step model is proposed to prepare nurses for providing telehealth: 1) improve nurses' *intention*, 2) define what nursing telehealth activities (NT-EPAs) are applicable to the nurse setting, 3) check what specific *competencies* are required, 4) assess nurses *self-confidence* in possessing these competencies, and 5) deliver *training* on the NT-EPAs. In the nurses' transformed profession, nurses can play a key role in supporting older people's technology use and enhance the elderly population's ability to receive telehealth services. Future nurses can be trained in telehealth care by integrating the NT-EPAs into nursing schools' curricula. Although several other barriers remain, the results of this thesis can be used to train current and future nurses. Adequate nurse training can accelerate telehealth diffusion and consequently contribute to older peoples' opportunity to live independently in their own home.

SAMENVATTING VAN HET PROEFSCHRIFT

Dit proefschrift beschrijft welke competenties verpleegkundigen nodig hebben voor het verlenen van telehealth (zorg op afstand) en hoe zij hierin geschoold kunnen worden.

In **hoofdstuk 1** wordt een algemene inleiding op het onderwerp 'telehealth-competentie in de verpleegkunde' gegeven en wordt het belang van dit onderwerp uiteengezet. 'Telehealth' (waar geen goede Nederlandse vertaling voor is) wordt omschreven als het verlenen van zorg op afstand, in plaats van face-to-face, met behulp van digitale technologie, zoals bijvoorbeeld beeldbellen. In deze samenvatting worden zowel de begrippen 'telehealth' als 'zorg op afstand' gehanteerd. Hiermee wordt hetzelfde bedoeld. 'Competentie' is het vermogen taken op de juiste manier uit te voeren doordat je beschikt over de daarvoor benodigde kennis, attitudes en vaardigheden. Een aantal veranderingen in de gezondheidszorg hebben ervoor gezorgd dat verpleegkundigen in staat moeten zijn om zorg op afstand te verlenen, te weten: (a) het toenemend gebruik van internet-technologieën in de gezondheidszorg, (b) de verschuiving van geïnstitutionaliseerde zorg naar zorg thuis, (c) het toenemend aantal mensen dat thuis oud wil worden en (d) wereldwijde ambities om de inzet van zorg op afstand uit te breiden. Ook de Nederlandse overheid heeft zich ten doel gesteld om de hoeveelheid zorg op afstand te vergoten. In de komende jaren moet 75% van de chronisch zieken en kwetsbare ouderen zelf thuis metingen kunnen uitvoeren en moet iedereen met zorg en ondersteuning thuis 24/7 via een beeldscherm met zorgverleners kunnen communiceren. De verschuiving naar meer zorg op afstand verloopt echter moeizaam. Onder andere doordat veel verpleegkundigen aangeven de vereiste telehealth-competenties te missen. In dit proefschrift werd onderzocht hoe deze barrière bij verpleegkundigen weggenomen kan worden. Aan de hand van vier onderwerpen en vragen (geïllustreerd in onderstaand figuur) werd onderzocht hoe verpleegkundigen competent kunnen worden in het verlenen van telehealth:

1. *Intentie*: Hoe kunnen potentiële telehealth-gebruikers, zowel verpleegkundigen als patiënten, gemotiveerd worden om telehealth-toepassingen te gebruiken?
2. *Competenties*: Op welke manier kunnen verpleegkundigen telehealth-toepassingen integreren in hun werk en welke competenties zijn hiervoor vereist?
3. *Zelfvertrouwen*: In hoeverre voelen (toekomstige) verpleegkundigen zich bekwaam om zorg op afstand te verlenen?
4. *Training*: Hoe kunnen verpleegkundigen getraind worden in het verlenen van zorg op afstand en wat draagt deze training bij aan hun praktijk?



ONDERWERP 1: INTENTIE OM TELEHEALTH TE GEBRUIKEN

Veel telehealth-toepassingen worden gebruikt tussen zorgverleners (vaak verpleegkundigen) en patiënten (vaak ouderen). Beide doelgroepen dienen klaar te zijn om gebruik te maken van deze nieuwe vorm van zorgverlening.

In **hoofdstuk 2** wordt de bereidheid van Nederlandse verpleegkundigen om zorg op afstand te verlenen verkend. Zorg op afstand kan ingezet worden om ouderen

te ondersteunen in het zo lang mogelijk zelfstandig thuis wonen. De beschikbare telehealth-toepassingen zullen echter weinig toevoegen als verpleegkundigen niet gemotiveerd zijn deze te gebruiken. Hoofstuk 2 is geschreven met als doel een bijdrage te leveren aan de ontwikkeling van verpleegkundig onderwijs over zorg op afstand en het verbeteren van de acceptatie en gebruik hiervan. Met behulp van een vragenlijstonderzoek onder 67 wijkverpleegkundigen met ervaring in telehealth en 167 verpleegkundigen zonder ervaring met telehealth, werd verkend welke factoren van invloed zijn op hun bereidheid telehealth-toepassingen te gebruiken. Er werden vier significante factoren gevonden: (1) het verwachte nut voor de cliënt, (2) het verwachte gebruiksgemak, (3) de verwachte kosten en (4) sociale invloed. De resultaten van hoofdstuk 2 laten zien wat de meerwaarde kan zijn van informeren van verpleegkundigen over het potentiële nut van zorg op afstand voor hun cliënt en het trainen van verpleegkundigen hen vertrouwd te maken met het gebruik van de technologie. De bereidheid van verpleegkundigen om zorg op afstand te verlenen zal ook verbeteren wanneer zij omgeven worden door collega's die hiervoor gemotiveerd zijn. Tot slot is het van belang verpleegkundigen te informeren over de kosten die verbonden zijn aan het gebruik van telehealth-toepassingen.

In **hoofdstuk 3** werd stilgestaan bij andere mogelijke gebruikers van telehealth: ouderen. Er werd een *mixed-method* gebruikt, bestaande uit twee fases: (1) een vragenlijst over hun intentie om via beeldbellen zorg te ontvangen en (2) observaties bij ouderen thuis, terwijl zij verschillende technologische handelingen uitvoerden (bijvoorbeeld een route opzoeken via internet of een contactpersoon opslaan in hun mobiele telefoon). Het verwachte nut, verwachte gebruiksgemak en verwachtingen over privacy en veiligheid bleken van invloed te zijn op de bereidheid van ouderen om beeldbellen te gebruiken. Uit de observaties kwam naar voren dat *self-efficacy* (het vertrouwen in eigen kunnen) en digitale vaardigheden een grote rol spelen in de mogelijkheden van ouderen om gebruik te maken van digitale technologie. Daarnaast spelen nog vier thema's hierin een rol: (1) (technische) obstakels in het gebruik, (2) eerdere ervaring en frequentie van gebruik, (3) hulpbronnen en faciliteiten en (4) het verwachte nut. Het hoofdstuk sluit af met verschillende aanbevelingen over hoe ouderen ondersteund kunnen worden in het gebruik van technologie, bijvoorbeeld door het organiseren van trainingen waarin zij succeservaringen kunnen opdoen. Dit zal een positief effect hebben op het zelfvertrouwen van ouderen in hun vaardigheden.

ONDERWERP 2: VEREISTE COMPETENTIES VOOR TELEHEALTH

Beter inzicht in verpleegkundige 'telehealth-activiteiten' - professionele taken waarin zij digitale technologie kunnen integreren - en de hiervoor vereiste competenties is nodig voor de ontwikkeling van adequaat verpleegkundig onderwijs over zorg op afstand.

Hoofdstuk 4 beschrijft de uitkomsten van een Delphi-studie, waarin 51 experts (in vier rondes) consensus bereikten over 14 relevante verpleegkundige telehealth-taken en welke competenties verpleegkundigen moeten bezitten om deze taken effectief uit te kunnen voeren. Verpleegkundigen kunnen op verschillende manieren gebruikmaken van technologie om zorg op afstand te verlenen, bijvoorbeeld door het verlenen van psychosociale steun via een beeldcommunicatie of het uitvoeren van een dubbelcheck van risicovolle medicatie via beeld. Per telehealth-activiteit werd vastgesteld welke kennis, vaardigheden en attitude (samengevat als competenties) hiervoor vereist zijn. Totaal werden er 52 verschillende competenties vastgesteld. Hiervan waren er 32 'nieuw' (zoals kennis van de (klinische) beperkingen van telehealth). De overige 20 competenties waren competenties die voor allerlei verpleegkundige activiteiten nodig zijn (zoals klinische kennis of analytisch vermogen). Het hoofdstuk sluit af met de aanbeveling om de vastgestelde verpleegkundige telehealth-taken en bijhorende competenties te gebruiken als vertrekpunt in de ontwikkeling van trainingen en onderwijs.

ONDERWERP 3: ZELFVERTROUWEN IN TELEHEALTH-COMPETENTIES

Verpleegkundestudenten die momenteel in opleiding zijn worden gezien als '*digital natives*'. Deze generatie kent geen wereld zonder internet. Als gevolg daarvan zou verondersteld kunnen worden dat voor deze studenten geen speciale aandacht nodig is voor technologie in het verpleegkundig curriculum. Zij hebben immers van nature al oog hebben voor de mogelijkheden van technologie. **Hoofdstuk 5** gaat in op de vraag of dit ook echt zo is; heeft de internet-generatie daadwerkelijk een positief beeld van het gebruik van technologie in de zorg? Het korte antwoord is 'nee'. Een vragenlijstonderzoek, waar 1.113 verpleegkundestudenten aan deelnamen, allen

behorend tot de internetgeneratie, wees uit dat deze studenten een significant minder positief beeld hebben van verpleegkundige telehealth-taken (zoals het triëren bij inkomende alarmmeldingen), dan hun beeld van taken die al langer bestaan (zoals klinische redeneren). Er wordt op basis hiervan geconcludeerd dat onderwijs over telehealth nodig is voor alle verpleegkundigen, onafhankelijk van iemands kennis en ervaring met digitale technologie.

Het gebruik van telehealth-technologieën komt nog maar gestaag op gang, deels door het beperkte vertrouwen dat verpleegkundigen hebben in hun eigen telehealth-competenties. In **Hoofdstuk 6** wordt hier dieper op ingegaan op basis van resultaten uit een onderzoek onder 1.017 verpleegkundigen uit drie verschillende Nederlandse ziekenhuizen. De verpleegkundigen werd in een vragenlijst gevraagd hun zelfvertrouwen te scoren in 31 verschillende competenties (afkomstig uit hoofdstuk 4) die vereist zijn voor het gebruik van telehealth-toepassingen. Het onderzoek liet zien dat de meerderheid van de verpleegkundigen zelfvertrouwen had in 9 van de 31 competenties. Daar staat tegenover dat het zelfvertrouwen in 19 van de 31 competenties middelmatig of zelfs laag was. Het hoofdstuk sluit af met een opsomming van 8 competenties die beschouwd mogen worden als een essentieel onderdeel van telehealth-trainingen voor ziekenhuisverpleegkundigen. Training in deze essentiële competenties kan het gebruik van telehealth-toepassingen vergroten.

ONDERWERP 4: TRAINING IN TELEHEALTH

Scholing wordt in de literatuur regelmatig aangedragen als strategie om barrières weg te nemen bij verpleegkundigen die zich nu niet competent genoeg voelen om telehealth-toepassingen te gebruiken. Hoe zo'n training er precies uit moet zien en wat het daadwerkelijk oplevert was echter onduidelijk. In dit proefschrift wordt gepoogd deze '*knowledge gap*' te dichten. **Hoofdstuk 7** beschrijft hoe, op basis van de bevindingen uit voorgaande hoofdstukken, een telehealth-training voor verpleegkundigen werd ontwikkeld en wat deze training bijdroeg aan hun kennis, *self-efficacy* en het daadwerkelijke gebruik van telehealth-toepassingen. Er werd een tweedaagse training verzorgd aan drie verpleegkundige teams. Twaalf eerstelijnsverpleegkundigen, veertien wijkverpleegkundigen en elf ziekenhuisverpleegkundigen werden geschoold in verschillende telehealth-taken. De training werd door de verpleegkundigen goed gewaardeerd. In elk team nam

de kennis van verpleegkundigen over telehealth significant toe. In twee van de teams werd deze toename van kennis ook nog gezien in de nameting, 6-10 weken na de training. Ook het zelfvertrouwen dat verpleegkundigen hadden in hun telehealth-competenties (*self-efficacy*) nam significant toe. Het aantal keren dat verpleegkundigen daadwerkelijk zorg op afstand verleenden, gemeten over een periode van 6-10 weken voor en na de training, nam in twee teams toe en in één team af. Er wordt geconcludeerd dat training in verpleegkundige telehealth-taken bijdraagt aan de kennis en *self-efficacy* van verpleegkundigen. De training zorgde er echter niet in alle teams voor dat verpleegkundigen telehealth vaker gingen gebruiken. Mogelijk spelen hier andere barrières.

In **hoofdstuk 8** worden alle bevindingen uit het proefschrift bediscussieerd, inclusief de sterkte kanten (zoals de toepasbaarheid in het onderwijs en de praktijk) en beperkingen (zoals de beperkte bewijskracht van het effect van de training). Er wordt een model geschetst om in vijf stappen verpleegkundigen voor te bereiden op het verlenen van zorg op afstand: (1) verbeter de *intentie* van verpleegkundigen, (2) stel vast welke telehealth-taken toepasbaar zijn in de verpleegkundige setting, (3) controleer welke *competenties* vereist zijn voor deze taken, (4) stel vast hoeveel *zelfvertrouwen* verpleegkundigen al hebben in deze competenties, en (5) verzorg een *training* in de vastgestelde telehealth-taken met speciale aandacht voor de competenties waar verpleegkundigen nog onvoldoende vertrouwen in hebben. Op deze manier kunnen verpleegkundigen hun beroep aanpassen; van face-to-face naar een beroep waarin zij *ook* zorg op afstand verlenen. De nieuwe generatie verpleegkundigen kan geschoold worden op het verlenen van zorg op afstand door telehealth-taken (uit hoofdstuk 4) op te nemen in de curricula van verpleegkundeopleidingen. Adequaat opgeleide verpleegkundige kunnen de verdere implementatie van zorg op afstand versnellen en zo een bijdrage leveren aan de mogelijkheden van ouderen om zo lang mogelijk zelfstandig thuis te wonen met behulp van telehealth.

DANKWOORD

Dat het promoveren vrij soepel verliep heb ik voor een groot deel te danken aan de mensen om mij heen; participanten, begeleiders, collega's, vrienden en familie die mij direct of indirect hielpen bij dit onderzoek. Al deze mensen wil ik ontzettend bedanken! Een aantal wil ik in het bijzonder noemen.

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Dan het promotieteam, prof.dr. Olle ten Cate, prof.dr. Helianthe Kort en dr. Roelof Ettema. We vormden een bont gezelschap van disciplines: Olle, opgeleid als arts, nu hoogleraar Medische Onderwijskunde. Helianthe, opgeleid als bioloog, nu lector Technologie voor Zorginnovaties en een leerstoel aan de TU Eindhoven. Roelof, opgeleid als verpleegkundige, later verplegingswetenschapper, epidemioloog en gepromoveerd op het ontwikkelen van een evidence based interventie. Ikzelf, opgeleid als verpleegkundige en socioloog. Al vrij snel werd duidelijk bij wie ik moest zijn voor welke vragen. De grove indeling was: Olle - alles over onderwijs, Helianthe - alles over technologie, Roelof - statistiek en klinische relevantie voor de verpleegkundige praktijk.

Olle, jouw enthousiasme voor medische onderwijskunde werkte aanstekelijk. Het was leuk en leerzaam om onder jouw inspirerende leiding in de CTL-sessies (Cyclus van Theorie en Literatuur) met medepromovendi over onderwijskundige theorieën te spreken. Ik heb je bedachtzame, creatieve geest gewaardeerd. Maar ook het tempo waarmee je reageerde op stukken. Als ik iets op zaterdagmiddag stuurde, had ik het in de avond terug met feedback. Ik vond het prettig dat je je mening nooit oplegde. Anekdotisch: ik kreeg tegenstrijdige adviezen vanuit het promotieteam. Jouw reactie: 'Nu zit je in de luxepositie dat je geen verkeerde keus kunt maken'. Heel veel dank voor je inzet en betrokkenheid.

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delen op congressen, in vakbladen of in het onderwijs. Tegelijkertijd trok je af en toe aan de rem en kreeg iemand de boodschap: 'Thijs heeft hier nu geen tijd voor, de focus ligt nu op het schrijven van de manuscripten'. Daarnaast had jij ook altijd oog voor het leven naast het werk; mijn gezin. Mooi dat we weer twee jaar verder kunnen gaan samenwerken in het project COUNT! Heel veel dank voor je inzet en betrokkenheid.

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CURRICULUM VITAE

Thijs van Houwelingen was born in Aduard (1983), in the north of the Netherlands, and grew up in Zwolle. After completing his high school, he moved to Utrecht to become a nurse. During his study at the University of Applied Sciences Utrecht (Hogeschool Utrecht), he worked as a nursing student on several wards of the University Medical Center Utrecht (UMCU). After completing his nursing degree in 2006, Thijs studied Sociology at the University of Amsterdam and simultaneously worked as a nurse on a psychiatric ward of the UMCU. He was in charge of different projects aimed at reducing the practice of restraining and secluding psychiatric patients. In his master thesis, which was awarded the '*MCN muziekscriptieprijs*' (the Dutch Music Center thesis award), he mapped out the world system of classical music. In 2012, Thijs came back to the University of Applied Sciences Utrecht, to start a PhD research on 'Telehealth competence in nursing', supervised by prof.dr. Olle ten Cate, prof.dr. Helianthe Kort and dr. Roelof Ettema. Along his research activities, Thijs worked as a lecturer in nursing at the University of Applied Sciences Utrecht, and later also at the Utrecht University, supervising students within the pre-master program of Clinical Health Sciences. In his work as a lecturer, Thijs implemented findings of this doctoral thesis in the nursing curriculum. Furthermore, he wrote a number of Dutch publications, aimed at supporting other nursing schools to integrate telehealth into their education. His last article in '*Onderwijs & Gezondheidszorg*' was awarded the '*Henk Ritzen Prijs*' (best article prize). Thijs is married to Aafke. They are blessed with three sweet children: Lize (2012), Cato (2015) and Benne (2017).

LIST OF PUBLICATIONS

IN THIS THESIS

- **van Houwelingen**, C.T.M., Ettema, R.G.A., Bleijenberg, N., Os-Medendorp, H., Kort, H.S.M., ten Cate, O. Training nurses to increase their knowledge, self-efficacy and usage of telehealth: a multi-setting pretest-posttest study. *Submitted for publication*
- **van Houwelingen**, C.T.M., Ettema, R.G.A., Kort, H.S.M., ten Cate, O. Hospital Nurses' Self-Reported Confidence in Their Telehealth Competencies. *Submitted for publication.*
- **van Houwelingen**, C.T.M., Ettema, R.G.A., Antonietti, M.G.E.F., Kort, H.S.M. *Journal of Medical Internet Research*, *20*(4):e123. doi: 10.2196/jmir.8407.
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