

**MASTER THESIS**

# **Helping Nurses into the Digital Future**

Qualitative research to the added  
value of the chief nursing  
information officer for the  
digitalisation of the nursing  
profession in the Netherlands

Xenia Yocarini (s2584654)

Faculty of Science and Technology  
MSc Health Sciences

Prof. Dr. W. H. van Harten  
Dr. S.M. Kelders

University of Twente

31-08-2023

# Preface

In high school, a dimly lit computer science room was where my fascination with digitalisation began, though I admittedly saw more of the penal room. Despite this early interest, I pursued nursing as a career path. After dedicating five years to nursing, I became a full-time student at the University of Twente with a goal to combine my nursing insights with digitalisation. This thesis shows that journey.

My research about the added value of the Chief Nursing Information Officer (CNIO) for the digitalisation of the nursing profession, would not have been possible without the guidance of my supervisors. I would like to thank Wim for his critical insights and for providing an opportunity to explore my interest area. I am equally thankful to Saskia for her guidance in qualitative research and keeping me upbeat.

A special shout out to Mascha for her valuable insights and giving me the first scoop on the CNIO function and providing feedback during my research. I also deeply appreciate all the individuals who participated in this study and contributed to the richness of this research.

Furthermore, I owe a thank you to my family who offered unconditional support during this journey. My parents, thanks for the calls from “our” sunny (not so) second To Στέκι. My sisters: Iris, you’ve always been someone to look up to, especially having shown the resilience of the Yocarini spirit. Niki and Steffen, I am really appreciative of being gifted with the new role of an Aunt. Alexi, your joyful spirit was uplifting and your chilling sessions at my place are a pleasure to host. To my in-laws, your encouragement and tasteful dinners from the Bastard have been a good distraction.

A heartfelt thank you to my friends (LL-group, Hanne, MNV directors) for being there when the tough gets tougher and my study buddies Kim and Roald for the long walks.

Above all, my sincere thanks to Pim, for being the constant in my life and who always supported me during this journey. I am looking forward to travelling the world (by motorbike?!) with you!

I hope my thesis provides an enriching and insightful read. It has been a journey of both endurance and enjoyment, and I am thrilled to share it.

Xenia Yocarini

# Abstract

This study aimed to investigate the added value of the Chief Nursing Information Officer (CNIO) for the digitalisation of the nursing profession in the Netherlands according to the CNIOs and associated stakeholders. Currently, the function of the CNIO is growing in the Netherlands, yet its specific value in driving digitalisation for the nursing profession remains unclear.

By conducting qualitative research, comprising of conducting an online cross-sectional survey with CNIOs (n=14) and nurses from a nursing council (n=6) and two rounds of interviews with CNIOs (n=9) and associated stakeholders (n=10) this study revealed that the CNIO has a pivotal role in the digitalisation of the nursing profession and beyond. Both CNIOs as nurses were more than satisfied with the added value of the CNIO. It argues that the function of the CNIO is indispensable for the digitalisation of the nursing profession and healthcare organisations. By bridging the gap between information technology and nursing practice, CNIOs embarked on a culture shift where nurses were empowered to take ownership of their work. Resulting in improving their work with or without digitalisation. For CNIOs to thrive it is important to address structural aspects such as professional growth, decision making authority, fair financial compensation and having human resources.

**Tweetable abstract:** Unveiling the value of Chief Nursing Information Officers (CNIOs) in nursing's digital future. This study revealed that CNIOs are crucial for cultural change where nurses themselves shape their future's work and emphasises the importance of professionalisation within the field.

**Keywords:** CNIO, digitalisation, nursing

# Table of contents

Preface .....	2
Abstract .....	3
List of figures and tables.....	5
List of abbreviations .....	6
<b>1. Introduction.....</b>	<b>7</b>
<b>2. Theoretical framework.....</b>	<b>11</b>
<b>3. Methodology .....</b>	<b>13</b>
3.1. Overview.....	13
3.2. Phase 1: Online survey.....	13
3.3. Phase 2: Interviews.....	16
<b>4. Results .....</b>	<b>20</b>
4.1. Phase 1: Online survey.....	20
4.2. Phase 2: Interviews, round 1 (CNIOs).....	24
4.3. Phase 2: Interviews, round 2 (associated stakeholders of the CNIO).....	31
4.3. Comparative analysis .....	40
<b>5. Discussion.....</b>	<b>42</b>
5.1 Limitations.....	47
5.2 Recommendation for practice.....	47
5.3 Recommendations for future research .....	50
<b>6. Conclusion .....</b>	<b>52</b>
<b>Bibliography .....</b>	<b>53</b>
<b>Appendix 1. Introduction survey (dutch) .....</b>	<b>61</b>
<b>Appendix 2. Survey CNIO (dutch) .....</b>	<b>62</b>
<b>Appendix 3. Survey nurses on nursing council (dutch) .....</b>	<b>66</b>
<b>Appendix 4. Round 1 interview topic list - CNIO (dutch).....</b>	<b>70</b>
<b>Appendix 5. Round 2 interview topic list - associated stakeholders of the CNIO (dutch).....</b>	<b>72</b>
<b>Appendix 6. Characteristics respondents survey .....</b>	<b>74</b>
<b>Appendix 7. Results survey.....</b>	<b>75</b>

# List of figures and tables

## Figures

<b>Figure 1. Role in relation to superior .....</b>	<b>21</b>
<b>Figure 2. Role in relation to nurse .....</b>	<b>21</b>
<b>Figure 3. Responsibilities CNIO by CNIOs.....</b>	<b>22</b>
<b>Figure 4. Responsibilities CNIO by nurses .....</b>	<b>22</b>

## Tables

<b>Table 1. Overview themes and subthemes interview round 1: CNIOs .....</b>	<b>24</b>
<b>Table 2. Characteristics participants interviews round 1: CNIOs.....</b>	<b>24</b>
<b>Table 3. Overview themes and subthemes interview round 2: Associated stakeholders of CNIO....</b>	<b>31</b>
<b>Table 4. Characteristics interview round 2: Associated stakeholders of CNIO .....</b>	<b>32</b>
<b>Table 5. Recommendations for practice.....</b>	<b>48</b>
<b>Table 6. Characteristics respondents survey.....</b>	<b>74</b>
<b>Table 7. Results survey.....</b>	<b>75</b>

## List of abbreviations

ANA	American Nurses Association
BoD	Board of Directors
CIO	Chief Information Officer
CNO	Chief Nursing Officer
CNIO	Chief Nursing Information Officer
CMIO	Chief Medical Information Officer
CPIO	Chief Pharmacists information officer
EHR	Electronic Health Record
IT	Information Technology
NI	Nursing Informatics

# 1. Introduction

Nurses are the backbone of our society as they provide service and care when people need it the most. Problematically, in the coming years there will be a global deficit of nurses. The World Health Organization and the Global Health Workforce Alliance have predicted that there will be a global shortage of 12.9 million healthcare workers in 2035 (Campbell et al., 2013). This is caused by demographic changes of the population resulting in multimorbidity leading to an increased demand for healthcare services (Rijksinstituut voor Volksgezondheids en milieu, 2020a, 2020b) in addition to the persistent challenge in maintaining nurse retention rates (Heinen et al., 2013; Homburg et al., 2013; Kox et al., 2020; Van Der Heijden et al., 2019).

With rising job demand, digitalisation of the field of nursing may offer solutions to predicted shortages. Digitalisation refers to the integration of digital technologies with the involvement of organisational and cultural changes for inclusion and maintenance of technologies in the process of service delivery to meet established goals (Iyamu et al., 2021). In recent years, multiple reports have been published suggesting that investing in digitalisation could offer unique opportunities or be a solution for the Dutch workforce shortages (Commissie Toekomst zorg thuiswonende ouderen, 2020; Deloitte, 2015; EXPH, 2019; Gupta Strategists, 2022; ING Economisch Bureau, 2019; Organisation for Economic Co-operation and Development, 2020; Sociaal-Economische Raad, 2020). Here, possible integration of digital technologies covers a wide range of nursing job tasks.

Digitalisation could offer a solution for the nursing shortages because it could decrease the workload by improving efficiency (e.g. communication) (Foong et al., 2020; Puolitaival et al., 2022), streamlining workflows (Barakat & Franklin, 2020; Hain et al., 2022), improving staffing scheduling (Tuominen et al., 2019), improving outcomes (McMahon, 2002) and improving patient independence (Nakrem et al., 2018). As there are endless digital technologies, the following is not an exclusive list of digital technologies used by nurses and their advantages but rather several examples. Such as freeing up time and reducing routine nursing activities through remote monitoring (Puolitaival et al., 2022), alternative forms of treatment such as telehealth to reach patients in rural and remote areas (Speyer et al., 2018), providing care without speaking the same language as the patient through multilingual mobile devices or digital translation machines (Al Shamsi et al., 2020), and the use of tactile technology which has been shown to reduce the deployment of healthcare workers as sensor equipped incontinence materials alert nurses when change is needed, saving time and improving patient comfort (Gupta Strategists, 2022). Simply put, driven by a

shortage of healthcare workers in combination with global digital innovations, a growth of deployment of digitalisation in health care has been evoked.

In combination with nurses being the majority of end-users, the surge in Electronic Health Records (EHR) adoption in America from 2004, initiated by President George W. Bush and reinforced by the American Recovery and Reinvestment Act, has resulted in a call for nursing informatics leadership to guide the implementations of EHRs from an executive level. This growth of digitalisation was answered by the introduction of the role of the Chief Nursing Information Officer (Kirby, 2015). Although the specific role titles may differ across organisations (Kannry et al., 2016), the title CNIO is used in the remainder of this thesis. The CNIO role evolved from the specialty nursing informatics (Cummins et al., 2016) and was initially created with the purpose of bridging the information technology systems, the nursing practice (Asiri, 2016) and patient care (American Organization of Nurse Executives, 2012).

The interdisciplinary speciality Nursing Informatics (NI) is concerned with the digitalisation of the nursing profession. According to the American Nurses Association (American Nurses Association, 2015), NI is defined as follows: "the speciality that integrates nursing science with multiple information management and analytical sciences to identify, define, manage, and communicate data, information, knowledge, and wisdom in nursing practice." (p 1-2). In order to accomplish desired results, NI supports nurses, consumers, patients, the interprofessional healthcare team, and other stakeholders in all roles and situations. Information architecture, processes, and technologies are used to provide this support. Nurse informaticists today are crucial in advocating for patients and fellow nurses, and are often digital solutions' key stakeholders and recipients (Sensmeier, 2011). As nursing informaticists know the nursing practice and are educated in informatics, they can bridge different stakeholders (e.g., patients, IT specialists, nurses and Chief Medical Information Officers).

As of today, there are still many barriers of digitalisation which the role of the CNIO and NI could help overcome. Barriers from an organisational level include limited evidence of effectiveness of digital technologies and lack of high-quality studies as studies hereon are rare (Huter et al., 2020; Servaty et al., 2020), as well as costs and unclear reimbursement situations (Scott Kruse et al., 2018; Servaty et al., 2020). From a healthcare provider's perspective, barriers may include negative attitudes (Koivunen & Saranto, 2018; Scott Kruse et al., 2018; Servaty et al., 2020) and technically-challenged staff (Kleib et al., 2022; Konttila et al., 2019; Scott Kruse et al., 2018). It has been shown that elderly nurses are digitally lagging (De Leeuw et al., 2020; Hammerton et al., 2022), but younger nurses seem more



competent in comparison (Hack-Polay et al., 2022; Kaihlanen et al., 2021). Furthermore, digitalisation could lead to change of patient-nurse relationship (e.g. impersonal or less direct patient care) (Koivunen & Saranto, 2018; Misto et al., 2018; Tolentino & Gephart, 2020), increased cognitive work (Wisner et al., 2019), negative cognitive impact due to inoperability of the technology (Melnick et al., 2021) and the need for redefinition of the role of nurses in healthcare (Booth et al., 2021; Pepito & Locsin, 2019; Topaz et al., 2016). Consequently, there is still some room for improvement for the nursing profession to adapt to digitalisation and the CNIO to guide this process.

Nurse leaders, such as the CNIOs, are vital in procuring, developing, and implementing new technologies (Mahone E. & Denckla B., 2017). Therefore, it is important that nurse leaders have sufficient knowledge about digital technologies. However, according to current research the current on-the-job training in nursing informatics competencies of nurse leaders is not sufficient due to the complex healthcare environment, the lack of validated competencies and the rapid advancement of health information technology (Collins et al., 2017). In addition, Strudwick et al. (2019) suggests that nurse leaders are likely unaware of the gaps they may have in their knowledge and skill of informatics. As nurse leaders become more educated about nursing informatics and the relation to the nursing practice, they could help shape a future where all technologies by nurses are complementary. In order to do so, the creation of a nursing digital strategy is mentioned in literature (Staggers et al., 2018). For the nursing profession to fully embrace the endless opportunities of digitalisation it is imperative that their voices are heard where the (digital) decisions are being made (Rubeis, 2021).

The future of healthcare is facing significant challenges with the shortage of nurses. Simultaneously, the adaptation of digital technologies in healthcare is increasing, making a shift toward digitalisation. The function of the Chief Nursing Information Officer (CNIO), which was first introduced in the Netherlands in 2014 (Eikholt, 2021), was created as a response to these changes. This function represents a growing recognition in the Netherlands and beyond (American Nursing Informatics Association, 2018; Australian College of Nursing, 2022; Canadian Nurses Association & Canadian Nursing Informatics Association, 2022) of the need for dedicated nurse leaders with specific informatics expertise.

Despite the increasing acceptance of the CNIO function, empirical evidence about its value and specific application remains scarce. Nursing informaticists, bridging the gap between nursing and information technology, are considered essential team members in healthcare

organisations. While some studies suggest a lack of support for NI as a distinct discipline (Peltonen et al., 2019), the potential influence and value of the CNIO are nonetheless recognised (Tupper & Alexander, 2012).

Strudwick et al. (2019) argue that CNIOs could significantly impact health information technology decision making and implementation. This view is supported by Topaz et al. (2016), who found that current NI professionals recommend increased support for CNIO roles. Moreover, Booth et al. (2019) states that the presence and recognition of the CNIO is a step in the right direction for the digitalisation of the nursing profession. In an international survey, Ronquillo et al. (2017) suggests that incorporating nurse informaticists in leadership roles would help integrate nursing practice in technology design and implementation.

These findings suggest that the CNIO function could be a valuable asset in the digitalisation of the nursing profession. However, the evidence base about the value and application of the function remains limited. Consequently, research is needed to clearly delineate and validate the specific contributions of CNIOs to healthcare technology management and the advancement of nursing informatics. By utilising an online survey and conducting interviews with CNIOs and associated stakeholders this study aimed to answer the following research question: “What is the added value of the CNIO for the digitalisation of the nursing profession in the Netherlands”?

## 2. Theoretical framework

The research conducted in this study is framed within the quality of care framework by Donabedian, a widely utilised framework for assessing the quality of care (Donabedian, 1966). This framework is particularly valuable in nursing informatics, where it serves as a guide for evaluating the effects of new technologies and data management. Donabedian's framework provides a comprehensive model to assess healthcare performance and is commonly employed in nursing research (Ghofrani et al., 2022; McCullough et al., 2023; Siegel & Young, 2021; Upenieks & Abelew, 2006).

According to Donabedian there are three domains on which the quality of care can be assessed: structure, processes, and outcomes (Donabedian, 1966). These domains are interconnected and interdependent, as they collectively contribute to the overall quality of care in a healthcare setting. Each domain influences and affects the others.

The structure domain represents the attributes that reflect the setting in which care is delivered and can consist of material resources, human resources and organisational characteristics (Donabedian, 2003). For example, in the context of CNIOs, this might involve examining leadership competencies, adequate working hours and sufficient financial resources. In this research the aim is to identify structural characteristics that influence the added value of the CNIO for the digitalisation of the nursing profession such as enhancing their informatics knowledge (Collins et al., 2017).

Process relates to how things work within an organisation or how care is delivered (Donabedian, 2003). For example, for CNIOs this could include collaborating with relevant stakeholders within the information technology governance. This research seeks to explore application of the CNIO function for the added value of the function for the digitalisation of the nursing profession such as improving the collaboration between the CNIO and Chief Medical Information Officer (CMIO) to strategically integrate clinical decision support for optimal patient care as suggested by Kirby (2015).

Finally, outcomes reflect the outcome of care (Donabedian, 2003). For example, a result could be an electronic health record system that is reliable and used by nurses throughout the healthcare chain. In addition, nurses experience the EHR system as supportive and comfortable to use. The success of this example of digitalisation, experienced as both effective and comfortable, aligns with the vision of the American Organization for Nurse

Executives (2012) which highlights the CNIOs pivotal role in bridging the gap between technology and nursing practice while maintaining the quality of patient care.

## 3. Methodology

### 3.1. Overview

The aim of this study is to provide insight into the added value of the Chief Nursing Information Officer (CNIO) for the digitalisation of the nursing profession in the Netherlands. This study uses a two-phase multi method sequential qualitative design. Qualitative research is used when a complex, detailed understanding of the issue is needed that cannot be answered using (only) quantitative methods (Creswell & Poth, 2018). In a sequential design, the different phases of data collection are conducted one after the other. The purpose of the sequential design is to use the results of the first phase to inform the design and data collection of the second phase (Holloway & Galvin, 2016). To provide insights in the added value of the CNIO for the digitalisation of the nursing profession, a two-phase multi method sequential qualitative design was used as no previous research on this topic has been performed in the Netherlands. The first phase was a preliminary exploration of the added value of the CNIO for the digitalisation of the nursing profession according to the Donabedian quality of care model via an online cross-sectional survey. After analysing the survey data, an in-depth understanding of perceptions and opinions was gathered via semi-structured interviews with CNIOs in the second phase of this research. This was repeated for a second round of semi-structured interviews with associated stakeholders of the CNIO. By combining two different research methods, the survey and interviews, a broader understanding of the added value of the CNIO for digitalisation has been gathered. The study was conducted between October 2022 until May 2023.

### 3.2. Phase 1: Online survey

#### 3.2.1. Design

An online cross-sectional survey is a research method whereby a survey is distributed to gather information from a target population at a specific point in time (Callegaro et al., 2015). In the first phase of the research, an online cross-sectional survey was distributed to nurses working in the position of a CNIO and to those participating in nursing councils within healthcare organisations in the Netherlands. The online survey was selected because it is cost-effective, quick and minimises data entry errors (Callegaro et al., 2015). Another advantage is that respondents can complete the answers at their own convenience and at their own pace, which may increase response rate (Callegaro et al., 2015). Qualtrics was used for this survey. In addition, the visualisation of the survey is correct independently of

the device (mobile or computer) of the respondents. Visualisation is critical as it affects interviewers' perception (Bethlehem & Biffignandi, 2021).

### 3.2.2. Setting and participants

The survey was distributed on 17 October 2022 via Qualtrics and was open until 18 November 2022. The survey was distributed to two groups, nurses working as a CNIO in a healthcare organisation in the Netherlands or nurses who are participating on a nursing council within the organisation of the CNIO. The current estimate suggests that approximately 52 CNIOs are employed in hospitals across the Netherlands. To gather a comprehensive and presentative understanding of the CNIO function, a purposive sampling strategy was used. Purposive sampling is a sampling technique in which, sampling units are selected for a specific purpose on which the researcher decides (Holloway & Galvin, 2016). This strategy, chosen for its ability to select participants who are nurses and close to the strategy level, aimed to yield a rich understanding of the research objective. The survey was distributed by one CNIO via a private Microsoft Teams group to all CNIOs in the Netherlands, all of whom are members of the V&VN's CNIO network, a Dutch nursing union group. For nurses working on a nursing council the snowballing technique or chain referral was used. The snowball technique or chain referral uses previously chosen participants to identify other potential participants with knowledge of a particular area or topic (Holloway & Galvin, 2016). This method was chosen, because it is not known if every hospital has a nursing council and because it would be very time consuming to address all the nursing boards separately. CNIOs were asked to send the survey to nurses working on a nursing council within their organisation. Inclusion criteria include nurses working in the role of a CNIO or nurses participating in a nursing council and working in a Dutch healthcare organisation. Exclusion criteria were refusal of informed consent. After 1,5 weeks a reminder was sent to boost the number of respondents. The final sample consisted of 14 CNIOs and 6 nurses. Multiple participation of participants was prevented by using the prevention option in Qualtrics.

### 3.2.3. Data collection

The online survey consisted of 29 questions for those working as CNIOs and 26 questions for non-CNIO's respondents. On average, it took participants 20 minutes to complete. An introductory explanation detailed the research purpose, researcher identity, and provided informed consent information (see Appendix 1). As all participants work within Dutch healthcare organisations, the survey was conducted in Dutch. The survey began with informed consent and role-related questions, tailoring content for CNIOs and non-CNIOs. The survey was structured according to the Donabedian quality of care framework, with

questions addressing structure, process, and outcome of CNIOs contribution to digitalisation. To investigate the domain of structure, characteristics such as age, education, experience were asked. In addition, from earlier research by Lalleman et al. (2020) it seems that the relationship with the Board of Directors (BoD) or the superior of the nurse leader such as a CNIO is important. To do so in the survey, questions about organisational placement, team size, collaboration with superior and nurses were asked. To further investigate the domain of process, the survey was based on prior research by the Nursing Informatics Workforce survey (HIMSS, 2020) and the function profile of the CNIO (V&VN CNIO Netwerk Nederland, 2019). In their questionnaire they identified the responsibilities and priorities of the CNIO. Questions regarding the outcome domain focused on the added value of the function of the CNIO for the digitalisation of the nursing profession. The current survey employed a mix of open-ended, closed-ended, Likert scale and multiple-choice questions to provide rich, diverse data while maintaining clarity and ease of completion. To ensure the surveys' clarity and address potential issues before distribution, a pilot test was conducted with a small group of nurses (n=6). Amongst them, two were from the target population (one active in a nursing council and one as CNIO), while the others were not part of the target population. Valuable feedback from the pilot test informed necessary adjustments to enhance survey user-friendliness and efficiency. The survey is available in Appendix 2 and 3.

#### 3.2.4. Ethical considerations

Ethical approval was designated by the BMS ethical committee (nr. 221123). In addition, informed consent was actively asked for within the survey. To reduce the burden of respondents, only the first two questions were obligated. At last, respondents were notified at the beginning that they can stop the survey any time without reasoning. An anonymous link to the survey was provided, so anonymity was guaranteed. However, respondents could offer their contact information which was separately stored from the original data to ensure confidentiality. Only the first author could access the original data through a protected online storage provided by the university of Twente for a period of ten years.

#### 3.2.5. Data analysis

The data analysis was conducted in Excel. For the quantitative data descriptive statistics such as average and range were used. The findings from the free text questions were analysed using the six-step thematic analysis approach by Braun and Clarke (2013). These steps consist of familiarisation of data and identifying items of interest, generation of codes, combining codes into themes, reviewing potential themes, defining and naming the themes and producing the report (Braun & Clarke, 2013). During the first step, the first author familiarised themselves with the data by thoroughly reading and re-reading the answers

provided by the participants searching for patterns and meaning. In the second step, inductive coding was used. As part of step three initial codes were identified. Multiple codes for the same piece of text were allowed, ensuring each presented a distinct concept. In the fourth step, the themes were thoroughly reviewed to ensure their relevance and coherence. The sixth and final step was the preparation of the comprehensive report, which included a detailed discussion of the themes. Translations were conducted by a back-and-forward process to ensure the accuracy of the Dutch quotes used in the report, providing a precise representation of the original data in English.

One respondent answered to be working as a “other” but stated in the free text to be working as CNIO. Therefore, the answers of this respondent were coded as a CNIO.

### 3.3. Phase 2: Interviews

#### 3.3.1. Design

In the second phase of the study, 19 semi-structured interviews were conducted to provide an in-depth understanding of the added value of the CNIO for the digitalisation of the nursing profession. Individual face-to-face interviews were used to gather rich and detailed data about individual experiences and perspectives (Braun & Clarke, 2013). Additionally, the flexible nature of interviews allowed interviewees to introduce new topics, which the researcher may not have considered (Smith & Sparkes, 2016). This is particularly important when investigating complex and multifaceted topics such as the function of the CNIO for the digitalisation of the nursing profession, which requires a deep understanding of the attitudes and perceptions of CNIOs and associated stakeholders.

#### 3.3.2. Setting and participants

Convenience sampling was used to get participants for the interviews with CNIOs. With convenience sampling the researcher uses opportunities to ask potential participants who might be useful and easy to access (Holloway & Galvin, 2016). CNIOs were approached via contact details (email) they had provided in the online survey during phase one. They participated on a voluntary basis to provide a more in-depth understanding of their added value. For the associated stakeholders of the CNIOs snowballing technique was used as three CNIOs were asked to provide participants who worked closely with the CNIO such as nurses, other healthcare professionals and IT staff. The reason for using snowballing technique was to identify key resources effectively and efficiently in a niche field. Inclusion criteria included those who were working as a CNIO or associated stakeholders of the CNIO in hospitals in the Netherlands. Exclusion criteria were refusal of informed consent. It was important that associated stakeholders of the CNIO knew who the CNIO in their organisation



was and had some understanding of the CNIO function to provide insights for answering the research question. All interviewees were approached via email and accepted the interview invitation. A few days before the interviews they received an email with the topic list and informed consent form. Semi-structured interviews were conducted in January until March of 2023 with 19 interviewees. Nine of them were CNIOs and ten of them were associated stakeholders of the CNIO. Interviews were conducted and recorded either face-to-face at a location chosen by the participant or online via platforms like Teams or Zoom, depending on the interviewees' preference.

### 3.3.3. Data collection

Participants were interviewed once by the first author after signing an informed consent form. A pre-planned interview guide was used to ask participants relatively focused but open questions regarding the added value of digitalisation for the nursing profession (Appendix 4 and 5). The initial interview guide topics were based on the authors' experiences and based on structure, process and outcome domains of the Donabedian quality framework. Pilot testing with one CNIO and one associated stakeholder of the CNIO did not necessitate changes in the interview guide topics. All interviews were voice recorded upon interviewees' permission. Immediately after the interviews, recordings were transcribed using Amberscript and field notes were made. Upon request, participants received the interview text by email. Interviews in round one lasted approximately 32 [12-51] minutes. Interviews in round two lasted approximately 29 [24-40] minutes. The number of interviews depended on when data saturation was achieved. Data saturation was considered when conducting interviews with three participants resulted in no new codes added during the second step of data analysis (see 3.3.5. Data analysis). This indicated that a comprehensive understanding of the research topic had been attained and the data collection of phase two was complete.

### 3.3.4. Role of the researchers

Given that the COREQ (Consolidated Criteria for Reporting Qualitative Research) checklist has been followed in this study (Tong et al., 2007), the following section provides a detailed explanation of the role of the researchers. The first author (XY) identifies as female, is a Dutch registered nurse working in community care and MSc candidate in Health Science and conducted all the interviews. XY has some experience with doing interviews obtained during her Bachelor of Nursing. XY had no prior relationship with any of the interviewees. However, there was one interviewee who recognised her from an earlier research presentation about Nursing Councils. Before every interview there was a short description of XY where she gave some details: occupation, age and reason for doing the research.

The first supervisor (WvH) is professor on *Quality Management and Health Care Technology* at the department of Health Technology and Services Research of the School of Management and Governance. The second supervisor (SK) is associate professor at the department of Psychology, Health and Technology at the University of Twente.

### 3.3.5. Data analysis

For the data analysis, the six-step reflective thematic analysis approach by Braun and Clarke was used (Braun & Clarke, 2013) as explained in chapter 3.2.5. The analysis was conducted in Dutch using ATLAS.TI software.

During the first step, the verbatim transcripts were thoroughly read and re-read searching for patterns and meanings. After reading the interviews, first thoughts and findings were written down. Transcripts were confirmed with the original audio recordings for accuracy. Important perspectives and data analysis ideas were documented in field notes written directly after a transcription of the interview. The field notes informed the data analysis parallel to the interview transcripts (Braun & Clarke, 2022; Creswell & Poth, 2018). In the second step, initial codes were identified, encompassing both semantic and latent aspects, and following an inductive approach. As part of step three, the identified codes were organised into potential themes, and the relationships between codes and themes were considered. In this step the quality Donabedian framework was kept in mind. In the fourth step, the themes were thoroughly reviewed to ensure their relevance and coherence. Step five involved defining and naming the themes to provide a clear understanding of their meaning and significance. The sixth and final step was the preparation of the comprehensive report, which included a detailed discussion of the themes. During the progress of thematic analysis XY kept a reflective journal according to Braun and Clarke (Braun & Clarke, 2022) to enhance reflexivity and recognize the influence of XYs own experiences and perspectives to identify and examine biases and assumptions. In addition, the journal helped to support the developments of insights by stimulating thinking and helping to discover new insights. A back-and-forward translation process was conducted to ensure the accuracy of the Dutch quotes used in the report, providing a precise representation of the original data in English. Upon completion of the report, participants were given the opportunity to provide feedback through mail.

In the second round of data analysis, a comparative approach was used to examine the differences and similarities between the participating hospitals. The comparison aimed to gain insights into conductive factors or barriers among the participating hospitals. By comparing the participating hospitals potential variations in strategies, practices and

approaches employed by CNIO or organisation to overcome or mitigate barriers were identified.

### 3.3.6. Ethical considerations

Ethical approval was obtained by the BMS ethical committee (nr. (221108 and 221447). Before the interviews, the purpose and significance of the study was explained to each interviewee and informed consent was obtained. At last, interviewees were notified at the beginning that they could stop the interview any time without reasoning. To protect the privacy of each interviewee, their names are replaced by numbers (e.g. I1, I2). Only the first author could access the original data through a protected online storage provided by the university of Twente for a period of ten years.

## 4. Results

### 4.1. Phase 1: Online survey

A cross-sectional survey study was conducted to explore the added value of the role of the Chief Nursing Information officer (CNIO) for the digitalisation of the nursing profession. A total of 25 unique respondents started the survey, 20 of whom finished it in full. The partially completed surveys by five respondents had only one or two filled out questions, so they were removed from the analysis. This decision was based on the premise that the limited data provided by these surveys may not give an accurate representation of the respondent's perspectives.

Of the respondents, 14 were CNIOs and 6 were nurses on a nursing council. The response rate for CNIOs was  $14/52 * 100\% = 27\%$

The characteristics of the study population are presented in Appendix 6. Most respondents were female, aged 45-55 years, and had a degree from a University of Applied Sciences as their highest level of education. Additional CNIOs education includes information technology, nursing specialisation and management courses. For nurses, the additional education consists of nursing specialisation and management. The average work experience as a nurse in years was higher for the nurses (21.2) compared to the CNIOs (17.6). The average work experience as a CNIO was 1.5 ranging from 0 to 5. Most of the respondents worked in a top clinical hospital, with a peripheral hospital as the second most common type of workplace.

Three of the CNIOs worked only as a CNIO, while 11 of them had multiple job functions, with 7 of them working as a CNIO combined with a nursing role and 4 working as a CNIO combined with a different role such as team manager or project manager. CNIOs worked an average of 17 hours per week, ranging from 8 to 32 hours.

The job functions that CNIOs had before they became CNIOs (n=13) were mainly related to digitalisation and leadership roles in nursing (n=8), such as nurse champion, superuser, quality officer (digitalisation), and digital coach. However, some did not have a job function where digitalisation was part of their previous roles (n=5), such as home care nurse, team manager and specialised nurse.

## Structure

As shown in Figure 2, the majority of Chief Nursing Information Officers (CNIO) could not place themselves within the governance structure. Reasons for this were the discrepancy between the formal and practical IT governance structures or the lack of hierarchy mentioned by CNIOs. Nurses tended to view CNIOs as part of the "daily management" in the governance structure of their organisation. "Consultation on healthcare information, data, and technology" came in second, followed by "other". The "other" category noted that the CNIO's function affects multiple areas, such as care, data, research, and business operations. Additionally, most CNIOs reported to the board of directors, followed by the Chief Information Officer (CIO) or "other" individuals. The free text indicated that, while CNIOs formally report to the board of directors, they often have a more practical reporting relationship with the CIO or the care manager for ICT. In contrast, most nurses thought that the CNIO should report to the Chief Nursing Officer, followed by the Board of Directors and the CIO. On average, CNIOs have 3.3 formal contact moments per month with their superior, ranging from 1 to 12 moments per month. Only two CNIOs had more than 7 contact moments. CNIOs rated the support they received from their superior at an average of 8.2, ranging from 3 to 10. Whereby only two CNIOs rated the support insufficient (5 or below).

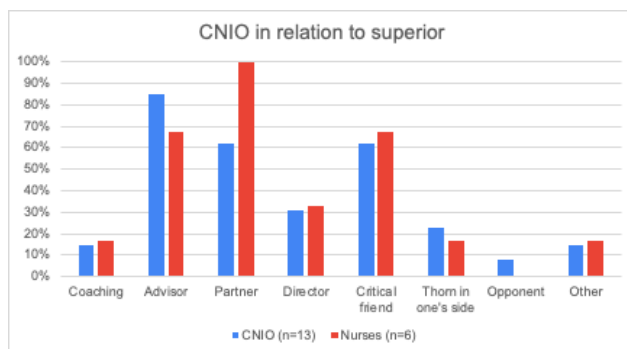


Figure 1. Role in relation to superior

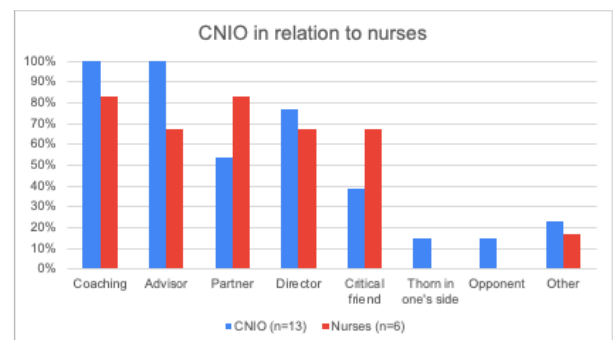


Figure 2. Role in relation to nurse

The results of the multiple-choice question in Figure 1 reveal that CNIOs often serve as advisors, partners and critical friends to their superiors. Nurses preferred CNIOs to take on the partner role, with an advisor or critical friend also considered desirable.

Regarding CNIOs' relationships with nurses in their organisations, Figure 2 demonstrates that being a coach or advisor was the most common role. Both the CNIO and the nurses felt that the support they got from each other showed mutual satisfaction in their collaboration, rating at an average of 7,3.

## Process

As for the process, the CNIO and the nurses identified that their primary focus is the Electronic Health Record (EHR), nursing clinical documentation and quality improvement.

Figures 3 and 4 display the results of the top three ranking questions, highlighting the consensus in the perceived importance of CNIO responsibilities between CNIOs and nurses. Both CNIOs and nurses considered system optimisation/use their top priority, followed by quality improvement and system implementation.

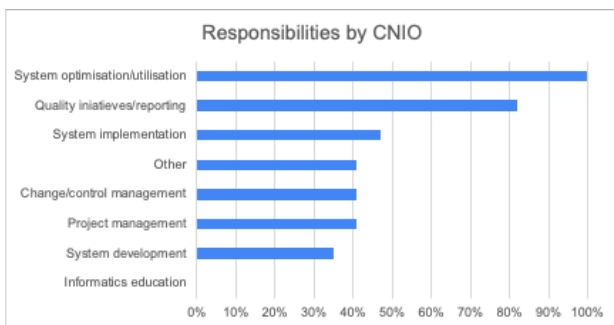


Figure 3. Responsibilities CNIO by CNIOs

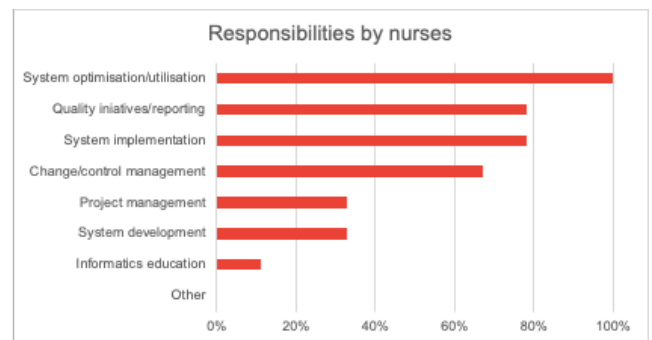


Figure 4. Responsibilities CNIO by nurses

All the CNIOs' were more than satisfied with their added value for the digitalisation of the nursing profession where they rated their added value at an average of 8.8, ranging from 8 to 10. All the quantitative findings are summarised in Appendix 7.

The themes that emerged from the qualitative data on why CNIOs' gave a particular rating to the added value of the CNIO for the digitalisation of the nursing profession included "digital transformation is happening", "nurse representation", and "functioning as a bridge". To quote one CNIO who put the themes together:

*"Digitalisation is no longer a choice, given IZA [Integrated Care Agreement] and all the developments in healthcare. We cannot continue providing care without changing, there are fantastically beautiful opportunities that need to be deployed and that will not happen without a connection to healthcare and technology, we are too far apart now, and nurses are often too busy to take this on independently".*

All the nurses were more than satisfied with the role of the CNIO for the digitalisation of their profession where they rated the added value at an average of 8.3, ranging from 7 to 9.

Themes that emerged from the qualitative data on why nurses gave a particular rating to the added value of the CNIO for the digitalisation of the nursing profession included "bridge function" and "nurse representation". One nurse stated the importance of the bridge function in combination with nurse representation:

*“She [CNIO] is the linking pin between ICT/data experts and end-users. She speaks the language of both, she understands the professional development of our profession [nursing] and tries to achieve (digital) consistency in it.*

## Outcome

In terms of the most important results of the CNIOs' work in the past year, the CNIOs identified that “system implementation” was most important, such as implementing a new version of the EHR and working on the electronic handover for nurses. Other emerging themes that emerged included "building a network" and "involving nurses" for CNIOs with examples such as coaching superusers, letting enthusiastic key users be nursing ambassadors, and setting up an end-user group of consulting nurses.

The nurses thought “system optimisation” was the most important and mentioned examples, such as linking blood pressure metres with the EHR. Another important theme emerged: “nurse representation”, with examples such as creating urgency for support tools for nurses and participating in digitisation from a nursing perspective. It is worth noting that two nurses indicated that the CNIO had been working for less than a year and therefore had not yet achieved significant results.

## 4.2. Phase 2: Interviews, round 1 (CNIOs)

In this section, four overarching themes are presented to describe the added value of the chief nursing information officer (CNIO) for the digitalisation of the nursing profession according to the CNIOs: (1) From nurse to CNIO (2) Nursing the connection (3) Owning our digital future, as shown in the table 1 below.

*Table 1. Overview themes and subthemes interview round 1: CNIOs*

Themes	Subthemes
From nurse to CNIO	A. Professionalisation within the CNIO function B. Organisational conditions C. Improvement of resources
Nursing the connection	A. Navigating nurse engagement B. Building bridges between relevant stakeholders
Owning our own digital future	A. Driving cultural change B. Shaping nurses' future work

The data for this study was collected through in-depth interviews with 9 CNIOs working in various hospitals. Table 2 below provides an overview of the characteristics of the participants. Notably, these CNIOs came from 7 provinces spread across the Netherlands.

*Table 2. Characteristics participants interviews round 1: CNIOs*

		Number or participants (N=9) (%)
<b>Function</b>	CNIO	9 (100%)
<b>CNIO experience in years</b>	1-2	5 (55,6%)
	3-4	3 (33,3%)
	5-6	1 (11,1%)
<b>Age group</b>	25-35	2 (22,2%)
	35-45	3 (33,3%)
	45-55	4 (44,4%)
<b>Sex</b>	Female	8 (88,9%)
	Male	1 (11,1%)



<b>Type of workplace</b>	Academic hospital	1 (11,1%)
	Peripheral hospital	5 (55,6%)
	Top clinical hospital	4 (44,4%)

## Theme 1: From nurse to CNIO

The first theme “From nurse to CNIO” encompasses structural aspects that influence the CNIOs’ added value for digitalisation of the nursing profession such as professional development, organisational conditions and optimisation of resources.

### 1.1. Professionalisation within the CNIO function

The function of the CNIO, being relatively new, often leads to ambiguity concerning its function, responsibilities and skills required. Six participants mentioned the vagueness surrounding the expectations of their function. A female CNIO with three years of experience and being the first CNIO in the organisation, shared her experience of this:

*“That means that whoever is going to replace me in the future may have even better skills, so that we better understand what the mission of this function is going to be. The downside of course of the first generation, is that I may not be the best for the job, but I am the first for the Job.”*

Despite these challenges, the novelty of the CNIO function offers opportunities for personal and professional growth. Eight participants described their transition from being nurses to becoming CNIOs. This shift required them to enhance their leadership abilities and deepening their understanding of informatics, contributing to the ongoing evolution of the CNIO function. In addition, four participants talked about resources like the Chief Medical Information Officer (CMIO)-CNIO course that have been beneficial for expanding their knowledge. Interestingly, even after completing the course, several CNIOs expressed the desire to further expand their IT proficiency and leadership qualities. Eight of the participants mentioned learning from other CNIOs in the CNIO network or Electronic Health Record (EHR) networks as a way to improve personal development.

### 1.2. Organisational conditions

Organisational conditions also play a crucial role in enhancing the added value of the CNIO for the digitalisation of the nursing profession. Six participants highlighted the operating level, significance of receiving support from organisational management and being granted decision-making authority. These factors enable CNIOs to effectively advocate for digital initiatives and ensure their successful implementation within the organisation. Four operated

on a more strategic level and expressed that they felt empowered by their Board of Directors (BoD), whereas two participants talked about wanting to operate on a more strategic level. A female CNIO with one year of experience expressed that she didn't have a role in drafting a vision document and was only permitted to review it as she was not yet integrated into the strategic governance.

### **1.3. Need for resources**

The need for more time in their function as CNIO was mentioned by eight of the participants. The only participant who did not talk about needing more time, did talk about needing to increase her supporting staff so she could take on more projects. Time is essential to foster stronger relationships with nurses across the hospital, better understanding of their needs and prioritise projects accordingly. Needing a supportive staff was emphasised by seven participants. Participants spoke about the role of super-, key users and Nursing Information Officers (NIO's) as supporting staff for the CNIO. They emphasised the importance of having a dedicated team to assist them in managing their workload and responsibilities effectively. By addressing these resource constraints, CNIOs can better focus on strategic initiatives that drive digital transformation within the nursing profession. A female CNIO with 3 years of experience spoke about needing more hours as a CNIO and needing a team around her:

*“Reaching those 2,500 nurses I do pretty lousy at the moment still, so that is really a continuous learning stream. Hence, I also feel I need more of a team for that, because I can't manage such a large group by myself. And the team is not just a set of nurses, but also people with die-hard IT Expertise, but also marketing, communications.”*

In summary, the first theme, transitioning “From nurse to CNIO” presents both challenges and opportunities. Challenges are the lack of clarity, although the newness of the CNIO function also provides opportunities for professionalisation. The professionalisation within the CNIO role is an ongoing process, with the relative novelty of the position creating some ambiguity in terms of expectations and required skills. The CMIO-CNIO course, EHR and CNIO networks have an impact on these developments and transitions. Opportunities include the importance of addressing the organisational position, having a say in strategic digital decisions and expansion of human resources.

### Theme 2: Nursing the connection

The second theme, "Nursing the connection", delves into the processes that CNIOs employ to contribute to the digitalisation of the nursing profession. This theme encompasses two

main areas: maintaining close contact with nurses and building bridges between non nursing stakeholders.

### **2.1. Navigating nurse engagement**

All participants discussed various strategies they employed to stay in direct contact with nurses, allowing for a better understanding of their needs and concerns. One method involves maintaining a visible presence by working closely with the nursing council, visiting nursing wards, interacting with nurses and giving nursing talks. Furthermore, distributing newsletters and ensuring visibility on the intranet are also mentioned as effective ways to engage with nurses. Participants spoke about the importance of keeping a low threshold presence with nurses. A female CNIO with three years of experience emphasised that it is important to let nurses know you are one of them:

*“I very quickly notice that some colleagues are like: oh CNIO and then act as if they have to look up to me, and then I always say: I'm really a colleague, hey, so I, of course I also work in white, so then they also see me in white from time to time.”*

A challenge that was identified in collaborating with nurses by five CNIOs is dealing with resistance to digitalisation from nurses. Reasons for the resistance of digitalisation by nurses that were mentioned by the participants were the primary patient care being the main priority of nurses, the workload being too high, IT developments going too slow and the nursing staff lacking knowledge or skills for adapting to new innovations.

To mitigate this resistance, CNIOs can emphasise the benefits of digitalisation and the importance of having a voice in the decision-making process. Challenges such as workload, slow IT developments, and lack of knowledge or skills can be overcome by providing adequate training, support, and time for digital adaptation. However, three CNIOs expressed struggles with balancing nursing workload and allocating time for nurses' digital adaptation. CNIOs could help address by advocating for the benefits of digitalisation and letting nurses recognize that digitalisation is something they should want to participate in as it could be beneficial to their primary task, patient care. A female CNIO offered a compelling perspective, noting that the emphasis should not be on digitalisation but on ensuring nurses have a say in the process. She conveyed that her motivation is not driven by technology, but by the potential benefits to patients. By directly sharing her perspective, many nurses agreed they would like a voice in the digital transition.

There is debate among five participants about the necessity of a dual function, working as a nurse and CNIO. Three believe it is essential to maintain a close connection with the work floor, while others argue that it may limit the CNIO's potential and that alternative methods to

stay connected with nurses should be considered such as visiting wards, tagging along and observing nurses during their shifts. A female CNIO with one year of experience thought it is important to work as a nurse as well as an CNIO:

*“I don't think it's good [not to be a nurse as a CNIO]. [...] I think it's very nice that nurses also see that you are also working with them. I can give a lot of specifics as to why something is or isn't going to work, that I will do it myself the next morning. I think it's very important that I retain those two roles, as you also see with the CMIO, CPIO, who also have both roles, because you just have a piece of the work floor and a piece of the CNIO.”*

On the other hand, working in a dual function may be limiting the outcome of the CNIO and there are other methods to stay in contact with the nurses, without working in a dual function as a nurse themselves according to a female CNIO with three years of experience:

*“Well, what is very challenging is that, on the one hand, it is very good and beautiful that we see it as a dual job function, also in terms of support among colleagues, but also, for example, at the board table, that you yourself also hold that position from a professional perspective. The downside is that this leaves me with little time.”*

## **2.2. Building bridges between relevant stakeholders**

CNIOs play a vital role in bridging the gap between various internal and external stakeholders, such as the nursing council, CMIO, IT department, CXIO<sup>1</sup> group, software vendors, and other healthcare organisations. Seven participants discussed the importance of being a connector between the IT department and nursing, facilitating communication and understanding between the two. A female CNIO with one year experience explains:

*“Because those areas are so far apart. A nurse on the floor doesn't care, he or she just wants the electronic health records (EHR) to work, so to speak, and doesn't understand, for instance, why the vital values of the blood pressure monitor are sent to our EHR, but when I want to measure a patient every 15 minutes, they don't understand why it can't be done. Yes, so you do need the IT department to explain to the nurse why it's not possible. And before, it was just like this: yes, it's not possible, too bad.”*

---

<sup>1</sup> CXIO group is a consultative body presenting the various healthcare professionals such as the Chief Medical Information Officer, Chief Pharmacy Information Office, Chief Clinical Information Officer and CNIO.

Participants also spoke that their role includes more than connecting nursing to the IT department. CNIOs also work on connecting different initiatives and programs within large organisations, bringing together stakeholders with common goals.

Collaboration with CMIOs and vendor companies is another essential aspect of their role. Here, two participants noted opportunities to improve these relationships as now the CMIO is often included at a directors' meeting with software vendors, whereas the CNIO is missing.

Having a nursing background offers unique value, especially when communicating with stakeholders. CNIOs act as strong advocates for the nursing profession. Six participants highlighted their role in advocating nurses during technology-related discussions. A female CNIO with two years of experience expressed:

*“So I always try, I always say the very simple phrase of: and where are the nurses in this story? That's sometimes all I have to say and then it falls silent and then they say: oh, yes, [CNIO name]. What should we arrange for them for this?”*

The "Nursing the connection" theme highlights the importance of CNIOs' process-oriented approaches in fostering digitalisation in the nursing profession. By maintaining close contact with nurses and building bridges between relevant stakeholders, CNIOs can facilitate a smoother transition to digital practices and help overcome resistance to change. In addition, the CNIO can help bridge the gap between different stakeholders and advocate for the nursing profession.

### Theme 3: Owning our digital future

#### **3.1. Driving cultural change**

Eight participants reported that the presence of a CNIO allowed for better decision-making in terms of technology adoption and digitalisation efforts. By ensuring that nurses' perspectives are considered through their presence in decision-making processes leads to better outcomes in terms of technology adoption are achieved. They empower nurses to take ownership of their digital future, embracing technological advancement as integral to the evolution of nursing practice. CNIOs facilitate a shift away from the traditional approach where nurses' involvement was limited to being asked to adopt technology. Now, they elevate nursing professionals' perspective, placing care at the forefront of digital decision making. A female CNIO with two years of experience illustrated this:

*“It used to always be a party of the Medical ICT. Nurses, they were asked if they had to. And now care is more in the lead.”*

### 3.2. Shaping nurses future work

All the CNIOs acknowledged the crucial role of shaping the future of nursing work, whether through digitalisation or not, as a core aspect of their responsibilities. Examples that were given focused on EHR, telenursing and digitalisation of the nursing handover. By combining their senior knowledge of nursing practice with their newly acquired informatics knowledge, a CNIO becomes uniquely positioned to effectively anticipate the evolving needs of the nursing field. They can adeptly identify areas for enhancement and implement innovative solutions. A female CNIO with three years of experience shared her insight:

*“How can we make that digital transformation in the work of nurses [...]. For example, to make sure that the information blood pressure monitors, bladders scans etcetera records shoots directly into the EHR. “*

In summary, the “Owning our digital future” theme highlights the vital role of the CNIO in the digitalisation of the nursing profession by fostering cultural change where nurses actively engage in the decision-making process. This shift involves transformation of the organisation from an IT-centric perspective to one that prioritises healthcare professionals’ perspectives and expertise.

In conclusion, this study explores several themes central to the added value of the CNIO for the digitalisation of the nursing profession. The first theme, “From nurse to CNIO”, examines the novel function of the CNIO, focusing on the challenges posed by the newness of their function, the organisational conditions that support their transformation and the crucial aspect of improving available human resources. The second theme, “Nursing the connection” highlights the vital role of the CNIO in maintaining close contact with the nursing profession and building bridges between relevant stakeholders to facilitate effective collaboration. Lastly, “Owning our own digital future” emphasises the importance of the CNIO in driving cultural change and shaping a vision of a future where nurses are empowered to take an active role in the decision-making process of digitalisation and their working processes are improved with or without digitalisation.

### 4.3. Phase 2: Interviews, round 2 (associated stakeholders of the CNIO)

In this section, four themes and ten sub themes are presented to describe the added value of the Chief Nursing Information Officer (CNIO) for the digitalisation of the nursing profession provided by associated stakeholders of the CNIO. In table 3 below the themes are presented.

*Table 3. Overview themes and subthemes interview round 2: Associated stakeholders of CNIO*

<b>Themes</b>	<b>Subthemes</b>
Establishing the CNIO function	<ul style="list-style-type: none"> <li>A. Professionalisation of the CNIO function</li> <li>B. Debating the dual function</li> <li>C. Resources requirements for CNIOs</li> </ul>
Conditions for digitalisation in nursing	<ul style="list-style-type: none"> <li>A. Organisational support for digitalisation</li> <li>B. Evolution of digitalisation</li> </ul>
Nursing the connection	<ul style="list-style-type: none"> <li>A. Championing nurses and digitalisation</li> <li>B. Building bridges beyond nursing</li> </ul>
Empowerment and Transformation in Nursing Practice	<ul style="list-style-type: none"> <li>A. Changing nursing work</li> <li>B. Nurses taking ownership</li> </ul>

The data for this study was collected through in-depth interviews with 10 professionals working in various positions within top clinical and academic hospitals. All the participants have close contact with three CNIOs from the interviews of round 1. The participants comprised a diverse group in terms of age, sex, and job function, as summarised in table 4.

Table 4. Characteristics interview round 2: Associated stakeholders of CNIO

		<b>Number or participants (N=1) (%)</b>
<b>Function</b>	NIO	3 (30%)
	CMIO	1 (10%)
	Member nursing council	3 (30%)
	Clinical informatician	1 (10%)
	Project leader	1 (10%)
	Project manager	1 (10%)
<b>Age group</b>	25-35	2 (20%)
	35-45	2 (20%)
	45-55	5 (50%)
	55-65	1 (10%)
<b>Sex</b>	Female	7 (70%)
	Male	3 (30%)
<b>Type of workplace</b>	Academic hospital	3 (30%)
	Peripheral hospital	0 (0%)
	Top clinical hospital	7 (70%)

## Theme 1: Establishing the CNIO function

The first theme “Establishing the CNIO function” explores the structural aspects that influence the CNIOs added value for digitalisation of the nursing profession. Participants shared their insights on the CNIOs transition from nurse to a strategic digital leader, highlighting the challenges and benefits associated with this change.

### 1.1 Professionalisation of the CNIO function

Two participants acknowledged the CNIO as a new function that is still evolving. Three participants expressed concerns about the lack of uniformity in the CNIOs responsibilities and tasks across healthcare organisations in the Netherlands and expressed a desire for a more standardised role definition. A nurse on the nursing council provided an example, stating that she was uncertain about what to ask the board due to the lack of clear standardisation, which made it challenging to support the CNIO in balancing her CNIO duties with her nursing responsibilities.



This was also seen by three participants who mentioned the lack of consistent employment conditions for CNIOs such as the contract period or the amount of salary. A Nurse Information Officer (NIO) explains the problems around the amount of salary:

*“As a nurse, you get an irregularity allowance [for evening/night shifts], which is quite a lot of money. If you accept an office job, then that irregularity allowance is gone. [...] if you deploy someone as an ICT worker, you also must pay as an ICT worker, and they are therefore on a much higher scale.*

A CMIO also shed some light on this issue:

*“My pay is my salary, and her pay is linked to her base salary. If you feel you have a strategic role, I think that should be rewarded differently. My salary is already high, so my salary is already what you expect as a managerial or overarching role. But the salary of a nurse is well below managerial salary.”*

Four participants praised the CNIOs for their specialised digital knowledge and staying up to date. Additionally, six participants mentioned the CNIOs effort in personal development such as enhancing their leadership and IT skills. Two participants also talked about the development they are making as a team surrounding the CNIO such as the Nursing Information Officers (NIOs).

Furthermore, four participants discussed the variations in the CNIOs organisational position within different organisations and wished to see the CNIO in direct contact with the BoD to make the most impact with their CNIO function. In addition, half of the participants believed that the CNIO should operate at a strategic level to effectively contribute to the digitalisation of the nursing profession.

## **1.2 Debating the dual function**

Seven participants highlighted the added value of being a nurse in combination with a CNIO function. This dual perspective enabled CNIOs to bridge the gap between nursing practice and digitisation initiatives. A NIO, talked about the importance of having a nursing background as a CNIO:

*“Someone who knows the ins and outs of a department. I am now working with our Computer On Wheels (COWs). Those COWs often have connection problems. And if you are working on the ABCDE-method of a patient and you get a network error, ICT will say: yes, we'll deal with that at some point. To which I then say: it's a matter of life and death if I cannot access a file at an acute moment. I think you only know what the need and relevance is when you are or have been a nurse.”*

Notable was that three participants talked about the sustainability of the CNIOs' nursing experience and therefore argued for a dual nurse-CNIO dual function. A NIO explained his view on this:

*“There is a kind of durability to it [experience as a nurse]. [...] If [name of CNIO] stops being a nurse today, then she's a very good CNIO today and sometime in the next few years, that knowledge wears off and then she's no longer good CNIO so I think to stay connected with nursing practice and to understand how the process works, you have to provide care, but that doesn't have to be too much out, it can be a few times a week. But you do have to stay at the bedside, I think.”*

On the contrary, a nurse on a nursing council thought: “once a nurse, always a nurse”. She also indicated that it was important to stay connected to nurses on the work floor. Although that did not necessarily mean being a practising nurse themselves, having conversations or tagging along during shifts were also options.

### **1.3 Resources requirements for the CNIO**

Nine of the participants indicated that the CNIO is overloaded with work and expressed the need for more time for the function. As a result, some projects experience delays, others are not pursued or there is a lack in connection with the nurses because the CNIOs do not have enough time to connect with them. A clinical informatician who put it in perspective, expressed that a CNIO only has two days to represent one-third of the hospital staff.

Besides needing more time, the need for a supportive staff or more staff around the CNIO to fulfil their potential value was emphasised by all participants. A nurse on a nursing council painted a picture:

*“The beauty of the nursing profession is that you can be deployed in so many different places. But that also means for your care processes that sometimes you can be quite framed by your own piece of the care process and, indeed, to get the whole picture, you just need your team.”*

In addition, five of the participants talked about the necessity of having financial resources as a CNIO, since digitalisation requires an investment.

Overall, “Establishing the CNIO function” theme suggests that the function of the CNIO varies between healthcare organisations. According to associated stakeholders of the CNIO, to ensure the added value of the function for the digitalisation of the nursing profession it is important to address the structural aspects of the function such as professionalisation such as professional and personal development, organisational position and operating level. In

addition, the lack of employment conditions such as financial reward and dealing with a dual function. Most participants thought that working in a dual function added value to the CNIO function, whereas one nurse thought that staying closely connected with the nursing workforce was enough. Lastly, it was believed that organisations should invest more resources for the CNIO function such as time and financial.

## Theme 2: Conditions for digitalisation in nursing

The second theme identified in this study is “Conditions for digitalisation in nursing”. This theme highlights the challenges and requirements for successful implementation of digitalisation in the nursing profession.

### **2.1 Organisational support for digitalisation**

Four of the participants talked about the challenges of a hierarchical organisational structure for digitalisation and how it limits the added value of the CNIO. A structure whereby nursing have more influences or a less hierarchical organisational structure was mentioned as a promoting factor. A clinical informaticists explained this:

*“In a hospital, you want to transform and apply innovation. If we then talk about hierarchical structure, my hospital is hierarchical, whereas for innovation and for new things you need more of a start-up mentality and maybe a flatter organisation.”*

### **2.3 Evolution of digitalisation**

Two participants noted that digitalisation is still developing and it helps having people on board who are enthusiastic about digitalisation. One of the participants acknowledged the growing presence of digital natives in the workforce as a promoting factor.

Overall, the theme “conditions for digitalisation in nursing” suggests that successful implementation of digitalisation in nursing requires supportive organisational structures and ongoing adaptation to the evolving digital landscape.

## Theme 3: Nursing the connection

The theme “Nursing the connection”, highlights the importance of advocating for nurses and digitalisation as well as building relationships and fostering collaboration between all stakeholders involved in the digitalisation of the nursing profession.

### **3.1 Championing nurses and digitalisation**

Seven participants emphasised the importance of the CNIO in the role of informing nurses

about digitalisation and creating awareness among nurses over digitalisation. A NIO, talks about how the CNIO does this:

*“I think from what she [CNIO] ends up doing, is putting themes on the agenda back and forth, so the themes that are going on in ICT country, she puts them on the agenda in healthcare, so that we understand in time what is going on and that we can take positions or help in time. And vice versa.”*

Two participants talked about the importance of the CNIO attending meetings for the prioritising of digitisation initiatives. By being present, the nursing occupation is represented because the CNIO can act as a spokesperson for nurses. In addition, seven of the participants thought that having a CNIO alone is a condition for creating support for digitalisation among nurses and within the organisation. A project manager explained:

*“The fact that there is a CNIO, which tells nurses: it's really a topic for us too [digitalisation]. That as an organisation you state that digitalisation of nurses is indeed very important, that you support that and that you show that you do support that.”*

Four participants talked about how the CNIO facilitates knowledge expansion about digitalisation for nurses. A project manager mentioned that it was more than only facilitating knowledge and expressed that it is also about motivating the nursing staff to get involved in digitisation by experimenting with new technologies.

### **3.2 Building collaborative relationships with stakeholders**

Six participants talked about how the CNIOs stay in contact with nurses. Methods to stay in contact that were mentioned were through digi coaches, key users, by being visible through tagging along during nursing shifts and inspiration sessions such as nurse talks.

Seven of the participants talked about the importance of building collaborative relationships with stakeholders for the digitalisation of the nursing profession. Not only finding connections with nurses, but also with other fields such as the information technology department. A NIO shed some light on this:

*“ICT does things, invents things, devises plans and sets up their systems without intimate knowledge of healthcare. And that's where I think the CNIO is very important to establish that connection, so to link healthcare providers to ICT staff. So that connection and ambassadorship is, then I think a bit of the same thing, so making sure those two worlds start talking to each other.”*

Four participants acknowledged that one of the strengths of the CNIOs is to act on multiple layers in the organisation: on strategic, tactical and operational level, from the board to the

nursing work floor. Whereby it was mentioned by two participants that having to collaborate in a large organisation is a challenge on its own.

The relationship with the software vendor was mentioned by six participants, as the main task seems to be the Electronic Health Records (EHR). They noted that the CNIO was constrained by the software vendor and that the CNIOs were doing their best to jointly influence the software vendor so that they can improve the EHRs for nurses. In addition, it was mentioned that software vendors lacked knowledge about practical implications of their systems or the workflow of nurses.

In the third theme “Nursing the connection”, CNIOs were described as championing nurses and digitalisation. CNIOs play an active role in informing nurses about digitalisation and being an advocate for nurses about the subject of digitalisation within the healthcare organisation. In addition, facilitating knowledge expansion and motivating nurses about digitalisation. CNIOs were thought to connect different stakeholders by building collaborative relationships across multiple layers of the organisation, collaborating with both internal and external stakeholders such as the software vendor.

#### Theme 4: Empowerment and transformation in nursing practice

The fourth theme identified in this study is “Empowerment and Transformation in Nursing Practice”. This theme emphasises the main task of CNIOs of changing nursing work processes with or without digitalisation. In addition, it underscores the importance of the CNIO for nurses to take ownership of their work.

##### **4.1 Changing nursing work**

Nine of the participants felt that the main task of the CNIO is to improve nursing work processes with or without digitalisation. Most of the examples that were given in the interviews focused on improving the EHR or linking the EHR to patient measurement devices such as blood pressure monitors and digitalisation of the nursing handover.

##### **4.2 Nurses taking ownership**

Five participants mentioned that the CNIO creates opportunities for nurses to have a say in the process of digitalisation by giving them a seat at the right tables or through informing the nurses. In addition, six of the participants mentioned that the CNIO is a force for culture change within the organisation by providing a bottom-up approach instead of a top-down approach for implementing digitalisation. Helping nurses to take ownership or control over their own care processes. A clinical informaticist explained this:

*“We have a smart nursing department and what I think is the best development there is that we are thinking more consciously. And I'm mainly talking about nurses who think about their own work and conclude that a decubitus score doesn't have to be recorded every day, but that once a week is also sufficient.”*

A NIO also mentioned that he sees a cultural change within the organisation whereby he feels that there is more trust between the ICT and nursing world through co-creations. This reduces prejudices and creates space to relinquish autonomy so that more co-creation can occur.

To further empower nurses to take ownership in the process of digitalisation, two participants mentioned the need for the development of a long-term digitalisation vision from the CNIO. A nurse on a nursing council, describes what is meant by this:

*“What for me is a task of the CNIO is to think about what does the care of the future look like and what is needed for that? And how do we work towards that, so I think that would be a very important task of a CNIO. [...] but also creating a structure, what I just said: that nurses know and think about how they provide care and how technology can play a role in their care process. And with a CNIO, there is a structure that nurses know: I must approach that person and then maybe the technology will get there.”*

Overall, this theme suggests that the role of the CNIO is to change nursing work processes and empower nurses to take ownership in the process of digitalisation and beyond. The CNIO can act as an enabler of change by driving culture change and optimising care processes, with or without digitisation. By owning their own future and taking an active role in the digitalisation process, nurses can ensure that digitisation initiatives directly benefit the nursing profession and patient care.

In conclusion, several themes were explored in this phase of the study that were central to the added value of the CNIO for the digitalisation of the nursing profession according to associated stakeholders of the CNIO. The first theme, “Establishing the CNIO function”, examines the novel function of the CNIO, focusing on the professionalisation of the CNIO function, debating the dual function and the crucial aspect of improving resources that CNIOs require to be successful. The second theme, “conditions for digitalisation in nursing”, highlights the importance of having organisational support for digitalisation and how the evolution of digitalisation itself can be a condition for digitalisation in nursing. The third theme “Nursing the connection” emphasises the importance of the CNIO for championing nurses

and digitalisation. In addition to collaborating with relevant stakeholders for digitalisation. Lastly, "Empowerment and Transformation in Nursing Practice " highlights the importance of the CNIO in changing nurses practise with or without digitalisation and helping nurses take ownership of their work.

### 4.3. Comparative analysis

During the thematic analysis of the second round of interviews, it was possible to make comparisons between three Dutch hospitals to look for facilitating factors or barriers for the added value of the CNIO for the digitalisation of the nursing profession. These hospitals, referred to as hospital A, hospital B and hospital C, were chosen to represent diverse organisational structures and context. Both hospital A and B are top clinical hospitals, whereas hospital C is an academic hospital.

In hospital A, the organisational structure for digitalisation for nurses was mentioned as a facilitating factor. Meaning that a digital nursing structure is created within the organisation whereby digi coaches provided coaching to fellow nurses. By using ambassadors in the nursing departments, knowledge about technology increases and a nursing consultation structure is put in place. The interviewees talked about the shift in nurses' attitudes towards digitalisation, shifting to technology adaptive thinking. Nurses are learning to think about their own work process and how digitalisation can play a role.

In hospital B, the COVID-19 pandemic was cited as a facilitating factor for the adaptation of digitalisation and positively affected nurses' support for digitisation. Interviewees from hospital B also talked about the special organisational structure for nurses to create leadership throughout a nursing council in combination with a nursing platform. Next to the leadership structure, there was also a digital nursing structure with digi coaches in place. Although both structures were in place, it was found to be a difficult task to get more support towards digitalisation from nurses.

In hospital C, interviewees thought that the CNIO function was an enabling factor to give nurses a voice and an active role in the decision-making process of digitalisation. However, they did feel that nurses as a group are difficult to influence to shift to a more positive attitude towards digitalisation. The interviewees mentioned that they have an end user group of nurses, who are in direct contact with the CNIO and that NIOs are part of the digital nursing organisational structure. In addition, they talked about the different power relations that affect the execution of the CNIOs work. The interviewees felt that originally, the information technology department and doctors are higher in the hierarchy and that it is important to invest in the relationships to change the organisational culture.

The main finding is that in the two hospitals that have NIOs in place, hospital A and hospital C, the interviewees talked more about a task reallocation for CNIOs. While at the hospital C,



where no NIOs work, interviewees expressed a desire for a shift from the current operational level of a CNIO to a more tactical-strategic level at which the CNIO should operate. In addition, although in both hospital A and hospital C the CNIOs have a team of NIOs surrounding their function, it is still mentioned that the CNIO or NIO lack time to manage their tasks. Furthermore, it is mentioned that there currently are more fields within digitalisation that should have the focus of the CNIO. Fields include data management, artificial intelligence, robotics and other fields within nursing digitalisation. Suggesting that the CNIOs should have more time to spend on their tasks, their workload should change or the function could be too much for one person.

Hospital B was the only hospital where the CNIO was in direct contact with the board of directors, had a digital nursing structure in place and the only hospital where a hospital-wide vision of digitalisation was present. In addition, the pandemic-19 had a positive impact on nurses' attitudes toward embracing technology. Despite all these facilitating factors, the hospital still faced difficulties in changing nurses' attitudes.

Remarkable was that in all hospitals the CNIO had a special connection with the nursing council or a separate member status focussing on digitalisation. In addition, the CNIOs' primary focus was not solely on the EHR, but also on technologies and innovations that could help the nursing profession improve their work processes. Almost all the interviewees talked about how the CNIOs made connections with other departments inside the hospitals such as information technology, physicians and pharmacists as well as making connections outside the hospital.

In conclusion, this comparative analysis between hospital A, B and C of the function of the CNIO in three Dutch hospitals underscores the contextual nature of this position and its diversity in facilitating factors and barriers which influence the added value of the CNIO for the digitalisation of the nursing profession. These results underscore the significance of organisational structures, leadership involvement, power dynamics and task allocation for successful digital transformation. Overcoming challenges requires fostering a culture of change, addressing power dynamics, providing adequate resources and facilitating intramural and extramural collaborations.

## 5. Discussion

The purpose of this study was to investigate the added value of the chief nursing information officer (CNIO) for the digitalisation of the nursing occupation in the Netherlands. The study used a mixed-methods approach, combining an online survey and two rounds of interviews to gather both quantitative and qualitative data. In this chapter the main findings, implications and recommendations for practice will be discussed. Theoretical and practical implications are described and limitations of this study are also discussed. At last, suggestions for further research are done.

In examining the value addition of the CNIO for the digitalisation of the nursing profession in the Netherlands, as perceived by CNIOs and associated stakeholders, our study has yielded insightful results. Interestingly, opinions of CNIOs and associated stakeholders often aligned, noting similar bottlenecks. The CNIOs function spans across various dimensions of structure, process, and outcome. Structurally, professionalisation, organisational positioning, operating level, managerial support, decision-making authority, and resource allocation emerge as critical factors for the additive value. In terms of process, the CNIO plays a pivotal role in creating a supportive environment, fostering knowledge expansion, mitigating resistance towards digitalisation and bridging gaps among stakeholders. The CNIOs involvement in these areas is seen to facilitate a smooth transition towards digitalisation. The outcome of CNIOs influence is evidenced by a cultural shift within the nursing profession towards increased ownership, co-creation, and improved decision-making processes, thereby significantly contributing to the digital transformation of nursing. The outcome of the online survey supported this finding by revealing that both nurses and CNIO express a high degree of satisfaction with the contribution that the CNIO brings to the digitalisation of the nursing occupation.

### **Professionalisation within the CNIO function**

These findings align with the professionalisation theory proposed by (Noordegraaf, 2007), which explains that certain professions evolve and develop new roles, often hybrid in nature, in response to changing societal and organisational needs. The CNIO, as a hybrid professional, merges clinical nursing expertise and managerial functions required in information technology and initiatives of digitalisation. Noordegraaf's theory emphasises the emergence of "hybrid" professionals who only have an in-depth understanding of their core profession but also obtain new competencies related to management and coordination. The CNIO function illustrates this hybridity, adapting to meet the increasing demand for

digitalisation in the healthcare setting by means of a dual function where CNIOs (often) provide care themselves. According to Noordegraaf (2007), such hybrid roles often emerge in response to organisational changes and demands, which is consistent with this study's observations regarding the evolution and professionalisation of the CNIO function in the digitalisation of the nursing occupation.

Being a hybrid professional, combining the responsibilities of both nursing and the CNIO position, is a topic of discussion. Some CNIOs and associated stakeholders argue that CNIOs solely focused on their primary function can channel more dedication towards their professional growth. Contrarily, being current in nursing practice offers a unique advantage for CNIOs, enhancing outcomes such as improving nursing work with or without digitalisation. The longevity and sustainability of this duality in the function was a concern raised by participants. An opinion that was also reflected in the recent study of Strudwick et al. (2023), where a participant expressed the credibility that comes from being in the “trenches” in clinical practice, noting that one can lose touch quickly when not actively engaged. Interestingly, some CNIOs in this study relied on their nursing roles to maintain a direct line to nurses, indicating that the dual capacity extends beyond merely staying updated on nursing practice and care methods.

Being a newly developed function, professional growth within the CNIO position was evaluated. Strudwick et al. (2023) highlighted in their study on the multifaceted journey of Canadian CNIOs in their pursuit of professional growth CNIOs tenacity, having to rely on hands-on experience in the absence of structured learning opportunities. In the Netherlands, the presence of a dedicated CNIO course and an engaged nationwide CNIO network forms the basis of their professional development. Dutch CNIOs actively participate within this network, keeping each other updated on new developments, benefiting from mutual mentorship and collaborating on joint initiatives. Yet, it is currently mostly the hands-on experience that continues to shape their expertise. Collins et al. (2017) echoed this sentiment, emphasising to move towards a competency-focused approach, developing a tool that identifies specific competencies required for nurse leaders. While Backonja et al. (2022) highlighted the importance of mentoring, training and networking. These findings highlight the adaptability and commitment of CNIOs, as they blend structured learning with hands-on experience to pioneer advances at the intersection of nursing and technology. In my opinion, CNIOs should have a strong foundation in information technology and leadership skills, gained from dedicated CNIO courses and (master) degrees at the start of their function. While hands-on experience is essential, it should complement foundational knowledge.

Standardising this knowledge is crucial to further professionalise the CNIO function, filling the educational gap in traditional nursing.

Both CNIOs and associated stakeholders in this study envisioned the CNIO operating at a more strategic level, moving away from operational tasks towards strategic decision making. However, to transform into a strategic leader, several structures should be in place. This research underscored the necessity of human resources such as the allocation of time and a dedicated team. In addition, financial support was needed for CNIOs to realise their vision. Furthermore, digitisation of healthcare remains an evolving landscape. As CNIOs navigate through digital transformation, it is evident that the environment is continuously changing, challenging their process. With more tech-savvy healthcare workers entering the healthcare sector, familiar with and reliant upon technology, it could help get nurses on board with digitalisation. Although this assumption, being exposed to digital technologies does not necessarily lead to digital literacy, should be continually tested (Reid et al., 2023). This change further underscores the importance of a well-supported, strategically positioned CNIO in steering the digitalisation of the nursing profession.

While associated stakeholders of CNIOs emphasised the structural importance of a CNIOs placement within an organisation, advocating a placement with direct access to the board of directors, CNIOs themselves accentuated the importance of having support from management. For both CNIOs and the associated stakeholders, it is integral to these discussions that the largest added value of a CNIO was the CNIOs decision making authority. Without the power to effect change, even the most well-formed relationship or strategic positions fails its purpose. Burgess and Honey (2022) recognise this, noting that nurses feel sidelined and powerless when they are not actively engaged or listened to in the digital decision-making process. They emphasise the need to listen and empower nurses with decision authority to effectively strategise. Importantly, the support of management should not solely be about organisation positioning or symbolic gestures. Fundamentally, it is about entrusting CNIOs with decision making authority. This empowerment ensures that CNIOs are not just participants but active members in the process of digitalisation. Not just included after the fact, but ideally initiating and driving digitalisation processes. Therefore, it appears that the effectiveness of a CNIO goes beyond structural positioning but is linked to the depth of their relationships and the authority they employ.

Interesting is that the associated stakeholders of the CNIO talked about the disparity in compensation structures, especially when comparing with CMIOs. Despite both positions holding overarching responsibilities in the digitalisation structure, CNIOs are compensated at

the nursing pay scale, whereas CMIOs are rewarded at a doctors pay grade. This wage gap not only raises questions about the perceived value of these functions in information technology but can also steer nursing talent away from aspiring to become a CNIO and pursuing other specialised functions in informatics or information technologies. If the sector aims to truly leverage the power of digitalisation and foster a culture of innovation, it is imperative that the biggest group in the healthcare workers, nurses, is on board. Therefore, it is crucial that compensation is reflective of the responsibilities and expertise these functions entail. This discrepancy does not just have implications for individual career choices but can influence the trajectory of digitalisation in healthcare as a whole.

### **Bridging the gap between information technology and nursing**

In the rapidly advancing digital landscape of healthcare, nurse leaders, notably the CNIOs, play a pivotal role in procuring, developing, and implementing new technologies (Mahone E. & Denckla B., 2017). However, their responsibility extends beyond technical aspects. They also champion nurses and inform nurses about digitalisation. Through their close contact with the nursing workforce CNIOs ensure technologies introduced align with the nursing practice and demands. Proactive strategies like real-time feedback sessions, job shadowing, and talks help CNIOs understand the nursing workforce's demands. Their advocacy further guarantees that nurses' concerns are directly communicated to the right stakeholders within the information technology governance structure. Similarly, Burgess & Honey (2022), in their literature review on the theme of leaders as advocates, stress the need for active feedback collection from nurses. By advocating, CNIOs can ensure their insights influence the digital decision-making processes (Staggers et al., 2018; Surani et al., 2019). As digitalisation is happening and evolving, CNIOs remain at the forefront, responsible for keeping the nursing workforce informed and prepared for changes in their profession.

A related theme amongst all participants was the significance of building and maintaining relationships with key stakeholders. Especially, connecting nursing with stakeholders in information technology governance. This finding aligns with a literature review by Burgess and Honey (2022) on how nurse leaders could foster digital capability in the nursing workforce. Even though their focus wasn't specifically on CNIOs, they highlighted the essential nature of connecting the digital and clinical worlds. One notable sub-theme, enabling integration into clinical practice, echoes findings from this study, underscoring the importance of fostering collaboration between nursing practice and information technology departments. Participants from this study identified the Chief Medical Information Officer as an important collaborator. However, they also noted instances where nurses were overlooked by CMIOs. In Strudwick et al. (2023) study, participants emphasised the

importance of being partners in the relationship, ensuring that the needs of both are bridged and met.

Digitalisation, despite its benefits, often encounters resistance. This is also observed in the field of nursing, where patient care is primary. By creating a support system using champions or key users, CNIO could mitigate these resistances. This support goes beyond technical assistance but extends to emotional and educational support. By championing nurses in technology discussion and advocating for their needs, CNIO positions themselves as an essential condition for the support of nurses in the digital age. CNIOs are instrumental in introducing new technologies but also laying the groundwork for acceptance, ensuring that nurses embrace digitalisation as a step forward and not away from the core value of nursing.

### **Added value of CNIO**

This thesis serves as empirical evidence supporting Strudwick et al. (2019) suggestion that CNIOs can significantly impact health information technology decision-making and implementation. It also aligns with Topaz et al. (2016) suggestion that existing NI professionals advocate for heightened support for CNIO roles. The CNIOs have triggered a monumental shift, empowering nurses from being executors to taking ownership of their work process, telling how technologies integrate in their practice. This function has effectively bridged the gap between nursing and information technology, integrating digital technologies with patient care, a vision shared by Asiri (2016) and the American Organization of Nurse Executives (2012). This change has been reflected in the interviews with the mention of the emergence of co-creation, where nurses collaborate closely with tech teams, ensuring that digital technologies are designed with their needs and challenges in mind. This development affirms the anticipation of Ronquillo et al. (2017) and supports Tupper & Alexander (2012) perspective on the potential value of the CNIO function.

Even with existing challenges, the satisfaction expressed by nurses and CNIOs underscores the added value brought by the CNIO role, improving both the efficiency and effectiveness of healthcare delivery and nursing experience. This perspective aligns with the growing international recognition, acknowledged by the American Nursing Informatics Association (2018), Australian College of Nursing (2022), and Canadian Nurses Association & Canadian Nursing Informatics Association (2022), of the need for dedicated nurse leaders with informatics expertise. Echoing Rubeis's (2021) emphasis on the importance of nurses' voices in decision-making, the CNIO role has undoubtedly played a pivotal part in the digitalisation of the nursing profession in the Netherlands.

## 5.1 Limitations

While this study provides valuable insights into the added value of the CNIO for the digitalisation of the nursing profession, it is important to acknowledge the limitations below. One limitation of this study is that the same participants for the survey as for the interviews were asked to participate, which may have introduced response bias. While efforts were made to minimise this bias by ensuring the anonymity of the survey and the confidentiality of the interviews and doing two rounds of interviews with different character groups, it is possible that participants provided socially desirable responses or were influenced by their previous responses. Future research could use a different sampling strategy, such as recruiting participants for the interviews who did not participate in the online survey. Looking back, the richness and depth of information obtained from the interviews suggest that this phase alone might have sufficed. Nonetheless, future research might benefit from employing a survey to verify the outcomes of this study, offering a complimentary quantitative measure to the qualitative richness of interview data. Having a topic guide might have assisted in shaping the interview questions more effectively, allowing for optimal use of the available interview time.

Lastly, the findings in this study are largely tied to its particular context, the healthcare system and the CNIO function in the Netherlands. Therefore, direct generalisation of these findings to other contexts or countries may not be entirely valid given the difference in healthcare delivery models, funding structures and cultural nuances. However, the insights collected in this study align with findings from international studies as reported by Burgess and Honey (2022) and Strudiwck et al. (2023), which underlines the global relevance of these findings. This overlap strengthens the credibility of our research, positioning it as a valuable reference point for similar studies conducted globally.

## 5.2 Recommendation for practice

The findings of this study have important implications for nurses, CNIOs, healthcare organisations and beyond. The following paragraphs delve into the implications for practice and recommendations based on structure, process and outcome across different levels. Table 5 provides a quick overview of all the recommendations mentioned in this discussion.

Table 5. Recommendations for practice

<b>Recommendation Area</b>	<b>Description</b>	<b>Example</b>
<b>Added value of the CNIO</b>	Deploy a CNIO in healthcare and related tech organisations	-
<b>Positioning and Empowering CNIOs</b>	Improve the positioning of CNIOs by empowering them	Assign CNIO with dedicated team, including a communication specialist, Nurse Information Officer, marketing specialist and nursing informatics researcher; Assign CNIO its own budget; Position the CNIO in direct line with board of directors or within CXIO group with according authority; Address CNIO compensation disparities.
<b>Relationships with Stakeholders</b>	Enhance stakeholder engagement, bridge gap between clinical practice & IT	Asking, "What about the nurses?"
	Maintain updated knowledge on nursing practice	Adopting dual roles for CNIOs or deploying job shadowing with nurses
	Foster collaboration on regional and national levels	V&VN CNIO network & NVZ promoting CNIO's role
<b>Engaging Nurses in Digital Decision Making</b>	Establish and evaluate feedback structure in place and increase digital literacy	Make use of user groups, key users and champions. Host webinars, try-out sessions with new technologies and appoint Nurse Educator Digital Literacy. Allocate dedicated time for nurses in the digitisation process
<b>Promoting a Culture of Co-Creation</b>	Sharing platforms for best practices and creation of interdisciplinary teams	Give CNIO role in regular tech talks, workshops, and the creation of CXIO group with decision making authority
	Promote interdisciplinary understanding and collaboration	Continuously working together across departments
<b>Driving Value</b>	Establish a strong CNIO network that adds value to the digitisation of nursing	V&VN CNIO network enhances collaboration with vendor companies & CMIO network
	Align digital strategies with the nursing digital roadmap.	NVZ hosting webinars for alignment with the nursing digital roadmap.

### **Added value of the CNIO**

First, this study serves as empirical evidence to demonstrate the value CNIOs bring to nurses and hospitals in the process of digitising and beyond. The data suggests that healthcare organisations, as well as other organisations such as organisations deploying technologies in healthcare (software vendors), should deploy a CNIO. This would not only



accelerate the digitalisation of the nursing profession, but also ensure nurses' perspectives are integrated.

### **Positioning and empowering CNIOs**

Recognising the value of the function of the CNIO, healthcare organisations must address various key aspects. This includes addressing compensational disparities, providing opportunities for professional growth, equipping the CNIO with a dedicated team and granting the CNIO with decision making authority. Furthermore, this research suggests that the dual function extends beyond having current knowledge of nursing practice, healthcare organisations should consider flexibility for the deployment of both functions. Moreover, it is not just the CNIOs who should be placed in a position to engage in the process of digitalisation, nurses too should be allocated dedicated time.

### **Relationships with stakeholders**

This research confirms existing evidence suggesting nurse leaders, such as CNIO, are pivotal in bridging the gap between clinical practice and information technology departments. Therefore, it is important for CNIOs to enhance their stakeholder engagement, advocating not only for the technology, but also for the needs for nurses. Sometimes a simple question: "What about the nurses?" is all it takes. Other chiefs or members of the Board of Directors could also benefit from asking the same question. To avoid reaching their expiry date on nursing practice and offering feedback that may be outdated, CNIOs might consider adopting dual roles or utilise other methods to stay in touch with nursing practice.

As digital transformation extends further than the hospital walls, fostering collaboration on both regional and national levels becomes crucial. The V&VN CNIO network and the Dutch Association of Hospitals (NVZ) can play an important role in highlighting the significant contribution of CNIOs to the digitalisation of the nursing profession. By hosting meetings and other educational initiatives, they can ensure a more standardised approach across regions.

### **Engaging nurses in digital decision making**

Changing the moment when nurses are involved in the decision-making process of digitalisation could have major implications for the implementation of new technologies. By being part of the process early on, nurses can familiarise themselves with new technologies and give feedback to ensure technologies align with nursing practice. Therefore, it is important for CNIOs, together with nurses, to evaluate current feedback structures and identify areas for improvement. In addition, CNIOs could employ strategies to increase the

digital literacy of nurses to tackle the resistance such as hosting webinars, try out sessions or appointing a Nurse Educator Digital Literacy.

### **Promoting a culture of co-creation**

The primary aim for CNIOs is the seamless integration of digital technology within nursing practice without compromising the quality of care. Regular sharing platforms, like tech talks or workshops for CNIOs, can be instrumental in exchanging best practices and solutions. For healthcare organisations, fostering a culture that promotes co-creation that aligns with organisational objectives while listening to the nursing voice is vital. This can be achieved through interdisciplinary teams such as the Chief X Information Officer (CXIO) with significant decision-making power. In addition, information technology stakeholders and nurses should learn to speak each other's language, by continuously working together.

### **Driving value**

The V&VN CNIO network can be pivotal in highlighting the value added by the CNIO function in the digitisation of the nursing profession. By fostering a forceful CNIO network that embodies a comprehensive body of knowledge on digitalisation within the nursing profession. This network should be so integral and influential that vendor companies and the CMIO network find it not only beneficial, but necessary to collaborate with them. This would not only drive digitalisation, but also ensure a more standardised approach across regions. The NVZ could help encourage healthcare organisations to integrate the nursing digital road map in their digital strategies. For example, by hosting webinars to ensure alignment of healthcare institutions with the nursing digital roadmap.

## **5.3 Recommendations for future research**

Future research could explore the potential challenges and barriers to implementing a CNIO function in healthcare organisations, as well as the competencies and qualifications that are necessary for the function to be successful. To what degree should a CNIO develop his or her technical skills and for example be able to code? What degree of in-depth knowledge of artificial intelligence is required? How does the seniority of the CNIO relate to their added value? All these questions could be extended to the NIO function as well. Researching and defining these aspects might aid in professionalisation of the CNIO role and improving role description.

Additional studies could investigate the disagreement of needing a dual function as CNIO. To what degree does a CNIO still need to be in the trenches, and how does this relate to their added value? Could similar value be obtained through different methods such as job

shadowing and dedicated end user groups? In addition, future research could investigate the impact of a CNIO quantitatively such as increased nursing efficiency or patient outcomes such as improved patient satisfaction or reduction of medical errors. To investigate it qualitatively, nurse satisfaction or improved communication could be evaluated. Additionally, future studies could explore how the function of the CNIO can be further developed to support the digitalisation of the nursing profession. Furthermore, additional research could further investigate the added value of the collaboration by interviewing different stakeholders such as board of directors, IT stakeholders and vendor companies. This could lead to recommendations on how to improve the relationship between nurses and the different stakeholders within digital transformation.

In conclusion, the CNIO has emerged as a crucial player in the field of healthcare information technology, driving digitalisation while representing nurses' interests. However, more research is needed to fully understand and optimise this function.

## 6. Conclusion

The goal of this study was to investigate the added value of the Chief Nursing Information Officer (CNIO) for the digitalisation of the nursing profession in the Netherlands. Both CNIOs and associated stakeholders consistently recognised the broad influence of the CNIO function.

Essential structural components were identified. Highlighting the need for professional growth, decision making authority, fair financial compensatory and enough time and support from a dedicated team.

In the process of digitalisation, the CNIO was seen as a central figure, encouraging knowledge expansion, tackling resistance to digital changes and bridging between different stakeholders. Their efforts in these domains have paved the way for a more efficient adoption of digital technologies and practices within the nursing profession.

As a result, a notable shift in the nursing culture has been observed. Nurses are now more involved, embracing collaborative approaches and speaking up in the decision-making process related to their own work process and digital innovations. These cultural changes illustrate that the added value of the CNIO is broader than solely the aspect of digitalisation.

In an era where digitalisation is unavoidable and the landscape of healthcare is continuously changing, the presence of a visionary CNIO becomes increasingly important. Their strategic insights, collaborative approach and ability to navigate the complexities of digital transformation contribute to the overall advancement of healthcare organisations. The CNIO position is a promise for innovation, guiding the healthcare industry towards a future where technology seamlessly intertwines with compassionate patient care.

Essentially, the CNIO is a key figure in revolutionising the healthcare system. By embracing opportunities for human resources allocation and fostering continuous professional growth, organisations can empower their CNIOs to emerge as transformational leaders. Together we can redefine the future of healthcare, unlocking the boundless potential within nursing informatics.

# Bibliography

- Al Shamsi, H., Almutairi, A. G., Al Mashrafi, S., & Al Kalbani, T. (2020). Implications of Language Barriers for Healthcare: A Systematic Review. *Oman Medical Journal*, 35(2), e122. <https://doi.org/10.5001/omj.2020.40>
- American Nurses Association. (2015). *Nursing Informatics: Scope and Standards of practice* (2nd ed.). Silver Spring.
- American Nursing Informatics Association. (2018). *The Role of the Chief Nursing Informatics Officer: Position Statement of the American Nursing Informatics Association Board of Directors*.
- American Organization of Nurse Executives. (2012). Position paper: Nursing Informatics Executive Leader. *Nurse Leader*, 10(3), 17–21. <https://doi.org/10.1016/j.mnl.2012.04.002>
- Asiri, H. (2016). An overview of nursing informatics (NI) as a profession: How we evolved over the years. *HEALTHINF 2016 - 9th International Conference on Health Informatics, Proceedings; Part of 9th International Joint Conference on Biomedical Engineering Systems and Technologies, BIOSTEC 2016*, 5(Biostec), 200–212. <https://doi.org/10.5220/0005658202000212>
- Australian College of Nursing. (2022). *Position Statement. Leading digital health transformation: the value of the Chief Nursing Information Officer (CNIO) roles*. <https://www.acn.edu.au/wp-content/uploads/position-statement-leading-digital-health-transformation-value-cnio-roles.pdf>
- Backonja, U., Langford, L. H., & Mook, P. J. (2022). How to support the Nursing Informatics Leadership Pipeline: recommendations for nurse leaders and professional organizations. *CIN: Computers, Informatics, Nursing*, 40(1), 8–20.
- Barakat, S., & Franklin, B. D. (2020). An Evaluation of the Impact of Barcode Patient and Medication Scanning on Nursing Workflow at a UK Teaching Hospital. In *Pharmacy* (Vol. 8, Issue 3, p. 148). <https://doi.org/10.3390/pharmacy8030148>
- Bethlehem, J., & Biffignandi, S. (2021). *Handboek of web surveys*. John Wiley & Sons.
- Booth, R. G., Strudwick, G., McBride, S., O'Connor, S., & Solano López, A. L. (2021). How the nursing profession should adapt for a digital future. *The BMJ*, 373(June). <https://doi.org/10.1136/bmj.n1190>
- Braun, & Clarke. (2022). *Thematic analysis: a practical guide* (First edit). SAGE Publications.
- Braun, V., & Clarke, V. (2013). *Successful qualitative research: A practical guide for beginners*. Sage.
- Burgess, J.-M., & Honey, M. (2022). Nurse Leaders Enabling Nurses to Adopt Digital Health:

- Results of an Integrative Literature Review. *Nursing Praxis in Aotearoa New Zealand*, 38, 1–13. <https://doi.org/10.36951/001c.40333>
- Callegaro, M., Manfreda, K. L., & Verhovar, V. (2015). *Web survey methodology*. Sage.
- Campbell, J., Dussault, G., Buchan, J., Pozo-Martin, F., Guerra Arias, M., Leone, C., Siyam, A., & Cometto, G. (2013). *A universal truth: no health without a workforce*.
- Canadian Nurses Association, & Canadian Nursing Informatics Association. (2022). *The Value of the Chief Nursing Informatics Officer role for Healthcare Organizations in Canada*. <https://cna.ca/resources/Documents/The Value of CNIOs in Canada.pdf>
- Collins, S., Yen, P.-Y., Phillips, A., & Kennedy, M. K. (2017). Nursing Informatics Competency Assessment for the Nurse Leader: The Delphi Study. *The Journal of Nursing Administration*, 47(5), 271–277. <https://doi.org/10.1097/NNA.0000000000000478>
- Commissie Toekomst zorg thuiswonende ouderen. (2020). *Oud en zelfstandig in 2030 Een reisadvies*. <https://www.rijksoverheid.nl/documenten/rapporten/2020/01/15/oud-en-zelfstandig-in-2030-een-reisadvies>
- Creswell, J. W., & Poth, C. N. (2018). *Qualitative Inquiry & Research Design: Choosing Among Five Approaches* (Fourth edi). SAGE Publications.
- Cummins, M. R., Gundlapalli, A. V, Murray, P., Park, H.-A., & Lehmann, C. U. (2016). Nursing Informatics Certification Worldwide: History, Pathway, Roles, and Motivation. *Yearbook of Medical Informatics*, 1, 264–271. <https://doi.org/10.15265/IY-2016-039>
- De Leeuw, J. A., Woltjer, H., & Kool, R. B. (2020). Identification of factors influencing the adoption of health information technology by nurses who are digitally lagging: In-depth interview study. *Journal of Medical Internet Research*, 22(8). <https://doi.org/10.2196/15630>
- Deloitte. (2015). *Connected health - How digital technology is transforming health and social care*.
- Donabedian, A. (1966). Evaluating the quality of medical care. *The Milbank Fund Quarterly*, 44(3). <https://doi.org/10.2307/3348969>
- Donabedian, A. (2003). *An Introduction to Quality Assurance in Health Care* (Issue 1). Oxford university press.
- Eikholt, S. (2021). *Digitalisering in de zorg: "Processen zijn leidend, technologie volgend"*. <https://smarthealth.live/2021/11/10/digitalisering-in-de-zorg-processen-zijn-leidend-technologie-volgend/>
- EXPH. (2019). *Assessing the Impact of Digital Transformation of Health Services, Expert Panel on Effective Ways of Investing in Health (EXPH)*. <https://doi.org/10.2875/09099>
- Foong, H. F., Kyaw, B. M., Upton, Z., & Tudor Car, L. (2020). Facilitators and barriers of using digital technology for the management of diabetic foot ulcers: A qualitative

- systematic review. *International Wound Journal*, 17(5), 1266–1281.  
<https://doi.org/10.1111/iwj.13396>
- Ghofrani, M., Valizadeh, L., Zamanzadeh, V., Ghahramanian, A., Janati, A., & Taleghani, F. (2022). What should be measured? Nursing education institutions performance: a qualitative study. *BMJ Open*, 12(12), e063114. <https://doi.org/10.1136/bmjopen-2022-063114>
- Gupta Strategists. (2022). *Uitweg uit de schaarste. Over de noodzaak en belofte van medische technologie in de aanpak van personeelstekort in de zorg*. [https://gupta-strategists.nl/storage/files/220515-Gupta-Strategists-FME-Uitweg-uit-de-schaarste.pdf%0Ahttps://www.skipr.nl/nieuws/gupta-kennisgebrek-bestuurders-blokkeert-opmars-tech-in-zorg/?daily=1&utm\\_medium=email&utm\\_source=20220517skipr-daily-nieuws](https://gupta-strategists.nl/storage/files/220515-Gupta-Strategists-FME-Uitweg-uit-de-schaarste.pdf%0Ahttps://www.skipr.nl/nieuws/gupta-kennisgebrek-bestuurders-blokkeert-opmars-tech-in-zorg/?daily=1&utm_medium=email&utm_source=20220517skipr-daily-nieuws)
- Hack-Polay, D., Mahmoud, A. B., Ikafa, I., Rahman, M., Kordowicz, M., & Verde, J. M. (2022). Steering resilience in nursing practice: Examining the impact of digital innovations and enhanced emotional training on nurse competencies. *Technovation*, May, 102549. <https://doi.org/10.1016/j.technovation.2022.102549>
- Hain, P. P., Cancio, P., Morales, G., Nhieu, M., Antonio, R. G., & Moreno, J. V. (2022). Improving Nurse and Patient Experiences with Voice-Controlled Intelligent Personal Assistants. *Nurse Leader*. <https://doi.org/10.1016/j.mnl.2022.06.009>
- Hammerton, M., Benson, T., & Sibley, A. (2022). Readiness for five digital technologies in general practice: perceptions of staff in one part of southern England. *BMJ Open Quality*, 11(2). <https://doi.org/10.1136/bmjopen-2022-001865>
- Heinen, M. M., van Achterberg, T., Schwendimann, R., Zander, B., Matthews, A., Kózka, M., Ensio, A., Sjetne, I. S., Casbas, T. M., Ball, J., & Schoonhoven, L. (2013). Nurses' intention to leave their profession: A cross sectional observational study in 10 European countries. *International Journal of Nursing Studies*, 50(2), 174–184.  
<https://doi.org/10.1016/j.ijnurstu.2012.09.019>
- HIMSS. (2020). *2020 Nursing Informatics Workforce Survey* (Issue May).
- Holloway, I., & Galvin, K. (2016). *Qualitative research in nursing and healthcare* (3rd editio). John Wiley & Sons.
- Homburg, V., van der Heijden, B., & Valkenburg, L. (2013). Why do nurses change jobs? An empirical study on determinants of specific nurses' post-exit destinations. *Journal of Nursing Management*, 21(6), 817–826. <https://doi.org/10.1111/jonm.12142>
- Huter, K., Krick, T., Domhoff, D., Seibert, K., Wolf-Ostermann, K., & Rothgang, H. (2020). Effectiveness of digital technologies to support nursing care: Results of a scoping review. *Journal of Multidisciplinary Healthcare*, 13, 1905–1926.  
<https://doi.org/10.2147/JMDH.S286193>

- ING Economisch Bureau. (2019). *Digitale ziekenhuiszorg. Noozakelijk maar niet vanzelfsprekend*. [https://www.ing.nl/media/ING\\_EBZ\\_digitale-ziekenhuiszorg\\_tcm162-180669.pdf](https://www.ing.nl/media/ING_EBZ_digitale-ziekenhuiszorg_tcm162-180669.pdf)
- Iyamu, I., Xu, A. X. T., Gómez-Ramírez, O., Ablona, A., Chang, H.-J., Mckee, G., & Gilbert, M. (2021). Defining Digital Public Health and the Role of Digitization, Digitalization, and Digital Transformation: Scoping Review. *JMIR Public Health and Surveillance*, 7(11), e30399. <https://doi.org/10.2196/30399>
- Kaihlanen, A. M., Gluschkoff, K., Kinnunen, U. M., Saranto, K., Ahonen, O., & Heponiemi, T. (2021). Nursing informatics competences of Finnish registered nurses after national educational initiatives: A cross-sectional study. *Nurse Education Today*, 106(July), 105060. <https://doi.org/10.1016/j.nedt.2021.105060>
- Kannry, J., Sengstack, P., Thyvalikakath, T. P., Poikonen, J., Middleton, B., Payne, T., & Lehmann, C. U. (2016). The Chief Clinical Informatics Officer (CCIO): AMIA Task Force Report on CCIO Knowledge, Education, and Skillset Requirements. *Applied Clinical Informatics*, 7(1), 143–176. <https://doi.org/10.4338/ACI-2015-12-R-0174>
- Kirby, S. B. (2015). Informatics leadership: the role of the CNIO. *Nursing*, 45(4), 21–22. <https://doi.org/10.1097/01.NURSE.0000462394.23939.8e>
- Kleib, M., Nagle, L. M., Furlong, K. E., Paul, P., Duarte Wisnesky, U., & Ali, S. (2022). Are Future Nurses Ready for Digital Health? *Nurse Educator, Publish Ah*(5). <https://doi.org/10.1097/nne.0000000000001199>
- Koivunen, M., & Saranto, K. (2018). Nursing professionals' experiences of the facilitators and barriers to the use of telehealth applications: a systematic review of qualitative studies. *Scandinavian Journal of Caring Sciences*, 32(1), 24–44. <https://doi.org/10.1111/scs.12445>
- Konttila, J., Siira, H., Kyngäs, H., Lahtinen, M., Elo, S., Kääriäinen, M., Kaakinen, P., Oikarinen, A., Yamakawa, M., Fukui, S., Utsumi, M., Higami, Y., Higuchi, A., & Mikkonen, K. (2019). Healthcare professionals' competence in digitalisation: A systematic review. *Journal of Clinical Nursing*, 28(5–6), 745–761. <https://doi.org/10.1111/jocn.14710>
- Kox, J. H. A. M., Groenewoud, J. H., Bakker, E. J. M., Bierma-Zeinstra, S. M. A., Runhaar, J., Miedema, H. S., & Roelofs, P. D. D. M. (2020). Reasons why Dutch novice nurses leave nursing: A qualitative approach. *Nurse Education in Practice*, 47(May), 102848. <https://doi.org/10.1016/j.nepr.2020.102848>
- Lalleman, P., Yocarini, X., Boers, M., & Verhoeven, A. (2020). Invloed VAR op zorgbeleid. *TVZ- Verpleegkundige in de Praktijk En Etenschap*, 130(30–33).
- Mahone E., M., & Denckla B., M. (2017). Predicted Influences of Artificial Intelligence on the Domains of Nursing: Scoping Review. In *Clinical Infectious Diseases*.



- McCullough, K., Andrew, L., Genoni, A., Dunham, M., Whitehead, L., & Porock, D. (2023). An examination of primary health care nursing service evaluation using the Donabedian model: A systematic review. *Research in Nursing & Health*, 46(1), 159–176. <https://doi.org/10.1002/nur.22291>
- McMahon, D. D. (2002). Evaluating new technology to improve patient outcomes: a quality improvement approach. *Journal of Infusion Nursing : The Official Publication of the Infusion Nurses Society*, 25(4), 250–255. <https://doi.org/10.1097/00129804-200207000-00008>
- Melnick, E. R., West, C. P., Nath, B., Cipriano, P. F., Peterson, C., Satele, D. V., Shanafelt, T., & Dyrbye, L. N. (2021). The association between perceived electronic health record usability and professional burnout among US nurses. *Journal of the American Medical Informatics Association*, 28(8), 1632–1641. <https://doi.org/10.1093/jamia/ocab059>
- Misto, K., Padula, C., Bryand, E., & Nadeau, K. (2018). Nurses ' Perception of the Impact of Electronic Documentation on the Nurse-Patient Relationship. *Journal of Nursing Care Quality*, 34(2), 163–168. <https://doi.org/10.1097/NCQ.0000000000000339>
- Nakrem, S., Solbjør, M., Pettersen, I. N., & Kleiven, H. H. (2018). Care relationships at stake? Home healthcare professionals' experiences with digital medicine dispensers - A qualitative study. *BMC Health Services Research*, 18(1), 1–10. <https://doi.org/10.1186/s12913-018-2835-1>
- Noordegraaf, M. (2007). From 'pure' to 'hybrid' professionalism: Present-day professionalism in ambiguous public domains. *Administration and Society*, 39(6), 761–785. <https://doi.org/10.1177/0095399707304434>
- Organisation for Economic Co-operation and Development. (2020). *Empowering the health workforce. Strategies to make the most of the digital revolution.*
- Peltonen, L.-M., Nibber, R., Lewis, A., Block, L., Pruinelli, L., Topaz, M., Lozada Perezmitre, E., & Ronquillo, C. (2019). Emerging Professionals' Observations of Opportunities and Challenges in Nursing Informatics. *Nursing Leadership*, 32(2).
- Pepito, J. A., & Locsin, R. (2019). Can nurses remain relevant in a technologically advanced future? *International Journal of Nursing Sciences*, 6(1), 106–110. <https://doi.org/10.1016/j.ijnss.2018.09.013>
- Puolitaival, A., Savola, M., Tuomainen, P., Asseburg, C., Lundström, T., & Soini, E. (2022). Advantages in Management and Remote Monitoring of Intravenous Therapy: Exploratory Survey and Economic Evaluation of Gravity-Based Infusions in Finland. In *Advances in Therapy* (Vol. 39, Issue 5, pp. 2096–2108). <https://doi.org/10.1007/s12325-022-02093-6>
- Reid, L., Button, D., & Brommeyer, M. (2023). Challenging the Myth of the Digital Native: A Narrative Review. *Nursing Reports*, 13(2), 573–600.

<https://doi.org/10.3390/nursrep13020052>

- Rijksinstituut voor Volksgezondheids en milieu. (2020a). *Trendscenario | Sterfte en levensverwachting*. <https://www.volksgezondheidtoekomstverkenning.nl/c-vtv/trendscenario-update-2020/sterfte-en-levensverwachting>
- Rijksinstituut voor Volksgezondheids en milieu. (2020b). *Trendscenario | Ziekten en aandoeningen*. <https://www.volksgezondheidtoekomstverkenning.nl/c-vtv/trendscenario-update-2020/ziekten-aandoeningen>
- Ronquillo, C., Topaz, M., Pruinelli, L., Peltonen, L. M., & Nibber, R. (2017). Competency Recommendations for Advancing Nursing Informatics in the Next Decade: International Survey Results. *Studies in Health Technology and Informatics*, 232, 119–129. <https://doi.org/10.3233/978-1-61499-738-2-119>
- Rubeis, G. (2021). Guardians of humanity? The challenges of nursing practice in the digital age. In *Nursing Philosophy* (Vol. 22, Issue 2). <https://doi.org/10.1111/nup.12331>
- Scott Kruse, C., Karem, P., Shifflett, K., Vegi, L., Ravi, K., & Brooks, M. (2018). Evaluating barriers to adopting telemedicine worldwide: A systematic review. *Journal of Telemedicine and Telecare*, 24(1), 4–12. <https://doi.org/10.1177/1357633X16674087>
- Sensmeier, J. (2011). Transforming nursing practice through technology and informatics. *Nursing Management*, 42(11), 20–23. <https://doi.org/10.1097/01.NUMA.0000406572.04085.e8>
- Servaty, R., Kersten, A., Brukamp, K., Möhler, R., & Mueller, M. (2020). Implementation of robotic devices in nursing care. Barriers and facilitators: an integrative review. In *BMJ open* (Vol. 10, Issue 9, p. e038650). <https://doi.org/10.1136/bmjopen-2020-038650>
- Siegel, E. O., & Young, H. M. (2021). Assuring Quality in Nursing Homes: The Black Box of Administrative and Clinical Leadership-A Scoping Review. *The Gerontologist*, 61(4), e147–e162. <https://doi.org/10.1093/geront/gnaa175>
- Smith, B., & Sparkes, A. (2016). *Handbook of Qualitative Research in Sport and Exercise*. Sociaal-Economische Raad. (2020). *Zorg voor de toekomst: Over de toekomstbestendigheid van de zorg*.
- Speyer, R., Denman, D., Wilkes-Gillan, S., Chen, Y.-W., Bogaardt, H., Kim, J.-H., Heckathorn, D.-E., & Cordier, R. (2018). Effects of telehealth by allied health professionals and nurses in rural and remote areas: A systematic review and meta-analysis. *Journal of Rehabilitation Medicine*, 50(3), 225–235. <https://doi.org/10.2340/16501977-2297>
- Staggers, N., Elias, B. L., Makar, E., & Alexander, G. L. (2018). The Imperative of Solving Nurses' Usability Problems With Health Information Technology. *The Journal of Nursing Administration*, 48(4), 191–196. <https://doi.org/10.1097/NNA.0000000000000598>
- Strudwick, G., Lo, B., Kemp, J., Tajirian, T., White, P., & Nagle, L. (2023). Opportunities and

- challenges to enhance the value and uptake of Chief Nursing Informatics Officer ( CNIO ) Roles in Canada : A Qualitative Study. *AMIA Annu Symp Proc*, 1012–1021.
- Strudwick, G., Nagle, L., Kassam, I., Pahwa, M., & Sequeira, L. (2019). Informatics Competencies for Nurse Leaders: A Scoping Review. *Journal of Nursing Administration*, 49(6), 323–330. <https://doi.org/10.1097/NNA.0000000000000760>
- Surani, Z., John, M., Solano López, A. L., Gbenro, V., Slodan, L., & Strudwick, G. (2019). Role Played and Strategies Employed by Managers to Support Point-of-Care Nurses' Use and Adoption of Health Information Technology: A Scoping Review. *Nursing Leadership (Toronto, Ont.)*, 32(2), 85–101. <https://doi.org/10.12927/cjnl.2019.25959>
- Tolentino, D. A., & Gephart, S. M. (2020). State of the Science of Dimensions of Nurses' User Experience When Using an Electronic Health Record. *Computers, Informatics, Nursing : CIN*, 39(2), 69–77. <https://doi.org/10.1097/CIN.0000000000000644>
- Tong, A., Sainsbury, P., & Craig, J. (2007). Consolidated criteria for reporting qualitative research (COREQ): A 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*, 19(6), 349–357. <https://doi.org/10.1093/intqhc/mzm042>
- Topaz, M., Ronquillo, C., Peltonen, L. M., Pruinelli, L., Sarmiento, R. F., Badger, M. K., Ali, S., Lewis, A., Georgsson, M., Jeon, E., Tayaben, J. L., Kuo, C. H., Islam, T., Sommer, J., Jung, H., Eler, G. J., & Alhuwail, D. (2016). Advancing nursing informatics in the next decade: Recommendations from an international survey. *Studies in Health Technology and Informatics*, 225, 123–127. <https://doi.org/10.3233/978-1-61499-658-3-123>
- Tuominen, O., Lundgrén-Laine, H., Flinkman, M., Boucht, S., & Salenterä, S. (2019). Rescheduling nursing staff with information technologybased staffing solutions: a scoping review. *International Journal of Healthcare Technology and Management*, 17(2–3), 145–167.
- Tupper, S. R., & Alexander, D. (2012). Leading from the future: the nursing informatics executive. *Computers, Informatics, Nursing : CIN*, 30(3), 123–125. <https://doi.org/10.1097/NXN.0b013e318251aa35>
- Upenieks, V. V., & Abelew, S. (2006). The magnet designation process: a qualitative approach using Donabedian's conceptual framework. *The Health Care Manager*, 25(3), 243–253. <https://doi.org/10.1097/00126450-200607000-00009>
- V&VN CNIO Netwerk Nederland. (2019). *CNIO Functieprofiel*. 4. <https://www.venvn.nl/media/c5ebg3ws/cnio-functieprofiel-v1-0-maart-2019.pdf>
- Van Der Heijden, B., Mahoney, C. B., & Xu, Y. (2019). Impact of job demands and resources on nurses' burnout and occupational turnover intention towards an age-moderated mediation model for the nursing profession. In *International Journal of Environmental Research and Public Health* (Vol. 16, Issue 11). <https://doi.org/10.3390/ijerph16112011>

Wisner, K., Lyndon, A., & Chesla, C. A. (2019). The electronic health record's impact on nurses' cognitive work: An integrative review. *International Journal of Nursing Studies*, 94, 74–84. <https://doi.org/10.1016/j.ijnurstu.2019.03.003>

# Appendix 1. Introduction survey (dutch)

Beste collega-verpleegkundige en CNIO's,

De rol van de Chief Nursing Information Officer (CNIO\*) is een relatief nieuwe rol in Nederland. Als verpleegkundige en masterstudent Health Sciences aan de Universiteit Twente hoefde ik dan ook niet lang na te denken over een onderwerp voor mijn afstudeeronderzoek. Met mijn afstudeeronderzoek wil ik graag onderzoeken wat de toegevoegde waarde is van de CNIO voor de digitalisering van het verpleegkundig beroep.

Om dit te onderzoeken wil ik vragen of je

(1) deze vragenlijst wilt doorsturen naar verpleegkundigen in de verpleegkundig adviesraad of verpleegkundig stafbestuur binnen jouw organisatie

(2) de vragenlijst hieronder wilt invullen. De vragenlijst zal ongeveer 15 minuten van je tijd in beslag nemen.

Link naar de vragenlijst: [https://utwentebs.eu.qualtrics.com/jfe/form/SV\\_9Munmmh3bQY18j4](https://utwentebs.eu.qualtrics.com/jfe/form/SV_9Munmmh3bQY18j4)

Alvast veel dank voor jouw medewerking!

Met vriendelijke groeten,

Xenia Yocarini

Bij vragen kun je mij mailen op: [x.k.yocarini@student.utwente.nl](mailto:x.k.yocarini@student.utwente.nl)

\* Met CNIO worden verpleegkundigen met een brugfunctie naar technologie bedoeld zoals beschreven in het functieprofiel CNIO van de V&VN. Andere benamingen voor deze rol kunnen zijn: projectleider technologie, Inurse, diginurse, superuser, key user, digitaal verpleegkundige enzovoort.



## Appendix 2. Survey CNIO (dutch)

Q1 Geef je toestemming om de gegevens van de vragenlijst te gebruiken voor dit onderzoek naar de toegevoegde waarde van de CNIO voor de digitalisering van het verpleegkundig beroep?

*[ja/nee]*

Q2 Wat is je huidige functie? Indien je meerdere functies hebt, selecteer dan meerdere antwoorden

*[CNIO/ik werk als brugfunctie tussen verpleegkunde en technologie maar dit heeft een andere naam dan CNIO. Voorbeelden zijn: Inurse, dignurse, superuser, key user, digitaal verpleegkundige enzovoort/verpleegkundige/anders]*

Q3 CNIO Wat is jouw leeftijd?

*[18 tot 25 jaar/25 tot 35 jaar/35 tot 45 jaar/45 tot 55 jaar/55 tot 65 jaar/65 tot 70 jaar]*

Q4 CNIO Met welk geslacht identificeer jij je?

*[man, vrouw, anders, zeg ik liever niet]*

Q5 CNIO Wat is je hoogst genoten opleiding?

*[MBO, HBO, Universitair]*

Q6 CNIO heb jij een aanvullende opleiding gedaan?

*[ja/nee]*

{Display Q7 CNIO if Q6 CNIO = ja}

Q7 CNIO Welke aanvullende opleiding heb je gedaan?

*[open text]*

Q8 CNIO Hoeveel werkervaring in jaren heb jij als verpleegkundige?

*[slider van 0 tot 50 in jaren]*

{Text: Bij de volgende vragen wordt het woord CNIO gebruikt. Met CNIO worden verpleegkundigen met een brugfunctie naar technologie bedoeld zoals beschreven in het functieprofiel CNIO van de V&VN. Andere benamingen voor deze rol kunnen zijn: projectleider technologie, Inurse, dignurse, superuser, key user, digitaal verpleegkundige enzovoort.}

Q9 CNIO Hoeveel uur per week werk je per functie? Indien functies niet van jou op toepassing zijn kun je 0 uur invullen.

*[table met twee kolommen. Linker kolom staat: CNIO, verpleegkunde, answer anders van Q2 en totaal. Rechter kolom kunnen participanten invullen hoeveel uur ze per functie werken]*

Q10 CNIO Wat was je functie voordat je de functie als CNIO in nam?

*[open text]*

Q11 CNIO Hoeveel jaar draag je formeel de CNIO functie?

[slider van 0 tot 50 in jaren]

Q12 CNIO Hoeveel mensen zijn betrokken bij de verpleegkundige informatie technologie?

Voer een aantal in achter elke functie. Indien een functie niet aanwezig is kan je een 0 invullen.

[Tabel met twee kolommen. De linker kolom staat: CNIO, NIO, anders namelijk [open text] en totaal. Rechter kolom kunnen participanten invullen hoeveel mensen er per functie werkzaam zijn]

Q13 CNIO In wat voor een organisatie ben jij momenteel werkzaam?

[Perifeer ziekenhuis/Topklinisch ziekenhuis/Academisch ziekenhuis/Verpleegverzorgingshuizen en thuiszorg/Geestelijke gezondheidszorg]

Q14 CNIO Waar binnen de governance structuur bevindt de rol van de CNIO zich? Klik het desbetreffende vak aan binnen de afbeelding. Indien jij je niet kunt vinden in deze governance structuur, de rol bevindt zich ergens anders of je weet het niet, kies dan het vak "anders".



Afbeelding 1: Governance structuur. Geadopteerd van V&VN CNIO Netwerk Nederland, 2022 from <https://www.venvn.nl/media/3jvjq1vx/cnio-netwerk-presentatie-15-juni-2022-zorgen-ict-beurs-84.pdf>

{Display Q15 CNIO if Q14 CNIO = anders}

Q15 CNIO Je hebt aangegeven dat je de positie als CNIO niet kon plaatsen in de structuur of dat de rol van de CNIO zich ergens anders bevindt. Kun je dit toelichten?

[open text]

Q16 CNIO Aan wie leg jij eindverantwoording af als CNIO?

[Raad van Bestuur, Chief Nursing Officer of verpleegkundig directeur/Chief Information Officer of IT-directeur/Anders, namelijk [open text]]

Q17 CNIO Welke rol neem je als CNIO aan ten opzichte van [antwoord Q14 CNIO]? Denk hierbij aan, coachend, adviseur, partner, sturend, critical friend, luis in de pels, opponent (graag aanvullen, meerdere antwoorden mogelijk)

*[multiple choice: coachend/adviseur/partner/sturend/critical friend/luis in de pels/opponent/anders, namelijk [open text]]*

Q18 CNIO Hoeveel formele contactmomenten met [antwoord Q14 CNIO] zijn er per maand in de rol van de CNIO?

*[slider van 0 tot 50 momenten]*

Q19 CNIO Geef met een cijfer van 1-10 aan in hoeverre je je gesteund voelt in je rol als CNIO binnen de relatie met [antwoord Q14 CNIO]?

*[slider 0 tot 10. 0= helemaal niet gesteund. 5=neutraal. 10=extreem gesteund]*

Q20 CNIO Welke rol neem je aan als CNIO ten opzichte van verpleegkundigen werkzaam in jouw organisatie? Denk hierbij aan, coachend, adviseur, partner, sturend, critical friend, luis in de pels, opponent (graag aanvullen, meerdere antwoorden mogelijk)

*[multiple choice: coachend/adviseur/partner/sturend/critical friend/luis in de pels/opponent/anders, namelijk [open text]]*

Q21 CNIO Geef met een cijfer van 1-10 aan in hoeverre je je gesteund voelt in je rol als CNIO binnen de relatie met verpleegkundigen werkzaam in jouw organisatie

*[slider 0 tot 10. 0= helemaal niet gesteund. 5=neutraal. 10=extreem gesteund]*

Q22 CNIO Met welke technologieën en/of applicaties werk je als CNIO? Er zijn meerdere antwoorden mogelijk.

*[multiple choice: Elektronisch patiënten dossier (EPD)/Verpleegkundige verslaglegging/Point of Care Clinical Decision Support/Geautomatiseerde orderinvoer (CPOE)/Elektronische medicatie administratie (eMAR)/Kwaliteitsverbetering/risico management/Barcode Scanner (BCMA)/Anders, namelijk [open text]]*



Q23 CNIO Met welke verantwoordelijkheden houd jij je als CNIO het meest mee bezig in een maand? Indien je verantwoordelijkheden mist kun je de lijst aanvullen (max 3). Sleep de 3 belangrijkste in het rechtervak en zet ze op volgorde, waarbij 1 de belangrijkste bezigheid is.

*[Top three: systeem implementatie/systeem optimalisatie of gebruik/systeemontwikkeling/ kwaliteit initiatieven of verslaglegging/project management/ change of control management/ informatics onderwijs/[open text]/[open text]/[open text]]*

Q24 CNIO Wat vind jij dat de toegevoegde waarde is van de CNIO voor het digitaliseren van het verpleegkundig beroep?

*[slider 0 tot 10. 0= helemaal geen toegevoegde waarde. 5=neutraal. 10=Extreem van toegevoegde waarde]*

Q25 CNIO Kun je toelichten waarom je de toegevoegde waarde van de CNIO voor het digitaliseren van het verpleegkundig beroep een [antwoord vraag Q24 CNIO] hebt gegeven?

*[open text]*

Q26 CNIO Wat vind jij de belangrijkste resultaten van je werk als CNIO in het afgelopen jaar? Noem 3 voorbeelden.

*[open text]*

{tekst Om de onderzoeksvraag: "Wat is de toegevoegde waarde van de rol van de CNIO voor de digitalisering van het verpleegkundig beroep" te kunnen beantwoorden worden er nog interviews en focusgroepen afgenomen als vervolgonderzoek.}

Q27 CNIO Wil jij meewerken aan vervolgonderzoek of heb jij iemand binnen jouw netwerk die de onderzoeker mag benaderen om mee te werken met vervolgonderzoek? Meerdere opties zijn mogelijk

*[Multiple choice: Ja, ik wil meewerken aan vervolgonderzoek en daarvoor mag je mij benaderen/ja, je mag iemand binnen mijn netwerk benaderen voor vervolgonderzoek/Nee, ik wil niet benaderd worden]*

{Display Q28 CNIO if Q27 CNIO = Ja, ik wil meewerken aan vervolgonderzoek en daarvoor mag je mij benaderen and/or ja, je mag iemand binnen mijn netwerk benaderen voor vervolgonderzoek/ }

Q29 CNIO Wat is de naam, functie, e-mailadres en/of telefoonnummer van jou of diegene in jouw netwerk die de onderzoeker mag benaderen?

*[multiple choice: naam, functie, telefoonnummer, emailadres]*

*{text: Einde vragenlijst. Dit is het einde van de vragenlijst. Indien je op verder klikt worden de antwoorden van de vragenlijst verstuurd}*

## Appendix 3. Survey nurses on nursing council (dutch)

Q1 Geef je toestemming om de gegevens van de vragenlijst te gebruiken voor dit onderzoek naar de toegevoegde waarde van de CNIO voor de digitalisering van het verpleegkundig beroep?

*[ja/nee]*

Q2 Wat is je huidige functie? Indien je meerdere functies hebt, selecteer dan meerdere antwoorden

*[CNIO/ik werk als brugfunctie tussen verpleegkunde en technologie maar dit heeft een andere naam dan CNIO. Voorbeelden zijn: Inurse, dignurse, superuser, key user, digitaal verpleegkundige enzovoort/verpleegkundige/anders]*

Q3vpk Heeft jouw organisatie een CNIO? Met CNIO worden verpleegkundigen met een brugfunctie naar technologie bedoeld zoals beschreven in het functieprofiel CNIO van de V&VN. Andere benamingen voor deze rol kunnen zijn: projectleider technologie, Inurse, dignurse, superuser, key user, digitaal verpleegkundige enzovoort.

*[Ja/nee/weet ik niet]*

Q4 VPK Wat is jouw leeftijd?

*[18 tot 25 jaar/25 tot 35 jaar/35 tot 45 jaar/45 tot 55 jaar/55 tot 65 jaar/65 tot 70 jaar]*

Q5 VPK Met welk geslacht identificeer jij je?

*[man, vrouw, anders, zeg ik liever niet]*

Q6 VPK Wat is je hoogst genoten opleiding?

*[MBO, HBO, Universitair]*

Q7 VPK heb jij een aanvullende opleiding gedaan?

*[ja/nee]*

{Display Q8 VPK if Q7 VPK = ja}

Q8 VPK Welke aanvullende opleiding heb je gedaan?

*[open text]*

Q9 VPK Hoeveel werkervaring in jaren heb jij als verpleegkundige?

*[slider van 0 tot 50 in jaren]*

Q10 VPK Hoeveel uur per week werk je per functie? Indien functies niet van jou op toepassing zijn kun je 0 uur invullen.

*[tabel met twee kolommen. Linker kolom staat: CNIO, verpleegkunde, answer anders van Q2 en totaal. Rechter kolom kunnen participanten invullen hoeveel uur ze per functie werken]*

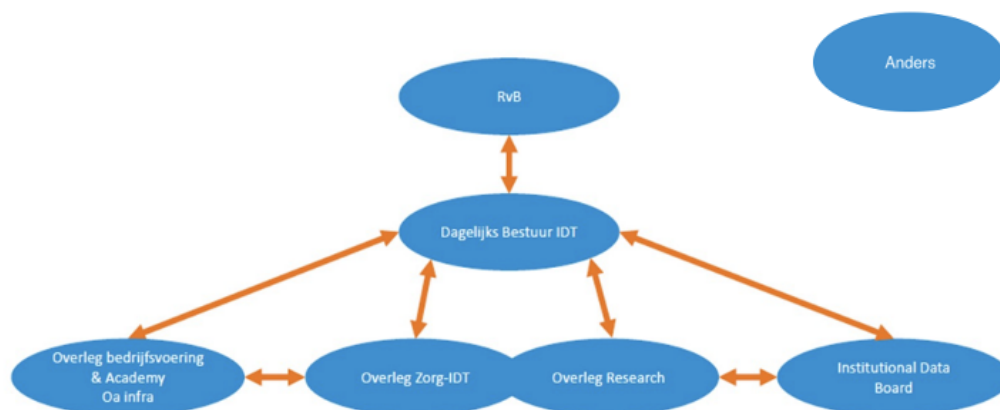
Q11 CNIO In wat voor een organisatie ben jij momenteel werkzaam?

*[Perifeer ziekenhuis/Topklinisch ziekenhuis/Academisch ziekenhuis/Verpleeg-  
verzorgingshuizen en thuiszorg/Geestelijke gezondheidszorg]*

*{text: Bij de volgende vragen wordt het woord CNIO gebruikt. Met CNIO worden  
verpleegkundigen met een brugfunctie naar technologie bedoeld zoals beschreven in het  
functieprofiel CNIO van de V&VN. Andere benamingen voor deze rol kunnen zijn:  
projectleider technologie, Inurse, dignurse, superuser, key user, digitaal verpleegkundige  
enzovoort. }*

Q12 VPK Waar binnen de governance structuur zou de rol van de CNIO zich moeten  
bevinden volgens jou? Klik het desbetreffende vak aan. Indien jij je niet kunt vinden in deze  
governance structuur of de rol bevindt zich ergens anders, kies dan het vak "anders".

Afbeelding 1: Governance structuur. Geadopteerd van V&VN CNIO Netwerk Nederland,  
2022 from [https://www.venvn.nl/media/3jvjq1vx/cnio-netwerk-presentatie-15-juni-2022-zorg-  
en-ict-beurs-84.pdf](https://www.venvn.nl/media/3jvjq1vx/cnio-netwerk-presentatie-15-juni-2022-zorg-<br/>en-ict-beurs-84.pdf)



{Display Q13 VPK if Q12 VPK = anders}

Q13 VPK Je hebt aangegeven dat je de positie als CNIO niet kon plaatsen in de structuur of  
dat de rol van de CNIO zich ergens anders bevindt. Kun je dit toelichten?

*[open text]*

Q14 VPK Aan wie zou een CNIO eindverantwoording moeten afleggen volgens jou?

*[Raad van Bestuur, Chief Nursing Officer of verpleegkundig directeur/Chief  
Information Officer of IT-directeur/Anders, namelijk [open text]]*

Q15vpk Welke rol vind je dat een CNIO zou moeten aannemen ten opzichte van [antwoord vraag Q14]]volgens jou? Denk hierbij aan, coachend, adviseur, partner, sturend, critical friend, luis in de pels, opponent (graag aanvullen, meerdere antwoorden mogelijk)

*[multiple choice: coachend/adviseur/partner/sturend/critical friend/luis in de pels/opponent/anders, namelijk [open text]]*

Q16 VPK Welke rol vind je dat een CNIO volgens jou zou moeten aannemen ten opzichte van de verpleegkundigen werkzaam in jouw organisatie? Denk hierbij aan, coachend, adviseur, partner, sturend, critical friend, luis in de pels, opponent (graag aanvullen, er zijn meerdere antwoorden mogelijk)

*[multiple choice: coachend/adviseur/partner/sturend/critical friend/luis in de pels/opponent/anders, namelijk [open text]]*

Q17 VPK Geef met een cijfer van 1-10 aan in hoeverre je je gesteund voelt door de rol van de CNIO

*[slider 0 tot 10. 0= helemaal niet gesteund. 5=neutraal. 10=extreem gesteund]*

Q18vpk Met welke technologieën en/of applicaties zou een CNIO zich moeten bezighouden voor het digitaliseren van het verpleegkundig beroep? Sleep de 3 belangrijkste in het rechtervak en zet ze op volgorde, waarbij 1 de belangrijkste bezigheid is.

*[multiple choice: Elektronisch patiënten dossier (EPD)/Verpleegkundige verslaglegging/Point of Care Clinical Decision Support/Geautomatiseerde orderinvoer (CPOE)/Elektronische medicatie administratie (eMAR)/Kwaliteitsverbetering/risico management/Barcode Scanner (BCMA)/Anders, namelijk [open text]]*

Q19 VPK Welke verantwoordelijkheden van een CNIO zijn het belangrijkste voor het digitaliseren van het verpleegkundig beroep? Sleep de 3 belangrijkste in het rechtervak en zet ze op volgorde, waarbij 1 de belangrijkste verantwoordelijkheid is.

*[Top three: systeem implementatie/systeem optimalisatie of gebruik/systeemontwikkeling/ kwaliteit initiatieven of verslaglegging/project management/ change of control management/ informatics onderwijs/[open text]/[open text]/[open text]]*

Q20 VPK Geef met een cijfer van 1-10 aan wat jij de toegevoegde waarde vindt voor het digitaliseren van het verpleegkundig beroep

*[slider 0 tot 10. 0= helemaal geen toegevoegde waarde. 5=neutraal. 10=Extreem van toegevoegde waarde]*

Q21 VPK Kun je toelichten waarom je de toegevoegde waarde van de CNIO voor het digitaliseren van het verpleegkundig beroep een [antwoord vraag Q20 VPK] hebt gegeven?

*[open text]*

Q21 VPK Wat vind jij de belangrijkste resultaten die de CNIO in jouw organisatie het afgelopen jaar heeft bereikt? Noem 3 voorbeelden.

*[open text]*

{text: Om de onderzoeksvraag: "Wat is de toegevoegde waarde van de rol van de CNIO voor de digitalisering van het verpleegkundig beroep" te kunnen beantwoorden worden er nog interviews en focusgroepen afgenomen als vervolgonderzoek.}

Q22 VPK Wil jij meewerken aan vervolgonderzoek of heb jij iemand binnen jouw netwerk die de onderzoeker mag benaderen om mee te werken met vervolgonderzoek? Meerdere opties zijn mogelijk

*[Multiple choice: Ja, ik wil meewerken aan vervolgonderzoek en daarvoor mag je mij benaderen/ja, je mag iemand binnen mijn netwerk benaderen voor vervolgonderzoek/Nee, ik wil niet benaderd worden]*

{Display Q23 VPK if Q22 VPK = Ja, ik wil meewerken aan vervolgonderzoek en daarvoor mag je mij benaderen and/or ja, je mag iemand binnen mijn netwerk benaderen voor vervolgonderzoek/ }

Q29 CNIO Wat is de naam, functie, e-mailadres en/of telefoonnummer van jou of diegene in jouw netwerk die de onderzoeker mag benaderen?

*[multiple choice: naam, functie, telefoonnummer, emailadres]*

{text: Einde vragenlijst. Dit is het einde van de vragenlijst. Indien je op verder klikt worden de antwoorden van de vragenlijst verstuurd.}

# Appendix 4. Round 1 interview topic list - CNIO (dutch)

Als eerste, hartelijk dank dat je wilt deelnemen aan dit onderzoek. Met dit onderzoek wordt geprobeerd inzicht te krijgen in de toegevoegde waarde van de chief nursing information officer voor de digitalisering van het verpleegkundig beroep. De antwoorden die je geeft zullen vertrouwelijk behandeld worden en bij een publicatie niet herleidbaar zijn naar jou. Deelname aan dit onderzoek is vrijwillig en je kunt je op elk moment terugtrekken uit het onderzoek.

*Voorafgaand aan het interview zal de onderzoeker toestemming vragen voor audio opname van het interview en of de deelnemer akkoord is met de verwerking van informatie die hij/zij in het interview verstrekt.*

**Ga je akkoord met deelname aan dit onderzoek en vind je het goed als dit gesprek wordt opgenomen?**

## **Vragen**

### **Algemeen**

1. Wat is je leeftijd?
2. Met welk geslacht identificeer jij je?
3. Wat is jouw huidige functie(s)?
  - a. Hoe lang ben je werkzaam als CNIO?
4. In wat voor een soort organisatie ben je momenteel werkzaam?
5. Hoeveel verpleegkundigen zijn er werkzaam in jouw organisatie?

Ijsbreker: Hoe is de functie van de CNIO binnen jouw organisatie ontstaan?

### **Structuur**

1. Met wie werk jij als CNIO het meeste samen om digitalisering van het verpleegkundig beroep te ondersteunen of bevorderen?
2. Kun je beschrijven hoe je samenwerkt met andere belanghebbende in de C-suite zoals de CMIO, raad van bestuur, Directie IT en de voorzitter van de Verpleegkundige Adviesraad om de digitalisering van het verpleegkundig beroep te ondersteunen?
  - i. Ben je tevreden over deze samenwerking?
  - ii. Hoe zou dit verbeterd kunnen worden?

3. Welke rol speel jij als CNIO bij het opbouwen van relaties en partnerschappen ter ondersteuning van de invoering van digitale technologieën voor verpleegkundigen?
  - a. Ben je tevreden over deze rol?
  - b. Hoe zou dit verbeterd kunnen worden?

### **Process**

4. Wat zijn drie hoofdthema's waar jij je het meest mee bezig houdt in de rol van CNIO?
  - a. Waarom deze thema's?
  - b. Zijn dit ook de thema's die jij zelf zou uitkiezen om aan het werken?
5. Hoe draag jij, als CNIO, bij aan de ontwikkeling van de digitalisering strategie voor het verpleegkundig beroep?
6. Op welke manier vertegenwoordig jij, als CNIO, de verpleegkundige beroepsgroep?
7. Welke strategieën gebruik jij als CNIO om verpleegkundigen te betrekken bij digitalisering?
  - a. Ben je tevreden over je gebruikte strategieën?
  - b. Hoe zou je dat verbeteren?

### **Outcome**

8. Wat zijn de belangrijkste resultaten in het aankomende jaar wilt behalen als het gaat om de digitalisering van de verpleegkundigen binnen jouw rol als CNIO?
  - a. Doorvragen: en in de komende vijf jaar?
  - b. Wat is er voor nodig om jouw gestelde doelen te behalen?
9. Hoe zie jij de rol van de CNIO in de toekomst nog (door)ontwikkelen?
  - a. Welke uitdagingen verwacht je bij de doorontwikkeling van de rol van de CNIO?
  - b. Welke bevorderende factoren verwacht je bij de doorontwikkeling van de rol van de CNIO?
10. Wat denk jij dat de toegevoegde waarde is van de CNIO voor het digitaliseren van het verpleegkundig beroep?

Prompt: kan je daar een voorbeeld bij geven?

### **Afsluiting**

Zijn er nog dingen die niet aan bod zijn gekomen in het gesprek maar die je wel belangrijk vindt om te vertellen?

Ik wil je graag bedanken voor jouw tijd en deelname aan het interview. Ik hoop dat je het gevoel hebt dat je jouw verhaal hebt kunnen vertellen en dat er naar jouw verhaal is geluisterd. Mocht je nog vragen hebben dan mag je mij bellen of mailen. [telefoonnummer]  
[mailadres].

# Appendix 5. Round 2 interview topic list - associated stakeholders of the CNIO (dutch)

## Introductie

Als eerste, hartelijk dank dat je wilt deelnemen aan dit onderzoek. Met dit onderzoek wordt geprobeerd inzicht te krijgen in de toegevoegde waarde van de chief nursing information officer voor de digitalisering van het verpleegkundig beroep. De antwoorden die je geeft kunnen niet naar jou herleid worden en zullen vertrouwelijk behandeld worden. Deelname aan dit onderzoek is vrijwillig en je kunt je op elk moment terugtrekken uit het onderzoek.

Voorafgaand aan het interview zal de onderzoeker toestemming vragen voor audio opname van het interview en of de deelnemer akkoord is met de verwerking van informatie die hij/zij in het interview verstrekt.

Ga je akkoord met deelname aan dit onderzoek en vind je het goed als dit gesprek wordt opgenomen?

## Vragen

### Algemeen

1. Wat is je leeftijd?
2. Wat is jouw huidige functie(s)?
3. In wat voor een soort organisatie ben je momenteel werkzaam?
4. Hoeveel verpleegkundigen zijn er werkzaam in jouw organisatie?

### Structuur

1. Kun je in het kort de rol als [rol geïnterviewde] en jouw verantwoordelijkheden binnen de organisatie beschrijven?
2. Hoe zou je je relatie met de CNIO beschrijven?
  - a. Doorvragen: welke rol neem je aan tegenover CNIO in jouw organisatie?
3. Hoe werk je samen met de CNIO om de digitalisering van de verpleegkundige beroepsgroep te ondersteunen?
4. Wat zijn volgens jou de belangrijkste vaardigheden en kwalificaties waarover een CNIO moet beschikken om succesvol te zijn in zijn rol?

### Process

5. Wat zijn drie hoofdthema's waar de CNIO zich het meest mee bezig zou moeten houden?



6. Op welke manieren draagt de CNIO bij aan de digitalisering van de verpleegkundige beroepsgroep?
  - a. Kun je hierbij voorbeelden noemen?
    - i. Verbeter patiëntenzorg en/of uitkomsten?
    - ii. Verbeter de efficiency of effectiviteit van verpleegkundigen?
    - iii. Ondersteun professionele ontwikkeling van verpleegkundigen?
7. Hoe past het werk van de CNIO binnen de digitalisering strategie?

### **Outcome**

8. Wat zijn de belangrijkste resultaten in het afgelopen jaar van de CNIO als het gaat om de digitalisering van de verpleegkundige beroepsgroep?
  - a. Doorvragen: en in de komende vijf jaar?
9. Hoe zie jij de rol van de CNIO in de toekomst nog (door)ontwikkelen?
  - a. Welke uitdagingen verwacht je bij de doorontwikkeling van de rol van de CNIO?
  - b. Welke bevorderende factoren verwacht je bij de doorontwikkeling van de rol van de CNIO?
10. Wat denk jij dat de toegevoegde waarde is van de CNIO voor het digitaliseren van het verpleegkundig beroep?

Prompt: kan je daar een voorbeeld bij geven?

### **Afsluiting**

Zijn er nog dingen die niet aan bod zijn gekomen in het gesprek maar die je wel belangrijk vindt om te vertellen?

Ik wil je graag bedanken voor jouw tijd en deelname aan het interview. Ik hoop dat je het gevoel hebt dat je jouw verhaal hebt kunnen vertellen en dat er naar jouw verhaal is geluisterd. Mocht je nog vragen hebben dan mag je mij bellen of mailen. [telefoonnummer]  
[mailadres].

## Appendix 6. Characteristics respondents survey

Table 6. Characteristics respondents survey

		CNIO (n=14)	Nurses (n=6)
<b>Gender</b>	Female	12	5
	Male	2	1
<b>Age group</b>	25 to 35	4	1
	35 to 45	4	1
	45 to 55	6	3
	55 to 65	0	1
<b>Highest education</b>	Secondary vocational education	1	0
	University of Applied Science	12	4
	University	1	2
<b>Additional education</b>	IT courses	6	
	Nursing specialisation	5	
	Management courses	2	
	None	4	
<b>Work Experience (years)</b>	Nursing	17,6 (8-30)	21,2 (4-36)
	CNIO	1,5 (0-5)	
<b>Type of workplace</b>	Peripheral hospital	6	1
	Top clinical hospital	6	5
	Academic hospital	1	0
	Nursing home and home care	1	0

## Appendix 7. Results survey

Table 7. Results survey

		CNIO (n=13)	Nurses (n=6)
<b>Governance structure</b>	Board of directors	0	0
	Daily management	3	4
	Consultation business operations & academy	0	0
	Consultation research	0	0
	Institutional data board	0	0
	Other	5	1
	<b>Accountability</b>	Board of directors	7
	Chief Nursing Officer	0	3
	Chief Information Officer	4	1
	Other	2	0
<b>Formal contacts</b>	Average	3,3	
	Minimum	1,0	
	Maximum	12,0	
<b>Support by those they report to</b>	Average	7,8	
	Minimum	3,0	
	Maximum	10,0	
<b>Support felt by CNIO/nurses*</b>	Average	7,3	7,3
	Minimum	6	5
	Maximum	8	9
<b>Added value CNIO</b>	Average	8,8	8,3
	Minimum	8	7
	Maximum	10	9

\* CNIOs were asked what they would rate (1 till 10) the support of nurses in their organisation and nurses were asked what they would rate (1 till 10) the support of CNIOs in their organisation.