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# Experiences of nurses working in novel virtual care centres in the Netherlands: a qualitative study

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## Abstract

**Background**  Virtual care centres (VCCs) are novel wards of hospitals and facilitate the provision of remote monitoring and home-based patient care. Whereas since the COVID-19 pandemic VCCs have rapidly emerged, there is no standardised framework for the development and implementation of VCCs. To develop such a framework, insight in current experiences of employment in VCCs is needed. Therefore, the aim of this study was to explore nurses' perceptions and experiences of working in VCCs.

**Results**  Between February and July 2023, semi-structured online interviews were conducted with thirteen nurses (age 45 ± 8 years) from four VCCs in the Netherlands. Interviews were thematically analysed using a six-stage approach, yielding six themes of nurses' perceptions and experiences of working in VCCs: 1)' Changing role of nurses', especially in the patient-professional relationship, transformation of care and communication; 2)'Clinical perspective of nurses', need for general medical knowledge and use of data in relation to nurses' clinical perspective, 3)'Education and training', need to keep nurses' knowledge up-to-date and create time for education; 4)'Organisation of care', nurses' role in the development of protocols and need for sufficient technological preconditions; 5)'Cooperation with other healthcare professionals', consisted of the collaboration with and needed support by other healthcare professionals to organize and provide care to VCC patients; 6)'Experienced effects of VCCs' included advantages and disadvantages of VCCs for the nurses, patients and the hospital. Themes were mapped onto the Capability, Opportunity and Motivation of Behaviour (COM-B) model where all themes included components of capability, opportunity and motivation.

**Conclusions**  Our findings highlight the importance of considering COM-B components of nurses' work in VCCs. Due to the changing roles of nurses in VCCs, there are evolving educational needs in to communicate with patients and colleagues, and the use of data to support their clinical view, as well as providing technological optimisations to further support nurses' work and the VCCs.

**Keywords**  Digital Health [MeSH], Home Care Services, Hospital-Based [MeSH], Virtual care centers, Virtual care, Telemonitoring, Remote care, Virtual care nurses, Nurses' work, Perceptions, COM-B, Interviews

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## Background

Healthcare systems are facing considerable challenges globally. The number of older patients with complex conditions is increasing [1, 2], and healthcare expenditures will rise substantially [2, 3]. In addition, healthcare faces a growing shortage of adequately equipped staff to properly provide patient-centred care and support [4, 5]. This calls for innovative care models for sustainable care delivery while remaining safe, effective and accessible [6].

A growing innovative care model is providing care through virtual care centres (VCC). Although there is no uniform definition of a VCC, recent studies about VCCs focused on community or self-management health without the need for direct contact with a healthcare professional and some were limited to remote digital consultations [7–10]. Moreover, studies of virtual wards found varying effects on patient outcomes [11, 12]. For hospitals, VCCs focus on delivering a variety of medical specialist care using information and communication technology [6, 13]. VCCs enable disease monitoring at a distance and facilitate interaction between patients and healthcare professionals without requiring in-person visits to a healthcare facility. Virtual care is delivered through various communication tools such as phone and video calls, secure messaging platforms, and mobile applications for remote monitoring and connecting patients with healthcare professionals, predominantly nurses [8]. By virtual feedback, guidance and contact with these so-called VCC nurses, patients are empowered to discuss their health conditions and treatment options from a distance (e.g., receive medical advice, get prescriptions).

VCC departments, originated in the COVID-19 pandemic and swiftly implemented by numerous hospitals in the Netherlands, may play a pivotal role in improving healthcare access, reducing healthcare costs, and enhancing patient empowerment, making healthcare services more efficient and accessible to a broader population than COVID-19 patients [14]. Therefore, after the pandemic, VCCs of hospitals were further developed and implemented with a focus on delivering care in postoperative care, chronic disease management and preventive care, and pre- and rehabilitation care for multiple specialisms and for in- and outpatients.

Although VCCs are established rapidly and becoming common practice, optimisation remains largely practice-based. There may be large organisational variability between hospitals and the evidence regarding the effects of VCCs on patient outcomes remains limited [8]. In addition, commercial technologies may claim certain patient or professional benefits without adequate scientific evidence. This knowledge gap is particularly important given the challenges of access to virtual care

for certain patient groups with limited health literacy. On the other hand, the increase in virtual self-assessment can lead to latent or unnecessary care needs for patients, resulting in an increase in ineffective care [15–17]. Furthermore, organisational challenges may arise such as increased workforce in VCCs and technological preconditions may not be arranged or set up optimally to work successfully in a VCC [15, 18]. The innovative nature of VCCs and the diversity in the type of care and diseases, may require both different knowledge and skills of the caregiver compared to regular care.

To the best of our knowledge, there is no standardized framework available to overcome these challenges and to guide the development and implementation of VCCs. Using a standardized framework for optimization of VCCs may be useful because it promotes consistency, efficiency, and effectiveness in delivering such healthcare services, while also facilitating interoperability and scalability across hospitals. In prelude to develop such an implementation framework, insight in the current experiences of healthcare professionals of VCCs is needed. Therefore, the aim of this study was to explore nurses' perceptions and experiences of working in VCCs.

## Methods

### Study design

A qualitative study design was applied utilizing semi-structured individual interviews with nurses employed in VCCs in four teaching hospitals in the Netherlands. This study is reported in concordance with the Consolidated criteria for reporting qualitative research (COREQ) (Supplementary File 1) [20].

### Virtual care centres

The VCCs included in the study were centralized departments of teaching hospitals primarily focusing on utilizing care by 1) digital technologies to deliver medical services virtually and remotely and 2) Outpatient Parenteral Antimicrobial Therapy (OPAT) with no restriction to a certain care pathways. All departments were established during the COVID-19 pandemic (between period 2020–2022). They differed in size, number of patients receiving virtual care, number and types of care pathways included in the VCC, and number of nurses (registered nurses) working at a VCC (Table 1).

### Participant selection

The interviews were conducted with conveniently sampled registered nurses working at the VCC in the hospital. Inclusion criteria of nurses were primary employment at a VCC of the hospital, use information and communication technologies in their work, and able to speak and understand the Dutch language. There were

**Table 1** Characteristics of Virtual Care Centres of the four Dutch teaching hospitals

| Hospital | Hospital size, beds (n) | Care pathways in VCC (n) | Type of care pathways | Patients receiving virtual care (n) | Virtual care nurses employed (n) |
|---|---|---|---|---|---|
| A | 1206 | 12 | Outpatient, Inpatient | 146 | 5 |
| B | 724 | 9 | Outpatient, Inpatient | 60 | 9 |
| C | 1045 | 8 | Outpatient | 1575 | 5 |
| D | 1120 | 29 | Outpatient, Inpatient | 1600 | 8 |

no restrictions in working hours or years of work experience as virtual care nurse. Nurses were approached by e-mail and written informed consent was obtained from all nurses prior to participation, and digital individual interviews were scheduled.

### Data collection

The interview guide (Supplementary File 2) was developed by three researchers (AW, JL, AL) based on topics related to the Capability, Opportunity and Motivation of Behaviour (COM-B) model and the domains performance and effort expectancy, social influences and facilitating conditions of the Unified Theory of Acceptance and Use of Technology (UTAUT) model [21, 22].

According to the COM-B model, behaviour is part of an interacting system of the social and physical factors. For an individual VCC nurse to engage in a specific 'behaviour' (B), to successfully provide care through the VCC, there is a need for 'capability' (C) to do it, both psychological and physical. Psychological capability is the capability that involves a person's mental functioning. Physical capability refers to bodily functions, such as having the strength, stamina or dexterity needed to perform a behaviour. Furthermore, Opportunity refers to the external factors. Physical opportunity is the opportunity that involves inanimate parts of the environmental system and time (e.g. what the environment allows or facilitates in terms of time, triggers, resources, and integration in the hospital information system). Social opportunity involves other people and organisations (e.g. culture and social norms; the feeling of a shared responsibility). r. Finally, there must be sufficient strong 'motivation' (M) to influence our decision making and behaviours. Its two components are automatic- and reflective motivation. Automatic motivation involves habitual, instinctive, drive-related, and affective processes. Reflective motivation involves conscious thought processes. By translating the components of COM-B into the Behaviour Change Techniques (BCTs) of the Behaviour Change Wheel this enables forming a future framework of targeted implementation or optimisation strategies of virtual care pathways in VCCs.

Furthermore, questions were added about the applications utilized, the various care pathways involved and demographic data. The interview guide was pilot tested with one ward nurse. The interviewer (AW) was guided by the interview guide but was allowed to change the sequence of questions within the topics or to add questions for emerging topics. Different probing techniques such as remaining silent, echoing, and asking for elaboration were used to gain further insight into nurses' experiences working in a VCC [23].

The interviews were performed by AW with supervision of JL and AL, who both had prior experience with conducting interviews with healthcare professionals. Semi-structured interviews via Microsoft Teams were conducted with the nurses between February 2023 and July 2023. All interviews were audiovisual-recorded and transcribed verbatim using Amberscript (*Amberscript Global B.V., Amsterdam, the Netherlands*). Keynotes were used to record feelings and thoughts of the interviewer. Recruitment of VCC nurses continued until data saturation was reached.

### Data analysis

The interviews were analysed using thematic analysis using the qualitative data analysis software Atlas.ti (*Scientific Software Development, Berlin, Germany*). The transcripts were analysed using a six-stage thematic analysis as outlined by Braun and Clarke [24]. The stages include: (1) immersion; (2) generating initial codes; (3) searching for and identifying themes; (4) reviewing themes; (5) defining and naming themes; and (6) writing the report.

Stage 1 to 3 were conducted independently by two researchers (JL and YJ). During the first and second stage, JL and YJ became familiar with the data by listening to the audio recordings, checking the transcriptions against the audio recording, reading, listening sections again and re-reading the final transcripts. During the third stage, both researchers read the transcripts and codes for categorizing similar statements into first themes. For the fourth and fifth stages all authors independently were responsible for reviewing, defining and naming themes, which were discussed with the other authors. During

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the fifth stage, the themes were shown to the nurses for member checking, which did not result in any changes to the themes. In addition, the themes were mapped onto the components of the COM-B model by all researchers as this model might structure and prioritize these experiences to guide future optimisation and implementation [19].

## Results

All approached VCC nurses (*n* = 13) of four hospitals agreed to participate in the interviews with a mean duration of 36 min (Standard deviation: (SD) 9.5). All respondents were female with a mean age of 45 (SD: 8) years old, and a mean of 24 (SD: 10.3) years of work experience, of which 1.6 (SD: 0.6) years in the VCC. The analytical process resulted in six main themes and six subthemes (Table 2). All elements of the COM-B model were found across the themes.

### Theme 1: changing role of the nurse
#### *Patient-professional relationship*
Despite that care is provided mainly virtual in VCCs, nurses reported a good relationship with the patient. "*Well, I think it's very good, because at first I thought: It is virtual care, it's going to be a bit impersonal, but that's not at all, because you've just had very real contact with the patient, that you speak to them daily and also tell them more personal things. So, I think that we provide very warm care from a distance. So no, I didn't expect it to be experienced that way, even by the patients themselves.*" (Nurse #10). Nurses however also mentioned that their relationship with patients was changed: the nurse takes on a more guiding and coaching role, with more autonomy given to the patient. Nurses' perspectives varied regarding whether they missed physical contact with

patients. Some of them indicated that they missed the physical contact with patients whereas others said that the phone calls or video calls were a good substitute for the physical contact with patients. In addition, several nurses mentioned that they had more time to devote to patients. This was partly due to the high accessibility of virtual care through messages or telephone calls while on duty. Although this also motivated them, one nurse mentioned that this highly accessible nature may lead to a longer period of provided care and possible in non-valuable care being provided in relation to major patient outcomes. Therefore, they felt that clear and direct patient instructions were important to prevent non-valuable care delivery. One nurse said: "*You do have to be able to convince the patient that he or she is doing well. So for example, conclude that they are doing well based on the data, reduce the litres of oxygen and give instruction to adjust the oxygen supplementation downward. You really must have persuasion and empathy sometimes, combined with good listening to maintain effective care.*" (Nurse #10).

#### *Transformation of care*
All nurses indicated that, in addition to clinical care, they have an important role to play in transforming care. In doing so, they speak of a bridging role in a number of areas. Firstly, VCC nurses experience a different role in initiatives to develop a new digital care pathway together with colleagues. They jointly convert the ideas of the healthcare professionals into a protocol and practices, but also challenge other healthcare professionals to think innovatively about the design of their care pathway. "*Because there is simply a very big gap between an idea and the people who want to implement this idea, and how it can actually be implemented in the clinic. So, we have been deployed to act as a bridge in that regard.*" (Nurse

**Table 2** Themes and subthemes mapped onto the Capability Opportunity Motivation of Behaviour (COM-B) model

| Theme | Sub theme | Capability | Opportunity | Motivation |
|---|---|---|---|---|
| Changing role of the nurse | Patient-professional relationship | Psychological | Physical | |
| | Transformation of care | Psychological | | |
| | Communication skills | Psychological | | |
| | General skills | Psychological | | Automatic |
| Clinical perspective | The need of general knowledge of nursing | Psychological | | |
| | Use of data in the clinical perspective | Psychological | | |
| Education and training | | Psychological | Physical, Social | |
| Organisation of care | Development of care protocols | Psychological | Social | |
| | Technological preconditions | | Physical | |
| Cooperation with other healthcare professionals | | | Social | |
| Experienced impact of VCC | Impact on nurses | Psychological, Physical | | Automatic |
| | Impact on patients | | | Automatic, Reflective |
| | Impact on hospital | | Physical | Reflective |

#1). In addition, nurses also mentioned that they have a role to play in the acquisition for the expansion of new care pathways and in the external communication of this form of care. The work in a VCC is constantly changing, which requires nurses to be adaptable: *"Yes, so you have to like change, otherwise you're not in the right place."* (Nurse #11).

### Communication skills
Nurses indicated that their role has changed, with much more emphasis on coaching and mentoring. The patient has more control on and autonomy in their disease and contact with a VCC nurse is easy because of the accessibility. Nurses stated that motivational interviewing was important, as was being directive with the patient during counselling. In almost all interviews, it was stated that listening carefully and asking questions is essential in this way of providing care. Providing virtual care requires different communication skills compared to physical care, due to the lack of clinical observation. The following two quotes illustrate this: *"You have that clinical perspective over the phone. It is a completely different clinical view, not in terms of vision, but in terms of... you need to hear things. How does someone sound, what did someone do that day? What medication does someone take? So, you just have to listen carefully."* (Nurse #11) and *'(...) because you do not see the patient, so you have lost your clinical observation, you have to make use of other methods."* (Nurse #5).

### General skills
In addition to the previously mentioned aspects of their changing role, nurses mentioned the need for basic and generic skills such as effective communication skills and digital literacy, nurses highlighted several specific competencies that were crucial for success in the VCC. Nurses emphasised the importance of being resilient to stress, able to make quick decisions and able to adapt to dynamic situations. They emphasised that considerable determination, perseverance and motivation were required to cope with the innovative nature of the VCC. One nurse said: *"Yes, we have to make our own way and we are exceptionally self-motivated. We have all taught ourselves that, driven by passion and enthusiasm, we just make things happen."* (Nurse #1).

### Theme 2: clinical perspective
#### The need of general knowledge of nursing
Nurses indicate that general nursing knowledge is necessary for working in a VCC. This differs from what they were used to working in the clinic, in which specialized knowledge was of importance. Several nurses mentioned

the challenge of the need for general knowledge about diseases instead of having a specialization, in contrast to what is common in the hospital. Therefore, one VCC divided the care pathways to specialized nurses. Nurses indicated that this was desirable but not always possible due to capacity issues. Due to the rapid growth of VCCs, there is not always sufficient capacity to differentiate by patient group or specialization.

*"Perhaps we should start to differentiate, so that, for example, I only deal with patients, for example with a stroke or and my other colleagues, they only deal with lung disease because otherwise, yes, you would have more than ten care paths. That just doesn't work."* (Nurse #11).

### The use of data in the clinical perspective
Several VCC nurses mentioned that although more data is available about patients, it does not always capture a sufficient clinical assessment of the patient because it lacks the nurse's clinical perspective. For example, nurses may assess several symptomatic signs or contextual factors during their telephone calls, which are not captured in the data. Therefore, they felt that direct telephone contact with patients was often necessary in many care pathways to capture the clinical perspective beyond the data. In doing so, they argue that data is supportive to their clinical perspective. Furthermore, nurses indicate that the clinical perspective needs to be developed before nurses start working at the VCC. *"I think you do have to have several years of clinical experience before you can work here. Surely, you have to have the clinical perspective, have already experienced and seen a few things in different departments. You get all kinds of patients here, so you have to have some background."* (Nurse #8).

### Theme 3: education and training
All interviewed nurses mentioned the need for further education and training. For example, when starting a new care pathway, nurses must have sufficient knowledge regarding pathology and anatomy. Nurses indicated that learning from and with each other is important. According to them, there are sufficient opportunities for education, and it fits within their current work. *"Yes, we really make time and space for education, because we have to, otherwise we cannot do the monitoring."* (Nurse #9). However, the nurses also mentioned that they developed the training themselves based on their own defined needs and initiatives. Due to the rapid growth of VCCs, and with their increasing number of care pathways, much training is provided on care pathway content (e.g., anatomy and pathology). However, following training is not a structural part of VCC nurses' work. The need for education is intrinsically stimulated and often self- initiated

by VCC nurses. For example, when a new care path is drawn up nurses decide for themselves when training is necessary. *"You just have to be intrinsically committed to keeping up with knowledge. Yes, that you do have the knowledge and skills to properly help people* via *a phone call. And well, you can create an e-learning course or you can, for example, invite a specialist to give a clinical lesson, but you have to work on it independently, because no one says, you have to do this and that now, that just has to be done/initiated by yourself."* (Nurse #11).

> *We have a lack of knowledge in a particular area. Can a doctor come and explain or a nurse from the department? No, so we ask ourselves, we actually arrange our own training in this regard." (Nurse #10).*

Although most training was based on the implementation of new care pathways, VCC nurses recognized the need for more general educational topics such as technical skills in how to use certain data in their clinical perspective and motivational interviewing to facilitate patient compliance and self-management.

### Theme 4: organization of virtual care
#### Development of care protocols
All the nurses mentioned that developing clinical protocols of care pathways that are included in VCCs was an important part of their work. They felt that care protocols were essential for providing and maintaining quality of care for patients. They also felt that their role needed to be clearly defined when working with professionals both inside and outside the hospital, to avoid confusion over responsibilities. One nurse said about this: *"These protocols have to be clear and consistent of course. They simply state very clearly who does what and when and what is expected from the department, from the physician and which steps you have to follow. So, when there are deviations, then it should be very clear what you have to do and what you can accept or not. So that's nice, especially because we have a lot of care pathways, and these protocols vary a lot, so the protocols are really a guideline for our work."* (Nurse #10).

Nurses also mentioned the need to test and adapt the protocol in order to provide a clear and appropriate care protocol. They felt that the novel nature of virtual care underlined the need to test it extensively. Within these testing phases, it was important to obtain patient feedback to further optimise the protocol. In addition, the rapid evolving nature of the technology, resulted in more attention to keeping the protocol up to date according to the nurses. A nurse said: *'Yes, many programs are under development, so there are areas for improvement that emerge from the evaluations. And these can be areas for improvement in the app. But these can also be areas for improvement in the process, or quite broad actually.'* (Nurse #9).

#### Technological preconditions
Nurses mentioned a variety of technological requirements to provide virtual care through VCCs and experienced many challenges in their current work. These include working with different platforms, such as the electronic patient record and the telemonitoring platform. They noted limited data sharing, making double registration unavoidable. According to them, this also leads to an increased susceptibility to errors. They indicated that intuitiveness and usability are essential for both professionals and patients. This was reflected in the following quote:*"It's a shame, but understandable, that the technology is so far behind. You are dealing with patients' medical data, so it just has to be handled with extreme precision, so I know that very well. But as a result, it is very time consuming and frustrating for us sometimes. And each application does its own thing, each one is an island, but really you need to connect it all together."* (Nurse #1).

Regarding the hardware, nurses indicated that they not only played a role in determination of the accuracy of the measurements, but also in providing guidance to patients in execution of accurate measurements. For example, some patients only managed to conduct saturation level measurements with clear instructions from VCC nurses.

Regarding the handling and routing of notifications and messages, nurses also discussed the high incidence of notifications, which led to an increased sense of workload. They also mentioned that the increase in data availability could potentially lead to data overload, which may not improve the quality of care. They suggested that this could be improved by making alerts and messages more 'intelligent'. For example, by prioritising all alerts appropriately, automating certain response messages or directing the message or notification to the right healthcare professional such as a VCC nurse, consultant or medical secretary.

### Theme 5: cooperation with other healthcare professionals
Several nurses mentioned that collaboration with hospital colleagues was essential to their work. They pointed out that it took time to gain the trust of these involved colleagues when initiating new care pathways. The nurses felt that this was related to the difficulty of delegating their care to the relatively unknown VCC colleagues. They indicated that this difficulty contrasted with COVID-19, where there was a greater sense of urgency to organise care differently to ensure accessibility. However, nurses indicated that they believe this urgency is

a cultural change where a snowball effect is likely to be important for further acceptance of virtual care by colleagues in the hospital. Physicians and the hospital board were seen as important stakeholders in this issue. Physicians had a key role in the initiation and development of care pathways and the board in the promotion of the new hospital based VCCs. A nurse said about this: '*Some departments have enthusiastic physicians. And then you also see that such a care pathway is initiated easily and works more smoothly. And eventually other colleagues will also see great benefits from it. And then you get a sort of snowball effect, but you have to start somewhere.*' (Nurse #7).

### Theme 6: experienced impact of virtual care from VCCs

Several perceived effects, both beneficial and detrimental, of providing virtual care from VCCs were mentioned by nurses. Below they are divided into VCC nurses' experienced impact of virtual care through VCCs on nurses, patients and hospital.

#### *Impact on nurses*

The nurses identified several benefits of their work at a VCC. First, they found their work less physically demanding. This was especially important for nurses with a higher age. On the other hand, they said that it was also very physically demanding because they worked in a sedentary position behind a computer for most of the time, which led to physical complaints. Furthermore, the nurses indicated that the regular working hours were an advantage, because alternating shifts were usually seen as demanding and exhausting. Regarding the job contents, they also found the combination of patient care and project work for implementing a new care pathway attractive, because of the variety and innovative nature of the work. However, at times this combination resulted in increased work pressure because of the unpredictable nature and growth of the VCC. Another beneficial combination they mentioned was clinical work at a general ward next to the VCC. They also indicated that the VCC is a good place for the reintegration of nursing colleagues. Finally, they noticed that they experienced a high degree of autonomy and control. One quote of nurse illustrates this "*we are given a lot of freedom to decide where and when to provide virtual care and how to organise it.*"

#### *Impact on patients*

The nurses identified many potential benefits for patient care from their experience. They indicated that virtual care made it much easier for patients to connect with their nurse by telemonitoring and messaging. In this context, nurses also thought that this would reduce patients' travel time between home and hospital. They heard from patients that they felt safer at home because they were being monitored remotely by a healthcare professional, e.g., after a hospital admission. Nurses also felt that this type of care was safer for patients and that disease deterioration was detected more quickly. This was because both the nurses and the patients had more insight into their condition. In addition, nurses felt that patients were more empowered by being actively involved in their virtual care. In line with this, the role of informal carers also increased in importance. Nurses received feedback from patients that they preferred to be at home and that they might recover faster than in a hospital. Finally, nurses also reported that they felt there was more privacy for patients.

Negative aspects mentioned by nurses were that patients should be willing to receive virtual care instead of usual care, otherwise the implementation of virtual care as a potential new standard of care will be hindered by the lack of patients included. The potentially large role of the VCCs in the patient's illness was also raised by the nurses, who said that self-management should be encouraged, rather than the VCC nurses taking a large role when the patient could do it themselves. Another factor related to this process was the patient's compliance with their treatment. The VCC nurses thought that this compliance would decrease over time as the patient progressed in their recovery process and therefore felt less ill, or as the number of measurements taken by the patient increased. One nurse said: '*think it depends on the group, for example the heart failure patients. These patients are all quite compliant. I think these people really see the added value, but we also have other groups where quite a lot of them measure very poorly (…) In general, people do quite well, but as soon as they conduct fewer measurements, say once a week, you actually see that the patients' compliance is better. I think patients find that number of measurements sufficient.*' (Nurse #7).

Finally, some nurses mentioned that due to a decrease in physical contact with patients, they had less insight into the patient. In this regard, nurses said that the complexity of the treatment should determine the amount of direct patient contact by telephone for instance.

#### *Impact on the hospital*

Nurses identified a number of benefits for the organization, believing that it would free up capacity in the hospital by reducing the need for patients to attend outpatient clinics or by allowing them to be discharged earlier. They also indicated that it would increase the efficiency of their colleagues' work, as many patients could be cared for remotely at the same time. One nurse said: '*The advantage is mainly that less staff is needed, I can see many more patients than when I am at the inpatient clinic,*

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*because then I had six patients, and now I sometimes have thirty, who you can all do something for in a day. Fewer nurses are needed and there simply are not any. So, that is the biggest added value eventually, that you need less staff.* (Nurse #11). In addition, similar to patient benefits, nurses indicated that virtual care could prevent patients from traveling to the outpatient clinic and costs could also be reduced. However, they mentioned that up-front financial investments in purchasing, and implementation of technology used and human resources in VCCs is needed before the benefits might outweigh the costs.

## Discussion

This study found six themes of perceptions and experiences of nurses working in VCCs in the Dutch hospitals. By mapping these themes onto te COM-B model, the study findings can inform targeted implementation strategies to support further optimisation of virtual care delivery, implementation of new care pathways and improve the core competencies of nurses working in VCCs. In general, nurses perceive that their nursing role has changed when working in VCCs, particularly in terms of the patient-professional relationship and the use of data to support their clinical view of the patient. In addition, they indicate that they have an important role in the actual transformation of care through the organisation of new care pathways together with other healthcare professionals. Despite current organized training for nurses, there is still a need for dedicated education in providing virtual care. Finally, nurses indicate that they experience many benefits from their new role in VCCs, not only for themselves, but also for the patient and the organisation. Multiple components of the COM-B occurred within one theme, indicating the relationship between components as defined in the model.

### Capability

Of the six themes, five fell under the capability component of COM-B, indicating that work experiences are primarily based on physical capabilities. The emergence of VCCs has undeniably changed the role of nurses, requiring new or enhanced knowledge, skills and attitudes around care with a renewed focus on patient-centred care, care coordination, data analytics, and quality improvement in comparison to adjustments to traditional approaches [25]. First, there is a changing patient-professional relationship as delivering virtual care requires a different role for the VCC nurse, i.e., they are no longer physically close to the patient and contact is often relatively brief and via digital tools or telephone. Therefore, the mentioned communication skills of VCC nurses, such as specific questioning and coaching of patients while maintaining a supportive attitude, were

typical and in line with previous studies on nurses' competencies with telehealth [26]. Furthermore, the use of technology (e.g., a vital sign by remote monitoring) into their care delivery seem to have a direct impact on how VCC nurses assess patients and provides a ground for asking specific questions about symptoms in relation of the data generated by the technology. Besides, the technology generates a wealth of data that was previously unavailable. This increases the need for VCC nurses to not only be skilled in the understanding and use of technology (e.g., how the hardware functions or how to assess trend data in the software), but also to embrace data-driven approaches and effectively integrate information into their nursing practice, especially in the communication with the patients and clinical (shared) decision making [15, 26].

Another relevant finding is the role of VCC nurses as change agents in the transformation of care requiring physiological capabilities. We found that nurses felt they had a key role to play in the development and implementation of effective care protocols in VCCs. Besides establishing a protocol, this may require new knowledge and skills in the field of change and project management, especially given the fast-growing nature of VCCs and blended care pathways involving numerous stakeholders [27, 28], and the need for the innovative role mentioned by nurses. The role of the VCC nurse as a change manager in the transformation of care is extremely important given the facilitating role of the nurse in working with colleagues in the hospital [25, 29]. Moreover, a leadership role performed by nurses is key when new technologies are structurally part of the healthcare process and service delivery [18]. Therefore, nursing education programs should consider training of skills development in leadership, project and change management.

### Opportunity

The development and implementation of VCCs is complex due to variety of care and patient population (e.g., inpatient vs. outpatient care, postoperative vs. chronic diseases) and the utilization of often relatively novel technologies centralised in these centres. Therefore, clinical protocols play a crucial role in ensuring the physical opportunity for patient safety and promoting effective care within VCCs [28, 30]. VCC nurses indicated they played an important role to establish and update care protocols. However, there is a need to ensure that the use of protocols does not lead to situations where quality of care or patient safety is compromised. First, because the low-threshold contacts between nurses and patients by the virtual care from VCCs may result in an increase rather than a reduction or improvement in efficiency and effectivity by generating latent or unnecessary care needs

for patients [28]. It is therefore important to standardise the work in VCCs and the continuous evaluation of care, preferably derived from clinical guidelines. Another relevant aspect is that the technology used in VCCs is seen as an integral part of the protocol. Given the speed at which technology is evolving, VCC nurses can play a key role in translating the needs of end users to developers and IT officers in order to maximise the benefits and efficiency of technology used in VCCs [29, 31, 32]. In addition, the improvement of technology products such as the telemonitoring and patient record system used in VCCs, should therefore take place in close and early collaboration or even co-creation with the VCC nurses to meet technological preconditions [33].

Furthermore, another important finding within social opportunity is the collaboration of VCC nurses with other professionals in the hospital. Especially, strong managerial support and a shared organisational vision within the hospital is needed to foster a positive culture in which collaboration between VCC nurses and other healthcare professionals can flourish [34, 35]. This is particularly important given that the organisation of new care pathways in VCCs still seems to depend mainly on healthcare professionals who are proponents of virtual care and also willing to (partially) delegate this care to the VCC.

### Motivation

The results indicate that nurses in VCCs are enthusiastic about their work in these departments and show creativity and an innovative nature, as they highlighted themselves. This enthusiasm and innovative seem to be influenced by the dynamic environment of the VCCs and their involvement with various digital health technologies utilized in their roles. These findings are consistent with previous research showing that nurses are motivated because they are able to provide high quality care and have a positive impact on the health and well-being of patients [36, 37]. Besides, being highly motivated by the direct impact they have on the patients they serve, development of novel care pathways, working with technology and the autonomy seem to be reflective motivators for nurses. The degree of autonomy in the conduct and the organisation of their work in the VCC may contribute to higher job satisfaction [38]. In contrast to the perspectives of VCC nurses, previous studies found that other tasks beside patient care and use of and affinity with technology may have a negative effect on motivation and satisfaction [37, 39–41]. This contrast may be related to the creative and innovative nature mentioned by the VCC nurses.

In addition, working as a nurse in VCCs may be one of the solutions to the challenges of increasing demand for care and staff shortages in the healthcare sector, by retaining qualified staff and reducing nurse burnout [42]. In our study nurses reported that their work was less physically demanding and involved less irregular working hours (physical capability), which may contribute to a better work-life balance and less burnout. In addition, the combination of working in a physical less demanding VCC with working on the general ward could increase job satisfaction and reduce the attrition of nurses from the profession but should be further investigated [43].

Several VCC nurses mentioned the impact of their work at the hospital level, such as increasing the bed capacity in the hospital as patients are referred to home earlier to receive virtual care. This might help to overcome the challenges of the current healthcare system (e.g. increasing care demand by ageing population). These results suggest a high level of reflective motivation and awareness among nurses of the wider potential impact of VCC care at meso-level. According to a previous review, this awareness may be beneficial for nurses' job satisfaction [38].

### Strengths and limitations

Strengths of this study were the rich insight in perspectives of nurses working in VCCs by our multicentre approach. In addition, our systematic approach using the COM-B model provides a complete overview of the core components of nurse behaviour in VCCs, enabling targeted implementation strategies. By translating the components of COM-B into the Behaviour Change Techniques (BCTs) of the Behaviour Change Wheel during the implementation of virtual care pathways in VCCs, techniques such as shaping knowledge about virtual care, providing sufficient social support from key stakeholders, and rewarding new care pathways initiated with the VCC can be applied.

A limitation of this study was that although several VCCs were included, we did not focus on the distribution of the types of care provided, for example telemonitoring and OPAT care pathways or outpatient and inpatient care. This may have influenced the nurses' perspective of working in a VCC as these care pathways may require other tasks and roles (e.g., in guidance and support of these patients). Second, only female nurses were included in the study, whereas it has been demonstrated that gender could influence performance expectancy, effort expectancy and social influence [22]. However, a previous study did not show a significant difference in technology acceptance between gender [44, 45]. Third, the (expected) impact of care through VCCs on nurses, patients and hospitals was derived from the perspective

of the nurse only. Currently, predominantly nurses are employed within the VCCs in the Netherlands. Nevertheless, in further research it would be of interest to elicit experiences of other stakeholders involved in VCCs, such as physicians, managers or policy advisors. Fourth, although the COM-B model considers the contextual and motivational factors of VCC nurses, framing the themes to the COM-B model may have limited the interpretation of the results.

## Implications

This study contributes to insights into nurses' perceptions and experiences of their work in VCCs, which offer valuable insights for hospitals aiming to optimise their VCC by addressing the experienced barriers and properly supporting or enhancing the positive experiences. By using the COM-B model, we gained insight into elements which are essential for nurses working in VCCs. Understanding current nursing work in terms of their changing role in delivering patient care as the transformation of care, provides insight in the selection of implementation interventions to enhance their role. These interventions may include educational programs and training initiatives in the field of technological skills, communication, change management and leadership. It is essential that these educational efforts are supported by well-designed didactic methods and expert guidance rather than developed by the VCC nurses themselves. In addition, environmental adaptations such as optimising the technological environment (hard- and software) and enhancing the role model role of VCC nurses to other healthcare professionals might increase the uptake of VCC care by hospitals [19]. Furthermore, it is worth noting that our study involved a select group of healthcare professionals. Therefore, further research is needed with a representation from all involved healthcare and managerial professionals, as well as patients. Besides, contextual factors such as the types of care delivered, the volume of patients and used technologies should be considered for better understanding the implementation challenges and successes of VCCs [46].

## Conclusions

The evolution of VCCs requires adaptations in nursing competencies, particularly in communication, technology integration and data-driven approaches, highlighting the need for continuous education and skills development. In addition, the complex landscape and evolving nature of VCCs underscores the importance of robust care protocols and seamless technology integration, requiring collaboration between nurses and other healthcare professionals. Despite the challenges, the study revealed that highly motivated and innovative nurses are attracted to VCCs, driven by the direct impact on patient care and their role in organisational processes, suggesting potential solutions to staffing challenges and nurse burnout. In conclusion, this study provides valuable insights into the perceptions and experiences of nurses in VCCs in the Netherlands, with implications for optimising VCCs and implementing new care pathways. Taken together, these findings provide a basis for tailored interventions and policies, guided by the COM-B model, to improve nursing practice and optimise care delivery in VCCs.

## Abbreviations

BCT     Behaviour Change Techniques
COM-B   Capability Opportunity Motivation – Behaviour
SD      Standard deviation
UTAUT   Unified Theory of Acceptance and Use of Technology
VCC     Virtual care centre

## Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s44247-024-00127-3.

Supplementary Material 1.

Supplementary Material 2.

## Availability of data and materials
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

## Declarations

### Ethics approval and consent to participate
The Medical Ethics Committee of the Isala Hospital reviewed the protocol (protocol nr. 20230321) and declared that the Medical Research Involving Human Subjects Act did not apply for this study. This study was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants in the study.

### Consent for publication
Not applicable.

### Competing interests
The authors declare no competing interests.

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