Internal and Emergency Medicine (2022) 17:1225–1227
https://doi.org/10.1007/s11739-021-02896-5

CE-RESEARCH LETTER TO THE EDITOR

An educational intervention to reduce unjustified peripheral intravenous infusions in the emergency department

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Received: 8 November 2021 / Accepted: 13 November 2021 / Published online: 20 November 2021

Dear Editor,

Peripheral intravenous infusion (PIVI) is a frequent procedure, especially in emergency departments (EDs). However, studies revealed that 33.8–60.7% of these procedure orders are unjustified, for example "to keep vein open" (KVO), "just in case" or for intravenous drug administration (even though an oral alternative is available) [1–4]. PIVI are time-consuming for nurses and may cause various adverse events such for patients as pain, hematoma, thrombophlebitis or infection [5, 6]. The aim of this study was to evaluate the efficacy of an educational intervention in an ED to reduce the number of unjustified PIVI.

A single-center before and after study was conducted in an urban university hospital ED. The "before" period lasted from June 13 to June 20, 2019. The educational intervention occurred in October 2019. Hospital guidelines regarding PIVI order were presented to the ED medical and nursing staff during one dedicated meeting and three posters were displayed in the ED [7]. The guidelines specified when PIVI was justified (life-threatening emergency, need for an exclusive intravenous drug with no oral alternative, impossibility to administer oral medication, need to maintain an empty stomach) or unjustified (KVO, "just in case", to collect a blood sample). The "after" period took place from January 6 to January 13, 2020 and was extended from February 6 to February 9, 2020 because of a slow inclusion rate. All patients receiving a PIVI in the ED between 8 and 12 am during both study periods were eligible. Patients admitted to the resuscitation room were excluded. This study involved the reuse of routinely collected data and fell within the scope of the reference methodology MR-004 of the French legislation. The protocol was registered in the *Assistance Publique-Hôpitaux de Paris* studies registry (number 20210423180128).

For each patient, the emergency physician was asked to specify the main reason for prescribing a PIVI among the six following categories: life-threatening emergency, volume expansion or hydration, KVO, exclusive intravenous drug, impossibility of oral administration or need to maintain an empty stomach. Other data collected included age, sex, chief complaint, intravenous drug administration, blood test, imaging with contrast agent, and visit outcome. Three emergency physicians randomly selected and not involved in the study reviewed the patients' emergency medical records to assess the relevance of the decision to order PIVI and classify the procedure as justified or unjustified. They followed the guidelines and were blinded to the main reason PIVI order. A PIVI was considered unjustified if at least two evaluators considered it as such.

Qualitative variables were expressed as numbers and percentage and compared using Chi^2 or Fischer's exact test. Quantitative variables were expressed as mean and standard deviation and compared using Student's *t* test. Inter-evaluators agreement was analyzed using Fleiss' kappa. Statistical analyses were performed with the R software (version 4.0.2). A p value < 0.05 was considered statistically significant.

One hundred forty-five patients were included: 83 during the "before" period (mean of 10.4 per day, 8.5% of all ED

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visits) and 62 during the "after" period (mean of 5.2 per day, 3.6% of all ED visits). Patients' characteristics are presented in Table 1. During the "after" period, the population was significantly older (60.2 years vs 51.7 years, $p=0.021$) and received more intravenous medications (81% vs 63%, $p=0.019$). A significant difference was found between the two periods regarding the reason for PIVI orders ($p<0.001$). KVO was the main reason during the "before" period (57%) and was almost never the reason during the "after" period (2%).

Unjustified PIVI significantly decreased in the "after" period compared to the "before" period (26% vs 52%, $p=0.002$; Table 2) with a relative risk reduction of 0.50 (95% CI 0.31–0.80). Agreement between the three evaluators was moderate in the "before" period (kappa 0.419) and low in the "after" period (kappa 0.293). Individual analysis for each evaluator showed a significantly lower unjustified PIVI orders rate after the intervention.

The rate of unjustified PIVI prior to the intervention is consistent with the literature [1–4]. Implementation of an educational intervention in the ED resulted in a 50% relative risk reduction of unjustified PIVI. There was a significant reduction of daily patient inclusions between the two periods, which may be related to the reduction in PIVI orders as a result of the intervention. The number of KVO orders strongly reduced in the "after" period. This result is consistent with an improved application of guidelines. Due to the Covid-19 pandemic, we were unable to conduct a third inclusion period to confirm the sustainability of practice improvement, as it has already been shown in other countries [8]. Inter-rater agreement was low to moderate, which was potentially expected given the complexity of this retrospective evaluation. However, the significant decrease in unjustified PIVI orders for each evaluator supports the validity of our results.

This study has some limitations. First, a few eligible patients might not have been included by their treating physician. This risk was reduced by the presence of a coordinating physician during the daytime, who ensured that all eligible patients were included, and the choice of a convenience sample (no patients were enrolled during night shifts). Second, the "after" period had to be extended to obtain a sufficient sample size. Third, a Hawthorne effect may have affected and enhanced the changes in practices, through careful attention to following guidelines or a possible change in the reason chosen for ordering PIVI. Fourth, the typology of patients might have been different between the two study periods. Fifth, evaluators were not blinded to the inclusion period.

Table 1 Patients' characteristics

	Before $n=83$	After $n=62$	p
Age, mean (± standard deviation)	51.7 (±21.8)	60.2 (±21.4)	0.021*
Sex, *n* (%)			
Male	41 (49)	29 (47)	0.755
Female	42 (51)	33 (53)	
Chief complaint, *n* (%)			
Abdominal pain	26 (31)	26 (42)	0.002*
Trauma	10 (12)	12 (19)	
Thoracic pain	11 (13)	1 (2)	
Impaired general condition	5 (6)	5 (8)	
Headache	8 (10)	0	
Neurological deficit	5 (6)	0	
Others[a]	18 (22)	18 (29)	
Mean reason for a PIVI order, *n* (%)			
Life-threatening emergency	0	0	<0.001*
Volume expansion or hydration	13 (16)	38 (61)	
To keep vein open	47 (57)	1 (2)	
Exclusive intravenous drug	7 (8)	8 (13)	
Impossible oral administration	8 (10)	5 (8)	
Not-by-mouth status	8 (10)	10 (16)	
Intravenous drug, *n* (%)			
Yes	52 (63)	50 (81)	0.019*
No	31 (37)	12 (19)	
Blood sample, *n* (%)			
Yes	77 (93)	60 (97)	0.467
No	6 (7)	2 (3)	
Imaging with contrast agent, *n* (%)			
Yes	23 (28)	14 (23)	0.483
No	60 (72)	48 (77)	
Visit outcome, *n* (%)			
Hospitalization	41 (49)	36 (58)	0.301
Discharged	42 (51)	26 (42)	

*Statistically significant ($p < 0.05$)

[a]Complaints with frequency < 5%

Table 2 Unjustified PIVI orders

	Before $n=83$	After $n=62$	p
Evaluator n°1, *n* (%)	46 (56)	22 (36)	0.017*
Evaluator n°2, *n* (%)	34 (41)	11 (18)	0.003*
Evaluator n°3, *n* (%)	53 (64)	28 (45)	0.025*
Majority, *n* (%)	43 (52)	16 (26)	0.002*
Unanimity, *n* (%)	27 (33)	8 (13)	0.006*

*Statistically significant ($p<0.05$)

In conclusion, implementation of an educational intervention in an ED appeared to reduce the number of unjustified PIVI orders. This may result in reduced adverse events, improve patients' comfort, reduce nurses' job strain, associated costs and environmental footprint.

Acknowledgements The authors would like to thank Dr. Fabien Brigant, Dr. Nicolas Cury and Dr. Sofiane Yefsah for agreeing to participate in this study as evaluators. We would also like to thank the medical and paramedical staff of the emergency department of Saint-Antoine Hospital, Paris, France.

Author contributions FN, P-CT: conceptualization, methodology, literature search, data curation, writing—original draft; PH: formal analysis; A-SB, YY: investigation, writing—review & editing; JT: writing—review & editing.

Funding None.

Availability of data and material All data analyzed during this study are included in this article.

Code availability Not applicable.

Declarations

Conflict of interest The authors declare that they have no conflicts of interest.

Human and animal rights This study involving the reuse of routinely collected data fell within the scope of the reference methodology MR-004 of the French legislation and did not need ethical approval. The protocol was approved by the Data Protection Committee of the *Assistance Publique-Hôpitaux de Paris. Sorbonne Université*.

Informed consent This study involving the reuse of routinely collected data fell within the scope of the reference methodology MR-004 of the French legislation and did not need individual consent. The information is collective and patients have the right to oppose the use of their personal data.

Presentation The results of this study have been presented at the French National Congress of Emergency Medicine in June 2–4, 2021 (*Urgences 2021* virtual congress).

References

1. Guihard B, Rouyer F, Serrano D, Sudrial J, Combes X (2018) Appropriateness and complications of peripheral venous catheters placed in an emergency department. J Emerg Med 54:281–286. https://doi.org/10.1016/j.jemermed.2017.10.005
2. Vandenbos F, Basar A, Tempesta S, Fournier JP, Bertrand F, Vanesland L, Oualid H, Dunais B, Dellamonica P, Roger PM (2003) Relevance and complications of intravenous infusion at the emergency unit at Nice university hospital. J Infect 46:173–176. https://doi.org/10.1053/jinf.2002.1101
3. Limm EI, Fang X, Dendle C, Stuart RL, Egerton Warburton D (2013) Half of all peripheral intravenous lines in an Australian tertiary emergency department are unused: pain with no gain? Ann Emerg Med 62:521–525. https://doi.org/10.1016/j.annemergmed.2013.02.022
4. Salvetti M, Paini A, Colonetti E, Mutti S, Bonetti A, Broggi F, Bertacchini F, Muiesan ML (2021) Intravenous access placement and fluid administration appropriateness in the emergency department. Emerg Care. https://doi.org/10.4081/ecj.2021.9150
5. Marsh N, Webster J, Ullman AJ, Mihala G, Cooke M, Chopra V, Rickard CM (2020) Peripheral intravenous catheter non-infectious complications in adults: a systematic review and meta-analysis. J Adv Nurs 76:3346–3362. https://doi.org/10.1111/jan.14565
6. Miliani K, Taravella R, Thillard D, Chauvin V, Martin E, Edouard S, Astagneau P (2017) Peripheral venous catheter-related adverse events: evaluation from a multicentre epidemiological study in France (the CATHEVAL project). PLoS ONE 12:e0168637. https://doi.org/10.1371/journal.pone.0168637
7. Comité des dispositifs médicaux de la CODIMS APHP (2015) Bon usage des dispositifs médicaux de perfusion. http://ageps.aphp.fr/wp-content/blogs.dir/68/files/2012/12/Recommandations-CODIMS-Bon-usage-DM-perfusion-juillet-2015.pdf. Accessed 31 August 2021
8. Lim ZJ, Nagle D, McAllan F, Ramanan R, Dendle C, Stuart RL, Egerton-Waburton D (2020) Evaluating the sustained effectiveness of a multimodal intervention aimed at influencing PIVC insertion practices in the emergency department. Emerg Med J 37:444–449. https://doi.org/10.1136/emermed-2019-208852