

*Full Length Research Paper*

# Good practice guidance to support safe oral medication preparation and administration through feeding tubes

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**The objective of this work is to elaborate good practice guidance, aimed at preparing and administering drugs through feeding tube. This study was performed at a secondary level hospital in the interior of São Paulo state, Southeast Region of Brazil. For the first phase, a literature review was carried out in the following databases: LILACS, MEDLINE, Web of Science, and MICROMEDEX® Solutions. A manual search was also carried on other sources. In a second phase, the guide was refined for the hospital through meetings. Out of 104 references found, seven were read in full. The most employed technique for drug preparation was a simultaneous crushing of solid formulations. Participants identified a need to standardize techniques for drug preparation and administration through feeding tube, and the importance of using best practice guidance for patient safety was acknowledged.**

**Key words:** Feeding tube, medication errors, hospital, good practice.

## INTRODUCTION

Medication errors related to feeding tube route happen more often than reported or recognized. These errors are often the result of administering medications that are incompatible with administration via, preparing the medications improperly, and/or administering a drug using improper administration techniques (Seyede et al., 2017) (ISMP, 2010). Errors occurring in oral medication

preparation and administration can lead to an occluded feeding tube, reduce the effects of drugs, lead to unsuccessful treatment, and increase the risk of potential adverse drug reactions (Emami et al., 2012; Seyede et al., 2017). Potential leading causes of these errors include lack of drug knowledge among physicians, inadequate training of nurses and lack of pharmacists participation in

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medical setting (Johnson et al., 2018).

Previous study showed that 40.5% of medications were not administered in appropriate dosage forms via feeding tube; 58% pharmacists, 17% nurses and 24% doctors were aware of the fact that enteric-coated tablets should not be crushed owing to the risk of tube occlusion and lack of efficacy when they are administered via feeding tube (Demirkan et al., 2017). Brazilian study identified that the technique mostly used to prepare the medicines was to grind (50%); 4.1% nursing staff let the tablets to dissolve in the water and then medicate the patient. It is revealed that enteral medication preparation and administration practices are inconsistent and nurses are still using unsafe practices that may compromise patients' care (Anderle et al., 2018).

In response to this scenario, World Health Organization (WHO) identified *Medication Without Harm* as the theme for the third Global Patient Safety Challenge with the aims to reduce severe avoidable medication-related harm by 50% in the next 5 years and propose solutions to address many of the obstacles the world faces today to ensure the safety of medication practices (WHO, 2017). One solution may be related to the development of protocols and evidence based guides (Figueiredo et al., 2018) that can provide clear and easily accessible information for the general and standard rules on how to prepare and administer oral medications through feeding tubes safely. To reduce these risks, guides for the safe administration of drugs via enteral feeding tube are now available (Neto et al., 2016); however, there is a gap between the best evidence available and clinical practice. Thus, the aim of this study is to develop a good practice guidance (GPG) for safe oral medication preparation and administration through feeding tubes in order to support prescribers, nurses and pharmacists to provide high quality care for patients in hospital setting.

## MATERIALS AND METHODS

This article is the result of an initiative between the research team and a Brazilian public hospital. This is a descriptive study, composed of two phases and conducted in one general medium teaching hospital, between April 2014 and December 2015. The hospital has a 50 bed medical ward, four operating rooms, and encourages scientific production of high level research. The medical ward was chosen because it provides care for adult patients in various medical specialties and most of the patients have chronic conditions, thus many require enteral nutrition and medications through enteral feeding tube. This study was approved by the Research Ethics Committee (n° 412.833), according to the Resolution n° 466/2012, of the National Council of Ethics in Research of the Brazilian Ministry of Health. Healthcare professionals were informed of the research and asked to voluntarily sign the consent form. Participants were informed that the results will be used for publication and researchers guaranteed their confidentiality and anonymity. The study was conducted in two phases, as described as follows:

### Phase 1: Development of good practice guidance

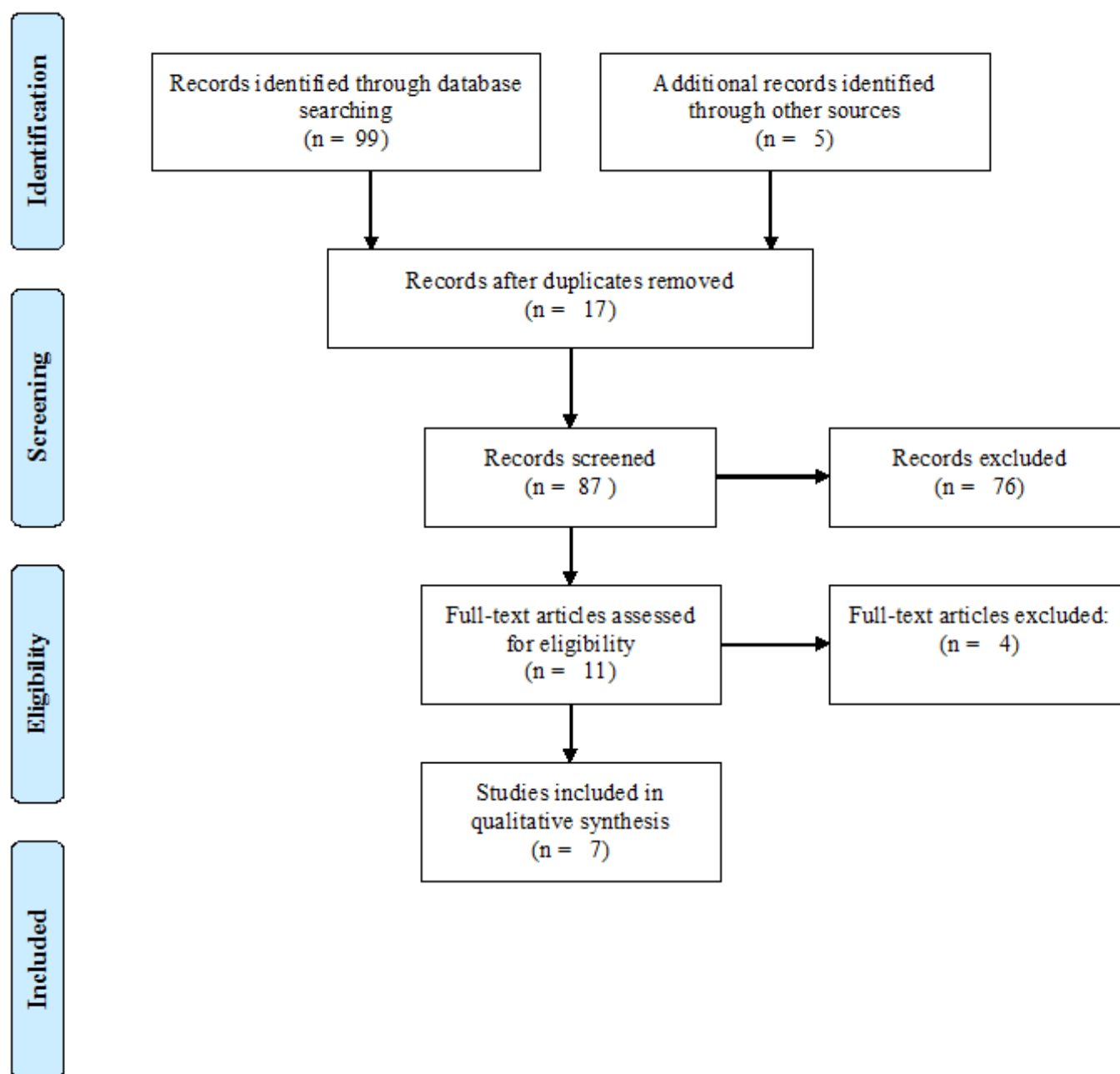
Based on the results of a previous investigation (Gimenes et al., 2017), a good practice guidance (GPG) for safe oral medication preparation and administration was developed, based on an integrative review. The population, intervention of interest, comparison and outcomes (PICO) strategy was used (Santos et al., 2007). Thus, the PICO question for the review was: "In adults requiring feeding tube (P), which techniques should be used to prepare and administer oral medications (I), (C) to avoid medication adverse events related to feeding tube (O)?"

A search from the literature was conducted in October 2014 in the following databases: Latin American and Caribbean Literature in Health Sciences (LILACS), Medical Literature Analysis and Retrieval System Online (MEDLINE) and Web of Science. A manual search was also carried out on the website of the National Health Surveillance Agency (ANVISA), Brazil, in national and international guidelines, in textbooks related to the subject, in theses and dissertations, and in the MICROMEDEX® Solutions database, which provide health professionals with up-to-date clinical information about the medicines. Descriptors and keywords used for searching included: "adults"; "enteral administration of drugs"; "intubation, gastrointestinal"; "medication errors". These descriptors or keywords were combined using the Boolean conjunctions "AND" and "OR". A data collection tool adapted from Ursi (2005) was used to analyze the evidence. The studies were selected, analyzed and the results were synthesized. Data extraction from the selected studies was initially performed by the principal investigator and subsequently, by two reviewers who acted as independent validators (Favretto et al., 2012).

Only original articles published in English, Portuguese or Spanish were included in this review. Studies of children or infants and literature reviews were excluded. The strategy for selection of the studies is illustrated in Figure 1. Based on the results of this integrative review, the first version of the GPG was developed by the research team to address the continuing need to refine the techniques associated with oral medication preparation and administration through feeding tubes. This guide was composed of a title; objective; target audience; methodology; risks / critical points for patients; expected results; basic recommendations for safe oral medication preparation and administration through feeding tube; and a table containing explicit instructions for oral medication preparation of standardized drugs within the hospital. Table 1 exemplifies these instructions.

### Phase 2: Refinement of the good practice guidance (GPG)

The first version of the GPG was presented and reviewed with the multidisciplinary team of the hospital, that included the research project coordinator, one nurse research fellow, one nursing manager, a nurse member of the Hospital Infection Control Committee, a nurse member of the training program, a pharmacist, a nutritionist, and a secretary. The reviewing process involved four meetings with the multidisciplinary team; they were held from April 2015 to August 2015 to discuss the guide and improve the processes of oral medication preparation and administration through enteral feeding tube, according to the hospital's individual requirements. The meetings took place in the hospital, so that the project coordinator could assist the team in action planning; they were accompanied by a nurse research fellow of the research project and had a maximum duration of 60 min each. The members of the multidisciplinary team exchanged experiences and knowledge to solve the task.



**Figure 1.** PRISMA flow diagram.  
Source: (Moher, Liberati, Tetzlaff, & Altman, 2010).

## RESULTS

### Phase 1: Literature revision

Seven primary qualitative studies were included in the integrative review. The most commonly used techniques in the preparation of drugs via feeding tube were simultaneous grinding of solid drugs (Heydrich et al.,

2009; Mota et al., 2010) and the reconstitution of the drugs in tap water (Mota et al., 2010). Since these drugs are administered concomitantly to patients, the probe is not washed before and after administration (Heydrich et al., 2009; Mota et al., 2010; Ramos et al., 2013). The main drug incident was feeding tube obstruction (Phillips and Endacott, 2011; Lisboa et al., 2011; Renovato et al., 2010) and the authors recommended the development of

**Table 1.** Examples of specific recommendations for preparing standardized drugs, contained on the GPG's first version.

Medicine	Can be crushed? (Yes/No)	Recommended technique	Recommendation for enteral nutrition
Captopril (25 mg tablet)	Yes	Crush until turning fine and homogeneous powder and reconstitute in 10 ml of distilled water	Pause enteral nutrition 30 minutes before administering the tablet*
Esomeprazole	No	Reconstitute in 25 ml of distilled water*	Do not administer along with diet. Patient should be fasted*

\*Source: White and Bradnam, (2015).

ongoing training programs for the nursing team as a strategy to reduce adverse events associated with medications. They also suggested that health services stimulate the joint work of multidisciplinary teams and the elaboration of protocols for good practices in the preparation and administration of drugs via feeding tube (Van Den et al., 2006; Mota et al., 2010).

## Phase 2: Meeting good practice guidance (GPG)

In the first meeting, two doctors, three registered nurses, one pharmacist and one nutritionist participated. The objectives were to present the first version of the GPG and to discuss the suggestions proposed by the researchers. We addressed aspects related to patient safety, among them, replacing the plastic mortar used in the crushing of solid drugs with ceramic or glass mortar. The researchers also suggested to the pharmacist to label those medicines that should never be crushed; the standardization of reconstitution of solid forms and the dilution of oral liquid formulas with filtered water, since professionals used distilled water, saline or filtered water to reconstitute / dilute the drugs. The team also discussed cost-related issues involving the replacement of plastic mortar and considered it important to standardize the reconstitution / dilution of oral medications, depending on the hospital's individual requirements.

In the second meeting, three nurses and one pharmacist participated. The objectives were to discuss the items included in the GPG and to adapt them to the hospital's individual requirements. There was disagreement among participants in the group regarding the need to crush and reconstitute / dilute the drugs separately; to test the positioning of the tube before administering the drugs; and the simultaneous administration of the drugs with the enteral diet. For some participants, these recommendations would not be feasible in view of the disproportion between the number of drugs scheduled for the same time and the number of nursing professionals responsible for the preparation and administration of drugs. However, other participants

pondered the importance of all nursing professionals to understand the importance of these recommendations for patient safety. Therefore, the recommendations were maintained in the guidance. The participants presented the need to elaborate a second table containing specific information on medicines that can be reconstituted / diluted with other medicines and on those that should not be administered simultaneously with enteral diets. They also discussed the importance of using color scheme in the table containing specific recommendations for the preparation of the medicines, in order to draw the attention of the team regarding the recommendations.

The third meeting was attended by four nurses and one pharmacist. The objective was to present and review the second version of the GPG that presented the drugs grouped according to pharmacological groups and with a color scheme and symbols to draw the attention of the professional to the particularities of each medicine. Once again, the group discussed the importance of not crushing, reconstituting / diluting and administering multiple medications simultaneously; as well as the need to respect the intervals between administration of the drug and enteral diet infusion. Other changes were suggested by participants in the group, such as: red color would be used to signal medications that should never be crushed, and yellow to signal medications that should not be administered along with the enteral diet.

The participants also decided that the medications would be presented in alphabetical order, and not according to the pharmacological group, in order to facilitate the understanding by mid-level nursing professionals. In the space for the observations of the medicines, the participants decided that the standard recommendations for medication preparation (crushing to a fine and homogeneous powder and reconstituting in 10 ml of distilled water) and / or specific recommendations as described in the literature (reconstitute the tablet in distilled water and administer at the end of the effervescence). Regarding the interruption of the enteral diet, it was decided to establish a standard pause before and after the drug administration (30-min pause before and after the drug administration), so as not to delay the infusion of the diets for the patients. At the end of the

**Table 2.** Synthesis of GPG development and refinement process.

<b>Process of constructing and refining the protocol</b>		
<b>Previous research*</b>	<b>First version</b>	<b>Final version</b>
Drug reconstituted in distilled water, 0.9% saline or filtered water.	Perform reconstitution in potable water.	Perform reconstitution of drug(s) in distilled water.
Liquid pharmaceutical form diluted, without volume measurement.	Dilute liquid drugs with high osmolarity/viscous drugs in 60 to 90 ml of potable water.	Dilute liquid drugs with high osmolarity/viscous drugs in 60 to 90 ml of distilled water (question nurses/doctors when patient is under water restriction).
Solid pharmaceutical form (pill/tablet/dragee/capsule) crushed simultaneously, without observing commitment of biopharmaceutical aspects.	Crush solid drugs separately and verify if capsules can be open without commitment of biopharmaceutical aspects.	For solid drugs, observe standard reconstitution: crush until obtaining a thin and homogeneous powder, and reconstitute in 10 ml of distilled water. For capsules, verify if these can be opened. Specific drugs which do not follow standard reconstitution: observe the recommended technique for drug preparation.
Feeding tube were not tested for correct positioning before drug administration.	Confirm correct positioning of NGT/NET before drug(s) administration, using the following technique: inject 20 ml of air with a syringe through the tube; perform abdominal auscultation with stethoscope, under the xiphoid process; aspirate injected air and observe characteristics of aspirated contents.	Confirm correct positioning of NGT/NET at least once a day: inject 20 ml of air with a syringe through the tube; perform abdominal auscultation positioning the stethoscope under the xiphoid process; aspirate injected air; observe and register characteristics of aspirated contents.
-	-	Recommendation for use of surgical gloves and masks during drug preparation, when indicated, was included.
-	-	Recommendation for using the red color, in order to indicate drugs that must never be crushed and administered through NGT/NET was included.

Source: Author.

third meeting, the participants suggested that they decided to meet to finalize the adaptation of the medication list to the hospital's context and to send the researchers, by electronic mail, to finish the GPG. Five nurses and one pharmacist attended the fourth meeting. The objective was to present the final version of the GPG for the multidisciplinary team of the hospital. At this meeting, more adjustments were required, such as using only the red color to signal the particularities in the preparation / administration of the drug. Table 2 presents an overview of the entire process of the GPG development and refinement for the preparation and administration of medication through feeding tubes.

## DISCUSSION

The objective of the study is develop a good practice

guidance for the preparation and administration of medicines via feeding tube, based on the results of the integrative literature review. It was verified that the trituration of solid drugs was the technique most used by the nursing team to prepare the drugs in the studies included in the integrative review. Concomitant preparation and administration of the medicinal products may result in physico-chemical interactions capable of rendering drug therapy unfeasible. In addition, nursing professionals use various substances (water, juices, teas) in the reconstitution / dilution of medications. However, this practice compromises biopharmaceutical aspects, which may result in feeding tube obstruction and serious adverse events in the patient (Phillips and Endacott, 2011).

The nursing staff use plastic crush solid dosage forms. This fact is relevant when considering some important points: 1) change in the dose to be administered, since

fragments of the drug can be adhered in the pestle; 2) possible physico-chemical interactions between the components of the pharmaceutical formulation and the material of the pestle; and 3) drug interactions as a consequence of the simultaneous grinding of several drugs (Heydrich et al., 2009). Safety in health care means avoiding, preventing and improving adverse outcomes and damages generated by the health care process. It also includes the reduction and mitigation of unsafe acts within the healthcare system, as well as the use of good practices to achieve optimal outcomes for patients. In this context, it is fundamental to standardize the techniques of drug preparation and administration feeding tube through good practice guidance (Goedecke et al., 2016).

Good practices regarding preparing and administering oral drugs through feeding tube have recently been addressed at an international level. A study conducted in France verified how drug administrations through tubes occurred in 46 health care units in the country; 1,110 nurses took part in the study, and two-thirds of them said to crush tablets and capsules at least once a month, while 28% reported performing this practice on a daily basis. In addition, 71% of the total stated that they never asked pharmacists their doubts about crushing of medications. Although considering preparation and administration of drugs an innocuous procedure, this is a common practice that can bring risks for patients (Clauson et al., 2016).

Main risks that may happen during administration of drugs through enteral tubes are related to interactions between medications administered simultaneously or between drugs and enteral diet; destruction of enteric drug protection resulting from incorrect crushing; complications due to erroneous administration of substances outside the gastrointestinal tract; and obstruction of enteral tubes due to incorrect handling. Therefore, discussing this issue in different health care environments becomes necessary, so that professionals involved in preparing and administering medications through enteral tubes are able to understand the risks involved in this care, and can provide better safety to patients (Silva and Guaraldo, 2016; Marquez et al., 2018).

Simultaneously crushing medications is a common procedure in clinical practice and, in many cases, medicines are crushed using the same pestle. In one previous study, the researchers verified improvements, after implementing good practice guidance for crushing medication in elderly patients. Authors observed that 90% of nurses performed this type of procedure during the preparation of drugs. After implementation of system improvements, there was reduction of nonconformities to 70%, especially regarding the crushing of enteric coated pills. They also found that, after utilizing the good practice. Thus, it was observed that recommendations of the guide

contributed to improvements in the care practice of elderly patients (Goedecke et al., 2016) (Bourdenet et al., 2015).

Elaboration of guidance to guide good practices of different procedures in health care environments is necessary due to the importance of improvements in the care and to patients' safety. However, it is fundamental to think of strategies according to each hospital's individual requirements, with some changes being feasible for some environments and infeasible for others. In this study, through discussion groups with a multidisciplinary team, improvements were made in the GPG, appropriate to the hospital's context. It is important to reinforce that elaboration of good practice guidance must be substantiated in literature reviews, so that care practices can be based on the best scientific evidences. Literature reviews can improve guides, so these can be used as a tool during medication preparation and administration through feeding tubes, with decrease in medication errors, thus improving drug therapy and patients' safety (Johnson et al., 2018), (Shawn and Paul, 2018). Use of guides for improvement of nursing care requires a constant review of them according to recent literature, so that new knowledge is applied in clinical practice. Therefore, the process of implementing these guides in assistance seeks constant evaluation of expected results from new evidence that emerges from scientific research (Kenny and Goodman, 2010).

The knowledge of nursing teams regarding the process of drug administration via enteral tube is important, in order to perform these procedures safely and to achieve positive results of the drug therapy. In addition, it must be considered that there is a distance between academic theory and the knowledge of health teams, such as crushing modified-release pills, with consequent increase or decrease in absorption. A lack of training of the teams (doctors, pharmacists and nursing) was observed, with constant doubts presented by them and a lack of materials for consultation on the safe and effective execution of pharmacotherapy through tubes. These point to the need for formulating formal material of consultation, such as manuals, folders, explanatory videos and posters, to guide conducts, as well as the implementation of continuing education programs for the employees involved (Godoi et al., 2016). Therefore, it is necessary to elaborate guides that help nursing professionals to know the good practices in the process of preparation and administration of drugs by enteral tubes, as well as to stimulate the study and the search for knowledge for improvements in the care of patients (Johnson et al., 2018).

### Study limitations

The study presented limitations. The good practice

guidance was developed with a multidisciplinary team. However, there was no participation of mid-level nursing professionals. In addition, the guide was refined based on the requirements of a general mid-sized hospital and may not reflect the context of other health care institutions.

## Conclusion

The good practice guidance for safe oral medication preparation and administration through feeding tubes was developed through joint collaboration between researchers and the multidisciplinary team and relied on scientific evidence of best practice and on ethical principles. It is a comprehensive resource to support safe practices and it optimally utilizes the skills of healthcare teams. The development of a robust document to support safe medication practices should consider the hospital's individual requirements to promote adherence by all healthcare professionals. In addition, training programs should be planned to educate healthcare teams in accepting full responsibility and accountability for the decision to use the guide. The next step is to evaluate the impact of the GPG on medication errors and patients' outcomes.

## CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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