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# Peripheral intravenous cannulation decision making in emergency settings: A qualitative descriptive study.

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## ABSTRACT

### Objectives

Rates of unused *('idle')* peripheral intravenous catheters (PIVCs) are high but can vary per setting. Understanding factors that influence the decision making of doctors, nurses and paramedics in the emergency setting regarding PIVC insertion, and what factors may modify their decision is essential to identify opportunities to reduce unnecessary cannulations and improve patient-centred outcomes. This study aimed to understand factors associated with clinicians' decision making on when to insert or use a PIVC in the emergency care setting.

### Design

A qualitative descriptive study using in-depth semi-structured interviews and thematic analysis. Interviews were recorded, transcribed verbatim and then thematically analysed by three researchers.

### Setting

Gold Coast, Queensland, Australia, in a large tertiary level Emergency Department (ED) and local government ambulance service.

### Participants

Participants recruited were ED clinicians (doctors, nurses) and paramedics who regularly insert PIVCs. Five clinicians from each discipline were interviewed. A variety of skill and experience levels across these groups were purposively selected.

### Results

From the fifteen clinicians interviewed four key themes: *knowledge and experience, complicated and multifactorial*, *convenience, anticipated patient clinical course,* and several sub-themes emerged relating to clinician decision-making across all disciplines. The first two themes focused on decision-making to gather data and evidence, such as '*knowledge and experience'*, and decisions being *"complicated and*

*multifactorial*'. The remaining two themes related to the actions clinicians took such as *'convenience'* and *'anticipated patient clinical course'*.

**Conclusion**

Many PIVCs are inserted with no immediate need or use, and decision making around PIVC insertion is complex. When considering PIVC insertion, more time needs to be devoted to the awareness of; 1) decision making in the context of the clinicians own experience, 2) Cognitive biases, and 3) Patient centred factors. Such awareness will support an appropriate risk assessment which will benefit the patient, clinician, and healthcare system.

**Strengths and limitations of this study**

- This study provides new insights into how emergency care clinicians consider PIVC insertion and use.
- Emergency care clinicians from multi-disciplinary backgrounds interviewed, including paramedics, doctors, and nurses.
- Data collected from a single centre; further themes may have emerged with broader sampling.

## INTRODUCTION

Billions of peripheral intravenous catheters (PIVCs) are inserted globally every year; they are a fundamental part of emergency health care.[1-3] As a result the PIVC has become an ingrained and ubiquitous part of modern medicine. Clinicians are comfortable with its presence, it has become part of the environment like the patient gown or cubical curtain, in plain sight, yet invisible.[4] Many of these PIVCs are inserted in the Emergency Department (ED) or pre-hospital setting, where patients suffering severe trauma and life-threatening medical emergencies are managed.[5] The PIVC is a relatively cheap, simple way to manage patients' symptoms through the administration of analgesics or fluids and improve diagnostic accuracy with the use of intravenous contrast dye.[5] It is clear the PIVC is an integral part of the modern emergency health care system, with many clinicians of different professions possessing varying skill levels for PIVC insertion.[6]

While there are clear benefits, PIVC insertion can be a traumatic and painful procedure for many patients.[7] First time insertion failure is common, occurring in up to 32% of insertion attempts and is not only distressing for patients, but has been known to result in needle-phobia and hospital avoidance.[8] A PIVC can pose a serious risk to patients as each insertion breaches the patient's skin and can act as a conduit for hazardous pathogens to enter the patient's bloodstream.[9] Most PIVC complications are associated with inflammatory processes such as phlebitis which occurs in 18-54% of PIVCs insertions.[10-14]

With the abundant use of PIVCs in the emergency setting, it is likely that many patients are suffering these complications unnecessarily.[2] Clinicians can perpetuate this with the need or compulsion to intervene and the mindset that doing something is better than doing nothing. However this may not always be the case.[15] The idle PIVC is a catheter that is inserted and never used; it exposes the patient to avoidable harm, provides no benefit to the patient, and has additional, unnecessary costs for the healthcare system.[16] In the emergency setting, idle PIVCs are common, with up to 50% of PIVCs placed "just in case".[17] An observational study from an ED in Australia reported that one-third of PIVCs inserted did not have a clinical indication.[18] Further, patients requiring an in-patient admission who had a pre-hospital PIVC were 4 times more likely to receive an additional PIVC.[18]

How clinicians determine the appropriateness for PIVC insertion, and their perceptions of the risks associated with the procedure, requires a detailed and comprehensive examination. Previous work from London studied paramedics' intentions to cannulate using the theory of reasoned action.[19] This study found that past PIVC insertion behaviour was directly related to the intention to place further PIVCs and subsequently called for future research to examine social psychological theories to better understand clinicians' behaviours surrounding PIVC insertion.[19] Surveys of patients who had a PIVC placed by a paramedic found that patient distress was higher if the patient had no understanding of why the PIVC was placed.[20]

In-hospital studies have described the experiences, knowledge and attitudes towards PIVC from both doctors and nurses.[21, 22] These studies identified that junior doctors had a poor understanding of the risks associated with PIVC insertion and lacked knowledge about common PIVC adverse events. Nurses acknowledged that taking more time when inserting a PIVC is one of the most important factors for successful PIVC placement in difficult patients, whilst nursing students highlighted inconsistencies in practices between clinicians impeded learning and knowledge translation regarding PIVC insertion.[22, 23] Previous intervention studies that have introduced a human factors approach have successfully reduced the rate of idle PIVCs in single centre studies; however, a higher yield may be possible with a greater understanding of clinical decision making amongst emergency staff.[16, 24] Decision making regarding PIVC insertion is complex, often leading to more questions surrounding decision points of PIVC insertion or removal, resulting in answers that are ambiguously stated as "it depends".[25] Furthermore, this research highlighted that clinicians of different disciplines such as doctors, nurses or paramedics had differing views on PIVC insertion and removal.[25]

Understanding factors that influence the decision making of doctors, nurses and paramedics in the emergency setting regarding PIVC insertion, and what factors may modify their decision is essential to identify opportunities to reduce unnecessary cannulations and improve PIVC practices. This is the first Australian study to explore PIVC decision making amongst the multidisciplinary emergency care cohort.

**Aim**

To understand factors associated with clinicians' decision making on when to insert or use a PIVC in the emergency care setting.

## METHODS

### Design

This research used a qualitative descriptive approach based on the approach by Sandelowski (2010) and Colorafi (2016).[26, 27] Additionally, this research used the Standards for Reporting Qualitative Research (SRQR) guidelines as advocated by the Enhancing the QUAlity and Transparency Of health Research (EQUATOR) Network.[28]

### Setting

This study was set in the Gold Coast, Queensland, Australia. The population in this region is approximately 570,000 based on the most recent government census.[29] In addition the region has a large tourism focus, based on key tourism events and holiday periods. The area is serviced by a large mixed adult and paediatric tertiary level trauma centre emergency department (ED), which sees over 110,000 presentations annually. Additionally, prehospital paramedical services are provided by the local government ambulance service who see approximately 122,000 patients annually.

### Population / sample

The population for this study included over 100 medical and 280 nursing staff from the tertiary level ED, and over 433 staff from the local ambulance service that were invited to respond.

A purposive sample of fifteen participants were recruited with the intention to recruit additional participants if saturation of data was not achieved. Five clinicians from each discipline (paramedics, nurses, medical officers) volunteered their interest and participate in this research.

### Participant recruitment

A purposive sampling technique with snowballing was used to recruit participants. This was achieved via a group e-mail, sent through normal health service communication distribution lists, inviting participants to be involved in the study. Additionally, posters were placed in the workplace to further distribute the invitation to potential participants. Health professionals who expressed interest in the

study were emailed a participant information and consent form. Prior to the interviews, participants completed a written informed consent.

**Data collection**

Narratives were obtained from 15 participants between July and September 2020 via individual, one point in time per participant, semi-structured interviews. This was found to be an appropriate number of participants to explore the complexity of decision making relating to PIVC insertion. A trained research assistant [MC] who is an emergency nurse, with regular support from a qualitative research expert [JR], who is also an emergency nurse, conducted the interviews. The semi-structured interview questions were orientated to the research question and informed by existing literature, local experts and results of a recent study regarding PIVC insertion in the pre-hospital and ED context.[30] An interview schedule was created to ensure consistency between interviews. Due to the COVID-19 pandemic, the planned face-to-face interviews were instead conducted via Microsoft Teams at a mutually agreeable time between the researchers and participants. The interviews were recorded using Microsoft Teams and transcribed verbatim for analysis.

**Data analysis**

Once transcribed, data were thematically analysed using the six step approach as outlined by Braun and Clarke.[31] Three of the authors [HE, JR, MC] concurrently and independently completed the first three steps: familiarisation with the data, generating initial codes and searching for themes. Step four, reviewing themes, was undertaken collectively between three authors [HE, JR, MC]. During this step, consensus was reached through detailed conversation and critical questioning resulting in an agreement of the key themes and sub-themes. Step five consisted of a presentation of the main themes and sub-themes, with participant exemplars, to the remainder of the research team [GK, NM, AS, JB, CR]. During this presentation, research team members were encouraged to critically question the three authors [HE, MC, JE] in defining and naming the themes and sub-themes. Minor modifications to the sub-themes were made during this step. Finally, step 6, producing the report, occurred during the drafting and writing of this paper. Throughout the research process, the authors were conscious of

the various elements of trustworthiness, such as credibility, dependability, conformability, transferability, and authenticity.[32] These aspects have been implicitly outlined throughout this methodological section.

**Ethics approval and consent to participate**

Ethical approval to conduct this research was received by the Gold Coast Health Human Research Ethics Committee, reference: HREC/2019/QGC/53353. Participation in this research was voluntary. The transcriptions were anonymised, and names replaced with alphanumerical pseudonyms. The alphanumerical pseudonyms represent, D for doctor, N for nurse and P for paramedic, where the number represents the order of interview.

**Patient and Public Involvement**

No patients involved.

**RESULTS**

The average age of participants was 37 years with eight males and seven females. All participants were practicing clinicians within the ED or pre-hospital setting (paramedics). The data analysis revealed four main themes, 1) Knowledge and experience, 2) Complicated and multifactorial, 3) Convenience, and 4) Anticipated clinical course. Additionally, 32 sub-themes were identified under these four themes. The first two main themes relate to gathering data and evidence to inform decision making, which involved the clinicians' knowledge and experience, and was complex and multifactorial (Table 1-2). The other two themes relate to actions clinicians do, associated with decisions of convenience and considering the anticipated clinical course of the patient (Table 3-4). A short description and some participant narrative exemplifying the themes are outlined below. Of note, many of the sub-themes and exemplars within these themes are overlapping and interconnected. As such, factors are not independent of one another and occur in a synergistic manner. Further, exemplars are included as representations of the participants' narrative.

**Gathering data and evidence**

When making a decision to insert or use a PIVC, clinicians use their own knowledge and experience, data which has been accumulated over years of practice. This helps create a "data bank" of evidence for the clinician consisting of multiple components. The various components that clinicians considered drawing on their knowledge and experience are outlined (see Table 1-2).

**Table 1.**

| **Theme 1: Gathering data and evidence: knowledge and experience** | |
|---|---|
| **Sub-themes:** PIVC saves lives, perspectives change with more experience, skills maintenance, using policy and/or protocols, to a point | |
| Participants stated that on some occasions, they have witnessed timely insertion of PIVCs that have saved lives. On these occasions, the PIVC was integral to the successful management of a patient and interviewees attributed survival to appropriate placement of a PIVC. Therefore, in situations that may be life threatening, PIVCs are inserted | *". . . certainly haemorrhaging patients you need large bore access to be able to give the fluids and blood products faster. I've certainly seen patients where that can be lifesaving in my career." (D5)*<br><br>*". . . without IV access, she probably, would have seized, and died on the way to hospital." (P5)* |
| As clinicians gain experience and become more comfortable with the procedural competency of PIVC insertion. This experience influences their decisions to insert or not insert a PIVC. | *"I guess as you kind of move through a year [of] registrar training, you start to move on to bigger and better procedures. Like the, the victory lap of getting a difficult cannula in probably matters less." (D3)*<br><br>*". . . I think I've come to realise when a patient does and doesn't need a cannula . . . when I was a grad or whatever you want everybody [to get] a cannula because that was just the way things were done. But as time's progressed not only within myself, but as a culture, I think cannulas are less sort of important . . ." (N3)* |

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| Many clinicians said that they have inserted PIVCs to improve their skills or maintain their skill level. This aspect, combined with clinicians seeing PIVCs as potentially lifesaving, are contributors in their decision to insert cannulas. | *"The only way you get good at cannulation is by cannulating people, which means that looking around you for every gun cannulator that's in ED and anaesthetics, there's, you know, thousands of patients that have on a low level been traumatised . . ." (D3)*<br><br>*"I would have put cannulas in people to keep my skills up." (P2)* |
| Clinicians identified that there are a lack of decision trees or algorithms to help with decision making and that policy and or protocols guide them, to a point. | *"It's too complex to have like a nice, simple algorithm" D3.*<br><br>*". . . clinically by looking at the child, but also following State-wide guidelines for that one." D4*<br><br>*"Somebody would have come along and said . . . this patient's going to [cardiac] cath lab. If you follow the checklist here partway down the checklist it says two large bore IV cannulas." N3* |

**Table 2.**

| **Theme 2: Gathering data and evidence: Complicated and multifactorial** | |
|---|---|
| **Sub-themes:** *Patient*-Primary complaint and differential diagnosis, needle-phobia, repeat tests, paediatric versus adult, patient expectations; *Other*-Time to ED | |
| Regardless of knowledge and experience, the decision to insert a PIVC is often multifactorial, including patient and other factors such as local policy or environment. The primary complaint and differential diagnoses influenced the decision making of clinicians, with trauma and cardiac presentations likely to receive a PIVC. Participants described how the limited information and time constraints of emergency medicine can lead to over-cannulation. | *"Obviously it's about making decisions with limited information in a timely manner. Inevitably that will mean that we over cannulate people." (D5)*<br><br>*"I know that there's going to be an ongoing ah requirement for pain relief or some type of intervention IV… they're, they're basically the two, two major categories, yes, trauma and cardiac." (P1)* |

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| Many clinicians identified that patients with needle-phobias influenced the approach taken by them as emergency care clinicians for this patient cohort. | *"I had someone ask for nitrous, an adult ask for nitrous, prior to having the cannula inserted, because they'd had such a bad experience in the past, of people attempting, and failing multiple times." (N1)*<br><br>*"There's probably an argument that we can cause a bit of post-traumatic stress disorder, and pain, especially if we're restraining patients to gain IV access. I'm thinking particularly about mental health patients, and our paediatric patients." (P5)* |
| Clinicians had difficulty in deciding whether phlebotomy or PIVC was the best choice for patients; however, if the patient was likely to require repeat tests, a PIVC was likely to be inserted. | *"I think venepuncture's easier on the patient and easier to get. Like it's harder to get a nice stable flushing cannula in, than to steal a bit of blood, and you can use a much smaller needle to get blood, so overall I think that venepuncture is easier and probably safer infection wise." (N5)*<br><br>*"And that's the thing you hate when you do a normal needle stick is, you've mislabelled something or the specimen is haemolysed and all you've done is, a phlebotomy and you come back 15 minutes later and tell the patient that they need another needle." (D3)* |

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| Clinicians described giving more thought to placing a PIVC in a child compared to an adult. | *"I think if we applied the same principles that we do to paediatrics to adults that would probably change our mindsets. We're very happy to stab an adult, whereas we think twice when it comes to a paediatric patient." (D2)*<br><br>*". . . adults, sometimes it's a lot easier to . . . educate them on the need for the cannula and then they're more accepting of getting one." (N4)*<br><br>*"Cannulating a paediatric [patient], one, it's traumatising because, you know, they're upset and, and there's a lot of emotion involved, and then two, you're working with little structures." (P1)* |
| It was identified by clinicians that they believe some patients expect a PIVC to be inserted, which adds pressure on the clinician to insert a PIVC. | *"It's something that we quite frequently do in the emergency department and is almost nearly expected from a lot of people, as part of their treatment, when they come in, is that they need fluids through a drip, or they need medications through the drip, and we probably cave to that more often than we should." (N1)*<br><br>*"I guess some adults want a cannula. They feel that if they have one, then they must really need to be in hospital as well" (N4)* |

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| Pre-hospital clinicians considered the distance to the ED in their decision making. Participants describe that patients who are at a considerable distance to hospital are likely to get to a PIVC if they needed interventions. Conversely, paramedics would forgo PIVC insertion even if the patient was critically unwell, yet close to hospital resulting in a short transport time. | *"Say you're on the other side of [town] and it's a long transport time, then you could justify having multiple attempts and spending time to try and get that cannula in to get that thrombolysis, because in the long run if you can get that in and get the thrombolysis in . . . as opposed to someone who you were trying to put one into maybe an anti-emetic and you go, well we could probably just give them a wafer and leave the cannula." (P2)*<br><br>*"So, patient acuity, and also distance to hospital. They could be really sick, and two minutes from the hospital, and I'd just happily just deliver them there and say, look, sorry guys [ED doctors and nurses]." (P4)* |

**Undertaking actions**

Once clinicians had gathered evidence and data as outlined above, this would then form the basis for the clinicians' actions regarding PIVC insertion, removal and/or use that was based on convenience and the patient's anticipated clinical course (see Table 3-4).

**Table 3.**

| **Theme 3: Undertaking actions: Convenience** | |
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| **Sub-theme:** PIVC equipment at hand, no venepuncture close, allocated bed space | |
| The insertion of a PIVC can sometimes be related to the convenience of having the appropriate equipment at hand. Clinicians within the ED identified that the lack of phlebotomy equipment contained in vascular access trolleys throughout the ED led to them inserting a PIVC. | *"If we had the phlebotomy gear on the top of the cannulation trolley so we thought about it, that would be first rather than cannulation first or something." (D4)*<br><br>*"There is a lot of education about [using venepuncture over PIVC] but it's more, I guess, access to the right equipment as well." (N4)* |

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| Participants based in ED stated that patients would receive a PIVC depending on their allocated bed area. For example, patients in the acute area get a PIVC, as opposed to the minor injuries area. | *". . . any patient that rocks up to ED that gets streamed . . . to acute or resus is automatically almost a knee jerk reaction that they get bloods and that's usually via a cannula insertion." (D5)*<br><br>*". . . as nurses or doctors, [we] tend to put cannulas in to get bloods. We tend to leave that in and I think that's just a part of the culture with the emergency department and I guess um, I don't know why we do it." (N2)* |

**Table 4.**

| **Theme 4: Undertaking actions: Anticipated clinical course** | |
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| **Sub-theme:** *Flow / journey*- Maybe used by others (ambulance to ED, or ED to in-patient), time pressures and patient flow; *Clinical*- Medications (analgesia, fluids etc…), better to put one in a well patient, before they become unwell, location and size of cannula | |
| Emergency care clinicians describe inserting PIVCs based on the anticipated clinical course for the patient. For example, pre-hospital clinicians will insert PIVCs if it is anticipated that the PIVC will be used in ED and that they are assisting the ED by inserting one. The same was identified by ED clinicians whereby a PIVC would be inserted to smooth the patient journey from the ED to an in-patient unit. | *". . . when we go through the hospital, what's their likely pathway? Are they going to be sitting on an ambulance stretcher for two or three hours? I'm thinking that I'm going to add value to the hospital and the patient journey in terms of onwards through the system". (P1)*<br><br>*". . . there's definitely been sometimes where you're like, you know, borderline, borderline, oh look, let's just give them IVs to, to smooth their ride into the hospital." (D3)* |

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| The ED in this setting is extremely busy, the time pressures associated with this workload results in many patients receiving a PIVC, and most likely to reduce the wait time for patients rather than actual clinical needs. Peripheral Intravenous Cannula insertion is perceived to hasten flow of patients through the ED, even if the device is not required. | *"A lot of our staff on arrival time do cannula blood tests because they feel that's probably really good to get the ball rolling per se." (D1)*<br><br>*". . . with the busyness of our emergency department . . . we want everything sorted before they get to the doctor, so that the bloods are back and that the doctor can just see them and that's I guess [a] faster turnover." (N2)*<br><br>*". . . that seems to be the big driver for cannulas, is just to get patients through quickly". (D3)* |
| The vast majority of clinicians insert PIVCs with the intention for administration of pain relief, or in patients that could become unwell; however, many are also inserted for the sole purpose of collecting blood samples. | *". . . we manage pain, with cannulas, which is probably the biggest one, especially pain that can't be, controlled with paracetamol or other orals, that they [the patient] may have at home. Giving those strong narcotics is, probably the most common thing that we use it for." (P3)*<br><br>*". . . for me it's [the insertion of a PIVC] the bleeding, severe abdominal pain, respiratory distress, suspected cardiac abnormality, as well as the abnormal haemodynamics, blood pressure, heart rate." (D2)*<br><br>*"So I guess my main reason for putting cannulas in are probably to get bloods. Unless the patient is obviously sick [then it's inserted for other reasons too]." (D5)* |

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| Emergency clinicians have seen patients deteriorate very quickly and unexpectedly; this in turn leads to them inserting a PIVC even in well patients, as participants describe that it is better to insert a PIVC and not need it, rather than need a PIVC and not have one inserted. | *". . . so having seen patients go off, deteriorate very quickly, I would always err on the side of caution in those kinds of cases [and insert a PIVC]." (D5)*<br><br>*"If we're not only looking at analgesia requirements, then yes, I would like to have a cannula in place in case their condition changes, and it becomes harder to establish IV access." (P5)*<br><br>*"Particularly the more junior doctors who are, you know, they feel it's almost like a comfort thing when you're not sure about the acuity of the patient." (D2)* |
| Clinicians had varying approaches to selecting the size and location of PIVC insertion, with past experiences influencing their decisions. Placing an 18 gauge PIVC in an antecubital fossa was the default choice for most clinicians. | *"I also think that we've probably been in the situation that you put one somewhere else, their forearm or hand, and then had to replace it later in the cubital fossa for a scan, so then we just learnt to just put in the cubital fossa, without thinking about it." (D4)*<br><br>*". . . as I've moved around the [emergency] department in terms of, the different areas and the increase of patient acuity and severity. Picking up a cannula and selecting [the right] gauge is very important." (N2)* |



## DISCUSSION

The aim of this research was to understand factors associated with clinicians' decision making on when to insert or use a PIVC in the emergency care setting. This is the first Australian study to explore PIVC decision making amongst this multidisciplinary emergency care cohort.

Within the emergency setting, four main themes that influenced clinician decision making and actions around PIVC insertion were identified: Knowledge and experience, complicated and multifactorial, convenience, anticipated clinical course.

Clinicians' experiences had significant bearing on their decisions for PIVC insertion. Clinicians could recall that whilst junior, they were more likely to insert a PIVC in comparison to now. This reflected various factors, including the importance placed on the procedure; PIVC insertion was seen as a

lifesaving intervention and that "*you live and die by vascular access in the ED*". Insertion of a PIVC is one of the first invasive and painful procedures that emergency clinicians perform, and as such there is a degree of hubris with successful PIVC insertion; "victory laps" "tally boards" and "gun cannulators" were all described. This likely led to clinicians, especially early in their training, inserting PIVCs for practice, or skills maintenance. However, with time and experience, the pride associated with successful PIVC insertion seems to fade, this may be because it has been replaced with another more advanced skill such as intubation or that the clinician is more aware of the true value and risks associated with PIVCs.[21]

Decision making surrounding PIVC insertion is complicated and multifactorial; it is far more complex than most clinicians realise. The dual process theory of decision making suggests that decisions are made using two distinct pathways. Using system 1, people act instinctively or in line with a learnt reflex that requires very little conscious effort; however, system 2 requires metacognition, engagement and effort.[33] Reverting to system 1 is not uncommon in healthcare and this was demonstrated amongst our participants with most inserting a PIVC as a reflex rather than engaging in a purposeful, critical thought process.[34] Patient factors influenced decision making and the sub-themes we identified included the patient's medical history, primary complaint, differential diagnosis, vital signs, and having the perception of an unwell versus well patient. Additionally, needle-phobia had a significant impact on clinician decision making, especially when the patient required blood collection for pathology. There were queries surrounding whether to insert a PIVC when repeated blood draws were required as opposed to using the venepuncture method twice; this was a particularly pertinent consideration for needle-phobic patients and presented as a prominent theme. Blood twice? Our results suggest that most ED clinicians would rather insert one cannula, providing it is successful on the first attempt, rather than perform two venepunctures; however, the common complication of haemolysis resulting from drawing pathology from a PIVC was not discussed by any clinician.[35] Paramedics' transport time to ED was another factor; paramedics aware of their proximity to hospital would forgo PIVC insertion prior to transport if they were close to hospital. Some patients expected a PIVC to be inserted as it may be perceived as an indicator or marker of how unwell they are and that they are being appropriately cared for; hence placing pressure on the clinician to insert a PIVC in potentially clinically inappropriate circumstances. Similar findings to ours have been found in recent literature.[25]

Most clinicians would agree that a sick child presents a different set of challenges for the clinicians that care for them. With worried parents and an upset child adding an extra element of stress, the avoidance of further distressing parents and patients alike via PIVC insertion, is highly desirable. This was evident with vastly different decision-making factors for PIVC insertion in adults versus children. Clinicians were more judicious about inserting a PIVC in a child due to the associated stress and

trauma it may cause for both the patient and their parents or guardians. This is a unique perspective as the clinical need for the PIVC is essentially the same for adults and children, however the paediatric population influenced the clinician into a thought process of avoidance rather than routine insertion.

For our respondents, the PIVC was seen as a device to speed up patient flow through the ED. Time pressures to move patients through the ED were a recurrent theme. ED staff perceived it as easier to manage the patient with a PIVC in place. A PIVC was perceived to provide a safety net in the event of patient deterioration *"just in case" "to be safe" "better to put one in a well patient before they become unwell"*. This has precipitated a "knee jerk" reaction around PIVC placement for ED clinicians, with an, "everyone in ED gets a PIVC" mentality prevailing. Recent literature suggests that if clinicians think about the probability of the PIVC actually being used, a reduction in the rate of unused PIVCs can be expected; it is likely that if a similar intervention was implemented among this population, it would yield comparable results.[16, 24]

Environmental and cognitive factors also play an important role in the decision making within the ED *"the trolleys at triage are set up for cannulation, not venepuncture"*. Clinicians reported that the easiest option was to insert a PIVC rather than to source a phlebotomy kit. These subtle nudges have an impact on decision making and help reinforce the psychology of system 1.[36] For example, a trolley with phlebotomy materials in the top drawer, with PIVCs out of sight would nudge a clinician towards venepuncture.[36] Clinicians had clear decision making for patients that required a PIVC for a specific purpose including the administration of blood products, fluids, antibiotics, analgesia and for pre-empting the use of diagnostic imaging requiring intravenous contrast. This aligns with recent literature examining decision aids for PIVC insertion.[18] For these patients that have an actual need for the device, the nudge is likely to be overridden and the clinician will insert a PIVC that has a high probability of being used.

For paramedics, the limited time spent with patients often means an early judgement call must be made on the patient's likely clinical trajectory. Similar to ED staff, a *"to be safe"* approach was used, erring on the side of caution, with paramedics preferring to insert a PIVC in a stable patient, rather than having difficulty trying to insert one in a patient already in extremis. Paramedics also would insert PIVCs in anticipation of the PIVC going on to be used in the ED (most likely for pathology, IV medications or diagnostic imaging).

## CONCLUSION

The decision to insert a PIVC is more complicated than clinicians, administrators and policymakers may realise. When explored, clinician decisions were multifaceted with many factors influencing the decision to insert a PIVC. In actual practice, clinicians routinely insert PIVCs in most patients as a learnt reflex with little cognitive input, with the exception of children and needle-phobic patients.

At the time of PIVC insertion, more time needs to be devoted to the awareness of; 1) decision making in the context of the clinicians own experience, 2) Cognitive biases, and 3) Patient centred factors. Such awareness will support an appropriate risk assessment which will benefit the patient, clinician, and healthcare system.

**Limitations**

While this study involved emergency care clinicians from a variety of disciplines, the sample was from a single centre, further themes may have emerged with broader sampling. As a result, the data generated may not be generalisable with other populations. While saturation of data was achieved a variation of themes may have emerged with a larger sample.

**Competing interests**

NM reports investigator-initiated research grants and speaker fees provided to Griffith University from vascular access product manufacturers (Becton Dickinson, 3M, Eloquest Healthcare and Cardinal Health); and a consultancy payment for expert advice from Becton Dickinson. CR discloses that her current or previous employers have received funding on her behalf in the form of investigator initiated research grants from BD-Bard, Cardinal Health, and Eloquest Healthcare as well as consultancy payments from 3M and BD Bard. All other authors declare that they have no competing interests.

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**Data sharing**

The datasets generated and/or analysed during the current study are not publicly available due to local ethics and governance regulations but are available from the corresponding author on reasonable request.

**Authors' contributions**

HE, developed concept, led project and wrote manuscript. MC performed interviews, analysis and assisted with manuscript writing. GK assisted with concept development, manuscript writing and supervision of HE. NM provided intellectual input, content expertise and assisted with manuscript preparation. AS assisted with concept development, assisted with manuscript writing. JB provided intellectual input and assisted with manuscript preparation. CR provided intellectual input, content expertise, interpretation of results and assisted with manuscript preparation. PC provided intellectual

input, content expertise, and with manuscript preparation. JR assisted with concept development, interviews, data analysis and manuscript writing and supervised HE.

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# Peripheral intravenous cannulation decision making in emergency settings: A qualitative descriptive study.

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## ABSTRACT

### Objectives

Rates of unused *('idle')* peripheral intravenous catheters (PIVCs) are high but can vary per setting. Understanding factors that influence the decision making of doctors, nurses and paramedics in the emergency setting regarding PIVC insertion, and what factors may modify their decision is essential to identify opportunities to reduce unnecessary cannulations and improve patient-centred outcomes. This study aimed to understand factors associated with clinicians' decision making on whether to insert or use a PIVC in the emergency care setting.

### Design

A qualitative descriptive study using in-depth semi-structured interviews and thematic analysis.

### Setting

Gold Coast, Queensland, Australia, in a large tertiary level Emergency Department (ED) and local government ambulance service.

### Participants

Participants recruited were ED clinicians (doctors, nurses) and paramedics who regularly insert PIVCs.

### Results

From the fifteen clinicians interviewed four key themes: *knowledge and experience, complicated and multifactorial*, *convenience, anticipated patient clinical course,* and several sub-themes emerged relating to clinician decision-making across all disciplines. The first two themes focused on decision-making to gather data and evidence, such as '*knowledge and experience'*, and decisions being *"complicated and multifactorial*'. The remaining two themes related to the actions clinicians took such as *'convenience'* and *'anticipated patient clinical course'*.

**Conclusion**

The decision to insert a PIVC is more complicated than clinicians, administrators and policymakers may realise. When explored, clinician decisions were multifaceted with many factors influencing the decision to insert a PIVC. In actual practice, clinicians routinely insert PIVCs in most patients as a learnt reflex with little cognitive input. When considering PIVC insertion, more time needs to be devoted to the awareness of; 1) decision making in the context of the clinician's own experience, 2) cognitive biases, and 3) patient centred factors. Such awareness will support an appropriate risk assessment which will benefit the patient, clinician, and healthcare system.

**Strengths and limitations of this study**

- This study provides new insights into how emergency care clinicians consider PIVC insertion and use.
- Emergency care clinicians from multi-disciplinary backgrounds interviewed, including paramedics, doctors, and nurses.
- Data collected from a single centre; further themes may have emerged with broader sampling.

## INTRODUCTION

Billions of peripheral intravenous catheters (PIVCs) are inserted globally every year; they are a fundamental part of emergency health care.[1-3] As a result the PIVC has become an ingrained and ubiquitous part of modern medicine. Clinicians are comfortable with its presence, it has become part of the environment like the patient gown or cubical curtain, in plain sight, yet invisible.[4] Many of these PIVCs are inserted in the Emergency Department (ED) or pre-hospital setting, where patients suffering severe trauma and life-threatening medical emergencies are managed.[5] The PIVC is a relatively cheap, simple way to manage patients' symptoms through the administration of analgesics or fluids and improve diagnostic accuracy with the use of intravenous contrast dye.[5] It is clear the PIVC is an integral part of the modern emergency health care system, with many clinicians of different professions possessing varying skill levels for PIVC insertion.[6]

While there are clear benefits, PIVC insertion can be a traumatic and painful procedure for many patients.[7] First time insertion failure is common, occurring in up to 32% of insertion attempts and is not only distressing for patients, but has been known to result in needle-phobia and hospital avoidance.[8] A PIVC can pose a serious risk to patients as each insertion breaches the patient's skin and can act as a conduit for hazardous pathogens to enter the patient's bloodstream.[9] Most PIVC complications are associated with inflammatory processes such as phlebitis which occurs in 18-54% of PIVCs insertions.[10-14]

With the abundant use of PIVCs in the emergency setting, it is likely that many patients are suffering these complications unnecessarily.[2] Clinicians can perpetuate this with the need or compulsion to intervene and the mindset that doing something is better than doing nothing. However this may not always be the case.[15] The idle PIVC is a catheter that is inserted and never used; it exposes the patient to avoidable harm, provides no benefit to the patient, and has additional, unnecessary costs for the healthcare system.[16] In the emergency setting, idle PIVCs are common, with up to 50% of PIVCs placed "just in case".[17] An observational study from an ED in Australia reported that one-third of PIVCs inserted did not have a clinical indication.[18] Further, patients requiring an in-patient admission who had a pre-hospital PIVC were 4 times more likely to receive an additional PIVC.[18] Previous qualitative research from the United

States of America has highlighted that PIVCs are often the last medical device removed prior to discharge.[19] This study identified several themes around PIVC use insertion and removal centred around "knowledge and skills", "organisational policies and practices" patient centric", "emotional response", and the "expectations of others".[19]

Understanding factors that influence the decision making of doctors, nurses and paramedics in the emergency setting regarding PIVC insertion, and what factors may modify their decision is essential to identify opportunities to reduce unnecessary cannulations and improve PIVC practices. This is the first Australian study to explore PIVC decision making amongst the multidisciplinary emergency care cohort.

### Aim

To describe factors associated with clinicians' decision making on whether to insert or use a PIVC in the emergency care setting.

## METHODS

### Design

This research used a qualitative descriptive approach based on the approach by Sandelowski (2010) and Colorafi (2016).[20, 21] Additionally, this research used the Standards for Reporting Qualitative Research (SRQR) guidelines as advocated by the Enhancing the QUAlity and Transparency Of health Research (EQUATOR) Network.[22]

### Setting

This study was set in the Gold Coast, Queensland, Australia. The population in this region is approximately 570,000 based on the most recent government census.[23] The region has a large tourism focus, based on key tourism events and holiday periods. The area is serviced by a large mixed adult and paediatric tertiary level trauma centre emergency department (ED), which sees over 110,000 presentations annually. Additionally, prehospital paramedical services are provided by the local government ambulance service who see approximately 122,000 patients annually.

**Population / sample**

The population for this study included over 100 medical and 280 nursing staff from the tertiary level ED, and 433 staff from the local ambulance service that were invited to respond. A purposive sample of fifteen participants was determined a priori, with potential to interview more if saturation was not reached. This sample was considered an appropriate number of participants to explore the complexity of decision making relating to PIVC insertion. Five clinicians from each discipline (paramedics, nurses, medical officers) volunteered their interest and participate in this research.

**Participant recruitment**

A purposive sampling technique with snowballing was used to recruit participants. This was achieved via a group e-mail, sent through normal health service communication distribution lists, inviting participants to be involved in the study. Additionally, posters were placed in the workplace to further distribute the invitation to potential participants. Health professionals who expressed interest in the study were emailed a participant information and consent form. Prior to the interviews, participants completed a written informed consent. In total 9 paramedics, 9 nurses and 12 medical staff responded to the invitation. The first five clinicians from each group who expressed interest participated in the interviews. All fifteen agreed and none dropped out or refused to participate.

**Data collection**

Narratives were obtained from 15 participants between July and September 2020 via individual, one point in time per participant, semi-structured interviews. The interview schedule is available as supplementary material.. A trained research assistant [MC] who is an emergency nurse, was supported from a qualitative research expert [JR], who is a qualitative doctoral prepared emergency nurse, conducted the interviews. Researcher JR conducted the first two interviews with MC as an observer. Researcher MC then conducted two interviews with JR as an observer. All further interviews were conducted by MC and reviewed by JR.

The semi-structured interview questions were orientated to the research question and informed by existing literature, local experts and results of a recent study regarding PIVC insertion in the pre-hospital and ED context.[24] An interview schedule was created to ensure consistency between interviews.

Due to the COVID-19 pandemic, the planned face-to-face interviews were instead conducted via Microsoft Teams at a mutually agreeable time between the researchers and participants. The interviews were recorded using Microsoft Teams and transcribed verbatim for analysis.

**Data analysis**

Once transcribed, data were thematically analysed using the six step approach as outlined by Braun and Clarke.[25] Three of the authors [HE, JR, MC] concurrently and independently completed the first three steps: familiarisation with the data, generating initial codes and searching for themes. Step four, reviewing themes, was undertaken collectively between three authors [HE, JR, MC]. During this step, consensus was reached through detailed conversation and critical questioning resulting in an agreement of the key themes and sub-themes. This step identified independently from the three authors that data saturation was achieved from the fifteen participants. Step five consisted of a presentation of the main themes and sub-themes, with participant exemplars, to the remainder of the research team [GK, NM, AS, JB, CR]. During this presentation, research team members were encouraged to critically question the three authors [HE, MC, JE] in defining and naming the themes and sub-themes. Minor modifications to the sub-themes were made during this step. Finally, step 6, producing the report, occurred during the drafting and writing of this paper. Throughout the research process, the authors were conscious of the various elements of trustworthiness, such as credibility, dependability, conformability, transferability, and authenticity.[26] These aspects have been implicitly outlined throughout this methodological section.

**Ethics approval and consent to participate**

Ethical approval to conduct this research was received by the Gold Coast Health Human Research Ethics Committee, reference: HREC/2019/QGC/53353. Participation in this research was voluntary. The transcriptions were anonymised, and names replaced with alphanumerical pseudonyms. The alphanumerical pseudonyms represent, D for doctor, N for nurse and P for paramedic, where the number represents the order of interview.

**Patient and Public Involvement**

No patients involved

## RESULTS

On average, the level of clinical experience was 11 years with eight males and seven females included. All participants were practicing clinicians within the ED or pre-hospital setting (paramedics). The data analysis revealed four main themes, 1) Knowledge and experience, 2) Complicated and multifactorial, 3) Convenience, and 4) Anticipated clinical course. Additionally, 32 sub-themes were identified under these four themes. The first two main themes relate to gathering data and evidence to inform decision making, which involved the clinicians' knowledge and experience, and was complex and multifactorial (Table 1-2). The other two themes relate to actions clinicians do, associated with decisions of convenience and considering the anticipated clinical course of the patient (Table 3-4).

A short description and some participant narrative exemplifying the themes are outlined below. Of note, many of the sub-themes and exemplars within these themes are overlapping and interconnected. As such, factors are not independent of one another and occur in a synergistic manner. Further, exemplars are included as representations of the participants' narrative.

### Gathering data and evidence

When making a decision to insert or use a PIVC, clinicians use their own knowledge and experience, data which has been accumulated over years of practice. This helps create a "data bank" of evidence for the clinician consisting of multiple components. The various components that clinicians considered drawing on their knowledge and experience are outlined (see Table 1-2).

**Table 1.**

| **Theme 1: Gathering data and evidence: knowledge and experience** | |
|---|---|
| **Sub-themes:** PIVC saves lives, perspectives change with more experience, skills maintenance, using policy and/or protocols, to a point | |
| Participants stated that on some occasions, they have witnessed timely insertion of PIVCs that have saved lives. On these occasions, the PIVC was integral to the successful management of a patient and interviewees attributed survival to appropriate placement of a PIVC. Therefore, in situations that may be life threatening, PIVCs are inserted | *". . . certainly haemorrhaging patients you need large bore access to be able to give the fluids and blood products faster. I've certainly seen patients where that can be lifesaving in my career." (D5)*<br><br>*". . . without IV access, she probably, would have seized, and died on the way to hospital." (P5)* |
| As clinicians gain experience and become more comfortable with the procedural competency of PIVC insertion. This experience influences their decisions to insert or not insert a PIVC. | *"I guess as you kind of move through a year [of] registrar training, you start to move on to bigger and better procedures. Like the, the victory lap of getting a difficult cannula in probably matters less." (D3)*<br><br>*". . . I think I've come to realise when a patient does and doesn't need a cannula . . . when I was a grad or whatever you want everybody [to get] a cannula because that was just the way things were done. But as time's progressed not only within myself, but as a culture, I think cannulas are less sort of important . . ." (N3)* |
| Many clinicians said that they have inserted PIVCs to improve their skills or maintain their skill level. This aspect, combined with clinicians seeing PIVCs as potentially lifesaving, are contributors in their decision to insert cannulas. | *"The only way you get good at cannulation is by cannulating people, which means that looking around you for every gun cannulator that's in ED and anaesthetics, there's, you know, thousands of patients that have on a low level been traumatised . . ." (D3)*<br><br>*"I would have put cannulas in people to keep my skills up." (P2)* |
| Clinicians identified that there are a lack of decision trees or algorithms to help with decision making and that policy and or protocols guide them, to a point. | *"It's too complex to have like a nice, simple algorithm" D3.*<br><br>*". . . clinically by looking at the child, but also following State-wide guidelines for that one." D4*<br><br>*"Somebody would have come along and said . . . this patient's going to [cardiac] cath lab. If you follow the checklist here partway down the checklist it says two large bore IV cannulas." N3* |

**Table 2.**

| **Theme 2: Gathering data and evidence: Complicated and multifactorial** | |
|---|---|
| **Sub-themes:** *Patient*-Primary complaint and differential diagnosis, needle-phobia, repeat tests, paediatric versus adult, patient expectations; *Other*-Time to ED | |
| Regardless of knowledge and experience, the decision to insert a PIVC is often multifactorial, including patient and other factors such as local policy or environment. The primary complaint and differential diagnoses influenced the decision making of clinicians, with trauma and cardiac presentations likely to receive a PIVC. Participants described how the limited information and time constraints of emergency medicine can lead to over-cannulation. | *"Obviously it's about making decisions with limited information in a timely manner. Inevitably that will mean that we over cannulate people." (D5)*<br><br>*"I know that there's going to be an ongoing ah requirement for pain relief or some type of intervention IV… they're, they're basically the two, two major categories, yes, trauma and cardiac." (P1)* |
| Many clinicians identified that patients with needle-phobias influenced the approach taken by them as emergency care clinicians for this patient cohort. | *"I had someone ask for nitrous, an adult ask for nitrous, prior to having the cannula inserted, because they'd had such a bad experience in the past, of people attempting, and failing multiple times." (N1)*<br><br>*"There's probably an argument that we can cause a bit of post-traumatic stress disorder, and pain, especially if we're restraining patients to gain IV access. I'm thinking particularly about mental health patients, and our paediatric patients." (P5)* |
| Clinicians had difficulty in deciding whether phlebotomy or PIVC was the best choice for patients; however, if the patient was likely to require repeat tests, a PIVC was likely to be inserted. | *"I think venepuncture's easier on the patient and easier to get. Like it's harder to get a nice stable flushing cannula in, than to steal a bit of blood, and you can use a much smaller needle to get blood, so overall I think that venepuncture is easier and probably safer infection wise." (N5)*<br><br>*"And that's the thing you hate when you do a normal needle stick is, you've mislabelled something or the specimen is haemolysed and all you've done is, a phlebotomy and you come back 15 minutes later and tell the patient that they need another needle." (D3)* |

| | |
|---|---|
| Clinicians described giving more thought to placing a PIVC in a child compared to an adult. | *"I think if we applied the same principles that we do to paediatrics to adults that would probably change our mindsets. We're very happy to stab an adult, whereas we think twice when it comes to a paediatric patient." (D2)*<br><br>*". . . adults, sometimes it's a lot easier to . . . educate them on the need for the cannula and then they're more accepting of getting one." (N4)*<br><br>*"Cannulating a paediatric [patient], one, it's traumatising because, you know, they're upset and, and there's a lot of emotion involved, and then two, you're working with little structures." (P1)* |
| It was identified by clinicians that they believe some patients expect a PIVC to be inserted, which adds pressure on the clinician to insert a PIVC. | *"It's something that we quite frequently do in the emergency department and is almost nearly expected from a lot of people, as part of their treatment, when they come in, is that they need fluids through a drip, or they need medications through the drip, and we probably cave to that more often than we should." (N1)*<br><br>*"I guess some adults want a cannula. They feel that if they have one, then they must really need to be in hospital as well" (N4)* |
| Pre-hospital clinicians considered the distance to the ED in their decision making. Participants describe that patients who are at a considerable distance to hospital are likely to get to a PIVC if they needed interventions. Conversely, paramedics would forgo PIVC insertion even if the patient was critically unwell, yet close to hospital resulting in a short transport time. | *"Say you're on the other side of [town] and it's a long transport time, then you could justify having multiple attempts and spending time to try and get that cannula in to get that thrombolysis, because in the long run if you can get that in and get the thrombolysis in . . . as opposed to someone who you were trying to put one into maybe an anti-emetic and you go, well we could probably just give them a wafer and leave the cannula." (P2)*<br><br>*"So, patient acuity, and also distance to hospital. They could be really sick, and two minutes from the hospital, and I'd just happily just deliver them there and say, look, sorry guys [ED doctors and nurses]." (P4)* |

### Undertaking actions

Once clinicians had gathered evidence and data as outlined above, this would then form the basis for the clinicians' actions regarding PIVC insertion, removal and/or use that was based on convenience and the patient's anticipated clinical course (see Table 3-4).

**Table 3.**

| **Theme 3: Undertaking actions: Convenience** | |
|---|---|
| **Sub-theme:** PIVC equipment at hand, no venepuncture close, allocated bed space | |
| The insertion of a PIVC can sometimes be related to the convenience of having the appropriate equipment at hand. Clinicians within the ED identified that the lack of phlebotomy equipment contained in vascular access trolleys throughout the ED led to them inserting a PIVC. | *"If we had the phlebotomy gear on the top of the cannulation trolley so we thought about it, that would be first rather than cannulation first or something." (D4)*<br><br>*"There is a lot of education about [using venepuncture over PIVC] but it's more, I guess, access to the right equipment as well." (N4)* |
| Participants based in ED stated that patients would receive a PIVC depending on their allocated bed area. For example, patients in the acute area get a PIVC, as opposed to the minor injuries area. | *". . . any patient that rocks up to ED that gets streamed . . . to acute or resus is automatically almost a knee jerk reaction that they get bloods and that's usually via a cannula insertion." (D5)*<br><br>*". . . as nurses or doctors, [we] tend to put cannulas in to get bloods. We tend to leave that in and I think that's just a part of the culture with the emergency department and I guess um, I don't know why we do it." (N2)* |

**Table 4.**

| **Theme 4: Undertaking actions: Anticipated clinical course** | |
|---|---|
| **Sub-theme:** *Flow / journey*- Maybe used by others (ambulance to ED, or ED to in-patient), time pressures and patient flow; *Clinical*- Medications (analgesia, fluids etc…), better to put one in a well patient, before they become unwell, location and size of cannula | |
| Emergency care clinicians describe inserting PIVCs based on the anticipated clinical course for the patient. For example, pre-hospital clinicians will insert PIVCs if it is anticipated that the PIVC will be used in ED and that they are assisting the ED by inserting one. The same was identified by ED clinicians whereby a PIVC would be inserted to smooth the patient journey from the ED to an in-patient unit. | *". . . when we go through the hospital, what's their likely pathway? Are they going to be sitting on an ambulance stretcher for two or three hours? I'm thinking that I'm going to add value to the hospital and the patient journey in terms of onwards through the system". (P1)*<br><br>*". . . there's definitely been sometimes where you're like, you know, borderline, borderline, oh look, let's just give them IVs to, to smooth their ride into the hospital." (D3)* |
| The ED in this setting is extremely busy, the time pressures associated with this workload results in many patients receiving a PIVC, and most likely to reduce the wait time for patients rather than actual clinical needs. Peripheral Intravenous Cannula insertion is perceived to hasten flow of patients through the ED, even if the device is not required. | *"A lot of our staff on arrival time do cannula blood tests because they feel that's probably really good to get the ball rolling per se." (D1)*<br><br>*". . . with the busyness of our emergency department . . . we want everything sorted before they get to the doctor, so that the bloods are back and that the doctor can just see them and that's I guess [a] faster turnover." (N2)*<br><br>*". . . that seems to be the big driver for cannulas, is just to get patients through quickly". (D3)* |
| The vast majority of clinicians insert PIVCs with the intention for administration of pain relief, or in patients that could become unwell; however, many are also inserted for the sole purpose of collecting blood samples. | *". . . we manage pain, with cannulas, which is probably the biggest one, especially pain that can't be, controlled with paracetamol or other orals, that they [the patient] may have at home. Giving those strong narcotics is, probably the most common thing that we use it for." (P3)*<br><br>*". . . for me it's [the insertion of a PIVC] the bleeding, severe abdominal pain, respiratory distress, suspected cardiac abnormality, as well as the abnormal haemodynamics, blood pressure, heart rate." (D2)*<br><br>*"So I guess my main reason for putting cannulas in are probably to get bloods. Unless the patient is obviously sick [then it's inserted for other reasons too]." (D5)* |

| | |
|---|---|
| Emergency clinicians have seen patients deteriorate very quickly and unexpectedly; this in turn leads to them inserting a PIVC even in well patients, as participants describe that it is better to insert a PIVC and not need it, rather than need a PIVC and not have one inserted. | *". . . so having seen patients go off, deteriorate very quickly, I would always err on the side of caution in those kinds of cases [and insert a PIVC]." (D5)*<br><br>*"If we're not only looking at analgesia requirements, then yes, I would like to have a cannula in place in case their condition changes, and it becomes harder to establish IV access." (P5)*<br><br>*"Particularly the more junior doctors who are, you know, they feel it's almost like a comfort thing when you're not sure about the acuity of the patient." (D2)* |
| Clinicians had varying approaches to selecting the size and location of PIVC insertion, with past experiences influencing their decisions. Placing an 18 gauge PIVC in an antecubital fossa was the default choice for most clinicians. | *"I also think that we've probably been in the situation that you put one somewhere else, their forearm or hand, and then had to replace it later in the cubital fossa for a scan, so then we just learnt to just put in the cubital fossa, without thinking about it." (D4)*<br><br>*". . . as I've moved around the [emergency] department in terms of, the different areas and the increase of patient acuity and severity. Picking up a cannula and selecting [the right] gauge is very important." (N2)* |

## DISCUSSION

The aim of this research was to describe factors associated with clinicians decision making on whether to insert or use a PIVC in the emergency care setting. This is the first Australian study to explore PIVC decision making amongst this multidisciplinary emergency care cohort.

Within the emergency setting, four main themes that influenced clinician decision making and actions around PIVC insertion were identified: Knowledge and experience, complicated and multifactorial, convenience, anticipated clinical course.

Clinicians' experiences had significant bearing on their decisions for PIVC insertion. Clinicians' could recall more likelihood of PIVC insertion as juniors in comparison to their present clinical level. This reflected various factors, including the importance placed on the procedure; PIVC insertion was seen as a lifesaving intervention and that "*you live and die by vascular access in the ED*". Insertion of a PIVC is one of the first invasive and painful procedures that emergency clinicians perform, and as such there is a degree of hubris with successful PIVC insertion; "victory laps" "tally boards" and "gun cannulators" were all described.

This likely led to clinicians, especially early in their training, inserting PIVCs for practice, or skills maintenance. The maintenance of PIVC insertion skills and the confidence that comes with the procedural competency has previously been reported in a Swedish study as an important factor in successful PIVC insertion.[27] However, with time and experience, the pride associated with successful PIVC insertion seems to fade, this may be because it has been replaced with another more advanced skill such as intubation or that the clinician is more aware of the true value and risks associated with PIVCs.[28]

Decision making surrounding PIVC insertion is complicated and multifactorial; it is far more complex than most clinicians realise. The dual process theory of decision making suggests that decisions are made using two distinct pathways. Using system 1, people act instinctively or in line with a learnt reflex that requires very little conscious effort; however, system 2 requires metacognition, engagement and effort.[29] Reverting to system 1 is not uncommon in healthcare and this was demonstrated amongst our participants with most inserting a PIVC as a reflex rather than engaging in a purposeful, critical thought process.[30] Patient factors influenced decision making and the sub-themes we identified included the patient's medical history, primary complaint, differential diagnosis, vital signs, and having the perception of an unwell versus well patient. Additionally, needle-phobia had a significant impact on clinician decision making, especially when the patient required blood collection for pathology. There were queries surrounding whether to insert a PIVC when repeated blood draws were required as opposed to using the venepuncture method twice; this was a particularly pertinent consideration for needle-phobic patients and presented as a prominent theme. Blood twice? Our results suggest that most ED clinicians would rather insert one cannula, providing it is successful on the first attempt, rather than perform two venepunctures; however, the common complication of haemolysis resulting from drawing pathology from a PIVC was not discussed by any clinician.[31] Research from the United Kingdom exploring the ongoing care of PIVCs has highlighted that clinicians can have a low risk perception for the impact of PIVC use on patient safety.[32] Paramedics' transport time to ED was another factor; paramedics aware of their proximity to hospital would forgo PIVC insertion prior to transport if they were close to hospital. Some patients expected a PIVC to be inserted as it may be perceived as an indicator or marker of how unwell they are and that they are being appropriately cared for; hence placing pressure on the clinician to insert a PIVC in potentially clinically inappropriate circumstances. Similar findings to ours have been found in recent literature.[19]

Most clinicians would agree that a sick child presents a different set of challenges for the clinicians that care for them. With worried parents and an upset child adding an extra element of stress, the avoidance of further distressing parents and patients alike via PIVC insertion, is highly desirable. This was evident with vastly different decision-making factors for PIVC insertion in adults versus children. Clinicians were more judicious about inserting a PIVC in a child due to the associated stress and trauma it may cause for both the patient and their parents or guardians. This is a unique perspective as the clinical need for the PIVC is essentially the same for adults and children, however the paediatric population influenced the clinician into a thought process of avoidance rather than routine insertion.

For our respondents, the PIVC was seen as a device to speed up patient flow through the ED. Time pressures to move patients through the ED were a recurrent theme. ED staff perceived it as easier to manage the patient with a PIVC in place. A PIVC was perceived to provide a safety net in the event of patient deterioration *"just in case" "to be safe" "better to put one in a well patient before they become unwell"*. This has precipitated a "knee jerk" reaction around PIVC placement for ED clinicians, with an, "everyone in ED gets a PIVC" mentality prevailing. Recent literature suggests that if clinicians think about the probability of the PIVC actually being used, a reduction in the rate of unused PIVCs can be expected; it is likely that if a similar intervention was implemented among this population, it would yield comparable results.[16, 33]

Environmental and cognitive factors also play an important role in the decision making within the ED *"the trolleys at triage are set up for cannulation, not venepuncture"*. Clinicians reported that the easiest option was to insert a PIVC rather than to source a phlebotomy kit. These subtle nudges have an impact on decision making and help reinforce the psychology of system 1.[34] For example, a trolley with phlebotomy materials in the top drawer, with PIVCs out of sight would nudge a clinician towards venepuncture.[34] Clinicians had clear decision making for patients that required a PIVC for a specific purpose including the administration of blood products, fluids, antibiotics, analgesia and for pre-empting the use of diagnostic imaging requiring intravenous contrast. This aligns with recent literature examining decision aids for PIVC insertion.[18] For these patients that have an actual need for the device, the nudge is likely to be overridden and the clinician will insert a PIVC that has a high probability of being used.

For paramedics, the limited time spent with patients often means an early judgement call must be made on the patient's likely clinical trajectory. Similar to ED staff, a *"to be safe"* approach was used, erring on the side of caution, with paramedics preferring to insert a PIVC in a stable patient, rather than having difficulty trying to insert one in a patient already in extremis. Paramedics also would insert PIVCs in anticipation of the PIVC going on to be used in the ED (most likely for pathology, IV medications or diagnostic imaging).

Our findings draws parallels with other qualitative work carried out in the United State of America exploring PIVC decision making[19]. Similar themes of "knowledge and skills" "patient-centric" "organisational policies/practices" and "anticipation of clinical needs" were all reported. [19] This research included mostly nursing staff as participants, with participants not just from the ED but also acute care wards and implies that factors influencing PIVC decision making may be consistent in different clinical settings and different countries.

**Limitations**

While this study involved emergency care clinicians from a variety of backgrounds, the sample was from a single centre and may not reflect all emergency centres. Although data

saturation was achieved with no new themes emerging, we cannot exclude that if different clinicians with different backgrounds had participated (including less clinical experience, or more quality improvement or academic experience) that this may have led to different themes.

## CONCLUSION

The decision to insert a PIVC is more complicated than clinicians, administrators and policymakers may realise. When explored, clinician decisions were multifaceted with many factors influencing the decision to insert a PIVC. In actual practice, clinicians routinely insert PIVCs in most patients as a learnt reflex with little cognitive input, with the exception of children and needle-phobic patients.
At the time of PIVC insertion, more time needs to be devoted to the awareness of; 1) decision making in the context of the clinician's own experience, 2) cognitive biases, and 3) Patient centred factors. Such awareness will support an appropriate risk assessment which will benefit the patient, clinician, and healthcare system.



### Competing interests

NM reports investigator-initiated research grants and speaker fees provided to Griffith University from vascular access product manufacturers (Becton Dickinson, 3M, Eloquest Healthcare and Cardinal Health); and a consultancy payment for expert advice from Becton Dickinson. CR discloses that her current or previous employers have received funding on her behalf in the form of investigator initiated research grants from BD-Bard, Cardinal Health, and Eloquest Healthcare as well as consultancy payments from 3M and BD Bard. All other authors declare that they have no competing interests.

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### Data sharing

The datasets generated and/or analysed during the current study are not publicly available due to local ethics and governance regulations but are available from the corresponding author on reasonable request.

### Authors' contributions

HE, developed concept, led project and wrote manuscript. MC performed interviews, analysis and assisted with manuscript writing. GK assisted with concept development, manuscript writing and supervision of HE. NM provided intellectual input, content expertise and assisted with manuscript preparation**.** AS assisted with concept development, assisted with manuscript writing. JB provided intellectual input and assisted with manuscript preparation. CR provided intellectual input, content expertise, interpretation of

results and assisted with manuscript preparation. PC provided intellectual input, content expertise, and with manuscript preparation. JR assisted with concept development, interviews, data analysis and manuscript writing and supervised HE.

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# INTERVIEW SCHEDULE

## Peripheral intravenous cannulation decision making in emergency settings: A qualitative descriptive study.

This interview will focus on the clinical decision making for PIVC usage in the emergency health care setting.

| Time | Activity |
|---|---|
| 0 – 10 mins | • Introduction of the research team<br>• Reiterate information on 'invitation and information sheet' and 'consent form'<br>• Ensure consent form has been signed |
| 10 – 45 mins | Ice breaker questions:<br>• What is your clinical background?<br>• What are your thoughts on PIVC use?<br>• How many PIVCs would you use on an average day?<br><br>Exploratory questions:<br>• Can you tell me about a typical patient who has a PIVC inserted/removed?<br>• Can you tell me about a time when you decided to insert, use and remove a PIVC, from the moment you became involved in the patients care to the time they left your care?<br><br>Decision making questions:<br>If these questions have not been addressed during the above, ask at this point. Ask the participant to provide clinical examples for each.<br>• How do you decide if a patient needs a PIVC?<br>• What approaches do you use to make this determination?<br><br>Research objective questions:<br>If these questions have not been addressed during the above, ask at this point. Ask the participant to provide clinical examples for each.<br>• What influences your decision to insert a PIVC?<br>• What influences your decision to use a PIVC?<br>• What influences your decision to remove a PIVC?<br>• What influences your decision about the risks of PIVC usage?<br>• What influences your decision about the benefits of PIVC usage?<br>• What do you perceive to be the risks or benefits?<br><br>• Is there anything that you would like to add your experience with using PIVC (insertion, usage, and/or removal)? |
| 45 – 70 mins | • Summary of research process to-date and expected outcomes,<br>• Reiterate the information on the 'invitation and information sheet' and 'consent form' |

**Key phrases**

**Exploring –** *Can you tell me more about … ?*

**Validating** – *So, is what you are saying … ?*