Hospital nurses participating in designing programs of healthcare technologies

A qualitative generic study

Author:	A.C.M. Meeuse
Student number:	5690161
Education:	Master Clinical Health Science, Utrecht University, UMC-Utrecht
Program:	Nursing Science
Supervisor:	Dr. C.T.M. van Houwelingen Prof. Dr. H.S.M. Kort
Lecturer:	Dr. J. Van Dijk
Internship setting:	University of Applied Science Utrecht, Utrecht
Magazine:	Journal of Medical Internet Research
Date of submission:	27 June 2019
Status Master thesis:	Final
Number of words thesis:	3799 Words
Number of words Abstract:	294 Words
Number of words Dutch summary:	285Words
Reference style:	Vancouver reference style
Criteria of reporting:	COREQ

Abstract

Hospital nurses participating in designing programs of healthcare technologies

Background: In the growing elderly population, care innovation is important to maintain quality and keep patient care safe, effective and patient centred. Healthcare technologies could be a solution to innovate, maintain or improve the quality of care and simultaneously decrease the workload of nurses. Currently, nurses are rarely involved in designing programs of healthcare technologies, mostly due to nurses' lack of time or lack of insights in technology design. To ensure that healthcare technologies fit into nurses' daily practice, nurses should be actively involved in the designing process.

Aim: Discovering the main requirements for hospital nurses to participate actively in the designing programs of healthcare technologies.

Method: An exploratory descriptive qualitative design with a generic approach was used. Data were collected by semi-structured interviews with hospital nurses with experiences in designing programs. The thematic analysis method of Braun and Clarke was used for analysis.

Results: Twelve nurses from three academic hospitals in the Netherlands participated in the study. Identified themes were: nurses' motivations to participate, process of technology development, required competence to participate and facilitating and organizing nurses' participation.

Conclusion: To participate, nurses have to be motivated and enthusiastic. Nurses need competences such as assertiveness, to be able to think creatively and have insights in practice. Nurses experience their involvement in the design process as necessary. However, nurses should be facilitated by the organisation to participate actively.

Recommendations: Further research is necessary to explore what the hospitals possibilities are to facilitate nurses to participate. Nonetheless the hospital organisations could already start facilitating nurses to participate. Further research in non-academic hospitals is necessary before the outcomes could be generalized to all hospital nurses in the Netherlands.

Keywords: Healthcare Technology, Stakeholder Participation, Equipment Design, Co-creation, Competence

Nederlandse Samenvatting

Betrekken van ziekenhuisverpleegkundigen in ontwerpprojecten van gezondheidszorgtechnologieën.

Achtergrond: In de groeiende ouder wordende bevolking is het verbeteren van de kwaliteit van zorg belangrijk om de patiëntenzorg veilig, effectief en patiëntgericht te houden. Het gebruik van gezondheidszorgtechnologieën kan een oplossing zijn om de kwaliteit van zorg te verbeteren en de werkdruk van verpleegkundigen te verminderen. Momenteel zijn verpleegkundigen zelden betrokken bij het ontwerpen van gezondheidszorgtechnologieën, vanwege gebrek aan tijd of kennis in technologieontwerp. Om ervoor te zorgen dat gezondheidszorgtechnologieën effectief werken op de dagelijkse verpleegkundige werkplek, behoren deze technologieën actief te worden ontworpen samen met verpleegkundigen.

Doel: Onderzoeken wat vereisten zijn van ziekenhuisverpleegkundigen om actief deel te nemen aan het ontwerpproces van gezondheidszorgtechnologieën.

Methode: Een exploratief, generieke, beschrijvende kwalitatieve onderzoeksmethode werd gebruikt. Gegevens werden verzameld bij ziekenhuisverpleegkundigen met ervaring in ontwerpprojecten met semigestructureerd interviews. De thematische analysemethode van Braun en Clarke werd gebruikt voor de data-analyse.

Resultaten: Bij 12 deelnemers uit drie academische ziekenhuizen in Nederland, was er dataverzadiging. Geïdentificeerde thema's waren: motivatie van verpleegkundigen om deel te nemen, het proces van technologische ontwikkeling, vereiste competenties om deel te nemen en het faciliteren en organiseren van de deelname van verpleegkundigen

Conclusie: Verpleegkundigen ervaren hun betrokkenheid als noodzakelijk, maar om deel te nemen moeten verpleegkundigen gemotiveerd en enthousiast zijn en hebben ze competenties nodig zoals assertiviteit, creatief denken en inzicht hebben in de praktijk. Verpleegkundigen vinden dat zij door de organisatie gefaciliteerd moeten worden om actief deel te nemen.

Aanbevelingen: Verder onderzoek is nodig om te ontdekken welke mogelijkheden ziekenhuizen hebben om verpleegkundigen te laten deelnemen aan innovatieprojecten. Onderzoek in niet academische ziekenhuizen zou kunnen worden uitgevoerd om de uitkomsten te generaliseren naar alle Nederlands ziekenhuisverpleegkundigen.

Sleutelwoorden: gezondheidszorg technologie, belangstellende participatie, apparatuur ontwerp, co-creatie, competenties

Introduction

The worldwide population is growing, people are getting older, and also the number of patients continues to rise[1–3]. In the Netherlands, by the increasing number of patients, less nurses are available per patient to provide all the patients care need[4,5]. Because of the shortage of nurses, the nurses experience a high workload of administrative burden and have little time to spend with their patients[5–9]. The less time nurses have to spend to the patients, the lower the quality of care according to the humanistic care theory[5,6,10–17]. Quality of care is an important topic in the healthcare sector, which should be safe, effective, patient centred and timely[18,19].

The high workload is experienced by all Dutch nurses, whose 40% are hospital nurses[10,20]. To improve quality of care by reducing nurses' administrative tasks to create more time for patient contact, hospitals often use healthcare technologies (HT). Examples of these HT are electronical health record systems, robots or measurement devices[21–23]. By the right and sufficient use of the HT, the administrative burden could decrease and errors can be recognised earlier[23–25]. Then, nurses would have more time left to spend to the patients actual needs and quality of care could increase[15–17]. Although HT such as electronical health record systems exist, they not always contributed to patient care, because they are time consuming or difficult to use[25,26]. When HT are adequately designed and aligned with nurses daily practice, nurses can take the advantage of effects at the use of technologies[25,27].

Decisions on which HT should be used are often made by policy makers and hospital management. The actual design of such HT is performed by engineers[21,26,28]. Although, nurses as end users could have a valuable role to increase the possibility of adoption of HT, in both processes nurses are rarely involved[29,30]. This could be seen as a missed opportunity, as nurses on wards are the experts in delivering care and have the most adequate insights on what technologies are actually needed and what is needed to make technological innovations work effectively[23,31,32]. Nowadays, involving end users in design programs in the healthcare sector becomes more common[33]. Literature shows involving end users, such as patients or healthcare professionals, in the healthcare sector is necessary and should be involved during the entire process[34]. Despite the fact that nurses and designers both see the importance of involvement of nurses in designing HT in co-creation, literature indicates it is hard to involve them[30–32,35,36]. The lack of involvement could be caused by the limited time of nurses and their lack of leadership skills to defending their involvement rights and necessity and knowledge of HT[36]. However, there is a lack of knowledge regarding this topic.

To increase nurses' knowledge of technologies, innovations and implementation, thereof, the current Dutch nursing curriculum "Bachelor 2020" states that nurses have to be both a professional and a quality promoter[37]. Therefore, the curriculum states that a nurse must be open minded to innovations and must be able to implement processes and innovations[37]. Thereby, the current curriculum states bachelor nurses should be educated to develop healthcare technologies in practice to promote quality[37].

To make sure that future HT are aligned with daily nursing practice and could help to improve quality of care, hospital nurses should participate actively in the designing phase of healthcare technology[33,34,36]. Although literature shows what competencies and knowledge nurses might need on the ways to use technology in practice and how to design[37,38], there is a lack of knowledge on the way that hospital nurses can actively participate and subsequently examine their role as quality promotor and innovator[39]. Insights in nurses' experiences to participate, could gain insights in the requirements of nurses to participate in HT design programs (HTDP).

Aim

This study aims to explore what main requirements of the hospital nurses are to be able to actively participate in the design programs of healthcare technologies.

Method

Design

An exploratory descriptive qualitative design with a generic approach was used[40–43]. An exploratory design suited best, based on the lack of knowledge and to prior outcomes of the main requirements to participate in HTDP. To describe nurses' experiences in general, a generic approach was chosen[43]. The study is part of a larger research project: Communication On the Unit Between Nurses and Technology (COUNT), a project of the University of Applied Sciences Utrecht[44–46]. The consolidated criteria for reporting qualitative research guideline(COREQ) was used to enhance the transparency of reporting[47].

Population and setting

The study was conducted in three academic hospitals in the Netherlands. Participants were included if they (1) were Dutch speakers, (2) have graduated and were registered hospital nurses, (3) have participated at least once in a design project of HT and (4) have at least once worked with HT in practice. Recruitment of participants was done by purposive sampling to come to a heterogenous sample with variance in gender, age and work experience for representativeness to other hospital nurses[48].

Data collection & procedures

Recruitment of study participants occurred between February and March 2019. Potential participants known form the COUNT study and the cooperating researchers (CR) network, were invited by an email with an information letter of the study to participate. Participants were allowed to forward the invitation in their own network to recruit other participants. When participants were interested to participate and agreed with the inclusion criteria, they were asked to send the principal researcher (PR) their approval by email. Then the interview was planned and further study information was sent to the participant.

Data were collected by semi-structured interviews, because by this method specific topic areas of interest could be discovered in a structured way[49]. Interviews were occupied by PR, who is a female master student in Clinical Health Science. To ensure quality, the PR was trained in interview techniques. The interview guide was developed using the method of developing questionnaires for educational research by Artino[50], which ensure the quality. Outcomes of a previous COUNT study and literature were used to formulate topics[31,36,44]. By discussing the interview guide with an expert panel of two independent researchers with experiences in the research topic and the CR, the guide was validated to enhance the quality[50].

Prior to the actual interviews, a pilot interview has conducted to establish whether or not questions and topics of the guide were relevant and interpreted adequately to ensure quality.

The pilot interview was executed by a recently graduated nursing student who executed a COUNT study as well. By evaluating the results of the pilot interview, no questions were added or removed. During the process of interviewing, some questions were added and removed to the final interview guide (Appendix I). Each interview was audio recorded in nurses work place at the hospital within a room with limited ambient noise. The interviews lasted from 30 minutes to 1 hour. Before the interviews started, participant characteristics as age and working experience were asked. In every interview, memos of impressions and remarks were made.

Data analysis

For analysing the data, the thematic analysis method of Braun and Clarke was used[41]. The interviews were transcribed verbatim in Microsoft Word 2016 by PR. First transcripts were read and reread to get familiar with the data. Thereafter in phase two, initial codes were generated. Therefore, the first transcript was coded together by PR and CR to come an agreement about coding meaningful parts of the data using the NVIVO version 12, QRS international software. Subsequently, themes were searched by categorizing codes to relevance and relation to each other. These categories of codes were then further organised in more meaningful themes and were reviewed with the data. Finally, in the last phase the found themes could be defined and named. To ensure quality, the defined themes were discussed with all authors and together we came to an agreement about the themes. Finally, the themes were submitted for member checking[51], by sending them to three participants, each from a different hospital ensure quality.

Ethical issues

This study was conducted following the principles of the Declaration of Helsinki[52]. Because participants did not undergo any form of treatment or actions, the Dutch Medical Research Involving Human Subjects Act did not apply. Therefore, no official ethical approval was required[53]. At the beginning of each interview, informed consent (IC) was signed by the participants and the PR. Data was stored confidentially by numbering participants, transcripts and audio, with only access by the researchers. Data and IC's are saved for fifteen years at the University of Applied Sciences Utrecht.

Results

Participant characteristics

In total, twelve hospital nurses participated in this study, of which 75% were female. The ages ranged from 28 to 59 years, with a working experience range of 7 to 35 years. An overview of all demographic characteristics is presented in Table 1. One participant did not fully agree the inclusion criteria, since she, in hindsight appeared to have no experience in participating in HT design projects. However, she had a relevant point of view, suitable with the research question and was therefore still included. This data was analysed in line with the other data. Saturation of data was achieved by twelve participants, when no more new information was mentioned. (insert Table 1)

Themes

The four main themes identified, which all four were mentioned by all participants, were (1) Nurses' motivation to participate, (2) Process of technology development, (3) Required competence to participate and (4) Facilitating and organizing nurses' participation.

Nurses' motivation to participate

To be involved early in the design process, most participants mentioned nurses have to be motivated. Nurses' motivation seemed to be built on experiences and their understanding of importance of their participation in designing processes. Nevertheless, according to the participants, nurses know best what happens in practice and what HT are necessary. Participants mentioned working with HT is a part of the job and technologies will be more adapted in the future. According to participants, most nurses are interested in HT and enjoy working with HT. Participants described HT as necessary to provide qualitative good care. They believe that participating in HTDP contributes to their self-esteem and it will give them confidence.

> "*That something you have designed and produced in here which is produced thereafter, how proud can you be about yourself and your nursing profession."* (P1)

However, not all nurses appeared to be motivated to participate in HTDP. When nurses believe using HT is difficult, is hard to understand or HT does not interest them, resistance towards HT development and implementation arises. Furthermore, when nurses do not speak the language of HT developers or way of thinking differs from theirs, it is hard for nurses to be

motivated according some participants. In addition, thereto, participants mentioned the importance of involving nurses is not taken into account, which demotivates them to participate.

> "*It seems that the importance of involving a nurse is not sufficiently taken into account in this."* (P7)

Process of technology development

Most participants said involvement of nurses in HTDP should already begin at the start, when discussing the needs and every single problem to solve. Then, according participants, involvement of nurses is also required during the development phase, piloting, implementing HT and evaluating the designed HT. Participants mentioned, nurses have insights into the way existing HT works in practice, what HT is missing in daily practice or what the main problem of existing HT is. Therefore, participants experience their involvement as end-user in the process of developing as necessary.

> "*I think, it is a very missed opportunity, if you want to introduce something new and there are no nurses involved."* (P1)

However, several participants said that not all nurses have to participate in the entire HT design process. These participants suggested that nurses should only be able to suggest ideas or give feedback on the technologies which are already designed.

Participants indicated designing HT is necessary to be done in co-creation in good collaboration with a variety of disciplines. Thereby, participants appointed working in co-creating means the nurses feedback should be taken into account.

> "*If you want to develop technology for the benefit of patient care, you also need those [nurses] people."* (P8)

Nevertheless, participants mentioned that the process of designing, implementing and innovating, takes a lot of time and is hard. Therefore, participants suggest that designing must begin accessible in several rounds with a small problem. Then, during the process nurses should be assist by coaches to understand the process of designing.

Required competence to participate

To participate in designing projects, nurses need several competencies. In total 48 competencies were mentioned by the participants. These competencies could be divided in three sub-themes: knowledge, skills and attitude. All 48 competencies are listed in Table 2 (insert Table 2).

Knowledge. Participants mentioned nurses must have insights and knowledge about the way the daily nursing practice works and what is necessary to make HT work in their daily practice.

> *"As a nurse you naturally have a view on what works and what does not work, or whether it fits in the workflow."* (P1)

According participants, knowledge about the way technologies are designed and work in practice is also required to understand and be able to talk and think along about designing new HT. To have an adequately role in the design program group, some participants noted nurses need to know their network connections in their work environment well. Network connection could be helpful during the design process

Skills. Participants mentioned 17 skills which are required to be able to participate HTDP. Many participants indicated you have to be able to enthuse others to take them along in the process and convince others to the necessity of the new HT. To participate, participants also noted it is important to be skilled in communication with other disciplines and how to communicate in groups to translate outcomes of HT designs into practice. Another important skill noted by participants to participate in HTDP but also in the daily practice is, as a nurse you seem to be able to think out of the box, think in creative solutions, be able to work in project groups and should be able to think transcendent.

> "*You must dare to look beyond the boundaries of the project itself."* (P11)

Attitudes. When nurses want to participate, they seem to have to adopt certain attitudes to have an active role in the HT design program. Participants mentioned the following attitudes as most important to be able to participate: being enthusiastic, being intrinsically motivated and being curious. Furthermore, nurses should have perseverance and courage. Another frequently mentioned attitude is nurses have to be critical.

> "*You must be able to be critical and make good judgments."* (P7)

Education. According to most participants, nurses have to be educated in competencies as knowledge, skills and attitude to be able to participate in HTDP. Therefore, participants noted education in these competencies should part of the undergraduate nursing curriculum. Participants recommended nursing school should educate future nurses in these skills by providing an assignment to practice with these skills and get educated in it.

> "*Bachelor nursing students have to do an innovation assignment; I think that is a very good idea."* (P12)

Participants mentioned possibilities to get graduate nurses skilled in competencies by participating in further trainings and workshops. Another possibility mentioned by participants is, to train future and graduate nurses in a separate specific minor or even a complete specific bachelor program about innovating healthcare technologies.

Facilitating and organizing nurses' participation

When nurses are educated and skilled in competencies of HT to participate, participants noted nurses have to be facilitated to actually use such skills in practice. Although all nurses should have the possibility to participate in HTDP, the role as participating nurse in a HT design program is important and a responsible one. As participating nurse, you are the point of contact for colleagues on the ward and the centre point of patient care. In this role, nurses use the input they get from the wards of working groups and team meetings about questions and problems of HT in daily practice.

To make it possible for nurses to participate and give input for HT innovations, participants mentioned the hospital management could organize innovation meetings and contests to motivate and encourage nurses.

> *"We also have some innovation days, as a nurse you can come and says: I have an idea, what do you think of it?"* (P9)

Also, participants mentioned innovation centres as *Create4Care* in Erasmus MC Rotterdam and *Reshape* in Radboud MC in Nijmegen, are facilities which organisations could take as an example. In these facilities, nurses can walk in, think along, get participated and start designing of HT solutions by themselves with the help of coaches. As a result, participants noted nurses should be given time to participate in these meetings during working hours. If nurses do not participate actively in HTDP on their own, participants said they must be invited actively and personally to participate.

However, participants also mentioned that when they are skilled and want to participate, they are not always allowed to. Team managers want nurses to stay on the wards, because there is a shortage of nurses, patient care get priority and consequently, no time can be freed up to participate in HTDP. Participants mentioned their organisation should set a clear mission and vision about usage and development of healthcare technologies by all disciplines. Therefore, participation in HTDP should be subject of discussion at the wards and in the hospital. Team managers should give their approval when nurses want to participate. Designing and innovating HT is a part of the job.

> *"It just has to be self-evident that you are there [in the project group], that innovation is also part of your nursing work."* (P8)

Discussion

This study has identified four main themes about the requirements of nurses to participate actively in HTDP. First, nurses should be motivated and enthusiastic. Thereby, nurses need to be assured their input shall be used. Second, designing should occur in co-creation, because the nurses' insights are necessary for design. The entire design process must be accessible for all nurses, during which they should get help from coaches. Third, required competences nurses need to participate such as knowledge, skills and attitude, can be taught during nursing school, in workshops or in a specific minor or bachelor HT design. Fourth, hospitals have to facilitate and organise the possibility for nurses to participate in HTDP, such as facilitating time. Thereby, the hospital management should set a clear vision about innovating.

Prior research

Prior research shows there are eight essential competencies what hospital nurses should be educated in how to use HT in practice[38]. The current study implies undergraduate nurses have also to be educated in competences in developing and designing HT. However, nowadays bachelor nurses are already getting educated in the CanMEDS roles in the newest curriculum[37,54]. The CanMEDS roles describe that nurses have to be educated in technology as a professional and quality improver[37,54].

To strengthen nurses in their role as co-designer, the present study states nurses need to be assertive and show nursing leadership. Nursing leadership is also one of the CanMEDS roles in which new graduate nurses are educated in[37,54]. Literature shows nurses need these nursing leadership skills to be able to have an active role in development of new policies or a new HT[55,56]. Nursing leaders are essential for motivating and have an important role to distinguish whether which HT will be implemented to provide qualitative high care[36,56,57]. Increasing these nursing leadership will strengthen nurses in the process of HT development as co-creator and nursing leader, nurses have to be trained to get skilled[55]. Besides, increasing nurses leadership skills, could also have a positive effect on quality of care and nursing outcomes[11]. Team managers have an important role in increasing nursing leadership, by mentoring and stimulating the working culture[58]. Increasing quality of care, supporting nursing leaders and HT development corresponds with the present study.

The current study shows the necessity of nurse's involvement in HTDP. Prior research determined outcomes in line with these outcomes[59]. When HT is developed adequately, this could increase quality of care and increases the working satisfaction. The facilitation of nursing participation in HTDP is complicated, as shown in this study. This due to hospital policy and non-patient time nurses are allowed to use, which is also shown in literature[55].

Strengths and limitations

The inclusion of a participant who did not fully agree all inclusion criteria was a limitation of the study. The lack of experiences with HTDP caused it was not possible to explore the experiences in line with the research question. However, the inclusion seems to have had no influence on the data saturation. Therefore, this data is analysed in line with the other data, which is another limitation. To prevent bias, this diverge data should have been analysed separate from the other data to compare the outcomes. Another limitation is discussing topics as competences and facilities which might could have affected participants' responses by making the participants think in certain direction. However, prior research determined these topics as relevant to include[31,36,44]. In addition, the use of a valid method for developing an interview guide was a strength of the study to ensure quality[50]. Because an expert panel of independent researchers discussed and validate the interview guide, some necessary alterations have been made. Finally, the data analysis was executed together with PR and CR, which strengthens the study. Investigator triangulation reduce the risk of biased decisions about coding relevant data and defining themes. By analysing and discuss the data the most relevant data was coded and defined themes were agreed by all researchers.

Implications for practice, education and future research

Nurses who are intrinsic motivated to participate in HTDP, should be proactive and start the conversation with their team and managers about participation. Thereby, when the hospital is innovating, nurses should show their courage and search for knowledge how they could participate. Then, nurses should just start by taking part in innovating meetings to show their experiences and input. Designing teams should allowed nurses to explain the necessity of nursing involvement and input in HTDP. When nurses not invited themselves, the design teams should actively search for motivated nurses and invite them to participate in HTDP.

To get nurses educated in the required competences, it is recommended to bachelor nursing schools to incorporate and increase the knowledge of designing HT in the curriculum. For those students who are more interested in designing HT, a minor of designing HT can be developed. Another recommendation is to develop a specific education of HT design. Graduated nurses should be able to follow workshop, developed by hospitals or nursing schools, to retrain them in required competences to participate in HTDP.

Subsequently, hospital management should allow one or two most motivated nurses at first to participate in HTDP. Therefore, they should facilitate them in time during working hours. Besides, hospital management should discuss their vision about innovating care, to ensure innovation is a main goal. Then the hospital policy could be described with this vision, which

incorporate involving all end-users in HTDP. Thereby, another recommendation is to set up innovation centres where nurses can help innovating and which are accessible.
However, facilitating nurses in HTDP requires organisational changes in policy to make it possible for the organisation to allow nurses to participate in HTDP. To discover what hospital organisational attributes are required, further research is recommended to explore what hospitals possibilities are to facilitate nurses in participating in HTDP.

Conclusion

To be able to participate actively in HTDP, there are four main requirements for hospital nurses. Nurses need to be motivated and enthusiastic. Thereby, the design process has to occur in cocreation, to use the experiences and input of the end-users. Required competences to be able to participate are knowledge, skills and attitudes of HT which could be educated. When hospital organisation facilitates nurses in time and facilities to participate in HTDP, this might eventually lead to more adequately designed healthcare technologies solutions that can help to improve quality of care.

Reference list

1. United Nations. World Population Prospects The 2017 Revision Key Findings and Advance Tables. World Popul Prospect 2017. 2017;1–46.
2. CBS. Prognose levensverwachting 65-jarigen [Internet]. 2018 [cited 2019 May 21]. Available from: https://www.cbs.nl/nl-nl/nieuws/2018/44/prognose-levensverwachting-65-jarigen
3. Zorg voor beter. Cijfers: vergrijzing en toenemende zorg [Internet]. 2017 [cited 2019 May 21]. Available from: https://www.zorgvoorbeter.nl/veranderingen-langdurige-zorg/cijfers-vergrijzing
4. CBS. Aantal verpleegkundigen toegenomen [Internet]. 2019 [cited 2019 May 21]. Available from: https://www.cbs.nl/nl-nl/nieuws/2019/19/aantal-verpleegkundigen-toegenomen
5. V&VN. Personeelstekorten in de zorg Oplossingen van de werkvloer. 6 Oktober 2017 [Internet]. 2017; Available from: https://www.venvn.nl/Portals/1/Downloads/Personeelstekorten-zorg-oplossingen-van-de-werkvloer.pdf
6. Hinno S, Partanen P, Vehvila K. Nursing activities , nurse staffing and adverse patient outcomes as perceived by hospital nurses. J Clin Nurs. 2011;21:1584–93.
7. Myny D, Goubergen D Van, Gobert M, Vanderwee K, Hecke A Van, Defloor T. Non-direct patient care factors influencing nursing workload: a review of the literature. J Adv Nurs. 2011;67(10):2109–29.
8. Mittmann N, Seung SJ, Pisterzi LF, Isogai PK, Michaels D. Nursing Workload Associated with Hospital Patient Care. Dis Manag Heal outcomes. 2008;16(1):53–61.
9. Lindqvist R, Alenius LS, Runesdotter S, Ensio A, Jylhä V, Kinnunen J, et al. Organization of nursing care in three Nordic countries : relationships between nurses ' workload , level of involvement in direct patient care , job satisfaction , and intention to leave. BMC Nurs. 2014;13(27):1–13.
10. Liu X, Zheng J, Liu K, Gedney J, Liu J, Wu Y, et al. Hospital nursing organizational factors , nursing care left undone , and nurse burnout as predictors of patient safety : A structural equation modeling analysis. Int J Nurs Stud. 2018;86(May):82–9.
11. Hurst K. UK ward design : Patient dependency , nursing workload , staffing and quality — An observational study. Int J Nurs Stud. 2008;45:370–81.

12. Bichel-Findlay J, Callen J, Sara A. Health information systems and improved patient outcomes: Do nurses see the connection? Stud Health Technol Inform. 2009;146:378–82.

13. Kraljic S, Zuvic M, Desa K, Blagaic A, Sotosek V, Antoncic D, et al. Evaluation of nurses ' workload in intensive care unit of a tertiary care university hospital in relation to the patients ' severity of illness : A prospective study. Int J Nurs Stud. 2017;76(2017):100–5.

14. Braaf S, Manias E, Riley R. The role of documents and documentation in communication failure across the perioperative pathway . A literature review. Int J Nurs Stud. 2011;48(8):1024–38.

15. du Plessis E. Caring presence in practice: facilitating an appreciative discourse in nursing. Int Nurs Rev. 2016;63(3):377–80.

16. Delmas P, Reilly LO, Cara C, Brousseau S, Weidmann J, Roulet-schwab D, et al. Effects on nurses ' quality of working life and on patients ' quality of life of an educational intervention to strengthen humanistic practice among hemodialysis nurses in Switzerland : a protocol for a mixed-methods cluster randomized controlled trial. BMC Nurs. 2018;17(47):1–11.

17. Khademi M, Mohammadi E, Vanaki Z. A grounded theory of humanistic nursing in acute care work environments. Nurs Ethics. 2017;24(8):908–21.

18. Joshi MS, Ransom ER, Nash DB, Ransom SB. Healthcare quality and the patient. In: The healthcare quality book. third. Health administration press; 2018. p. 3–29.

19. Institute of Medicine. Crossing the quality chasm: a new health system for the 21th century. Iom. 2001;(March):1–8.

20. CBS. Meer verpleegkundigen afgestudeerd [Internet]. CBS. 2018. Available from: https://www.cbs.nl/nl-nl/nieuws/2018/19/meer-verpleegkundigen-afgestudeerd

21. Jha AK, DesRoches CM, Campbell EG, Donelan K, Rao SR, Ferris TG, et al. Use of Electronic Health Records in U.S. Hospitals. N Engl J Med. 2009;360:1628–38.

22. Li L, Benton WC. Hospital technology and nurse staffing management decisions. J Oper Manag. 2006;24(5):676–91.

23. Bates DW, Gawande AA, Bates D.W. G a. a. Improving safety with information technology. N Engl J Med. 2003;348(25):2526–34.

24. Lee J, Ae Y, Ji S, Jung Y, Jeong H, Ram B, et al. Nurses ' needs for care robots in

integrated nursing care services. J Adv Nurs. 2018;(March):2094–105.

25. Baumann LA, Baker J, Elshaug AG. The impact of electronic health record systems on clinical documentation times : A systematic review. Health Policy (New York). 2018;122(8):827–36.

26. Sharman Z. Remembering the basics: Administrative technology and nursing care in a hospital emergency department. Int J Med Inform. 2007;76(2007):222–8.

27. Drach-Zahavy A, Somech A, Admi H, Peterfreund I, Peker H, Priente O. (How) do we learn from errors? A prospective study of the link between the ward's learning practices and medication administration errors. Int J Nurs Stud. 2014;51(3):448–57.

28. Chiang H-Y, Hsiao Y-C, Lee H-F. Predictors of Hospital Nurses ' Safety Practices. J Nurs Care Qual. 2017;32(4):359–68.

29. Wyszewianski L. Basic concepts of healthcare quality. In: Joshi M., Ransom ER, Nash DB, Ransom SB, editors. The healthcare quality book. Thrids. Chicago, Arlington: Health administration press; 2018. p. 31–54.

30. Burnes Bolton L, Gassert CA, Cipriano PF. Smart Technology, Enduring Solutions. J Healthc Inf Manag. 2008;22(4):24–30.

31. Poel P van de. Entreprenurse' eist plek aan beleidstafel op [Internet]. Skipr. 2018 [cited 2018 Mar 13]. Available from: https://www.skipr.nl/actueel/id33911-entreprenurse-eist-plek-aan-beleidstafel-op.html

32. Hulsebos M. Ruim baan voor de entrepreNURSE [Internet]. ICT/Magazine. 2018 [cited 2018 Jun 18]. Available from: https://www.ictmagazine.nl/achter-het-nieuws/ruim-baan-voor-de-entreprenurse/

33. Calvillo-Arbizu J, Roa-Romero LM, Estudillo-Valderrama MA, Salgueira-Lazo M, Aresté-Fosalba N, del-Castillo-Rodríguez NL, et al. User-centred design for developing e-Health system for renal patients at home (AppNephro). Int J Med Inform [Internet]. 2019;125(February):47–54. Available from: https://doi.org/10.1016/j.ijmedinf.2019.02.007

34. Årsand E, Demiris G. User-centered methods for designing patient-centric self-help tools. Informatics Heal Soc Care. 2008;33(3):158–69.

35. Lefebvre H, Brault I, Levert M, Roy O, Alarie S, Proulx M. Co-developing a knowlegde exchange network to facilitate access to clinical best practives during care trasitions of patients witg chronic diseases: An example in oncoloy. In: Knowledge Creation and

Transfer : New Research. Quebec; 2016. p. 43–59.

36. Hamer S. Involving nurses in developing new technology. Nurs Times. 2013;109(47):18–9.

37. Landelijk Overleg Opleidingen Verpleegkunde. Bachelor nursing 2020.

38. Houwelingen CTM van, Moerman AH, Ettema RGA, Kort HSM, ten Cate O. Competencies required for nursing telehealth activities: A Delphi-study. Nurse Educ Today. 2016;39:50–62.

39. Marques A, Oliveira T, Martins MO. Medical Records System Adoption in European Hospitals. Electron J Inf Syst Eval [Internet]. 2011;14(1):89–99. Available from: www.ejise.com

40. Polit DF, Beck CT. Nursing research. Generating and Assessing Evidence for Nursing Practive. 10th ed. Wolters Kluwer; 2017.

41. Braun V, Clarke V. Thematic analysis. APA Handb Res methods Psychol Vol 2 Res Des Quant Qual Neuropsychol Biol. 2012;2:57–71.

42. Cooper S, Endacott R. Generic qualitative research: A design for qualitative research in emergency care? Emerg Med J. 2007;24(12):816–9.

43. Kahlke RM, Hon BA. Generic Qualitative Approaches : Pitfalls and Benefits of Methodological Mixology. Int J Qual methods. 2014;13:37–52.

44. Verhoeven F, Cremers A, Houwelingen T Van, Jaspers J, Zielhuis M. COUNT. Utrecht; 2017.

45. Hogeschool Utrecht. Communication and Operation on the Unit Between Nurses and Technology (COUNT) [Internet]. Hogeschool Utrecht. 2018. Available from: https://www.onderzoek.hu.nl/Projecten/Communication-and-Operation-on-the-Unit-Between-Nurses-and-Technology-COUNT

46. Hogeschool Utrecht. COUNT [Internet]. Hogeschool Utrecht. 2018. Available from: http://codesigners.nl/projects-item/count/

47. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research: A 32-item checklist for interviews and focus groups. Int J Qual Heal Care. 2018;19(6):349–57.

48. Holloway I, Wheeler S. Sampling and site selection. In: Qualitative research in nursing and healthcare. third. Wiley-Blackwell; 2014. p. 137–50.

49. Holloway I, Wheeler S. Interviewing. In: Qualitative research in nursing and healthcare. third. Wiley-Blackwell; 2014. p. 87–107.

50. Artino AR, La Rochelle JS, Dezee KJ, Gehlbach H. Developing questionnaires for educational research: AMEE Guide No. 87. Med Teach. 2014;36(6):463–74.

51. Bygstad B, Munkvold BE. The significance of member validation in qualitative analysis: Experiences from a longitudinal case study. Proc Annu Hawaii Int Conf Syst Sci. 2007;1–10.

52. World Medical Association. World Medical Association Deceleration of Helsinki-Ethical principles for medical research involving human subjects [Internet]. 2013. Available from: https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects/

53. Centrale Commissie Menselijk Onderzoek. Uw onderzoek: WMO-plichtig of niet? [Internet]. CCMO. 2018. Available from: https://www.ccmo.nl/onderzoekers/wet-en-regelgeving-voor-medisch-wetenschappelijk-onderzoek/uw-onderzoek-wmo-plichtig-of-niet

54. Schuurmans M, Lambregts J, Grotendorst A, Merwijk C van. Beroepsprofiel verpleegkundige. Verpleegkundigen Verzorg 2020 Deel 3 [Internet]. 2012;41. Available from: http://www.venvn.nl/Portals/1/Nieuws/Ouder dan 2010/3_profiel verpleegkundige_def.pdf

55. AbuAlRub RF, Foudeh FN. Jordanian Nurses' involvement in health policy: perceived benefits and barriers. Int Nurs Rev. 2017;64(1):13–21.

56. Burkoski V. ... what is the impact of all this digital infrastructure on nursing practice and patient outcomes ? Nursing Leadership in the Fully Digital Practice Realm. Nurs leadership2. 2019;32(special):8–15.

57. Castner J, Sullivan SS, Titus AH, Klingman KJ. Strengthening the Role of Nurses in Medical Device Development. J Prof Nurs [Internet]. 2016;32(4):300–5. Available from: http://dx.doi.org/10.1016/j.profnurs.2016.01.002

58. Scully NJ. Leadership in nursing: The importance of recognising inherent values and attributes to secure a positive future for the profession. Collegian [Internet]. 2015;22(4):439–44. Available from: http://dx.doi.org/10.1016/j.colegn.2014.09.004

59. Suserud B-O. Caring for patients at high speed. Nurs Pract [Internet]. 2013;21(7):14–9. Available from: https://www.nursinginpractice.com/article/caring-patients-dementia

Tables

Table 1: Demographic characteristics of participants

Participant nr.	Gender	Age	Working experience (y)
1	Male	55	29
2	Female	35	15
3	Male	33	11
4	Female	29	7
5	Male	47	19
6	Female	55	20
7	Female	39	15
8	Female	28	6
9	Female	30	7
10	Female	59	35
11	Female	47	25
12	Female	32	8

Table 2: Required competencies to being able to participate in design projects

Required Competencies	**FQ appointed by participants***
Knowledge	
Insight into how the practice works	11
Using and knowing the network	7
Knowledge of technology	7
Knowledge of possibilities within the organisation	8
Have experience before participate	6
Knowledge of implementation strategies	8
Educated as bachelor nurse	7
Insight in development process	3
Familiarity with technological development	3
Understanding of technology	1
Insight in required and necessary skills	1
Knowledge were to update skills, knowledge and innovations	1
Skills	
Thinking out-of-the-Box	8
Transcendent thinking	6
Transfer enthusiasm	8
Creative thinking	6
Project working skills	4
Use persuasiveness	4
Estimate what works in practice and what doesn't	7
Being able to communicate well	4
Translate innovations and solutions to own practice	4
Picking up signals into the practice	2
Not being technical skilled	3
Being able to coordinate projects and wards	4
Being practical in finding solutions	2
Being able to set up flexibly	2
Thinking abstractly	2
Being able to think how things could be done differently	2
Being innovatively	2
Being able to switch quickly between subjects	1
Attitude	
Being enthusiastic	11
Being intrinsically motivated	8
Demonstrate and using nursing leadership	5
Having courage	6
Take responsibility and show professionalism	4
Show perseverance	7
Being open to innovations	6

Being proactively	5
Being tenacious	4
Taking initiative	4
Being critical	6
Be open to making mistakes	5
Being curious	3
Being assertive	3
Being visible	1
Being proud	2
Assume a designing role	2
Assume an advisory role	1

**FQ appointed by participants*: frequency how many participants appointed the required competence.

Appendix I:

Table 1: final interview guide with alterations made based during the interview phase

Startvraag: Wat vind je ervan als dat verpleegkundigen betrokken worden in het ontwerpproces van (gezondheid) technologieën die bijdragen aan de zorg voor patiënten?
Kennis Kun je toelichten of je de rol als innovator/ ontwerper/ontwikkelaar vindt passen bij jouw verpleegkundig beroep? - Wat is hierin volgens jou de rol van de verpleegkundige? (Toelichten)
Ervaringen Kun je iets vertellen over je ervaringen over het meewerken in het ontwikkelproces van nieuwe gezondheidstechnologieën? Wat leverde het voor jou op om deel te nemen aan een ontwikkelproces van een nieuwe technologie t.b.v. verbetering van de patiëntenzorg? Wat had je nodig om jouw bijdrage van nut te laten zijn in het proces? Kun je wat vertellen over je betrokkenheid in het proces? - Op welk punt/welke fase werd je betrokken? - Wat was je input? Kun je iets vertellen over hoe je als verpleegkundige in het proces betrokken werd - Voelde je je op je plek? - Hoe heb je het ervaren? (Als gelijkgestemde, adviseur of anders?)
Competenties Kun je toelichten welke competenties (kennis/houding/vaardigheden) je nodig hebt als verpleegkundigen om te kunnen deelnemen aan ontwerp projecten betreft innovatie van gezondheidstechnieken? • Welke kennis/vaardigheden kwamen je goed van pas toen bij het participeren in het ontwerp? • Welke kennis/vaardigheden heb je gemist bij het participeren in het ontwerp? Wat voor kennis/vaardigheden zou je nodig hebben om nog een betere bijdrage te kunnen leveren? • Welke specifieke vaardigheden/competenties heb je nodig?

(Wanneer ze op niets komen: bijvoorbeeld) communicatie, project vaardigheden, techniek, leiderschap, kennis

Hoe zouden competenties voor actieve deelname moeten worden aangeleerd/ worden ontwikkeld? Kun je dat nader toelichten?

- (Tijdens de verpleegkunde-opleiding)
- (Ervaring opdoen gedurende mijn jaren werkervaring/ in het werkveld in praktijk)
- (In bijscholingen door de werkgever)

Faciliteiten/bronnen/in staat stellers

Wat is er nodig voor een actieve deelname van verpleegkundigen in het proces? (Doorvragen... Wat nog meer? En nog meer?)
Hoe zou je deelname kunnen activeren?

Als jij het voor het zeggen had, en tijd en geld geen beperking zouden zijn: op welke manier zou je verpleegkundigen laten participeren in innovatieprojecten? (1 verpleegkundige per team? Alle verpleegkundigen? Hoeveel tijd per week?)
Hoe kan er tijd worden gecreëerd om wel te kunnen deelnemen?

Wat vind je ervan om juist de minder gemotiveerder te betrekken in het proces? (Zij moeten er ook mee werken)

Hoe kan landelijk volgens jou meer aandacht worden gevestigd op het participeren in de ontwikkeling? (VZI van V&VN)

Hoe is het nu geregeld dat je kan deelnemen aan innovatieprojecten met betrekking tot gezondheidstechnologie?

- Kun je toelichten of tijd en rol speelt?
- Kun je toelichten of en hoe er binnen het rooster/n planning rekening meer kan worden gehouden?
- Kun je toelichten hoe er wordt omgegaan met eventuele vergoedingen of beloningen? Hoe beleef je dit?
- Kun je aangeven of er de nodige voorzieningen beschikbaar zijn?
- Kun je iets vertellen over hoe de werkcultuur van invloed kan zijn?
- Hoe kan de support van collega's/ team/management van invloed zijn op actieve deelname?

Hoe kunnen de benodigde omstandigheden/benodigdheden worden gerealiseerd?