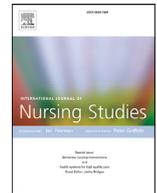




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Exploring infection prevention practices in home-based nursing care: A qualitative observational study



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ABSTRACT

Background: Home-based nursing care continues to expand, delivering care to increasingly older clients with multiple, chronic and complex conditions that require the use of additional and more numerous invasive medical devices. Therefore, the prevention of infections poses a challenge for nurses, professional caregivers and clients.

Objective: This article explores infection prevention practices and related behavioural factors in both nurses and clients to identify barriers and facilitators of infection prevention practices in home-based nursing care.

Design: A qualitative, exploratory design.

Setting: Four healthcare organisations providing home-based nursing care in the Netherlands.

Methods: Participant observations were used as the main source of data collection complemented with focus group discussions and semi-structured interviews.

Participants: Participant observations: 16 nurses, three professional caregivers and 80 clients.

Semi-structured interviews: 11 clients.

Focus group discussions: 15 nurses and four professional caregivers.

Results: A total of 87 unique care delivery situations were observed for 55 h, complemented with three focus group discussions and 11 individual semi-structured client interviews. Infection prevention practices in home-based nursing care appeared to be challenged by 1. The specific context or environment in which the care occurred, which is more autonomous, less structured, less controlled and less predictable than other care settings; 2. Suboptimal and considerable variation in professional performance concerning the application of hand hygiene and the proper use of personal protective equipment such as face masks, barrier gowns and disposable gloves; 3. Extensive use in and outside the client's surroundings of communication devices that are irregularly cleaned and tend to interrupt nursing procedures; and 4. Inadequate organisational support in the implementation and evaluation of new information or policy changes and fragmentation, variation and conflicting information regarding professional guidelines and protocols.

Conclusions: From a first-hand observational viewpoint, this study showed that the daily practice of infection prevention in home-based nursing care appears to be suboptimal. Furthermore, this research revealed considerable variation in the work environment, the application of hand hygiene, the proper use of personal protective equipment, the handling of communication devices and organisational policies, procedures and support. Finally, the study identified a number of important barriers and facilitators of infection prevention practices in the work environment, professional and team performance, clients and organisations.

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What is already known

- Home-based nursing care continues to expand delivering care to increasingly older clients with multiple, chronic and complex conditions that require the use of more numerous and invasive medical devices.
- Little is known about infection prevention precautions in home-based nursing care, their determinants – barriers and facilitators – or related professional behaviours.
- Studies that have been conducted on this subject have mostly consisted of self-reported questionnaires and may not accurately reflect current practice.

What this paper adds

- A detailed description of the application of basic infection prevention practices in home-based nursing care.
- The identification of a number of important barriers and facilitators of infection prevention practices in home-based nursing care.
- A starting point for the development of a theory- and evidence-based implementation strategy to improve the application of basic infection prevention practices in home-based nursing care.

1. Background

Worldwide, home-based nursing care continues to expand rapidly ([WHO Study Group on Home-Based Long-Term Care, 2000](#)). The increased demand for home-based nursing care has been largely driven by a combination of demographic shifts; changes in social attitudes, values and expectations; changes in epidemiology, scientific and technological progress; and political choices ([Tarricone and Tsouros, 2008](#); [World Health Organization, 2015](#)). Additionally, a similar trend has been seen in the Netherlands, where the need for such care has increased due to a number of factors. These include an ageing population with increasingly frequent, more chronic diseases; a societal attitude toward more personalised care; medical and nonmedical technological improvements; new (home) treatment options; and policy choices aiming to shift institutionalised care toward the home environment ([Dubois et al., 2005](#); [Sharma et al., 2015](#); [Stuurgroep Kwaliteitskader Wijkverpleging, 2018](#); [Veldheer et al., 2012](#); [World Health Organization, 2015](#)). In 2018, approximately 589,000 clients received home-based nursing care in the Netherlands, a steady increase from 512,000 clients in 2015 and 557,000 in 2017 ([Centraal Bureau Statistiek; Vektis Intelligence, 2020](#); [Vektis Intelligence, 2018](#)). These clients have received home-based nursing care from close to 5000 home-based nursing care providers, costing a total of 3.4 billion euros ([Centraal Bureau Statistiek; Vektis Intelligence, 2018](#)).

The increasing number of clients with complex conditions and the increased use of invasive medical devices place these clients at high risk for infections ([Jarvis, 2001](#); [Keller et al., 2018](#); [Miliari et al., 2015](#); [Shang et al., 2015](#); [Shang et al., 2014](#); [Stuurgroep Kwaliteitskader Wijkverpleging, 2018](#)). Therefore, the prevention of infections poses a special challenge in home-based nursing care ([Markkanen et al., 2007](#); [Shang et al., 2018](#)). Literature on the prevalence of infections acquired from this type of care is limited, but a small number of studies have been conducted. For example, a 2012 French study reported that more than a third (35.5%) of all active healthcare-associated infections were associated with home care ([Miliari et al., 2015](#)). Elsewhere, a systematic review including 25 studies reported that 4.5–11.5% of home healthcare clients had at least one episode of infection during their exposure to home healthcare ([Shang et al., 2014](#)). Most of these studies are now between 10 and 20 years old and were mainly

conducted in the United States and Canada. Both studies reported considerable variation in infection rates between different health-care organisations, probably due to differences in infection control policies and a lack of infection control professionals ([Keller et al., 2018](#); [Shang et al., 2018](#)).

In the Netherlands, registered nurses and professional caregivers work together in a team and therefore have a shared responsibility to ensure that, for example, protocols, guidelines and the code of conduct are followed to ensure professional and safe home-based nursing care ([Rosendal, 2019](#)). The Dutch Health Inspectorate is the organisation that monitors compliance with legal and field standards such as the Home Care Quality Framework ([Inspectie Gezondheidszorg en Jeugd, 2019](#)). In cases of gross negligence they have the authority to launch investigations and file complaints at the disciplinary court, however, the primary focus of the Health Inspectorate and the Home Care Quality Framework is on learning and improvement ([Stuurgroep Kwaliteitskader Wijkverpleging, 2018](#)). At the same time registered nurses and professional caregivers often deliver nursing care alone which makes it difficult to assess individual nursing interventions and have them corrected by colleagues if necessary. Where surveillance methods for monitoring infections in hospitals and long-term care facilities are routinely used in the Netherlands, these methods are lacking in home-based nursing care ([Rijksinstituut voor Volksgezondheid en Milieu, 2021](#)). In summary, infections in home-based nursing care are hardly detected and there is little insight in whether and how infection prevention regulations are followed in practice.

Nevertheless, infections arising from home-based nursing care create a heavy burden for clients and may impede recovery or rehabilitation. Infections are frequently underdiagnosed and left untreated can lead to sepsis and become life-threatening. A substantial percentage of clients with a respiratory, urinary tract, wound or an intravenous catheter related infection need emergency care, often causing unplanned hospital admission and increased costs ([Russell et al., 2018](#); [Shang et al., 2015](#); [World Health Organization, 2017](#)). To mitigate these consequences, two recent studies have focused on identifying clients that are at high risk of infection and predicting the risk of hospitalisation to inform infection control interventions ([Dowding et al., 2020](#); [Shang et al., 2020](#)). However, for clients at high risk of infection and in light of the emergence of novel infectious diseases such as SARS-CoV-2, appropriate infection prevention and control measures remain crucial in preventing home-based nursing care associated infections ([Rhinehart, 2001](#); [Shang et al., 2018](#)).

While the growing demand for evidence-based resources are recognized both in national and international literature ([Bleijenberg et al., 2018](#); [Jarrín et al., 2019](#)) little is known about infection prevention precautions in home-based nursing care, including determinants – barriers and facilitators – and related professional behaviours ([Adams et al., 2020](#); [Rhinehart, 2001](#)). Two studies observed and measured hand hygiene compliance in daily home-based nursing care practice based on the World Health Organisation's 'Five Moments for Hand Hygiene' ([Sax et al., 2009](#)). One of these reports, a 2012 Australian study, reported an average hand hygiene adherence rate of 59.2%, but it was limited by a small sample size ([Felembam et al., 2012](#)). Next, a recent and more rigorous American study observed an average hand hygiene adherence rate of 45.6%, which is comparable to hospital settings ([McDonald et al., 2021](#)). Other studies examining infection prevention practices in home-based nursing care have consisted mostly of self-reported questionnaires and may not accurately reflect current practice ([Adams et al., 2020](#); [Gershon et al., 2009](#); [Russell et al., 2018](#)). Furthermore, the operational activities of the 'Taskforce Infection Prevention' – responsible for developing and revising infection prevention guidelines in the Netherlands – have been discontinued by government defunding, leaving behind guidelines

Table 1
Care delivery during participant observations (number of times observed).

Nursing procedure (related to)	Organisation 1	Organisation 2	Organisation 3	Clients who perform procedures themselves
Intravenous total parenteral nutrition	7	3	1	4
Intravenous antibiotics/chemotherapy/diuretics/liquids	7	10	5	
Wound care	2	3		
Drain (wound or biliary)	2	1		
Injection (subcutaneous or intramuscular)	3	5		
Peritoneal dialysis (cyclic or ambulatory)		2	6	
Urinary Tract Catheter		1		
Non-invasive ventilator support		1		
Eye drops (administering)		5	2	
Activities of Daily Living (washing, dressing)	3	15	8	

whose revision dates have lapsed by as much as 10 years (Rijksinstituut voor Volksgezondheid en Milieu, 2017; Rijksinstituut voor Volksgezondheid en Milieu, 2019).

Therefore, this study aims to explore infection prevention practices and related behavioural factors in both nurses and clients to identify barriers to and facilitators of infection prevention practices in home-based nursing care.

2. Methods

2.1. Research design

The study used a qualitative, exploratory approach, including participant observations, focus group discussions and semi-structured interviews. The qualitative design allowed the researchers to gather rich, detailed and comprehensive observations and descriptions. Additionally, the research team gained an in-depth understanding of infection prevention practices, procedures and their determinants amongst both nurses and clients in home-based nursing care in the Netherlands.

2.2. Population and sampling

Four healthcare organisations providing home-based nursing care in the eastern part of the Netherlands were purposively selected to participate in the study for the participant observations (Organisations 1, 2 and 3) and focus group discussions (Organisations 2, 3 and 4). Each of these healthcare organisations has 2300–6000 employees providing home-based nursing care to 14,000–30,000 clients each in both urban and rural environments. The recruitment of clients who manage their own treatment was conducted by an additional organisation: the Radboudumc centre for Home Parenteral Nutrition Treatment. This organisation provides medical care for more than 200 clients on long-term (longer than three months) home parenteral nutrition.

Three groups of participants were included: 1. Home healthcare nurses who provide highly complex (technical) procedures; 2. Home healthcare nurses and professional caregivers who provide daily, low-complex care; and 3. Clients who manage home parenteral nutrition without the support of home healthcare i.e. clients performing highly complex procedures themselves. Within these groups, individual clients and nurses were both purposively and conveniently recruited. Recruitment stopped when data saturation was reached, meaning that no new codes or information emerged from the data (Saunders et al., 2018).

2.3. Data collection

To allow a first-hand experience (Verschuren, 2017) of the behaviours, events, activities and interactions in the home environment (Twycross and Shorten, 2016) participant observations were

used as the main source of data collection. All of the participant observations were carried out by a researcher (BW) with experience as both a Level 6 home healthcare nurse and a health scientist. Prior to the start of the fieldwork, the researcher was trained in qualitative research methods and was trained on performing participant observations. Subsequently, a comprehensive observation list was developed based on standard infection prevention practices derived from literature and expert advice. The aim was to provide a list enabling the observer to explore infection prevention practices in a broad, open context without quantitatively measuring compliance or focusing on one specific infection prevention precaution. This allowed for the inclusion of spontaneous and unforeseen circumstances. A multidisciplinary panel consisted of home healthcare nurses, infection prevention specialists, nursing scientists, policymakers in home healthcare and a client receiving home-based nursing care. This group discussed the concept observation list and agreed on the outcome of the definitive list on the basis of consensus. Next, the observation list was piloted in two observation sessions, resulting in minor layout changes (Appendix A). In the final data collection, a total of 87 unique care delivery situations (Table 1) – including 12 Level 6 nurses, four Level 4 nurses, four Level 3 professional caregivers and 80 clients – were observed for 55 h. Additionally, Table 2 displays a more detailed description of the educational level and professional status of care professionals in The Netherlands. The data collection took place from January to September 2019.

At the beginning of each observation session, time was taken to create a bond of trust between the participating nurse and client. Having experience as a home healthcare nurse himself, the researcher was quickly viewed as being an ‘insider’. All participants were aware of the purpose of the observations. The researcher was only present as a direct observer and did not take part in any nursing activities Spradley (1980). Notes were taken based on the observation list, producing jottings. These jottings were then typed out on the day the observations took place, producing digital field notes. Additionally, a fieldwork journal was kept to record interactions (date and time), conversations or any other possible relevant observations not specifically described in the observation guide as well as evidence or suspicions of bias such as selection bias or the Hawthorne effect (Hagel et al., 2015).

When time allowed during the observation sessions, 11 clients were asked a number of open-ended questions (Appendix C) relating to their own experiences with infection prevention practices, both with nurses performing procedures as well as any practices related to the clients themselves. These interviews were not audio-recorded, but the answers were written down in conjunction with the observations.

Next, three focus group discussions were organised to explore behavioural factors that could influence infection prevention practices of home healthcare nurses. A topic guide (Appendix B) was

Table 2
Educational and professional status of care professionals in The Netherlands.

Profession	Educational level*	General task description
Registered Nurse (Bachelor's degree)	Level 6	High complex nursing and care – responsible for quality of care and team expertise – coaching colleagues – coordination of care – indication of care
Registered Nurse (Vocationally trained)	Level 4	(Complex) nursing and care – coordination on patient level
Professional caregiver	Level 3	Low complex nursing, care and support – care plan
Professional caregiver	Level 2	Care and support

Note: According to Dutch Qualification Framework (NCP NLQF, 2019)*.

developed using seven domains synthesised by Flottorp et al. to identify potential barriers to and facilitators of infection prevention practices (Flottorp et al., 2013). Two focus group discussions had six participants and one had five participants totalling 11 Level 6 nurses, two Level 4 nurses and four Level 3 professional caregivers. The focus group discussions were held in meeting rooms belonging to the included healthcare organisations and were close to where the participants worked. The focus group discussions were led by an experienced moderator, ensuring that all relevant topics were discussed, were audio recorded and transcribed and lasted between 79 and 88 min.

2.4. Data analysis

Analysis of the data spanned multiple analytical steps Boeije (2009). Both an inductive, data-driven analysis and a deductive, theory-driven analysis was conducted while the data collection continued (Braun and Clarke, 2006; Van Staa and Evers, 2010). Two groups (ABJ and BW, JvH and GH) containing both researchers and research assistants coded all the field notes and transcripts independently using open coding. These codes were then discussed extensively to explore similarities and differences between and within the groups to ensure consistency, obtain intercoder agreement and monitor data saturation (Creswell and Poth, 2016). When consensus was not reached between the two groups, a third member of the research group (AH) was consulted to make the final decision. Subsequently, all of the codes were clustered into sub-themes. The latter were then summarised in a matrix into broader themes and discussed amongst all of the researchers and the same multidisciplinary panel from the observation list to improve trustworthiness (Holloway and Galvin, 2016). All coding took place with the help of ATLAS.ti version 8.4.20 Friese (2019).

2.5. Ethical considerations

The research ethics committee of the Radboud University Medical centre concluded that ethical approval was not required under Dutch law (CMO no. 2015–2261). However, prior to inclusion in the study, all included participants signed a form stating that they were informed both in writing as well as verbally; of the purpose of the study, that participation was voluntary, that confidentiality and anonymity of recordings, transcripts and observations were assured and that participants had the right to withdraw from the study at any given time without disclosure of a reason.

3. Results

From the observations, interviews, focus group discussions and field notes, four key themes were identified regarding infection prevention practices and related behavioural factors focused specifically on home-based nursing care: 1. Work environment; 2. Hand hygiene and personal protective equipment; 3. Communication devices; and 4. Organisational policies, procedures and support. To illustrate each (sub)theme quotes are provided both in-text as well

as in Supplementary Tables 1–4. Corresponding results and quotes in the supplementary tables are referred to with a '[TxQx]'-type reference.

3.1. Work environment

3.1.1. The home-based nursing care environment

Nurses travel from one house, room or apartment to the next to deliver home-based nursing care. The nursing care environment varied from impeccably clean and tidy – without visible dirt, dust or damaged interiors – to dilapidated and contaminated households. The latter were littered with putrid waste, sticky floors, damaged interiors and inadequate lighting and lacked fresh air or adequate space for movement. Some of these observations are described below:

The house looks very punctual, neat, orderly and well maintained. No lingering objects or visible dirt or dust to be seen. [...] The house is spacious and accessible. In the bedroom where the wound care takes place, there is plenty of light complemented by directional spotlights in the ceiling. [Observation] [...] the house in general is: old, messy, dirty and full. It smells of stale urine and wet dog. [...] The bedroom is an old hobby room of approximately 20 m². In the room there is a single bed (not adjustable in height), five chairs, a table, a filing cabinet, a freezer, a linen closet, a display case, a bedside table and a gas stove. All five chairs are in use because they are hung with clothes, towels and bedding or because there is a tray with a saucer and a small cow bell on it. The walls are covered with paintings and picture frames, a wall lamp without hood and a red plastic jug. Uncovered areas are stained brown-yellow, [and] in several places the wallpaper curls, and in the corners of the room, cobwebs can be seen in the light. [...] All horizontal surfaces are covered with a towel or carpet, on which all kinds of things are placed: glass vases, works of art, religious statues, candles, porcelain ashtrays (empty), a card game, cans with unknown contents, bottles of soap and shampoo, cardboard boxes with magazines, bookends, a sewing machine, a teapot, ski poles and continence material for women. Stains can be discovered on several of the towels and carpets. The windows in the bedroom are closed, and there are no ventilation grills in the room. [Observation]

Besides the client and nurse, other people, animals or both could be present during the delivery of care, varying from none to many; for example, healthcare staff, relatives, acquaintances, children, domestic help, pets, farm animals and pests [T1Q3]. In this study, nurses indicated that they adapted their behaviour to circumstances, for example, before entering a contaminated household, these nurses felt an increased awareness regarding infection prevention. Additionally, equipment and materials are left behind, and these households are often planned at the 'end' of a nurse's schedule [T1Q4], possibly to limit the transmission of microorganisms from one household to the next.

3.1.2. Workspace and work conditions

Before initiating a procedure, a nurse, caregiver or client would create a clean workspace using various materials, predominantly including the surface of a table but also other plastic surfaces or cotton towels [T1Q5]. The workspace was cleaned irregularly before use [T1Q6]. When the surface was cleaned with an alcohol-based disinfectant, it was regularly visibly wet when materials were placed on it [T1Q7]. Sometimes communication devices or workwear touched the clean workspace [T1Q8]. In some cases, there was not enough of a free flat surface to create a clean workspace [T1Q9], as in the following description:

During the delivery of care, there is no "clean working area" to be identified. Except for a small corner on which items are prepared, the table is packed with stacks of magazines, a cardboard box with a stockpile of materials, two large format fake leather wallets and a keyring. [Observation]

Cluttered and contaminated households presented nurses with a dilemma. Nurses indicated that they could not refuse to provide care because clients have a 'right to receive healthcare', but at the same time there is a need for guidance on how to address contaminated households to minimise the spread of infectious microorganisms as the following quotes demonstrate:

You have a duty of care, [...] but to what extent[...]? [Focus group]
It's a very large grey area right now, and I think as caregivers we're going pretty far. We don't scare easily. [...] But where are the limits? [Focus group]

3.1.3. Workwear

Considerable differences were found in clothing worn while providing care, from casual, day-to-day clothing to uniforms [T1Q11]. Sometimes a uniform jacket was present in the car with a nurse but not worn during the delivery of care. Additionally, it was often up to nursing staff to clean their own workwear [T1Q12], but casual clothing is not cleaned at the recommended temperature, as nurses find this temperature would damage their clothing [T1Q13]. Lastly, nurses pay little or no attention to the bags they carry to and from different households.

And whatever you just brought up, huh? How dirty is your bag?
I have never thought about that. I just put my food in it. [Focus group]

3.1.4. Storage and quality control of materials

In this study, all materials, tools and equipment needed for home-based nursing care were stored in various ways, sorted in plastic or cardboard boxes with or without a closable lid or loose in plastic or paper bags. These boxes or bags were kept on tables, chairs, the floor or under a bed. In some cases, a cupboard, dresser or desk was used to store materials using different drawers for different materials. In a few cases, there was no obvious place to store materials [T1Q15].

Before use, materials were often checked for flaws, broken packaging or use-by dates by the person responsible for the procedure [T1Q16]. Both the use of safety needles and regular needles were observed [T1Q17]. On occasion not all materials needed for a procedure were present, as in the following explanation:

There's a shortage of 10 ml syringes and adhesive bandages in the plastic container. [Observation]

Numerous materials were dependant on a third party to deliver to the home environment such as a medical supplies wholesaler, a pharmacy or drugstore [T1Q19].

3.1.5. Gloves for putting on compression stockings

Gloves used to put on compression stockings were regularly not cleaned before or after use, and when they were cleaned, in most cases hand disinfectants were inappropriately used.

Next to the basket are green rubber studded [brand name] gloves. The nurse herself also carries the same green rubber gloves: the gloves are folded together, and the name of the nurse is written on the inside with a ballpoint pen. No hand hygiene is applied before or after use of the gloves, nor are the gloves themselves cleaned. [Observation]

In some instances, these gloves stay behind in the house of the client to be used by different nurses [T2Q21], but on other occasions nurses take the gloves with them and use the same gloves to help multiple clients [T2Q22].

3.1.6. Handling waste

Sharps containers were widely available and accessible where needles or sharps were used [T1Q23]. In some cases, sharps containers were full or filled above the 'do not exceed' line or handled inappropriately [T1Q24], as demonstrated by the following quote:

Sticking out of the needle container are plastic blister bags that had medication in them. Before the needles can be thrown away, they must first be removed. The client says: "I'll just empty it". The nurse asks: "How will you do that?" The client responds: "I'll just chuck it in the bin". [Observation]

Used materials and waste were regularly separated (paper, plastic or other), sorted and placed in a small bin bag. However, some used materials and waste were also found scattered across various surfaces [T1Q25] for the client or someone else to throw away [T1Q26]. Additionally, food waste was observed in a few instances [T1Q27]. On occasion, contaminated waste from a nursing procedure came into contact with other persons such as toddlers and spouses [T1Q28], as described in the following example:

[...] the toddler sees an opportunity to take the used 'non-return valve' from the table and put it in her mouth. The mother responds to this and says that the toddler has to spit out what she took and she did. [Observation]

3.2. Hand hygiene and personal protective equipment

3.2.1. Hand hygiene

Two forms of hand hygiene were observed, one using an alcohol-based disinfectant and another washing at a washing stand or kitchen sink (with or without soap). Nurses, professional caregivers and clients then dried their hands in various ways, such as using paper tissues, cotton towels or the sides of their uniforms [T2Q1]. Alcohol-based disinfectants and washing stands were generally available and accessible [T2Q2]. However, nurses indicated that they had reservations regarding whether the World Health Organisation's recommended 'Five Moments for Hand Hygiene' 'fit' the home-based nursing care environment [T2Q3], as reflected by the following quote:

Is it really necessary for us to do this hand hygiene – even within the client's house – or is it unnecessary in the home environment? Because that is all based on research done in the hospital. Look, there, I get it. [Focus group]

Although many nurses stated that they performed hand hygiene in accordance with the WHO's 'Five Moments of Hand Hygiene' [T2Q4], the observations revealed that hand hygiene was varying, inconsistent and irregular [T2Q5] as the following observations describe:

Neither before nor after the using the rubber gloves [was] hand hygiene [...] performed. [Observation]
Before flushing the PICC-line, no hand hygiene was observed. [Observation]

Clients who performed nursing procedures themselves showed a greater awareness in relation to hand hygiene - possibly due to extensive in-hospital training - resulting in a tendency to overperform hand hygiene as the following quote shows:

After handwashing with water and soap and before preparing the IV-system hand hygiene is performed with chlorhexidine 0,5%/ethanol 70%. [Observation]

3.2.2. Personal protective equipment

As in materials for nursing procedures, personal protective equipment must also be brought or delivered to the home environment, by either the nurse or a third-party supplier. Additionally, on occasion nurses lacked the right materials for in-home care, such as disinfectants, gloves and aprons [T2Q6]:

No gloves [were] observed in the house. [Observation]
We're out of aprons, we just [...] We just walk like this [without aprons]. [Focus group]

Sometimes single-use disposable materials - gloves, surgical masks, aprons and overshoes - were used incorrectly or irregularly, were re-used or were 'cleaned' with hand disinfectants [T2Q7].

During [...] care, "hand hygiene" was applied to the non-sterile gloves with [brand name] from a 100 ml container. The gloves are not yet dry when the nurse continues to work. [Observation]

3.3. Communication devices

A variety of electronic communication devices were used before, during and after the delivery of home-based nursing care. The most frequently used devices were (smart)phones and computer tablets, and these were often used simultaneously. Additionally, devices were constantly being carried around [T3Q1] for consulting electronic health records or to examine nurses' schedules.

The tablet is carried between two clients under the nurse's arm. Upon entry, the tablet is placed on the countertop. At the end of the delivery of care, the tablet is again put under the arm on the way out [of the home]. [Observation]

Additionally, devices were used for calling, sending messages and as navigation aids to and from clients. On occasion devices were not exposed to the clients' surroundings on purpose, for example, when it was known that a client was contaminated with a multidrug-resistant organism [T3Q2]. Generally, in offices or in the nurses' cars, cleaning or disinfecting wipes were available [T3Q3], but the nurses doubted the right ways (method and materials) and times to clean [T3Q4] as the following quote illustrates:

There isn't actually any kind of guideline which tells you, "This exists, and you can order that. And you use this in that situation, and you use that [...]" That just doesn't exist. [Focus group]

Thus, these wipes were used in only a few instances.

In addition to being physically present during the delivery of care, communication devices also tend to be distracting because they can interrupt nursing procedures. The latter is especially true because nurses feel pressure to answer the phone in case the call involves peer consultations or possible difficulties [T3Q5] as shown by the following excerpt:

Especially if that phone is red-hot. [...] Sometimes you're doing twenty things at once. In the meantime, your schedule goes on, so yes, then it often goes wrong [...], like forgetting to put on gloves preparing an antibiotic. [Focus group]

3.4. Organisational policies, procedures and support

3.4.1. Guidelines

For nursing procedures and the use of tools and equipment, guidelines and protocols were used. Nurses often had to sign hard-copy 'action lists' when performing various procedures [T4Q1]. Nurses, professional caregivers and clients found that different protocols were given by different institutions, hospitals and colleagues, resulting in fragmentation, variation, discrepancies or conflicting information [T4Q2]. Furthermore, these nurses, caregivers and clients recognised differences between home-based nursing care teams in dealing with certain situations, guidelines and protocols, and clients also confronted nurses when they experienced care variations [T4Q3] as the following quote will demonstrate:

Yes, and also in terms of hygiene, hospitals, we notice that they [...] sometimes use very different protocols. [...] That some protocols are just very different from the [name of organisation] protocol. [...] There's really quite a difference between that and that, yes, if a client is sometimes focused on that, it can sometimes cause quite a bit of friction [...]. [Focus group]

At times, these nurses and professional caregivers doubted the accuracy of the information they received:

And [...] those protocols don't [seem to] fit well in home-based nursing either. Those are all questions [...]. Can we expect an unambiguous answer? [...], we can't, can we? [Focus group]

3.4.2. Organisational support

Within home-based nursing care teams, there was often a designated team member with a focus on 'quality of care' or 'hygiene and infection prevention'. These team members were tasked to keep knowledge up-to-date and function as go-to people if other team members have questions [T4Q5]. Additionally, these members were sometimes organised in groups involved in designing policies and spreading new information called 'shared governance' [T4Q6] which is explained in the following quote:

This, in turn, has to do with the "shared governance structure". We get together once every six weeks to see what's currently happening. What is changing? Sometimes we consult other people. Infection prevention employees from another organisation [...] that we can ask questions. And from there the policy is adjusted: the policy officer looks at it and it is then distributed on the intranet. That way we really try to stay up-to-date. [Focus group]

However, working alone made it very difficult for nurses to observe their colleagues or to discuss infection prevention practices [T4Q7]. In such cases, the implementation and evaluation of new information or policy changes were problematic [T4Q8].

Yeah, it [guideline or policy changes] gets thrown over the fence, and there's no way to assess whether it's implemented properly. [Focus group]

Furthermore, a high workload played a negative role in knowledge transfer. Beyond this, the fact that employees are not paid for time spent on knowledge transfer was seen as an impediment [T4Q9]:

Everything the employees get in writing, they have to read on their own time. [Focus group]

Additionally, nurses sometimes experienced untimely or incomplete transfers of clients' health records when clients were transferred from other care environments to their homes. For instance, this can occur when a client carries a multidrug-resistant organism as shown by the following quote:

Moderator: And you already indicated that you would actually like to know when a patient from a hospital or another institution goes home, whether or not he or she is suffering from something [multidrug-resistant organism].

Respondent: Yes. That's a notorious one. [Focus group]

3.5. Barriers and facilitators of infection prevention practices in home-based nursing care

To facilitate a more abstract, aggregated interpretation of the findings regarding factors that prevent or enable future improvements of daily practice, the (sub)themes from the results were sorted into categories. This was done according to the seven domains identified by Flottorp et al., which were then provided with an excerpt from the findings as an illustration (Flottorp et al., 2013). This resulted in an overview of possible barriers and facilitators of infection prevention practices in home-based nursing care, as demonstrated in Table 3.

4. Discussion

This study set out to explore infection prevention practices and related behavioural factors of both nurses and clients. From these practices and factors, the researchers identified barriers and facilitators of infection prevention practices in home-based nursing care.

The results are consistent with several studies that show that home-based nursing care is a more autonomous practice and takes place in an environment that is less structured, less controlled and less predictable than other forms of care, such as hospital care (Kenneley, 2012; Kenneley, 2010; Markkanen et al., 2007; Rhinehart, 2001). Exposure to unsanitary conditions, contaminated households and poor air quality, are also recognised as well as lack of space and inconsistent cleaning of work surfaces (Adams et al., 2020; Keller et al., 2019; Markkanen et al., 2007; Steffens et al., 2019). In contrast to a recent study conducted in the United States, lack of running water as a barrier to infection prevention is not prevalent in the Netherlands (Adams et al., 2020).

These findings demonstrate that home-based nursing care occurs in a context that is significantly different from other care settings. Existing guidelines on infection prevention are often designed for intramural settings, are formulated too generally to be of use or are out of date (Rijksinstituut voor Volksgezondheid en Milieu, 2019). Nurses in this study indicate practice variation as a result of discrepancies in guidelines and protocols and state that ambiguous information makes them doubt the available information, which echoes findings of Rowe et al. (2020). In fact, a new collaborative to revise and develop infection prevention guidelines in the Netherlands was implemented in April 2021 (Federatie Medisch Specialisten, 2021). However, attention is needed to tailor infection prevention guidelines specifically to the home-based nursing care environment.

Furthermore, hand hygiene is considered a primary measure for reducing the risks of transmitting infections and is widely studied along with the influence of availability of disinfectants, soaps, towels and access to sinks to facilitate hand hygiene compliance (Adams et al., 2020; Gould et al., 2000; World Health Organisation, 2009). As identified in previous research, this study's results show that nurses generally have access to alcohol-based disinfectants, but on occasions these disinfectants, soaps or towels can

be unavailable (Felembam et al., 2012; Gould et al., 2000). Even though these findings may be limited by not including quantitative measurements for hand hygiene compliance, the results indicate a discrepancy between a higher level of self-reported compliance in the focus group discussions and a much more modest level of compliance directly observed in practice. This indication is consistent with studies that have used self-reported questionnaires (Adams et al., 2020; Gershon et al., 2009; Russell et al., 2018) and studies that have used direct observations (Felembam et al., 2012; Gould et al., 2000; McDonald et al., 2021; Steffens et al., 2019). Overall, these findings support the impression that the application of hand hygiene in this field is suboptimal. However, further research is needed to obtain a complete picture of hand hygiene compliance in home-based nursing care.

Additionally, nurses and professional caregivers and clients are at risk for acquiring bloodborne pathogens; that is, through percutaneous injuries (Gershon et al., 2009). Contrary to the work of Markkanen et al. but in accordance with that of Gershon et al., sharps containers were widely available in our study (Gershon et al., 2009; Markkanen et al., 2007). Additionally, Amuwo et al. (2011) reported on the risk of blood or body fluid exposure amongst home-based nursing care staff; while this issue did not occur in the present study, we did however find evidence of blood and body fluid exposure amongst clients' family members, including young children. This raises questions on the roles of clients and their families in infection prevention, especially as contact with nurses or professional caregivers is of relatively short duration (Shang et al., 2018). Some efforts have been made to engage and involve clients to become active partners in infection prevention, but this approach is still underused (Landers et al., 2012). Thus, further research to involve and engage clients and their families in infection prevention measures might prove fruitful in the prevention of home-based nursing care acquired infections.

Furthermore, smartphones and other electronic devices may act as reservoirs for pathogens and therefore play a role in the transmission of infections (Badr et al., 2012; Brady et al., 2009). This study's results show that communication devices are constantly being moved to and from clients' homes and are thus exposed to the clients' surroundings. While it was observed that cleaning wipes for electronic devices were generally available, electronic devices were cleaned in only a few instances, echoing findings from a hospital care setting (Ulger et al., 2009). Consistent with the available literature, the present results include other negative side effects of using smartphones, such as increased distractions from healthcare staff (McBride and LeVasseur, 2017; Pucciarelli et al., 2017; Wu et al., 2011). These results also show that peer pressure plays a role in the use of smartphones, as nurses and professional caregivers feel obligated to answer incoming calls and messages. This practice could possibly aid cross-transmission of microorganisms. Therefore, guidelines on device cleaning, hand hygiene recommendations and restricting use of mobile devices during high-risk nursing procedures might prove useful in managing the negative effects of these devices in care settings.

Adams et al. demonstrated that the availability of infection prevention supplies is directly and positively related to adherence (Adams et al., 2020). This study shows that personal protective equipment such as face masks, barrier gowns and disposable gloves were mostly available and accessible, but even when they were available, they were not always used. In addition, the observations show evidence of incorrect use of personal protective equipment. A study by Gershon et al. (2009) using self-reported questionnaires showed similar results on availability and non-use of personal protective equipment. For this reason, paying specific attention to personal protective equipment in nursing education as well as in continuous in-service training might improve the preparedness and proper use of infection prevention materials.

Table 3
Barriers and facilitators of infection prevention practices in home-based nursing care.

Domain*	(Sub)theme	Facilitator	Barrier
Guideline factors Individual health professional factors	Guidelines		<i>Fragmentation, variation, discrepancies or conflicting information</i>
	Workspace and work conditions	<i>Sufficient room for a clean workspace</i> <i>Behaviours adapted to the circumstances: increased awareness with respect to infection prevention practices when confronted with contaminated households</i>	<i>The workspace was cleaned irregularly.</i> <i>Materials touched the cleaned workspace.</i> <i>Need for information on how to judge and deal with contaminated households</i>
	Workwear		<i>Differences in clothing worn</i> <i>It was often up to nursing staff to clean their own workwear.</i> <i>Clothing was not cleaned at the recommended temperature.</i> <i>Little or no attention was given to the bags that are being carried to and from different households by nurses.</i>
	Hand hygiene	<i>Alcohol-based disinfectants and washing stands were available and accessible.</i>	<i>Nurses doubt whether the WHO 'five moments for hand hygiene' actually 'fit' the home-based nursing care environment.</i> <i>Although nurses state that they performed hand sanitisation in accordance with the WHO's 'five moments of hand hygiene', observations showed that hand sanitisation is varying, inconsistent and irregular.</i> <i>Nurses did not possess the correct materials, such as soap, disinfectants, gloves and aprons</i>
	Personal protective equipment		<i>Single-use disposable materials, including gloves, surgical masks, aprons and overshoes, were used incorrectly or irregularly and were re-used or were 'cleaned'.</i>
	Communication devices	<i>On occasion devices were intentionally not exposed to the clients' surroundings.</i> <i>In offices or in the car of the nurse, some form of cleaning or disinfecting wipes were generally available.</i>	<i>Nurses doubted the right ways (method and materials) and time to clean.</i> <i>Devices were cleaned in only a few instances.</i> <i>Communication devices tended to be distracting.</i> <i>Nurses felt pressure to use communication devices during care delivery.</i> <i>Regularly not cleaned before or after use</i>
	Gloves for putting on compression stockings		<i>Gloves stay behind in the house of the client to be used by different nurses.</i> <i>Nurses took the gloves with them and used the same gloves to help multiple clients.</i>
Patient factors	Guidelines		<i>Conflicting information makes that nurses doubted the accuracy of the information they receive.</i>
	The home-based nursing care environment	<i>Impeccably clean and tidy housing conditions</i>	<i>Different forms of housing</i> <i>Deteriorating housing</i> <i>Unsanitary conditions</i> <i>Questionable air-quality</i> <i>Lack of space to move around</i> <i>Many different actors present during care delivery</i> <i>Not enough free flat surface to create a clean workspace</i>
	Workspace and work conditions	<i>A clean workspace</i>	<i>No obvious place of storing materials</i> <i>Use of regular needles</i>
	Storage and quality control of materials	<i>Sorted in boxes with a closable lid</i> <i>Materials were often checked for flaws, broken packaging or use-by dates.</i> <i>Use of safety needles</i>	
Professional interactions	Handling waste	<i>Sharps containers were widely available.</i> <i>Used materials and waste were separated, sorted and placed in a small bin bag.</i>	<i>Sharps containers were full or filled above the 'do not exceed' line.</i> <i>Used materials and waste lay scattered on different surfaces.</i> <i>Waste from a nursing procedure came into contact with other persons.</i>
	Guidelines	<i>Nurses recognised differences between home-based nursing care teams in dealing with certain situations, guidelines and protocols, and clients also confronted nurses when they experience variations.</i>	<i>Working alone made it very difficult for nurses to observe their colleagues or discuss infection prevention practices.</i>
	Incentives and Resources Capacity for organisational change	Organisational support	
Organisational support		<i>Designated team member with a focus on 'quality of care' or 'hygiene and infection prevention'</i> <i>Designated team members were sometimes organised in a group that is involved in designing policy and spreading new information, called 'shared governance'</i>	<i>A heavy workload played a negative role in knowledge transfer.</i> <i>Nurses were not paid for time spent on knowledge transfer.</i>
Social, political and legal factors	Workspace and work conditions		<i>In relation to contaminated households, nurses indicated that they could not refuse care, as clients have a 'right to healthcare'.</i>

Note: According to Flottorp et al. (2013)*.

Moreover, these results indicate that working alone, having a heavy workload and not being paid for time spent on knowledge transfer are barriers to the implementation and evaluation of policy or guideline changes. Contrary to [Kenneley \(2012\)](#) and [Gershon et al. \(2009\)](#), all of the participating agencies in this study employed an infection prevention and control nurse or 'focal point'; that is, someone trained in all infection prevention activities to ensure supervision, support and implementation ([Gershon et al., 2009](#); [Kenneley, 2012](#)). Thus, it is recommended that healthcare organisations accommodate a knowledge infrastructure that mitigates the barriers identified in the results. Additionally, surveillance on incidence and prevalence of infections and infection prevention audits are necessary – on team, organisational and national levels – to fully comprehend and evaluate the scale of the problem and the application of infection prevention practices in home-based nursing care. Active surveillance and audits will reveal practice variation and non-compliance with infection prevention measures within and across organisations and may act as a starting point for quality improvement.

4.1. Strengths and limitations

A limitation of participant observations as a data collection method is known as the Hawthorne effect ([Eckmanns et al., 2006](#)). In this study, the researchers explicitly sought and found evidence of this bias. We therefore assumed that nurses and professional caregivers adapted their behaviours in a positive way (for example, increased awareness and compliance with regards to hand hygiene or other infection prevention practices). As our results reveal a suboptimal performance in relation to infection prevention practices, one can assume that during the day-to-day delivery of home-based nursing care, these practices are performed even less favourable.

This study was conducted at four medium- to large-sized healthcare organisations providing home-based nursing care in the eastern part of the Netherlands, so selection bias might have played a role, as there are also many smaller sized organisations in the Netherlands. However, we did not suspect smaller organisations would perform convincingly better, because infection prevention in the specific context of the home environment has been an understudied topic receiving little attention.

The strength of this study is that it offers a detailed and in-depth exploration into the practice of infection prevention in home-based nursing care. This investigation is further strengthened by the use of multiple data collection methods, including different perspectives from a mixed set of participants and many hours spent observing daily practices. The steady increase in clients receiving home-based nursing care makes the results both relevant and important.

5. Conclusions

This study shows from a first-hand observational viewpoint that the daily practice of infection prevention in home-based nursing care appears to be suboptimal. Additionally, this study reveals considerable variation with regard to the work environment; the application of hand hygiene; the proper use of personal protective equipment; and the handling of communication devices and organisational policies, procedures and support.

Furthermore, this study identifies a number of important barriers and facilitators of infection prevention practices at the levels of the work environment, professional and team performance, clients and organisations. Together, these results could act as a starting point for the development of a theory- and evidence-based implementation strategy to improve the adherence to hand hygiene practices and the correct use of personal protective equipment in

home-based nursing care practice. Beyond this, aligning infection prevention guidelines with the home-based nursing care setting is needed. In this case, consideration should be given to the knowledge and attitudes of nurses, professional caregivers and clients, both in practice as in professional education.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this study.

CRedit authorship contribution statement

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Supplementary materials

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