






ORIGINAL ARTICLE

## Factors that condition the use of intraosseous vascular access by nurses in the emergency service

### HIGHLIGHTS

1. Only 14.5% of nurses used intraosseous vascular access.
2. The practical training was associated with the positive perception of intraosseous access.
3. Main barriers: technical insecurity and lack of training.
4. Updated institutional protocols can encourage the use of the technique.

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### ABSTRACT

**Objective:** Evaluate the perceptions, training experiences and challenges faced by emergency nurses regarding the implementation of intraosseous vascular access in Portugal. **Method:** Transversal and descriptive study, with convenience sampling, conducted in May 2024 in a surgical medical hospital in northern Portugal. The data were collected by structured questionnaire and analyzed with descriptive and inferential statistics (Kolmogorov-Smirnov; Shapiro-Wilk exact Fisher test and punctual biserial correlation,  $p < 0.05$ , following the STROBE guidelines). **Results:** Only 14.5% had practical experience with intraosseous vascular access. After peripheral access failure, central venous catheterization predominated. The main barriers were lack of training (90.8%) and technical insecurity (67.1%). The simulation-based training was associated with the most positive evaluation of the procedure ( $p = 0.012$ ). **Conclusion:** The results reinforce the need for simulation training programs and updated institutional protocols to increase the competence of nurses and promote the adoption of intraosseous vascular access in emergency services, aligning the practice with international recommendations.

**DESCRIPTORS:** Nursing; Infusions, Intraosseous; Emergency Medical Services; Vascular Access Devices; Simulation Training.

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## INTRODUCTION

Intravenous Vascular Access (IVA) has emerged as a crucial alternative for emergency situations, especially when peripheral intravenous access (PIA) is difficult to establish. This technique ensures rapid administration of medicines and fluids, offering a pharmacokinetic profile similar to that of intravenous administration<sup>1-3</sup>. Its use is especially relevant in critical scenarios such as cardiac arrest and severe trauma, where time-sensitive interventions are crucial<sup>4</sup>.

Despite its advantages, IVA is underused in clinical practice. The studies identified significant barriers to its adoption, including lack of practical training, technical insecurity and the absence of clear institutional protocols<sup>5-8</sup>. In many cases, health care providers continue to prefer central venous catheterization, even when IVA would be a more efficient option<sup>3,9</sup>.

International guidelines, such as those established by the *American Heart Association*<sup>4</sup>, advocate the use of IVA in emergency situations as the primary alternative when the PIA is not immediately feasible. Studies show that structured training and simulation-based teaching can significantly improve the competence and confidence of healthcare professionals in achieving IVA<sup>5,7,10</sup>.

In Portugal, research on the adoption of IVA among emergency nurses is limited. Understanding your perspectives, training experiences and perceived barriers is essential for developing targeted educational programs and institutional protocols that promote IVA as an emergency procedure to consider.

This study aims to evaluate the perceptions, training experiences and challenges faced by emergency nurses regarding the implementation of IVA in Portugal. The results will contribute to evidence-based recommendations to improve IVA training and adherence to the usage protocol, ultimately improving emergency care outcomes.

## METHOD

This is a descriptive, cross-sectional study conducted in May 2024 in an emergency medical service of a surgical medical hospital in northern Portugal. The study followed STROBE guidelines for observational studies, ensuring transparency and methodological rigor<sup>11</sup>.

The target population was comprised of 96 emergency nurses, with a non-probability sampling of convenience. The final sample included 76 participants, corresponding to a response rate of 79%. Nurses with professional record and at least six months of experience in emergency care were included. To reduce the bias of selection, all nurses of the emergency medical service were invited to participate. No missing data was identified. Eligibility criteria: nurses with professional registration and a minimum of six months in emergency. Not eligible: professionals with exclusively administrative or non-clinical functions.

The data collection was carried out through a structured and self-applied questionnaire, consisting of five sections: (1) socio-demographic and professional characteristics; (2) clinical practices related to vascular access; (3) prior training and confidence in the technique; (4) evaluation of perceived efficacy and barriers; (5) factors

that influence the adoption of the procedure. The questionnaire was subjected to a pre-test with five nurses from another hospital, aimed at evaluating drafting, clarity and adequacy.

The statistical analysis was performed with the software *IBM SPSS Statistics v.28*. Descriptive statistics (average, standard deviation, frequencies, percentages), normality tests (Kolmogorov-Smirnov; Shapiro-Wilk), the exact Fisher test and the punctual biserial correlation were used. The adopted level of significance was  $p < 0.05$ . The exact Fisher test was adopted due to the expected frequencies  $< 5$  in some cells. The punctual biserial correlation was used by involving a dichotomy variable (use of IVA: yes/no) and a continuous variable (years of experience).

The research was approved by the Institutional Ethics Committee (Opinion No. 102/2023), complying with national legislation applicable to human research. All participants signed the informed consent. The data was treated anonymously and confidentially.

## RESULTS

The results presented characterize the sample, describe the practices related to IVA and identify barriers and associations relevant to its implementation in emergency care.

### Demographic and professional characteristics

Of the 96 guest nurses, 76 (79%) participated in the study. The average age was 39.9 years (standard deviation = 8.62), with a range between 26 and 62 years. The average professional experience in emergency services was 15.8 years (standard deviation = 8.69). The majority of participants were female ( $n = 51$ ; 67.1%). As for academic education, 48 (63.2%) had a bachelor's degree and 17 (22.4%) had postgraduate education. Table 1 presents the demographic and professional characteristics of the participants.

**Table 1.** Demographic and professional characteristics of emergency nurses. Guimarães, Portugal, 2024

Characteristics	n	%
<b>Total Participants</b>	76	100
<b>Sex</b>		
Male	25	32.9
Female	51	67.1
<b>Academic Training</b>		
Licensure	48	63.2
Postgraduate training	17	22.4
Speciality	8	10.5
Master	3	3.9
<b>Average age (years) (DP, Interval)</b>	39.9	(8.62, 26-62)
<b>Professional experience (Years) (Medium) (DP, Interval)</b>	15.8	(8.69, 3-42)

Source: The authors (2024).

## Practices and experience with intraosseous vascular access

Only 11 (14.5%) of nurses said they had already performed an IVA procedure. Of these, 10 (90.9%) indicated the proximal tibia as the place of election. The procedure was generally tried after four or more failures in the PIA. In failure situations, in most cases ( $n=69$ ; 90.8%), central venous catheterization was performed by the emergency team, while only seven (9.2%) cases used IVA (Table 2).

**Table 2.** Practices and experience with IVA. Guimarães, Portugal, 2024

Variables	n	%
Previous experience with IVA	11	14.5
Never performed IVA	65	85.5
> 4 AIVP attempts before IVA	9	81.8
Preferred location: proximal tibia	10	90.9
Try IVA after failure in PIA	7	9.2
Opted for CVC after failure in PIA	69	90.8

Legend: IVA: Intraosseous Vascular Access; PIA: Intravenous peripheral venous access; CVC: Central Venous Catheter.

Source: The authors (2024).

Nurses with practical training based on simulation showed greater recognition of the clinical importance of this procedure ( $p = 0.012$ ) (Table 3). A statistically significant association was found between satisfaction with the knowledge of the procedure and agreement as to its applicability ( $p = 0.019$ ) (Table 3)

Nurses with longer professional experience showed a slight tendency to use IVA ( $ppb = 0.29$ ;  $p < 0.05$ ). However, this correlation was weak. Participation in structured training programs was significantly associated with higher levels of confidence in the completion of the procedure ( $p < 0.05$ ) (Table 3).

**Table 3.** Statistical analysis of associations and correlations between variables related to IVA. Guimarães, Portugal, 2024

Compared variables	Statistical method	(p)
Simulated Practical Training vs IVA Importance	Fisher's exact test	0.012
Simulated practical training vs Satisfaction with the knowledge about IVA	Fisher's exact test	0.045
Satisfaction with knowledge about IVA vs Intent to use IVA	Fisher's exact test	0.019
Professional experience (years) vs Using IVA	Point-biserial correlation	<0.05

Legend: IVA: Intraosseous Vascular Access; Significant p value:  $p < 0,05$ .

Source: The authors (2024).

## Formation and perceived barriers

The majority of participants ( $n=50$ ; 65.8%) said they had attended simulation-based training on the procedure. However, 68 (89.5%) expressed dissatisfaction with their level of competence. Continuously, 64 (84.2%) believed that additional training would increase the use of IVA in emergency situations. The most mentioned barriers were: lack of practical training ( $n = 69$ ; 90.8%), technical insecurity ( $n = 51$ ; 67.1%) and lack of clear institutional protocols ( $n = 29$ ; 38.2%) (Table 4).

**Table 4.** Perceived barriers and training factors that influence the use of IVA. Guimarães, Portugal, 2024

Variables	n	%
<b>Training factors</b>		
Participated in simulation-based training	50	65.8
Dissatisfaction with the competence in IVA	68	89.5
Believes more training would increase IVA usage	64	84.2
<b>Barriers to the implementation of IVA</b>		
Lack of training	69	90.8
Barriers to the implementation of IVA	51	67.1
Limited institutional protocols	29	38.2

Legend: IVA: Intraosseous vascular access.

Source: The authors (2024).

## DISCUSSION

This study highlights that although IVA is widely recognized as a crucial technique in emergency environments, its use remains limited among emergency nurses in Portugal. Although 95% recognized the importance of IVA, only 14.5% had previous experience, reinforcing the results of the previous study<sup>8</sup>. This low adherence to IVA is in line with the preference for central venous catheterization at the expense of IVA (90.8% vs 9.2%), as mentioned earlier by Torres et al.<sup>9</sup>. These results suggest that institutional protocols in Portugal may still give priority to central venous catheterization as a primary alternative when PIA fails, although international guidelines advocate IVA as a first-line option in these cases<sup>4</sup>.

Our results confirm that structured training programs play a significant role in promoting the adoption of IVA. Nurses who participated in simulation-based training actions reported higher levels of confidence and a higher likelihood of considering IVA in emergency scenarios ( $p = 0.019$ ). These results support the conclusions of Smereka et al.<sup>8</sup>, which showed that practical training improves procedural success rates. In addition, James Cheung et al.<sup>10</sup> emphasize that practical training reduces hesitation in critical moments, which may explain the fact that nurses without prior experience in simulation have manifested greater technical insecurity in this study.

The barriers identified in this study are consistent with previous investigations that highlight the lack of training (90.8%) and technical insecurity (67.1%) as the main factors limiting the adoption of IVA<sup>7,8,12</sup>. In addition, institutional factors, such as the absence of standardized protocols, were mentioned by nurses, reinforcing the need for clearer clinical guidelines<sup>9</sup>. These results suggest that, in addition to individual training, institutional interventions are needed to improve the use of IVA in emergency situations.

An especially relevant result was the poor correlation between professional experience and adoption of IVA, which suggests that the experience alone does not generate confidence in the use of IVA. Instead, structured training played a more significant role in increasing familiarity with the procedure. This result supports previous studies, which demonstrate that even experienced nurses may not have competence in IVA without practical experience and appropriate training programs, based on high fidelity simulation, with greater practical workload and periodic assessment of competencies<sup>8,10,12-13</sup>. Consistently, the identified barriers (lack of training and technical

insecurity) align with previous investigations<sup>7-8,13</sup> that highlight the need for structured educational strategies to improve competence and reduce hesitation in using IVA.

## Limitations

This study has some limitations. First, using a convenience sample from a single hospital can limit the generalization of results to other health care contexts. Future research should include multicenter studies to capture a wider range of nursing practices and institutional policies. Secondly, as the data were self-reported, the bias of response may have influenced participants' assessments of their knowledge and confidence. Future studies should consider objective evaluations of IVA competence through clinical simulations or practical evaluations. Finally, although this study has identified key barriers and facilitators, further research is needed to explore the impact of increased use of IVA on clinical outcomes in emergency situations.

## Implications for Emergency Nursing

The results of this study have direct implications for the practice of emergency nursing, highlighting the need for structured training programs and institutional support to improve the use of IVA. Since a significant proportion of nurses have identified lack of training as a major obstacle, health care institutions should give priority to the integration of simulation-based IVA training into nurses' education and professional development curricula.

In addition, institutional preferences for central venous catheterization at the expense of IVA may result from outdated protocols and limited knowledge about IVA. To solve this problem, emergency nursing leaders should advocate protocol revisions that integrate IVA as a primary option when the PIA fails, in accordance with international recommendations<sup>4</sup>.

From a clinical perspective, the strong association between simulation training and confidence in the use of IVA suggests that routine practice and competence assessments should be integrated into continuing training programs. This fact is consistent with previous studies that indicate that nurses who receive training in high-fidelity simulation demonstrate higher success rates of procedures and less hesitation in emergency situations<sup>10</sup>.

Implementing these changes would not only increase the frequency of use of IVA in emergency situations, but would also improve outcomes for patients by reducing access time in critical scenarios. Ultimately, addressing these barriers through structured training and institutional support will increase the competence and confidence of emergency nurses in carrying out IVA, thus optimizing emergency care.

## CONCLUSION

This study achieved the goal of evaluating the perceptions, barriers and training needs about IVA among emergency nurses, identifying formative and organizational gaps. Despite its recognized importance in emergency contexts, IVA continues to be underused by nurses in this service, and this reality may also be reflected in other similar contexts in Portugal. This study identified lack of training and technical insecurity as the main barriers to the adoption of IVA, with a strong institutional preference for central venous catheterization to the detriment of IVA. Although most participants recognized

the importance of IVA, few had practical experience with the technique, highlighting the gap between theoretical knowledge and application in the real world.

One of the main conclusions was the association between simulation-based training and confidence in the use of IVA, reinforcing the need for structured educational programs to improve procedural competence. Since professional experience alone was not a strong predictor of IVA use, the study highlights the importance of continuous training throughout a nurse's career.

The results suggest that increased training opportunities and the revision of institutional protocols could promote greater adoption of IVA in Portuguese emergency medical services, aligning the practice with international guidelines. Future research should focus on the long-term impact of IVA training programmes on clinical outcomes as well as conducting multicenter studies to validate these outcomes in various health care contexts. Additionally, more research is needed to assess how protocol modifications influence decision-making and how often IVA is used in emergency care.

This study by identifying the barriers can contribute to the implementation of specific training, achieving institutional support and the implementation of updates to the protocols founded in the literature. In this way, emergency nurses can increase their competence in critical situations, ultimately improving the outcomes for patients and optimizing strategies for the administration of medications in emergency care.

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**Role of Authors:**

Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work - **Fernandes PMFA, Moreira ASBC, de Oliveira LCN**. Drafting the work or revising it critically for important intellectual content - **Fernandes JFFA, Alves TR**. Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved - **Fernandes PMFA, Alves TR**. All authors approved the final version of the text.

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The authors have no conflicts of interest to declare.

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The authors declare that all data are fully available within the article.

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