

## PREPARATION OF INTRAMUSCULAR DRUGS IN PEDIATRICS: NURSING TEAM

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**ABSTRACT:** The objective of this study was to analyze work by a nursing team regarding the environmental organization, preparation and dilution of drugs administered intramuscularly in a pediatric setting. This was an observational and quantitative study developed through 327 observations of the preparation of intramuscular medication from December 2014 to May 2015 in a pediatric hospital in Fortaleza, in the state of Ceará. Observations employed a two-stage checklist: organization of the environment with four actions; preparation and dilution of medications with 12 actions. For organization of the environment, performance regarding the action of organizing the bench with a count of 231 (70.6%) was satisfactory. The stage of medication preparation and dilution achieved satisfactory performance in six actions: separation of cotton balls soaked with alcohol from dry ones with 252 (77%); selection of syringe compatible with the volume to be administered with 264 (80.7%); proper selection of the needle for aspiration with 233 (71.2%); needle for administration with 320 (97.8%); change of needle after preparation with 266 (81.3%); reconstitution of medication in distilled water with 327 (100%). This allowed for the identification of weaknesses, such as observing the sell-by date of medications and identifying the medications prepared, actions that interfere with the safe administration of medications in pediatrics.

**DESCRIPTORS:** Nursing; Intramuscular Injections; Hospital Medication Systems; Pediatrics; Patient Safety.

### PREPARO DE MEDICAMENTOS ADMINISTRADOS VIA INTRAMUSCULAR NA PEDIATRIA: ATUAÇÃO DA EQUIPE DE ENFERMAGEM

**RESUMO:** Objetivou-se avaliar a atuação da equipe de Enfermagem na organização do ambiente, no preparo e na diluição de medicamentos administrados por via intramuscular na pediatria. Estudo observacional, quantitativo, desenvolvido mediante 327 observações do preparo de medicamento intramuscular, no período de dezembro de 2014 a maio de 2015, em um hospital pediátrico, Fortaleza-Ceará. Para observações utilizou-se um checklist composto pelas etapas: organização do ambiente com quatro ações; preparo e diluição de medicamentos com 12 ações. Na organização do ambiente, alcançou-se desempenho satisfatório na ação organizar a bancada, com 231 (70,6%). A etapa de preparo e diluição do medicamento obteve desempenho satisfatório em seis ações: separar bolas de algodão com álcool e seca, com 252 (77%); escolher seringa compatível com o volume a ser administrado, com 264 (80,7%); selecionar adequadamente a agulha para aspiração, com 233 (71,2%), e a agulha para administração, com 320 (97,8%); trocar agulha depois do preparo, com 266 (81,3%); e reconstituir medicação em água destilada, com 327 (100%). Com isso, identificaram-se fragilidades como observar a data de validade do medicamento e identificar a medicação preparada que interferem na segurança da administração de medicamentos na pediatria.

**DESCRIPTORIOS:** Enfermagem; Injeções Intramusculares; Sistemas de Medicação no Hospital; Pediatria; Segurança do Paciente.

### PREPARACIÓN DE MEDICAMENTOS DE ADMINISTRACIÓN INTRAMUSCULAR EN PEDIATRÍA: ACTUACIÓN DEL EQUIPO DE ENFERMERÍA

**RESUMEN:** Se objetivó evaluar la actuación del equipo de Enfermería en la organización del ámbito, la preparación y dilución de medicamentos de administración intramuscular en pediatria. Estudio observacional, desarrollado sobre 327 observaciones de preparación de medicamentos intramusculares, entre diciembre de 2014 y mayo de 2015 en un hospital pediátrico de Fortaleza-Ceará. Se utilizó en las observaciones un check-list integrado por las etapas: organización del ámbito, con cuatro acciones; preparación y dilución de medicamentos, con 12 acciones. En la organización del ámbito se alcanzó desempeño satisfactorio en acción de organización de mesada, con 231 (70,6%). La etapa de preparación y dilución del medicamento obtuvo desempeño satisfactorio en seis acciones: separar trozos de algodón con alcohol y secos, con 252 (77%); elegir jeringa compatible con volumen a administrar, con 264 (80,7%); selección adecuada de aguja para aspiración, con 233 (71,2%); cambiar aguja luego de preparación, con 266 (81,3%); y reconstitución de medicación con agua destilada, con 327 (100%). Así, fueron identificadas debilidades, como observar fecha de vencimiento del medicamento e identificar la medida preparada, que interfieren con la seguridad de administración de medicamentos en pediatria.

**DESCRIPTORIOS:** Enfermería; Inyecciones Intramusculares; Sistemas de Medicación en Hospital; Pediatría; Seguridad del Paciente.

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## ● INTRODUCTION

The safety of patients involves avoiding errors during delivery of care to eliminate grievances resulting from these errors. To that end, health professionals should develop behaviors such as leadership, teamwork, communication, learning from past mistakes, justice, patient-focused care, and evidence-based practice<sup>(1)</sup>.

In Brazil, nurses are responsible for administering medications. The nursing team leader plays a core role in administering care to patients under drug therapy and in the dissemination of knowledge about this practice to the team<sup>(2)</sup>.

Law # 7498 oversees nursing and its accessory activities, and postulates that nursing activities must be performed by legally skilled individuals registered at the competent Nursing Regional Council in the area where they practice nursing. According to this law the planning, management and execution of the nursing program are also a part of professional duties. Nurses should direct nursing care to critically ill patients at risk of dying with technical skill, based on scientific grounds and with the ability to make prompt decisions<sup>(3)</sup>.

Among the routes used to administer medications, the intramuscular (IM) route is one of the most frequently used due to fast absorption of the solution administered, lagging behind only in the endovenous route that acts immediately. The use of the intramuscular route is preferred because the endovenous route is faced with the challenge of keeping catheters in place for longer periods, reducing potential complications related to drug therapy<sup>(4)</sup>.

Intramuscular administration of medication is a highly complex process, and if it is not planned, controlled and monitored through indicators it is exposed to unpredictability of results that can interfere with the quality of care. In addition, the high number of drugs administered to patients increases their vulnerability to risks<sup>(5)</sup>.

The most noticeable risks involved in the process of drug administration via IM route are: persistent local pain, hardening; reduction of sensibility; tissue damage (lesion of nerves); hematomas; abscesses; allergic reactions; tissue necrosis lesions; contracture of muscle groups; fibrosis and even loss of range of joint movements<sup>(6-7)</sup>.

In this context, the process of drug administration via IM route in pediatrics demands knowledge about proper preparation of the drugs from concerned professionals considering the fact that children are the most vulnerable group. They are subject to quickly-changing pharmacokinetics and pharmacodynamics characteristic of a child's development<sup>(8-9)</sup>.

Therefore, to improve the applicability of intramuscular drugs preparation in pediatrics the following question should be answered. "How do environmental organization, medication preparation and dilution occur for IM administration in children?"

Nursing practice in the preparation of intramuscular injection drugs in pediatrics has some divergences with relation to the technique recommended by scientific literature referring to material selection, medication dilution and identification, and verification of sell-by date<sup>(10)</sup>.

This study is of foremost relevance for everyone working with IM administration of drugs and for other healthcare professionals because it aims to identify potential failures during medication preparation that could interfere with patient safety. It allows further correction and improvement of the process of eliminating such failures, thus avoiding repetition of the same errors.

This paper aimed to analyze work by a nursing team regarding the environmental organization, preparation and dilution of medications administered via intramuscular route in pediatrics.

## ● METHODS

This was an observational, cross-sectional study with a quantitative approach, developed in a pediatric hospital which is a member of the municipal healthcare network in Fortaleza, Ceará. The

hospital is equipped with six wards for clinical care for children and adolescents (three months to 18 years old) and which operates 24/7.

The study comprised 11 nursing professionals working in the unit of the intramuscular administration of drugs in the institution. It consisted of one nurse and ten nursing technicians who met the following inclusion criteria: were nursing professionals working with the process of intramuscular administration of drugs; were on duty on the days when the observations were performed. The exclusion criteria were as follows: being on vacation; leave or license during the data collection period.

Data were collected from December 2014 to May 2015 in the morning shift (8:00 to 12:00), afternoon shift (13:00 to 17:00) or nightshift (18:00 to 22:00) on random days, comprising six shifts a week. The collection comprised 327 systematic observations of the preparation of intramuscular injection of drugs administered to children served by the institution. Children met the following inclusion criteria: they were less than 10 years old; had a medical prescription of the drug to be administered via intramuscular route; and had the intramuscular injection of the drugs in the institution. The exclusion criteria were emergent clinical conditions like convulsion.

The checklist instrument used for the systematic observation of drug preparation was a form with the children's identification data (sex, weight, age and body temperature) that were collected by reading the medical prescription. Data referred to two stages: 1) the stage of organizing the environment to prepare the drugs; 2) stage of preparation and dilution of drugs to be administered via intramuscular route.

Observation was performed by three nursing students previously oriented to the instrument and apprised of the required cautions by the time of data collection, such as non-intervention at the time of the procedure in order to avoid influencing the research.

During observation, one student remained at the unit on the day and time established, waiting for the event to occur. When the child arrived, students requested the signature of the free and informed consent terms to authorize them to observe the procedure.

A checklist instrument was used containing actions developed during the process of administering the intramuscular injection of drugs. It comprised the environmental organization, drugs preparation and dilution. Experts in the field of child health validated the instrument regarding relevance and clarity of items, using the Content Validity Index (CVI) above 0.8.

The state of environmental organization for the preparation of drugs consisted of four actions. They were, cleaning the bench, organizing the bench, having a tray or kidney basin and using personal protective equipment.

Twelve actions composed the stage of medication preparation and dilution. They were: checking drug labels against prescription; observing the drug sell-by date; checking integrity of enclosures; inspecting flasks for potential particles, changes of color, cracks or leakages and disinfecting the ampoule or flask-ampoule. Other actions were: separating cotton balls soaked with alcohol from the dry ones; selecting syringes compatible with the volume to be administered, properly selecting needles for aspiration, properly selecting needles for IM administration, changing needles after preparation (whenever required); reconstitution of drugs in distilled water (DW); respecting the principles of hospital infection prevention (whenever required); and, identifying the drug prepared.

Data collected during the survey were stored in a database produced in Windows Excel 2010, processed and analyzed with descriptive statistics and according to the relevant literature in the field. The professionals' performance analysis at each stage of the process of administration of intramuscular injection of drug considered the performance satisfactory with a cut-off point equal to or higher than 70%<sup>(11-12)</sup>.

The study was carried out in compliance with the ethical precepts, respecting the rules established by the Brazilian National Health Council Resolution # 466/2012<sup>(13)</sup> and was approved by the ethics committee through report # 805953. All nursing professionals and companions were instructed about the study objectives and agreed to being observed during the process of administration of intramuscular injection of drug, signing the free and informed consent term.

## ● RESULTS

The children's profile observed regarding the preparation of drugs administered via intramuscular route was as follows: 186 (56.9%) male; with a mean age of 3.4 years old; 147 toddlers (44.9%) of the age group from 12 to 36 months; 229 (70.2%) children with hyperthermia.

Table 1 shows information about the environmental organization in the preparation of drugs administered via the intramuscular route.

The performance during the stage of environment organization for the preparation of drugs comprising the above four actions were satisfactory with > 70% percentage in an action that comprises 25% of the total actions in this stage.

According to Table 1, in 93 (28.4%) of the observations professionals had cleaned the bench, while in 231 observations (70.6%) they organized the material under the bench for further preparation of the medication.

In 185 (56.5%) observations, professionals had trays or kidney basins to take the medication to the child, while on the remaining occasions the professional carried the drugs in their hands.

Regarding the action of using personal protective equipment, in 195 (59.6%) of the observations, professionals were wearing caps and masks. Caps were the personal protective equipment used in most observations, with a count of 192 (58.7%). No observation detected the use of gloves.

Table 2 shows information about the actions in the stage of preparation and dilution of drugs administered via intramuscular route.

Table 1 - Distribution of the number of observations according to actions in the stage of environment organization to prepare medications. Fortaleza, Ceará, Brazil, 2015

Actions	N	%
Clean the bench	93	28.4
Organize the bench	231	70.6
Have tray or kidney basin	185	56.5
Use personal protective equipment	195	59.6

Table 2 - Distribution of the number of observations according to actions in the stage of preparation and dilution of drugs. Fortaleza, Ceará, Brazil, 2015

Actions	N	%
Check drug label against prescription	128	39.1
Observe the drug sell-by date	17	5.1
Check the integrity of enclosures	34	10.3
Check flask for potential particles, change of color, cracks or leakages	86	26.2
Disinfect the ampoule or flask-ampoule	19	5.8
Separate cotton balls soaked with alcohol and the dry ones	252	77
Select syringe compatible with the volume to be administered	264	80.7
Properly select the needle for aspiration	233	71.2
Properly select the needle for administration via IM route	320	97.8
Change needle after preparation (whenever required)	266	81.3
Reconstitution of drug in DW, respecting the principles of hospital infection prevention (whenever required)	327	100
Identify the drug prepared	17	5.1

In the stage of drug preparation comprising these 12 actions, performance was satisfactory with >70% in six actions covering 50% of the total actions in this stage.

The actions relate to checking drug labels, observing sell-by dates, checking integrity of enclosures, inspecting flasks and disinfection reached 128 (39.1%). 17(5.1%). 34(10.3%). 86 (26.2%) and 19(5.8%), respectively

Regarding separation of cotton balls soaked with alcohol from the dry ones, in 77% (n=252) of the observations this was done, but only in 16.8% (n=55) of the procedures was this fully done. Most of this action (60.2%, n=197) was partially performed, with only the separation of cotton balls soaked with alcohol.

The action 'select syringe compatible with the volume to be administered' was observed in 80.7% (n=264) of the preparations. Regarding the action of properly selecting needles for aspiration, the ideal is 40 x 12, but the institution made available only 25x8 and 25x7 needles. However, this factor does not interfere on the preparation of drugs, as it only extends preparation time. The action 'properly select needles to administer medications via IM route' was found in 97.8% (n=320) of the observations. Regarding change of needles whenever required, it was performed in 1.3% (n=226) of the cases.

When observing reconstitution of drug in distilled water (DW), in 100% of the observations it was satisfactorily done respecting the principles of hospital infection prevention.

Regarding the action 'identify drug prepared' in 5.1% (n=17) of the observations this action was performed. This action is of foremost importance to ensure patients' safety and prevent potential errors during the administration of drugs.

## ● DISCUSSION

Discussions are shown following the section about actions performed to organize the environment, prepare and dilute drugs to be administered to children via intramuscular route.

With relation to the stage of organizing the environment to prepare drugs administered via the intramuscular route, it is very important to follow the pertinent recommendations to ensure microbiological safety and their implications for patient safety<sup>(14)</sup>.

Microbiological safety is damaged when, during the drug administration process, the nursing team fails to adopt the following actions: cleaning the bench before and after preparing drugs; using a mask when preparing solutions; disinfecting flasks and ampoules; among other factors that maximize risks<sup>(14)</sup>.

The nursing team should properly prepare materials and solutions in an aseptic way. Disinfection of materials and benches; organization and selection of proper material for the procedure; preparation of the drugs; inspection of solutions for the presence of particles and foreign bodies, changes of color and sell-by dates; and organized disposing of all materials are crucial actions in successfully administering intramuscular injections.

In this study, the disinfection of benches was not satisfactory, being present in only 28.4% of the observations, while disinfection of flasks and ampoules was observed in 5.8%. This is in keeping with a survey carried out in a municipal public hospital belonging to the Rio de Janeiro Sentinel Network. In critically ill patients in clinics who were subjected to therapy with multiple drugs, it was found that in 77.26% of the preparations observed the benches were not disinfected, while in 80.27% the ampoules and flasks were not disinfected<sup>(14)</sup>.

Disinfection should be undertaken using 70% alcohol to reduce microbiological load, and this is low-cost and easy to apply<sup>(15)</sup>. 70% alcohol is one of the main disinfectants used in healthcare services and can be used on surfaces or articles through friction<sup>(16)</sup>.

Another important action for patients' safety is the use of personal protective equipment when preparing medication. The procedure glove is a very important preventive equipment because it reduces the risk for health professionals in having their hands contaminated with blood and other body fluids; reduces the risk of disseminating germs into the environment; and, protects professionals

and patients against the risk of cross infection<sup>(17)</sup>.

However, the use of gloves is not prescribed for situations like the application of routine intradermal, subcutaneous and intramuscular injections, as long as the health professional's and the patient's skin was untouched<sup>(18)</sup>.

Confirming of the drug label against the prescription was found in 39.1% of the observations. Some crucial procedures are, reading drug labels; checking them against medical prescription; identifying drugs by name and checking the patient's name, bed number, and name of the professional in charge, administration route, proper dosage and right time. These factors minimize risks due to communication failures. Moreover, listening to what the patient says and checking the identification wristband is important to make sure that there is no chance of mistaking a patient's identity<sup>(19)</sup>.

Prescription errors can be classified under wording errors with prevalence of problems with the pharmaceutical form, data omission and administration route<sup>(20)</sup>. Overlooking an error hinders the implementation of interventions in preventing or remedying consequences for patients, and in also in preventing recurrence of the error<sup>(8)</sup>.

A study carried out in a pediatric hospital unit in Minas Gerais observed that in 5% of the cases prescriptions were not consulted prior to preparation; in 42% the incorrect preparation technique was used; in 53.2% hand sanitation was poor; in 31.2% flask-ampoule disinfection was insufficient; in 12.5% materials and drugs were contaminated; in 3.1% materials were reused<sup>(21)</sup>.

A study on antisepsis during the administration of medications via endovenous and intramuscular routes observed that in 40.5% of administrations via endovenous routes and in 37.5% of intramuscular injections five or more movements were made in the same direction with cotton soaked with 70% alcohol. This is the procedure recommended for skin antisepsis and/or disinfection of the rubber injector<sup>(22)</sup>.

Another aspect to be considered is the length of the needle to be used, which should be long enough to penetrate the subcutaneous tissue and deposit medication in the muscle body. Needles of short diameter (25 to 30) cause less discomfort, however, more viscous medications demand larger diameters<sup>(23)</sup>.

Considering the results found, the action of properly selecting the needle for administration via IM route demands professional knowledge in evaluating patients regarding their muscle mass distribution and the drug characteristics such as viscosity and volume to be administered<sup>(24)</sup>.

Changing the needle after preparing drugs and before administering them is of utmost relevance to patients' safety, because it maintains the infusion system integrity, ensuring non-exposure to contamination from external agents<sup>(25)</sup>.

During the process of reconstitution or dilution of drugs, aspects such as time of preparation and stability duration after reconstitution / dilution should be weighed considering the potential alterations that can occur when a drug is prepared well before the administration time, or when dilution protocols are not observed. These factors are frequently present in the everyday work of nursing teams and end up hindering the prevention of errors and assuring safety in drug therapy<sup>(14)</sup>.

Regarding the action 'identify the drug prepared', 5.1% were satisfactorily performed. It is worth mentioning a study developed discussing errors in medication administration according to which identification is a requirement for the preparation and administration processes, and which advocates for the display of some data like patient's name and bed number to minimize errors in the drug administration process<sup>(26)</sup>.

The manual transportation of drugs entails risks of accidents, contamination of the solution and compromise of safety. The use of trays or kidney basins<sup>(27)</sup> ensures the maintenance of the physical, chemical and microbiological integrity of drugs.

## ● CONCLUSION

This study evaluated actions performed by nursing professionals during the preparation of drugs administered via intramuscular route in pediatrics. It came up with the following findings: satisfactory performance regarding bench cleaning; selection of syringe compatible with the volume to be administered; proper selection of needles for aspiration and administration. On the other hand, performance was unsatisfactory regarding the use of personal protective equipment recommended for the procedure, observation of sell-by date of drugs and disinfection of ampoule or flask-ampoule.

The study allowed for a situational diagnosis of nursing teams working on the stages of environment organization and preparation and dilution of drugs administered via intramuscular route in pediatrics. By implementing efficacious practices, healthcare quality will be improved and contribute to solving the problems identified.

Therefore, it is worth highlighting the need for new studies in different contexts using different evaluation methodologies to make the process of administering drugs in pediatrics safer.

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