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Original research article

THE RELATIONSHIP BETWEEN NURSES' EDUCATION AND SAFETY PRACTICES FOR INTRAMUSCULAR AND SUBCUTANEOUS INJECTIONS – AN OBSERVATIONAL STUDY

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Abstract

Current situation: Intramuscular and subcutaneous injections rank among the most frequently performed nursing procedures in clinical practice. The correct administration technique is essential to ensure patient safety. Failure to adhere to recommended procedures can lead to medication errors, infections, tissue damage, or reduced therapeutic effectiveness.

Methods: The study was conducted as a quantitative observational study using participant observation to examine the procedures for injectable drug administration in clinical practice. Data were collected in the internal medicine and surgery departments of a selected healthcare facility between August and October 2023. A total of 100 observations were made. Data were obtained using a structured observation sheet and analyzed using descriptive statistics and a chi-square test at a significance level of $\alpha = 0.05$.

Results: Deficiencies were identified primarily in the labeling of injectable medicinal products and in the technique of skin disinfection before application. In contrast, a relatively high level of compliance was observed in the area of hand hygiene.

Conclusion: Nurses' educational attainment was associated with adherence to selected safety procedures during intramuscular injection administration, particularly patient identification and hand hygiene. No such association was observed for subcutaneous injections. A notable finding was the consistently low rate of correct labeling of prepared injections, highlighting an important and persistent risk factor for medication errors in clinical practice.

Keywords: *Administration of drugs; Intramuscular injection; Nursing practice; Patient safety; Subcutaneous injections*

INTRODUCTION

The administration of injectable medicines is one of many routinely performed clinical procedures, with an estimated 16 billion injections administered annually worldwide across a variety of healthcare settings (Akbari Sari et al., 2014). Injectable routes are used particularly in situations requiring a rapid onset of therapeutic effect, such as acute infections, allergic reactions, cardiovascular events, or analgesic interventions (Bélová and Krause, 2022).

Given the invasive nature of the procedure, injections put high demands on the professional competence of healthcare personnel and on strict adherence to standardized procedures, since improper technique can lead to infections, local complications, or systemic adverse effects (Dingová Šliková et al., 2018). Several forms of injectable administration are used in clinical practice, differing in delivery site, depth of injection, and rate of drug absorption (Jin et al., 2015).

Intramuscular injection (IM) is the most commonly used injectable route and involves injecting the medication directly into muscle tissue, allowing for relatively rapid systemic absorption because muscle is highly vascularized. In IM injections, the choice of injec-

tion site depends on the patient's age and the volume of the medication being administered (with larger volumes requiring larger muscles) (Ogston-Tuck, 2014a). Subcutaneous injection (SC) involves depositing the drug into the subcutaneous tissue (located beneath the skin and above the underlying muscle), where slower, more uniform absorption occurs because this loose connective tissue (abundant in the subcutaneous layer) has relatively poor vascularity (Ogston-Tuck, 2014b). The SC route is commonly used for medications intended for long term therapy, such as insulin or anticoagulant preparations (Ayinde et al., 2021).

The safety of injectable medication administration depends on consistent adherence to standardized nursing procedures, including hand hygiene, accurate patient identification, proper preparation and labeling of medications, selection of an appropriate injection site, and use of the correct injection technique (Keers et al., 2013). In medication safety, "proper preparation and labeling" refers to ensuring that the medication can be clearly verified during preparation and before administration. The medication container must be identifiable (drug name, strength, form, expiration), and when a dose is not administered immediately, the prepared medication must also be marked or placed in a way that allows the drug and dose to be later confirmed. Correct patient identification and consistency with the medication order are also essential components of safe administration. Failure to follow these principles substantially increases the risk of complications such as infection, hematoma, or nerve injury (Jin et al., 2015).

The study aimed to evaluate compliance with selected safety procedures in the application of intramuscular and subcutaneous injectable medicinal products in clinical practice and to assess the association between the level of education attained by nurses and selected aspects of safe administration.

MATERIALS AND METHODS

The research was carried out as a quantitative observational study using participant observation focused on the procedures used in the administration of injectable medications in clinical practice. Data collection took place in a selected healthcare facility in the departments of internal medicine and surgery between August and October 2023. These departments were intentionally chosen due to the higher frequency of intramuscular and subcutaneous drug administration. Nurses with different levels of education were included in the study.

Among the monitored characteristics, the highest level of education attained by each nurse was recorded. For statistical analysis, this variable was categorized into two groups. The higher-education category included tertiary education (DiS., Bc., Mgr.) and specialized postgraduate training, while the lower-education category included secondary medical education without a tertiary degree. A total of 100 observations of injectable medicinal administration were conducted, of which 50 were IM and 50 SC. All observations took place during day shifts. A total of 50 nurses participated in the observation, of whom 37 were in the higher-education category and 13 in the lower-education category. The unit of analysis was the individual injection administration rather than the nurse. Individual nurses were observed on one to three occasions during the data collection period.

Data collection

Data were collected through direct structured observation using a custom observation sheet developed on the basis of a review of professional literature and nursing standards related to the administration of injectable medications. Before starting the research, a pilot test of the instrument was carried out, which led to adjustments and refinement of individual items. The observation sheet contained a total of 43 items focused on nurse characteristics, medication handling, patient identification, hand hygiene, injection site disinfection, and injection technique. The obtained data were then transferred into a prepared data matrix. Each item was evaluated using a predefined set of response categories. Most items were recorded as "performed" or "not performed". Selected items included additional categories describing the specific manner in which the step was performed. For example, patient identification was recorded as verbal identification, identification using a wristband, or no identification. Disinfection of the injection site was recorded as disinfectant applied directly to the skin, applied using a swab or

gauze, or not performed. The observer recorded the appropriate category for each item directly during the observed procedure, without interfering with its performance.

Data analysis

Data were analyzed using SASD (Statistical Analysis of Social Data) and SPSS (Statistical Package for the Social Sciences) statistical software. Absolute and relative frequencies and basic descriptive statistics were calculated. To assess the relationships between variables, the chi-square test was used at a statistical significance level of 0.05. Several variables (e.g., patient identification, hand hygiene) were originally coded using multi level categorical scales, which resulted in higher degrees of freedom in the chi square tests.

RESULTS

Table 1 describes the relationship between the attained education level of nurses and selected items IM variables (i.e., correct labeling of the drug, patient identification, hand disinfection, disinfection of the injection site, disinfection method, and correct injection site). A statistically significant association was found for two of the monitored variables, namely patient identification ($\chi^2 = 10.566$; $p < 0.05$) and hand disinfection ($\chi^2 = 18.179$; $p < 0.01$). In the case of patient identification, nurses in the lower-education category were more likely to omit this step, whereas nurses with higher education more consistently used standard identification procedures. Similarly, for hand disinfection, nurses in the lower education category were more likely to omit this step, whereas nurses in the higher education category more frequently incorporated glove use as part of their hygiene measures.

No statistically significant relationships were found between education category and the other monitored variables, i.e., the correct labeling of the drug, disinfection of the injection site, disinfection method, and choice of the injection site ($p > 0.05$). However, a low adherence rate to recommended procedures was observed in the area of injection labeling, although it was not statistically significant ($p = 0.069$). Correct labeling of injections was recorded in only 28% of cases, while in the majority of observations (72%), the injection was without any identifying information. This finding indicates that the low rate of correct labeling was consistent across both education categories; in other words, nurses with higher and lower education levels adhered to this procedure at similarly low rates, which explains why the association did not reach statistical significance despite the overall 72% failure rate.

These results indicate that the attained education level of nurses is primarily associated with adherence to basic safety and hygiene procedures (e.g., patient ID, hand hygiene) during the administration of intramuscular injections, whereas no association with education level was observed for the technical aspects of the procedure.

Table 2 presents the results of the analysis examining the association between nurses'

Table 1 – Association between nurses' education and selected aspects of intramuscular injection administration

Variable	χ^2	df	p	Statistical significance
Correct labeling of the drug	8.698	4	0.069	n.s.
Patient identification	10.566	4	<0.05	*
Hand disinfection	18.179	4	<0.01	**
Disinfection of the injection site	6.708	4	0.152	n.s.
Disinfection method	6.580	4	0.160	n.s.
The correct injection site	3.806	4	0.433	n.s.

Note: * $p < 0.05$; ** $p < 0.01$; n.s. = statistically insignificant

education category and selected aspects of subcutaneous injection administration. The statistical analysis showed no significant relationships between education category and any of the monitored variables ($p > 0.05$). This pattern was consistent across all evaluated areas, including patient identification, hand disinfection, selection of the application needle, disinfection of the injection site, and other procedural elements. These findings indicate that subcutaneous injections are performed in a similarly uniform manner across education categories, suggesting a high degree of standardization in this type of procedure.

Table 2 – Association between nurses' education and selected aspects of subcutaneous injection administration

Variable	χ^2	df	p	Statistical significance
Patient identification	3.780	4	0.437	n.s.
Hand disinfection	5.512	4	0.239	n.s.
Correctly selected needle	0.921	2	0.631	n.s.
Disinfection of the injection site	2.797	2	0.247	n.s.

Note: * $p < 0.05$; ** $p < 0.01$; n.s. = statistically insignificant

DISCUSSION

The results of this study show that nurses' education level, operationalized as two categories (Category 1: lower level education; Category 2: higher level education), was associated with compliance with selected safety and hygiene procedures during intramuscular injection administration. Specifically, nurses in Category 2 demonstrated higher adherence to patient identification and hand hygiene, whereas nurses in Category 1 more frequently omitted these steps. These findings correspond to the key domains of safe care described by the WHO (2016). The insufficient identification of patients among Category 1 nurses is clinically significant, as patient identification is one of the primary tools for preventing medication errors.

The role of knowledge and attitudes in adherence to standard precautions is supported by Zhu et al. (2019), who demonstrated that these factors significantly influence compliance among healthcare personnel. Similarly, Bélová and Krause (2022) identified gaps in the knowledge of students in health related fields, which may directly affect clinical practice.

One of the main findings of this study was the low rate of proper labeling of injections. In 72% of the cases examined, identification information was missing. Although no statistically significant association with education category was demonstrated, this represents a substantial safety concern. Correct labeling of prepared injectable medications is a basic principle of medication safety and is emphasized by the WHO (2017). As Zhu et al. (2019) note, insufficient adherence to standard precautions increases the risk of errors in clinical practice.

Inadequate labeling increases the risk of medication errors, particularly when multiple medications are prepared simultaneously or when work is performed under time pressure. Jin et al. (2015) highlight that proper handling of medications and the choice of an appropriate route of administration are key determinants of safe pharmacotherapy. The shortcomings identified in this study, therefore, likely do not relate solely to education category but may reflect broader systemic factors, such as work organization, workload, or insufficient implementation of standard procedures. The role of such conditions is documented by Keers et al. (2013), who identified high workload, problems with written communication, and interruptions during administration among the principal error-provoking conditions in hospital settings.

Hand hygiene was another area in which differences between the two education cate-

gories were observed. Although hand disinfection was performed in more than half of the cases, failure to carry it out, or replacing it with the use of gloves, represents a deviation from recommended procedures. Goldberg (2017) stresses that adherence to proper hand hygiene is the first step in reducing healthcare associated infections. Low adherence to hand hygiene has also been described by Al Anazi et al. (2022), who note that hand hygiene among healthcare workers, particularly nurses, is the main preventive measure available for controlling healthcare associated infections. The importance of skin disinfection before injection in preventing infectious complications is likewise emphasized by Gittens and Bunnell (2009).

In contrast, no association between education category and the technical aspects of intramuscular administration, such as the choice of injection site, method of disinfection, or application technique, was identified. This may reflect the high degree of standardization of these procedures, which form part of both basic and continuing education for healthcare personnel (Dingová Šliková et al., 2018). The literature consistently highlights the importance of correct injection technique in minimizing complications such as pain, tissue damage, or local reactions (Ayinde et al., 2021; Charmode et al., 2022; Cook, 2015). The absence of statistically significant associations for subcutaneous administration may similarly reflect lower variability in these procedures or their higher degree of standardization in clinical practice.

Limitations of the study

The study has several limitations that should be considered when interpreting the findings. The research was carried out in only one medical facility and within two selected departments, i.e., internal and surgical, which limits the generalizability of the results. The total number of observations was relatively small, and the unit of analysis was the injection event rather than an individual nurse. As a result, repeated observation of the same nurse cannot be excluded, which may have influenced the distribution of behaviors across the two education categories.

Another limitation is the potential observer effect, in which the presence of the researcher may have influenced the behavior of the observed nurses. This phenomenon is well described in clinical observational research and can affect adherence to procedures such as hand hygiene or patient identification.

For these reasons, the results should be interpreted as a local snapshot of clinical practice rather than a representative picture of nursing practice across healthcare facilities more broadly. Nonetheless, the findings provide valuable insight into real world adherence to safety procedures and highlight areas where targeted interventions may improve practice.

Ethical aspects

Before the start of the research, the approval of the medical facility was obtained. The observed nurses were informed about the aim and course of the research and gave their consent to be observed during the performance of their work. The research was non-interventional in nature and did not interfere with the nursing care provided or the rights of patients. All observations were conducted exclusively as part of routine nursing care. No personal or identifying information about the patients was recorded in the observation sheets, the observations focused exclusively on the nurses' adherence to the procedures being monitored. The privacy and dignity of the patients were respected throughout all monitored procedures. All collected data were processed anonymously and used exclusively for research purposes. In accordance with the internal regulations of the medical facility, this non interventional observational study did not require review by the ethics committee.

CONCLUSION

The results of the study showed that the attained level of education of nurses was associated with adherence to certain safety procedures during intramuscular injections, especially in the areas of correct patient identification and hand hygiene. In contrast, no such associations were seen relative to subcutaneous injections.

An important finding of the study was the low rate of clear medication identification during injection preparation, as in most cases, it was not possible to verify which medication

had been drawn into the syringe. Although this issue was not statistically associated with the education category, insufficient labeling of medicines can pose a serious risk of medication errors and jeopardize patient safety. These results underscore the importance of adherence to standardized procedures in clinical practice and emphasize the value of ongoing education for healthcare personnel in the safe administration of injectable medications.

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Conflict of interest
The authors declare that they have no conflict of interest relevant to this study.

REFERENCES

1. Akbari Sari A, Janani L, Mohammady M, Nedjat S (2014). Slow versus fast subcutaneous heparin injections for prevention of bruising and site-pain intensity. Cochrane Database Syst Rev (7): CD008077. DOI: 10.1002/14651858.CD008077.pub3.
2. Al-Anazi S, Al-Dhefeery N, Al-Hjaili R, Al-Duwaihees A, Al-Mutairi A, Al-Saeedi R, et al. (2022). Compliance with hand hygiene practices among nursing staff in secondary healthcare hospitals in Kuwait. BMC Health Serv Res 22(1): 1325. DOI: 10.1186/s12913-022-08706-8.
3. Ayinde O, Hayward RS, Ross JDC (2021). The effect of intramuscular injection technique on injection-associated pain: A systematic review and meta-analysis. PLoS One 16(5): e0250883. DOI: 10.1371/journal.pone.0250883.
4. Bélová M, Krause M (2022). Principles of administration of selected medicinal products from the point of view of students' knowledge. Klin Farmak Farm 36(1): 8–12. DOI: 10.36290/far.2022.002
5. Charmode S, Sharma S, Kushwaha SS, Mehra S, Sangma SS, Mishra V (2022). Deltoid intramuscular injections: A systematic review of underlying neurovascular structures to the muscle and proposing a relatively safer site. Cureus 14(4): e24172. DOI: 10.7759/cureus.24172.
6. Cook IF (2015). Best vaccination practice and medically attended injection site events following deltoid intramuscular injection. Hum Vaccin Immunother 11(5): 1184–1191. DOI: 10.1080/21645515.2015.1017694.
7. Dingová Šliková M, Vrabelová L, Lidická L (2018). Základy ošetřovatelství a ošetřovatelských postupů pro zdravotnické záchranáře [Basics of Nursing and Nursing Practices: For Paramedics]. Praha: Grada Publishing, 312 p.
8. Gittens G, Bunnell T (2009). Skin disinfection and its efficacy before administering injections. Nurs Stand 23(39): 42–44. DOI: 10.7748/ns2009.06.23.39.42.c7039.
9. Goldberg J (2017). Guideline implementation: Hand hygiene. AORN J 105(2): 203–212. DOI: 10.1016/j.aorn.2016.12.010.
10. Jin JF, Zhu LL, Chen M, Xu HM, Wang HF, Feng XQ, et al. (2015). The optimal choice of medication administration route regarding intravenous, intramuscular, and subcutaneous injection. Patient Prefer Adherence 9: 923–942. DOI: 10.2147/PPA.S87271.
11. Keers RN, Williams SD, Cooke J, Ashcroft DM (2013). Causes of medication administration errors in hospitals: a systematic review of quantitative and qualitative evidence. Drug Saf 36(11): 1045–1067. DOI: 10.1007/s40264-013-0090-2.
12. Ogston-Tuck S (2014a). Intramuscular injection technique: an evidence-based approach. Nurs Stand 29(4): 52–59. DOI: 10.7748/ns.29.4.52.e9183.
13. Ogston-Tuck S (2014b). Subcutaneous injection technique: an evidence-based approach. Nurs Stand 29(3): 53–58. DOI: 10.7748/ns.29.3.53.e9183.
14. WHO (2016). WHO guidelines on the use of safety-engineered syringes for intramuscular, intradermal and subcutaneous injections in health care settings. Geneva: WHO Press. [online] [cit. 2026-01-22]. Available from: https://www.who.int/publications/i/item/9789241549820

15. WHO (2017). Medication Without Harm: WHO Global Patient Safety Challenge. Geneva: WHO. [online] [cit. 2026-01-22]. Available from: https://learning.quamed.org/helpdesk/articles/medication-without-harm-who-global-patient-safety-challenge/
16. Zhu S, Kahsay KM, Gui L (2019). Knowledge, attitudes and practices related to standard precautions among nurses: A comparative study. J Clin Nurs 28(19–20): 3538–3546. DOI: 10.1111/jocn.14945.

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