

## Difficult peripheral venous puncture in adults: integrative review

*Punção venosa periférica difícil: revisão integrativa*

*Punción venosa periférica difícil: revisión integradora*

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### ABSTRACT

**Objective:** to identify factors that pose difficulties in peripheral venipuncture in adults. **Method:** in this integrative literature review, with no time cutoff, search of the PubMed, LILACS, CINAHL, SciELO, Web of Science, and Scopus databases, in January 2018, yielded 12 articles for inclusion. These were examined for year, country of publication, associated factors, and level of evidence. **Results:** publications were found from 2003 to 2017. The prevalence of difficult peripheral venipuncture ranged from 17% to 59.3%. The most frequent factors making for difficult puncture were: demographic (gender, age), clinical (comorbidities, nutritional status, visibility and palpability of the venous network), device-related (caliber and model), and professional skill. **Conclusion:** difficulty in puncture varies with complexity of care. Demographic-, clinical-, device- and professional skill-related factors should be considered.

**Descriptors:** Catheterization, peripheral; nursing; adult; difficulties.

### RESUMO

**Objetivo:** identificar os fatores que dificultam a punção venosa periférica em adultos. **Método:** revisão integrativa da literatura, sem recorte temporal. A busca dos artigos ocorreu no mês de janeiro de 2018 nas seguintes bases de dados: *PubMed*, LILACS, CINAHL, SciELO, *Web of Science* e *Scopus*, com inclusão de 12 artigos. Foram analisados quanto ao ano, país de publicação, fatores associados e nível de evidência. **Resultados:** foram encontradas publicações de 2003 a 2017. A prevalência da punção venosa periférica difícil variou entre 17% e 59,3%. Entre os fatores que dificultam a punção, os mais frequentes foram: demográficos (sexo, idade), clínicos (comorbidades, estado nutricional, visibilidade e palpabilidade da rede venosa), do dispositivo (calibre e modelo) e a habilidade do profissional. **Conclusão:** a dificuldade para punção é variável de acordo com a complexidade assistencial. Fatores demográficos e clínicos, do dispositivo e a habilidade do profissional devem ser considerados.

**Descritores:** Cateterismo periférico; enfermagem; adulto; dificuldades.

### RESUMEN

**Objetivo:** identificar los factores que dificultan la punción venosa periférica en adultos. **Método:** revisión integradora de la literatura, sin recorte temporal. Los artículos se buscaron en enero de 2018 en las siguientes bases de datos: *PubMed*, LILACS, CINAHL, SciELO, *Web of Science* y *Scopus*, con inclusión de 12 artículos. El análisis se hizo respecto al año, al país de publicación, a los factores asociados y al nivel de evidencia. **Resultados:** se encontraron publicaciones entre 2003 y 2017. La prevalencia de punción venosa periférica difícil osciló entre un 17% y un 59.3%. Entre los factores que dificultan la punción, los más frecuentes fueron: demográficos (género, edad), clínicos (comorbidades, estado nutricional, visibilidad y cuán palpable es la red venosa), el dispositivo (calibre y modelo) y la habilidad del profesional. **Conclusión:** la dificultad en la punción varía según la complejidad de la atención. Deben considerarse factores demográficos y clínicos, del dispositivo y la habilidad del profesional.

**Descriptorios:** Cateterismo periférico; enfermería; adulto; dificultades.

## INTRODUCTION

Peripheral venous puncture (PVP) is a hospital-based procedure<sup>1</sup>, and more than half of inpatients require the insertion of a peripheral venous catheter (PVC)<sup>2</sup>.

Success in the first attempt at performing PVP, in addition to reducing patient discomfort, reduces material costs<sup>3</sup> and enables the start of the established therapy<sup>4</sup>. However, in one out of nine or ten adults who require PVC, peripheral venous access is difficult to obtain<sup>5</sup>.

Researchers consider peripheral venous puncture difficult (DPVP) when there is more than one insertion attempt<sup>5,6</sup> or when there are more than two or three attempts<sup>7</sup>.

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Some factors can contribute to DPVP, namely: age<sup>5,8,9</sup>, skin color<sup>5</sup>, nutritional status<sup>7,8</sup>, the patient's clinical complexity<sup>8</sup>, PVP history<sup>5,8</sup>, chemotherapy use<sup>5,7,8</sup>, PVC type and caliber<sup>9,10</sup>, which can influence the increase in the number of insertion attempts and also affect patient safety in the hospital environment<sup>5,7-10</sup>.

Because it is an innovative theme that represents nursing practice in hospitals, it is necessary to consolidate research and studies that support evidence-based practice and patient safety.

Given the above, the guiding question in this study was: *What are the factors that hinder peripheral venous puncture in adults?* Therefore, the objective was to identify the factors that hinder peripheral venous puncture in adults.

## METHODOLOGY

This is a primary study, a literature review. The integrative review is a method that synthesizes the literature regarding a particular clinical problem or phenomenon of interest incorporating multiple perspectives and literature types<sup>11</sup>.

It is a methodology that contributes to the process of systematization and analysis of results, aiming at understanding a certain theme from other independent studies<sup>12</sup>. The diversity of the sampling system is the main feature of this review method. Thus, the reviewer can include studies with different research designs<sup>11</sup>.

The PICO strategy was adopted for the search design. The acronym PICO stands for Patient, Intervention, Comparison, and Outcomes<sup>13</sup>.

Given the research question, the PICO strategy was represented by: P - Population: Adult; I - Intervention: Peripheral Catheterization; C - Control: none, and O - Outcome: Difficulty.

The study was conducted by following the six recommended steps: definition of the hypothesis or guiding question (definition of the theme and research question, selection of descriptors); literature search (database, strategy development, database search and selection of studies); categorization of information (summarization and formation of a database); evaluation of the studies included in the review (critical analysis and inclusion and exclusion); interpretation of results and synthesis of knowledge<sup>11</sup>.

The articles were searched on the following databases in January 2018: National Library of Medicine (PubMed), Latin American and Caribbean Health Sciences Literature (LILACS), Cumulative Index to Nursing and Allied Health Literature (CINAHL), Scientific Electronic Library Online (SciELO), Web of Science and Scopus. The crossing occurred by using the controlled descriptors from Medical Subject Headings (MeSH) and Descriptors in Health Sciences (DeCS), with the following key words: adults AND catheterization; peripheral AND difficult and *adulto AND cateterismo OR punção venosa AND difícil OR dificuldade*.

Three independent reviewers performed the search and selection of articles. Inclusion criteria were: publications whose theme was related to PVP, regardless of the time period or language of publication, and which addressed adult subjects with PVC. Studies that used technologies, such as ultrasound, and in simulated environments (PVP dummies or simulators) were excluded, as well as reviews, monographs, theses and dissertations.

The first selection was performed by reading the titles and abstracts, pointing out those that met the criteria and answered the guiding question. At this stage, those with repeated titles and those that did not fit the proposed theme were excluded. Then the articles were thoroughly read and translated. From this stage, the articles that did not meet the criteria were removed.

For the analysis of studies and synthesis of information, a validated instrument<sup>14</sup> was used to systematize the results, which were organized on Microsoft Office® Excel® sheets, according to the identification of the studies, publication area, methodological characteristics and evaluation of methodological rigor, including the level of evidence<sup>15</sup>.

The results identified in the literature were considered, such as professional variables (length of experience and professional category), clinical variables (comorbidities, nutritional status, visibility and palpability of the venous network), device-related variables (caliber and model) and professional skills.

## RESULTS

In all, 547 studies were identified. On PubMed, 286 (52.3%) studies were found; 200 (36.6%) on Scopus; 33 (6%) on EBSCO; 23 (4.2%) on the Web of Science; four (0.7%) on LILACS and only one (0.18%) on SciELO.

Ninety-three studies remained for analysis. Among the 454 studies discarded, 64 were repeated and 390 did not fit the theme or did not meet the eligibility criteria. In the second selection, after the texts were thoroughly read, there were 12 studies, as shown in Figure 1.

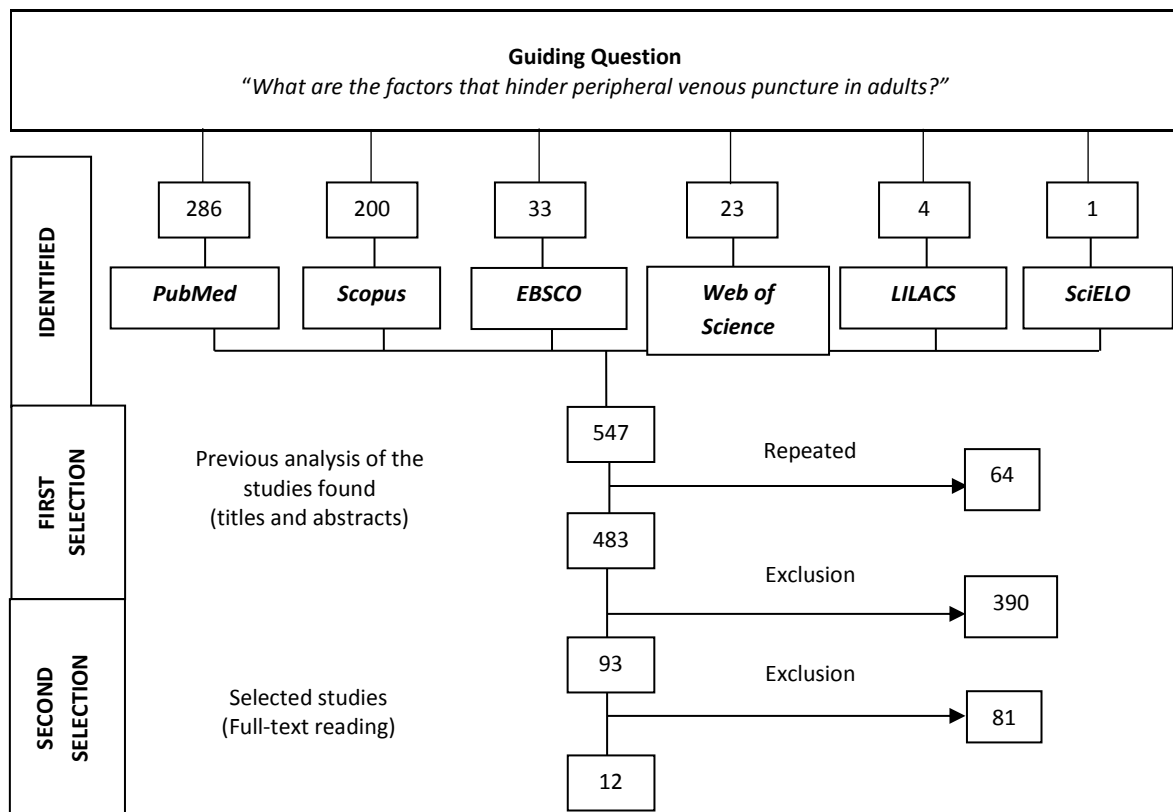


FIGURE 1: Flow chart for the search, selection and exclusion of studies. Uberaba, MG, Brazil, 2018.

Publications from 2003 to 2017<sup>3,5,6,8,9,16-22</sup> were found, according to Figure 2. The countries of origin of the studies were Australia, Spain, Italy and the Netherlands, with one study in each country, totaling 4 (33.3%); France and the USA, with four studies each, totaling 8 (66.7%).

An increase in the number of publications made in recent years was identified, mainly in 2016, with 3 (25%) articles; 2014 and 2017 with two texts each, totaling 4 (33.3%). The other years presented only one article, totaling 5 (41.6%). No Brazilian publications were found. Only one study showed a prospective and randomized approach, being classified as level of evidence 2B; the others were all observational. See Figure 3.

Demographic and clinical factors were: gender<sup>8,9</sup>, skin color<sup>3</sup>, age<sup>3,8,9,16</sup>, obesity<sup>9,17,18</sup> or malnutrition<sup>6,18</sup>, patient hygiene<sup>19</sup>, clinical complexity<sup>6</sup>, dehydration<sup>3,18</sup>, vein visibility and/or palpability<sup>3,9,18,20</sup>, chronic diseases<sup>5,8,18</sup> and DPVP history<sup>3,9,20</sup>, among other conditions.

Regarding the device-associated factors, the following were pointed out: catheter caliber<sup>21</sup> and device type<sup>22</sup>. Also, the experience and skill of the professional performing PVP were indicated<sup>6,19,22</sup>.

Title of article	Country	Year of publication
Is peripheral line placement more difficult in obese than in lean patients? <sup>17</sup>	France	2003
Variables influencing intravenous catheter insertion difficulty and failure: an analysis of 339 intravenous catheter insertions <sup>21</sup>	United States of America	2005
Prospective evaluation of peripheral venous access difficulty in emergency care <sup>19</sup>	France	2007
A prospective randomized trial of two safety peripheral intravenous catheters <sup>22</sup>	France	2008
Predicting peripheral venous access difficulty in the emergency department using body mass index and a clinical evaluation of venous accessibility <sup>6</sup>	France	2012
Risk factors associated with difficult venous access in adult ED patients <sup>5</sup>	United States of America	2014
Association between multiple IV attempts and perceived pain levels in the emergency department <sup>16</sup>	United States of America	2014
Development of the A-DIVA Scale: a clinical predictive scale to identify difficult intravenous access in adult patients based on clinical observations <sup>20</sup>	Netherlands	2016
Predicting and preventing peripheral intravenous cannula insertion failure in the emergency department: clinician 'gestalt' wins again <sup>18</sup>	Australia	2016
Factors affecting difficult peripheral intravenous cannulation in adults: a prospective observational study <sup>9</sup>	Italy	2016
Prevalence of difficult venous access and associated risk factors in highly complex hospitalised patients <sup>8</sup>	Spain	2017
Establishing a dedicated difficult vascular access team in the emergency department <sup>3</sup>	United States of America	2017

FIGURE 2: Synthesis of the included articles by title, country and year of publication. Uberaba, 2018.

Study	Level of Evidence	Design	Factors associated with difficult venous puncture in adults
S <sup>17</sup>	2C	Observational	Obesity
S <sup>21</sup>	2C	Observational	Professional experience
S <sup>19</sup>	2C	Observational	Catheter caliber, professional's skills, patient hygiene
S <sup>22</sup>	2B	Prospective and randomized	Device/catheter type
S <sup>6</sup>	2C	Observational	Clinical complexity, professional's skills, body mass index <18.5
S <sup>5</sup>	2C	Observational	Diabetes, sickle cell disease and intravenous drug abuse
S <sup>16</sup>	2C	Observational	Age
S <sup>20</sup>	2C	Observational	Palpable or visible, smaller-caliber vein; DPVP history, non-elective surgery
S <sup>18</sup>	2C	Observational	Vein caliber, palpable vein, previous hospitalization, intravenous drug abuse, obesity or cachexia, recent chemotherapy, skin abnormality, chronic disease, dehydration, agitation and hemodynamic instability
S <sup>9</sup>	2C	Observational	Palpable or visible vein, age, chemotherapy, sex, vascular fragility, DPVP history, valves, obesity
S <sup>8</sup>	2C	Observational	Female, osteoarticular disease, age, history of treatment with anticoagulants or corticosteroids
S <sup>3</sup>	2C	Observational	Age, dehydration, skin color, DPVP history, previous treatments or surgery, non-visible veins

FIGURE 3: Synthesis of included articles, level of evidence, design and factors associated with difficult venous puncture in adults. Uberaba, 2018.

## DISCUSSION

DPVP prevalence varied, but studies showed values ranging from 17%<sup>5</sup> to 59.3%<sup>8</sup>. There was a predominance of observational studies with evidence level 2C which addressed the associated factors simultaneously, and it was not possible to isolate the variables and analyze their association with DPVP.

The presence of comorbidities was shown as a factor to be considered. A Brazilian study associated the presence of chronic noncommunicable diseases with increased hospitalization<sup>23</sup>.

At each hospitalization process, the individual undergoes different therapeutic and diagnostic procedures; however, most of such procedures show the need for venous access, thus compromising the vascular network.

The articles pointed out that vein visibility and palpability are considered crucial in successful PVP<sup>3,7,9,18,20,24</sup>.

Technologies that aid vein visibility, such as ultrasound use, have contributed to the success rate of punctures, including for adults with DPVP<sup>20</sup>.

Researchers pointed out that when ultrasound use was incorporated, the success rate in the first PVP attempt was 64.9% and that it was possible to puncture deeper and larger caliber veins<sup>25</sup>.

However, technology alone is not sufficient for a successful procedure. As shown in studies<sup>6,7,19,22</sup>, when performing it, the professional needs knowledge and skills.

The selection of professionals with experience in PVP for procedures in patients previously identified as difficult to access is recommended, since teams specializing in difficult punctures minimize costs with materials and human resources and increase patient satisfaction<sup>3,26</sup>. Another necessary strategy is the establishment of institutional protocols<sup>27</sup>, training and educational materials<sup>28</sup> aimed at reducing multiple puncture attempts.

Infusional therapy, although often present in clinical practice and in daily nursing practice, needs improvements in care provision. The linking of care-academic practices and the incorporation of new devices and technologies are presented as proposals<sup>29,30</sup>.

The exclusion of articles that were not freely available was considered to be a limitation to the study.

## CONCLUSION

DPVP occurrence was associated with different factors: demographics (gender, age), clinical aspects (comorbidities, nutritional status, visibility and palpability of the venous network), device (caliber and model) and the professional's skills. Only one study was not observational, and investigations with other designs and approaches and better levels of evidence are required.

Identifying factors associated with DPVP can guide professionals' conduct as well as contribute to the development of screening tools and strategies to minimize multiple PVP attempts or failure. The use of technologies, such as ultrasound, has helped as well as reduced failure rates, therefore, it is important for nurses to learn about and make use of them, as a successful insertion at the first attempt reduces patient discomfort and consequently decreases professional frustration and costs to the institution.

For a better understanding of DPVP, further studies on the subject are of utmost importance, especially those on demographic and clinical factors, which are prevalent.

## REFERENCES

1. Institute for Safe Medication Practices (ISMP). ISMP Safe Practice Guidelines for Adult IV Push Medications; 2015 [cited 2019 Feb 10]. Available from: <https://www.ismp.org/guidelines/iv-push>
2. Alexandrou E, Ray-Barruel G, Carr PJ, Frost S, Inwood S, Higgings N, et al. International prevalence of the use of peripheral intravenous catheters. *J. Hosp. Med.* 2015[cited 2019 Feb 10]; 10(8):530-3. DOI: <https://doi.org/10.1002/jhm.2389>
3. Whalen M, Maliszewski B, Baptiste DL. Establishing a dedicated difficult vascular access team in the emergency department: a needs assessment. *J. Infus. Nurs.* 2017 [cited 2019 Feb 21]; 40(3):149-54. DOI: <https://doi.org/10.1097/NAN.0000000000000218>
4. Witting, MD. IV access difficulty: incidence and delays in an urban emergency department. *J. Emerg. Med.* 2012 [cited 2019 Feb 09]; 42(4):483-7. DOI: <https://doi.org/10.1016/j.jemermed.2011.07.030>
5. Fields, JM, Piela NE, Au AK, Ku BS. Risk factors associated with difficult venous access in adult ED patients. *Am. J. Emerg. Med.* 2014 [cited 2019 Feb 17]; 32(10):1179-82. DOI: <https://doi.org/10.1016/j.ajem.2014.07.008>
6. Sebbane M, Claret PG, Lefebvre S, Mercier G, Rubenovitch J, Jreige R. Predicting peripheral venous access difficulty in the emergency department using body mass index and a clinical evaluation of venous accessibility. *J. Emerg. Med.* 2012 [cited 2019 Feb 21]; 44(2): 299-305. DOI: <https://doi.org/10.1016/j.jemermed.2012.07.051>
7. Carr PJ, Rippey JC, Budgeon CA, Cooke ML, Higgins N, Rickard CM. Insertion of peripheral intravenous cannula in the emergency department: factors associated with first-time insertion success. *J. Vasc. Access.* 2016 [cited 2019 Feb 21]; 17(2):182-90. DOI: <https://doi.org/10.5301/jva.5000487>
8. Armenteros-Yeguas V, Gárate-Echenique L, Tomás-López MA, Cristóbal-Domínguez E, Moreno-de Gusmão B, Miranda-Serrano E, et al. Prevalence of difficult venous access and associated risk factors in highly complex hospitalized patients. *J. Clin. Nurs.* 2017 [cited 2019 Feb 18]; 26(23-24):4267-45. DOI: <https://doi.org/10.1111/jocn.13750>

9. Piredda M, Biagioli V, Barella B, Carpisassi I, Ghinelli R, Giannarelli D, et al. Factors affecting difficult peripheral intravenous cannulation in adults: a prospective observational study. *J. Clin. Nurs.* 2017 [cited 2019 Feb 21]; 26(7-8):1074-84. DOI: <https://doi.org/10.1111/jocn.13444>
10. Malyon L, Ullman AJ, Phillips N, Young J, Kleidon T, Murfield J, et al. Peripheral intravenous catheter duration and failure in paediatric acute care: a prospective cohort study. *Emerg. Med. Australas.* 2014 [cited 2019 Feb 17]; 26(6):602-8. DOI: <https://doi.org/10.1111/1742-6723.12305>
11. Mendes KDS, Silveira RCCP, Galvão CM. Integrative literature review: a research method to incorporate evidence in health care and nursing. *Texto & contexto enferm.* (Online). 2008 [cited 2019 Feb 21]; 17(4):758-64. DOI: <http://dx.doi.org/10.1590/S0104-07072008000400018>
12. Lanzoni GMM, Meirelles BHS. Leadership of the Nurse: an Integrative Literature Review. *Rev. latinoam. enferm.* (Online). 2011[cited 2019 Feb 21];19(3): 651-8. DOI: <http://dx.doi.org/10.1590/S0104-11692011000300026>
13. Santos CMC, Pimenta CAM, Nobre MRC. The pico strategy for the research question construction and evidence search. *Rev. latinoam. enferm.* (Online). 2007 [cited 2019 Feb 18]; 15(3). DOI: <http://dx.doi.org/10.1590/S0104-11692007000300023>
14. Ursi ES, Galvão CM. Perioperative prevention of skin injury: an integrative literature review. *Rev. latinoam. enferm.* (Online). 2006 [cited 2019 Feb 15];14(1):124-31. DOI: <http://dx.doi.org/10.1590/S0104-11692006000100017>
15. Pedrosa KKA, Oliveira ICM, Feijão AR, Machado RC. Evidence-based nursing: characteristics of studies in brazil. *Cogitare enferm.* 2015 [cited 2019 Feb 21]; 20(4):733-41. DOI: <http://dx.doi.org/10.5380/ce.v20i4.40768>
16. Fields JM, Piela NE, Ku BS. Association between multiple IV attempts and perceived pain levels in the emergency department. *J. Vasc. Access.* 2014 [cited 2019 Feb 18]; 15(6):514-8. DOI: <https://doi.org/10.5301/jva.5000282>
17. Juvin P, Blarel A, Bruno F, Desmots JM. Is peripheral line placement more difficult in obese than in lean patients? *Anesth. Analg.* 2003 [cited 2019 Feb 21]; 96(4):1218. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/12651688>
18. Rippey JC, Carr PJ, Cooke M, Higgins N, Rickard CM. Predicting and preventing peripheral intravenous cannula insertion failure in the emergency department: clinician 'gestalt' wins again. *Emerg. Med. Australas.* 2016 [cited 2019 Feb 21]; 28(6):658-65. DOI: <https://doi.org/10.1111/1742-6723.12695>
19. Lapostolle F, Catineau J, Garrigue B, Monmartreau V, Houssaye T, Vecchi I, et al. Prospective evaluation of peripheral venous access difficulty in emergency care. *Intensive Care Med.* 2007 [cited 2019 Feb 21]; 33(8):1452-7. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/17554524>
20. Van Loon FH, Puijn LA, Houterman S, Bouwman AR. Development of the A-DIVA Scale: a clinical predictive scale to identify difficult intravenous access in adult patients based on clinical observations. *Medicine (Baltimore).* 2016 [cited 2019 Feb 21]; 95(16):e3428. DOI: <https://doi.org/10.1097/MD.0000000000003428>
21. Jacobson AF, Winslow EH. Variables influencing intravenous catheter insertion difficulty and failure: An analysis of 339 intravenous catheter insertions. *Heart Lung.* 2005[cited 2019 Feb 21]; 34(5): 345-59. DOI: <https://doi.org/10.1016/j.hrtlng.2005.04.002>
22. Prunet B, Meaudre E, Montcriol A, Asencio Y, Bordes J, Lacroix G. A prospective randomized trial of two safety peripheral intravenous catheters. *Anesth. Analg.* 2008 [cited 2019 Feb 21]; 107(1):155-8. DOI: <https://doi.org/10.1213/ane.0b013e318174df5f>
23. Malta DC, Bernal RTI, Lima MG, Araújo SSC, Silva MMA, Freitas MIF, et al. Noncommunicable diseases and the use of health services: analysis of the National Health Survey in Brazil. *Rev. Saude Publica.* 2017[cited 2019 Feb 17]; 51(Supl 1:4s). DOI: <https://doi.org/10.1590/S1518-8787.2017051000090>
24. Pagnutti L, Bin A, Donato R, Di Lena G, Fabbro C, Fornasiero L et al. Difficult intravenous access tool in patients receiving peripheral chemotherapy: a pilot-validation study. *J. Oncol. Nurs.* 2016 [cited 2019 Feb 21]: 58-63. DOI: <https://doi.org/10.1016/j.ejon.2015.06.008>
25. Oliveira AM, Danski MTR, Oliveira EP. Ultrasound-guided peripheral venipuncture: prevalence of success and associated factors. *Cogitare Enferm.* 2017 [cited 2019 Feb 21]; (22)3: e49599. DOI: <http://dx.doi.org/10.5380/ce.v22i3.49599>
26. Campos LB, Martins JR, Arreguy-Sena C, Alves MS, Teixeira CV, Souza LC. Experiences of hospitalized patients with the venipuncture process. *Esc. Anna Nery Rev. Enferm.* 2016 [cited 2019 Feb 18]; 20(3): e20160078. DOI: <http://dx.doi.org/10.5935/1414-8145.20160078>
27. Alves DA, Lucas TC, Martins DA, Cristianismo RS, Braga EVO, Guedes HM. Evaluation of peripheral intravenous catheter puncture and maintenance procedures. *RECOM.* 2019 [cited 2019 Feb 12]; 9: e3005. DOI: <http://dx.doi.org/10.19175/recom.v9i0.3005>
28. Pereira KC, Cogo ALP, Silva APSS Critical analysis of peripheral catheter venipuncture videos available on YouTube. *REME rev. min. enferm.* 2016 [cited 2019 Feb 18]; 20:e970. Available from: <http://www.reme.org.br/exportar-pdf/1106/e970.pdf>
29. Oliveira FT, Machado KMF, Santos LPR, Quiroz NR, Silva J, et al. Praxis of nursing students in intravenous therapy: a before and after study. *Rev. enferm. UERJ.* 2014 [cited 2019 Aug 25]; 22(2):219-25. Available from: <http://www.facenf.uerj.br/v22n2/v22n2a12.pdf>
30. Costa LM, Benet ERR, Pai DD, Camponogara S. Factors that influence the use of peripherally inserted central catheter in adult patients *Rev. enferm. UERJ.*2017 [cited 2019 Aug 28]; 25:e20976. DOI: <http://dx.doi.org/10.12957/reuerj.2017.20976>