

Student compliance with indications for intravenous cannulation during clinical learning

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Background. Intravenous (IV) cannulation is a commonly performed procedure that is taught to a number of health science students. As with most invasive medical interventions, there is a possibility of unintended adverse effects. Therefore, IV cannulation should only be performed for a clearly established need.

Objective. To assess the extent to which emergency medical care students, during the course of their clinical learning, establish IV access in patients without a clearly documented indication.

Methods. A retrospective analysis of historical data from a clinical learning database was done to investigate whether patients seen by students over a 2-year period received IV cannulation in line with indications taught to students.

Results. Of the 5 893 cases reviewed, 1 862 (32%) were cannulated intravenously. Of these, 426 (23%) did not have a clearly documented indication that had been taught for the procedure. Therefore, these patients may potentially have been 'overtreated'.

Conclusion. This study demonstrates that a high number of IV lines were established by students, with no clearly documented indication. This potential overtreatment may in part be attributed to pressures placed on students to achieve the minimum prescribed number of skills. Such practices remain common in medical education and may be detrimental to the patient. Medical educators need to ensure that students value the patient rather than the procedure. Further research needs to be conducted to investigate and identify other possible reasons for overtreatment of patients by medical students.

Afr J Health Professions Educ 2015;7(2):158-160. DOI:10.7196/AJHPE.273



One of the guiding principles of the teaching and performance of a medical intervention is to 'firstly do no harm'. Gaining access to a patient's circulatory system for the purpose of administering fluid and/or medications is commonly achieved through a procedure that involves piercing of the skin with a needle and inserting a cannula into a vein. While intravenous (IV) cannulation is a relatively common procedure routinely performed by a number of healthcare professionals, it has the potential to create unintended adverse effects. Subjecting patients to medical procedures in the absence of a clearly established need may be considered an unethical form of 'overtreatment'. Conversely, failing to perform an intervention when it is clearly indicated is equally undesirable. Therefore, it is important for medical professionals and educators to ensure that there is a real need or an indication for IV cannulation before students perform the procedure.

The University of Johannesburg (UJ) is one of four higher education institutions in South Africa (SA) that currently offers a 4-year professional Bachelor degree in emergency medical care. IV cannulation is a clinical procedure that is taught in the second year of study. The didactic approach followed at UJ is to firstly teach and assess theoretical knowledge and understanding of the procedure with regard to the technique, indications, risks and benefits. The procedure is then demonstrated, practised and assessed in a simulated environment, making use of an IV trainer (medium-fidelity manikin). Thereafter, students are required to demonstrate performance of the procedure a set number of times on real patients. While this creates a desire in students to perform IV cannulation when the opportunity presents itself, as mentioned above, it is essential to seek clear indications to prevent unnecessary exposure of patients to potential adverse effects. The Department of Emergency Medical Care at UJ currently teaches four indications for IV cannulation in the

prehospital setting, which are well supported in the literature. These include: (i) administration of IV fluid in an effort to reverse hypovolaemic and associated dehydrated states; (ii) administration of IV medications; (iii) securing IV access in the case of acutely ill, high-acuity 'priority 1' or 'code red' patients; and (iv) obtaining blood samples/specimens for further laboratory testing. We aimed to assess the extent to which emergency medical care students may have been accessing patients intravenously during the course of their clinical learning, without a clear indication.

Method

A retrospective quantitative design was used comprising 5 893 cases from an existing database, Emergency Medical Database and Analysis System (EMDATA), which contains prehospital patient care records relating to students' clinical learning, facilitated by the Department of Emergency Medical Care at UJ. Data from two consecutive academic years were extracted using Structured Query Language (SQL) statements and analysed to establish the number and percentage of the following patients seen by students over that period:

- Those who received IV cannulation.
- Those who received IV cannulation and IV medication, but <500 mL of fluid.
- Those who received IV cannulation and >500 mL of fluid, but no IV medication.
- Those who received IV cannulation, >500 mL of fluid and IV medication.
- Those who were cannulated, acutely ill, high-acuity priority 1 patients, but who did not receive >500 mL of fluid or IV medication.
- Those who received IV cannulation, but were not acutely ill, high-acuity priority 1 patients, and did not receive IV medication or >500 mL of

fluid. This would constitute the cohort for whom there was no clearly documented taught indication supporting performance of the procedure. Consequently, based on the data extracted from the database, this cohort of patients may have potentially been unnecessarily cannulated or 'overtreated'.

Results

Table 1 summarises the cases per category.

Table 1. Cases per category

Category	n (%)
Number cannulated intravenously	1 862/5 893 (32)
Received IV medication, but not fluid resuscitation*	431/1 862 (23)
Received fluid resuscitation,* but no IV medication	590/1 862 (32)
Received fluid resuscitation and IV medication	289/1 862 (16)
High-acuity (P1), but received no IV medication or fluid resuscitation*	126/1 862 (7)
Received no IV medication or fluid resuscitation and not high-acuity (P1)	426/1 862 (23)

IV = intravenous; P1 = priority 1.
*Fluid resuscitation was defined as the administration of >500 mL fluid.

Discussion

Research in the SA prehospital emergency care education environment is in its infancy. Consequently, there is currently limited published literature describing the practices of local emergency medical care students. In an attempt to compare the abovementioned findings with the existing literature, we performed a literature search in the Medline database using medical subject headings (MeSHs) and textwords: 'IV cannulation' [MeSH], 'prehospital' [MeSH] and 'emergency medical services' [MeSH]. Articles published over the past 15 years were prioritised. These searches highlighted that there was limited international literature on emergency medical care students and the performance of IV cannulation.

Patients who were cannulated intravenously

The percentage of patients (32%) in this study who received IV cannulation was found to be lower than that in international studies. Gausche *et al.*^[1] found that 84% of the patients in their study were cannulated intravenously. Two other studies found that peripheral IV cannulation had been performed in 57% and 58% of patients, respectively.^[2,3]

The lower percentage of patients who received IV cannulation in relation to international figures may be because, in SA, ambulances transport many low-acuity 'stable' ambulatory patients who do not require any form of prehospital medical intervention, but merely need transport to hospital.^[4] Another reason may be that students work with ambulance crews whose scope of practice does not include IV cannulation. As students may only practise within the scope of the registered supervisor, they would not have been able to perform this skill – even if it were indicated.

Patients who were cannulated intravenously, received IV medication, but <500 mL fluid

There were 23% of patients in this category compared with 71% who received only IV medication in the Minville *et al.*^[2] study. One reason may be that many of the ambulance crews in SA with whom the students

work qualified at the Intermediate Life Support level. SA Intermediate Life Support providers have few IV medications in their scope of practice, yet are still able to establish an IV line.

Patients who were cannulated intravenously, received >500 mL fluid, but no IV medication

Of the patients who were cannulated, 32% received fluid resuscitation. This is higher than the percentage reported in similar international studies, where only 7% and 5% of patients received fluid resuscitation, respectively.^[1,2] The difference may be attributed to the higher incidence of trauma (with associated blood loss) to which SA emergency services respond. SA has one of the highest motor vehicle accident rates in the world. Violence and injuries are the second leading cause of death and lost disability-adjusted life-years in SA. The overall injury death rate of 158/100 000 population is nearly twice the global average.^[5] Another possible reason is that local Basic and/or Intermediate Life Support providers spend longer in the prehospital environment than their international counterparts.^[6] Additional time spent treating and transporting patients allows for more fluid to be administered.

Patients who received >500 mL fluid together with IV medication

A total of 289 (16%) of the study patients received both IV medication and >500 mL of fluid. This could not be compared with international studies, as those reviewed did not identify these patients as a separate group.

Acutely ill, high-acuity priority 1 patients cannulated intravenously, but who did not receive >500 mL fluid or IV medication

As mentioned above, one of the taught indications for establishing IV access is obtaining IV access in the acutely ill, high-acuity priority 1 patient so that, should rapid deterioration occur during transit, the IV line is already in place. One hundred and twenty-six (7%) of the patients who received IV cannulation were categorised as high-acuity priority 1, but did not receive IV medication or >500 mL of fluid. This percentage is much lower than the 24% described in the Minville *et al.*^[2] study. The reasons for this difference are not clear; it could be related to a failure by ambulance personnel and students to properly assess the patient and correctly predict deterioration.

Patients who were cannulated intravenously, but not categorised as high-acuity priority 1, received no IV medication and not >500 mL fluid

Four hundred and twenty-eight (23%) of the patients did not have a clearly documented indication for IV cannulation, suggesting that they may have been potentially overtreated. This finding is similar to the 22% and 29% of IV lines that remained unused in the studies by Allen *et al.*^[7] and Pace *et al.*^[3] respectively. However, the percentage is considerably lower than the 56% unused IV lines in the Gausche *et al.*^[1] study.

As mentioned above, there is a paucity of literature describing the clinical education and training practice of emergency medical care students. Despite a number of searches, no studies could be found describing overtreatment of patients by such students. The reasons for overtreatment may include over-eagerness of the student and a desire to practise and master newly found clinical skills.

Barsuk *et al.*,^[8] in dealing with medical education and learning, highlight the potential of simulation-based learning to assist in achieving minimum

standards and mastery of clinical skills prior to interactions with real patients. Jantz and McGaghie⁽⁹⁾ rightfully note that while many medical education programmes demand the performance of a set number of skills and procedures, the numbers are not scientifically validated. Nonetheless, the setting of minimum numbers naturally creates pressure on student and educator alike. Observations and feedback from students and educators in our emergency medical care environment are that there is indeed pressure to perform skills and interventions for the purposes of teaching, learning and assessment.

This study showed that of the 5 893 patients seen by students during the 2-year period, 1 862 (32%) received IV cannulation and, of these, 426 (23%) did not have a clearly documented taught indication for the procedure. This evidence suggests that these patients may potentially have been overtreated. Subjecting patients to medical procedures in the absence of an evidence-based need may be considered an unethical form of overtreatment. Conversely, failing to perform an intervention when it is clearly indicated is equally undesirable. Therefore, it is incumbent upon medical professionals and educators to ensure a real need or an indication for a procedure such as IV cannulation before performing the procedure. It is also acknowledged that emergency medical care students work under direct supervision. The power-authority relationship between them and their clinical mentors may limit their autonomy to make clinical decisions. Such findings are interesting and applicable to emergency medical care students and educators.

Medical educators should consider recent evidence and research in the area of simulation-based learning, as this appears to be an under-used didactic approach, which, if properly implemented, may reduce current overreliance on patient contact.

Conclusion

Of all the patients cannulated intravenously, few had medications administered via the established IV line. A higher number of patients received >500 mL of fluid than in similar international studies. In a number of patients an IV line had been established, yet they did not receive medications or clinically significant volumes of fluid, and were not documented as acutely ill, high-acuity priority 1. In such cases the indication to perform this procedure was unclear, and therefore these patients may have been overtreated. While IV cannulation remains a relatively common procedure routinely performed by a number of healthcare professionals, it has the

potential to create unintended adverse effects. This study demonstrates that students established a significant number of IV lines – without a clearly documented indication. This potential overtreatment may in part be attributed to pressure placed on students to achieve a prescribed minimum number of skills. The value of quantitative approaches to determine clinical competence based purely on the performance of a skill or procedure a set number of times may be questioned, because many of the targets are not scientifically validated. Despite this, such practices remain common in medical education and may be detrimental to the patient. Medical educators need to ensure that their students value the patient rather than the procedure. Further research needs to be conducted to investigate and identify other possible reasons for overtreatment of patients by medical students.

Ethical considerations. Ethical clearance for the study was granted by the UJ's Faculty of Health Sciences Academic Ethics Committee.

Protection of the patient's rights to privacy. The researchers (CVL and BVN) signed a confidentiality agreement, stating that the information they had access to remained confidential. In light of the research design it was not necessary to identify individual students, patients, supervising practitioners, emergency medical service providers or receiving medical facilities. The researchers only extracted data from the database on the premises of UJ. The files remained password protected and were deleted after data extraction was complete.

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