

ORIGINAL ARTICLE

Compliance with semiotics nursing procedures in the administration of vaccines via intramuscular injections in children

HIGHLIGHTS

1. There were 302 vaccinations, 290 of which were carried out by nursing technicians.
2. Average compliance with the semiotics was 68.4% among the participants.
3. The Triple Bacterial vaccine had the highest average compliance rate (72.8%).
4. There was a lack of hand hygiene, PPE, guidance, and vigilance.

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ABSTRACT

Objective: To analyze compliance with nursing semiotics procedures in the administration of vaccines via intramuscular injections in children. **Method:** An observational, cross-sectional study was conducted between May and November 2024 at a Basic Health Unit in the coastal lowlands of Rio de Janeiro, Brazil. A checklist was used to observe compliance with semiotics procedures in the pre-administration, administration, and post-administration phases of vaccine administration. Descriptive analyses and the Kruskal-Wallis test were used to compare means. **Results:** A total of 302 vaccinations were observed, with 97% administered by nursing technicians. The average compliance with the checklist was 68.4%, with the highest average for the triple bacterial vaccine (72.8%). In most observations, we found a lack of hand hygiene, inadequate use of personal protective equipment, and a lack of guidance and surveillance regarding events supposedly attributable to vaccination or immunization. **Conclusion:** Compliance with nursing semiotics procedures in vaccine administration was unsatisfactory. Educational interventions that promote professional training and ensure safety in vaccine administration are necessary.

DESCRIPTORS: Vaccination; Injections, Intramuscular; Patient Safety; Immunization Programs; Licensed Practical Nurses.

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INTRODUCTION

Vaccination is one of the most effective public health practices for preventing infectious diseases. In Brazil, public policies such as the National Immunization Program (PNI, acronym in Portuguese), the Comprehensive Child Health Care Program, and the Family Health Strategy highlight the importance of early vaccination. Established in 1973, the PNI seeks to reduce morbidity and mortality from vaccine-preventable diseases in Brazil and has made significant international contributions through vaccination campaigns and technical cooperation in several countries. In addition to offering a wide range of vaccines, serums, and immunoglobulins free of charge through the Brazilian Unified Health System (SUS)^{1,2}.

The PNI has specific immunization schedules for different population groups, and the supply of vaccines through the SUS has been expanded to include 48 immunobiological products, of which 31 are vaccines, including 19 for children and adolescents. Among these, 11 are administered by intramuscular injections, including Hepatitis B, Pentavalent, VIP, 10-valent pneumococcal, meningococcal C, DTP, hepatitis A, DT, HPV, 23-valent pneumococcal, and COVID-19, which correspond to more than 60% of the vaccines for this population. The influenza vaccine, although administered by the same route, is given in campaigns and is not part of the national childhood vaccination schedule^{3,4}.

Intramuscular administration, a technique commonly used by nursing professionals, is considered a straightforward procedure. For a safe technique, the following are highlighted: hand hygiene, appropriate needle selection, anatomical knowledge, antisepsis, plunger traction before administration, correct volume, local manual pressure, and use of pain relief techniques.⁵ However, the scientific literature highlights complications in the administration process, such as failure to check the appearance of the solution, the validity of the immunobiological product, hand hygiene, post-vaccination guidelines, monitoring of Events Supposedly Attributable to Vaccination or Immunization (ESAVI), as well as errors in the route and dosage⁵⁻⁸. Between 2015 and 2019, in Brazil, there were 3,829 reports of immunization errors, with 2,445 (63.85%) occurring in children under the age of nine. Of these errors, 1,127 (29.4%) were intramuscular administrations and 131 (3.4%) occurred at the time of administration⁶⁻⁷.

To ensure safety in the vaccination process, the PNI developed the concept of "Safe Vaccination," which includes preventing ESVI due to errors in administration. Thus, the efficacy and safety of vaccines depend on correct handling and administration. To this end, nursing professionals must be trained, with up-to-date knowledge, technical skills, and academic training that includes vaccination. To this end, continuing education is essential for the quality of the process^{1,9-10}.

The semiotics nature of administering vaccines via intramuscular injections in children requires specific knowledge and skills that increase the difficulty; however, this aspect receives little attention in professional training. Nursing technicians, although not technically responsible for vaccination rooms, are often the most active staff members, frequently without adequate training, which creates risks and exposes them to errors, compromising the safety of both patients and professionals themselves.¹¹

The literature indicates a gap in publications on this topic, particularly in recent and updated studies that evaluate nursing semiotics for the intramuscular administration of vaccines in children. Thus, the present study has the potential to identify nursing semiotics in intramuscular vaccination in children, supporting strategies to prevent errors and promote safe practice based on technical and scientific knowledge. In this context, the development of this study will contribute to filling this gap and encourage future research, strengthening knowledge about nursing semiotics.

This study aims to address the following guiding question: How are nursing semiotics skills applied in the administration of intramuscular vaccines to children? I think the need to discuss this topic further is urgent, given its connection to patient safety, a crucial pillar for ensuring practice is free from harm, in line with standards of excellence. Therefore, this study aims to analyze compliance with nursing semiotics used in the administration of vaccines via intramuscular injections in children.

METHOD

This study employed an observational design with a cross-sectional approach and was conducted between May and November 2024. It analyzed compliance with nursing semiotics procedures used in the administration of vaccines via intramuscular injections in children at a Basic Health Unit in a coastal city in the state of Rio de Janeiro, Brazil. This study followed the *Strengthening the Reporting of Observational Studies in Epidemiology* (STROBE) guidelines¹².

The unit serves as a reference center for the population of three medium-sized neighborhoods, meeting the spontaneous demand of the municipality, which has 156,491 inhabitants¹³.

The study participants were nursing professionals and children whose parents sought the institution's vaccination room for intramuscular vaccinations. The study population consisted of eight professionals, including three nurses and five nursing technicians, and the estimated population of children in the municipality that made up the study setting was 20,716¹³.

The inclusion criteria for professionals were nurses and technicians working in the vaccination room. The exclusion criteria for professionals were those who do not administer vaccines via intramuscular injections to children aged 0 to 9 years.

The inclusion criteria for children were an age between zero and nine years, and parents who sought the vaccination room on their own initiative. The following exclusion criteria were considered: children who had not received intramuscular immunobiologicals, and children with conditions that would make participation in the study a stressor, such as mental disorders, developmental disorders, or intellectual disabilities. Children between seven and nine years of age, whose parents had consented to their participation but did not provide their own consent to participate in the study, were excluded and did not comprise the sample.

To calculate the sample size, the total number of IM vaccines administered to children aged 0 to 9 years in the study unit between March and May 2024 was considered as the population for the formula. Therefore, for the sample calculation, 877 was considered the population size, a 95% confidence interval, $p = 0.5$ for a heterogeneous population, and a 5% margin of error, using the formula for finite populations.

Substituting the values into the formula, the sample was estimated to be approximately 268 observations of intramuscular applications. It is worth noting that the sample estimate refers to the number of applications. In this study, observations of the technique were made, and, in numerous instances, more than one vaccine was administered via intramuscular injection to the same child. Thus, each application, even if administered to the same child, was considered a separate observation and counted as a distinct sample unit.

The professionals were approached by the research team during their workday and invited to participate. If interested, they were taken to a private room to complete the consent process, which included reading the entire Free and Informed Consent Form (FICF) and receiving a copy of it.

The sample of children was selected for convenience, with potential participants approached individually before the start of the procedure. During the consent process, which took place in a private room, the research team provided information and explained how to participate with the potential participants. Children aged seven to nine, whose parents had consented to their participation, had their consent recorded in the Free and Informed Consent Form. After consent/assent and meeting the eligibility criteria, participants were taken to the vaccination room.

The entire vaccine administration process was observed by the research team, composed of a nursing student supervised by the principal investigator. Non-participant observation began when the nursing professionals entered the vaccination room and ended when the administered vaccine was recorded in the child's health record. The study team intervened in the procedure when the professional's conduct could cause harm to the child's health, respecting the bioethical principles of beneficence and non-maleficence¹⁴⁻¹⁵.

Non-participant observation was guided by a checklist developed by the study team based on the systematization of the procedure, considering and covering all items related to compliance with the semi-technical procedure for the administration of vaccines via intramuscular injections, as set out in the Manual of Standards and Procedures for Vaccination and in the Technical Note of the Ministry of Health published in 2020 (SEI/MS - 0014128030)¹⁶⁻¹⁷. The checklist has 21 items covering the pre-administration, administration, and post-administration moments, which can be checked as "performed," "not performed," or "could not be observed," and three items referring to the size of the syringe, the needle, and the application site. The following items were observed at each stage: 1) Pre-administration phase - items 1 to 7; 2) Administration phase - items 8 to 18; and 3) Post-administration phase - items 19 to 24.

The data were entered into an Excel spreadsheet and processed using the Statistical Package for the Social Sciences (SPSS) program, version 21. The data were then analyzed using descriptive statistics, including absolute frequency, relative frequency, mean, and standard deviation. The Shapiro-Wilk test was used to verify normality, resulting in a non-normal distribution of data ($p < 0.000$) for the variable "average compliance with checklist items"-considering 21 items. The nonparametric Kruskal-Wallis test was then used to compare the mean compliance with the checklist items between the "immunobiological," "age," and "professional" groups. A p -value <0.05 was considered significant.

This research was approved by the Research Ethics Committee (CEP) of the Fluminense Federal University (UFF) (opinion no. 6,776,478, CAAE: 77987824.0.0000.8160), in accordance with Resolution 466/12 of the National Health Council.

RESULTS

A total of 302 (100.0%) observations of nursing semiotics procedures for administering vaccines via intramuscular injections in children were performed. Of

these, 290 (97.0%) administrations were performed by a nursing technician, while nine (3.0%) were performed by nurses. Interruption was necessary in three observations during the pre-administration phase, and the reason for the interruption was that the professional had administered the wrong vaccine, despite having checked the vaccine to be administered according to the child's age in the vaccination booklet.

Most of the observations, corresponding to 163 (54.0%) administrations, were made in children under one year of age, ranging from two months to nine years. Regarding the immunobiologicals administered, the most administered was the pentavalent vaccine, with 57 applications (18.9%), followed by the influenza vaccine, with 54 applications (17.9%), the inactivated polio vaccine, with 53 applications (17.5%), and the 10v pneumococcal vaccine, also with 53 applications (17.5%) (Table 1).

During the pre-administration phase, there was a high rate of compliance with patient identification, which was performed in 300 (99.3%) of the administrations, and with the preparation of immunobiologicals according to their presentation, also in 300 (99.3%) of the administrations. However, it was observed that gloves were not used in 301 (99.7%) of the administrations, and the use of masks was neglected in 257 (85.1%) of the cases (Table 2).

Table 1. List of immunobiologicals administered between May and November 2024. Rio das Ostras, RJ, Brazil, 2025

Immunobiological administered	Number of administrationsn (%)
Pentavalent	57 (18.9)
Influenza	54 (17.9)
Inactivated Polio Vaccine	53 (17.5)
Pneumococcal 10v	53 (17.5)
Meningococcal C	23 (7.6)
Hepatitis A	19 (6.3)
Meningococcal ACWY	16 (5.3)
Triple Bacterial (DTP)	14 (4.6)
COVID-19	13 (4.3)

Legend: n=302.

Source: The authors (2024).

During the administration phase, the item related to the rapid injection of the immunobiological agent was fully complied with. In addition, in 300 (99.3%) of the applications, there was no aspiration at the administration site. However, the patient was not positioned correctly in 112 (37.1%) of the injections, and in 48 (15.9%) of the observations, the needle was not inserted at a 90° angle, as recommended.

As for the application site, the vastus lateralis muscle of the thigh was the most frequently used, accounting for 271 (89.7%) of the administrations. The most administered volume was 0.5 ml in 250 (82.8%) observations. The 3 mL syringe was preferred in 263 (87.1%) cases, and the 20 × 5.5 mm needle was used in all 302 (100%) applications.

In the post-administration phase, high compliance was observed in the proper disposal of syringes and needles, which was performed in 293 (97%) of the applications, and in the correct recording in the vaccination booklet, which was conducted in 286 (94.7%) of the cases. However, in all 302 (100%) observations, users were not kept seated for 15 minutes to monitor psychogenic reactions. In addition, in 301 (99.7%) of the observations, professionals did not monitor for possible ESAVI.

Table 2. Compliance with the Checklist of the systematization of nursing semiotics in the application of intramuscular vaccines in children. Rio das Ostras, RJ, Brazil, 2025

Item to be analyzed	Done n(%)	Not done n(%)	It was not possible to observe n(%)
1. Patient identification	300 (99.3)	2 (0.7)	0 (0.0)
2. Identification of the immunobiological(s) to be administered, according to the vaccination booklet	294 (97.4)	8 (2.6)	0 (0.0)
3. Explained the procedure to the user	222 (73.5)	80 (26.5)	0 (0.0)
4. Hand hygiene before administration	91 (30.1)	211 (69.9)	0 (0.0)
5. PPE used (surgical mask)	45 (14.9)	257 (85.1)	0 (0.0)
6. PPE used (raincoats)	1 (0.3)	301 (99.7)	0 (0.0)
7. Prepared the immunobiological according to its presentation	300 (99.3)	2 (0.7)	0 (0.0)
8. Positioned the patient	190 (62.9)	112 (37.1)	0 (0.0)
9. Place of application			
Deltoids	31 (10.3)	0 (0.0)	0 (0.0)
Vastus lateralis	271 (89.7)	0 (0.0)	0 (0.0)
Ventrogluteal	0 (0.0)	0 (0.0)	0 (0.0)
Gluteal	0 (0.0)	0 (0.0)	0 (0.0)
10. Hard or sore sites, scars, stains, tattoos, and lesions were avoided for administration	297 (98.3)	3 (1)	2 (0.7)
11. Cleaning the area with dry absorbent cotton	274 (90.7)	28 (9.3)	0 (0.0)
12. Inserted the needle at a 90° angle	254 (84.1)	48 (15.9)	0 (0.0)
13. Volume Applied			
0.25 ml	52 (17.2)	0 (0.0)	0 (0.0)
0.5 ml	250 (82.8)	0 (0.0)	0 (0.0)
1.0 ml	0 (0.0)	0 (0.0)	0 (0.0)
20x5.5mm	302 (100)	0 (0.0)	0 (0.0)
14. Needle used			
25x6mm	0 (0.0)	0 (0.0)	0 (0.0)
25x7mm	0 (0.0)	0 (0.0)	0 (0.0)
1 ml	39 (12.9)	0 (0.0)	0 (0.0)
15. Seringa used			
3 ml	263 (87.1)	0 (0.0)	0 (0.0)
5 ml	0 (0.0)	0 (0.0)	0 (0.0)
16. No aspiration of the administration site	300 (99.3)	0 (0.0)	2 (0.7)
17. Injected the immunobiological quickly	302 (100)	0 (0.0)	0 (0.0)
18. He withdrew the needle in a single, firm movement	284 (94)	18 (6)	0 (0.0)
19. Light compression of the administration site with dry absorbent cotton	286 (94.7)	16 (5.3)	0 (0.0)
20. Discarded syringe and needle in an inappropriate place	293 (97)	9 (3)	0 (0.0)
21. Kept the user seated for 15 minutes to prevent psychogenic reactions	0 (0.0)	302 (100)	0 (0.0)
22. Observed the occurrence of ESAVI	1 (0.3)	301 (99.7)	0 (0.0)
23. Hand hygiene after administration	103 (34.1)	199 (65.9)	0 (0.0)
24. Proper registration in the vaccination booklet	286 (94.7)	16 (5.3)	0 (0.0)
25. Advised the patient on home care and conduct in the event of ESAVI	209 (69.2)	93 (30.8)	0 (0.0)

Legend: n=302; ESAVI - Event Supposedly Attributable to Vaccination or Immunization.

Source: The authors (2024).

The main findings of the analysis indicate that average compliance with the checklist was 68.4%, with values ranging from 42.8% to 91.9%. Among professionals, nursing technicians (97.0%) had a slightly higher average compliance rate (68.5%) than nurses (64.5%), although the difference was not statistically significant ($p = 0.220$). Regarding the age of the children, the highest average compliance was observed in three-year-olds (71.1%), and the lowest in five-year-olds (63.4%), with no significant difference ($p = 0.409$). However, the type of vaccine administered significantly influenced compliance with the Checklist ($p = 0.012$), with the Triple Bacterial Vaccine (DTP) associated with the highest average (72.8%) and the COVID-19 vaccine with the lowest (63.0%) (Table 3)

Table 3. Comparison of the means of compliance with the Checklist of the systematization of nursing semiotics in the application of intramuscular vaccines in children. Rio das Ostras, RJ, Brazil, 2025

Variable	n(%)	Average	Min.	Max.	Standard Deviation	P Value
Observations	302 (100.0)	68.4	42.8	91.9	8.1	-
Professional						0.220
Nurse	9 (3.0)	64.5	52.3	71.4	5.3	
Nursing Technician	292 (97.0)	68.5	42.8	91.9	8.1	
Child's age						0.409
0-year-old	163 (54.0)	68.3	47.6	85.7	8.1	
1 year old	85 (28.1)	68.9	47.6	80.9	7.3	
2 years old	9 (3.0)	67.7	52.3	80.9	9.7	
3 years old	19 (6.3)	71.1	57.1	80.9	8.0	
4 years old	19 (6.3)	65.4	42.8	91.9	10.8	
5 years old	3 (1.0)	63.4	61.9	66.6	2.7	
6 years old	1 (0.3)	66.6	66.6	66.6	.	
7 years old	1 (0.3)	66.6	66.6	66.6	.	
8 years old	0 (0.0)	-	-	-	-	
9 years old	2 (0.7)	61.9	61.9	61.9	-	
Vaccine administered						0.012
Pentavalent	57 (18.9)	69.8	42.8	85.7	7.9	
Influenza	54 (17.9)	65.5	47.6	80.9	8.3	
Inactivated Polio Vaccine	53 (17.5)	68.4	52.3	80.9	7.7	
Pneumococcal 10v	53 (17.5)	69.4	57.1	80.9	7.3	
Meningococcal C	23 (7.6)	69.5	57.1	80.9	6.3	
Hepatitis A	19 (6.3)	69.4	47.6	80.9	9.3	
Meningococcal ACWY	16 (5.3)	66.9	52.3	80.9	8.4	
Triple Bacterial(DTP)	14 (4.6)	72.8	61.9	91.9	8.8	
COVID-19	13 (4.3)	63.0	52.3	80.9	8.0	

Legend: n=302; DTP - Diphtheria, tetanus, and pertussis.

Source: The authors (2024).

DISCUSSION

The study revealed that nursing semiotics skills in administering intramuscular vaccines to children are not being satisfactorily met. Failures were observed in essential steps, including hand hygiene, the use of PPE, guidance to patients and guardians, and the surveillance of ESAVI. Vaccination is one of the most effective strategies in public health, and for the immunization process to be efficient, it is essential to adopt safety measures, including surveillance and evaluation of procedures¹⁸.

It should be noted that nursing technicians primarily performed the vaccine administration technique, while nurses performed a limited number of administrations. This finding is related to the absence of these professionals in the vaccination room, which violates COFEN Resolution No. 564/2017. This resolution approves the Manual for the Supervision of Professional Nursing Practice and regulates the administration of vaccines as a competence of nursing professionals, specifically nurses and nursing technicians. However, technicians may only work in the vaccination room under the direct supervision of a nurse. Thus, the absence of a professional nurse in the vaccination room of the unit where this study was conducted indicates negligence on the part of these professionals.¹⁹

The study revealed that the average compliance with the checklist for intramuscular vaccine administration in children aged 0 to 9 years was less than 70%, indicating procedural failures and necessitating an investigation into the causes to ensure patient and professional safety. In the pre-administration phase of the nursing semiotics procedure, the identification of the patient and the immunobiological product to be administered, as indicated on the vaccination card, was satisfactorily performed, both of which are patient safety measures recommended and standardized in protocols by the National Health Surveillance Agency²⁰.

On the other hand, the absence of explanation to the user about the procedure stands out, violating the Organic Health Law and the Code of Ethics for Nursing Professionals, which ensure clarification about nursing care and citizen participation in the SUS. Adequate communication strengthens trust, bonding, and satisfaction with care^{19,21-22}.

Still in the pre-administration phase, the mandatory use of PPE, specifically surgical masks, was frequently neglected in observations. A study conducted with 24 nurses from different states in Brazil revealed that negligence in the use of PPE occurs because professionals lose their fear of becoming infected over time, despite recognizing its importance for their own safety and that of their patients²³.

Poor hand hygiene was a critical issue in the observations, both in the pre-administration and post-administration phases. This finding is consistent with a study that assessed hand hygiene adherence among 115 nurses and 456 nursing technicians, concluding that 66.7% of nurses and 79.2% of technicians did not perform hand hygiene before patient contact, and 44.8% and 57.9%, respectively, did not perform the technique after contact. Hand hygiene is essential for preventing Healthcare-Associated Infections and is crucial for the safety of both professionals and patients²⁴.

In the administration phase, the item on the angle of needle insertion stood out, as some professionals did not perform the technique correctly, in other words, at a 90° angle. According to the Ministry of Health's Manual of Standards and Procedures for Vaccination, although the standard angle is 90° for intramuscular injections in the lateral vastus of the thigh, it can be adjusted according to the patient's musculature. However,

knowledge gaps in this area are evident from technical training and nursing degrees. A study conducted with students in Minas Gerais showed that more than 20% of the 50 respondents were unaware of the correct angle for this route of administration²⁵⁻²⁶.

At the same stage, items such as patient positioning, removal of the needle in a single, firm movement, and light compression of the site with dry cotton were not followed in some administrations. Although the numbers are not high, it is essential to highlight them, as a study on nursing staff perceptions of patient safety in PHC showed that errors in the administration of injectables are common, especially with immunobiologicals, which can result in serious ESAVs²⁰.

The preference for the vastus lateralis muscle of the thigh, as well as the choice of needle gauge and immunobiological volume in most applications, is possibly related to the age of the vaccinated children, since this region is recommended for vaccination in children under two years of age, as is the volume of immunobiologicals²⁷.

In the post-administration phase, disposing of syringes and needles in an appropriate place after use was a positive highlight, demonstrating the professional's care in handling exposure to sharps. It should be noted that exposure to biological material and sharps is a notable cause of health hazards for nursing professionals, and the qualification and training of these professionals are essential measures to ensure their safety²⁷.

Regarding the observation of psychogenic reactions and ESAVI, neither item was performed adequately. It is emphasized that the nursing team's role in monitoring these events is indispensable, considering that adequate professional guidance and follow-up increase the number of voluntary notifications, reduce the risk of complications, and maintain the population's confidence in the PNI²⁸.

When comparing variables and compliance with the checklist items, it was observed that the highest average compliance was in the administration of the DTP vaccine. Considering the composition of this immunobiological product, which contains substances that favor the manifestation of inflammatory reactions and ESAVI, it is assumed that professionals are more attentive during its administration. The COVID-19 vaccine had the lowest average compliance with the checklist. Popular hesitation, caused by misinformation and fear, creates tension among professionals. As it is a new vaccine, with frequent changes in schedule, laboratory, and volume, the difficulty faced by professionals is understandable^{8,28}.

The limitations of the study include its conduct in only one UBS, which restricts the results to a single context, as well as the potential for professionals to be influenced by the fear of being observed during the procedure. Furthermore, convenience sampling may reduce the generalizability of the results obtained. Nevertheless, the study was conducted ethically and responsibly, ensuring the anonymity and security of the data collected. Further studies in various areas and regions are necessary to expand the scope of the results.

FINAL CONSIDERATIONS

The semiotics nursing procedure for administering vaccines via intramuscular injections in children has not been satisfactorily complied with. Significant failures were observed in several stages of the procedure, such as hand hygiene before and after the

administration of the immunobiological agent, and the use of mandatory PPE, such as surgical masks. In addition, measures related to the prevention of psychogenic reactions and the occurrence of ESAVI, as well as patient guidance regarding these events, were not performed in most of the observations. Even greater compliance with the semiotics procedure was observed in intramuscular injections of the DTP vaccine.

This research may reflect nursing practice by highlighting the need for technical and organizational improvements in the service. Among the various measures that can be applied, it is urgent to implement continuing education for professionals and review protocols in accordance with the guidelines of the Ministry of Health. In addition, correcting the flaws found contributes to increasing the population's confidence in the service offered, promoting better vaccination coverage, and reducing the occurrence of ESAVI.

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