

Patients' experiences of cannulation of arteriovenous access for haemodialysis: A qualitative systematic review

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Abstract

Introduction: Cannulation is an essential part of haemodialysis with arteriovenous access. Patients' experiences of cannulation for haemodialysis are problematic but poorly understood. This review aims to synthesise findings related to patients' experiences of cannulation for haemodialysis from qualitative studies, providing a fuller description of this phenomenon.

Methods: Eligibility criteria defined the inclusion of studies with a population of patients with end-stage kidney disease on haemodialysis. The phenomena of interest was findings related to patients' experiences of cannulation for haemodialysis and the context was both in-centre and home haemodialysis. MedLine, CINAHL, EMBASE, EMCARE, BNI, PsycInfo and PubMed were last searched between 20/05/2019 and 23/05/2019. The quality of studies was assessed using the Joanna Briggs Critical Appraisal Checklist for Qualitative Research. Meta-aggregation was used to synthesise findings and CERQual to assess the strength of accumulated findings.

Results: This review included 26 studies. The subject of included studies covered cannulation, pain, experiences of vascular access, experiences of haemodialysis and a research priority setting exercise. From these studies, three themes were meta-aggregated: (1) Cannulation for haemodialysis is an unpleasant, abnormal and unique procedure associated with pain, abnormal appearance, vulnerability and dependency. (2) The necessity of cannulation for haemodialysis emphasises the unpleasantness of the procedure. Success had multiple meanings for patients and patients worry about whether the needle insertion will be successful. (3) Patients survive unpleasant, necessary and repetitive cannulation by learning to tolerate cannulation and exerting control over the procedure. Feeling safe can help them tolerate cannulation better and the cannulator can invoke feeling safe. However, some patients still avoid cannulation, due to its unpleasantness.

Conclusions: Cannulation is a pervasive procedure that impacts on patients' experiences of haemodialysis. This review illuminates further patients' experiences of cannulation for haemodialysis, indicating how improvements can be made to cannulation.

Registration: PROSPERO (CRD42019134583).

Keywords

Haemodialysis, vascular access, arteriovenous access, cannulation, patients' experiences

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Introduction

Haemodialysis is a life-sustaining treatment for patients with end-stage kidney disease. An essential part of haemodialysis and a continuing challenge, is providing adequate vascular access (VA).¹ Recommendations about the type of VA used for haemodialysis are becoming more nuanced, promoting inclusion of patient choice and likelihood of success as considerations in this decision.² However,

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Table 1. Inclusion and exclusion criteria for studies.

Question	Population	Adults with end stage kidney disease undergoing haemodialysis
	Phenomena of interest	Experiences of cannulation of AV access
	Context	Both in-centre and home settings
	Further inclusion criteria for studies	Primary research Cannulation for both haemodialysis and hemodiafiltration Cannulation performed by both registered and unregistered nursing staff, carers or patients Qualitative research and the qualitative element of mixed methods studies Published articles and grey literature including PhD theses
	Exclusion criteria for studies	Secondary research, e.g. systematic review, literature reviews Solely on paediatric populations, i.e. only participants under 18 years old Solely about acute haemodialysis or other non-haemodialysis extra-corporeal therapies Solely staff perspectives on cannulation Solely about cannulation of novel and new vascular access, e.g. HeRo grafts Solely use of ultrasound to assist with cannulation

arteriovenous (AV) access continues to be recommended as the best option for the majority of haemodialysis patients.^{1–3} AV access continues to be associated with reduced mortality and better patency than central venous catheters (CVC)⁴ and better patient experience.^{5,6} Thus, efforts are still needed to reduce barriers to AV access use, optimising outcomes and patients' experiences, promoting AV access as a viable choice.

AV access for haemodialysis requires insertion of two needles at the start of each treatment, also known as cannulation. This is needed for each treatment, meaning thrice weekly haemodialysis requires 312 cannulations a year. Despite its frequency, cannulation for haemodialysis remains difficult for patients to tolerate. It is associated with pain, anxiety, vulnerability, fear and worry.^{7–10} In the UK, an annual survey of renal patients repeatedly identifies cannulation as the third poorest scoring area for patient experience.^{11–13} Fear of cannulation of AV access can also lead to patients avoiding AV access for haemodialysis, choosing to use a CVC.^{14,15} Therefore, an in-depth understanding of patients' experiences of cannulation is valuable to guide recommendations for improvements.

Several reviews illuminate patients' experiences of cannulation for haemodialysis. A systematic review of patients' experiences of VA highlights fear of cannulation. However, as this focusses on broader VA experience, it does not explore cannulation in depth.⁷ A scoping review of qualitative and quantitative studies identifies common problems with cannulation including pain, inability to cannulate, clinical complications and fear.¹⁶ However, this does not provide detailed description or synthesis of findings. Four individual qualitative studies examine patients' experiences of cannulation for haemodialysis in sub-populations^{8,17} or parts of cannulation,^{9,18} but provide no full description of this phenomenon. Therefore, we aimed to explore patients' experiences of cannulation of AV access for haemodialysis.

Methods

Study design

We decided to explore this phenomenon using a qualitative systematic review. A synthesis of qualitative studies that explore experiences of cannulation, VA and haemodialysis would enable findings from different studies to be drawn together, providing a fuller, in-depth description of patients' experiences of cannulation for haemodialysis, increasing understanding and focusing guidance on how to improve cannulation for haemodialysis. The protocol was developed using PRISMA-P¹⁹ and ENTREQ,²⁰ and registered on PROSPERO (CRD42019134583) prior to starting the review.

Review question

The review question was developed using the P (population), I (phenomena of Interest), Co (Context) formation for qualitative systematic reviews²¹:

'What are adults with end-stage kidney disease undergoing haemodialysis (P), experiences of cannulation of AV access (I), when undergoing haemodialysis in both in-centre and home settings (Co)?'

Studies were included if they generated findings directly related to the phenomenon, even if this was not the study focus. Inclusion and exclusion criteria (Table 1) maintained focus on everyday cannulation for haemodialysis, rather than less usual cannulation procedures which may generate unique findings. Non-English articles were translated for data extraction.

Data extraction

The search strategy was developed using the PICo, with examination of keywords used in 15 relevant articles, to prompt search terms (Supplemental Material 1). Databases were searched between 20/05/2019 and 23/05/2019 (Table 2,

Table 2. List of databases searched.**Databases searched:**

- Cumulative Index of Nursing and Allied Health Literature (CINAHL) from EBSCO (1981–present) via Healthcare Databases Advanced Search (HDAS)
- EMCARE (1995–present) from OVID via HDAS
- British Nursing Index (BNI) (1992–present) from Proquest via HDAS
- PsycInfo (1806–present) from Proquest via HDAS
- MedLine (1946–present) from Proquest via HDAS
- PubMed NCBI/NLM (1946–present)
- EMBASE (1974–present) from OVID via HDAS
- Trials
- Latin American and Caribbean Health Sciences Literature (LILACS) (1982–present)

Supplemental Material 2), against pre-set criteria. Reference lists of included articles and articles with a systematic literature search were searched for further sources, ensuring a comprehensive search of qualitative research which can be difficult to identify.^{20,21} A bespoke data extraction form was designed and piloted. Following the pilot, minor changes were made. Data extracted from each study included the study population, the type of cannulation used, methods used, conclusions and limitations. Any findings related to cannulation for haemodialysis were extracted, including verbatim quotes from the study article describing the finding and related participant quotes. The final data extraction form is available in Supplemental Material 3. No studies were excluded due to their quality, though quality was assessed using Joanna Briggs Critical Appraisal Checklist for Qualitative Research.²² Screening of articles, data extraction and assessment of quality of articles were completed by two authors independently. Disagreement between co-authors was discussed and, when required, adjudicated by a third author.

Synthesis of findings

Meta-aggregation was used to synthesise findings.²³ Meta-aggregation enables a broad exploration of a topic, with a complete search strategy.²³ It provides a comprehensive base to explore a poorly understood topic. The meta-aggregation of findings was implemented through a number of stages:

- (1) Each extracted finding was given an inductive category to describe what this finding illuminated about the phenomenon. Where appropriate, different findings were allocated into the same category.
- (2) All findings and categories were shared and discussed at a group co-author meeting, where all co-authors were present. During this discussion, co-authors were able to add their own interpretation of findings, which was then discussed. This led to changes in categories and how they were described.

- (3) Together, two co-authors (CF and HB) assimilated categories into synthesised findings, which are described as themes and sub-themes. This assimilation was regularly reviewed in meetings together.
- (4) Once both co-authors agreed the themes and sub-themes, these were circulated to all other co-authors for comments, with minor adjustments made.
- (5) CF and HB discussed the final themes and sub-themes, identifying the relationship between them. A diagram was produced to describe this, which was reviewed and agreed by all co-authors.

The final analysis became more interpretative than is traditionally produced by meta-aggregation.²³ However, this level of interpretation became necessary due the diversity and breadth of findings across studies, that were shaped by heterogeneous research questions. Once the analysis was complete, a CERQual assessment of accumulated findings²⁴ was completed by two co-authors.

To maintain trustworthiness, the primary author (who spent 20 years working as a haemodialysis nurse regularly performing cannulation) maintained a diary throughout to promote reflexivity.²⁵ As described by Fischer,²⁵ the primary author did not completely bracket her previous experience of the phenomenon, but used the reflexive diary to recognise her assumptions that could bias the analysis. Throughout the study, these assumptions were openly discussed with co-authors to minimise any inappropriate influence. However, her experience was used to form the categories, themes and sub-themes, whilst ensuring these remained focused on the extracted findings from studies.

Results

The results of the screening process are summarised in the PRISMA flow diagram (Figure 1). During full text screening, one potential inclusion (a dissertation in Portuguese) was excluded due to excessive translation costs. However, the study in this dissertation was included through a published article.¹⁸

Table 3 provides a description of the included studies. Only four studies were directly about cannulation.^{8,9,17,18} Other studies were about pain,^{26,27} experiences of VA for haemodialysis,^{14,28–33} experiences of in-centre and home haemodialysis^{34–46} and research priority setting.⁴⁷ Studies were conducted across five continents, but despite this diversity in study location themes extracted did not seem to vary due to culture, with the exception of one study, which developed themes linked to religion in a Thai culture.²⁷

The quality of studies varied (Supplemental Material 4). Most studies displayed congruity between the research methodology and the research question (present in 25/26 studies), methods used to collect data (24/26), data analysis (20/26) and interpretation of results (20/26). The most frequent limitations identified were a lack of: a stated

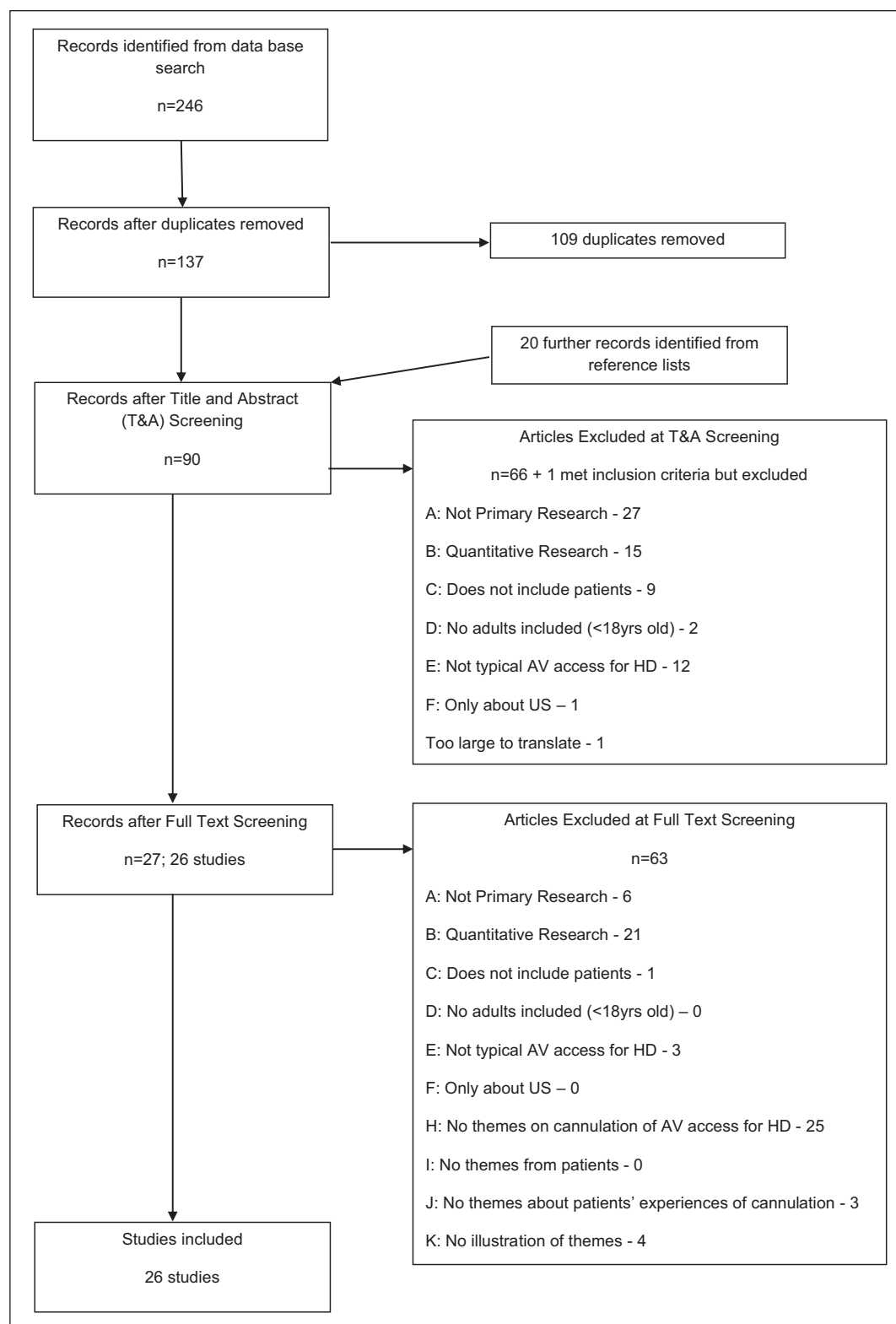


Figure 1. PRISMA flow Diagram.

philosophical perspective (absent in 16/26), statement locating the researcher (22/26) and the influence of the researcher on the research (22/26). This may be due to

journal requirements rather than being absent in the study itself. The results of the CERQual assessment are shown in Table 4. The remainder of the results describes the

Table 3. Description of included studies.

Authors	Country	Study methodology	Sample size	Population	Phenomenon of interest	Cannulation	Data collection methods
Bourbonnais and Tounignant ²⁶	Canada	Qualitative	25	Adult in-centre HD patient	Pain experience of patients on maintenance HD	Not specified	Interviews
Cafazzo ⁴² , Cafazzo et al. ⁴³	Canada	Ethnography	13 HD (20 in all)	Adult in-centre HD and nocturnal home HD	Barriers to nocturnal HD	Not specified	Interviews
Melo da Silva et al. ¹⁸	Brazil	Qualitative	15	Adult HD patient	Buttonhole cannulation, as perceived by patients	BH, 6 converted from RL	Interviews
Melo da Silva et al. ²⁸	Brazil	Mixed methods but only reports qualitative element—social phenomenology	30	Adult in-centre HD patients	Experience of people using AVF for HD	RL	Unstructured interviews
Furtado and Lima ²⁹	Brazil	Descriptive qualitative	21	Adult in-centre HD patients	AVF knowledge of HD patients	Not specified	Semi-structured interviews
Giles ⁴⁴	Canada	Phenomenology	4	Adult home HD patients either dialysing at home or training in-centre	Life experiences of ESRD and having home HD machine	Not specified	Semi-structured interviews
Hagren et al. ³⁹	Sweden	Interpretative qualitative design	15	Adult in-centre HD patients	Suffering from ESRD for patients on HD	Not specified	Semi-structured interviews
Hagren et al. ⁴⁰	Sweden	Qualitative	41	Adult in-centre HD patients	How patients on maintenance HD interpret their life situation	Not specified	Semi-structured interviews
Hanson et al. ⁴⁵	Australia	Mixed methods	20	Adult home HD patients training in-centre and then dialysing at home	Patients' perspectives of home HD training and transition period	Patient and carer cannulation	Interviews
Herlin and Wann-Hansson ³⁴	Sweden	Phenomenology	9	Adult in-centre HD patients	30–45 years old experience of dependence on HD	Not specified	Interviews
Lima Nogueira et al. ³⁰	Brazil	Descriptive qualitative	28	Adult in-centre HD patients	Care of CKD patients towards their AV access	Not specified	Semi-structured interviews
Lin ³⁵	Taiwan	Phenomenology	12	Adult in-centre HD patients	Experiences of making a decision about HD in Taiwanese patients	Not specified	Interviews
Mafara et al. ⁸	Australia	Interpretative phenomenology	6	Adult in-centre HD patients	Lived experience of cannulation of a new AVF in a satellite unit	Not specified	Interviews
Moore et al. ¹⁷	UK	Report of qualitative part of mixed methods study—interpretative phenomenology	8	Adult home HD patients	Experiences of self-cannulation of male HHD patients	Self cannulation	Semi-structured interviews

(Continued)

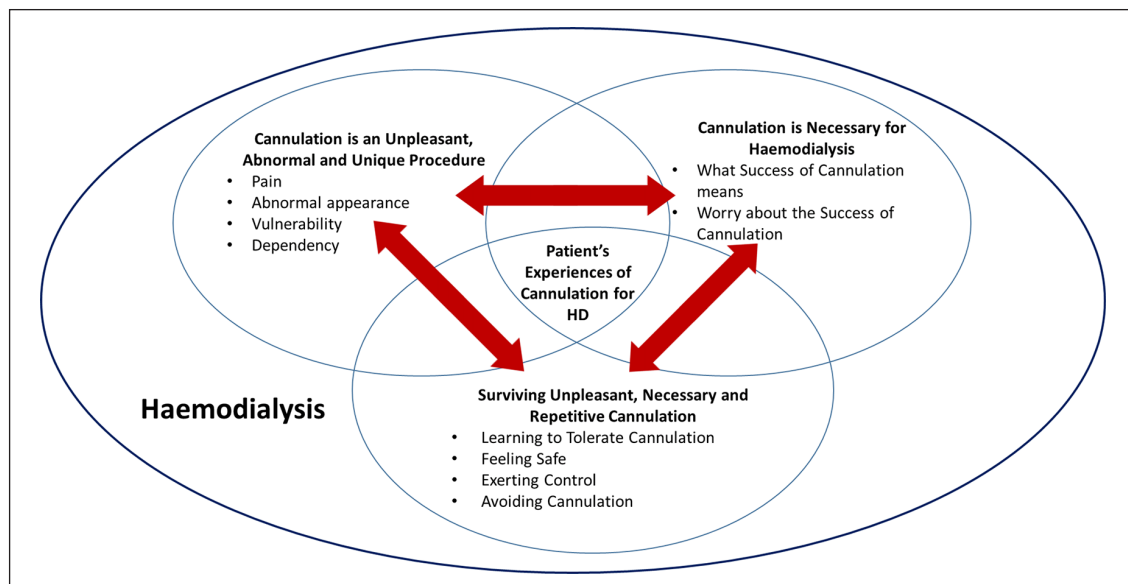
Table 3. (Continued)

Authors	County	Study methodology	Sample size	Population	Phenomenon of interest	Cannulation	Data collection methods
Piccoli et al. ⁴¹	Italy	Mixed methods	30	Adult home and in-centre HD patients	Advantages and disadvantages of daily HD	Not specified	Semi-structured interviews
Richard and Engebretson ³¹	US	Descriptive ethnography	14	Adult HD patients	How patients on HD negotiate living with an AVF	Not specified	Semi-structured interviews
Romyn et al. ³²	Canada	Interpretative descriptive qualitative	11	Adult in-centre HD patients	Experiences of patients on HD who had used a CVC and transition to AVF	Not specified	Semi-structured interviews
Sanz Turrado et al. ³⁷	Spain	Phenomenology	7 1 focus group	In-centre HD patients	Factors that affect patients' satisfaction with nursing staff	Not specified	Focus group
Taylor et al. ³³	Australia	Qualitative	26	Adult home and in-centre HD patients	Vascular access experience in both in-centre and home HD patients	Nurse, patient and carer cannulation	Interviews
Tong et al. ⁴⁷	Australia	Qualitative	63 9 focus groups	Adult pre HD, transplant and dialysis patients	Patient priorities for health research into renal disease	Not specified	Focus groups
Wells ³⁸	US	Mix of ethnography and grounded theory	12	Adult in-centre HD and PD patients, previously on HD	Lived experiences of ESRD for Mexican Americans and the effect on occupational deprivation	Not specified	Semi-structured interviews and video recording
Whittaker and Albee ³⁶	US	Grounded theory	20	Adult dialysis patients	Dialysis modality decision making for patients with ESRD	Not specified	Unstructured interviews
Wilson and Harwood ⁹	Canada	Descriptive qualitative	17	Adult in-centre HD patients	What successful cannulation means to HD patients	Nursing cannulation	Semi-structured interviews and field notes
Wise et al. ⁴⁶	US	Mixed methods—grounded theory	26 (13 dyads)	Adult home HD patients and their carer	Experiences of dyads who successfully perform short daily HD at home	Patient and carer cannulation	Semi-structured telephone interviews
Xi et al. ¹⁴	Canada	Phenomenology	13	In-centre HD patients	Patients decisions making in those who have refused an AVF	Not specified	Semi-structured interviews and field notes
Yodchai et al. ²⁷	Thailand	Qualitative	20	Adult in-centre HD patients	How Thai HD patients perceive and manage pain and the effect of HD on pain	Not specified	Semi-structured interviews

HD: haemodialysis; ESRD: end stage renal disease; PD: peritoneal dialysis; AVF: arteriovenous fistula; CVC: central venous catheter; BH: buttonhole; RL: rope ladder.

Table 4. Summary of CERQual assessment of qualitative findings.

Summary of review finding	Studies contributing to review finding	CERQual assessment of confidence in the evidence	Explanation of CERQual assessment
Cannulation is an unpleasant, abnormal and unique procedure Cannulation for haemodialysis is an unpleasant, abnormal and unique procedure to that is difficult to face.	8, 14, 17, 18, 26, 27, 28, 29, 31, 32, 35, 36, 38, 42, 43, 45, 46	Moderate confidence	'Minor concerns' for: Methodological design Whether conclusions flowed from the results analysis Whether findings were representative of all participants Relevance of findings.
Cannulation is necessary for haemodialysis Patients recognise that cannulation is essential for haemodialysis. They worry about success and this worry is exacerbated by the need for the procedure to be successful.	9, 14, 28, 31, 33, 34, 39, 40, 42, 43, 44, 45, 47	High confidence	—
Surviving unpleasant, necessary and repetitive cannulation Patients used various methods to deal with the needle insertion. The necessity and regularity of the procedure creates the need to survive this procedure, regardless of how unpleasant this is.	9, 14, 17, 18, 27, 29, 30, 31, 32, 33, 34, 36, 37, 38, 40, 41, 42, 43, 45, 46	High confidence	—

**Figure 2.** Patients' experiences of cannulation for haemodialysis.

synthesis of extracted findings from studies that describe patients' experiences of cannulation for haemodialysis.

Patients' experiences of cannulation

We identified 3 themes and 10 sub-themes to describe patients' experiences of cannulation for haemodialysis (Figure 2). Each theme interacts with the others, influencing

and altering the impact of each. Therefore, cannulation experience is one holistic entity, with three overlapping and influencing themes. Cannulation is part of the haemodialysis process and as such difficult to separate from this, thus happens within this wider context. Key quotes extracted from studies, to illustrate each theme and sub-theme, are indicated by *italics* within the text, with detailed quotes provided in Supplemental Material 5.

Theme 1: Cannulation is an unpleasant, abnormal and unique procedure

Cannulation creates unpleasant feelings and is not a normal procedure for patients to experience regularly: *'Cannulation is not normal, sticking a needle in. But my life depends on it. . . . Every time I get the needle ready I hear the music from Jaws'*.⁴⁵ Cannulation for haemodialysis is associated with pain, concern about the abnormal appearance of the arteriovenous access, vulnerability and dependency. The context of regular haemodialysis makes this a unique procedure that is not similar to other one-off cannulation events.

Pain was regularly associated with cannulation: *' . . . Then I would feel the big needles being pushed in . . . I still feel pain when they [the nurses] hit a nerve, whoa that is painful'*.⁸ Pain was a common theme in studies, but the extent of the pain and how much this affected individual patients varied. For some, the pain was short-lived or minor: *'It hurts, but it only hurts when the skin is punctured, after that, it doesn't hurt anymore'*.¹⁸ Patients often appeared to become less bothered by pain from cannulation over time: *'I used to dread coming to dialysis due to the fear of the painful needles but now I am getting better'*.⁸ For others pain progressed beyond the cannulation procedure or the pain was excessive: *' . . . how can these big needles not hurt when they pierce my skin huh?'*.⁸

Patients also worried about the **abnormal appearance** of their AV access, with cannulation creating scars, bruising and lumps: *'Only the deformation of my arm (. . .) my arm is covered in ugly cuts, covered in lumps'*.²⁹ For some it was not just about how they felt about their appearance, but also how others reacted to it, thus they would try to cover their access when going out: *'To me they are not beautiful, they are very unattractive, so I wear sleeves. . . because when I meet people they say, girl, they have really been cutting on you'*.³¹

The cannulation procedure itself induced feelings of **vulnerability** as patients *'surrendered their arm to the nurse'*.⁸ They viewed it as a *'form of self-torture, self-mutilation'*,³³ with the needle invading their body. How they were treated by the cannulator exacerbated this vulnerability: *'They should be concerned that you are a human being and that you're still alive. Instead, they come in there and punch you like you'd punch a tyre. They bruise you all over like that with no concern at all'*.³⁶

Some patients felt the cannulation procedure created **dependency**. This was not viewed positively and emphasised their vulnerability: *' . . . I have to depend on nurses to stick the needles in my arm . . . you know it just sucks to lose your independence and keep on wondering what the future holds for you . . . '*.⁸

Theme 2: Cannulation is necessary for haemodialysis

Patients recognised that cannulation is essential for haemodialysis: *'I come here to live. That's the short story. So*

whatever happens to me, thinking I am not going to like those needles put in, that is a fact'.⁹ The cannulation and arteriovenous access *'keeps me alive. If it wasn't for it, I wouldn't be here'*. . . .²⁸ This link with a life-sustaining treatment changes what success means and leads to worry about whether it will be successful.

What does successful cannulation mean to patients? Wilson and Harwood's⁹ study explored this concept directly. However, other studies also provided enlightenment in this area. Success was getting the needle in, but also more than this, as the needles were required to deliver a successful haemodialysis treatment: *'Perfect cannulation would be to get the needles in no problem and no problems with getting up to speed, whatever it needs to be, and just relaxing and it's done'*.⁹ Having 'no problems' with cannulation includes multiple aspects. Minimising pain associated with cannulation and an absence of pain during treatment is important: *'But under normal dialysis you, will not feel any pain of the blood going out of your body or the blood returning to your body'*.³⁰ Success also meant getting the needle in easily: *'They have trouble getting my needle in place. You see, not everyone here knows how to get my needle in place. And I'd say that's my biggest problem here. I don't have any problems except that'*.³⁹

Due to its link with haemodialysis, a life-sustaining procedure, patients **worried about the success of cannulation**. If the cannulation was difficult and thus not successful first time, patients *'feel like you didn't get something done properly; you didn't get the dialysis done properly'*,⁹ viewing difficult cannulation as making their haemodialysis treatment less effective. They also worried that difficult cannulation could damage their arteriovenous access: *'It is the feeling of fear, not really the pain . . . more that something would go wrong. The fistula would brake [sic]'*.³⁴

Theme 3: Surviving unpleasant necessary and repetitive cannulation

The necessity and regularity of cannulation created a need to survive the procedure regardless of its unpleasantness: *' . . . I was very scared the first time, but now I can take it [needle insertion]'*.²⁷ This theme illuminates how patients manage this unpleasant procedure not just once, but on a frequent and regular basis.

Patients often **learned to tolerate cannulation**, becoming used to it: *'Because I've accepted I know . . . it's my way of life, it's how I'm going to live . . . It's just part of life'*.¹⁷ For some, the cannulation remained *'exceedingly painful'*,²⁸ but they learned to *'bear the pain'*²⁷ and tolerate the unpleasantness. Some patients learned to accept cannulation as part of their life, reframing the stressor: *'Well I sort of get in the mindset that I'm going to the "office" [his dialysis room] . . . Still slightly apprehensive that the needles won't work . . . Slightly. But obviously it diminishes . . . '*.¹⁷ However others continue to struggle with the

cannulation: *'Why wouldn't it hurt? It does every single time. . . . I have lost interest now'*.²⁷

Feeling safe often affected how easy or difficult the cannulation procedure was to tolerate. The environment made patients feel safe: *'It's a nice environment here. I find it really comforting to be here'*,⁹ as does the cannulation technique used: *'I came here to this clinic because I knew it used the buttonhole technique. This technique is the best'*.¹⁸ However, the patient's relationship with the cannulator was often central to feeling safe. Patients had *'more confidence in somebody that you know is going to do it well'*.³⁷ Whereas patients often worried if they did not trust the cannulator: *'I was in non-stop panic because she'd stuffed up my buttonhole, my access'*.³³ The cannulator could also do things to make patients feel safer: *'Just talking through it, I think that really helps. You know? I really do. It makes you feel more comfortable and makes you feel more confident in the nurse, and so it helps. It really does'*.⁹

Some patients **exerted control** to help them survive the cannulation procedure. Self-cannulation was often a way to control cannulation. This enabled them to avoid problems with cannulation from others: *'So they. . . allow me to stick myself, and there's a new nurse that we have now, and she, in the worst way, wants to stick me, and. . . I just told her, "NO" [yelled]'*.³¹ Self-cannulation also provided patients with a sense of achievement, creating independence and self-efficacy, as *'it's very good and you feel that you are independent, you don't need help from anyone else'*.¹⁷ However, self-cannulating was not easy, with one patient describing it as *'an ordeal. . . to the norm'*.¹⁷ Some patients over-came challenges to be able to self-cannulate: *'First time I was shaking but I said "why are you shaking?" Nobody will do it for you. You have to do it yourself'*.⁴⁵ Some patients were unable to overcome these challenges: *'The barrier was putting in my own needles'*.^{42,43}

Finally, not all patients were able to cope with the unpleasantness of cannulation, leading to some **avoiding cannulation**. Some did this by reducing the frequency of haemodialysis: *' . . . and that you're getting cannulated 3 times, 3 out of 7 days as opposed to almost every day'*.^{42,43} Others felt *'it would be easier to do it having line access because of the way that the hookups work'*.^{42,43} However, where possible some patients completely avoid haemodialysis due to the thoughts of the cannulation: *' . . . I'm a terrible coward when it comes to needles, so hemo[dialysis] wasn't really even on the table for me'*.³⁸

Discussion

This review aims to explore patients' experiences of cannulation for haemodialysis, developing an in-depth description of this experience. Synthesising findings from multiple studies broadens what we already know from current studies into one cohesive description. Using qualitative findings to do this, maintains the focus on what

patients' feel and experience, rather than imposing health-care professionals' assumptions and preconceptions. If we can develop greater understanding of this phenomenon, this will focus improvements in cannulation.

Our findings start to illuminate how patients feel about cannulation for haemodialysis. It is an unpleasant, abnormal and unique procedure that is difficult to face. However, despite its unpleasantness, the necessity of successful cannulation for haemodialysis introduces extra emphasis on the procedure, creating worry about the success of the cannulation and whether multiple needle attempts will be needed. This necessity also drives a need to survive this unpleasant, repetitive procedure. Patients learn to tolerate the needle insertion and attempt to exert control over the procedure as a means to survive this. Feeling safe makes the cannulation easier to tolerate. Despite this, the procedure often remains unpleasant. Which can lead to patients avoiding needle insertions. Whilst we previously knew that cannulation was associated with challenges, this aggregation of findings starts to fully describe the trauma cannulation causes to patients, how the link to a life sustaining treatment exacerbates this and how patients survive this unpleasant procedure on a regular basis.

Our analysis has identified that cannulation is an inherent part of haemodialysis and VA use. The issue of cannulation is not only evident in studies that specifically explore cannulation, but is also highlighted in studies that explore experiences of VA^{14,28–33} and haemodialysis.^{34–46} Casey et al's⁷ systematic review identified 'fear of cannulation' as part of patients' experiences of VA for haemodialysis and a key area of concern. Whilst studies have found there was better patient satisfaction with AV fistulae in comparison to AV grafts and CVCs, patients with AV access were more likely to be bothered by symptoms associated with cannulation, namely the appearance of their access, pain, bruising and swelling.^{5,6} Since completion of our systematic review, Kuo et al.⁴⁸ have completed a qualitative study exploring what patients believe to be a 'bad run' for haemodialysis. Again, cannulation was highlighted as one of four main issues for haemodialysis patients, alongside cramps, 'crashing' and clotting. The consistency with which cannulation is highlighted in studies examining haemodialysis and VA experience indicates the pervasive nature of this issue.

The necessity of cannulation and its link to receiving a life-sustaining treatment appears to have a significant impact on patients, causing them to have a heavy burden of worry about whether cannulation will be successful. Despite its importance to patients, miscannulation continues to occur frequently^{49–51} and is often accepted as a part of haemodialysis. Whilst preventing miscannulation is the optimal solution, it is unlikely that it can be avoided completely. Therefore, better strategies are also needed to support patients through miscannulation.

Whilst patients may learn to survive unpleasant, necessary and repetitive cannulation for haemodialysis, this does not necessarily mean cannulation improves but that they learn to tolerate cannulation out of necessity for survival. Feeling safe can make cannulation easier to tolerate, with the cannulator, environment and cannulation technique influencing this. Whilst there is broad acceptance that cannulation varies with different cannulators, there is a paucity of studies exploring how we can reduce this variation and promote 'good' cannulators. Harwood et al.⁵² conducted a qualitative study with nurses, to identify what led to successful cannulation. They found this went beyond just technical skill, including patient-centred care, teamwork and self-awareness of the cannulator. Our review reflects this, where the attitude and communication of the cannulator can improve or adversely affect the patients' experiences. Training of cannulators is one area where cannulation can be improved,⁷ however consideration needs to be given not just to technical skill but also the social interaction during cannulation. The environment also plays a part in patients feeling safe, which was a theme in Wilson and Harwood⁹ study. This identified that a calm, relaxed environment improved patients' experiences of cannulation, whereas a chaotic environment had the opposite effect. Haemodialysis units are often busy, with adherence to schedules often leading to a pressured work environment. Cannulators, but also managers who influence nursing schedules and workloads, should aspire to create a calm haemodialysis unit that makes patients feel safe to undergo cannulation and survive its unpleasantness. The cannulation technique used also appears to affect whether patients feel safe. This was particularly evident in one included study that explored buttonhole cannulation, where patients appeared to feel safer with this technique.¹⁸ However, there were no studies exploring any other cannulation techniques. Therefore, it is difficult to determine whether buttonhole technique leads to a better cannulation experience. Quantitative studies have compared buttonhole to other cannulation techniques, using pain scores to measure patients' experiences of cannulation. A meta-analysis found that whilst observational studies indicated a significant reduction in pain with buttonhole cannulation, this was not replicated in randomised controlled trials.⁵³ Whilst there are no firm conclusions about how pain is affected by cannulation techniques, our review demonstrates that pain does not solely describe patients' experiences of cannulation, with many other factors influencing this. Therefore, further research is needed into how cannulation techniques influence patients' experiences of cannulation, including pain but also measuring other aspects of patients' experiences.

Control also appeared to improve patients' experiences of cannulation. Four studies included in our review specifically explored home haemodialysis,⁴²⁻⁴⁶ generating themes around self-cannulation, with two further studies

exploring self-cannulation.^{17,33} Whilst it is tempting to believe that self-cannulation will improve cannulation experience for many patients and should be promoted, our review indicates that self-cannulation is also difficult to achieve. It is unlikely to be a viable solution for all haemodialysis patients. However, control during cannulation is also evident in non-self-cannulation.³¹ Controlling who cannulates you or where they cannulate could be a form of gaining control over the procedure. Whilst it is good to promote self-cannulation, when it is not possible, we need to think beyond self-cannulation, considering how the dynamic between the cannulator and cannulatee can promote the patient feeling in control.

A strength of our review is that we have included articles in any language, encompassing a breadth of cultural backgrounds. As with all systematic reviews, the strength of findings is limited by the quality of studies included. We did not exclude any studies due to quality, to enable exploration of the breadth of findings available. This means we have included studies of varying quality. However, the CERQual assessment (Table 4) indicates high confidence in our findings, with moderate confidence in the first theme, 'Cannulation is an unpleasant, abnormal and unique procedure'. The moderate confidence in the first theme indicates a lack of richness in understanding of the unpleasantness of cannulation. Throughout studies, there appears to be an assumption that everyone knows this unpleasantness exists, limiting the depth with which it is explored. Further research needs to really explore how cannulation is unpleasant for patients and what this means to them.

In conclusion, this systematic review illuminates patients' experiences of cannulation for haemodialysis. The synthesis of qualitative findings provides a richness and depth of understanding of this phenomenon, which would not be possible to achieve through an examination of quantitative studies. Cannulation is a pervasive procedure that impacts on patients' experiences of haemodialysis. The unpleasantness of the cannulation procedure for haemodialysis patients is evident and includes issues related to pain, abnormal appearance, vulnerability and dependency. However, we still need further understanding of this unpleasantness. The necessity of cannulation for haemodialysis emphasises the unpleasantness of the procedure, leading to worry about whether it will be successful. Worry about unsuccessful cannulation is an issue for patients, but the frequency of this event means there needs to be exploration of how we minimise this but also how we support patients through this event. Patients learn to survive repetitive cannulation, where feeling safe and in control can improve their experiences. This indicates cannulation is not just a technical skill, but also a social process. Cannulators and haemodialysis environments need to make patients feel safe and in control. Cannulation techniques may also influence these aspects, but further research is needed to determine how. Whilst this review

has helped further develop our understanding about patients' experiences of cannulation for haemodialysis, there is still much to understand about this phenomenon, to continue to improve this for haemodialysis patients.

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Author contributions

All authors have contributed to the systematic review and manuscript as follows:

- Catherine Fielding: Development of the protocol, literature search, screening of articles, data extraction, assessment of quality of articles, data synthesis, CERQual assessment, drafting of manuscript.
- Dr. Louise Bramley: Development of the protocol, data extraction, assessment of quality of articles, data synthesis, review of manuscript.
- Dr. Carol Stalker: Development of the protocol, data extraction, assessment of quality of articles, data synthesis, review of manuscript.
- Dr. Sarah Brand: Development of the protocol, data extraction, assessment of quality of articles, data synthesis, review of manuscript.
- Suzanne Toft: Development of the protocol, literature search, screening of articles, review of manuscript.
- Dr. Heather Buchanan: Development of the protocol, screening of articles, data extraction, assessment of quality of articles, data synthesis, CERQual assessment, drafting of manuscript.

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Supplemental material

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References

1. Kumwenda M, Mitra S and Reid C. Renal association clinical practice guidelines: vascular access for haemodialysis, renal.org/wp-content/uploads/2017/06/vascular-access.pdf (2015, accessed 08 November 2019).
2. Lok CE, Huber TS, Lee T, et al. KDOQI clinical practice guideline for vascular access: 2019 update. *Am J Kidney Dis* 2020; 75(4 Suppl 2): S1–S164.
3. Schmidli J, Widmer MK, Basile C, et al. Editor's choice – vascular access: 2018 clinical practice guidelines of the European Society for Vascular Surgery (ESVS). *Eur J Vasc Endovasc Surg* 2018; 55(6): 757–818.
4. Almasri J, Alsawas M, Mainou M, et al. Outcomes of vascular access for hemodialysis: a systematic review and meta-analysis. *J Vasc Surg* 2016; 64(1): 236–243.
5. Kosa SD, Bhola C and Lok CE. Hemodialysis patients' satisfaction and perspectives on complications associated with vascular access related interventions: are we listening? *J Vasc Access* 2016; 17(4): 313–319.
6. Field M, Khawaja AZ, Ellis J, et al. The vascular access questionnaire: a single centre UK experience. *BMC Nephrol* 2019; 20(1): 299.
7. Casey JR, Hanson CS, Winkelmayer WC, et al. Patients' perspectives on hemodialysis vascular access: a systematic review of qualitative studies. *Am J Kidney Dis* 2014; 64(6): 937–953.
8. Mafara K, Magarey J and Rasmussen P. The lived experience of haemodialysis patients who have had a new arteriovenous fistula cannulated in a satellite unit. *Ren Soc Australas J* 2016; 12(3): 88–92.
9. Wilson B and Harwood L. Outcomes for successful cannulation of the arteriovenous fistula: perspectives from patients on hemodialysis. *J Nephrol Nurs* 2017; 44(5): 381–388.
10. Mulder M, Hoog JO, Buytene S, et al. Validation of a screening instrument for the fear of injection in dialysis patients. *J Ren Care* 2013; 39(4): 214–221.
11. UK Renal Registry and Kidney Care UK. Patient reported experience of kidney care in England and Wales 2017, <https://www.thinkkidneys.nhs.uk/ckd/wp-content/uploads/sites/4/2018/04/PREM-report-final-2.pdf> (2018, accessed 20 December 2021).
12. Renal Association and Kidney Care UK. Patient reported experience of kidney care in the UK 2018, <https://ukkidney.org/sites/renal.org/files/PREM-report-2018-final.pdf> (2019, accessed 20 December 2021).
13. Renal Association and Kidney Care UK. Patient reported experience of kidney care in the UK 2019, <https://ukkidney.org/sites/renal.org/files/PREM-report-2019-final.pdf> (2020, accessed 20 December 2021).

- org/sites/renal.org/files/PREM-report-2019-final-web-copy.pdf (2020, accessed 20 December 2021).
14. Xi W, Harwood L, Diamant MJ, et al. Patient attitudes towards the arteriovenous fistula: a qualitative study on vascular access decision making. *Nephrol Dial Transplant* 2011; 26(10): 3302–3308.
 15. Axley B and Rosenblum A. Learning why patients with central venous catheters resist permanent access placement. *Nephrol Nurs J* 2012; 39(2): 99–103; quiz 104.
 16. Harwood L, Wilson B and Goodman M. Cannulation outcomes of the arteriovenous fistula for hemodialysis: a scoping review. *J Nephrol Nurs* 2017; 44(5): 411–425.
 17. Moore C, Majeed-Ariss R, Jayanti A, et al. How an ordeal becomes the norm: a qualitative exploration of experiences of self-cannulation in male home haemodialysis patients. *Br J Health Psychol* 2018; 23(3): 544–560.
 18. Melo da Silva DM, Gurgel JL, Escudeiro CL, et al. Satisfaccao dos pacientes com a tecnica de buttonhole/Satisfaccion de los pacientes con la tecnica de buttonhole/Patient satisfaction with the buttonhole technique. *Cogitare Enferm* 2015; 20(3): 482–486.
 19. Shamseer L, Moher D, Clarke M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. *Br Med J* 2015; 350: g7647.
 20. Tong A, Flemming K, McInnes E, et al. Enhancing transparency in reporting the synthesis of qualitative research: ENTREQ. *BMC Med Res Methodol* 2012; 12: 181.
 21. Butler A, Hall H and Copnell B. A guide to writing a qualitative systematic review protocol to enhance evidence-based practice in nursing and health care. *Worldviews Evid Based Nurs* 2016; 13(3): 241–249.
 22. Joanna Briggs Institute. Checklist for qualitative research, <https://jbi.global/critical-appraisal-tools> (2020, accessed 20 December 2021).
 23. Joanna Briggs Institute. *Joanna Briggs Institute reviewers' manual 2014*. The Joanna Briggs Institute, 2014.
 24. Lewin S, Booth A, Glenton C, et al. Applying GRADE-CERQual to qualitative evidence synthesis findings: introduction to the series. *Implement Sci* 2018; 13(Suppl 1): 2.
 25. Fischer CT. Bracketing in qualitative research: conceptual and practical matters. *Psychother Res* 2009; 19(4–5): 583–590.
 26. Bourbonnais FF and Tousignant KF. The pain experience of patients on maintenance hemodialysis. *Nephrol Nurs J* 2012; 39(1): 13–19; quiz 20.
 27. Yodchai K, Dunning T, Savage S, et al. How do Thai patients receiving haemodialysis cope with pain? *J Ren Care* 2014; 40(3): 205–215.
 28. Melo da Silva D, Rosa Andrade Silva RMC, Ramos Pereira E, et al. The body marked by the arteriovenous fistula: a phenomenological point of view. *Rev Bras Enferm* 2018; 71(6): 2869–2875.
 29. Furtado AM and Lima FET. Knowledge of the patients in treatment of hemodialysis about arteriovenous fistula. *Rev Rede Enfermagem Nordeste* 2006; 7(3): 15–25.
 30. Lima Nogueira FL, Rodrigues de Freitas L, da Silva Cavalcante N, et al. Perception of patients with chronic kidney disease regarding care towards their hemodialysis access. *Cogitare Enferm* 2016; 21(3): 1–7.
 31. Richard CJ and Engebretson J. Negotiating living with an arteriovenous fistula for hemodialysis. *Nephrol Nurs J* 2010; 37(4): 363–374; quiz 375.
 32. Romyn A, Rush KL and Hole R. Vascular access transition: experiences of patients on hemodialysis. *J Nephrol Nurs* 2015; 42(5): 445–453; quiz 454.
 33. Taylor MJ, Hanson CS, Casey JR, et al. “You know your own fistula, it becomes a part of you”—patient perspectives on vascular access: a semistructured interview study. *Hemodial Int* 2016; 20(1): 5–14.
 34. Herlin C and Wann-Hansson C. The experience of being 30–45 years of age and depending on haemodialysis treatment: a phenomenological study. *Scand J Caring Sci* 2010; 24: 693–699.
 35. Lin CC, Lee BO and Hicks FD. The phenomenology of deciding about hemodialysis among Taiwanese. *West J Nurs Res* 2005; 27(7): 915–929.
 36. Whittaker AA and Albee BJ. Factors influencing patient selection of dialysis treatment modality. . . including commentary by Messer MA, Lee JA, and Parker KP with author response. *ANNA J* 1996; 23(4): 369–377.
 37. Sanz Turrado M, Garrido Perez L and Caro Dominguez C. Factores que influyen en la satisfaccion del paciente de dialisis con enfermeria/Factors influencing the degree of satisfaction of the hemodialysis patient with nursing. *Enferm Nefrol* 2017; 20(1): 66–75.
 38. Wells S. *Occupational performance of Mexican Americans with end-stage-renal-disease living on dialysis in the lower Rio Grande Valley*. Austin, TX: University of Texas, 2009.
 39. Hagren B, Pettersen IM, Severinsson E, et al. The haemodialysis machine as a lifeline: experiences of suffering from end-stage renal disease. *J Adv Nurs* 2001; 34(2): 196–202.
 40. Hagren B, Pettersen IM, Severinsson E, et al. Maintenance haemodialysis: patients' experiences of their life situation. *J Clin Nurs* 2005; 14(3): 294–300.
 41. Piccoli GB, Bechis F, Pozzato M, et al. Daily dialysis: toward a new standard in well-being. *Hemodial Int* 2001; 5(1): 19–27.
 42. Cafazzo JA. Facilitating patient self-care through remote patient monitoring: validation, design, and evaluation of an intervention for nocturnal hemodialysis. *Diss Abstr Int Sect B Sci Eng* 2008; 69(6-B): 3540.
 43. Cafazzo JA, Leonard K, Easty AC, et al. Patient-perceived barriers to the adoption of nocturnal home hemodialysis. *Clin J Am Soc Nephrol* 2009; 4(4): 784–789.
 44. Giles S. Transformations: a phenomenological investigation into the life-world of home haemodialysis. *Soc Work Health Care* 2003; 38(2): 29–50.
 45. Hanson CS, Chapman JR, Craig JC, et al. Patient experiences of training and transition to home haemodialysis: a mixed-methods study. *Nephrology* 2017; 22(8): 631–641.
 46. Wise M, Schatell D, Klicko K, et al. Successful daily home hemodialysis patient-care partner dyads: benefits outweigh burdens. *Hemodial Int* 2010; 14(3): 278–288.
 47. Tong A, Sainsbury P, Carter SM, et al. Patients' priorities for health research: focus group study of patients with chronic kidney disease. *Nephrol Dial Transplant* 2008; 23(10): 3206–3214.

48. Kuo PY, Saran R, Argentina M, et al. Cramping, crashing, cannulating, and clotting: a qualitative study of patients' definitions of a "bad run" on hemodialysis. *BMC Nephrol* 2020; 21(1): 67.
49. Coventry LL, Hosking JM, Chan DT, et al. Variables associated with successful vascular access cannulation in hemodialysis patients: a prospective cohort study. *BMC Nephrol* 2019; 20(1): 197.
50. White K, Fielding C, Rhodes C, et al. Development of a haemodialysis patient safety index. *J Kidney Care* 2018; 3(2): 96–101.
51. van Loon MM, Kessels AG, van der Sande FM, et al. Cannulation practice patterns in haemodialysis vascular access: predictors for unsuccessful cannulation. *J Ren Care* 2009; 35(2): 82–89.
52. Harwood LE, Wilson BM and Oudshoorn A. Improving vascular access outcomes: attributes of arteriovenous fistula cannulation success. *Clin Kidney J* 2016; 9(2): 303–309.
53. Wong B, Muneer M, Wiebe N, et al. Buttonhole versus rope-ladder cannulation of arteriovenous fistulas for hemodialysis: a systematic review. *Am J Kidney Dis* 2014; 64(6): 918–936.