

BMJ Open is committed to open peer review. As part of this commitment we make the peer review history of every article we publish publicly available.

When an article is published we post the peer reviewers' comments and the authors' responses online. We also post the versions of the paper that were used during peer review. These are the versions that the peer review comments apply to.

The versions of the paper that follow are the versions that were submitted during the peer review process. They are not the versions of record or the final published versions. They should not be cited or distributed as the published version of this manuscript.

BMJ Open is an open access journal and the full, final, typeset and author-corrected version of record of the manuscript is available on our site with no access controls, subscription charges or pay-per-view fees (<u>http://bmjopen.bmj.com</u>).

If you have any questions on BMJ Open's open peer review process please email <u>info.bmjopen@bmj.com</u>

BMJ Open

Association between peripheral venous catheter failure and care complexity factors in emergency department: A crosssectional study.

Journal:	BMJ Open
Manuscript ID	bmjopen-2024-090101
Article Type:	Original research
Date Submitted by the Author:	17-Jun-2024
Complete List of Authors:	Urbina, Andrea; Bellvitge University Hospital Adamuz, Jordi; Bellvitge University Hospital, Infectious Disease Juvé-Udina, Maria-Eulàlia; Catalan Institute of Health González-Samartino, Maribel; Hospital Universitari de Bellvitge, Department of Nursing Jiménez-Martínez, Emilio; Bellvitge University Hospital Delgado-Hito, Pilar ; Universitat de Barcelona, Romero-García, Marta ; University of Barcelona
Keywords:	Adverse events < THERAPEUTICS, Emergency Service, Hospital, Risk Factors, Safety





I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our <u>licence</u>.

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which <u>Creative Commons</u> licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

terez oni

Enseignement Superieur (ABES) Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies



Association between peripheral venous catheter failure and care complexity factors in emergency department: A cross-sectional study.

Andrea URBINA, Maria-Eulàlia JUVÉ-UDINA, Jordi ADAMUZ, Maribel GONZÁLEZ-SAMARTINO, Emilio JIMÉNEZ-MARTÍNEZ, Pilar DELGADO-HITO, Marta ROMERO-GARCÍA

AUTHORS AFFILIATIONS:

Andrea URBINA RN. MSc. PhD Student

- Nursing Knowledge Management and Information Systems Department, Bellvitge University Hospital, L'Hospitalet de Llobregat, Catalunya, Spain.
- IDIBELL, Institute of Biomedical Research.

Maria-Eulàlia JUVÉ-UDINA RN. MSc. PhD

- Nursing Executive Department, Catalan Institute of Health, Barcelona, Spain.
- IDIBELL, Institute of Biomedical Research.

Jordi ADAMUZ RN. MSc. PhD

- Nursing Knowledge Management and Information Systems Department, Bellvitge University Hospital, L'Hospitalet de Llobregat, Catalunya, Spain.
- IDIBELL, Institute of Biomedical Research.
- Fundamental Care and Medical-Surgical Nursing Department. Nursing Faculty. University of Barcelona (Barcelona). Spain.

Maribel GONZÁLEZ-SAMARTINO RN. MSc. PhD

- Nursing Knowledge Management and Information Systems
 Department, Bellvitge University Hospital, L'Hospitalet de Llobregat, Catalunya, Spain.
- IDIBELL, Institute of Biomedical Research.
- Fundamental Care and Medical-Surgical Nursing Department. Nursing Faculty. University of Barcelona (Barcelona). Spain.

Emilio JII - Inf L'H - ID - Fu Nu	MÉNEZ-MARTÍNEZ RN. MSc. PhD Fectious Disease Department, Bellvitge University Hospital, Hospitalet de Llobregat, Catalunya, Spain. IBELL, Institute of Biomedical Research. Indamental Care and Medical-Surgical Nursing Department. Irsing Faculty. University of Barcelona (Barcelona). Spain.
Pilar DEL	GADO-HITO RN. MSc. PhD
- Fu Nu - ID - Int Ca	ndamental Care and Medical-Surgical Nursing Department. Irsing Faculty. University of Barcelona (Barcelona). Spain. IBELL, Institute of Biomedical Research. Cernational Research Project for the humanization of Health Ire, Proyecto HU-CI
Marta RC	DMERO-GARCÍA RN. MSc. PhD
- Fu Nu - ID - Int	ndamental Care and Medical-Surgical Nursing Department. Irsing Faculty. University of Barcelona (Barcelona). Spain. IBELL, Institute of Biomedical Research. Cernational Research Project for the humanization of Health
Ca	re, Proyecto HU–CI
CORRESPOND	DING AUTOR CONTACT:
Jordi Adar Systems D 08907, L'H Fax: +34 9	muz, PhD, MSN, RN. Nursing Knowledge Management and Information Department, Hospital Universitari de Bellvitge - IDIBELL, Feixa Llarga s/n, Hospitalet de Llobregat (Barcelona), Spain. Telephone: +34 93 2602123. 3 2607561. E-mail: jadamuz@bellvitgehospital.cat
CONFLICT OF All authors de	INTEREST STATEMENT: clare they have no competing interests.
	GMENTS.
We thank the	CERCA Programme/Generalitat de Catalunya for institutional support.
FUNDING INF	ORMATION:
This study is p	part of the project "Individual Factors of Care Complexity, Care Intensity

and Patient Health Outcomes in Emergency Department", financed by the Official

Enseignement Superieur (ABES) . Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies

 College of Nurses of Barcelona (www.coib.cat) as part of the Nurse Research Projects Grants (PR-542/2022). This work was also supported by the Research Committee of the Bellvitge University Hospital and the Agency for Management of University and Research Grants (AGAUR - 2021SGR00929).

for oper teries only

ABSTRACT

Objective: To determine the prevalence of peripheral venous catheter failure and its association with care complexity factors in emergency department patients.

Design: A cross-sectional, descriptive-correlational study was performed.

Methods: All patients with a peripheral venous catheter inserted in the emergency department of a tertiary hospital were included. The period of study was from June 2021 to June 2022. The main outcomes were peripheral venous catheter failure (phlebitis, extravasation/infiltration, dysfunction/occlusion and dislodgement/involuntary withdrawal) and 26 care complexity factors categorized into five domains (psychomental-cognitive, sociocultural, developmental emotional. and comorbidity/complications). Other secondary variables were also collected, such as level of triage or nursing care plan. All data were collected retrospectively from the Electronic Health Record. A descriptive and inferential analysis was performed.

Results: A total of 35,968 patients with one or more PVC inserted during their emergency department visit were included in the study. The prevalence of catheter failure was 0.9% (n=316). The care complexity factors associated with catheter failure were: incontinence, hemodynamic instability, transmissible infection, vascular fragility, anxiety and fear, impaired adaptation, consciousness disorders, lack of caregiver support and agitation. In addition, we identified that patients with a higher number of care complexity factors more frequently experienced catheter failure.

Conclusion: This study identified a prevalence of PVC failure in the emergency department of around 1%. The most prevalent complication was dysfunction, followed by extravasation and dislodgement. In addition, peripheral catheter failure was associated with a higher number of care complexity factors.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- To the best of our knowledge, this is the first study in emergency department to investigate global health conditions to identify care complexity factors that could be associated with PVC failure.
- The study design is cross-sectional, hence can only describe associations between care complexity individual factors and catheter failure.
- The prevalence of catheter failure may have been underdetected because the length of stay of patients in emergency departments is relatively short.

INTRODUCTION

The insertion of a peripheral venous catheter (PVC) is one of the most common invasive procedures performed by healthcare providers, being an indispensable tool in medical practice for the administration of fluids, blood derivatives, electrolytes or drugs, and other important clinical interventions(1,2)

The use of a PVC may compromise patient safety, causing adverse effects such as phlebitis, occlusion or extravasation. These complications cause significant discomfort to the patient and can increase the length of hospital stay, mortality and the cost of hospitalization(3,4).

There are currently high rates of catheter-derived complications that affect millions of patients each year worldwide. Among other causes, the non-standardized practices reported among professionals could explain these complications. Furthermore, the lack of awareness of the risks associated with the use of a PVC has resulted in limited monitoring and prevention efforts(5).

The use of a PVC is a fundamental part of emergency healthcare. Over half of all Emergency Department (ED) patients will require a PVC during their visit (6). However, the literature has reported that the prevalence of unnecessary PVC is high, especially in this department (7,8)

In a recent systematic review, it was found that PVC failure due to infiltration and extravasation was higher in PVCs inserted in the ED compared with other departments (9), and in fact, other studies have also shown that catheter insertion in the ED has a higher rate of complications(10,11).

It is known that complex patients with multiple chronic conditions and psychosocial issues have more frequent interactions with healthcare systems, are more vulnerable to complications and are at higher risk for poor health outcomes(12). In addition, the number of older patients visiting the ED is increasing rapidly and, as a result, patients are becoming more fragile and complex(13).

There is currently evidence on the association of PVC failure with factors such as catheter gauge, insertion site, catheter dwell time, and drugs administered(14–16). Other studies have discussed patient-related factors like age or their chronic diseases(17,18). However, evidence on specific patient factors associated with PVC failure is scarce.

In this context, the concept of Care Complexity (CC) assumes a fundamental role by considering aspects related to the patient without limiting itself only to therapeutic aspects (19). In 2010, Juve-Udina et al. defined the Care Complexity individual Factors (CCiFs) as a set of specific characteristics in each person related to the different determining axes. These have the potential to lead to an increase in difficulty in the care delivery process and an increase in the consumption of nursing resources (20).

Previous studies found that several CCiFs were associated with adverse events (21,22), in-hospital mortality (22) and hospital readmission (23). In addition, a recent study revealed that the presence of more than two CCiFs was associated with a higher rate of revisit to the ED at 30 days(24).

Given the abundant use of PVCs in the ED, it is likely that many patients are suffering these complications. Therefore, the risk of PVC complications must be considered in order to improve patient outcomes. In order to help create strategies to reduce healthcare-acquired complications and strengthen safety culture, knowledge of the prevalence of PVC failure in the ED and its relationship with care complexity factors is essential.

METHODS

Objective, study design and sample population

The aim of this study was to determine the prevalence of PVC failure and its association with care complexity factors and other clinical and sociodemographic variables in patients admitted to the emergency department.

This cross-sectional, descriptive-correlational study was performed to evaluate the association between catheter failure and care complexity factors.

This monocentric study was carried from 1 June 2021 to 30 June 2022. A consecutive sampling method was used. Systematic selection of all patients admitted to the ED during the 1-year inclusion period was conducted. The inclusion criteria of the study were patients with a complete nursing health record including a nursing care plan. Patients who did not have a PVC registered in the nursing health records and all those under 16 years of age were excluded.

The study was carried out in accordance with current laws and regulations and was approved by the institutional review board of Bellvitge University Hospital (Ref. PR051/22). All data were collected retrospectively from the EHR; therefore, the need for informed consent was waived by the institutional review board.

Data collection

Data were collected retrospectively from the Electronic Health Record (EHR). The main outcomes were PVC failure and care complexity factors. These data were recorded in the EHR using ATIC terminology (Architecture, Terminology, Interface, Information, Nursing and Knowledge) by the ED nurses responsible for each patient, and refer to the patient's assessment, identified diagnoses and nursing interventions. For this study we obtained this information from the clinical data warehouse of the Catalan Health Institute. Sociodemographic variables were collected from the registry of the Minimum Basic Data Set (MBDS) of the ED. Then, an Excel database was designed. The information from both sources was linked in this database through the patient episode numbers. All data were pseudonymized independently by an individual outside the research team, who assigned a numerical code to each patient episode in an Excel database. In this way, the confidential data of the participants was preserved.

Measurements

 The main outcomes of the study were PVC failure and 26 CCiFs. The PVC failures were identified by nurses using ATIC terminology and were categorized into four main groups: Phlebitis (phlebitis and signs of infection); Extravasation (extravasation and infiltration); Occlusion (by clots or other mechanical occlusion); and Dysfunction (involuntary or accidental withdrawal, catheter dislodgement, dysfunction or leakage of fluid).

Care Complexity individual Factors were also identified by nurses in the EHR and were classified into five domains: comorbidity/complications, developmental, psycho-emotional, mental-cognitive and sociocultural.

The comorbidity/complications domain included 13 factors: (a) uncontrolled pain (verbal numerical rating scale above three points), (b) urinary or fecal incontinence, (c) hemodynamic instability (categorized with a moderate or high risk of acute impairment, according to the VIDA system), (d) anatomical and functional disorders (amputation, limitation of movement, joint stiffness or functional impotence), (e) transmissible infections (isolation measures), (f) high risk of hemorrhage (rectal bleeding, hematuria, hematemesis, metrorrhagia, petechiae, epistaxis, melena), (g) extreme weight (cachexia, obesity), (h) postural limitation (inability to carry out activities such as feeding, hygiene or toileting and to sit, ambulate or maintain balance), (i) vascular fragility (cutaneous and venous fragility, venous tortuosity, weak peripheral pulses), (j) communication disorders (aphasia, dysphasia, dysarthria, laryngectomy, tracheostomy), (k) edema, (l) involuntary movements (episodic or continuous, convulsions, tremors), and (m) dehydration (skin turgor). The developmental domain included one factor, extreme age (between 17 and 19 years old or over 75). The psycho-emotional domain comprised three factors: (a) fear and anxiety, (b) impaired adaptation (lability, negativity, distrust of the care team) and (c) aggressiveness. The mental-cognitive domain contained four factors: (a) consciousness disorders (disorientation, confusion, drowsiness, stupor, unconsciousness), (b) agitation, (c) impaired cognitive functions (intellectual disability) and (d) perception of reality disorders (hallucinations). Finally, the sociocultural domain included five factors: (a) language limitation, (b) lack of caregiver support, (c) belief conflict (hopelessness, anguish), (d) social exclusion (indigence) and (e) illiteracy.

Other clinical and sociodemographic variables such as age, sex, nursing care plan and triage level were also collected.

Validity and reliability

Care complexity individual factors were collected according to the classification created in 2010 by Juvé et al. Through a participatory action research study involving more than

400 nurses from eight public hospitals, CCiFs were identified and classified into a total of five domains. Each domain is structured into factors and specifications. These specifications were part of the coded and structured data in the initial and ongoing nursing assessment sections of the EHR, as described in the ATIC (Architecture, Terminology, Interface, Information, Nursing and Knowledge). This classification has been used in other studies to reveal associations between these factors of care complexity and other unfavorable patient outcomes (24), and the predictive validity of this classification has already been demonstrated (21–23).

Data regarding PVC failure were collected from the electronic nurse records, in which registered nurses reported any of the following nurse diagnoses during patient admission: catheter-associated phlebitis (code: 10001284); extravasation (code: 10002222); occlusion (code: 10005988) or dysfunction (code: 10005388); and dislodgement (code: 10017289) or involuntary withdrawal (code: 10010464/ 10010495/ 10010496), according to ATIC terminology.

Hemodynamic instability was recorded via an early warning system named VIDA (the Catalan acronym for Surveillance and Identification of Acute Deterioration). This nursing surveillance improvement program has evolved into an early warning score system that is used on a daily basis to assist clinical decision-making. The VIDA score automatically classifies patients into five groups according to patient progress data: no risk (level 0), low risk (level 1), moderate risk (level 2), high risk (impending complication if not stabilized) (level 3), manifested complication initial status (level 4). For the purposes of this study, the VIDA score was classified as mild (levels 1–2) or high (levels 3–4) risk. Patients were classified according to the highest VIDA score obtained during their hospitalization. Patient progress data were extracted from anonymized EHRs and included: respiratory rate (breaths per minute), oxygen saturation (%), temperature (°C), mental status (level of awareness: 1=aware and orientated, >1=disturbed mental status, including disorientation, acute confusion, and so on), pulse (cardiac rate, beats per minute) and systolic and diastolic blood pressure (mm Hg).

Patient and public involvement



None

Statistical analysis

IBM SPSS 25.0 statistical software was used.

We reported descriptive statistics for clinical and demographic variables in the study. Qualitative variables were described using absolute frequencies and percentages; and quantitative variables were expressed as median and interquartile range (IQR).

The chi-square test was used for the comparison of qualitative variables and the Student's t-test or Mann-Whitney U test for continuous variables, depending on

Enseignement Superieur (ABES) . Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Enseignement Superieur (ABES) . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

whether the data followed a normal distribution. The normality of data was evaluated using the Kolmogorov–Smirnov test.

Inferential analysis was used to identify significant relationships between catheter failure and care complexity factors. The Odds Ratio (OR) and confidence intervals were calculated and a 95% confidence interval was established for all cases. All statistical analyses were performed using two-tailed tests with an alpha error of 0.05, and a p-value of less than 0.05 was considered significant.

RESULTS

During the study period, 51,412 adult patients were admitted to an ED with a completed nursing health record. Of these, 35,968 (70%) patients with one or more PVC inserted during their ED visit were included.

Table 1 shows the clinical and sociodemographic characteristics of the patients included in the study. The median age was 70 years (IQR 53.1–81.0) and 54.3% were male patients. The median of length of stay was 12 hours and triage level was equal to or less than 3 in more than 85% of cases (this level means patients require more urgent care). The main reasons for ED visits were: dyspnea, malaise, COVID-19 infection, abdominal pain, chest pain, and heart rhythm disorders.

We observed that 80% (n=28,827) of patients had at least one CCiF. **Table 2** presents the prevalence of the different CCiFs organized by domains or sources of complexity. The most prevalent were uncontrolled pain (32.8%), extreme age (39.5%), anxiety and fear (16%) and consciousness disorders (14.9%).

Among patients with a PVC, 0.9% (n=316) had some complication. The reasons for the catheter failure recorded by the ED nurses were: dysfunction/occlusion 29% (n=92); extravasation/infiltration 26.3% (n=83); dislodgement/involuntary withdrawal 26.3% (n=83); and phlebitis 18.4% (n=58).

The association of CCiFs with PVC failure is summarized in **Table 3**. The CCiFs associated with CVP failure were: incontinence (OR: 1.85; 95% CI: 1.39–2.45; p<0.05), hemodynamic instability (OR: 3.06; 95% CI: 2.41–3.88; p<0.05), transmissible infection (OR: 1.61; 95% CI: 1.11–2.32; p<0.05), vascular fragility (OR: 2.94; 95% CI: 2.09–4.15; p<0.05), fear and/or anxiety (OR: 1.45; 95% CI: 1.10–1.89; p<0.05), impaired adaptation (OR: 3.57; 95% CI: 2.17–5.86; p<0.05), consciousness disorders (OR: 2.76; 95% CI: 2.18–3.50; p<0.05), lack of caregiver support (OR: 4.28; 95% CI: 1.04–17.63; p<0.05) and agitation (OR: 4.07; 95% CI: 2.15–7.72; p<0.05). The median number of CCiFs was higher in patients with PVC failure than those without PVC failure (2 vs 1; p-value=0.001). Moreover, **Table 4** shows the association of other clinical factors with PVC failure. The length of stay in the ED showed a statistically significant relationship with PVC failure. Also, elders and patients that consulted for urinary tract infections were associated with

 PVC failure. Conversely, consulting for dyspnea and chest pain were protective factors for PVC failure (p-value=0.001).

Finally, **Figure 1** shows that the prevalence of PVC failure showed an increasing trend in ED patients with a higher number of CCiFs (0.61% in patients with 0–1 CCiF, 0.89% in patients with 2–3 CCiFs, 1.78% in patients with 4–5 CCiFs, 2.58% in patients with 6–7 CCiFs, and 6.5% in patients with >8 CCiFs).

DISCUSSION

The prevalence of catheter failure in patients with PVC in the emergency department was around 1%. The presence of a higher number of care complexity factors was associated with catheter failure. The CCiFs associated with PVC failure were incontinence, hemodynamic instability, transmissible infection, vascular fragility, anxiety and fear, impaired adaptation, consciousness disorders, lack of caregiver support, and agitation.

To date, there have been few studies on care complexity factors in ED(24), however, there have been other studies carried out in other departments (hospitalization units). These studies have found associations between CCiFs and other patient health outcomes. The results of the current study showed that 80% of the patients showed some factor of complexity, and that the mean number of CCiFs was approximately 2 per patient, consistent with previous studies (21–23).

In relation to the number of patients with a PVC, the study showed that more than twothirds of patients with a registered nursing care plan required a PVC, consistent with studies carried out in EDs in which a similar prevalence has been reported (8)

The prevalence of CVP failure was lower than the prevalence typically reported in the literature, although reported rates are variable(9,10,25,26), with values ranging from less than 1% for some complications like phlebitis (27) to more than 50% for others (14).

It is true that many of these studies were not done in the ED, where the length of stay of patients is usually shorter, and therefore, the probability of developing a complication is also shorter, than in other departments. In addition, there is a great deal of variability when it comes to measuring and recording these complications, and this can lead to very different values. For example, in relation to phlebitis, at least 71 different phlebitis scales exist, with highly disparate criteria and minimal testing of validity (28). On the other hand, several studies have classified the complications of CVP in a similar way to the current study; however, many of them only considered phlebitis and infectious complications, without considering other causes of failure(29). In those studies where several catheter complications were considered, the highest rates were usually extravasation or phlebitis (4,9,25,30). In our study, the most prevalent cause was dysfunction/occlusion, followed by dislodgement and extravasation, and lastly, phlebitis.

In relation to sociodemographic variables, we observed a relationship between catheter failure and age, consistent with previous studies (31). However, no statistically significant differences were found in relation to sex, although some studies have reported an association with female sex (25). The length of patient stay in the ED was related to catheter failure. Given that patients who spend the longest time in the ED are those who have worn the catheter the longest, these results are consistent with studies that have associated the catheter dwell time with the risk of complications (32).

Our study found no association between the triage level and catheter failure, although another study found differences in risk of failure and the different levels of triage (31).

In relation to medical diagnoses, our study showed an association with catheter failure and urinary tract infections, with an increased risk of failure in patients with such infections. There is little evidence about the relationship between catheter failure and different medical or nursing diagnoses. However, this could be explained by the fact that patients with urinary tract infections often require the use of antibiotics, and this practice has been associated with higher rates of complications(30).

Regarding care complexity factors and CVP failure we observed the association of failure with the following factors within the comorbidity and complications domain: hemodynamic instability, incontinence, transmissible infection, and vascular fragility. In relation to this last complexity factor, 4.5% of patients who visited the ED presented it. This indicates that a relatively high proportion of patients can have venous tortuosity or fragility, something that makes it difficult for nurses to channel a catheter. Similarly, a recent study showed that the prevalence of patients with difficult access in emergency departments was 8.9%(33). These results are therefore in line with studies that have related the number of attempts to channel a catheter with the complications reported subsequently, thus confirming that difficult intravenous access is associated with more complications (14,34). Other studies have also found these types of associations and confirmed that age is an important factor to consider (31). Although the developmental domain was not associated with PVC failure, elders presented a higher frequency of PVC failure.

Patients with hemodynamic instability tend to take more drugs and have CVPs with a larger caliber, due to the risk of complications and the need for immediate life support, factors that have been associated with CVP failure (14,16). On the other hand, patients with transmissible infections require the intravenous administration of one or more antibiotics, a fact that has also been linked to CVP failure (30).

The psycho-emotional domain was also associated with catheter failure, specifically the complexity factors of fear or anxiety and impaired adaptation. There is little evidence linking these factors with CVP failure in the literature. However, other studies on care complexity have associated these factors with other unfavorable health outcomes, both in hospitalization units and in emergency departments (21–24).

In the mental-cognitive domain, consciousness disorders and agitation were found to be predictors of CVP failure. This relationship could be related to patient movement and catheter fixation and integrity. In recent years it has been demonstrated that optimal fixations or reinforced dressings reduce complications, as they attach the catheter to the skin and reduce movement. This causes less irritation of the vascular wall and reduces entry of bacteria into the wounded skin, among other benefits(10,35). Conversely, accidental or involuntary dislodgement has been one of the most prevalent causes of catheter failure (4,9).

Finally, in relation to the sociocultural domain, the lack of caregiver support was related to the failure of CVP. This care complexity factor was also previously associated with other adverse events, such as pressure ulcer, falls or aspiration pneumonia (22). Specifically, in the ED, the figure of the caregiver or companion plays a fundamental role in improving communication between the professional and patient, as they actively participate in the care process and play a crucial role in decision-making (36). However, the benefits of caregivers in the ED remain underexplored and future studies should delve deeper into this topic.

In summary, the evidence shows that in order to understand catheter failure we must consider other catheter factors, such as material, caliber or type of dressing used to fix it; clinical factors, such as days of catheter dwell, insertion site, or drugs used; and also patient factors, such as age and vascular fragility.

Limitations

This was an observational analysis with a large number of patients included in a referral hospital in Barcelona. In this study we evaluated global health conditions to identify care complexity factors that could be associated with PVC failure. Even so, there were clear limitations to the current study. First of all, this study did not consider the complexity factor "major chronic disease" because it was not possible to collect this data from the electronic clinical history. However, there is already evidence in the literature about the relationship between chronic diseases and catheter complications (17).

Secondly, the prevalence of catheter failure may have been underdetected because the length of stay of patients in emergency departments is relatively short. Patients are often transferred to inpatient units or other services, so a patient may have had catheter failure that was recorded by a nurse in another department. We should also take into account that EHRs in EDs were only implemented a few years ago, which may have impacted the compliance of nursing records.

Finally, a cross-sectional design was used to assess relationships, thus limiting the ability to determine causal inferences. Observational designs cannot control for confounding variables, and in this case, the effects of caliber, catheter dwell time or drugs administered were not considered. Future research should be conducted using a

Enseignement Superieur (ABES) . Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

longitudinal design to analyze the variables independently and thus provide more robust findings.

for occr terien only

The CCiFs associated with CVP failure were: incontinence, hemodynamic instability, transmissible infection, vascular fragility, anxiety and fear, impaired adaptation, consciousness disorders, lack of caregiver support, and agitation. Furthermore, the probability of PVC failure increased as patients had a higher number of care complexity factors.

The complications derived from peripheral catheters are common and compromise patient safety. Knowing the causes associated with them could help to avoid unfavorable catheter-related health outcomes.

These results should prompt nurses to identify patients with CCiFs that may potentially favor catheter failure, and provide a novel view of the global risk factors for catheter failure.

Early identification of catheter failure would help to stratify patients, design preventive strategies and improve our daily practice, ultimately reducing its incidence in emergency departments.

REFERENCES

- Webster J, Osborne S, Rickard CM, Marsh N. Clinically-indicated replacement versus routine replacement of peripheral venous catheters. Vol. 2019, Cochrane Database of Systematic Reviews. John Wiley and Sons Ltd; 2019.
- Helm RE, Klausner JD, Klemperer JD, Flint LM, Huang E. Accepted but Unacceptable: Peripheral IV Catheter Failure. Journal of Infusion Nursing [Internet]. 2019 May 1 [cited 2024 Jan 15];42(3):151–64. Available from: <u>https://journals-lwwcom.sire.ub.edu/journalofinfusionnursing/fulltext/2019/05000/accepted but unacce ptable peripheral iv catheter.7.aspx</u>
- Vendramim P, Avelar AFM, Rickard CM, Pedreira M da LG. The RESPECT trial– Replacement of peripheral intravenous catheters according to clinical reasons or every 96 hours: A randomized, controlled, non-inferiority trial. Int J Nurs Stud. 2020 Jul 1;107:103504.
- Alexandrou E, Ray-Barruel G, Carr PJ, Frost SA, Inwood S, Higgins N, et al. Use of Short Peripheral Intravenous Catheters: Characteristics, Management, and Outcomes Worldwide. J Hosp Med [Internet]. 2018 May 1 [cited 2024 Jan 17];13(5):E1–7. Available from: <u>https://pubmed.ncbi.nlm.nih.gov/29813140/</u>
- Zingg W, Barton A, Bitmead J, Eggimann P, Pujol M, Simon A, et al. Best practice in the use of peripheral venous catheters: A scoping review and expert consensus. Infection Prevention in Practice. 2023 Jun 1;5(2).
 - Alexandrou E, Ray-Barruel G, Carr PJ, Frost SA, Inwood S, Higgins N, et al. Use of Short Peripheral Intravenous Catheters: Characteristics, Management, and Outcomes Worldwide. J Hosp Med [Internet]. 2018 May 1 [cited 2024 Jan 15];13(5):E1–7. Available from: <u>https://pubmed.ncbi.nlm.nih.gov/29813140/</u>
 - Guihard B, Rouyer F, Serrano D, Sudrial J, Combes X. Appropriateness and Complications of Peripheral Venous Catheters Placed in an Emergency Department. Journal of Emergency Medicine. 2018 Mar 1;54(3):281–6.
 - Gledstone-Brown L, McHugh D. Review article: Idle 'just-in-case' peripheral intravenous cannulas in the emergency department: Is something wrong? Vol. 30, EMA - Emergency Medicine Australasia. Blackwell Publishing; 2018. p. 309–26.

2	
3	
4	
5	
6	
7	
/	
8	
9	
10	
11	
12	
12	
15	
14	
15	
16	
17	
18	
10	
20	
20	
21	
22	
23	
24	
25	
25	
20	
27	
28	
29	
30	
31	
27	
22	
33	
34	
35	
36	
37	
20	
20	
39	
40	
41	
42	
43	
44	
15	
45	
46	
47	
48	
49	
50	
51	
51	
52	
53	
54	
55	
56	
50	
5/	
58	
59	
60	

- Marsh N, Webster J, Ullman AJ, Mihala G, Cooke M, Chopra V, et al. Peripheral intravenous catheter non-infectious complications in adults: A systematic review and meta-analysis. Vol. 76, Journal of Advanced Nursing. Blackwell Publishing Ltd; 2020. p. 3346–62.
- Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409.
- Liu C, Chen L, Kong D, Lyu F, Luan L, Yang L. Incidence, risk factors and medical cost of peripheral intravenous catheter-related complications in hospitalised adult patients. J Vasc Access [Internet]. 2022 Jan 1 [cited 2024 Jan 17];23(1):57–66. Available from: https://pubmed.ncbi.nlm.nih.gov/33302797/
 - Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7.
- Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;
 381 (9868):752-62.
- Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022; Nov 1;23(6):911–21.
- 15. Atay S, Sen S, Cukurlu D. Phlebitis-related peripheral venous catheterization and the associated risk factors. Niger J Clin Pract. 2018; 1;21(7):827–31.
- Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6.
- Atay S, Sen S, Cukurlu D. Phlebitis-related peripheral venous catheterization and the associated risk factors. Niger J Clin Pract [Internet]. 2018 Jul 1 [cited 2024 Jan 15];21(7):827–31. Available from: https://pubmed.ncbi.nlm.nih.gov/29984711/
 - Carr PJ, Rippey JCR, Cooke ML, Higgins NS, Trevenen M, Foale A, et al. From insertion to removal: A multicenter survival analysis of an admitted cohort with peripheral intravenous catheters inserted in the emergency department. Infect Control Hosp Epidemiol. 2018 Oct;39(10):1216-1221.

Enseignement Superieur (ABES) . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

BMJ Open

Guarinoni MG, Motta PC, Petrucci C, Lancia L. Complexity of care: a concept analysis. Ig. 2014;26:226–36.
 Juvé-Udina ME. Intensidad de cuidados enfermeros: ¿cargas de trabajo o complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3]; Available from: <u>https://www.academia.edu/20754559/Intensidad de cuidados enfermeros cargas d e trabajo o complejidad individual</u>
 Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Pérez M, López-Jiménez MM, Rodríguez-Fernández H, et al. Risk of acute deterioration and care complexity individual factors associated with health outcomes in hospitalised patients with COVID-19: a multicentre cohort study. BMJ Open [Internet]. 2021 Feb 17 [cited 2021 Mar

 5];11(2):e041726. Available https://bmjopen.bmj.com/lookup/doi/10.1136/bmjopen-2020-041726

- 22. Adamuz J, Juve-Udina ME, Gonzalez-Samartino M, Jimenez-Martinez E, Tapia-Perez M, Lopez-Jimenez MM, et al. Care complexity individual factors associated with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July).
- Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Pérez M, López-Jiménez MM, Ruiz-Martínez MJ, et al. Care Complexity Individual Factors Associated With Hospital Readmission: A Retrospective Cohort Study. Journal of Nursing Scholarship. 2018 Jul 1;50(4):411–21.
- 24. Urbina, A., Juvé-Udina, M. E., Romero-García, M., Delgado-Hito, P., González-Samartino, M., & Adamuz, J. (2023). Care complexity factors associated with revisits to an emergency department. Factores de complejidad de cuidados asociados a la reconsulta en un servicio de urgencias. *Emergencias.* 2023 Aug;35(4):245-251.
- 25. Marsh N, Larsen EN, Takashima M, Kleidon T, Keogh S, Ullman AJ, et al. Peripheral intravenous catheter failure: A secondary analysis of risks from 11,830 catheters. Int J Nurs Stud [Internet]. 2021 Dec 1 [cited 2024 Jan 17];124. Available from: https://pubmed.ncbi.nlm.nih.gov/34689013/
 - 26. Larsen EN, Marsh N, O'Brien C, Monteagle E, Friese C, Rickard CM. Inherent and modifiable risk factors for peripheral venous catheter failure during cancer treatment: a

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

from:

Page 19 of 24

prospective cohort study. Support Care Cancer [Internet]. 2021 Mar 1 [cited 2024 Jan 17];29(3):1487–96. Available from: https://pubmed.ncbi.nlm.nih.gov/32710173/

- 27. Gregg SC, Murthi SB, Sisley AC, Stein DM, Scalea TM. Ultrasound-guided peripheral intravenous access in the intensive care unit. J Crit Care. 2010 Sep 1;25(3):514–9.
- 28. Ray-Barruel G, Polit DF, Murfield JE, Rickard CM. Infusion phlebitis assessment measures: A systematic review. J Eval Clin Pract. 2014;20(2):191–202.
- Arias-Fernández L, Suérez-Mier B, Martínez-Ortega M del C, Lana A. Incidencia y factores de riesgo de flebitis asociadas a catéteres venosos periféricos. Enferm Clin. 2017 Mar 1;27(2):79–86.
- 30. Johann DA, Danski MTR, Vayego SA, Barbosa DA, Lind J. Risk factors for complications in peripheral intravenous catheters in adults: Secondary analysis of a randomized controlled trial. Rev Lat Am Enfermagem. 2016;24.
- 31. Carr PJ, Rippey JCR, Cooke ML, Higgins NS, Trevenen M, Foale A, et al. From insertion to removal: A multicenter survival analysis of an admitted cohort with peripheral intravenous catheters inserted in the emergency department. Infect Control Hosp Epidemiol [Internet]. 2018 Oct 1 [cited 2024 Jan 17];39(10):1216–21. Available from: https://pubmed.ncbi.nlm.nih.gov/30196798/
- 32. Atay S, Sen S, Cukurlu D. Phlebitis-related peripheral venous catheterization and the associated risk factors. Niger J Clin Pract [Internet]. 2018 Jul 1 [cited 2024 Jan 17];21(7):827–31. Available from: https://pubmed.ncbi.nlm.nih.gov/29984711/
- 33. Davis EM, Feinsmith S, Amick AE, Sell J, McDonald V, Trinquero P, et al. Difficult intravenous access in the emergency department: Performance and impact of ultrasound-guided IV insertion performed by nurses. American Journal of Emergency Medicine. 2021 Aug 1;46:539–44.
- 34. Larsen EN, Marsh N, O'Brien C, Monteagle E, Friese C, Rickard CM. Inherent and modifiable risk factors for peripheral venous catheter failure during cancer treatment: a prospective cohort study. Supportive Care in Cancer [Internet]. 2021 Mar 1 [cited 2024 Jan 17];29(3):1487–96. Available from: <u>https://link-springercom.sire.ub.edu/article/10.1007/s00520-020-05643-2</u>
- 35. Marsh N, Webster J, Mihala G, Rickard CM. Devices and dressings to secure peripheral venous catheters to prevent complications. Cochrane Database of Systematic Reviews

 Enseignement Superieur (ABES) . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

2	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
17	
18	
19	
20	
21	
22	
23	
24	
25	
20 27	
27	
29	
30	
31	
32	
33	
34	
35	
30 37	
38	
39	
40	
41	
42	
43	
44	
45	
40 47	
48	
49	
50	
51	
52	
53	
54	
55	
50 57	
58	

1

[Internet]. 2015 Jun 12 [cited 2024 Jan 18];2015(6). Available from: https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD011070.pub2/full
36. Cooper S, Stevenson F. Communicating decisions about care with patients and companions in emergency department consultations. Health Expectations [Internet]. 2022 Aug 1 [cited 2024 Jan 29];25(4):1766–75. Available from: https://onlinelibrary-nations-internet/

wiley-com.sire.ub.edu/doi/full/10.1111/hex.13519

ior per terien ony

0.0 (53. 12 (7.4- 19515	.1–81 –21.9 (54
12 (7.4- 19515	–21.9 (54.
19515	(54.
19515	(54
16452	
10455	(45
806	(2.2
10261	(28
19557	(54
3752	(10
1283	(3.6
309	(0.9
1851	(5.1
790	(2.2
694	(1.9
673	(1.9
516	(1.4
484	(1.3
3589	(10)
2826	(7.9
2493	(6.9
2428	(6.8
2344	(6.5
1443	(4.0
	2826 2493 2428 2344 1443

T A B L E 2. Care complexity individual factors of adults in emergency department (N=	=
35,968)	

Care complexity individual factors	n (%)
Comorbidity and complications	22414	(62.3)
Uncontrolled pain	11793	(32.8)
Hemodynamic instability	4791	(13.3)
Incontinence	4078	(11.3)
Transmissible infection	2368	(6.6)
Anatomical and functional disorders	2281	(6.3)
Extreme weight	1899	(5.3)
Postural limitation	1691	(4.7)
High-risk of hemorrhage	1645	(4.6)
Vascular fragility	1620	(4.5)
Communication disorders	1148	(3.2)
Edema	708	(2.0)
Involuntary movements	270	(0.8)
Dehydration	45	(0.1)
Developmental	14223	(39.5)
Extreme age	14223	(39.5)
sycho-emotional	6145	(17.1)
Anxiety and fear	5750	(16.0)
Impaired adaptation	576	(1.6)
Aggressiveness	150	(0.4)
Mental-cognitive	5500	(15.3)
Consciousness disorders	5353	(14.9)
Agitation	294	(0.8)
Impaired cognitive functions	83	(0.2)
Perception of reality disorders	49	(0.1)
Sociocultural	423	(1.2)
Language limitation	286	(0.8)
Lack of caregiver support	55	(0.2)
Belief conflict	57	(0.2)
Social exclusion	35	(0.1)
Illiteracy	10	(0.0)

T A B L E 3. Association between peripheral venous catheter failure and care complexity individual factors

	PVC failure								
Care complexity individual factors	n (%) N=35,968		Yes N=316 n (%)		No N=35,652 n (%)		OR (CI)	p-value	
CCiF [median (IQR)]	1	(1–2)	2	(1–4)	1	(1–2)	1.33 (1.25–1.40)	<.001	
Comorbidity and complications	22414	(62.3)	232	(73.4)	22182	(62.2)	1.68 (1.31–2.16)	<.001	
Uncontrolled pain	11793	(32.8)	116	(36.7)	11677	(32.8)	1.19 (0.95–1.50)	.136	
Hemodynamic instability	4791	(13.3)	100	(31.6)	4691	(13.2)	3.06 (2.41–3.88)	<.001	
Incontinence	4078	(11.3)	60	(19.0)	4018	(11.3)	1.85 (1.39–2.45)	<.001	
Transmissible infection	2368	(6.6)	32	(10.1)	2336	(6.6)	1.61 (1.11–2.32)	.011	
Anatomical and functional disorders	2281	(6.3)	23	(7.3)	2258	(6.3)	1.16 (0.76–1.78)	.493	
Extreme weight	1899	(5.3)	21	(6.6)	1878	(5.3)	1.28 (0.82–2.00)	.277	
Postural limitation	1691	(4.7)	21	(6.6)	1670	(4.7)	1.45 (0.93–2.26)	.103	
High-risk of hemorrhage	1645	(4.6)	18	(5.7)	1627	(4.6)	1.26 (0.78–2.04)	.338	
Vascular fragility	1620	(4.5)	38	(12.0)	1582	(4.4)	2.94 (2.09–4.15)	<.001	
Communication disorders	1148	(3.2)	13	(4.1)	1135	(3.2)	1.31 (0.75–2.28)	.350	
Edema	708	(2.0)	7	(2.2)	701	(2.0)	1.13 (0.53–2.40)	.751	
Involuntary movements	270	(0.8)	3	(0.9)	267	(0.7)	1.27 (0.41–3.99)	.682	
Dehydration	45	(0.1)	1	(0.3)	44	(0.1)	2.57 (0.35–18.71)	.352	
Developmental	14223	(39.5)	141	(44.6)	14082	(39.5)	1.23 (0.99–1.54)	.064	
Extreme age (≥75 years old)	14223	(39.5)	141	(44.6)	14082	(39.5)	1.23 (0.99–1.54)	.064	
Psycho-emotional	6145	(17.1)	78	(24.7)	6067	(17.0)	1.60 (1.24–2.07)	<.001	
Anxiety and fear	5750	(16.0)	68	(21.5)	5682	(15.9)	1.45 (1.10–1.89)	.007	
Impaired adaptation	576	(1.6)	17	(5.4)	559	(1.6)	3.57 (2.17–5.86)	<.001	
Aggressiveness	150	(0.4)	2	(0.6)	148	(0.4)	1.53 (0.38–6.19)	.553	
Mental-cognitive	5500	(15.3)	102	(32.3)	5398	(15.1)	2.67 (2.11–3.39)	<.001	
Consciousness disorders	5353	(14.9)	102	(32.3)	5251	(14.7)	2.76 (2.18–3.50)	<.001	
Agitation	294	(0.8)	10	(3.2)	284	(0.8)	4.07 (2.15–7.72)	<.001	
Impaired cognitive functions	83	(0.2)	1	(0.3)	82	(0.2)	1.38 (0.19–9.92)	.751	
Perception of reality disorders	49	(0.1)	0	(0.0)	49	(0.1)	-	-	
Sociocultural	423	(1.2)	3	(0.9)	420	(1.2)	0.80 (0.26–2.52)	0.708	
Language limitation	286	(0.8)	1	(0.3)	285	(0.8)	0.39 (0.06–2.82)	.353	
Lack of caregiver support	55	(0.2)	2	(0.6)	53	(0.1)	4.28 (1.04–17.63)	.044	
Belief conflict	57	(0.2)	0	(0.0)	57	(0.2)	-	-	
Social exclusion	35	(0.1)	0	(0.0)	35	(0.1)	-	-	
Illiteracy	10	(0.0)	0	(0.0)	10	(0.0)	-	-	

PVC: Peripheral venous catheter; OR: Odds Ratio; CI: Confidence Interval; -: There was no individual with catheter failure in this group.

T A B L E 4. Association between peripheral venous catheter failure and characteristics of emergency department patients

Characteristics	N= : n	N= 35,968 PVC failure n (%) (n=316) n (%)		Not PVC failure (n=35,652) n (%)		OR (IC)	p-valu		
Age [median (IQR)]	70 (53.1–81.0)		73.0 (61.2–83.7)		70.0 (53.0–81.0)		1.01 (1.01–1.02)	<.001	
Length of stay (hours) [median (IQR)]	12 (7	.4–21.9)	28.8 (2	19.9–45.3)	11.9 (7.	4–21.6)	1.04 (1.04–1.05)	<.001	
Sex									
Male	19,515	(54.3)	158	(50.0)	19357	(54.3)	0.84 (0.68–1.05)	.128	
Female	16,453	(45.7)	158	(50.0)	16295	(45.7)	1.19 (0.95–1.48)	.128	
Triage level									
Level 1	806	(2.2)	0	(0.0)	806	(2.3)	-	-	
Level 2	10,261	(28.5)	94	(29.7)	10167	(28.5)	1.06 (0.83–1.35)	.630	
Level 3	19,557	(54.4)	172	(54.4)	19385	(54.4)	1.00 (0.80–1.25)	.984	
Level 4	3,752	(10.4)	36	(11.4)	3716	(10.4)	1.11 (0.78–1.57)	.575	
Level 5	1,283	(3.6)	13	(4.1)	1270	(3.6)	1.16 (0.67–2.03)	.599	
Main Medical Diagnoses									
Covid 19	1,851	(5.1)	12	(3.8)	1839	(5.2)	0.73 (0.41–1.30)	.278	
Abdominal pain	790	(2.2)	6	(1.9)	784	(2.2)	0.86 (0.38–1.94)	0.71	
Chest pain	694	(1.9)	1	(0.3)	693	(1.9)	0.16 (0.02–1.14)	.068	
Syncope and collapse	673	(1.9)	3	(0.9)	670	(1.9)	0.50 (0.16–1.56)	.234	
Cerebral infarction	516	(1.4)	5	(1.6)	511	(1.4)	1.11 (0.46–2.69)	.825	
Urinary tract infection	484	(1.3)	9	(2.8)	475	(1.3)	2.17 (1.11–4.24)	.023	
Main Nursing Care Plans									
Consult for dyspnea	3 <i>,</i> 589	(10)	7	(2.2)	3582	(10.0)	0.20 (0.09–0.43)	<.002	
General malaise/constitutional syndrome	2,826	(7.9)	33	(10.4)	2793	(7.8)	1.37 (0.96–1.97)	.087	
Coronavirus infection (COVID-19)	2,493	(6.9)	22	(7.0)	2471	(6.9)	1.01 (0.65–1.55)	.983	
Abdominal pain	2,428	(6.8)	26	(8.2)	2402	(6.7)	1.24 (0.83–1.86)	.294	
Consultation for chest pain	2,344	(6.5)	9	(2.8)	2335	(6.5)	0.42 (0.22–0.81)	.010	
Consultation for heart rhythm and/or driving disorders	1,443	(4.0)	14	(4.4)	1429	(4.0)	1.11 (0.65–1.90)	.704	

IQR: Interquartile Range; PVC: Peripheral venous catheter; OR: Odds Ratio; CI: Confidence Interval; -: There was no individual with catheter failure in this group.

FIGURE1.



.-S CCIF 6.

Enseignement Superieur (ABES) . Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

BMJ Open

Association between peripheral venous catheter failure and care complexity factors in emergency department: A cross-sectional study.

Journal:	BMJ Open
Manuscript ID	bmjopen-2024-090101.R1
Article Type:	Original research
Date Submitted by the Author:	02-Sep-2024
Complete List of Authors:	Urbina, Andrea; Bellvitge University Hospital, Nursing Knowledge Management and Information Systems Department. Nursing Research Group (IDIBELL).; University of Barcelona, Nursing Faculty Juvé-Udina, Maria-Eulàlia; Catalan Institute of Health; Bellvitge Institute for Biomedical Research, Nursing Reseach Group (IDIBELL) Adamuz, Jordi; Bellvitge University Hospital, Nursing Knowledge Management and Information Systems Department. Nursing Research Group (IDIBELL).; University of Barcelona, Nursing Faculty González-Samartino, Maribel; Bellvitge University Hospital, Nursing Knowledge Management and Information Systems Department. Nursing Research Group (IDIBELL).; University of Barcelona, Nursing Faculty Jiménez-Martínez, Emilio; Bellvitge University Hospital, Infectious Disease Department. Nursing Research Group (IDIBELL); University of Barcelona, Nursing Faculty Delgado-Hito, Pilar ; University of Barcelona, Nursing Faculty; Bellvitge Institute for Biomedical Research, Nursing Reseach Group (IDIBELL) Romero-García, Marta ; University of Barcelona, Nursing Faculty; Bellvitge Institute for Biomedical Research, Nursing Reseach Group (IDIBELL)
Primary Subject Heading :	Nursing
Secondary Subject Heading:	Emergency medicine, Nursing, Patient-centred medicine
Keywords:	Adverse events < THERAPEUTICS, Emergency Service, Hospital, Risk Factors, Safety

SCHOLARONE[™] Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our <u>licence</u>.

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which <u>Creative Commons</u> licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

terez oni

Enseignement Superieur (ABES) Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies



Enseignement Superieur (ABES) Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

2		
3	1	Association between peripheral venous catheter failure and care complexity factors
4 5	2	in emergency department: A cross-sectional study
6	2	in emergency department. A cross-sectional study.
7	3	
o 9	4	Andrea URBINA, Maria-Eulàlia JUVÉ-UDINA, Jordi ADAMUZ, Maribel GONZÁLEZ-
10	5	SAMARTINO, Emilio JIMÉNEZ-MARTÍNEZ, Pilar DELGADO-HITO, Marta ROMERO-
11 12	6	GARCÍA
13	_	
14	/	
15 16	8	AUTHORS AFFILIATIONS:
17 18	9	Andrea URBINA RN. MSc. PhD Student
19	10	- Nursing Knowledge Management and Information Systems Department,
20	11	Bellvitge University Hospital, L'Hospitalet de Llobregat, Catalunya, Spain.
21 22	12	- IDIBELL, Institute of Biomedical Research.
23	1 2	
24	13	Maria-Eulalia JUVE-UDINA RN. MSc. PhD
25 26	14	- Nursing Executive Department, Catalan Institute of Health, Barcelona, Spain.
20	15	- IDIBELL, Institute of Biomedical Research.
28	16	Jordi ADAMUZ RN. MSc. PhD
29 30	17	- Nursing Knowledge Management and Information Systems Department,
31	18	Bellvitge University Hospital, L'Hospitalet de Llobregat, Catalunya, Spain,
32	19	- IDIBELL. Institute of Biomedical Research.
33 34	20	- Fundamental Care and Medical-Surgical Nursing Department, Nursing
35	21	Faculty, University of Barcelona (Barcelona), Spain,
36		
37 38	22	Maribel GONZALEZ-SAMARTINO RN. MSc. PhD
39	23	 Nursing Knowledge Management and Information Systems Department,
40	24	Bellvitge University Hospital, L'Hospitalet de Llobregat, Catalunya, Spain.
41	25	- IDIBELL, Institute of Biomedical Research.
43	26	 Fundamental Care and Medical-Surgical Nursing Department. Nursing
44 45	27	Faculty. University of Barcelona (Barcelona). Spain.
46	28	Emilio IIMÉNE7-MARTÍNEZ RN. MSc. PhD
47	29	- Infectious Disease Department, Bellvitge University Hospital, L'Hospitalet de
48 40	30	Hobregat Catalunya Spain
50	21	DDELL Institute of Diamedical Research
51	וכ	- IDIBELL, INSULULE OF BIOTHEUICAI Research.
52 53	52 22	- Fundamental Care and Medical-Surgical Nursing Department. Nursing
55 54	55	Faculty. University of Barcelona (Barcelona). Spain.
55	34	Pilar DELGADO-HITO RN. MSc. PhD
56 57	35	- Fundamental Care and Medical-Surgical Nursing Department. Nursing
58	36	Faculty. University of Barcelona (Barcelona). Spain.
59	37	- IDIBELL, Institute of Biomedical Research.
60		,

1		
2		
3	1	- International Research Project for the humanization of Health Care, Proyecto
4	С	, , , , , , , , , , , , , , , , , , ,
5	2	
6	3	Marta ROMERO-GARCÍA RN MSc PhD
7	4	
8	4	- Fundamental Care and Medical-Surgical Nursing Department. Nursing
9	5	Faculty. University of Barcelona (Barcelona). Spain.
10	6	- IDIBELL Institute of Biomedical Research
11	-	
12	/	 International Research Project for the humanization of Health Care, Proyecto
15	8	HU-CI
14		
16	9	
17	5	
18	10	Jordi Adamuz, PhD, MSN, RN. Nursing Knowledge Management and Information
19	11	Systems Department Hospital Universitari de Bellvitge IDIPELL Egiva Llarge d'a
20	11	Systems Department, hospital Universitan de Benvilge - IDIDELL, reixa Lidiga S/II,
21	12	08907, L'Hospitalet de Llobregat (Barcelona), Spain. Telephone: +34 93 2602123.
22	13	Fax: +34 93 2607561. E-mail: jadamuz@bellvitgehospital.cat
23		
24	14	
25	15	
26		
27		
28		
29		
30 21		
27		
32		
34		
35		
36		
37		
38		
39		
40		
41		
42		
43		
44		
45 46		
40 17		
47 48		
-0 49		
50		
51		
52		
53		
54		
55		
56		
57		
58		
59		
60		

1 ABSTRACT

Objective: To determine the prevalence of peripheral venous catheter (PVC) failure and 3 its association with care complexity individual factors (CCIFs) in emergency department

4 patients.

Design: A cross-sectional, descriptive-correlational study was performed.

Methods: All patients with a PVC inserted in the emergency department of a tertiary hospital were included. The period of study was from June 2021 to June 2022. The main outcomes were PVC failure (phlebitis, extravasation/infiltration, dysfunction/occlusion and dislodgement/involuntary withdrawal) and 26 CCIFs categorized into five domains (psycho-emotional, mental-cognitive, sociocultural, developmental and comorbidity/complications). Other secondary variables were also collected, such as level of triage or nursing care plan. All data were collected retrospectively from the electronic health records. A descriptive and inferential analysis was performed.

Results: A total of 35,968 patients with one or more PVC inserted during their emergency department visit were included in the study. The prevalence of PVC failure was 0.9% (n=316). The statistically significant CCIFs associated with PVC failure were: incontinence, hemodynamic instability, transmissible infection, vascular fragility, anxiety and fear, impaired adaptation, consciousness disorders, lack of caregiver support and agitation. In addition, we identified that patients with a higher number of CCIFs more frequently experienced PVC failure.

Conclusion: This study identified a prevalence of PVC failure in the emergency department of around 1%. The most prevalent complication was dysfunction, followed by extravasation and dislodgement. In addition, PVC failure was associated with comorbidity/complications, psycho-emotional and mental-cognitive CCIFs domains.

- 42 26 STRENGTHS AND LIMITATIONS OF THIS STUDY
- 43 27 To the best of our knowledge, this is the first study in emergency department to
 44 28 investigate CCIFs that could be associated with PVC failure.
- 45 20 Investigate cell's that could be associated with PVC failure.
 46 29 This cross-sectional study identified several associations between CCIFs and PVC
 47 30 failure.
- 31 Patients were only follow-up during their stay in emergency department
 32 consequently it could impact in the prevalence of PVC failure.
- 51
52
5333
34The study included a large sample size, thereby ensuring broad representativeness
of study population.
- 54 35 Catheter dwell time or drugs administered have not been considered in this study.

1 INTRODUCTION

The insertion of a peripheral venous catheter (PVC) is one of the most common invasive procedures performed by healthcare providers, being an indispensable tool in medical practice for the administration of fluids, blood derivatives, electrolytes or drugs, and other important clinical interventions(1,2). The use of a PVC may compromise patient safety, causing adverse effects such as phlebitis, occlusion or extravasation. There are currently high rates of these catheter-derived complications that affect millions of patients each year worldwide (3). Previous studies show that PVC failure is associated with length of hospital stay, mortality and the cost of hospitalization (4,5).

Non-standardized practices reported among healthcare professionals, among others,
may play a significant role in the occurrence of these complications. One of the causes
of this variability could be the poor training and the low levels of clinical guidelines
implemented, that could have an impact in the prevention and the prior identification
of PVC failure (6).

The use of a PVC is a fundamental part of emergency healthcare. Over half of all Emergency Department (ED) patients will require a PVC during their visit (5). The evidence identified that the prevalence of unnecessary PVC ranges from 27% to 32% in ED (7–9). Additionally, in a recent systematic review, it was found that PVC failure due to infiltration and extravasation were higher in EDs compared to other healthcare settings (25.2 vs. 12.3%) (10). Although the success rates of the first insertion that have been reported are about 80% in ED (11,12). Other studies have shown that ED was also a risk factor for other complications such as suboptimal dressings(13) or phlebitis(14). It is known that complex patients with multiple chronic conditions and psychosocial issues have more frequent interactions with healthcare systems, are more vulnerable to complications and are at higher risk for poor health outcomes(15). In addition, the number of older patients visiting the ED is increasing rapidly and, as a result, patients are becoming more fragile and complex(16).

There is currently evidence on the association of PVC failure with factors such as catheter gauge, insertion site, catheter dwell time, and drugs administered(14,17,18). Other studies have discussed patient-related factors like age, sex or their chronic diseases(19–21). However, evidence regarding other sociocultural or emotional factors in the patient associated with PVC failure is scarce. In this context, the concept of care complexity assumes a fundamental role by considering aspects related to the patient without limiting itself only to the rapeutic aspects (22). In 2010, Juve-Udina et al. defined the Care Complexity Individual Factors (CCIFs) as a set of specific characteristics in each person related to the different determining axes. These have may complicate care delivery and contribute to adverse events (23).

38 Previous studies carried out in public hospitals of Catalonia found that several CCIFs
 39 were associated with adverse events (pressure ulcers, falls and aspiration pneumonia)
 60

Enseignement Superieur (ABES) . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

(24,25), in-hospital mortality (25), hospital readmission (26) and revisit to the ED at 30 days (27). In addition, recently a study also associated PVC failure with CCIF, however, this study was conducted in inpatient wards, without considering patients admitted in

Given the abundant use of PVCs in the ED, it is likely that many patients are suffering PVC related complications. Therefore, the risk of PVC complications must be considered to improve patient outcomes. In order to help create strategies to reduce healthcare-acquired complications and strengthen safety culture, knowledge of the prevalence of PVC failure in the ED and its relationship with CCIF is essential.

METHODS

ED (28).

Objective, study design and sample population

The aim of this study was to determine the prevalence of PVC failure and its association with CCIFs and other clinical and sociodemographic variables in patients admitted to the ED. This cross-sectional, descriptive-correlational study was performed to evaluate the association between PVC failure and CCIFs. This monocentric study was carried from 1 June 2021 to 30 June 2022. The setting of the study was the Bellvitge University Hospital, a tertiary care center located in the southern metropolitan area of Barcelona, Spain. It is a referral high-tech hospital for more than 200,000 inhabitants This facility has an ED equipped with five modules and 120 treatment rooms, and it attends approximately 118,000 patients annually. In addition, this department handles urgent cases of any specialty, except pediatrics and obstetrics (29).

A consecutive sampling method was used. Systematic selection of all patients admitted to the ED during the inclusion period was conducted. The inclusion criteria of the study were patients with a complete nursing care plan in the electronic health records (EHR). Patients who did not have a PVC registered and all those under 16 years of age were excluded. The study was carried out in accordance with current laws and regulations and was approved by the institutional review board of Bellvitge University Hospital (Ref. PR051/22). All data were collected retrospectively from the EHR; therefore, the need for informed consent was waived by the institutional review board.

Data collection

Data were collected retrospectively from the EHR. The main outcomes were PVC failure and CCIFs. These data were recorded in the EHR using ATIC terminology (Architecture, Terminology, Interface, Information, Nursing and Knowledge) by the ED nurses responsible for each patient, and refer to the patient's assessment, identified diagnoses and nursing interventions. For this study we obtained this information from the clinical data warehouse of the Catalan Health Institute. Sociodemographic variables were collected from the Minimum Basic Data Set (MBDS) of the ED (30). The information from

both sources was linked in this database through the patient episode numbers. All data
were pseudonymized independently by the Nursing Knowledge Management and
Information Systems Department using a unique identification number. In this way, the
confidential data of the participants was preserved.

5 Measurements

6 The main variables of the study were PVC failure and 26 CCIFs. Both variables were
7 identified and recorded in real time by the nurses in the nursing assessment form of EHR
8 when the patient was attended to the ED.

9 PVC failure

The PVC failure was identified by nurses using ATIC terminology and were categorized into four main groups: Phlebitis (phlebitis and signs of infection); Extravasation (extravasation and infiltration); Occlusion (by clots or other mechanical occlusion); and Dysfunction (involuntary or accidental withdrawal, catheter dislodgement, dysfunction or leakage of fluid). Data regarding PVC failure were collected from the electronic nurse records, in which registered nurses reported any of the following nurse diagnoses during patient admission: catheter-associated phlebitis (code: 10001284); extravasation (code: 10002222); occlusion (code: 10005988) or dysfunction (code: 10005388); and dislodgement (code: 10017289) or involuntary withdrawal (code: 10010464/ 10010495/ 10010496), according to ATIC terminology.

20 Care complexity individual factors (CCIFs)

CCIFs are a group of patient characteristics related to different health dimensions, that may complicate care delivery and contribute to poor health outcomes. CCIFs were identified by ED nurses and were classified into five domains: (1)comorbidity/complications, (2) developmental, (3) psycho-emotional, (4) mental-cognitive and (5) sociocultural. Patients were considered to have CCIF if they presented at least one related defined characteristic according to previous study (23). These CCIFs were collected from the nursing assessment e-charts as structured data based on the Architecture, Terminology, Interface, Knowledge terminology (31). The CCIFs included in this study are summarized in Supplementary file.

4647 30 Clinical and sociodemographic variables

Hemodynamic instability was obtained from the early warning system named VIDA (the Catalan acronym for Surveillance and Identification of Acute Deterioration). This nursing surveillance improvement program has evolved into an early warning score system that is used on a daily basis to assist clinical decision-making. The VIDA score automatically classifies patients into five groups according to patient progress data: no risk (level 0), low risk (level 1), moderate risk (level 2), high risk (impending complication if not stabilized) (level 3), manifested complication initial status (level 4). For the purposes of this study, the VIDA score was classified as mild (levels 1–2) or high (levels 3–4) risk. Patients were classified according to the highest VIDA score obtained during their visit.

Patient progress data were extracted from anonymized EHRs and included: respiratory
 rate, oxygen saturation, temperature, mental status (level of awareness: 1=aware and
 orientated, >1=disturbed mental status), heart rate, and systolic and diastolic blood
 pressure (24).

Other clinical and sociodemographic variables such as age, sex, nursing care plan and triage level were also collected. The nursing care plan is an instrument for standardizing clinical practice that includes nursing interventions and their programming, nursing diagnoses, and clinical variables of the patients attended (32). On the other hand, triage level is the process that allows the patient to be assigned a level of prioritization in clinical care. Nowadays there are different validated triage scales, Spanish Triage System (SET) is the tool used in the hospital setting. SET System is based on the five levels of triage: 1-Resuscitation; 2-Emergency; 3-Urgency, 4-Less urgent; and 5-Non urgent (33).

13 Validity and reliability

CCIFs were collected according to the classification created in 2010 by Juvé et al. Through a participatory action research study involving more than 400 nurses from eight public hospitals, CCIFs were identified and classified into a total of five domains. Each domain is structured into factors and specifications. These specifications were part of the coded and structured data in the initial and ongoing nursing assessment sections of the EHR, as described in the ATIC (Architecture, Terminology, Interface, Information, Nursing and Knowledge). This classification has been used in other studies to reveal associations between CCIFs and other unfavorable patient outcomes (27), and the predictive ability of this classification has already been demonstrated (24–26).

ATIC terminology has been used since 2020 in emergency department records, although this terminology has been used in hospitalization settings of Catalan Institute of Health since 2007, the major public healthcare provider in Catalonia (Spain). All nurses in the ED received training process and they were provided on-site mentorship in clinical practice and methodology before implantation. In addition, superuser nurses are responsible for supporting the training process of all staff and provide support on the use of the information systems, in clinical analysis and discussions to improve nursing care provision (32).

- 4748 31 Patient and public involvement
 - 32 None

⁵¹ **33**

34 Statistical analysis

IBM SPSS 25.0 statistical software was used. We reported descriptive statistics for
 clinical and demographic variables in the study. Qualitative variables (nominal, ordinal
 and dichotomous) were described using absolute frequencies and percentages; and
 quantitative variables were expressed as median and interquartile range (IQR). The chi-
square test was used for the comparison of qualitative variables and the Student's t-test or Mann-Whitney U test for continuous variables, depending on whether the data followed a normal distribution. The normality of data was evaluated using the Kolmogorov–Smirnov test. Inferential analysis was used to identify significant relationships between catheter failure and care complexity factors. The Odds Ratio (OR) and confidence intervals were calculated and a 95% confidence interval was established for all cases. All statistical analyses were performed using two-tailed tests with an alpha error of 0.05, and a p-value of less than 0.05 was considered significant.

RESULTS

During the study period, 51,412 adult patients were admitted to an ED with a completed nursing health record. Of these, 35,968 (70%) patients with one or more PVC inserted during their ED visit were included. Table 1 shows the clinical and sociodemographic characteristics of the patients included in the study. The median age was 70 years (IQR 53.1-81.0) and 54.3% were male patients. The median of length of stay was 12 hours and triage level was equal to or less than 3 in more than 85% of cases (this level means patients require more urgent care). The main reasons for ED visits were: dyspnea, malaise, COVID-19 infection, abdominal pain, chest pain, and heart rhythm disorders.

- We observed that 80% (n=28,827) of patients had at least one CCIF. Table 2 presents
 the prevalence of CCIFs organized by domains of complexity. The most prevalent CCIFs
 were uncontrolled pain (32.8%), extreme age (39.5%), anxiety and fear (16%) and
 consciousness disorders (14.9%).
- Among patients with a PVC, 0.9% (n=316) had some complication. The reasons for the
 PVC failure charted by the ED nurses were: dysfunction/occlusion 29% (n=92);
 extravasation/infiltration 26.3% (n=83); dislodgement/involuntary withdrawal 26.3%
 (n=83); and phlebitis 18.4% (n=58).

The association of CCIFs with PVC failure is summarized in Table 3. The CCIFs associated with PVC failure were: incontinence (OR: 1.85; 95% CI: 1.39–2.45; p<0.05), hemodynamic instability (OR: 3.06; 95% CI: 2.41–3.88; p<0.05), transmissible infection (OR: 1.61; 95% CI: 1.11–2.32; p<0.05), vascular fragility (OR: 2.94; 95% CI: 2.09–4.15; p<0.05), fear and/or anxiety (OR: 1.45; 95% CI: 1.10–1.89; p<0.05), impaired adaptation (OR: 3.57; 95% CI: 2.17–5.86; p<0.05), consciousness disorders (OR: 2.76; 95% CI: 2.18– 3.50; p<0.05), lack of caregiver support (OR: 4.28; 95% CI: 1.04–17.63; p<0.05) and agitation (OR: 4.07; 95% CI: 2.15–7.72; p<0.05). The median number of CCIFs was higher in patients with PVC failure than those without PVC failure (2 vs 1; p-value=0.001). Moreover, Table 4 shows the association of other clinical factors with PVC failure. The length of stay in the ED showed a statistically significant relationship with PVC failure.

⁵⁸
⁵⁹
⁵⁸
⁵⁹
⁵⁸
⁵⁹
⁵⁸
⁵⁹
⁵⁹
⁵⁸
⁵⁹
⁵⁰
⁵⁰
⁵¹
⁵¹
⁵¹
⁵¹
⁵²
⁵³
⁵³
⁵⁴
⁵⁶
⁵⁸
⁵⁸
⁵⁶
⁵⁸
⁵⁹
⁵⁸
⁵⁹
⁵⁸
⁵⁹
⁵⁸
⁵⁹
⁵⁸
⁵⁹
⁵⁹
⁵⁰
⁵¹
⁵¹
⁵¹
⁵¹
⁵²
⁵²
⁵³
⁵³
⁵⁴
⁵⁴
⁵⁴
⁵⁴
⁵⁶
⁵⁶
⁵⁷
⁵⁸
⁵⁶
⁵⁶
⁵⁷
⁵⁸
⁵⁶
⁵⁷
⁵⁸
⁵⁹
⁵⁸
⁵⁹
⁵⁸
⁵⁹
⁵⁹
⁵⁰
⁵¹
⁵¹
⁵¹
⁵²
⁵²
⁵³
⁵⁴
⁵⁴
⁵⁵
⁵⁶
⁵⁶</l

Enseignement Superieur (ABES) . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

patients with 2–3 CCIFs, 1.78% in patients with 4–5 CCIFs, 2.58% in patients with 6–7
 CCIFs, and 6.5% in patients with >8 CCIFs).

DISCUSSION

The prevalence of PVC failure in the ED was around 1%. The presence of a higher number of CCIFs was associated with PVC failure. Logistic regression identified the CCIFs significantly associated with PVC failure were incontinence, hemodynamic instability, transmissible infection, vascular fragility, anxiety and fear, impaired adaptation, consciousness disorders, lack of caregiver support and agitation. To date, there is the first study that evaluated CCIFs in the ED (27), however, there have been other studies carried out in other departments (hospitalization units) (24-26,28,34). These previous inquires have found associations between CCIFs and other patient health outcomes such as in-hospital mortality, adverse events or hospital readmission. The results of the current study showed that 80% of the patients had CCIFs, and that the mean number of CCIFs was approximately 2 per patient, consistent with previous studies (24–26,34).

In relation to the number of patients with a PVC, the study showed that more than two-thirds of patients with a registered nursing care plan required a PVC, according to previous studies carried out in EDs (8,35,36). The prevalence of PVC failure was lower than other reports in this same department (10,19). This difference could be explained by different criteria from the data collection and the PVC complications. In this sense, in our study all data have been obtained from EHC, and possibly the number of PVC complications has been underestimated. Accordingly, previous studies in other settings reported variable rates (13,21,37), with values ranging from less than 1% (38) to more than 50% of PVC failure (14). In addition, there is great variability when measuring and recording these complications. For example, in relation to phlebitis, at least 71 different phlebitis scales exist, with highly disparate criteria and minimal testing of validity (39). On the other hand, several studies have classified the complications of PVC in a similar way to the current study (40-42); however, many of them only considered phlebitis and infectious complications, without considering other causes of PVC failure (20,43,44). In those studies where several PVC complications were considered, the highest rates were usually extravasation or phlebitis (5,10,21,45). In our study, the most prevalent cause was dysfunction/occlusion, followed by dislodgement and extravasation, and lastly, phlebitis. Phlebitis often takes hours or days to develop (46); therefore, it is possible that the difference in the proportion of PVC failure in previous research is due to the patient follow-up period. Thus, the patient's shorter ED dwell time may explain these results.

In relation to sociodemographic variables, we observed a relationship between PVC
failure and age, consistent with previous studies (47). However, no statistically
significant differences were found in relation to sex, although some studies have
reported an association with female sex (21,28,48). The length of patient stay in the ED

was related to PVC failure. Patients who spend the longest time in the ED are those who have higher PVC dwell time, these results are consistent with studies that have associated the catheter dwell time with the risk of complications (20). Our study found no association between the triage level and PVC failure, although another study found differences in risk of PVC failure and the different levels of triage (47). The triage level assigned in ED categorizes the urgency of patients based on the reason for the consultation or severity, and determining their waiting time, but it does not reflect the care complexity. Therefore, within each triage level, there are heterogeneous patients with different CCIFs, which might explain our findings.

Regarding CCIFs and PVC failure we observed the association with several care complexity factors. First, in the comorbidity/complications domain was associated the hemodynamic instability, incontinence, transmissible infection and vascular fragility factors. In relation to this last complexity factor, 4.5% of patients who visited the ED presented it. This indicates that a relatively high proportion of patients can have venous tortuosity or fragility, that could hinder the PVC insertion. Similarly, a recent study showed that the prevalence of patients with difficult access in ED was 8.9% (49). These results are in line with studies that have related the number of attempts to catheter insertion with the complications reported subsequently, thus confirming that difficult intravenous access is associated with more complications (14,37). Patients who are hemodynamically instability often require higher gauche catheters and higher levels of intravenous drug administration, which can contribute to PVC failure (14,17). Similarly, patients with transmissible infections required the administration of one or more intravenous antibiotics that can be associated with PVC failure (18,45,50). Other studies confirmed that age is an important factor to consider (47). Although the developmental domain was not associated with PVC failure, elders presented a higher frequency of PVC failure. The psycho-emotional domain was also associated with PVC failure, specifically the complexity factors of fear or anxiety and impaired adaptation. There is little evidence related these factors and PVC failure. However, other studies show that fear and anxiety were associated with other unfavorable health outcomes, both in hospitalization units and in emergency departments (24–27). In the mental-cognitive domain, consciousness disorders and agitation were found to be predictors of PVC failure. This relationship could be related to patient movement and catheter fixation and integrity. In recent years it has been demonstrated that optimal fixations or reinforced dressings reduce complications, reducing movement. This causes less irritation of the endovascular tissue and reduces entry of bacteria into the wounded skin, among other benefits (13,51). Conversely, accidental or involuntary dislodgement has been one of the most prevalent causes of PVC failure (5,10). Finally, in relation to the sociocultural domain, the lack of caregiver support was related to the PVC failure, as shows in previous studies (28). Also this CCIF were associated to other adverse events, such as pressure ulcer, falls or aspiration pneumonia (25). Specifically, in the ED, the figure of the caregiver or companion plays a fundamental role in improving communication

Enseignement Superieur (ABES) . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

between the professional and patient, as they actively participate in the care process
 and play a crucial role in decision-making (52). However, the benefits of caregivers in
 the ED remain underexplored and more evidence is needed.

the ED remain underexplored and more evidence is needed. In summary, the CCIFs associated with PVC failure were incontinence, hemodynamic instability, transmissible infection, vascular fragility, fear and/or anxiety, impaired adaptation, consciousness disorders, lack of caregiver support and agitation. Nevertheless, the evidence shows that in order to understand PVC failure must be consider other factors: i) catheter factors, such as material, caliber or type of dressing used to fix it (13,51); ii) clinical factors, such as days of catheter dwell, insertion site, length of stay or drug administration (44,50); and also, iii) patient characteristics, such as age and vascular fragility (28).

12 Limitations

This was an observational analysis with a large number of patients included in a referral hospital in Barcelona. In this study we evaluated CCIFs that could be associated with PVC failure. Even so, there were some limitations to the current study. First of all, this study did not consider the complexity factor "major chronic disease" because it was not possible to collect this data from the EHR. However, there is already evidence regarding the relationship between chronic diseases and catheter complications (20). Secondly, the prevalence of PVC failure may have been under reported because the length of stay of patients in ED is relatively short. Patients are often transferred to inpatient units or other services, so a patient may have PVC failure that was recorded by a nurse in another department. We should take into account that EHRs in ED were only implemented a few years ago, which may have impact in the compliance of nursing records. In this sense, we relied on compliance in completing the EHR; however, since EHR are completed voluntary, some caution is required regarding interpretation. Finally, a cross-sectional design of our study limiting the ability to determine causal inferences, and we did not analyze other variables such as caliber catheter, catheter dwell time or drugs administered. Future research should be conducted using a longitudinal design to analyze the variables independently associated with PVC failure and thus provide more robust findings.

32 CONCLUSIONS

The CCIFs associated with PVC failure were: incontinence, hemodynamic instability, transmissible infection, vascular fragility, anxiety and fear, impaired adaptation, consciousness disorders, lack of caregiver support, and agitation. Therefore, PVC failure was associated with several CCIFs related comorbidity and complications, psycho-emotional and mental-cognitive domains. The prevalence of PVC failure increased as patients had a higher number of CCIFs. Therefore, complications derived from PVC are common and compromise patient safety. Knowing the causes associated with them could help to avoid unfavorable PVC-related health outcomes. Consequently, the early

identification of PVC failure would help to stratify patients and implement preventive strategies.
CONFLICT OF INTEREST STATEMENT: All authors declare they have no competing interests.
ACKNOWLEDGMENTS:
We thank the CERCA Programme/Generalitat de Catalunya for institutional support.
ETHICS APPROVAL STATEMENT:
This study was approved by the Clinical Research Ethics Committee of the Bellvitge University Hospital (reference PR051/22). Informed consent was waived due to the study's design. Ethical and data protection protocols related to anonymity and data confidentiality (access to records, data encryption and archiving of information) were complied with throughout the study.
CONTRIBUTION STATEMENT:
AU, JA, MRG conceived the study, designed the project, and secured research funding. JA, MJU, PDH, supervised the conduct of the study and the collection of data. AU, JA, MGS recruited participating centers and patients and managed data, including quality control. AU, JA, EJM provided statistical advice on study design and analyzed the data. AU and JA wrote the manuscript and EJM, MJU, MGS, MRG and PDH contributed substantially to its review. AU, JA and MRG assume responsibility for the item in its entirety.
FUNDING INFORMATION:
This study is part of the project <i>"Individual Factors of Care Complexity, Care Intensity and Patient Health Outcomes in Emergency Department</i> ", financed by the Official College of Nurses of Barcelona (www.coib.cat) as part of the Nurse Research Projects Grants (PR-542/2022). This work was also supported by the Research Committee of the Bellvitge University Hospital and the Agency for Management of University and Research Grants (AGAUR - 2021SGR00929). Ms. Udina is the recipient of a research grant from Official College of Nurses of Barcelona and Research Committee of the Bellvitge University Hospital and Dr. Juvé and Dr. Adamuz are the recipient of the AGAUR.
12 For peer review only - http://bmiopen.bmi.com/site/about/guidelines.xhtml

2 Supplementary Materials.

to peet teries on

4.

REFE	RENCES	
1.	Webster J, Osborne S, Rickard CM, Marsh N. Clinically-indicated replacement versus routine replacement of peripheral venous catheters. Vol. 2019, Cochrane Database of Systematic Reviews. John Wiley and Sons Ltd; 2019.	
2.	Helm, Robert E. MD; Klausner, Jeffrey D. MD, MPH; Klemperer, John D. MD; Flint, Lori M. BSN, RN, CCRN; Huang, Emily BA. Accepted but Unacceptable: Peripheral IV Catheter Failure. Journal of Infusion Nursing 42(3):p 151-164.	Prot
3.	Marsh N, Larsen EN, Ullman AJ, Mihala G, Cooke M, Chopra V, et al. Peripheral intravenous catheter infection and failure: A systematic review and meta-analysis. Int J Nurs Stud. 2024 Mar 1;151:104673.	ected by copyri
4.	Vendramim P, Avelar AFM, Rickard CM, Pedreira M da LG. The RESPECT trial– Replacement of peripheral intravenous catheters according to clinical reasons or every 96 hours: A randomized, controlled, non-inferiority trial. Int J Nurs Stud. 2020 Jul 1;107:103504.	E ght, including for us
5.	Alexandrou, E., Ray-Barruel, G., Carr, P. J., Frost, S. A., Inwood, S., Higgins, N., Lin, F., Alberto, L., Mermel, L., Rickard, C. M., & OMG Study Group (2018). Use of Short Peripheral Intravenous Catheters: Characteristics, Management, and Outcomes Worldwide. <i>Journal of hospital medicine</i> , <i>13</i> (5), 10.12788/jhm.3039. <u>https://doi.org/10.12788/jhm.3039</u>	nseignement Superieu es related to text and d
6.	Zingg W, Barton A, Bitmead J, Eggimann P, Pujol M, Simon A, et al. Best practice in the use of peripheral venous catheters: A scoping review and expert consensus. Infection Prevention in Practice. 2023 Jun 1;5(2).	· (ABES) ata mining, Al tr
7.	Guihard B, Rouyer F, Serrano D, Sudrial J, Combes X. Appropriateness and Complications of Peripheral Venous Catheters Placed in an Emergency Department. Journal of Emergency Medicine. 2018 Mar 1;54(3):281–6.	aining, and simi
8.	Gledstone-Brown L, McHugh D. Review article: Idle 'just-in-case' peripheral intravenous cannulas in the emergency department: Is something wrong? Vol. 30, EMA - Emergency Medicine Australasia. Blackwell Publishing; 2018. p. 309–26.	lar technologies
9.	Evison H, Sweeny A, Ranse J, Carrington M, Marsh N, Byrnes J, et al. Idle peripheral intravenous cannulation: an observational cohort study of pre-hospital and emergency department practices. Scand J Trauma Resusc Emerg Med. 2021 Dec 1;29(1).	

 10. Marsh N, Webster J, Uliman AJ, Mihala G, Cooke M, Chopra V, et al. Peripheral intravenous catheter non-infectious complications in adults: A systematic review and meta-analysis. Vol. 76, Journal of Advanced Nursing. Blackwell Publishing Ltd; 2020. p. 3346–62. 11. Carr PJ, Rippey JCR, Cooke ML, Trevenen ML, Higgins NS, Foale AS, et al. Factors associated with peripheral intravenous cannulation first-Time insertion success in the emergency department. A multicentre prospective cohort analysis of patient, clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4). 12. Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i>. 2016;17(2):182-190. doi: 10.5301/jva.5000487 13. Corley A, Uliman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Jou	2			
 Marsh N, Webster J, Ullman AJ, Mihala G, Cooke M, Chopra V, et al. Peripheral intravenous catheter non-infectious complications in adults: A systematic review and meta-analysis. Vol. 76, Journal of Advanced Nursing. Blackwell Publishing Ltd; 2020. p. 3346–62. Carr PJ, Rippey JCR, Cooke ML, Trevenen ML, Higgins NS, Foale AS, et al. Factors associated with peripheral intravenous cannulation first-Time insertion success in the emergency department. A multicentre prospective cohort analysis of patient, clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4). Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i>. 2016;17(2):182-190. doi: 10.5301/jva.5000487 Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 No 1;23(6):911–21. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan	3	1		
 intravenous catheter non-infectious complications in adults: A systematic review and meta-analysis. Vol. 76, Journal of Advanced Nursing. Blackwell Publishing Ltd; 2020. p. 3346–62. Carr PJ, Rippey JCR, Cooke ML, Trevenen ML, Higgins NS, Foale AS, et al. Factors associated with peripheral intravenous cannulation first-Time insertion success in the emergency department. A multicentre prospective cohort analysis of patient, clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4). Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i>. 2016;17(2):182-190. doi: 10.5301/iva.5000487 Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	4 5	2	10.	Marsh N, Webster J, Ullman AJ, Mihala G, Cooke M, Chopra V, et al. Peripheral
 and meta-analysis. Vol. 76, Journal of Advanced Nursing. Blackwell Publishing Ltd; 2020. p. 3346–62. 6 7 11. Carr PJ, Rippey JCR, Cooke ML, Trevenen ML, Higgins NS, Foale AS, et al. Factors associated with peripheral intravenous cannulation first-Time insertion success in the emergency department. A multicentre prospective cohort analysis of patient, clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4). 12. Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i>. 2016;17(2):182-190. doi: 10.5301/jva.5000487 13. Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 26 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 31 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 33 14. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective m	6	3		intravenous catheter non-infectious complications in adults: A systematic review
 5 2020. p. 3346–62. 6 11. Carr PJ, Rippey JCR, Cooke ML, Trevenen ML, Higgins NS, Foale AS, et al. Factors associated with peripheral intravenous cannulation first-Time insertion success in the emergency department. A multicentre prospective cohort analysis of patient, clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4). 11. Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i>. 2016;17(2):182-190. doi: 10.5301/jva.5000487 13. Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YO, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	7	4		and meta-analysis. Vol. 76, Journal of Advanced Nursing. Blackwell Publishing Ltd;
 Carr PJ, Rippey JCR, Cooke ML, Trevenen ML, Higgins NS, Foale AS, et al. Factors associated with peripheral intravenous cannulation first-Time insertion success in the emergency department. A multicentre prospective cohort analysis of patient, clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4). Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i>. 2016;17(2):182-190. doi: 10.5301/jva.5000487 Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is asociated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. Catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	8 9	5		2020. p. 3346–62.
 Carr PJ, Rippey JCR, Cooke ML, Trevenen ML, Higgins NS, Foale AS, et al. Factors associated with peripheral intravenous cannulation first-Time insertion success in the emergency department. A multicentre prospective cohort analysis of patient, clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4). Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i>. 2016;17(2):182-190. doi: 10.5301/jva.5000487 Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	10	6		
 11. Call PJ, Miple YCE, Cober ME, Hevenen ME, Higgins RS, Petal Factors associated with peripheral intravenous cannulation first-Time insertion success in the emergency department. A multicentre prospective cohort analysis of patient, clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4). 12. Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins NS, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i>. 2016;17(2):182-190. doi: 10.5301/jva.5000487 13. Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	11	7	11	Carr PL Rippov ICR Cooke ML Trovenen ML Higgins NS Feale AS et al Factors
 associated with peripheral intravenous calinulation inst-fine insertion success in the emergency department. A multicentre prospective cohort analysis of patient, clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4). 12. Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i> . 2016;17(2):182-190. doi: <u>10.5301/jva.5000487</u> 13. Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 24. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 25. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 26. 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (986):752-62. 37. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	12	0	11.	carry, hippey JCR, cooke ML, rrevenen ML, riggins NS, roale AS, et al. ractors
 the emergency department. A multicentre prospective cohort analysis of patient, clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4). clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4). Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i>. 2016;17(2):182-190. doi: 10.5301/jva.5000487 Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	14	0		associated with perpheral intravenous cannulation first-filme insertion success in
 10 clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4). 11 12 12. Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i>. 2016;17(2):182-190. doi: 10.5301/jva.5000487 13. Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	15	9		the emergency department. A multicentre prospective conort analysis of patient,
 11 12 12. Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i>. 2016;17(2):182-190. doi: <u>10.5301/jva.5000487</u> 13. Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	16	10		clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4).
 12 12. Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i>. 2016;17(2):182-190. doi: 10.5301/jva.5000487 13. Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	17 18	11		
2013cánulas intravenosas periféricas en el departamento de emergencias: factores2114asociados con el éxito de la primera inserción. The Journal of Vascular Access.23152016;17(2):182-190. doi: 10.5301/jva.50004872416251713.Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM.2718Peripheral intravenous catheter dressing and securement practice is associated2919with site complications and suboptimal dressing integrity: A secondary analysis of2040,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409.212214.2214.Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral23venous catheter failure: A prospective cohort study of 5345 patients. Journal of24Vascular Access. 2022 Nov 1;23(6):911–21.25752615.27Model to Predict Primary Care Physician-Defined Complexity in a Large Academic28Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun296;30(12):1741–7.206;30(12):1741–7.21222316.24Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People.25262617.27832816.296;30(12):1741–7.296;30(12):1741–7.20332116.21Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly	19	12	12.	Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de
14asociados con el éxito de la primera inserción. The Journal of Vascular Access.152016;17(2):182-190. doi: 10.5301/jva.50004871613.Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM.18Peripheral intravenous catheter dressing and securement practice is associated19with site complications and suboptimal dressing integrity: A secondary analysis of2040,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409.21222214.23chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral24venous catheter failure: A prospective cohort study of 5345 patients. Journal of24Vascular Access. 2022 Nov 1;23(6):911–21.2515.2615.27Model to Predict Primary Care Physician-Defined Complexity in a Large Academic28Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun296;30(12):1741–7.20312116.28Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People.291329343017.3116.32Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People.33243417.35catheters: Bad Outcomes are similar for emergency department and inpatient36placed catheters: A retrospective medical record review. Journal of Vascular37Access. 2022 Jan 1;23(1):50–6.	20	13		cánulas intravenosas periféricas en el departamento de emergencias: factores
 15 2016;17(2):182-190. doi: 10.5301/jva.5000487 16 17 13. Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 21 22 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 86 26 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 30 31 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 33 34 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	21 22	14		asociados con el éxito de la primera inserción. The Journal of Vascular Access .
 16 17 13. Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 21 22 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 25 26 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 30 31 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 33 34 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	23	15		2016;17(2):182-190. doi: <u>10.5301/jva.5000487</u>
 17 13. Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 21 21 21 22 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 25 26 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 30 31 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 33 4 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	24	16		
 Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	25 26	17	13.	Corley A. Ullman AJ. Mihala G. Ray-Barruel G. Alexandrou E. Rickard CM.
 19 with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 21 22 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 26 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 30 31 16. Clegg A, Young J, lliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 33 34 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	20	18		Peripheral intravenous catheter dressing and securement practice is associated
 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 21 22 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 25 26 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 30 31 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 33 34 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	28	19		with site complications and subontimal dressing integrity: A secondary analysis of
 40,037 calleters. Int J Nuls Stud. 2019 Dec 1,100.105409. 21 21 22 23 24 24 24 25 26 27 25 26 27 25 26 27 25 26 27 28 26 27 28 29 29 20 29 20 20 20 21 29 20 20 21 29 20 21 21 22 23 24 25 26 27 25 26 27 28 29 20 20 21 29 20 20 21 29 20 20 21 21 29 20 20 21 21 21 21 22 23 24 25 26 27 28 29 20 20 21 29 20 20 21 21 21 29 20 20 21 29 20 20 21 22 23 24 25 26 27 28 29 20 21 21 21 21 21 21 21 21 22 23 24 25 26 27 28 29 20 21 21 21 21 21	29	20		40.627 cathotors. Int L Nurs Stud. 2010 Doc 1:100:102400
 21 22 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 25 26 27 26 27 27 28 26 27 27 28 29 29 20(12):1741–7. 30 31 32 33 34 35 36 37 37 36 37 37 37 36 37 36 37 	30 31	20		40,057 Catheters. Int J Nurs Stud. 2019 Dec 1,100.105409.
 22 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 26 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 31 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 33 34 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	32	21		
 venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. Vascular Access. 2022 Nov 1;23(6):911–21. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	33	22	14.	Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral
 Vascular Access. 2022 Nov 1;23(6):911–21. Vascular Access. 2022 Nov 1;23(6):911–21. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. T. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	34 35	23		venous catheter failure: A prospective cohort study of 5345 patients. Journal of
 25 26 27 28 26 27 27 28 29 29 29 20(12):1741–7. 30 31 31 31 36 37 38 38 39 31 32 33 34 35 36 37 37 37 36 37 37 37 36 37 37 36 37 <	36	24		Vascular Access. 2022 Nov 1;23(6):911–21.
 26 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 30 31 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 33 34 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	37	25		
 Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 33 44 45 46 47 48 49 41 44 40 45 46 47 48 48 49 49 41 44 40 45 46 47 48 49 40 44 40 44 40 45 47 48 49 49 40 40 41 41 41 42 41 42 41 42 42 42 42 43 44 44 44 45 46 47 48 49 49 40 40 41 41 41 42 41 42 42 42 43 44 44 44 45 44 45 45 46 46 47 47 48 48 48 49 49 40 40 41 41 41 42 41 41 42 42 42 42 42 42 42 44 45 46 47 47 48 48 48 49 49 49 40 40 41 41 41 41 42 42 42 42 42 44 45 45 46 46 47 47 48 48 49 49 49 49 40 40 41 41 42 42 44 44	38 30	26	15.	Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a
4128Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun42296;30(12):1741–7.4430	40	27		Model to Predict Primary Care Physician-Defined Complexity in a Large Academic
 42 43 44 43 44 45 46 47 48 49 49 49 40 44 45 46 47 48 49 49 41 47 48 49 41 49 41 41 42 42 43 44 44 44 44 44 45 46 47 46 47 48 48 49 40 41 41 42 42 42 43 44 <	41	28		Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun
 30 31 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 33 34 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	42 43	29		6;30(12):1741–7.
 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 33 34 35. Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	44	30		
 Lancet. 2013;381 (9868):752-62. Lancet. 2013;381 (9868):752-62. 33 34 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	45	31	16.	Clegg A. Young J. Iliffe S. Rikkert MO. Rockwood K. Frailty in elderly People.
 33 34 35 35 36 36 37 37 37 38 38 39 39 30 31 32 33 34 35 36 37 37 36 37 37 37 36 37 <	46 47	32		Lancet, 2013:381 (9868):752-62.
493417.Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous5035catheters: Bad Outcomes are similar for emergency department and inpatient5236placed catheters: A retrospective medical record review. Journal of Vascular5337Access. 2022 Jan 1;23(1):50–6.	48	33		
505417.Rache 3, Pater 3, Chen NW, Qu L, Ban A. Doomed perpheral intravenous5135catheters: Bad Outcomes are similar for emergency department and inpatient5236placed catheters: A retrospective medical record review. Journal of Vascular5337Access. 2022 Jan 1;23(1):50–6.	49	34	17	Kache S. Patel S. Chen NW/ Ou I. Babl A. Doomed peripheral intravenous
5153Catheters: Bad Outcomes are similar for emergency department and inpatient5236placed catheters: A retrospective medical record review. Journal of Vascular5354375437Access. 2022 Jan 1;23(1):50–6.	50	25	17.	catheters: Red Outcomes are similar for emergency department and inpatient
$\frac{1}{53}$ $\frac{1}{54}$ $\frac{1}{37}$ Access. 2022 Jan 1;23(1):50–6.	52	22		catheters: Bad Outcomes are similar for emergency department and inpatient
$_{54}$ 37 Access. 2022 Jan 1;23(1):50–6.	53	30		placed catheters: A retrospective medical record review. Journal of Vascular
	54	3/		Access. 2022 Jan 1;23(1):50–6.
³⁵ 38	55 56	38		
39 18. Gras E, Jean A, Rocher V, Tran Y, Katsahian S, Jouclas D, et al. Incidence of and risk	57	39	18.	Gras E, Jean A, Rocher V, Tran Y, Katsahian S, Jouclas D, et al. Incidence of and risk
factors for local complications of peripheral venous catheters in patients older	58	40		factors for local complications of peripheral venous catheters in patients older
	59 60			
	60			

BMJ Open

1 than 70 years: Empirical research quantitative. J Clin Nurs. 2023 Aug 1;32(15–16):5000–9. 3 19. Carr PJ, Rippey JCR, Cooke ML, Higgins NS, Trevenen M, Foale A, et al. From insertion to removal: A multicenter survival analysis of an admitted cohort with peripheral intravenous catheters inserted in the emergency department. Infect Control Hosp Epidemiol. 2018 Oct;39(10):1216-1221. 8 9 20. Atay S, Sen S, Cukurlu D. Phlebitis-related peripheral venous catheterization and the associated risk factors. Niger J Clin Pract. 2018 Jul 1;21(7):827–31. 11 21. Marsh N, Larsen EN, Takashima M, Kleidon T, Keogh S, Ullman AJ, et al. Peripheral intravenous catheter failure: A secondary analysis of risks from 11,830 catheters. 11 11 11. Nurs Stud [Internet]. 2021 Dec 1 [cited 2024 Jan 17];124. Available from: https://pubmed.ncbi.nlm.nih.gov/34689013/ 16 22. Guarinoni MG, Motta PC, Petrucci C, Lancia L. Complexity of care: a concept analysis. Ig. 2014;26:226–36. 19 23. Juvé-Udina ME. Intensidad de cuidados enfermeros: ¿cargas de trabajo o complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3]; Available 24 Adamuz J, GonzĂllez-Samartino M, JimĂ(Onez-MartĂnez E, <i>et al</i> Risk of acute deterioration and care complexity individual factors associated with health outcomes in hospitalised patients with COVID-19: a multicentre cohort study <i>BMJ Open</i> 2021;11:e041726. doi: 10.1136/bmjopen-2020-041726 25 Adamuz J, Joue-Udina ME, Gonzalez-Samartino M, Jimenez-Martínez E, Tapia-Pérez M, López-Jimenez MM, et al. Care complexity individual factors associated with a	1			
 than 70 years: Empirical research quantitative. J Clin Nurs. 2023 Aug 1;32(15– 16):5000–9. 19. Carr PJ, Rippey JCR, Cooke ML, Higgins NS, Trevenen M, Foale A, et al. From insertion to removal: A multicenter survival analysis of an admitted cohort with peripheral intravenous catheters inserted in the emergency department. Infect Control Hosp Epidemiol. 2018 Oct;39(10):1216-1221. 20. Atay S, Sen S, Cukurlu D. Phlebitis-related peripheral venous catheterization and the associated risk factors. Niger J Clin Pract. 2018 Jul 1;21(7):827–31. 21. Marsh N, Larsen EN, Takashima M, Kleidon T, Keogh S, Ullman AJ, et al. Peripheral intravenous catheter failure: A secondary analysis of risks from 11,830 catheters. Int J Nurs Stud [Internet]. 2021 Dec 1 [cited 2024 Jan 17];124. Available from: https://pubmed.ncbi.nlm.nih.gov/34689013/ 22. Guarinoni MG, Motta PC, Petrucci C, Lancia L. Complexity of care: a concept analysis. Ig. 2014;26:226–36. 23. Juvé-Udina ME. Intensidad de cuidados enfermeros: ¿cargas de trabajo o complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3]; Available from: https://www.academia.edu/20754559/Intensidad de cuidados enfermeros c argas de trabajo o complejidad individual 24. Adamuz J, GonzÄilez-Samartino M, JimÃ@nez-MartĂnez E, <i>et al</i> Risk of acute deterioration and care complexity individual factors associated with health outcomes in hospitalised patients with COVID-19: a multicentre cohort study <i>BMJ</i> <i>Open</i> 2021;11:e041726. doi: 10.1136/bmjopen-2020-041726 25. Adamuz J, González-Samartino M, Jiménez-MartĬnez E, Tapia- Perez M, Lopez-Jimenez MM, et al. Care Complexity individual factors associated with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July). 26. Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia- Perez M, Lopez-Jimenez MM, et al. Care Complexity Individual factors associated With Hospital Readmission: A Retrospective Cohort Study. Journal of Nursing Scholar	2	1		then 70 means Frankrich research another to Clin Num 2022 Aug 1/22/45
5 2 16):5000–9. 6 3 7 4 19. Carr PJ, Rippey JCR, Cooke ML, Higgins NS, Trevenen M, Foale A, et al. From insertion to removal: A multicenter survival analysis of an admitted cohort with peripheral intravenous catheters inserted in the emergency department. Infect Control Hosp Epidemiol. 2018 Oct;39(10):1216-1221. 7 20. Atay S, Sen S, Cukurlu D. Phlebitis-related peripheral venous catheterization and the associated risk factors. Niger J Clin Pract. 2018 Jul 1;21(7):827–31. 11 11 12 21. Marsh N, Larsen EN, Takashima M, Kleidon T, Keogh S, Ullman AJ, et al. Peripheral intravenous catheter failure: A secondary analysis of risks from 11,830 catheters. Int J Nurs Stud [Internet]. 2021 Dec 1 [cited 2024 Jan 17];124. Available from: https://pubmed.ncbi.nlm.nih.gov/34689013/ 16 20. Guarinoni MG, Motta PC, Petrucci C, Lancia L. Complexity of care: a concept analysis. Ig. 2014;26:226–36. 19 20. 23. Juvé-Udina ME. Intensidad de cuidados enfermeros: ¿cargas de trabajo o complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3]; Available from: https://www.academia.edu/20754559/Intensidad de cuidados enfermeros c argas de trabajo o complejidad individual 21 Adamuz J, Gonzãilez-Samartino M, JimãOnez-MartÃnez E, <i>et al</i> Risk of acute deterioration and care complexity individual factors associated with health outcomes in hospitalised patients with COVID-19: a multicentre cohort study <i>BMJ Open</i> 2021;11:e041726. doi: 10.1136/bmjopen-2020-041726 23 24. Adamuz J, Gonzãilez-Samartino M, Jiménez-MartÍnez E, Ta	4	1		than 70 years: Empirical research quantitative. J Clin Nurs. 2023 Aug 1;32(15–
6 3 7 4 19. Carr PJ, Rippey JCR, Cooke ML, Higgins NS, Trevenen M, Foale A, et al. From insertion to removal: A multicenter survival analysis of an admitted cohort with peripheral intravenous catheters inserted in the emergency department. Infect Control Hosp Epidemiol. 2018 Oct;39(10):1216-1221. 11 7 20. Atay S, Sen S, Cukurlu D. Phlebitis-related peripheral venous catheterization and the associated risk factors. Niger J Clin Pract. 2018 Jul 1;21(7):827–31. 11 11 11 12 21. Marsh N, Larsen EN, Takashima M, Kleidon T, Keogh S, Ullman AJ, et al. Peripheral intravenous catheter failure: A secondary analysis of risks from 11,830 catheters. Int J Nurs Stud [Internet]. 2021 Dec 1 [cited 2024 Jan 17];124. Available from: https://pubmed.ncbi.nlm.nih.gov/34689013/ 16 22. Guarinoni MG, Motta PC, Petrucci C, Lancia L. Complexity of care: a concept analysis. Ig. 2014;26:226–36. 19 23. Juvé-Udina ME. Intensidad de cuidados enfermeros: ¿cargas de trabajo o complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3]; Available from: https://www.academia.edu/20754559/Intensidad de cuidados enfermeros c argas de trabajo o complejidad individual 24 Adamuz J, GonzÄilez-Samartino M, JimÄ©nez-MartÄnez E, et al Risk of acute deterioration and care complexity individual factors associated with health outcomes in hospitalised patients with COVID-19: a multicentre cohort study BMJ Open 2021;11:e041726. doi: 10.1136/bmjopen-2020-041726 25 Adamuz J, GonzÄilez-Samartino M, Jiménez-MartĬnez E, Tapia-Pérez M, López-Jimenez MM, et al. Care complexity in	5	2		16):5000–9.
4 19. Carr PJ, Rippey JCR, Cooke ML, Higgins NS, Trevenen M, Foale A, et al. From 9 insertion to removal: A multicenter survival analysis of an admitted cohort with 11 peripheral intravenous catheters inserted in the emergency department. Infect 12 Control Hosp Epidemiol. 2018 Oct;39(10):1216-1221. 13 8 14 9 20. Atay S, Sen S, Cukurlu D. Phlebitis-related peripheral venous catheterization and 16 10 the associated risk factors. Niger J Clin Pract. 2018 Jul 1;21(7):827–31. 17 11 18 21. Marsh N, Larsen EN, Takashima M, Kleidon T, Keogh S, Ullman AJ, et al. Peripheral 19 12 11. Marsh N, Larsen EN, Takashima M, Kleidon T, Keogh S, Ullman AJ, et al. Peripheral 19 12 12. Marsh N, Larsen EN, Takashima M, Kleidon T, Keogh S, Ullman AJ, et al. Peripheral 11 11 11 12 13 intravenous catheter failure: A secondary analysis of risks from 11,830 catheters. 13 14 J. Unvis Stud [Internet]. 2021 Dec 1 [cited 2024 Jan 17];124. Available from: 14 14 J. Unvis Stud [Internet]. 2021 Guarinoni MG, Motta PC, Petrucci C, Lancia L. Complexity of care: a concept 18 analysis. Ig. 2014;26:226–36. 12 20	6	3		
 insertion to removal: A multicenter survival analysis of an admitted cohort with peripheral intravenous catheters inserted in the emergency department. Infect Control Hosp Epidemiol. 2018 Oct;39(10):1216-1221. 20. Atay S, Sen S, Cukurlu D. Phlebitis-related peripheral venous catheterization and the associated risk factors. Niger J Clin Pract. 2018 Jul 1;21(7):827–31. 21. Marsh N, Larsen EN, Takashima M, Kleidon T, Keogh S, Ullman AJ, et al. Peripheral intravenous catheter failure: A secondary analysis of risks from 11,830 catheters. Int J Nurs Stud [Internet]. 2021 Dec 1 [cited 2024 Jan 17];124. Available from: https://pubmed.ncbi.nlm.nih.gov/34689013/ 22. Guarinoni MG, Motta PC, Petrucci C, Lancia L. Complexity of care: a concept analysis. Ig. 2014;26:226–36. 23. Juvé-Udina ME. Intensidad de cuidados enfermeros: ¿cargas de trabajo o complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3]; Available from: https://www.academia.edu/20754559/Intensidad de cuidados enfermeros c argas de trabajo o complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3]; Available 24. Adamuz J, Gonzăi Jez-Samartino M, Jimã©nez-MartĂnez E, <i>et al</i> Risk of acute deterioration and care complexity individual factors associated with health outcomes in hospitalized patients with COVID-19: a multicentre cohort study <i>BMJ Open</i> 2021;11:e041726. doi: 10.1136/bmjopen-2020-041726 25. Adamuz J, Gonzălez-Samartino M, Jiménez-Martinez E, Tapia-Perez M, López-Jimenez MM, et al. Care complexity individual factors associated with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July). 26. Adamuz J, González-Samartino M, Jiménez-Martinez E, Tapia-Pérez M, López-Jiménez MM, et al. Care Complexity Individual factors associated with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July). 27. Adamuz J, González-Samartino M, Jiménez-Martinez E, Tapia-Pérez M, López-J	/ 8	4	19.	Carr PJ, Rippey JCR, Cooke ML, Higgins NS, Trevenen M, Foale A, et al. From
10 6 peripheral intravenous catheters inserted in the emergency department. Infect 11 7 Control Hosp Epidemiol. 2018 Oct;39(10):1216-1221. 13 8 9 20. Atay S, Sen S, Cukurlu D. Phlebitis-related peripheral venous catheterization and the associated risk factors. Niger J Clin Pract. 2018 Jul 1;21(7):827–31. 14 10 11 12 15 12 Marsh N, Larsen EN, Takashima M, Kleidon T, Keogh S, Ullman AJ, et al. Peripheral intravenous catheter failure: A secondary analysis of risks from 11,830 catheters. 14 Int J Nurs Stud [Internet]. 2021 Dec 1 [cited 2024 Jan 17];124. Available from: https://pubmed.ncbi.nlm.nih.gov/34689013/ 16 22. Guarinoni MG, Motta PC, Petrucci C, Lancia L. Complexity of care: a concept analysis. Ig. 2014;26:226–36. 19 20 23. Juvé-Udina ME. Intensidad de cuidados enfermeros: ¿cargas de trabajo o complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3]; Available 23 Audanuz J, GonzÃ(Iez-Samartino M, JimÃ@nez-MartÃnez E, <i>et al</i> Risk of acute deterioration and care complexity individual factors associated with health outcomes in hospitalised patients with COVID-19: a multicentre cohort study <i>BMJ Open</i> 2021;11:e041726. doi: 10.1136/bmjopen-2020-041726 24 Adamuz J, Juve-Udina ME, Gonzalez-Samartino M, Jiménez-MartÍnez E, Tapia-Pérez M, López-Jiménez MM, et al. Care complexity individual factors associated with adverse events and in-hospital mortality. PLoS	9	5		insertion to removal: A multicenter survival analysis of an admitted cohort with
11 7 Control Hosp Epidemiol. 2018 Oct;39(10):1216-1221. 13 8 14 9 20. Atay S, Sen S, Cukurlu D. Phlebitis-related peripheral venous catheterization and the associated risk factors. Niger J Clin Pract. 2018 Jul 1;21(7):827–31. 17 11 18 12 19 21. Marsh N, Larsen EN, Takashima M, Kleidon T, Keogh S, Ullman AJ, et al. Peripheral intravenous catheter failure: A secondary analysis of risks from 11,830 catheters. 11 13 11 14 12 14. Marsh N, Larsen EN, Takashima M, Kleidon T, Keogh S, Ullman AJ, et al. Peripheral intravenous catheter failure: A secondary analysis of risks from 11,830 catheters. 14 11 J Nurs Stud [Internet]. 2021 Dec 1 [cited 2024 Jan 17];124. Available from: https://pubmed.ncbi.nlm.nih.gov/34689013/ 16 20 23. Juvé-Udina ME. Intensidad de cuidados enfermeros: ¿cargas de trabajo o complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3]; 17 24. argas de trabajo o complejidad individual? 21 Available from: <a href="https://www.academia.edu/20754559/intensidad de cuidados enfermeros:cargas de trabajo o complejidad individual? 22 24. argas de trabajo o compleijidad individual? argas de trabajo o complejidad individual? 25 26 <td< td=""><td>10</td><td>6</td><td></td><td>peripheral intravenous catheters inserted in the emergency department. Infect</td></td<>	10	6		peripheral intravenous catheters inserted in the emergency department. Infect
12 7 13 8 14 9 15 9 16 10 17 11 18 12 19 20. 10 the associated risk factors. Niger J Clin Pract. 2018 Jul 1;21(7):827–31. 11 11 12 21. 13 marsh N, Larsen EN, Takashima M, Kleidon T, Keogh S, Ullman AJ, et al. Peripheral 14 11 15 Intravenous catheter failure: A secondary analysis of risks from 11,830 catheters. 16 17 17 22. 18 Guarinoni MG, Motta PC, Petrucci C, Lancia L. Complexity of care: a concept 18 analysis. Ig. 2014;26:226–36. 19 20 21 Juvé-Udina ME. Intensidad de cuidados enfermeros: ¿cargas de trabajo o 18 complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3]; 22 Available from: 18 natysis. Ig. 20nzÅilez-Samartino M, JimÃ@nez-MartĂnez E, et al Risk of acute 24 Adamuz J, GonzÅilez-Samartino M, JimÃ@nez-MartĂnez E, et al Risk of acute 25 Adamuz J, GonzÅilez-Samartino M, J	11	7		Control Hosp Enidemiol 2018 Oct: 39(10):1216-1221
13 9 14 9 20. Atay S, Sen S, Cukurlu D. Phlebitis-related peripheral venous catheterization and the associated risk factors. Niger J Clin Pract. 2018 Jul 1;21(7):827–31. 11 11 12 21. Marsh N, Larsen EN, Takashima M, Kleidon T, Keogh S, Ullman AJ, et al. Peripheral intravenous catheter failure: A secondary analysis of risks from 11,830 catheters. 13 intravenous catheter failure: A secondary analysis of risks from 11,830 catheters. 14 11 J Nurs Stud [Internet]. 2021 Dec 1 [cited 2024 Jan 17];124. Available from: https://pubmed.ncbi.nlm.nih.gov/34689013/ 16 16 20 22. Guarinoni MG, Motta PC, Petrucci C, Lancia L. Complexity of care: a concept analysis. Ig. 2014;26:226–36. 21 23. Juvé-Udina ME. Intensidad de cuidados enfermeros: ¿cargas de trabajo o complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3]; Available 22 argas de trabajo o complejidad individual 23 11 24 argas de trabajo o complejidad individual 25 24. Adamuz J, GonzĂilez-Samartino M, JimÃ@nez-MartÃnez E, et al Risk of acute deterioration and care complexity individual factors associated with health outcomes in hospitalised patients with COVID-19: a multicentre cohort study BMJ Open 2021;11:e041726. doi: 10.1136/bmjopen-2020-041726 26 24. Adamuz J, Juve-Udina ME, Gonzalez-Samartino M, Jimenez-Martínez E, Tapia-Pérez M, López-Jimenez MM, et al. Care	12 12	0		control hosp Epidemiol. 2018 Oct, 55(10).1210 1221.
9 20. Atay S, Sen S, Cukurlu D. Phiebitis-related peripheral venous catheterization and the associated risk factors. Niger J Clin Pract. 2018 Jul 1;21(7):827–31. 11 11 12 21. Marsh N, Larsen EN, Takashima M, Kleidon T, Keogh S, Ullman AJ, et al. Peripheral intravenous catheter failure: A secondary analysis of risks from 11,830 catheters. Int J Nurs Stud [Internet]. 2021 Dec 1 [cited 2024 Jan 17];124. Available from: https://pubmed.ncbi.nlm.nih.gov/34689013/ 14 14 17 22. Guarinoni MG, Motta PC, Petrucci C, Lancia L. Complexity of care: a concept analysis. Ig. 2014;26:226–36. 19 20 23. Juvé-Udina ME. Intensidad de cuidados enfermeros: ¿cargas de trabajo o complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3]; Available 21 Available from: https://www.academia.edu/20754559/Intensidad de cuidados enfermeros c argas de trabajo o complejidad individual 25 24. Adamuz J, Gonzã[lez-Samartino M, Jimã©nez-MartÃnez E, <i>et al</i> Risk of acute deterioration and care complexity individual factors associated with health outcomes in hospitalised patients with COVID-19: a multicentre cohort study <i>BMJ</i> <i>Open</i> 2021;11:e041726. doi: 10.1136/bmjopen-2020-041726 26 24. Adamuz J, Juve-Udina ME, Gonzalez-Samartino M, Jimenez-Martinez E, Tapia- Perez M, Lopez-Jimenez MM, et al. Care complexity individual factors associated with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July). 27 26. Adamuz J, González	13	0	• •	
16 10 the associated risk factors. Niger J Clin Pract. 2018 Jul 1;21(7):827–31. 17 11 18 12 19 12 11 12 12 13 13 intravenous catheter failure: A secondary analysis of risks from 11,830 catheters. 14 Int J Nurs Stud [Internet]. 2021 Dec 1 [cited 2024 Jan 17];124. Available from: 15 https://pubmed.ncbi.nlm.nih.gov/34689013/ 16 17 17 22. 18 analysis. Ig. 2014;26:226–36. 19 21 20 23. 21 Juvé-Udina ME. Intensidad de cuidados enfermeros: ¿cargas de trabajo o complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3]; 23 Available 24 argas de trabajo o complejidad individual 25 24 argas de trabajo o complejidad individual 26 24. Adamuz J, GonzÃilez-Samartino M, JimÃ@nez-MartÃnez E, <i>et al</i> Risk of acute deterioration and care complexity individual factors associated with health outcomes in hospitalised patients with COVID-19: a multicentre cohort study <i>BMJ Open</i> 2021;11:e041726. doi: 10.1136/bmjopen-2020-041726 26 24. Adamuz J, Juve-Udina ME, Gonzalez-Samartino M, Jimenez-Martinez E,	15	9	20.	Atay S, Sen S, Cukurlu D. Phlebitis-related peripheral venous catheterization and
11 11 12 21. Marsh N, Larsen EN, Takashima M, Kleidon T, Keogh S, Ullman AJ, et al. Peripheral 13 intravenous catheter failure: A secondary analysis of risks from 11,830 catheters. 14 Int J Nurs Stud [Internet]. 2021 Dec 1 [cited 2024 Jan 17];124. Available from: 15 https://pubmed.ncbi.nlm.nih.gov/34689013/ 16 22. 21 Guarinoni MG, Motta PC, Petrucci C, Lancia L. Complexity of care: a concept 21 analysis. Ig. 2014;26:226–36. 22 Juvé-Udina ME. Intensidad de cuidados enfermeros: ¿cargas de trabajo o 21 complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3]; 23 Available from: 14 https://www.academia.edu/20754559/Intensidad de cuidados enfermeros c argas de trabajo o complejidad individual 24 25 24. Adamuz J, GonzĂilez-Samartino M, JimÃ@nez-MartĂnez E, <i>et al</i> Risk of acute 26 24. Adamuz J, Juve-Udina ME, Gonzalez-Samartino M, Jimenez-Martinez E, Tapia- 27 deterioration and care complexity individual factors associated with health 28 outcomes in hospitalised patients with COVID-19: a multicentre cohort study <i>BMJ Open</i> 2021;11:e041726. doi: 10.1136/bmjopen-2020-041726 28 Adamuz J, Juve-Udina ME, Gonzalez-Sam	16	10		the associated risk factors. Niger J Clin Pract. 2018 Jul 1;21(7):827–31.
1221.Marsh N, Larsen EN, Takashima M, Kleidon T, Keogh S, Ullman AJ, et al. Peripheral13intravenous catheter failure: A secondary analysis of risks from 11,830 catheters.14Int J Nurs Stud [Internet]. 2021 Dec 1 [cited 2024 Jan 17];124. Available from:15https://pubmed.ncbi.nlm.nih.gov/34689013/161722.Guarinoni MG, Motta PC, Petrucci C, Lancia L. Complexity of care: a concept18analysis. Ig. 2014;26:226–36.19102023.21Juvé-Udina ME. Intensidad de cuidados enfermeros: ¿cargas de trabajo o22complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3];23Available24argas de trabajo o complejidad individual25112624.27Adamuz J, GonzÃjlez-Samartino M, Jiménez-MartÃnez E, et al Risk of acute280290pen 2021;11:e041726. doi: 10.1136/bmjopen-2020-0417262023.242525262624.27Adamuz J, GonzÃjlez-Samartino M, Jiménez-MartÃnez E, et al Risk of acute290pen 2021;11:e041726. doi: 10.1136/bmjopen-2020-0417262025262627Adamuz J, Juve-Udina ME, Gonzalez-Samartino M, Jimenez-Martinez E, Tapia-2829290pen 2021;11:e041726. doi: 10.1136/bmjopen-2020-0417262023243125Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Pérez M, López-2631 </td <td>17</td> <td>11</td> <td></td> <td></td>	17	11		
 13 intravenous catheter failure: A secondary analysis of risks from 11,830 catheters. 14 Int J Nurs Stud [Internet]. 2021 Dec 1 [cited 2024 Jan 17];124. Available from: https://pubmed.ncbi.nlm.nih.gov/34689013/ 16 17 22. Guarinoni MG, Motta PC, Petrucci C, Lancia L. Complexity of care: a concept analysis. Ig. 2014;26:226–36. 19 20 23. Juvé-Udina ME. Intensidad de cuidados enfermeros: ¿cargas de trabajo o complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3]; Available from: https://www.academia.edu/20754559/Intensidad de cuidados enfermeros c argas de trabajo o complejidad individual 21 Available from: https://www.academia.edu/20754559/Intensidad de cuidados enfermeros c argas de trabajo o complejidad individual 25 26 24. Adamuz J, GonzÃilez-Samartino M, JimÃ@nez-MartÃnez E, <i>et al</i> Risk of acute deterioration and care complexity individual factors associated with health outcomes in hospitalised patients with COVID-19: a multicentre cohort study <i>BMJ Open</i> 2021;11:e041726. doi: 10.1136/bmjopen-2020-041726 31 25. Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Perez M, Lopez-Jimenez MM, et al. Care complexity individual factors associated with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July). 34 35 26. Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Pérez M, López-Jiménez MM, Ruiz-Martínez MJ, et al. Care Complexity Individual Factors Associated With Hospital Readmission: A Retrospective Cohort Study. Journal of Nursing Scholarship. 2018 Jul 1;50(4):411–21. 	18 19	12	21.	Marsh N, Larsen EN, Takashima M, Kleidon T, Keogh S, Ullman AJ, et al. Peripheral
2114Int J Nurs Stud [Internet]. 2021 Dec 1 [cited 2024 Jan 17];124. Available from: https://pubmed.ncbi.nlm.nih.gov/34689013/2315https://pubmed.ncbi.nlm.nih.gov/34689013/2416251722.Guarinoni MG, Motta PC, Petrucci C, Lancia L. Complexity of care: a concept analysis. Ig. 2014;26:226–36.292023.Juvé-Udina ME. Intensidad de cuidados enfermeros: ¿cargas de trabajo o complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3]; Available2023.Juvé-Udina ME. Intensidad de cuidados enfermeros: ¿cargas de trabajo o complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3]; Available3322Availablefrom: https://www.academia.edu/20754559/Intensidad de cuidados enfermeros c argas de trabajo o complejidad individual3423https://www.academia.edu/20754559/Intensidad de cuidados enfermeros c argas de trabajo o complejidad individual3524.Adamuz J, Gonzăilez-Samartino M, Jimã©nez-MartÃnez E, et al Risk of acute deterioration and care complexity individual factors associated with health outcomes in hospitalised patients with COVID-19: a multicentre cohort study BMJ Open 2021;11:e041726. doi: 10.1136/bmjopen-2020-041726443125.453125.463125.4725.Adamuz J, González-Samartino M, Jimenez-Martínez E, Tapia- Perez M, Lopez-Jimenez MM, et al. Care complexity individual factors associated with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July).483526.4437353526.<	20	13		intravenous catheter failure: A secondary analysis of risks from 11,830 catheters.
15https://pubmed.ncbi.nlm.nih.gov/34689013/16161722.18analysis. lg. 2014;26:226–36.192023.Juvé-Udina ME. Intensidad de cuidados enfermeros: ¿cargas de trabajo o complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3];2023.21complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3];22Available332223.https://www.academia.edu/20754559/Intensidad de cuidados enfermeros c argas de trabajo o complejidad individual342324argas de trabajo o complejidad individual3725382624.Adamuz J, GonzÃilez-Samartino M, Jiménez-MartÃnez E, et al Risk of acute deterioration and care complexity individual factors associated with health outcomes in hospitalised patients with COVID-19: a multicentre cohort study BMJ Open 2021;11:e041726. doi: 10.1136/bmjopen-2020-041726303125.3125.32Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia- Perez M, Lopez-Jimenez MM, et al. Care complexity individual factors associated with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July).343526.3526.Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Pérez M, López- Jiménez MM, Ruiz-Martínez MJ, et al. Care Complexity Individual Factors Associated With Hospital Readmission: A Retrospective Cohort Study. Journal of Nursing Scholarship. 2018 Jul 1;50(4):411–21.	21	14		Int I Nurs Stud [Internet] 2021 Dec 1 [cited 2024 Jan 17] 124 Available from:
23 15 Inteps://publiceuncommentation 24 16 25 17 22. 26 17 22. 37 22. Guarinoni MG, Motta PC, Petrucci C, Lancia L. Complexity of care: a concept analysis. Ig. 2014;26:226–36. 38 20 23. Juvé-Udina ME. Intensidad de cuidados enfermeros: ¿cargas de trabajo o complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3]; 38 21 complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3]; 39 22 Available from: 34 23 https://www.academia.edu/20754559/Intensidad de cuidados enfermeros c argas de trabajo o complejidad individual 37 25 argas de trabajo o complejidad individual 38 26 24. Adamuz J, Gonzăilez-Samartino M, Jimã©nez-Martãnez E, et al Risk of acute deterioration and care complexity individual factors associated with health outcomes in hospitalised patients with COVID-19: a multicentre cohort study BMJ 49 0pen 2021;11:e041726. doi: 10.1136/bmjopen-2020-041726 44 30 31 25. 45 31 25. Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Pérez M, López-Jiménez MM, et al. Care complexity individual factors associated with adverse events and in-hospital mortality.	22	15		https://pubmed.pcbi.plm.pib.gov/24689013/
2510261722.Guarinoni MG, Motta PC, Petrucci C, Lancia L. Complexity of care: a concept2718analysis. Ig. 2014;26:226–36.291919302023.Juvé-Udina ME. Intensidad de cuidados enfermeros: ¿cargas de trabajo o3121complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3];3322Availablefrom:4423https://www.academia.edu/20754559/Intensidad de cuidados enfermeros c3524argas de trabajo o complejidad individual3725382624.4027deterioration and care complexity individual factors associated with health4128outcomes in hospitalised patients with COVID-19: a multicentre cohort study <i>BMJ</i> 4329 <i>Open</i> 2021;11:e041726. doi: 10.1136/bmjopen-2020-04172644304453125.463125.472544833with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July).453526.463125.473526.473648334934403341344235433544364531463147254834493540354135 </td <td>23 24</td> <td>16</td> <td></td> <td><u>integration internet interne</u></td>	23 24	16		<u>integration internet interne</u>
261722.Guarinoni MG, Motta PC, Petrucci C, Lancia L. Complexity of care: a concept2718analysis. Ig. 2014;26:226–36.2919302023.Juvé-Udina ME. Intensidad de cuidados enfermeros: ¿cargas de trabajo o3121complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3];3322Availablefrom:3423https://www.academia.edu/20754559/Intensidad de cuidados enfermeros c3524argas de trabajo o complejidad individual3725382624.4027deterioration and care complexity individual factors associated with health4128outcomes in hospitalised patients with COVID-19: a multicentre cohort study <i>BMJ</i> 4329 <i>Open</i> 2021;11:e041726. doi: 10.1136/bmjopen-2020-041726443031453125.46Adamuz J, Juve-Udina ME, Gonzalez-Samartino M, Jimenez-Martinez E, Tapia-4732Perez M, Lopez-Jimenez MM, et al. Care complexity individual factors associated4833with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July).493435403526.413526.42Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Pérez M, López-4337344438453526.4636473748384939403	25	10	22	
2718analysis. Ig. 2014;26:226–36.2819302023.Juvé-Udina ME. Intensidad de cuidados enfermeros: ¿cargas de trabajo o complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3]; Available3122Availablefrom: https://www.academia.edu/20754559/Intensidad de cuidados enfermeros c argas de trabajo o complejidad individual3423https://www.academia.edu/20754559/Intensidad de cuidados enfermeros c argas de trabajo o complejidad individual3725382624.Adamuz J, GonzÃilez-Samartino M, Jiménez-MartÃnez E, et al Risk of acute deterioration and care complexity individual factors associated with health outcomes in hospitalised patients with COVID-19: a multicentre cohort study BMJ Open 2021;11:e041726. doi: 10.1136/bmjopen-2020-0417264430453146314732483349Perez M, Lopez-Jimenez MM, et al. Care complexity individual factors associated with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July).48334934513552Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Pérez M, López- Jiménez MM, Ruiz-Martínez MJ, et al. Care Complexity Individual Factors Associated With Hospital Readmission: A Retrospective Cohort Study. Journal of Nursing Scholarship. 2018 Jul 1;50(4):411–21.	26	17	22.	Guarinoni MG, Motta PC, Petrucci C, Lancia L. Complexity of care: a concept
2019302023.Juvé-Udina ME. Intensidad de cuidados enfermeros: ¿cargas de trabajo o complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3]; Available3121Availablefrom: https://www.academia.edu/20754559/Intensidad de cuidados enfermeros c argas de trabajo o complejidad individual3224Availablefrom: https://www.academia.edu/20754559/Intensidad de cuidados enfermeros c argas de trabajo o complejidad individual3725382624.Adamuz J, GonzÃilez-Samartino M, Jiménez-MartÃnez E, et al Risk of acute deterioration and care complexity individual factors associated with health outcomes in hospitalised patients with COVID-19: a multicentre cohort study BMJ Open 2021;11:e041726. doi: 10.1136/bmjopen-2020-0417264430453125.4430453125.453446334725483349Deze-Jimenez MM, et al. Care complexity individual factors associated with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July).48334926.40354135423643374438453546314732483349344035403541354236433744304531 <t< td=""><td>27</td><td>18</td><td></td><td>analysis. lg. 2014;26:226–36.</td></t<>	27	18		analysis. lg. 2014;26:226–36.
302023.Juvé-Udina ME. Intensidad de cuidados enfermeros: ¿cargas de trabajo o complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3]; Available3322Availablefrom: https://www.academia.edu/20754559/Intensidad de cuidados enfermeros c argas de trabajo o complejidad individual3423https://www.academia.edu/20754559/Intensidad de cuidados enfermeros c argas de trabajo o complejidad individual3725382624.Adamuz J, GonzÃilez-Samartino M, Jiménez-MartÃnez E, et al Risk of acute deterioration and care complexity individual factors associated with health outcomes in hospitalised patients with COVID-19: a multicentre cohort study BMJ Open 2021;11:e041726. doi: 10.1136/bmjopen-2020-0417264430453146314725.483349Perez M, Lopez-Jimenez MM, et al. Care complexity individual factors associated with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July).48334926.40354135423543364437453546334735483349Juve-Udina ME, Gonzalez-Samartino M, Jiménez-Martínez E, Tapia- Perez M, Lopez-Jimenez MM, et al. Care complexity individual factors associated with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July).48334935403541354236	20	19		
31 32 3321 complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3]; Available33 33 3422 Availablefrom: from: https://www.academia.edu/20754559/Intensidad de cuidados enfermeros c argas de trabajo o complejidad individual36 37 38 39 4024Adamuz J, GonzÃilez-Samartino M, Jiménez-MartÃnez E, et al Risk of acute deterioration and care complexity individual factors associated with health outcomes in hospitalised patients with COVID-19: a multicentre cohort study BMJ Open 2021;11:e041726. doi: 10.1136/bmjopen-2020-04172644 45 46 47 48 4925.Adamuz J, Juve-Udina ME, Gonzalez-Samartino M, Jimenez-Martinez E, Tapia- Perez M, Lopez-Jimenez MM, et al. Care complexity individual factors associated with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July).48 49 40 4126.Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia- Perez M, Lopez-Jimenez MM, et al. Care Complexity Individual Factors associated with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July).46 47 48 49 4926.Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Pérez M, López- Jiménez MM, Ruiz-Martínez MJ, et al. Care Complexity Individual Factors Associated With Hospital Readmission: A Retrospective Cohort Study. Journal of Nursing Scholarship. 2018 Jul 1;50(4):411-21.	30	20	23.	Juvé-Udina ME. Intensidad de cuidados enfermeros: ¿cargas de trabajo o
3222Availablefrom:3323https://www.academia.edu/20754559/Intensidad de cuidados enfermeros c3524argas de trabajo o complejidad individual3725382624.Adamuz J, GonzÃilez-Samartino M, Jiménez-MartÃnez E, et al Risk of acute4027deterioration and care complexity individual factors associated with health4128outcomes in hospitalised patients with COVID-19: a multicentre cohort study BMJ4229Open 2021;11:e041726. doi: 10.1136/bmjopen-2020-0417264330454430453125.4633473248334994994027413042304325.443045313125.4633473248334934513526.Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Pérez M, López-Jiménez MM, Ruiz-Martínez MJ, et al. Care Complexity Individual Factors533654375538543755385630	31	21		complejidad individual? Metas De Enfermeria [Internet]. [cited 2021 Mar 3];
 https://www.academia.edu/20754559/Intensidad de cuidados enfermeros c argas de trabajo o complejidad individual 25 24. Adamuz J, GonzÃilez-Samartino M, Jiménez-MartÃnez E, et al Risk of acute deterioration and care complexity individual factors associated with health outcomes in hospitalised patients with COVID-19: a multicentre cohort study BMJ Open 2021;11:e041726. doi: 10.1136/bmjopen-2020-041726 31 25. Adamuz J, Juve-Udina ME, Gonzalez-Samartino M, Jimenez-Martinez E, Tapia- Perez M, Lopez-Jimenez MM, et al. Care complexity individual factors associated with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July). 34 26. Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Pérez M, López- Jiménez MM, Ruiz-Martínez MJ, et al. Care Complexity Individual Factors Associated With Hospital Readmission: A Retrospective Cohort Study. Journal of Nursing Scholarship. 2018 Jul 1;50(4):411–21. 	32 33	22		Available from:
3524 argas de trabajo o complejidad individual3725382624.39274027412842043294429453146314725.483049314925.4430453146314725.4833499409419429439449453146314725.4833499409419429439449453146314725.483349949940941942943944945314633479489499499409419429439449459469479489499499409<	34	23		https://www.academia.edu/20754559/Intensidad de cuidados enfermeros c
 25 26 24. Adamuz J, GonzÃilez-Samartino M, Jiménez-MartÃnez E, et al Risk of acute deterioration and care complexity individual factors associated with health outcomes in hospitalised patients with COVID-19: a multicentre cohort study <i>BMJ</i> 29 29 29 29 29 29 20 20 25. Adamuz J, Juve-Udina ME, Gonzalez-Samartino M, Jimenez-Martinez E, Tapia-Perez M, Lopez-Jimenez MM, et al. Care complexity individual factors associated with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July). 34 35 26. Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Pérez M, López-Jiménez MM, Ruiz-Martínez MJ, et al. Care Complexity Individual Factors Associated With Hospital Readmission: A Retrospective Cohort Study. Journal of Nursing Scholarship. 2018 Jul 1;50(4):411–21. 	35	24		argas de trabajo o complejidad individual
 26 24. Adamuz J, GonzÃilez-Samartino M, Jiménez-MartÃnez E, <i>et al</i> Risk of acute deterioration and care complexity individual factors associated with health outcomes in hospitalised patients with COVID-19: a multicentre cohort study <i>BMJ</i> 29 <i>Open</i> 2021;11:e041726. doi: 10.1136/bmjopen-2020-041726 30 31 25. Adamuz J, Juve-Udina ME, Gonzalez-Samartino M, Jimenez-Martinez E, Tapia-Perez M, Lopez-Jimenez MM, et al. Care complexity individual factors associated with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July). 34 35 26. Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Pérez M, López-Jiménez MM, et al. Care Complexity Individual Factors Associated With Hospital Readmission: A Retrospective Cohort Study. Journal of Nursing Scholarship. 2018 Jul 1;50(4):411–21. 	36 37	25		
 ³⁹ 26 24. Addmid J, Gonzalez Samartino M, Jimite Nie J Marchiez E, et al. Misk of dedice deterioration and care complexity individual factors associated with health outcomes in hospitalised patients with COVID-19: a multicentre cohort study <i>BMJ</i> ⁴² 29 <i>Open</i> 2021;11:e041726. doi: 10.1136/bmjopen-2020-041726 ⁴⁴ 30 ⁴⁵ 31 25. Adamuz J, Juve-Udina ME, Gonzalez-Samartino M, Jimenez-Martinez E, Tapia- ⁴⁶ Perez M, Lopez-Jimenez MM, et al. Care complexity individual factors associated with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July). ⁴⁹ 35 ⁴⁰ 26. Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Pérez M, López-Jiménez MM, Ruiz-Martínez MJ, et al. Care Complexity Individual Factors ⁵¹ 35 ⁵² 26. Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Pérez M, López-Jiménez MM, Ruiz-Martínez MJ, et al. Care Complexity Individual Factors ⁵³ 37 Associated With Hospital Readmission: A Retrospective Cohort Study. Journal of Nursing Scholarship. 2018 Jul 1;50(4):411–21. 	38	26	24	Adamuz I. GonzÃilez-Samartino M. limÃ@nez-MartÃnez F. et. al. Risk of acute
 deterioration and care complexity individual factors associated with fleath outcomes in hospitalised patients with COVID-19: a multicentre cohort study <i>BMJ</i> <i>Open</i> 2021;11:e041726. doi: 10.1136/bmjopen-2020-041726 30 31 25. Adamuz J, Juve-Udina ME, Gonzalez-Samartino M, Jimenez-Martinez E, Tapia- Perez M, Lopez-Jimenez MM, et al. Care complexity individual factors associated with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July). 34 26. Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Pérez M, López- Jiménez MM, Ruiz-Martínez MJ, et al. Care Complexity Individual Factors Associated With Hospital Readmission: A Retrospective Cohort Study. Journal of Nursing Scholarship. 2018 Jul 1;50(4):411–21. 	39	27	27.	deterioration and care complexity individual factors associated with health
 Outcomes in nospitalised patients with COVID-19: a multicentre conort study <i>BMJ</i> <i>Open</i> 2021;11:e041726. doi: 10.1136/bmjopen-2020-041726 30 31 25. Adamuz J, Juve-Udina ME, Gonzalez-Samartino M, Jimenez-Martinez E, Tapia- Perez M, Lopez-Jimenez MM, et al. Care complexity individual factors associated with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July). 34 26. Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Pérez M, López- Jiménez MM, Ruiz-Martínez MJ, et al. Care Complexity Individual Factors Associated With Hospital Readmission: A Retrospective Cohort Study. Journal of Nursing Scholarship. 2018 Jul 1;50(4):411–21. 	40 41	27		automation and care complexity individual factors associated with health
4329Open 2021;11:e041726. doi: 10.1136/bmjopen-2020-0417264430453125.Adamuz J, Juve-Udina ME, Gonzalez-Samartino M, Jimenez-Martinez E, Tapia-4632Perez M, Lopez-Jimenez MM, et al. Care complexity individual factors associated4833with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July).49345034513526.5236533754375538562018 Jul 1;50(4):411–21.	42	20		outcomes in nospitalised patients with COVID-19: a multicentre conort study <i>Bivb</i>
 30 31 25. Adamuz J, Juve-Udina ME, Gonzalez-Samartino M, Jimenez-Martinez E, Tapia- 32 Perez M, Lopez-Jimenez MM, et al. Care complexity individual factors associated with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July). 34 35 26. Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Pérez M, López- Jiménez MM, Ruiz-Martínez MJ, et al. Care Complexity Individual Factors Associated With Hospital Readmission: A Retrospective Cohort Study. Journal of Nursing Scholarship. 2018 Jul 1;50(4):411–21. 	43	29		<i>Open</i> 2021; 11: e041/26. doi: 10.1136/bmjopen-2020-041/26
 Adamuz J, Juve-Udina ME, Gonzalez-Samartino M, Jimenez-Martinez E, Tapia- Perez M, Lopez-Jimenez MM, et al. Care complexity individual factors associated with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July). 34 26. Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Pérez M, López- Jiménez MM, Ruiz-Martínez MJ, et al. Care Complexity Individual Factors Associated With Hospital Readmission: A Retrospective Cohort Study. Journal of Nursing Scholarship. 2018 Jul 1;50(4):411–21. 	44 45	30		
32Perez M, Lopez-Jimenez MM, et al. Care complexity individual factors associated4833with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July).49345034513526. Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Pérez M, López-52365337543755385620	45 46	31	25.	Adamuz J, Juve-Udina ME, Gonzalez-Samartino M, Jimenez-Martinez E, Tapia-
 48 33 with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July). 34 35 26. Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Pérez M, López- 36 Jiménez MM, Ruiz-Martínez MJ, et al. Care Complexity Individual Factors 37 Associated With Hospital Readmission: A Retrospective Cohort Study. Journal of 55 38 Nursing Scholarship. 2018 Jul 1;50(4):411–21. 	47	32		Perez M, Lopez-Jimenez MM, et al. Care complexity individual factors associated
 34 34 35 26. Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Pérez M, López- 36 Jiménez MM, Ruiz-Martínez MJ, et al. Care Complexity Individual Factors 37 Associated With Hospital Readmission: A Retrospective Cohort Study. Journal of 38 Nursing Scholarship. 2018 Jul 1;50(4):411–21. 	48	33		with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July).
303526.Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Pérez M, López-5236Jiménez MM, Ruiz-Martínez MJ, et al. Care Complexity Individual Factors5337Associated With Hospital Readmission: A Retrospective Cohort Study. Journal of5538Nursing Scholarship. 2018 Jul 1;50(4):411–21.	49 50	34		
52 53 5436 37Jiménez MM, Ruiz-Martínez MJ, et al. Care Complexity Individual Factors Associated With Hospital Readmission: A Retrospective Cohort Study. Journal of Nursing Scholarship. 2018 Jul 1;50(4):411–21.56 5020	51	35	26.	Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Pérez M, López-
53565758Associated With Hospital Readmission: A Retrospective Cohort Study. Journal of5538Nursing Scholarship. 2018 Jul 1;50(4):411–21.5620	52	36		liménez MM. Ruiz-Martínez MI. et al. Care Complexity Individual Factors
 ⁵⁴ 37 Associated with hospital Readmission: A Refospective conort study, Journal of ⁵⁵ 38 Nursing Scholarship. 2018 Jul 1;50(4):411–21. ⁵⁶ 20 	53	37		Associated With Hospital Readmission: A Retrospective Cohort Study, Journal of
56 20	54 55	20		Nursing Scholarchin, 2019 Jul 1:E0(4):411, 21
	56	20		Nurshig Scholarship. 2018 Jul 1;50(4):411–21.
57 59	57	39	_	
58 40 27. Urbina, A., Juvé-Udina, M. E., Romero-García, M., Delgado-Hito, P., González-	58 50	40	27.	Urbina, A., Juvé-Udina, M. E., Romero-García, M., Delgado-Hito, P., González-
41 Samartino, M., & Adamuz, J. (2023). Care complexity factors associated with	60	41		Samartino, M., & Adamuz, J. (2023). Care complexity factors associated with

Enseignement Superieur (ABES) Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

BMJ Open

3	1		revisits to an emergency department. Factores de complejidad de cuidados
4	2		asociados a la reconsulta en un servicio de urgencias. Emergencias. 2023
6	З		Διισ·35(Δ)·245-251
7	1		//u6/33/17/213 231.
8	4	• •	
9	5	28.	Jimenez-Martinez E, Adamuz J, Gonzalez-Samartino M, Munoz-Carmona MA,
10	6		Hornero A, Martos-Martínez MP, et al. Peripheral intravenous catheter failure,
11	7		nurse staffing levels and care complexity individual factors: A retrospective
13	8		multicentre cohort study. PLoS One [Internet]. 2024 May 1 [cited 2024 Aug
14	9		22]:19(5). Available from: https://pubmed.ncbi.nlm.nih.gov/38722995/
15 16	10		
10	11	20	Relluitge University Hespital [Internet] [sited 2024 Jun 2] Available from:
18	11	29.	beinvitge University Hospital [Internet]. [cited 2024 Juli 5]. Available from.
19	12		https://bellvitgenospital.cat/es
20	13		
21	14	30.	Government of Catalonia. Department of Health. CMBD regulations and manual
23	15		[Internet]. Barcelona: Catalan Health Service; 2023 [cited 2024 Aug 28].
24	16		Disponible en: https://catsalut.gencat.cat/ca/proveidors-professionals/registres-
25	17		catalegs/registres/cmbd/normativa-manual/
20	18		
28	10	21	ATIC CARE [Internet] [cited 2024 Aug 22] Available from:
29	20	51.	And CARE [Internet]. [cited 2024 Aug 22]. Available from.
30 21	20		nttp://aticcare.peoplewaiking.com/
32	21		
33	22	32.	Juvé-Udina M-E, Adamuz J. Nursing Knowledge Tools and Strategies to Improve
34	23		Patient Outcomes and the Work Environment. Mentoring in Nursing through
35	24		Narrative Stories Across the World. Cham: Springer International Publishing;
37	25		2023. pp. 211–222. https://doi.org/10.1007/978-3-031-25204-4 29
38	26		
39	27	22	Font-Cabrera C. Juvé-Udina MF. Adamuz I. Diaz Membriyes M. Fabrellas N. Guiy-
40 41	27	55.	Compliant CM. Activity, triage levels and impact of the pendemic on begrital
42	20		comenas Ew. Activity, thage levels and impact of the pandemic on hospital
43	29		emergency departments: A multicentre cross-sectional study. J Adv Nurs. 2024;
44	30		
45 46	31	34.	Asensio Flores S, Juvé-Udina ME, Soldevila Cases R, Chacón Aparicio A, Castellà-
47	32		Creus M, Zuriguel-Pérez E, et al. Factores individuales de complejidad de cuidados
48	33		en pacientes ingresados en unidades de cardiología y cirugía cardiaca. Publicación
49	34		Científica de la Asociación Española en Enfermería en Cardiología. 2023:28–33.
50 51	35		
52	36	25	Willis M. Colonatti E. Bakir A. Alama VI. Appatts M. Avgin DT. at al. Prospective
53	50 27	55.	abconvetional study of paripharal introvenave consult utilization and fragments
54	57 20		observational study of peripheral intravenous cannula utilisation and frequency
55 56	38		of intravenous fluid delivery in the emergency department-Convenience or
57	39		necessity? PLoS One. 2024 Jun 1;19(6 June).
58	40		
59 60			
00			

36.

37.

38.

39.

40.

41.

42.

43.

44.

BMJ Open

Shokoohi H, Boniface KS, Kulie P, Long A, McCarthy M. The Utility and Survivorship of Peripheral Intravenous Catheters Inserted in the Emergency Department. Ann Emerg Med. 2019 Sep 1;74(3):381–90. Larsen EN, Marsh N, O'Brien C, Monteagle E, Friese C, Rickard CM. Inherent and modifiable risk factors for peripheral venous catheter failure during cancer treatment: a prospective cohort study. Support Care Cancer [Internet]. 2021 Mar 1 [cited 2024 Jan 17];29(3):1487–96. Available from:	-
https://pubmed.ncbi.nlm.nih.gov/32710173/ Gregg SC, Murthi SB, Sisley AC, Stein DM, Scalea TM. Ultrasound-guided peripheral intravenous access in the intensive care unit. J Crit Care. 2010 Sep 1;25(3):514–9.	Protected by copyrig
Ray-Barruel G, Polit DF, Murfield JE, Rickard CM. Infusion phlebitis assessment measures: A systematic review. J Eval Clin Pract. 2014;20(2):191–202.	yht, including
Simin D, Milutinović D, Turkulov V, Brkić S. Incidence, severity and risk factors of peripheral intravenous cannula-induced complications: An observational prospective study. J Clin Nurs [Internet]. 2019 May 1 [cited 2024 Aug 22];28(9– 10):1585–99. Available from: https://onlinelibrary.wiley.com/doi/full/10.1111/jocn.14760	Enseignement Su y for uses related to tex
Liu C, Chen L, Kong D, Lyu F, Luan L, Yang L. Incidence, risk factors and medical cost of peripheral intravenous catheter-related complications in hospitalised adult patients. J Vasc Access [Internet]. 2022 Jan 1 [cited 2024 Jan 17];23(1):57–66. Available from: https://pubmed.ncbi.nlm.nih.gov/33302797/	iperieur (ABES) . t and data mining, Al
Privitera D, Geraneo A, Li Veli G, Parravicini G, Mazzone A, Rossini M, et al. Complications related to short peripheral intravenous catheters in patients with acute stroke: a prospective, observational, single-cohort study. Intern Emerg Med [Internet]. 2024 [cited 2024 Aug 22]; Available from: https://pubmed.ncbi.nlm.nih.gov/38805082/	training, and similar te
Arias-Fernández L, Suérez-Mier B, Martínez-Ortega M del C, Lana A. Incidencia y factores de riesgo de flebitis asociadas a catéteres venosos periféricos. Enferm Clin. 2017 Mar 1;27(2):79–86.	chnologies.
Lv, L., & Zhang, J. (2020). The incidence and risk of infusion phlebitis with peripheral intravenous catheters: A meta-analysis. <i>The journal of vascular access</i> , <i>21</i> (3), 342–349. <u>https://doi.org/10.1177/1129729819877323</u>	
18	

Enseignement Superieur (ABES) . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

2			
3	1	45.	Johann DA, Danski MTR, Vayego SA, Barbosa DA, Lind J. Risk factors for
4 5	2		complications in peripheral intravenous catheters in adults: Secondary analysis of
6	3		a randomized controlled trial. Rev Lat Am Enfermagem. 2016;24.
7	4		
8	5	16	Higginson B. Barry A. Dhlohitis: treatment, care and provention. Nurs Times
9 10	c C	40.	nigginson K, Farry A. Fillebitis. treatment, care and prevention. Nurs nines.
11	0		2011;107(36):18-21.
12	/		
13 14	8	47.	Carr PJ, Rippey JCR, Cooke ML, Higgins NS, Trevenen M, Foale A, et al. From
14	9		insertion to removal: A multicenter survival analysis of an admitted cohort with
16	10		peripheral intravenous catheters inserted in the emergency department. Infect
17	11		Control Hosp Epidemiol [Internet]. 2018 Oct 1 [cited 2024 Jan 17];39(10):1216-
18 19	12		21. Available from: https://pubmed.ncbi.nlm.nih.gov/30196798/
20	13		
21	14	48	Wallis MC McGrail M Webster I Marsh N Gowardman I Playford EG et al Risk
22	15	40.	factors for paripharal intravonous cathotor failure: a multivariate analysis of data
25 24	16		from a randomized controlled trial infact Control Hoch Enidemial [Internet] 2014
25	10		for a failed controlled that meet control Hosp Epidemiol [internet]. 2014
26	17		Jan [cited 2024 Jan 17];35(1):63–8. Available from:
27 28	18		https://pubmed.ncbi.nlm.nih.gov/24334800/
29	19		
30	20	49.	Davis EM, Feinsmith S, Amick AE, Sell J, McDonald V, Trinquero P, et al. Difficult
31 22	21		intravenous access in the emergency department: Performance and impact of
32 33	22		ultrasound-guided IV insertion performed by nurses. American Journal of
34	23		Emergency Medicine. 2021 Aug 1;46:539–44.
35	24		
36 37	25	50	Larsen FN Marsh N Mihala G King M Zunk M Ullman AL et al Intravenous
38	26	50.	antimicrobial administration through peripheral venous catheters - establishing
39	20		rick profiles from an analysis of E2E2 devices. Int (Antimicrob Agents [Internet]
40 41	27		Tisk promes from an analysis of 5252 devices. Int J Antimicrob Agents [internet].
42	28		2022 Apr 1 [cited 2024 Aug 28];59(4). Available from:
43	29		https://pubmed.ncbi.nlm.nih.gov/35183678/
44 45	30		
45 46	31	51.	Marsh N, Webster J, Mihala G, Rickard CM. Devices and dressings to secure
47	32		peripheral venous catheters to prevent complications. Cochrane Database of
48	33		Systematic Reviews [Internet]. 2015 Jun 12 [cited 2024 Jan 18];2015(6). Available
49 50	34		from:
51	35		https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD011070.pub2
52	36		/full
53	37		,
54 55	יב גע	50	Cooper S. Stevenson E. Communicating decisions about care with nationts and
56	20	52.	companions in amorgancy department consultations. Health Evacetations
57	22		[Internet] 2022 Aug 1 [eited 2024 leg 20] 25(4) 4766 75 A state (
58 59	40		[internet]. 2022 Aug 1 [cited 2024 Jan 29];25(4):1/66–/5. Available from:
60	41		https://onlinelibrary-wiley-com.sire.ub.edu/doi/tull/10.1111/hex.13519

1

1		
2 TABLE1. Patients' demographic and clinical characte	eristics (N= 35,96	8)
3 Demographic and clinical characteristics	n (9	6)
4 Age [median (IOR)]	70.0/52	, 1 01
Age [median (IQR)]	/0.0 (53.	21.0
Stay [median (IQK)]	12 (7.4-	-21.9
Sex	10515	(- 4
, Male	19515	(54
Female	16453	(45
Triage level		
Level 1	806	(2.2
Level 2	10261	(28
Level 3	19557	(54
Level 4	3752	(10
Level 5	1283	(3.6
No triage	309	(0.9
Main Medical Diagnoses		
Covid 19	1851	(5.1
Abdominal pain	790	(2.2
Chest pain	694	(1.9
Syncope and collapse	673	(1.9
Cerebral infarction	516	(1.4
Urinary tract infection	484	(1 :
Main Nursing Care Plans		(1
Consult for dyspnea	3589	(10
General malaise/constitutional syndrome	2826	(10
Coronavirus infaction (COVID 10)	2020	(7
Abdominal nain	2495	(0.3
Abdollinial pain	2428	(0.0
Consultation for been whithm and for driving disorders	2544	(0.5
Abbreviations IOP: Interguartile Pages	1443	(4.0
Abbreviations. Ign. interquartie hange		

3	
4	
5	
6	
7	
8	
9	
10	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
21 22	
22	
23	
24	
25	
26	
27	
28	
29	
30	
31	
32	
33	
34	
35	
26	
20	
3/	
38	
39	
40	
41	
42	
43	
44	
45	
46	
47	
48	
49	
50	
50	
51	
52	
53	
54	
55	
56	
57	

1 T A B L E 2. Care complexity individual factors of adults in emergency department (N=

2 35,968)

Care complexity individual factors	n (%)
Comorbidity and complications	22414	(62.3
Uncontrolled pain	11793	(32.8
Hemodynamic instability	4791	(13.3
Incontinence	4078	(11.3
Transmissible infection	2368	(6.6)
Anatomical and functional disorders	2281	(6.3)
Extreme weight	1899	(5.3)
Postural limitation	1691	(4.7)
High-risk of hemorrhage	1645	(4.6)
Vascular fragility	1620	(4.5)
Communication disorders	1148	(3.2)
Edema	708	(2.0)
Involuntary movements	270	(0.8)
Dehydration	45	(0.1)
Developmental	14223	(39.5
Extreme age	14223	(39.5
Psycho-emotional	6145	(17.1
Anxiety and fear	5750	(16.0
Impaired adaptation	576	(1.6)
Aggressiveness	150	(0.4)
Mental-cognitive	5500	(15.3
Consciousness disorders	5353	(14.9
Agitation	294	(0.8)
Impaired cognitive functions	83	(0.2)
Perception of reality disorders	49	(0.1)
Sociocultural	423	(1.2)
Language limitation	286	(0.8)
Lack of caregiver support	55	(0.2)
Belief conflict	57	(0.2)
Social exclusion	35	(0.1)
Illiteracy	10	(0.0)

3 4 5

TABLE3. Association between peripheral venous catheter failure and care complexity individual factors

		PVC failure							
Care complexity individual factors	n (%) N=35,9	68	Yes N=316 n (%)		No N=35,652 n (%)		OR (CI)	p-value	
CCiF [median (IQR)]	1	(1–2)	2	(1–4)	1	(1–2)	1.33 (1.25–1.40)	<.001	
Comorbidity and complications	22414	(62.3)	232	(73.4)	22182	(62.2)	1.68 (1.31–2.16)	<.001	
Uncontrolled pain	11793	(32.8)	116	(36.7)	11677	(32.8)	1.19 (0.95–1.50)	.136	
Hemodynamic instability	4791	(13.3)	100	(31.6)	4691	(13.2)	3.06 (2.41–3.88)	<.001	
Incontinence	4078	(11.3)	60	(19.0)	4018	(11.3)	1.85 (1.39–2.45)	<.001	
Transmissible infection	2368	(6.6)	32	(10.1)	2336	(6.6)	1.61 (1.11–2.32)	.011	
Anatomical and functional disorders	2281	(6.3)	23	(7.3)	2258	(6.3)	1.16 (0.76–1.78)	.493	
Extreme weight	1899	(5.3)	21	(6.6)	1878	(5.3)	1.28 (0.82–2.00)	.277	
Postural limitation	1691	(4.7)	21	(6.6)	1670	(4.7)	1.45 (0.93–2.26)	.103	
High-risk of hemorrhage	1645	(4.6)	18	(5.7)	1627	(4.6)	1.26 (0.78–2.04)	.338	
Vascular fragility	1620	(4.5)	38	(12.0)	1582	(4.4)	2.94 (2.09–4.15)	<.001	
Communication disorders	1148	(3.2)	13	(4.1)	1135	(3.2)	1.31 (0.75–2.28)	.350	
Edema	708	(2.0)	7	(2.2)	701	(2.0)	1.13 (0.53–2.40)	.751	
Involuntary movements	270	(0.8)	3	(0.9)	267	(0.7)	1.27 (0.41–3.99)	.682	
Dehydration	45	(0.1)	1	(0.3)	44	(0.1)	2.57 (0.35–18.71)	.352	
evelopmental	14223	(39.5)	141	(44.6)	14082	(39.5)	1.23 (0.99–1.54)	.064	
Extreme age (≥75 years old)	14223	(39.5)	141	(44.6)	14082	(39.5)	1.23 (0.99–1.54)	.064	
ycho-emotional	6145	(17.1)	78	(24.7)	6067	(17.0)	1.60 (1.24–2.07)	<.001	
Anxiety and fear	5750	(16.0)	68	(21.5)	5682	(15.9)	1.45 (1.10–1.89)	.007	
Impaired adaptation	576	(1.6)	17	(5.4)	559	(1.6)	3.57 (2.17–5.86)	<.001	
Aggressiveness	150	(0.4)	2	(0.6)	148	(0.4)	1.53 (0.38–6.19)	.553	
ental-cognitive	5500	(15.3)	102	(32.3)	5398	(15.1)	2.67 (2.11–3.39)	<.001	
Consciousness disorders	5353	(14.9)	102	(32.3)	5251	(14.7)	2.76 (2.18–3.50)	<.001	
Agitation	294	(0.8)	10	(3.2)	284	(0.8)	4.07 (2.15–7.72)	<.001	
Impaired cognitive functions	83	(0.2)	1	(0.3)	82	(0.2)	1.38 (0.19–9.92)	.751	
Perception of reality disorders	49	(0.1)	0	(0.0)	49	(0.1)	-	-	
ociocultural	423	(1.2)	3	(0.9)	420	(1.2)	0.80 (0.26–2.52)	0.708	
Language limitation	286	(0.8)	1	(0.3)	285	(0.8)	0.39 (0.06–2.82)	.353	
Lack of caregiver support	55	(0.2)	2	(0.6)	53	(0.1)	4.28 (1.04–17.63)	.044	
Belief conflict	57	(0.2)	0	(0.0)	57	(0.2)	-	-	
Social exclusion	35	(0.1)	0	(0.0)	35	(0.1)	-	-	
Illiteracy	10	(0.0)	0	(0.0)	10	(0.0)	-	-	

PVC: Beripheral venous catheter; OR: Odds Ratio; CI: Confidence Interval; -: There was no individual with catheter failure in this group.

Enseignement Superieur (ABES) Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

TABLE4. Association between peripheral venous catheter failure and characteristics of emergency

2 department patients

	2
	≺

Characteristics	N= 35,968 n (%)			(n=316) n (%)		35,652) n (%)	OR (IC)	p-value	
Age [median (IQR)]	70 (53	8.1–81.0)	73.0 (61.2–83.7)	70.0 (53	3.0–81.0)	1.01 (1.01–1.02)	<.001	
Length of stay (hours) [median (IQR)]	12 (7	.4–21.9)	28.8 (2	19.9–45.3)	11.9 (7.	4–21.6)	1.04 (1.04–1.05)	<.001	
Sex									
Male	19,515	(54.3)	158	(50.0)	19357	(54.3)	0.84 (0.68–1.05)	.128	
Female	16,453	(45.7)	158	(50.0)	16295	(45.7)	1.19 (0.95–1.48)	.128	
Triage level									
Level 1	806	(2.2)	0	(0.0)	806	(2.3)	-	-	
Level 2	10,261	(28.5)	94	(29.7)	10167	(28.5)	1.06 (0.83–1.35)	.630	
Level 3	19,557	(54.4)	172	(54.4)	19385	(54.4)	1.00 (0.80–1.25)	.984	
Level 4	3,752	(10.4)	36	(11.4)	3716	(10.4)	1.11 (0.78–1.57)	.575	
Level 5	1,283	(3.6)	13	(4.1)	1270	(3.6)	1.16 (0.67–2.03)	.599	
Main Medical Diagnoses									
Covid 19	1,851	(5.1)	12	(3.8)	1839	(5.2)	0.73 (0.41–1.30)	.278	
Abdominal pain	790	(2.2)	6	(1.9)	784	(2.2)	0.86 (0.38–1.94)	0.717	
Chest pain	694	(1.9)	1	(0.3)	693	(1.9)	0.16 (0.02–1.14)	.068	
Syncope and collapse	673	(1.9)	3	(0.9)	670	(1.9)	0.50 (0.16–1.56)	.234	
Cerebral infarction	516	(1.4)	5	(1.6)	511	(1.4)	1.11 (0.46–2.69)	.825	
Urinary tract infection	484	(1.3)	9	(2.8)	475	(1.3)	2.17 (1.11–4.24)	.023	
Main Nursing Care Plans									
Consult for dyspnea	3 <i>,</i> 589	(10)	7	(2.2)	3582	(10.0)	0.20 (0.09–0.43)	<.001	
General malaise/constitutional syndrome	2,826	(7.9)	33	(10.4)	2793	(7.8)	1.37 (0.96–1.97)	.087	
Coronavirus infection (COVID-19)	2,493	(6.9)	22	(7.0)	2471	(6.9)	1.01 (0.65–1.55)	.983	
Abdominal pain	2,428	(6.8)	26	(8.2)	2402	(6.7)	1.24 (0.83–1.86)	.294	
Consultation for chest pain	2,344	(6.5)	9	(2.8)	2335	(6.5)	0.42 (0.22–0.81)	.010	
Consultation for heart rhythm and/or driving disorders 4	1,443	(4.0)	14	(4.4)	1429	(4.0)	1.11 (0.65–1.90)	.704	

IQR Interquartile Range; PVC: Peripheral venous catheter; OR: Odds Ratio; CI: Confidence Interval; -: There was no individual with catheter failure in this group.

BMJ Open

1 2 3 1 4 2 5 3 7 4 8 5 9 6 10 11 12 12	FIGURE1 . Prevalence of PVC failure according to the number of CCIF
13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34	
35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60	

FIGURE1. Prevalence of PVC failure according to the number of CCIF



Number of CCIF per patient

Imber G

Supplementary file. Care complexity individual factors included in this study.

CCIFs	Specifications		
Uncontrolled pain	Pain > 3 in Visual Analogue Scale (VAS) with analgesic treatment or with ineffective treatment.		
Hemodynamic instability	Categorized with a moderate or high risk of a impairment, according to the VIDA system.		
Incontinence	Urinary or fecal incontinence.		
Transmissible infection	Amputation, limitation of movement, joint stiffnes functional impotence.		
Anatomical and functional disorders	Patients with isolation measures.		
Extreme weight	Cachexia and obesity		
Postural limitation	Inability to carry out activities such as feeding, hygier toileting and to sit, ambulate or maintain balance.		
High-risk of hemorrhage	Rectal bleeding, hematuria, hematemesis, metrorrh petechiae, epistaxis, melena.		
Vascular fragility	Cutaneous and venous fragility, venous tortuosity, v peripheral pulses.		
Communication disorders	Aphasia, dysphasia, dysarthria, laryngecto tracheostomy.		
Edema	Peripheral edema with pitting, dependent edema wi pitting or anasarca.		
Involuntary movements	Episodic or continuous convulsions or tremor.		
Dehydration	Skin turgor.		
Extreme age	Age ≥75 years.		
Anxiety and fear	Anxiety or Fear (moderate or severe and punctual, episodic or continuous).		
Impaired adaptation	Lability, negativity, distrust of the care team.		
Aggressiveness	Physical or verbal aggressive behaviour (moderat intense and punctual, episodic or continuous)		
Consciousness disorders	Disorientation, confusion, drowsiness, stu unconsciousness		
Agitation	Occasional or episodic psychomotor agitation.		
Impaired cognitive functions	Intellectual disability.		
Perception of reality disorders	Hallucinations.		
Language limitation	Patient does not understand or speak the language a that they do not have a family or external interprete		
Lack of caregiver support	No caregiver, caregiver burnout.		
Belief conflict	Hopelessness, anguish		
Social exclusion	Indigence and extreme poverty.		
	Uncontrolled painHemodynamic instabilityIncontinenceTransmissible infectionAnatomical and functional disordersExtreme weightPostural limitationHigh-risk of hemorrhageVascular fragilityCommunication disordersEdemaInvoluntary movementsDehydrationExtreme ageAnxiety and fearImpaired adaptationAggressivenessConsciousness disordersAgitationImpaired cognitive functionsPerception of reality disordersLanguage limitationLack of caregiver supportBelief conflictSocial exclusion		

BMJ Open

Association between peripheral venous catheter failure and care complexity factors in emergency department: A cross-sectional study.

Journal:	BMJ Open
Manuscript ID	bmjopen-2024-090101.R2
Article Type:	Original research
Date Submitted by the Author:	29-Sep-2024
Complete List of Authors:	Urbina, Andrea; Bellvitge University Hospital, Nursing Knowledge Management and Information Systems Department. Nursing Research Group (IDIBELL).; University of Barcelona, Nursing Faculty Juvé-Udina, Maria-Eulàlia; Catalan Institute of Health; Bellvitge Institute for Biomedical Research, Nursing Reseach Group (IDIBELL) Adamuz, Jordi; Bellvitge University Hospital, Nursing Knowledge Management and Information Systems Department. Nursing Research Group (IDIBELL).; University of Barcelona, Nursing Faculty González-Samartino, Maribel; Bellvitge University Hospital, Nursing Knowledge Management and Information Systems Department. Nursing Research Group (IDIBELL).; University of Barcelona, Nursing Faculty Jiménez-Martínez, Emilio; Bellvitge University Hospital, Infectious Disease Department. Nursing Research Group (IDIBELL); University of Barcelona, Nursing Faculty Delgado-Hito, Pilar ; University of Barcelona, Nursing Faculty; Bellvitge Institute for Biomedical Research, Nursing Reseach Group (IDIBELL) Romero-García, Marta ; University of Barcelona, Nursing Faculty; Bellvitge Institute for Biomedical Research, Nursing Reseach Group (IDIBELL)
Primary Subject Heading :	Nursing
Secondary Subject Heading:	Emergency medicine, Nursing, Patient-centred medicine
Keywords:	Adverse events < THERAPEUTICS, Emergency Service, Hospital, Risk Factors, Safety

SCHOLARONE[™] Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our <u>licence</u>.

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which <u>Creative Commons</u> licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

terez oni

Enseignement Superieur (ABES) Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies



Enseignement Superieur (ABES) Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

2		
3	1	Association between peripheral venous catheter failure and care complexity factors
4 5	2	in emergency department: A cross-sectional study
6	2	in emergency department. A cross-sectional study.
7	3	
9	4	Andrea URBINA, Maria-Eulàlia JUVÉ-UDINA, Jordi ADAMUZ, Maribel GONZÁLEZ-
10	5	SAMARTINO, Emilio JIMÉNEZ-MARTÍNEZ, Pilar DELGADO-HITO, Marta ROMERO-
11 12	6	GARCÍA
13	_	
14	1	
15 16	8	AUTHORS AFFILIATIONS:
17 18	9	Andrea URBINA RN. MSc. PhD Student
19	10	- Nursing Knowledge Management and Information Systems Department,
20	11	Bellvitge University Hospital, L'Hospitalet de Llobregat, Catalunya, Spain.
21 22	12	- IDIBELL, Institute of Biomedical Research.
23	1.5	
24	13	Maria-Eulalia JUVE-UDINA RN. MSc. PhD
25 26	14	- Nursing Executive Department, Catalan Institute of Health, Barcelona, Spain.
20	15	- IDIBELL, Institute of Biomedical Research.
28	16	Jordi ADAMUZ RN. MSc. PhD
29 30	17	- Nursing Knowledge Management and Information Systems Department,
31	18	Bellvitge University Hospital. L'Hospitalet de Llobregat. Catalunya. Spain.
32	19	- IDIBELL. Institute of Biomedical Research.
33 34	20	- Fundamental Care and Medical-Surgical Nursing Department, Nursing
35	21	Faculty, University of Barcelona (Barcelona), Spain,
36		
37 38	22	Maribel GONZALEZ-SAMARTINO RN. MSc. PhD
39	23	 Nursing Knowledge Management and Information Systems Department,
40	24	Bellvitge University Hospital, L'Hospitalet de Llobregat, Catalunya, Spain.
41	25	- IDIBELL, Institute of Biomedical Research.
43	26	 Fundamental Care and Medical-Surgical Nursing Department. Nursing
44 45	27	Faculty. University of Barcelona (Barcelona). Spain.
46	28	Emilio IIMÉNE7-MARTÍNEZ RN. MSc. PhD
47	29	- Infectious Disease Department, Bellvitge University Hospital, L'Hospitalet de
48 40	30	Hobregat Catalunya Spain
50	21	DDELL Institute of Diamedical Research
51	וכ	- IDIBELL, INSULULE OF BIOTHEUICAI Research.
52 53	22 בר	- Fundamental Care and Medical-Surgical Nursing Department. Nursing
55 54	55	Faculty. University of Barcelona (Barcelona). Spain.
55	34	Pilar DELGADO-HITO RN. MSc. PhD
56 57	35	- Fundamental Care and Medical-Surgical Nursing Department. Nursing
58	36	Faculty. University of Barcelona (Barcelona). Spain.
59	37	- IDIBELL, Institute of Biomedical Research.
60		,

1		
2		
3	1	- International Research Project for the humanization of Health Care, Proyecto
4	С	, , , , , , , , , , , , , , , , , , ,
5	2	
6	3	Marta ROMERO-GARCÍA RN MSc PhD
7	4	
8	4	- Fundamental Care and Medical-Surgical Nursing Department. Nursing
9	5	Faculty. University of Barcelona (Barcelona). Spain.
10	6	- IDIBELL Institute of Biomedical Research
11	-	
12	/	 International Research Project for the humanization of Health Care, Proyecto
15	8	HU-CI
14		
16	9	CORRESPONDING ALITOR CONTACT:
17	5	
18	10	Jordi Adamuz, PhD, MSN, RN. Nursing Knowledge Management and Information
19	11	Systems Department Hospital Universitari de Bollvitge IDIPELL Egiva Llarge de
20	11	Systems Department, hospital Universital de Denvitge - IDIDELL, reixa Lidiga S/II,
21	12	08907, L'Hospitalet de Llobregat (Barcelona), Spain. Telephone: +34 93 2602123.
22	13	Fax: +34 93 2607561. E-mail: jadamuz@bellvitgehospital.cat
23		
24	14	
25	15	
26		
27		
28		
29		
30 21		
27		
32		
34		
35		
36		
37		
38		
39		
40		
41		
42		
43		
44		
45 46		
40 17		
47 48		
-0 49		
50		
51		
52		
53		
54		
55		
56		
57		
58		
59		
60		

1 ABSTRACT

Objective: To determine the prevalence of peripheral venous catheter (PVC) failure and

- 3 its association with care complexity individual factors (CCIFs) in emergency department
- 4 patients.

Design: A cross-sectional, descriptive-correlational study was performed.

Methods: All patients with a PVC inserted in the emergency department of a tertiary hospital were included. The period of study was from June 2021 to June 2022. The main outcomes were PVC failure (phlebitis, extravasation/infiltration, dysfunction/occlusion and dislodgement/involuntary withdrawal) and 26 CCIFs categorized into five domains (psycho-emotional, mental-cognitive, sociocultural, developmental and comorbidity/complications). Other secondary variables were also collected, such as level of triage or nursing care plan. All data were collected retrospectively from the electronic health records. A descriptive and inferential analysis was performed.

Results: A total of 35,968 patients with one or more PVC inserted during their emergency department visit were included in the study. The prevalence of PVC failure was 0.9% (n=316). The statistically significant CCIFs associated with PVC failure were: incontinence, hemodynamic instability, transmissible infection, vascular fragility, anxiety and fear, impaired adaptation, consciousness disorders, lack of caregiver support and agitation. In addition, we identified that patients with a higher number of CCIFs more frequently experienced PVC failure.

Conclusion: This study identified a prevalence of PVC failure in the emergency department of around 1%. The most prevalent complication was dysfunction, followed by extravasation and dislodgement. In addition, PVC failure was associated with comorbidity/complications, psycho-emotional and mental-cognitive CCIFs domains.

26 STRENGTHS AND LIMITATIONS OF THIS STUDY

- 27 The study was conducted in a high-complexity hospital.
- 28 This cross-sectional study included a large sample of patients treated in the
 29 emergency department.
- 47
48
4930-Patients were only follow-up during their stay in emergency department48
4931consequently it could impact in the prevalence of PVC failure.
 - 32 All data were collected retrospectively from electronic health records.
- ⁵¹ 33 Catheter dwell time or drugs administered have not been considered in this study.

INTRODUCTION

The insertion of a peripheral venous catheter (PVC) is one of the most common invasive procedures performed by healthcare providers, being an indispensable tool in medical practice for the administration of fluids, blood derivatives, electrolytes or drugs, and other important clinical interventions^{1,2}. The use of a PVC may compromise patient safety, causing adverse effects such as phlebitis, occlusion or extravasation. There are currently high rates of these catheter-derived complications that affect millions of patients each year worldwide ³. Previous studies show that PVC failure is associated with length of hospital stay, mortality and the cost of hospitalization^{4,5}.

Non-standardized practices reported among healthcare professionals, among others, may play a significant role in the occurrence of these complications. One of the causes of this variability could be the poor training and the low levels of clinical guidelines implemented, that could have an impact in the prevention and the prior identification of PVC failure ⁶.

The use of a PVC is a fundamental part of emergency healthcare. Over half of all Emergency Department (ED) patients will require a PVC during their visit ⁵. The evidence identified that the prevalence of unnecessary PVC ranges from 27% to 32% in ED 7-9. Additionally, in a recent systematic review, it was found that PVC failure due to infiltration and extravasation were higher in EDs compared to other healthcare settings (25.2 vs. 12.3%)¹⁰. Although the success rates of the first insertion that have been reported are about 80% in ED ^{11,12}. Other studies have shown that ED was also a risk factor for other complications such as suboptimal dressings¹³ or phlebitis¹⁴. It is known that complex patients with multiple chronic conditions and psychosocial issues have more frequent interactions with healthcare systems, are more vulnerable to complications and are at higher risk for poor health outcomes¹⁵. In addition, the number of older patients visiting the ED is increasing rapidly and, as a result, patients are becoming more fragile and complex¹⁶.

There is currently evidence on the association of PVC failure with factors such as catheter gauge, insertion site, catheter dwell time, and drugs administered^{14,17,18}. Other studies have discussed patient-related factors like age, sex or their chronic diseases^{19–} ²¹. However, evidence regarding other sociocultural or emotional factors in the patient associated with PVC failure is scarce. In this context, the concept of care complexity assumes a fundamental role by considering aspects related to the patient without limiting itself only to therapeutic aspects ²². In 2010, Juve-Udina et al. defined the Care Complexity Individual Factors (CCIFs) as a set of specific characteristics in each person related to the different determining axes. These have may complicate care delivery and contribute to adverse events ²³.

Previous studies carried out in public hospitals of Catalonia found that several CCIFs were associated with adverse events (pressure ulcers, falls and aspiration pneumonia)

Enseignement Superieur (ABES) . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

^{24,25}, in-hospital mortality ²⁵, hospital readmission ²⁶ and revisit to the ED at 30 days ²⁷.
 In addition, recently a study also associated PVC failure with CCIF, however, this study was conducted in inpatient wards, without considering patients admitted in ED ²⁸.

Given the abundant use of PVCs in the ED, it is likely that many patients are suffering
PVC related complications. Therefore, the risk of PVC complications must be considered
to improve patient outcomes. In order to help create strategies to reduce healthcareacquired complications and strengthen safety culture, knowledge of the prevalence of
PVC failure in the ED and its relationship with CCIF is essential.

10 METHODS

11 Objective, study design and sample population

The aim of this study was to determine the prevalence of PVC failure and its association with CCIFs and other clinical and sociodemographic variables in patients admitted to the ED. This cross-sectional, descriptive-correlational study was performed to evaluate the association between PVC failure and CCIFs. This monocentric study was carried from 1 June 2021 to 30 June 2022. The setting of the study was the Bellvitge University Hospital, a tertiary care center located in the southern metropolitan area of Barcelona, Spain. It is a referral high-tech hospital for more than 200,000 inhabitants This facility has an ED equipped with five modules and 120 treatment rooms, and it attends approximately 118,000 patients annually. In addition, this department handles urgent cases of any specialty, except pediatrics and obstetrics²⁹.

A consecutive sampling method was used. Systematic selection of all patients admitted to the ED during the inclusion period was conducted. The inclusion criteria of the study were patients with a complete nursing care plan in the electronic health records (EHR). Patients who did not have a PVC registered and all those under 16 years of age were excluded. The study was carried out in accordance with current laws and regulations and was approved by the institutional review board of Bellvitge University Hospital (Ref. PR051/22). All data were collected retrospectively from the EHR; therefore, the need for informed consent was waived by the institutional review board.

30 Data collection

Data were collected retrospectively from the EHR. The main outcomes were PVC failure and CCIFs. These data were recorded in the EHR using ATIC terminology (Architecture, Terminology, Interface, Information, Nursing and Knowledge) by the ED nurses responsible for each patient, and refer to the patient's assessment, identified diagnoses and nursing interventions. For this study we obtained this information from the clinical data warehouse of the Catalan Health Institute. Sociodemographic variables were collected from the Minimum Basic Data Set (MBDS) of the ED ³⁰. The information from both sources was linked in this database through the patient episode numbers. All data

BMJ Open

were pseudonymized independently by the Nursing Knowledge Management and
 Information Systems Department using a unique identification number. In this way, the

3 confidential data of the participants was preserved.

4 Measurements

- 5 The main variables of the study were PVC failure and 26 CCIFs. Both variables were
- 6 identified and recorded in real time by the nurses in the nursing assessment form of EHR
- 7 when the patient was attended to the ED.

8 PVC failure

The PVC failure was identified by nurses using ATIC terminology and were categorized into four main groups: Phlebitis (phlebitis and signs of infection); Extravasation (extravasation and infiltration); Occlusion (by clots or other mechanical occlusion); and Dysfunction (involuntary or accidental withdrawal, catheter dislodgement, dysfunction or leakage of fluid). Data regarding PVC failure were collected from the electronic nurse records, in which registered nurses reported any of the following nurse diagnoses during patient admission: catheter-associated phlebitis (code: 10001284); extravasation (code: 10002222); occlusion (code: 10005988) or dysfunction (code: 10005388); and dislodgement (code: 10017289) or involuntary withdrawal (code: 10010464/ 10010495/ 10010496), according to ATIC terminology.

19 Care complexity individual factors (CCIFs)

CCIFs are a group of patient characteristics related to different health dimensions, that may complicate care delivery and contribute to poor health outcomes. CCIFs were classified into five identified by ED nurses and were domains: (1)comorbidity/complications, (2) developmental, (3) psycho-emotional, (4) mental-cognitive and (5) sociocultural. Patients were considered to have CCIF if they presented at least one related defined characteristic according to previous study ²³. These CCIFs were collected from the nursing assessment e-charts as structured data based on the Architecture, Terminology, Interface, Knowledge terminology ³¹. The CCIFs included in this study are summarized in Supplementary file.

⁴⁵ 46 29 *Cl*

9 Clinical and sociodemographic variables

Hemodynamic instability was obtained from the early warning system named VIDA (the Catalan acronym for Surveillance and Identification of Acute Deterioration). This nursing surveillance improvement program has evolved into an early warning score system that is used on a daily basis to assist clinical decision-making. The VIDA score automatically classifies patients into five groups according to patient progress data: no risk (level 0), low risk (level 1), moderate risk (level 2), high risk (impending complication if not stabilized) (level 3), manifested complication initial status (level 4). For the purposes of this study, the VIDA score was classified as mild (levels 1–2) or high (levels 3–4) risk. Patients were classified according to the highest VIDA score obtained during their visit. Patient progress data were extracted from anonymized EHRs and included: respiratory

1 rate, oxygen saturation, temperature, mental status (level of awareness: 1=aware and

orientated, >1=disturbed mental status), heart rate, and systolic and diastolic blood
 pressure ²⁴.

Other clinical and sociodemographic variables such as age, sex, nursing care plan and triage level were also collected. The nursing care plan is an instrument for standardizing clinical practice that includes nursing interventions and their programming, nursing diagnoses, and clinical variables of the patients attended³². On the other hand, triage level is the process that allows the patient to be assigned a level of prioritization in clinical care. Nowadays there are different validated triage scales, Spanish Triage System (SET) is the tool used in the hospital setting. SET System is based on the five levels of triage: 1-Resuscitation; 2-Emergency; 3-Urgency, 4-Less urgent; and 5-Non urgent³³.

12 Validity and reliability

CCIFs were collected according to the classification created in 2010 by Juvé et al. Through a participatory action research study involving more than 400 nurses from eight public hospitals, CCIFs were identified and classified into a total of five domains. Each domain is structured into factors and specifications. These specifications were part of the coded and structured data in the initial and ongoing nursing assessment sections of the EHR, as described in the ATIC (Architecture, Terminology, Interface, Information, Nursing and Knowledge). This classification has been used in other studies to reveal associations between CCIFs and other unfavorable patient outcomes ²⁷, and the predictive ability of this classification has already been demonstrated ^{24–26}.

ATIC terminology has been used since 2020 in emergency department records, although this terminology has been used in hospitalization settings of Catalan Institute of Health since 2007, the major public healthcare provider in Catalonia (Spain). All nurses in the ED received training process and they were provided on-site mentorship in clinical practice and methodology before implantation. In addition, superuser nurses are responsible for supporting the training process of all staff and provide support on the use of the information systems, in clinical analysis and discussions to improve nursing care provision ³².

- 46
4730Patient and public involvement
 - 31 None

32 51

33 Statistical analysis

IBM SPSS 25.0 statistical software was used. We reported descriptive statistics for clinical and demographic variables in the study. Qualitative variables (nominal, ordinal and dichotomous) were described using absolute frequencies and percentages; and quantitative variables were expressed as median and interquartile range (IQR). The chi-square test was used for the comparison of qualitative variables and the Student's t-test

or Mann-Whitney U test for continuous variables, depending on whether the data followed a normal distribution. The normality of data was evaluated using the Kolmogorov–Smirnov test. Inferential analysis was used to identify significant relationships between catheter failure and care complexity factors. The Odds Ratio (OR) and confidence intervals were calculated and a 95% confidence interval was established for all cases. All statistical analyses were performed using two-tailed tests with an alpha error of 0.05, and a p-value of less than 0.05 was considered significant.

9 RESULTS

During the study period, 51,412 adult patients were admitted to an ED with a completed nursing health record. Of these, 35,968 (70%) patients with one or more PVC inserted during their ED visit were included. Table 1 shows the clinical and sociodemographic characteristics of the patients included in the study. The median age was 70 years (IQR 53.1-81.0) and 54.3% were male patients. The median of length of stay was 12 hours and triage level was equal to or less than 3 in more than 85% of cases (this level means patients require more urgent care). The main reasons for ED visits were: dyspnea, malaise, COVID-19 infection, abdominal pain, chest pain, and heart rhythm disorders.

- We observed that 80% (n=28,827) of patients had at least one CCIF. Table 2 presents
 the prevalence of CCIFs organized by domains of complexity. The most prevalent CCIFs
 were uncontrolled pain (32.8%), extreme age (39.5%), anxiety and fear (16%) and
 consciousness disorders (14.9%).
- Among patients with a PVC, 0.9% (n=316) had some complication. The reasons for the
 PVC failure charted by the ED nurses were: dysfunction/occlusion 29% (n=92);
 extravasation/infiltration 26.3% (n=83); dislodgement/involuntary withdrawal 26.3%
 (n=83); and phlebitis 18.4% (n=58).

The association of CCIFs with PVC failure is summarized in Table 3. The CCIFs associated with PVC failure were: incontinence (OR: 1.85; 95% CI: 1.39–2.45; p<0.05), hemodynamic instability (OR: 3.06; 95% CI: 2.41–3.88; p<0.05), transmissible infection (OR: 1.61; 95% CI: 1.11–2.32; p<0.05), vascular fragility (OR: 2.94; 95% CI: 2.09–4.15; p<0.05), fear and/or anxiety (OR: 1.45; 95% CI: 1.10–1.89; p<0.05), impaired adaptation (OR: 3.57; 95% CI: 2.17–5.86; p<0.05), consciousness disorders (OR: 2.76; 95% CI: 2.18– 3.50; p<0.05), lack of caregiver support (OR: 4.28; 95% CI: 1.04–17.63; p<0.05) and agitation (OR: 4.07; 95% CI: 2.15–7.72; p<0.05). The median number of CCIFs was higher in patients with PVC failure than those without PVC failure (2 vs 1; p-value=0.001). Moreover, Table 4 shows the association of other clinical factors with PVC failure. The length of stay in the ED showed a statistically significant relationship with PVC failure.

Finally, Figure 1 shows that the prevalence of PVC failure showed an increasing trend in
ED patients with a higher number of CCIFs (0.61% in patients with 0–1 CCIF, 0.89% in

Enseignement Superieur (ABES) . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

patients with 2–3 CCIFs, 1.78% in patients with 4–5 CCIFs, 2.58% in patients with 6–7
 CCIFs, and 6.5% in patients with >8 CCIFs).

DISCUSSION

The prevalence of PVC failure in the ED was around 1%. The presence of a higher number of CCIFs was associated with PVC failure. Logistic regression identified the CCIFs significantly associated with PVC failure were incontinence, hemodynamic instability, transmissible infection, vascular fragility, anxiety and fear, impaired adaptation, consciousness disorders, lack of caregiver support and agitation. To date, there is the first study that evaluated CCIFs in the ED ²⁷, however, there have been other studies carried out in other departments (hospitalization units)^{24–26,28,34}. These previous inquires have found associations between CCIFs and other patient health outcomes such as in-hospital mortality, adverse events or hospital readmission. The results of the current study showed that 80% of the patients had CCIFs, and that the mean number of CCIFs was approximately 2 per patient, consistent with previous studies $^{24-26,34}$.

In relation to the number of patients with a PVC, the study showed that more than two-thirds of patients with a registered nursing care plan required a PVC, according to previous studies carried out in EDs ^{8,35,36}. The prevalence of PVC failure was lower than other reports in this same department^{10,19}. This difference could be explained by different criteria from the data collection and the PVC complications. In this sense, in our study all data have been obtained from EHC, and possibly the number of PVC complications has been underestimated. Accordingly, previous studies in other settings reported variable rates ^{13,21,37}, with values ranging from less than 1% ³⁸ to more than 50% of PVC failure ¹⁴. In addition, there is great variability when measuring and recording these complications. For example, in relation to phlebitis, at least 71 different phlebitis scales exist, with highly disparate criteria and minimal testing of validity ³⁹. On the other hand, several studies have classified the complications of PVC in a similar way to the current study^{40–42}; however, many of them only considered phlebitis and infectious complications, without considering other causes of PVC failure^{20,43,44}. In those studies where several PVC complications were considered, the highest rates were usually extravasation or phlebitis^{5,10,21,45}. In our study, the most prevalent cause was dysfunction/occlusion, followed by dislodgement and extravasation, and lastly, phlebitis. Phlebitis often takes hours or days to develop⁴⁶; therefore, it is possible that the difference in the proportion of PVC failure in previous research is due to the patient follow-up period. Thus, the patient's shorter ED dwell time may explain these results.

In relation to sociodemographic variables, we observed a relationship between PVC failure and age, consistent with previous studies ⁴⁷. However, no statistically significant differences were found in relation to sex, although some studies have reported an association with female sex ^{21,28,48}. The length of patient stay in the ED was related to PVC failure. Patients who spend the longest time in the ED are those who have higher

PVC dwell time, these results are consistent with studies that have associated the catheter dwell time with the risk of complications ²⁰. Our study found no association between the triage level and PVC failure, although another study found differences in risk of PVC failure and the different levels of triage ⁴⁷. The triage level assigned in ED categorizes the urgency of patients based on the reason for the consultation or severity, and determining their waiting time, but it does not reflect the care complexity. Therefore, within each triage level, there are heterogeneous patients with different CCIFs, which might explain our findings.

Regarding CCIFs and PVC failure we observed the association with several care complexity factors. First, in the comorbidity/complications domain was associated the hemodynamic instability, incontinence, transmissible infection and vascular fragility factors. In relation to this last complexity factor, 4.5% of patients who visited the ED presented it. This indicates that a relatively high proportion of patients can have venous tortuosity or fragility, that could hinder the PVC insertion. Similarly, a recent study showed that the prevalence of patients with difficult access in ED was 8.9% ⁴⁹. These results are in line with studies that have related the number of attempts to catheter insertion with the complications reported subsequently, thus confirming that difficult intravenous access is associated with more complications^{14,37}. Patients who are hemodynamically instability often require higher gauche catheters and higher levels of intravenous drug administration, which can contribute to PVC failure^{14,17}. Similarly, patients with transmissible infections required the administration of one or more intravenous antibiotics that can be associated with PVC failure ^{18,45,50}. Other studies confirmed that age is an important factor to consider ⁴⁷. Although the developmental domain was not associated with PVC failure, elders presented a higher frequency of PVC failure. The psycho-emotional domain was also associated with PVC failure, specifically the complexity factors of fear or anxiety and impaired adaptation. There is little evidence related these factors and PVC failure. However, other studies show that fear and anxiety were associated with other unfavorable health outcomes, both in hospitalization units and in emergency departments²⁴⁻²⁷. In the mental-cognitive domain, consciousness disorders and agitation were found to be predictors of PVC failure. This relationship could be related to patient movement and catheter fixation and integrity. In recent years it has been demonstrated that optimal fixations or reinforced dressings reduce complications, reducing movement. This causes less irritation of the endovascular tissue and reduces entry of bacteria into the wounded skin, among other benefits^{13,51}. Conversely, accidental or involuntary dislodgement has been one of the most prevalent causes of PVC failure^{5,10}. Finally, in relation to the sociocultural domain, the lack of caregiver support was related to the PVC failure, as shows in previous studies ²⁸. Also, this CCIF were associated to other adverse events, such as pressure ulcer, falls or aspiration pneumonia ²⁵. Specifically, in the ED, the figure of the caregiver or companion plays a fundamental role in improving communication between the professional and patient, as they actively participate in the care process and play a

Enseignement Superieur (ABES) . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

crucial role in decision-making ⁵². However, the benefits of caregivers in the ED remain
 underexplored and more evidence is needed.

In summary, the CCIFs associated with PVC failure were incontinence, hemodynamic instability, transmissible infection, vascular fragility, fear and/or anxiety, impaired adaptation, consciousness disorders, lack of caregiver support and agitation. Nevertheless, the evidence shows that in order to understand PVC failure must be consider other factors: i) catheter factors, such as material, caliber or type of dressing used to fix it^{13,51}; ii) clinical factors, such as days of catheter dwell, insertion site, length of stay or drug administration^{44,50}; and also, iii) patient characteristics, such as age and vascular fragility²⁸.

11 Limitations

This was an observational analysis with a large number of patients included in a referral hospital in Barcelona. In this study we evaluated CCIFs that could be associated with PVC failure. Even so, there were some limitations to the current study. First of all, this study did not consider the complexity factor "major chronic disease" because it was not possible to collect this data from the EHR. However, there is already evidence regarding the relationship between chronic diseases and catheter complications²⁰. Secondly, the prevalence of PVC failure may have been under reported because the length of stay of patients in ED is relatively short. Patients are often transferred to inpatient units or other services, so a patient may have PVC failure that was recorded by a nurse in another department. We should take into account that EHRs in ED were only implemented a few years ago, which may have impact in the compliance of nursing records. In this sense, we relied on compliance in completing the EHR; however, since EHR are completed voluntary, some caution is required regarding interpretation. Finally, a cross-sectional design of our study limiting the ability to determine causal inferences, and we did not analyze other variables such as caliber catheter, catheter dwell time or drugs administered. Future research should be conducted using a longitudinal design to analyze the variables independently associated with PVC failure and thus provide more robust findings.

31 CONCLUSIONS

The CCIFs associated with PVC failure were: incontinence, hemodynamic instability, transmissible infection, vascular fragility, anxiety and fear, impaired adaptation, consciousness disorders, lack of caregiver support, and agitation. Therefore, PVC failure was associated with several CCIFs related comorbidity and complications, psycho-emotional and mental-cognitive domains. The prevalence of PVC failure increased as patients had a higher number of CCIFs. Therefore, complications derived from PVC are common and compromise patient safety. Knowing the causes associated with them could help to avoid unfavorable PVC-related health outcomes. Consequently, the early

1 2 3	identification of PVC failure would help to stratify patients and implement preventive strategies.
4	
5 6	CONFLICT OF INTEREST STATEMENT: All authors declare they have no competing interests.
7	
8	ACKNOWLEDGMENTS:
9 10	We thank the CERCA Programme/Generalitat de Catalunya for institutional support.
11	ETHICS APPROVAL STATEMENT:
12 13 14 15 16	This study was approved by the Clinical Research Ethics Committee of the Bellvitge University Hospital (reference PR051/22). Informed consent was waived due to the study's design. Ethical and data protection protocols related to anonymity and data confidentiality (access to records, data encryption and archiving of information) were complied with throughout the study.
17	
18	CONTRIBUTION STATEMENT:
19 20 21 22 23 24 25 26	AU, JA, MRG conceived the study, designed the project, and secured research funding. JA, MJU, PDH, supervised the conduct of the study and the collection of data. AU, JA, MGS recruited participating centers and patients and managed data, including quality control. AU, JA, EJM provided statistical advice on study design and analyzed the data. AU and JA wrote the manuscript and EJM, MJU, MGS, MRG and PDH contributed substantially to its review. AU is responsible for the overall content as guarantor and accepts full responsibility for the finished work and/or the conduct of the study, had access to the data, and controlled the decision to publish.
27	
28 29 30 31 32 33 34 35 36	FUNDING INFORMATION: This study is part of the project "Individual Factors of Care Complexity, Care Intensity and Patient Health Outcomes in Emergency Department", financed by the Official College of Nurses of Barcelona as part of the Nurse Research Projects Grants (PR- 542/2022) and, by the Research Committee of the Bellvitge University Hospital (PR051- 22). Ms. Urbina is the recipient of a research grant from Official College of Nurses of Barcelona and Research Committee of the Bellvitge University Hospital. This study also financed by the Agència de Gestió d'Ajuts Universitaris i de Recerca (2021SGR00929) whom Dr. Juvé-Udina and Dr. Adamuz are the recipient grant.
	12 For peer review only - http://bmiopen.bmi.com/site/about/guidelines.xhtml

2 Supplementary Materials.

to peet teries on

4.

REFE	RENCES	
1.	Webster J, Osborne S, Rickard CM, Marsh N. Clinically-indicated replacement versus routine replacement of peripheral venous catheters. Vol. 2019, Cochrane Database of Systematic Reviews. John Wiley and Sons Ltd; 2019.	
2.	Helm, Robert E. MD; Klausner, Jeffrey D. MD, MPH; Klemperer, John D. MD; Flint, Lori M. BSN, RN, CCRN; Huang, Emily BA. Accepted but Unacceptable: Peripheral IV Catheter Failure. Journal of Infusion Nursing 42(3):p 151-164.	Prot
3.	Marsh N, Larsen EN, Ullman AJ, Mihala G, Cooke M, Chopra V, et al. Peripheral intravenous catheter infection and failure: A systematic review and meta-analysis. Int J Nurs Stud. 2024 Mar 1;151:104673.	ected by copyri
4.	Vendramim P, Avelar AFM, Rickard CM, Pedreira M da LG. The RESPECT trial– Replacement of peripheral intravenous catheters according to clinical reasons or every 96 hours: A randomized, controlled, non-inferiority trial. Int J Nurs Stud. 2020 Jul 1;107:103504.	E ght, including for us
5.	Alexandrou, E., Ray-Barruel, G., Carr, P. J., Frost, S. A., Inwood, S., Higgins, N., Lin, F., Alberto, L., Mermel, L., Rickard, C. M., & OMG Study Group (2018). Use of Short Peripheral Intravenous Catheters: Characteristics, Management, and Outcomes Worldwide. <i>Journal of hospital medicine</i> , <i>13</i> (5), 10.12788/jhm.3039. <u>https://doi.org/10.12788/jhm.3039</u>	nseignement Superieu es related to text and d
6.	Zingg W, Barton A, Bitmead J, Eggimann P, Pujol M, Simon A, et al. Best practice in the use of peripheral venous catheters: A scoping review and expert consensus. Infection Prevention in Practice. 2023 Jun 1;5(2).	· (ABES) ata mining, Al tr
7.	Guihard B, Rouyer F, Serrano D, Sudrial J, Combes X. Appropriateness and Complications of Peripheral Venous Catheters Placed in an Emergency Department. Journal of Emergency Medicine. 2018 Mar 1;54(3):281–6.	aining, and simi
8.	Gledstone-Brown L, McHugh D. Review article: Idle 'just-in-case' peripheral intravenous cannulas in the emergency department: Is something wrong? Vol. 30, EMA - Emergency Medicine Australasia. Blackwell Publishing; 2018. p. 309–26.	lar technologies
9.	Evison H, Sweeny A, Ranse J, Carrington M, Marsh N, Byrnes J, et al. Idle peripheral intravenous cannulation: an observational cohort study of pre-hospital and emergency department practices. Scand J Trauma Resusc Emerg Med. 2021 Dec 1;29(1).	

 10. Marsh N, Webster J, Uliman AJ, Mihala G, Cooke M, Chopra V, et al. Peripheral intravenous catheter non-infectious complications in adults: A systematic review and meta-analysis. Vol. 76, Journal of Advanced Nursing. Blackwell Publishing Ltd; 2020. p. 3346–62. 11. Carr PJ, Rippey JCR, Cooke ML, Trevenen ML, Higgins NS, Foale AS, et al. Factors associated with peripheral intravenous cannulation first-Time insertion success in the emergency department. A multicentre prospective cohort analysis of patient, clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4). 12. Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i>. 2016;17(2):182-190. doi: 10.5301/jva.5000487 13. Corley A, Uliman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Jou	2			
 Marsh N, Webster J, Ullman AJ, Mihala G, Cooke M, Chopra V, et al. Peripheral intravenous catheter non-infectious complications in adults: A systematic review and meta-analysis. Vol. 76, Journal of Advanced Nursing. Blackwell Publishing Ltd; 2020. p. 3346–62. Carr PJ, Rippey JCR, Cooke ML, Trevenen ML, Higgins NS, Foale AS, et al. Factors associated with peripheral intravenous cannulation first-Time insertion success in the emergency department. A multicentre prospective cohort analysis of patient, clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4). Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i>. 2016;17(2):182-190. doi: 10.5301/jva.5000487 Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 No 1;23(6):911–21. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan	3	1		
 intravenous catheter non-infectious complications in adults: A systematic review and meta-analysis. Vol. 76, Journal of Advanced Nursing. Blackwell Publishing Ltd; 2020. p. 3346–62. Carr PJ, Rippey JCR, Cooke ML, Trevenen ML, Higgins NS, Foale AS, et al. Factors associated with peripheral intravenous cannulation first-Time insertion success in the emergency department. A multicentre prospective cohort analysis of patient, clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4). Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i>. 2016;17(2):182-190. doi: 10.5301/iva.5000487 Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	4 5	2	10.	Marsh N, Webster J, Ullman AJ, Mihala G, Cooke M, Chopra V, et al. Peripheral
 and meta-analysis. Vol. 76, Journal of Advanced Nursing. Blackwell Publishing Ltd; 2020. p. 3346–62. 6 7 11. Carr PJ, Rippey JCR, Cooke ML, Trevenen ML, Higgins NS, Foale AS, et al. Factors associated with peripheral intravenous cannulation first-Time insertion success in the emergency department. A multicentre prospective cohort analysis of patient, clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4). 12. Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i>. 2016;17(2):182-190. doi: 10.5301/jva.5000487 13. Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	6	3		intravenous catheter non-infectious complications in adults: A systematic review
 5 2020. p. 3346–62. 6 11. Carr PJ, Rippey JCR, Cooke ML, Trevenen ML, Higgins NS, Foale AS, et al. Factors associated with peripheral intravenous cannulation first-Time insertion success in the emergency department. A multicentre prospective cohort analysis of patient, clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4). 11. Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i>. 2016;17(2):182-190. doi: 10.5301/jva.5000487 13. Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YO, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	7	4		and meta-analysis. Vol. 76, Journal of Advanced Nursing. Blackwell Publishing Ltd;
 Carr PJ, Rippey JCR, Cooke ML, Trevenen ML, Higgins NS, Foale AS, et al. Factors associated with peripheral intravenous cannulation first-Time insertion success in the emergency department. A multicentre prospective cohort analysis of patient, clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4). Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i>. 2016;17(2):182-190. doi: 10.5301/jva.5000487 Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is asociated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. Catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	8 9	5		2020. p. 3346–62.
 Carr PJ, Rippey JCR, Cooke ML, Trevenen ML, Higgins NS, Foale AS, et al. Factors associated with peripheral intravenous cannulation first-Time insertion success in the emergency department. A multicentre prospective cohort analysis of patient, clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4). Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i>. 2016;17(2):182-190. doi: 10.5301/jva.5000487 Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	10	6		
 11. Call PJ, Miple YCE, Cober ME, Hevenen ME, Higgins RS, Petal Factors associated with peripheral intravenous cannulation first-Time insertion success in the emergency department. A multicentre prospective cohort analysis of patient, clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4). 12. Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins NS, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i>. 2016;17(2):182-190. doi: 10.5301/jva.5000487 13. Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	11	7	11	Carr PL Rippov ICR Cooke ML Trovenen ML Higgins NS Feale AS et al Factors
 associated with peripheral intravenous calinulation inst-fine insertion success in the emergency department. A multicentre prospective cohort analysis of patient, clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4). 12. Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i> . 2016;17(2):182-190. doi: <u>10.5301/jva.5000487</u> 13. Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 24. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 25. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 26. 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (986):752-62. 37. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	12	0	11.	carry, hippey JCR, cooke ML, revenen ML, higgins NS, roale AS, et al. ractors
 the emergency department. A multicentre prospective cohort analysis of patient, clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4). clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4). Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i>. 2016;17(2):182-190. doi: 10.5301/jva.5000487 Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	14	0		associated with perpheral intravenous cannulation first-filme insertion success in
 10 clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4). 11 12 12. Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i>. 2016;17(2):182-190. doi: 10.5301/jva.5000487 13. Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	15	9		the emergency department. A multicentre prospective conort analysis of patient,
 11 12 12. Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i>. 2016;17(2):182-190. doi: <u>10.5301/jva.5000487</u> 13. Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	16	10		clinician and product characteristics. BMJ Open. 2019 Apr 1;9(4).
 12 12. Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de cánulas intravenosas periféricas en el departamento de emergencias: factores asociados con el éxito de la primera inserción. <i>The Journal of Vascular Access</i>. 2016;17(2):182-190. doi: 10.5301/jva.5000487 13. Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	17 18	11		
2013cánulas intravenosas periféricas en el departamento de emergencias: factores2114asociados con el éxito de la primera inserción. The Journal of Vascular Access.23152016;17(2):182-190. doi: 10.5301/jva.50004872416251713.Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM.2718Peripheral intravenous catheter dressing and securement practice is associated2819with site complications and suboptimal dressing integrity: A secondary analysis of2040,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409.212214.Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral23venous catheter failure: A prospective cohort study of 5345 patients. Journal of24Vascular Access. 2022 Nov 1;23(6):911–21.25752615.Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic2906;30(12):1741–7.206;30(12):1741–7.21232416.25313616.37Access. 2013;381 (9868):752-62.38313941.303116.35catheters: A retrospective medical record review. Journal of Vascular363737Access. 2022 Jan 1;23(1):50–6.	19	12	12.	Carr PJ, Rippey JCR, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Inserción de
14asociados con el éxito de la primera inserción. The Journal of Vascular Access.152016;17(2):182-190. doi: 10.5301/jva.50004871613.Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM.18Peripheral intravenous catheter dressing and securement practice is associated19with site complications and suboptimal dressing integrity: A secondary analysis of2040,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409.21222214.23chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral24venous catheter failure: A prospective cohort study of 5345 patients. Journal of24Vascular Access. 2022 Nov 1;23(6):911–21.2515.2615.27Model to Predict Primary Care Physician-Defined Complexity in a Large Academic28Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun296;30(12):1741–7.20312116.28Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People.291329343017.3116.32Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People.33243417.35catheters: Bad Outcomes are similar for emergency department and inpatient36placed catheters: A retrospective medical record review. Journal of Vascular37Access. 2022 Jan 1;23(1):50–6.	20	13		cánulas intravenosas periféricas en el departamento de emergencias: factores
 15 2016;17(2):182-190. doi: 10.5301/jva.5000487 16 17 13. Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 21 22 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 86 26 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 30 31 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 33 34 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	21 22	14		asociados con el éxito de la primera inserción. The Journal of Vascular Access .
 16 17 13. Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 21 22 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 25 26 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 30 31 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 33 34 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	23	15		2016;17(2):182-190. doi: <u>10.5301/jva.5000487</u>
 17 13. Corley A, Ullman AJ, Mihala G, Ray-Barruel G, Alexandrou E, Rickard CM. Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 21 21 21 22 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 25 26 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 30 31 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 33 4 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	24	16		
 Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	25 26	17	13.	Corley A. Ullman AJ. Mihala G. Ray-Barruel G. Alexandrou E. Rickard CM.
 19 with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 21 22 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 26 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 30 31 16. Clegg A, Young J, lliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 33 34 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	20	18		Peripheral intravenous catheter dressing and securement practice is associated
 40,637 catheters. Int J Nurs Stud. 2019 Dec 1;100:103409. 21 22 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 25 26 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 30 31 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 33 34 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	28	19		with site complications and subontimal dressing integrity: A secondary analysis of
 40,037 calleters. Int J Nuls Stud. 2019 Dec 1,100.105409. 21 21 22 23 24 24 24 25 26 27 25 26 27 25 26 27 25 26 27 28 26 27 28 29 29 20 29 20 20 20 21 29 20 20 21 29 20 21 29 20 20 21 21 22 23 24 25 26 27 27 28 29 20 20 21 29 20 20 21 21 29 20 20 21 21 21 21 22 23 24 25 26 27 28 29 20 20 21 29 20 20 21 21 21 29 20 20 21 29 20 20 21 22 23 24 25 26 27 28 29 20 21 21 21 21 21 21 21 21 22 23 24 25 26 27 28 29 20 21 21 21 21 21	29	20		40.627 cathotors. Int L Nurs Stud. 2010 Doc 1:100:102400
 21 22 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 25 26 27 26 27 27 28 26 27 27 28 29 29 20(12):1741–7. 30 31 32 33 34 35 36 37 37 36 37 37 37 36 37 36 37 	30 31	20		40,057 Catheters. Int J Nurs Stud. 2019 Dec 1,100.105409.
 22 14. Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. 25 26 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 31 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 33 34 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	32	21		
 venous catheter failure: A prospective cohort study of 5345 patients. Journal of Vascular Access. 2022 Nov 1;23(6):911–21. Vascular Access. 2022 Nov 1;23(6):911–21. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	33	22	14.	Chen YM, Fan XW, Liu MH, Wang J, Yang YQ, Su YF. Risk factors for peripheral
 Vascular Access. 2022 Nov 1;23(6):911–21. Vascular Access. 2022 Nov 1;23(6):911–21. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. T. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	34 35	23		venous catheter failure: A prospective cohort study of 5345 patients. Journal of
 25 26 27 28 26 27 27 28 29 29 29 20(12):1741–7. 30 31 31 31 36 37 38 38 39 31 32 33 34 35 36 37 37 37 36 37 37 36 37 37 37 36 37 37 36 37 37 36 37 37 36 37 <	36	24		Vascular Access. 2022 Nov 1;23(6):911–21.
 26 15. Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. 30 31 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 33 34 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	37	25		
 Model to Predict Primary Care Physician-Defined Complexity in a Large Academic Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun 6;30(12):1741–7. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 33 417. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	38 30	26	15.	Hong CS, Atlas SJ, Ashburner JM, Chang Y, He W, Ferris TG, et al. Evaluating a
4128Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun42296;30(12):1741–7.4430	40	27		Model to Predict Primary Care Physician-Defined Complexity in a Large Academic
 42 43 44 43 44 45 46 47 48 49 49 49 40 44 45 46 47 48 49 49 41 47 48 49 41 49 41 41 42 42 43 44 44 44 44 44 45 46 47 46 46 47 46 47 48 49 40 40 41 41 42 42 43 44 <	41	28		Primary Care Practice-Based Research Network. J Gen Intern Med. 2015 Jun
 30 31 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 33 34 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	42 43	29		6;30(12):1741–7.
 16. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly People. Lancet. 2013;381 (9868):752-62. 33 34 35. Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	44	30		
 Lancet. 2013;381 (9868):752-62. Lancet. 2013;381 (9868):752-62. 33 34 17. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad Outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. Journal of Vascular Access. 2022 Jan 1;23(1):50–6. 	45	31	16.	Clegg A. Young J. Iliffe S. Rikkert MO. Rockwood K. Frailty in elderly People.
 33 34 35 35 36 36 37 37 37 38 38 39 39 30 31 32 33 34 35 36 37 37 36 37 37 37 36 37 <	46 47	32		Lancet, 2013:381 (9868):752-62.
493417.Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous5035catheters: Bad Outcomes are similar for emergency department and inpatient5236placed catheters: A retrospective medical record review. Journal of Vascular5337Access. 2022 Jan 1;23(1):50–6.	48	33		
505417.Rache 3, Pater 3, Chen NW, Qu L, Ban A. Doomed perpheral intravenous5135catheters: Bad Outcomes are similar for emergency department and inpatient5236placed catheters: A retrospective medical record review. Journal of Vascular5337Access. 2022 Jan 1;23(1):50–6.	49	34	17	Kache S. Patel S. Chen NW/ Ou I. Babl A. Doomed peripheral intravenous
5153Catheters: Bad Outcomes are similar for emergency department and inpatient5236placed catheters: A retrospective medical record review. Journal of Vascular5354375437Access. 2022 Jan 1;23(1):50–6.	50	25	17.	catheters: Red Outcomes are similar for emergency department and inpatient
$\frac{1}{53}$ $\frac{1}{54}$ $\frac{1}{37}$ Access. 2022 Jan 1;23(1):50–6.	52	22		catheters: Bad Outcomes are similar for emergency department and inpatient
$_{54}$ 37 Access. 2022 Jan 1;23(1):50–6.	53	30		placed catheters: A retrospective medical record review. Journal of Vascular
· F	54	3/		Access. 2022 Jan 1;23(1):50–6.
³⁵ 38	55 56	38		
39 18. Gras E, Jean A, Rocher V, Tran Y, Katsahian S, Jouclas D, et al. Incidence of and risk	57	39	18.	Gras E, Jean A, Rocher V, Tran Y, Katsahian S, Jouclas D, et al. Incidence of and risk
factors for local complications of peripheral venous catheters in patients older	58	40		factors for local complications of peripheral venous catheters in patients older
	59 60			
	60			
BMJ Open

2			
3	1		than 70 years: Empirical research quantitative. J Clin Nurs. 2023 Aug 1;32(15–
4 5	2		16):5000–9.
6	3		
7	4	19.	Carr PJ, Rippey JCR, Cooke ML, Higgins NS, Trevenen M, Foale A, et al. From
8 9	5		insertion to removal: A multicenter survival analysis of an admitted cohort with
10	6		nerinheral intravenous catheters inserted in the emergency department. Infect
11	7		Control Hosp Enidomiol 2018 Oct-29(10):1216 1221
12 13	2 2		
14	0	20	Atou C. Con C. Culturely, D. Dhiphitic related nericharoly open estheterization and
15	9	20.	Atay S, Sen S, Cukuriu D. Phiebitis-related peripheral venous catheterization and
16 17	10		the associated risk factors. Niger J Clin Pract. 2018 Jul 1;21(7):827–31.
17	11		
19	12	21.	Marsh N, Larsen EN, Takashima M, Kleidon T, Keogh S, Ullman AJ, et al. Peripheral
20	13		intravenous catheter failure: A secondary analysis of risks from 11,830 catheters.
21 22	14		Int J Nurs Stud [Internet]. 2021 Dec 1 [cited 2024 Jan 17];124. Available from:
23	15		https://pubmed.ncbi.nlm.nih.gov/34689013/
24	16		
25 26	17	22.	Guarinoni MG, Motta PC, Petrucci C, Lancia L. Complexity of care: a concept
27	18		analysis. lg. 2014;26:226–36.
28	19		
29 30	20	23	luvé-Udina ME Intensidad de cuidados enfermeros: ¿cargas de trabajo o
31	21	201	complejidad individual? Metas De Enfermeria [Internet] [cited 2021 Mar 3]:
32	27		Available from:
33 34	22		https://www.acadomia.odu/207E4EE0/Intensidad_do_cuidados_onformaros_c
35	23		intips.//www.academia.edu/20734339/intensidad de cuidados emermeros c
36	24		argas de trabajo o complejidad individual
37 38	25		
39	26	24.	Adamuz J, GonzAjlez-Samartino M, JimA©nez-MartAnez E, et al Risk of acute
40	27		deterioration and care complexity individual factors associated with health
41 42	28		outcomes in hospitalised patients with COVID-19: a multicentre cohort study BMJ
43	29		<i>Open</i> 2021; 11: e041726. doi: 10.1136/bmjopen-2020-041726
44	30		
45 46	31	25.	Adamuz J, Juve-Udina ME, Gonzalez-Samartino M, Jimenez-Martinez E, Tapia-
40	32		Perez M, Lopez-Jimenez MM, et al. Care complexity individual factors associated
48	33		with adverse events and in-hospital mortality. PLoS One. 2020 Jul 1;15(7 July).
49 50	34		
50 51	35	26.	Adamuz J, González-Samartino M, Jiménez-Martínez E, Tapia-Pérez M, López-
52	36		Jiménez MM. Ruiz-Martínez MJ. et al. Care Complexity Individual Factors
53	37		Associated With Hospital Readmission: A Retrospective Cohort Study, Journal of
55	38		Nursing Scholarship, 2018 Jul $1.50(4).411-21$
56	20		
57 58	۸ <u>۰</u>	77	Urbina A luvá Udina M E Romoro Carcía M Delgado Hito D Constitu-
50 59	40 1	27.	Sementing M. 8. Adomus, L. (2022). Care complexity fasters accessed at the
60	41		Samartino, Wi., & Auamuz, J. (2023). Care complexity factors associated with

Enseignement Superieur (ABES) Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

BMJ Open

3	1		revisits to an emergency department. Factores de complejidad de cuidados
4	2		asociados a la reconsulta en un servicio de urgencias. Emergencias. 2023
6	3		Διισ·35(4)·245-251
7	1		hub/ss(1).2 13 23 1.
8		20	
9	5	28.	Jimenez-Martinez E, Adamuz J, Gonzalez-Samartino M, Munoz-Carmona MA,
10 11	6		Hornero A, Martos-Martínez MP, et al. Peripheral intravenous catheter failure,
12	7		nurse staffing levels and care complexity individual factors: A retrospective
13	8		multicentre cohort study. PLoS One [Internet]. 2024 May 1 [cited 2024 Aug
14	9		22]:19(5). Available from: https://pubmed.ncbi.nlm.nih.gov/38722995/
15 16	10		
10	11	20	Belluitza University Hernital [Internet] [sited 2024 Jun 2] Available from
18	11	29.	Benvitge University Hospital [Internet]. [cited 2024 Juli 3]. Available from:
19	12		https://bellvitgehospital.cat/es
20	13		
21	14	30.	Government of Catalonia. Department of Health. CMBD regulations and manual
23	15		[Internet]. Barcelona: Catalan Health Service; 2023 [cited 2024 Aug 28].
24	16		Disponible en: https://catsalut.gencat.cat/ca/proveidors-professionals/registres-
25	17		catalegs/registres/cmbd/normativa-manual/
26 27	18		
28	10	24	ATIC CARE [Internet] [sited 2024 Ave 22] Aveilable from
29	19	31.	ATIC CARE [Internet]. [cited 2024 Aug 22]. Available from:
30	20		http://aticcare.peoplewalking.com/
31	21		
33	22	32.	Juvé-Udina M-E, Adamuz J. Nursing Knowledge Tools and Strategies to Improve
34	23		Patient Outcomes and the Work Environment. Mentoring in Nursing through
35	24		Narrative Stories Across the World, Cham: Springer International Publishing:
36 37	25		2023 np. 211-222 https://doi.org/10.1007/978-3-031-25204-4.29
38	25		2023. pp. 211 222. <u>https://doi.org/10.1007/570.5.051 25204 4_25</u>
39	20	22	
40	27	33.	Font-Cabrera C, Juve-Udina ME, Adamuz J, Diaz Membrives M, Fabrellas N, Guix-
41 42	28		Comellas EM. Activity, triage levels and impact of the pandemic on hospital
43	29		emergency departments: A multicentre cross-sectional study. J Adv Nurs. 2024;
44	30		
45	31	34.	Asensio Flores S, Juvé-Udina ME, Soldevila Cases R, Chacón Aparicio A, Castellà-
46 47	32		Creus M. Zuriguel-Pérez E. et al. Factores individuales de compleiidad de cuidados
48	33		en nacientes ingresados en unidades de cardiología y cirugía cardiaca. Publicación
49	24		Científica de la Acesiación Esnañela en Enformería en Cardiología 2022/28, 22
50	24		científica de la Asociación Española en Emermena en Cardiología. 2025,26–55.
51 52	35		
52 53	36	35.	Willis M, Colonetti E, Bakir A, Alame YJ, Annetts M, Aygin DT, et al. Prospective
54	37		observational study of peripheral intravenous cannula utilisation and frequency
55	38		of intravenous fluid delivery in the emergency department-Convenience or
56 57	39		necessity? PLoS One. 2024 Jun 1;19(6 June).
58	40		
59			
60			

BMJ Open

M. The Utility and Survivorship Emergency Department. Ann	
e C, Rickard CM. Inherent and atheter failure during cancer re Cancer [Internet]. 2021 Mar 7–96. Available from:	Pro
calea TM. Ultrasound-guided re unit. J Crit Care. 2010 Sep	tected by copyrig
Infusion phlebitis assessment 014;20(2):191–202.	yht, including
ce, severity and risk factors of blications: An observational y 1 [cited 2024 Aug 22];28(9– from: pcn.14760	Enseignement S y for uses related to te
ence, risk factors and medical complications in hospitalised [cited 2024 Jan 17];23(1):57– ov/33302797/	uperieur (ABES) xt and data mining, <i>F</i>
Mazzone A, Rossini M, et al. ous catheters in patients with ohort study. Intern Emerg Med 22]; Available from:	Al training, and similar
a M del C, Lana A. Incidencia y s venosos periféricos. Enferm	technologies.
isk of infusion phlebitis with ysis. <i>The journal of vascular</i> 129729819877323	(
1 0	-

36. Shokoohi H, Boniface KS, Kulie P, Long A, McCarthy of Peripheral Intravenous Catheters Inserted in the Emerg Med. 2019 Sep 1;74(3):381-90. 37. Larsen EN, Marsh N, O'Brien C, Monteagle E, Fries modifiable risk factors for peripheral venous ca treatment: a prospective cohort study. Support Car [cited Jan 17];29(3):1487 https://pubmed.ncbi.nlm.nih.gov/32710173/ 38. Gregg SC, Murthi SB, Sisley AC, Stein DM, Sc peripheral intravenous access in the intensive ca 1;25(3):514-9. 39. Ray-Barruel G, Polit DF, Murfield JE, Rickard CM. measures: A systematic review. J Eval Clin Pract. 20 40. Simin D, Milutinović D, Turkulov V, Brkić S. Inciden peripheral intravenous cannula-induced comp prospective study. J Clin Nurs [Internet]. 2019 Ma 10):1585-99. Available https://onlinelibrary.wiley.com/doi/full/10.1111/jd Liu C, Chen L, Kong D, Lyu F, Luan L, Yang L. Incide 41. cost of peripheral intravenous catheter-related adult patients. J Vasc Access [Internet]. 2022 Jan 1 66. Available from: https://pubmed.ncbi.nlm.nih.g 42. Privitera D, Geraneo A, Li Veli G, Parravicini G, Complications related to short peripheral intraven acute stroke: a prospective, observational, single-co [Internet]. [cited Aug https://pubmed.ncbi.nlm.nih.gov/38805082/ Arias-Fernández L, Suérez-Mier B, Martínez-Ortega 43. factores de riesgo de flebitis asociadas a catétere Clin. 2017 Mar 1;27(2):79-86. 44. Lv, L., & Zhang, J. (2020). The incidence and ri peripheral intravenous catheters: A meta-analy access, 21(3), 342-349. https://doi.org/10.1177/12

Enseignement Superieur (ABES) . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

2			
3	1	45.	Johann DA, Danski MTR, Vayego SA, Barbosa DA, Lind J. Risk factors for
4 5	2		complications in peripheral intravenous catheters in adults: Secondary analysis of
6	3		a randomized controlled trial. Rev Lat Am Enfermagem. 2016;24.
7	4		
8	5	16	Higginson B. Barry A. Dhlohitis: treatment care and provention. Nurs Times
9 10	c C	40.	nigginson K, Farry A. Fillebitis. treatment, care and prevention. Nurs nines.
11	0		2011;107(36):18-21.
12	/		
13 14	8	47.	Carr PJ, Rippey JCR, Cooke ML, Higgins NS, Trevenen M, Foale A, et al. From
14	9		insertion to removal: A multicenter survival analysis of an admitted cohort with
16	10		peripheral intravenous catheters inserted in the emergency department. Infect
17	11		Control Hosp Epidemiol [Internet]. 2018 Oct 1 [cited 2024 Jan 17];39(10):1216-
18 19	12		21. Available from: https://pubmed.ncbi.nlm.nih.gov/30196798/
20	13		
21	14	48	Wallis MC McGrail M Webster I Marsh N Gowardman I Playford EG et al Risk
22	15	40.	factors for paripharal intravonous cathotor failure: a multivariate analysis of data
25 24	16		from a randomized controlled trial infact Control Hoch Enidemial [Internet] 2014
25	10		for a failed controlled that meet control Hosp Epidemiol [internet]. 2014
26	17		Jan [cited 2024 Jan 17];35(1):63–8. Available from:
27 28	18		https://pubmed.ncbi.nlm.nih.gov/24334800/
29	19		
30	20	49.	Davis EM, Feinsmith S, Amick AE, Sell J, McDonald V, Trinquero P, et al. Difficult
31 22	21		intravenous access in the emergency department: Performance and impact of
32 33	22		ultrasound-guided IV insertion performed by nurses. American Journal of
34	23		Emergency Medicine. 2021 Aug 1;46:539–44.
35	24		
36 37	25	50	Larsen FN Marsh N Mihala G King M Zunk M Ullman AL et al Intravenous
38	26	50.	antimicrobial administration through peripheral venous catheters - establishing
39	20		rick profiles from an analysis of E2E2 devices. Int (Antimicrob Agents [Internet]
40 41	27		Tisk promes from an analysis of 5252 devices. Int J Antimicrob Agents [internet].
42	28		2022 Apr 1 [cited 2024 Aug 28];59(4). Available from:
43	29		https://pubmed.ncbi.nlm.nih.gov/35183678/
44 45	30		
45 46	31	51.	Marsh N, Webster J, Mihala G, Rickard CM. Devices and dressings to secure
47	32		peripheral venous catheters to prevent complications. Cochrane Database of
48	33		Systematic Reviews [Internet]. 2015 Jun 12 [cited 2024 Jan 18];2015(6). Available
49 50	34		from:
51	35		https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD011070.pub2
52	36		/full
53	37		,
54 55	יר גע	50	Cooper S. Stevenson E. Communicating decisions about care with nationts and
56	20	52.	companions in amorgancy department consultations. Health Evacetations
57	22		[Internet] 2022 Aug 1 [eited 2024 leg 20] 25(4) 4766 75 A state (
58 59	40		[internet]. 2022 Aug 1 [cited 2024 Jan 29];25(4):1/66–/5. Available from:
60	41		https://onlinelibrary-wiley-com.sire.ub.edu/doi/tull/10.1111/hex.13519

1		
2 TABLE1. Patients' demographic and clinical character	eristics (N= 35,96	8)
3 Demographic and clinical characteristics	n (5	%)
Age [median /IOP)]	70.0 (53	· 1_Q1 (
Stav [median (IQR)]	12 (7 4	
	12 (7.4	-21.9
6 Jex	10515	(54
7 Eomalo	19313	(34.
	10455	(43.
	80E	(2.2
	10261	(2.2
	10201	(20.
Level 5	19557	(54.
	3752	(10.
Level 5	1283	(3.6
No triage	309	(0.9
Main Medical Diagnoses	1051	/F 4
	1851	(5.1
Abdominal pain	/90	(2.2
Chest pain	694	(1.9
Syncope and collapse	6/3	(1.9
Cerebral infarction	516	(1.4
Urinary tract infection	484	(1.3
Main Nursing Care Plans		
Consult for dyspnea	3589	(10)
General malaise/constitutional syndrome	2826	(7.9
Coronavirus infection (COVID-19)	2493	(6.9
Abdominal pain	2428	(6.8
Consultation for chest pain	2344	(6.5
Consultation for heart rhythm and/or driving disorders	1443	(4.0
Abbreviations. IQK: Interquartile kange		

3	
4	
5	
6	
7	
, 0	
0	
9	
10	
11	
12	
13	
14	
15	
10	
10	
17	
18	
19	
20	
21	
22	
23	
24	
24	
25	
26	
27	
28	
29	
30	
31	
32	
33	
34	
35	
36	
27	
2/	
38	
39	
40	
41	
42	
43	
44	
45	
46	
17	
77 10	
40 40	
49	
50	
51	
52	
53	
54	
55	
56	
57	
51	

1 T A B L E 2. Care complexity individual factors of adults in emergency department (N=

2 35,968)

Care complexity individual factors	n (%)
Comorbidity and complications	22414	(62.3
Uncontrolled pain	11793	(32.8
Hemodynamic instability	4791	(13.3
Incontinence	4078	(11.3
Transmissible infection	2368	(6.6)
Anatomical and functional disorders	2281	(6.3)
Extreme weight	1899	(5.3)
Postural limitation	1691	(4.7)
High-risk of hemorrhage	1645	(4.6)
Vascular fragility	1620	(4.5)
Communication disorders	1148	(3.2)
Edema	708	(2.0)
Involuntary movements	270	(0.8)
Dehydration	45	(0.1)
Developmental	14223	(39.5
Extreme age	14223	(39.5
Psycho-emotional	6145	(17.1
Anxiety and fear	5750	(16.0
Impaired adaptation	576	(1.6)
Aggressiveness	150	(0.4)
Mental-cognitive	5500	(15.3
Consciousness disorders	5353	(14.9
Agitation	294	(0.8)
Impaired cognitive functions	83	(0.2)
Perception of reality disorders	49	(0.1)
Sociocultural	423	(1.2)
Language limitation	286	(0.8)
Lack of caregiver support	55	(0.2)
Belief conflict	57	(0.2)
Social exclusion	35	(0.1)
Illiteracy	10	(0.0)

3 4 5

TABLE3. Association between peripheral venous catheter failure and care complexity individual factors

				PVC	failure			
Care complexity individual factors	n (%) N=35,9	68	N= n	/es =316 (%)	N N=35 n (o 5,652 %)	OR (CI)	p-value
CCiF [median (IQR)]	1	(1–2)	2	(1–4)	1	(1–2)	1.33 (1.25–1.40)	<.001
Comorbidity and complications	22414	(62.3)	232	(73.4)	22182	(62.2)	1.68 (1.31–2.16)	<.001
Uncontrolled pain	11793	(32.8)	116	(36.7)	11677	(32.8)	1.19 (0.95–1.50)	.136
Hemodynamic instability	4791	(13.3)	100	(31.6)	4691	(13.2)	3.06 (2.41–3.88)	<.001
Incontinence	4078	(11.3)	60	(19.0)	4018	(11.3)	1.85 (1.39–2.45)	<.001
Transmissible infection	2368	(6.6)	32	(10.1)	2336	(6.6)	1.61 (1.11–2.32)	.011
Anatomical and functional disorders	2281	(6.3)	23	(7.3)	2258	(6.3)	1.16 (0.76–1.78)	.493
Extreme weight	1899	(5.3)	21	(6.6)	1878	(5.3)	1.28 (0.82–2.00)	.277
Postural limitation	1691	(4.7)	21	(6.6)	1670	(4.7)	1.45 (0.93–2.26)	.103
High-risk of hemorrhage	1645	(4.6)	18	(5.7)	1627	(4.6)	1.26 (0.78–2.04)	.338
Vascular fragility	1620	(4.5)	38	(12.0)	1582	(4.4)	2.94 (2.09–4.15)	<.001
Communication disorders	1148	(3.2)	13	(4.1)	1135	(3.2)	1.31 (0.75–2.28)	.350
Edema	708	(2.0)	7	(2.2)	701	(2.0)	1.13 (0.53–2.40)	.751
Involuntary movements	270	(0.8)	3	(0.9)	267	(0.7)	1.27 (0.41–3.99)	.682
Dehydration	45	(0.1)	1	(0.3)	44	(0.1)	2.57 (0.35–18.71)	.352
evelopmental	14223	(39.5)	141	(44.6)	14082	(39.5)	1.23 (0.99–1.54)	.064
Extreme age (≥75 years old)	14223	(39.5)	141	(44.6)	14082	(39.5)	1.23 (0.99–1.54)	.064
ycho-emotional	6145	(17.1)	78	(24.7)	6067	(17.0)	1.60 (1.24–2.07)	<.001
Anxiety and fear	5750	(16.0)	68	(21.5)	5682	(15.9)	1.45 (1.10–1.89)	.007
Impaired adaptation	576	(1.6)	17	(5.4)	559	(1.6)	3.57 (2.17–5.86)	<.001
Aggressiveness	150	(0.4)	2	(0.6)	148	(0.4)	1.53 (0.38–6.19)	.553
ental-cognitive	5500	(15.3)	102	(32.3)	5398	(15.1)	2.67 (2.11–3.39)	<.001
Consciousness disorders	5353	(14.9)	102	(32.3)	5251	(14.7)	2.76 (2.18–3.50)	<.001
Agitation	294	(0.8)	10	(3.2)	284	(0.8)	4.07 (2.15–7.72)	<.001
Impaired cognitive functions	83	(0.2)	1	(0.3)	82	(0.2)	1.38 (0.19–9.92)	.751
Perception of reality disorders	49	(0.1)	0	(0.0)	49	(0.1)	-	-
ociocultural	423	(1.2)	3	(0.9)	420	(1.2)	0.80 (0.26–2.52)	0.708
Language limitation	286	(0.8)	1	(0.3)	285	(0.8)	0.39 (0.06–2.82)	.353
Lack of caregiver support	55	(0.2)	2	(0.6)	53	(0.1)	4.28 (1.04–17.63)	.044
Belief conflict	57	(0.2)	0	(0.0)	57	(0.2)	-	-
Social exclusion	35	(0.1)	0	(0.0)	35	(0.1)	-	-
Illiteracy	10	(0.0)	0	(0.0)	10	(0.0)	-	-

PVC: Beripheral venous catheter; OR: Odds Ratio; CI: Confidence Interval; -: There was no individual with catheter failure in this group.

Enseignement Superieur (ABES) Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

TABLE4. Association between peripheral venous catheter failure and characteristics of emergency

2 department patients

	2
	- 1
	_

Characteristics	n= : n	(%)		(n=316) n (%)	(n= 1	35,652) 1 (%)	OR (IC)	p-value
Age [median (IQR)]	70 (53	8.1–81.0)	73.0 (61.2–83.7)	70.0 (53	3.0–81.0)	1.01 (1.01–1.02)	<.001
Length of stay (hours) [median (IQR)]	12 (7	.4–21.9)	28.8 (2	19.9–45.3)	11.9 (7.	4–21.6)	1.04 (1.04–1.05)	<.001
Sex								
Male	19,515	(54.3)	158	(50.0)	19357	(54.3)	0.84 (0.68–1.05)	.128
Female	16,453	(45.7)	158	(50.0)	16295	(45.7)	1.19 (0.95–1.48)	.128
Triage level								
Level 1	806	(2.2)	0	(0.0)	806	(2.3)	-	-
Level 2	10,261	(28.5)	94	(29.7)	10167	(28.5)	1.06 (0.83–1.35)	.630
Level 3	19,557	(54.4)	172	(54.4)	19385	(54.4)	1.00 (0.80–1.25)	.984
Level 4	3,752	(10.4)	36	(11.4)	3716	(10.4)	1.11 (0.78–1.57)	.575
Level 5	1,283	(3.6)	13	(4.1)	1270	(3.6)	1.16 (0.67–2.03)	.599
Main Medical Diagnoses								
Covid 19	1,851	(5.1)	12	(3.8)	1839	(5.2)	0.73 (0.41–1.30)	.278
Abdominal pain	790	(2.2)	6	(1.9)	784	(2.2)	0.86 (0.38–1.94)	0.717
Chest pain	694	(1.9)	1	(0.3)	693	(1.9)	0.16 (0.02–1.14)	.068
Syncope and collapse	673	(1.9)	3	(0.9)	670	(1.9)	0.50 (0.16–1.56)	.234
Cerebral infarction	516	(1.4)	5	(1.6)	511	(1.4)	1.11 (0.46–2.69)	.825
Urinary tract infection	484	(1.3)	9	(2.8)	475	(1.3)	2.17 (1.11–4.24)	.023
Main Nursing Care Plans								
Consult for dyspnea	3 <i>,</i> 589	(10)	7	(2.2)	3582	(10.0)	0.20 (0.09–0.43)	<.001
General malaise/constitutional syndrome	2,826	(7.9)	33	(10.4)	2793	(7.8)	1.37 (0.96–1.97)	.087
Coronavirus infection (COVID-19)	2,493	(6.9)	22	(7.0)	2471	(6.9)	1.01 (0.65–1.55)	.983
Abdominal pain	2,428	(6.8)	26	(8.2)	2402	(6.7)	1.24 (0.83–1.86)	.294
Consultation for chest pain	2,344	(6.5)	9	(2.8)	2335	(6.5)	0.42 (0.22–0.81)	.010
Consultation for heart rhythm and/or driving disorders 4	1,443	(4.0)	14	(4.4)	1429	(4.0)	1.11 (0.65–1.90)	.704

IQR Interquartile Range; PVC: Peripheral venous catheter; OR: Odds Ratio; CI: Confidence Interval; -: There was no individual with catheter failure in this group.

BMJ Open

1 2 3 1 4 2 5 3 6 3 7 4 8 5 9 6	FIGURE1 . Prevalence of PVC failure according to the number of CCIF
9 6 10 11 12 13 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38	
39 40 41 42 43 44 45 46 47 48 49 50 51 52	
52 53 54 55 56 57 58 59 60	

Enseignement Superieur (ABES) . Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

FIGURE1. Prevalence of PVC failure according to the number of CCIF



Number of CCIF per patient

Imber o

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Supplementary file. Care complexity individual factors included in this study.

Domains	CCIFs	Specifications		
Comorbidity and complications	Uncontrolled pain	Pain > 3 in Visual Analogue Scale (VAS) waanalgesic treatment or with ineffective treatment.		
	Hemodynamic instability	Categorized with a moderate or high risk of impairment, according to the VIDA system.		
	Incontinence	Urinary or fecal incontinence.		
	Transmissible infection	Amputation, limitation of movement, joint stiffr functional impotence.		
	Anatomical and functional disorders	Patients with isolation measures.		
	Extreme weight	Cachexia and obesity		
	Postural limitation	Inability to carry out activities such as feeding, hyg toileting and to sit, ambulate or maintain balance.		
	High-risk of hemorrhage	Rectal bleeding, hematuria, hematemesis, metror petechiae, epistaxis, melena.		
	Vascular fragility	Cutaneous and venous fragility, venous tortuosity peripheral pulses.		
	Communication disorders	Aphasia, dysphasia, dysarthria, larynge tracheostomy.		
	Edema	Peripheral edema with pitting, dependent edema pitting or anasarca.		
	Involuntary movements	Episodic or continuous convulsions or tremor.		
	Dehydration	Skin turgor.		
Developmental	Extreme age	Age ≥75 years.		
Psycho-emotional	Anxiety and fear	Anxiety or Fear (moderate or severe and punctual, episodic or continuous).		
	Impaired adaptation	Lability, negativity, distrust of the care team.		
	Aggressiveness	Physical or verbal aggressive behaviour (mode intense and punctual, episodic or continuous)		
Mental-cognitive	Consciousness disorders	Disorientation, confusion, drowsiness, successes		
	Agitation	Occasional or episodic psychomotor agitation.		
	Impaired cognitive functions	Intellectual disability.		
	Perception of reality disorders	Hallucinations.		
Sociocultural	Language limitation	Patient does not understand or speak the language that they do not have a family or external interpre		
	Lack of caregiver support	No caregiver, caregiver burnout.		
	Belief conflict	Hopelessness, anguish		
	Social exclusion	Indigence and extreme poverty.		