

Use of procedural ultrasound for the insertion of peripheral intravenous catheters: A nationwide survey in acute care departments in Belgium

F Dupriez, C Smets, H Raemen, M Van Laer & M Hachez

Abstract

Purpose: Assessment of ultrasound use for peripheral intravenous cannulation among acute care nurses and physicians.

Methods: Over a population of 17,437, the calculated sample size of respondents required was 376.

Results: A total of 388 health professionals; 249 (64.2%) physicians and 139 (35.8%) nurses completed the entire questionnaire. 166 (45.2%) used ultrasound for intravenous cannulation. A statistically significant difference favored physicians' ultrasound use ($p < 0.001$). Respondents with less than 10 years of clinical practice used ultrasound significantly more ($p < 0.001$). The main reported obstacle among users was the lack of time.

Conclusion: This survey revealed the gap between the current recommendations for ultrasound use for peripheral intravenous cannulation and the actual practices. Efforts should be made to develop specific training using ultrasound.

Keywords

procedural ultrasound, intravenous cannulation, catheter, acute care

Key points

- There is a gap between current recommendations for procedural ultrasound use in peripheral IV cannulation and current practices.
- Efforts should be made to develop curricula about procedural ultrasound use for peripheral IV cannulation among physicians and nurses in acute care.

Introduction

Peripheral intravenous (IV) catheter insertion is common in daily clinical practice.¹ However, in some situations, it can be challenging to gain reliable IV access (e.g., obese patients, patients with poor venous access, intravenous drug users).

Ultrasound guidance is not recommended for routine real-time use in peripheral venous cannulation.² Ultrasound use should nevertheless be considered for any kind of peripheral IV cannulation when access is predicted to be difficult.³⁻⁷ In many acute care conditions such as shock or in chemotherapy procedures with possible neutropenia, rapid IV placement should be performed, even though catheter insertion is challenging.⁸ Other conditions such as obesity, upper extremity swelling, dialysis, and intravenous drug use can also complicate IV placement.⁸ Procedural ultrasound, which can identify the presence, location, and patency of peripheral veins, increases cannulation success,^{3,4} diminishes the

time to successful cannulation,^{9,10} and decreases the number of percutaneous punctures.⁸ The use of ultrasound also contributes to greater patient satisfaction compared with the traditional landmark approach for difficult-access patients.^{9,11,12}

Despite previous evidence in favor, the current practices of peripheral IV catheter insertion using procedural ultrasound have not yet been evaluated in Belgium. A 2018 literature review found that the British National Institute for Health and Care Excellence (NICE) had not yet published guidelines to support ultrasound use by nurses for IV catheter placement, even though peripheral IV access is the most common invasive procedure performed on patients in the United Kingdom.⁸ Our literature review did not find any other evaluation of ultrasound use for IV catheter placement in European countries.

This study presents the results of a questionnaire designed to evaluate the use of procedural ultrasound for peripheral IV cannulation by physicians and

Florence Dupriez¹⁻⁴
MD

Cedric Smets¹
MD

Hannelore Raemen²⁻⁴
MD

Marie Van Laer³⁻⁴
MD

Martin Hachez¹
MD

¹ Emergency Department (ED),
Cliniques Universitaires Saint-
Luc (CUSL), 1200 Brussels,
Belgium

² Emergency Department
(ED), ZNA Middelheim, 2020
Antwerp, Belgium

³ Emergency Department (ED),
OLVZ Aalst, 9300 Aalst,
Belgium

⁴ Belgian Emergency Ultrasound
Society

Correspondence

Florence Dupriez
Email: Florence.dupriez@saintluc.
ucouvain.be

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nurses working in acute care in Belgium. It identifies the prevalence of common obstacles and proposes possible solutions to promote ultrasound use in cases of challenging peripheral IV catheter insertion.

Methods

Study setting

A questionnaire on procedural ultrasound use for peripheral IV cannulation was designed using simple, short, and mostly multiple choice questions in line with the guidelines.¹³ Questions were chosen for selected items in a closed-response format (i.e., yes/no or rating scale). As much as possible, items were chosen to discriminate respondents. Respondents could answer in an open-response format if none of the proposed items seemed adequate. The questionnaire was designed in three languages, namely, French, Dutch, and English. The questionnaire could not be completed more than once. The first part of the questionnaire covered demographic data about the respondent, the second part focused on the availability of ultrasound machines and hospital procedures, and the third part evaluated the respondents' ultrasound use for peripheral IV cannulation. The questionnaire was built using the TypeformTM online form builder. This survey did not involve any patients or personal data. The approval of the ethics committee was therefore consultative. The questionnaire is available in Appendix 1.

Enrolment of study subjects

According to the website of the Belgian Federal Public Service Health Food Chain Safety and Environment,¹⁴ the population of acute medical and paramedical professionals (i.e., emergency doctors, anesthetists, intensive care specialists, intensive care and emergency nurses) comprised 17,437 individuals in 2021. To reach a confidence level of 95% with a 5% margin of error, a sample size of 376 respondents was required. Considering an estimated response rate of 35%, 1,025 invitations were required based on the population and the estimated response rate.

Data collection

The internet link for the survey was sent by email to healthcare professionals working in acute care departments in Belgium, mostly in emergency departments. The email was sent in successive waves between May 12 and October 12, 2022, to the emergency department heads asking them to share the questionnaire with their medical and paramedical staff as well as the anesthesia and intensive care departments of their institutions. The questionnaire was also sent to the mailing list of the Ultrasound

and Emergency Medicine ASBL, which is a non-profit organization providing ultrasound courses to healthcare professionals, and to the *Association Française des infirmiers d'Urgence* (AFIU), a French-speaking association for emergency nurses, which shared the questionnaire with its members as well as nurses working in acute care services and emergency departments in Belgium.

Statistical analysis

The software IBM SPSS statistics 26.0 (SPSS Inc., Chicago, IL, USA) was used to analyze the anonymized data. Continuous variables describing the study population were expressed using means, standard deviations, and minimum and maximum values. Discrete variables were reported by category as numbers and percentages. The χ^2 test of independence and, when indicated, Fisher's exact test were used to compare discrete variables. The significance level corresponds to a p-value of <0.05. The 95% confidence interval was calculated using the mid-p exact value.

Results

Overall, 388 individuals (mean age [SD] of 38.77 [10.629] years) working in the acute care services in Belgium completed the survey. The margin of error for a 95% level of confidence was 4.92%. Over 1,025 (n=1,069) people opened the survey link, with 388 (36.3%) respondents completing the entire questionnaire. Table 1 summarizes the profile of respondents.

Among the respondents, 249 (64.2%) were physicians and 139 (35.8%) nurses, with 203 (52.3%) working in an emergency department. The vast majority of respondents (367, 94.6%) had access to at least one ultrasound machine in their department or loaned from another department. Among the available ultrasound machines used, 53 (14.4%) were ultraportable (probe connected to a tablet or smartphone), 333 (90.7%) portable

Table 1. Profile of respondents

Profile	Total (n = 388)
Sex	
Female	186 (47.9%)
Male	199 (51.3%)
Other/Non-binary	3 (0.8%)
Function	
Physician	249 (64.2%)
Nurse	139 (35.8%)
Type of hospital	
Non-university hospital	208 (53.6%)
University hospital	180 (46.4%)

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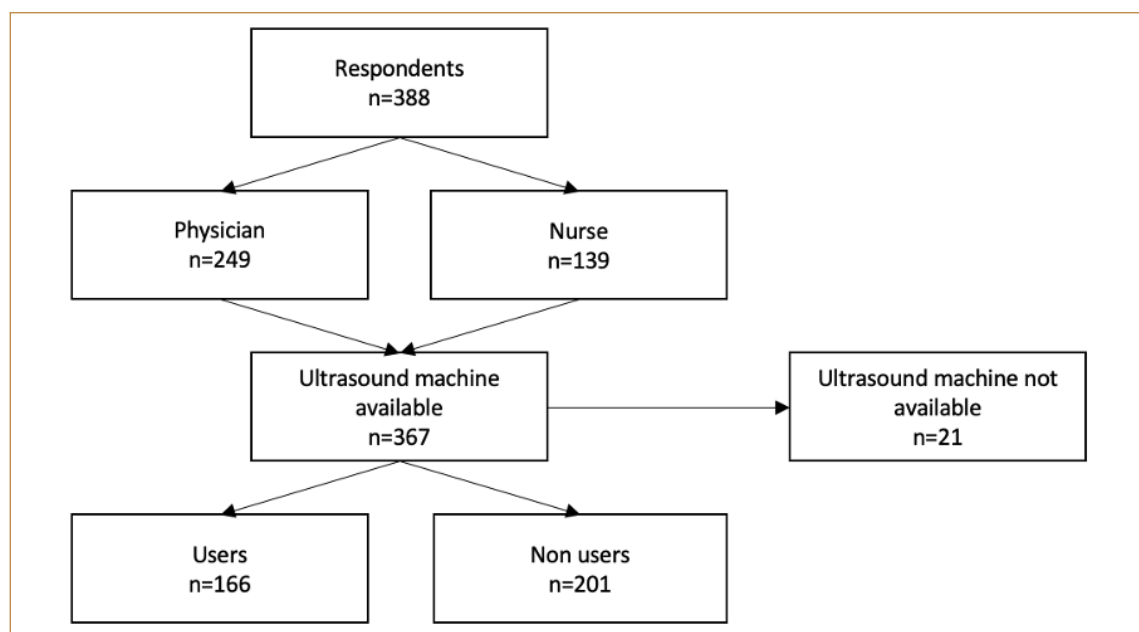


Figure 1.

(easily transportable on a portable trolley), and 38 (10.4%) static (ultrasound machine usually found in the radiology department and difficult to move). A total of 166 (45.2%) of respondents with ultrasound access used it for IV cannulation (Figure 1). No statistically significant differences were found

regarding the availability of ultrasound machines in university and non-university hospitals ($p = 0.738$).

Table 2 reports the factors influencing ultrasound use for peripheral IV cannulation. A significant difference was found in favor of physicians using ultrasound for peripheral IV access compared

Table 2. Factors influencing ultrasound use for peripheral intravenous cannulation

Influencing factors	Not using ultrasound n (%)	Using ultrasound n (%)	Total
Level of training for physicians (n=238)			
Physician in training	32 (46.4%)	37 (53.6%)	69
Specialist	70 (41.4%)	99 (58.6%)	169
	p=0.483		
Physician or nurse (n=367)			
Physician	102 (42.9%)	136 (57.1%)	238
Nurse	99 (76.7%)	30 (23.3%)	129
	p<0.001		
Ultrasound availability in the department (n=367)			
Outside the department	4 (66.7%)	2 (33.3%)	6
Inside the department	197 (54.6%)	164 (45.4%)	361
	p=0.694		
Type of hospital (n=367)			
Non-university	99 (50.5%)	97 (49.5%)	196
University	102 (59.6%)	69 (40.4%)	171
	p=0.079		
Years of experience (n=367)			
<10 years	98 (45.4%)	118 (54.6%)	216
>10 years	103 (68.2%)	48 (31.8%)	151
	p<0.001		

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Table 3. Characteristics of ultrasound use for peripheral intravenous cannulation among ultrasound users (n=166)

Question evaluated	Results n (%)
How often do you use ultrasound for IV cannulation?	
Daily	5 (3%)
Weekly	45 (27.1%)
Monthly	60 (36.1%)
Yearly	56 (33.7%)
*When do you consider using ultrasound compared with the standard technique?	
As the first technique when the patient is known to be difficult to cannulate	54 (37.5%)
After one failed attempt	24 (14.5%)
After two failed attempts	56 (33.7%)
After more than two failed attempts	63 (38%)
How many attempts do you require when using ultrasound?	
One attempt	92 (55.4%)
Two attempts	64 (38.6%)
Three attempts	7 (4.2%)
More than three attempts	3 (1.8%)
How easy do you find ultrasound compared with the standard technique?	
Much more difficult	11 (6.6%)
More difficult	38 (22.9%)
Similar	28 (16.9%)
Easier	51 (30.7%)
Much easier	38 (22.9%)
Do you encounter obstacles in using ultrasound?	
Yes	81 (48.8%)
No	85 (51.2%)

with nurses ($p<0.001$). Respondents with less than 10 years of clinical practice used ultrasound significantly more frequently than the more experienced respondents ($p<0.001$). Other factors such as the level of training of physicians, the type of hospital, and the location of the available ultrasound machine did not show any significant between-group differences.

Table 3 reports the descriptive statistics about the characteristics of ultrasound use for peripheral IV cannulation among respondents reporting ultrasound use, whereas Table 4 summarizes the different obstacles for ultrasound use encountered by users and non-users in their institutions. Among respondents with access to an ultrasound machine, 85 (23.2%) reported no obstacle to its use.

Discussion

Questionnaires are the most common method used to obtain data from healthcare professionals about

their demographic data, personal history, knowledge, behaviors, and attitudes.¹³ These surveys consistently and accurately collect data and produce results to address specific research questions.¹³ Questionnaires nevertheless have several limitations, as their responses depend on subjects' honesty and memory, which may thus differ from reality.¹³ To maximize the quality of the information provided by the results, this questionnaire included simple questions in a closed-response format, which provide discrete responses for analysis.¹³ The questionnaire was available in three languages to ensure that it was in the primary language of most respondents, thus avoiding language bias. The survey was conducted in a self-administered way to ensure the privacy and anonymity of responses and avoid interviewer bias. This nevertheless prevented the respondents from clarifying their answers.

Given that the link to the survey was shared through different channels either directly by the investigators or indirectly by respondents and national medical and paramedical associations, we could not evaluate the exact number of invitations sent to professionals. This limitation of the survey created a selection bias. The person sharing the survey with colleagues may have been influenced by its subject and thus less liable to share it if no ultrasound machine was available in the department or if staff members had no ultrasound training. The fact that the topic was stated at the start of the questionnaire could also have created a selection bias, so too could have the dissemination of this questionnaire through the mailing list of an ultrasound course provider. Finally, the population interested in the topic of ultrasound use for IV cannulation may have been more likely to answer the survey and complete it.

The number of links opened ($n=1,069$) nevertheless exceeded the required number of invitations calculated based on our population size ($n=1,025$), which increases the confidence in the survey results. The higher-than-expected response rate (36.3%) is a strength of this study, pointing to the real interest in the topic.

As a sufficient number of surveys were completed, our study provides accurate information about peripheral IV cannulation in acute care services in Belgium. The significant difference observed between nurses and physicians in terms of their ultrasound use in peripheral IV cannulation ($p<0.001$) is perhaps due to the lack of procedural teaching of ultrasound for nurses in Belgium. Although this topic is frequently included in the point-of-care ultrasound curriculum for physicians,¹⁵⁻¹⁷ to our knowledge, this is not yet the case for nurses in our country. Further, direct bedside teaching is often negatively impacted by

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Table 4. Obstacles to ultrasound use reported among respondents

Obstacle	Among Users (n=81)	Among non-users (n=201)	Total* (n=282)
Legally not allowed to use this technique	1 (1.2%)	1 (0.5%)	2 (0.7%)
Lack of time	50 (61.7%)	46 (22.9%)	96 (34.0%)
Insufficient availability of the ultrasound machine	20 (24.7%)	8 (4%)	28 (9.9%)
No linear probe available	3 (3.7%)	6 (3%)	9 (3.2%)
Insufficient opportunities for supervised training	26 (32.1%)	63 (31.8%)	89 (31.6%)
Immediate recourse to central venous catheter	2 (2.5%)	19 (9.5%)	21 (7.4%)
No permission from supervisor/treating physician to use the technique	3 (3.7%)	14 (7%)	17 (6%)
Not trained in this technique	0 (0%)	92 (45.8%)	92 (32.6%)
Not useful/not necessary	0 (0%)	74 (36.8%)	74 (26.2%)
Other	27 (33.3%)	25 (12.4%)	52 (18.4%)

*85 respondents reported no obstacle

high patient flow in the acute care departments. The literature supports the ultrasound use among nurses for IV cannulation,¹⁸⁻²² with many examples of curricula presently available.²³ Indeed, nurses usually cannulate peripheral veins in acute care services.²¹ Our survey results therefore suggest that efforts should be made to broaden ultrasound access to nurses in Belgium. The legal issue of nurses using procedural ultrasounds for peripheral IV cannulation should nevertheless be clarified before delegating this task to nurses. Although only two respondents reported legal issues as an obstacle to ultrasound use for IV cannulation, ultrasound is not yet regarded as a tool dedicated to nurses in our country due to the lack of published guidelines.

The significant difference found between respondents with less and more than 10 years of clinical practice is perhaps due to the current interest in ultrasound among younger nurses and physicians who are willing to learn more technical procedures. Evidence promoting the use of ultrasound for peripheral IV cannulation has increased in the last two decades. Moreover, it has been shown that learning new techniques is easier for younger people and that older adults have more difficulty with updating task requirements with new techniques than young adults do.^{24,25}

Although the current recommendations favor the direct use of ultrasound for IV cannulation in patients presumed to be difficult to cannulate,³ only 54 out of 166 (37.5%) respondents who reported using ultrasound followed this recommendation. This is possibly related to the limited number of nurses who are trained in procedural ultrasound, even though nurses tend to attempt cannulation first before asking a trained physician to complete the peripheral IV cannulation using ultrasound. This could also partly explain the higher number of

respondents who used ultrasound as a second-line technique. The fact that one-third of respondents used ultrasound less than once a month (56/166, 33.7%) could be explained by the larger number of physicians using ultrasound, as they are not in the first line for performing peripheral IV cannulations.

Overall, 89 (53.6%) of the 166 procedural ultrasound users for IV cannulation found this technique to be easier or much easier than the standard technique. This limited number could be secondary to the high number of users (116/166, 69.9%) who perform procedural ultrasound for IV cannulation less than once a week and therefore lack practice.

Considering the obstacles to ultrasound use, 96 (34%) respondents reported a lack of time, including 50 (61.7%) who were ultrasound users. This result is surprising, since recent studies have supported procedural ultrasound use for difficult cases of peripheral IV cannulation, as it reduces cannulation time.^{9,10} Another reported obstacle among the 201 non-users relates to the lack of practice. Indeed, 63 (31.8%) non-users report a lack of supervised training, whereas 92 (45.8%) had received no training at all. This highlights the importance of focusing on ultrasound curricula for nurses and physicians in acute care in Belgium.

Conclusions

Our questionnaire shows the gap between the current recommendations for procedural ultrasound use in peripheral IV cannulation and the current practices among acute care nurses and physicians in Belgium. In light of these results, efforts should be made to develop dedicated ultrasound courses accessible to both nurses and physicians. Assuming that nurses are first in line to cannulate peripheral veins in acute care settings, they should have access to procedural

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ultrasound use legally in their daily practice. Given the favorable ultrasound availability reported in the different departments, ultrasound use for peripheral IV cannulation could probably be easily promoted with the appropriate training.

Author Contributions

All authors contributed to the study conception and design. Material preparation, data collection

and analysis were performed by Florence Dupriez, Cedric Smets, and Martin Hachez. The first draft of the manuscript was written by Florence Dupriez. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Availability of data and material

All statistical analyses are available on demand.

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