

Characterization of adverse events occurring during nursing clinical rotations: A descriptive study

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ABSTRACT

Introduction: Patient safety is a pillar of quality health care. Nursing students may commit errors during clinical practice, compromising patient safety.

Objective: Analyze the adverse events, as well as the factors associated with the errors, reported by students from a private university in Santiago, Chile during nursing clinical rotations.

Methods: Quantitative cross-sectional descriptive study. A total of 68 errors by first- through fifth-year nursing students were reported between 2012 and 2018. The data collection instrument was the Adverse Events Notification Form from the School of Nursing. This form documented information about the study as well as about the event.

Results: After this reporting system was established in 2012, the number of events reported increased steadily each year. The greatest numbers of reported errors were committed by fifth-year students (73.5%), and the most common type of error was associated with medication administration (94.2%), including incorrect dose (27.9%) and incorrect medication (17.6%). The major factors contributing to errors were failure to review the “10 rights of medication administration” (85.3%) or lack of critical judgment (7.4%). Most of the errors occurred in public institutions (72.1%).

Conclusion: The results suggest that it would be beneficial to re-evaluate how safety and quality of care are taught at the school of nursing, with an emphasis on understanding the learning styles of students and teaching strategies of instructors. It is crucial that the academic institution remain actively involved in teaching safety-related skills to future nursing professionals. Furthermore, we suggest modifications to the adverse events reporting system that would avoid the need for personal interpretations of the event by the student.

1. Introduction

Any person seeking medical treatment should be able to expect timely, effective, and safe care. These elements have been established as basic pillars of modern healthcare by organizations and governmental institutions worldwide. Patient safety, defined as the absence of harm to the patient (Stevanin et al., 2015), is a key element of quality of care. Over the last decade, clinicians and researchers have used various strategies to address this issue. Of course, improving the safety and quality of healthcare requires first that professionals are aware of the possibility that errors may occur and wish to avoid causing such harm. While it can generally be assumed that clinicians rarely act with malice, hospital-based care may in fact cause inadvertent injuries, whether major or minor (Runcinman and Moller, 2001). Therefore, health systems place special emphasis on eliminating, reducing, and mitigating the effects of adverse events associated with healthcare services

(Aranaz and Moya, 2011).

This topic came to the forefront of public attention in the 1990s after the publication of the Harvard Medical Practice Study in 1991 and the United States Institute of Medicine (IOM) report “To Err is Human: Building a Safer Health System” (Kohn et al., 1999). The groundbreaking information and startlingly high rates of error described in these reports promoted awareness of numerous safety concerns associated with medical procedures as well as the costs associated with healthcare errors.

Most medical errors are attributable to systemic problems. Therefore, many efforts to reduce healthcare errors have focused on implementing strategies to improve healthcare systems and processes, as well as to reduce human error.

Healthcare-related injuries increase mortality and elevate economic costs for both the patient and the healthcare facility (Brady et al., 2009). While worldwide rates of adverse events are unknown, the WHO

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estimates that one in ten hospital patients suffers a healthcare-related injury, resulting in higher costs and prolonged hospital stays (Álvarez, 2008). In the United States, adverse events cause 98,000 deaths each year. Consistent with estimated worldwide rates, 10% of hospital patients suffer adverse events in Canada and New Zealand, and the United Kingdom Department of Health reported a total rate of 10% for adverse events attributable to healthcare errors in the year 2002 (Álvarez, 2008). A large study on adverse events carried out in Argentina, Colombia, Costa Rica, Mexico, and Peru (IBEAS 2005) reported an overall adverse event rate of 10.5% for (Aranaz and Aibar, 2010). Moreover, a study by Bates et al. (1997) estimated that healthcare-related adverse events result in an increased average hospital stay of 4.6 days, as well as roughly 2.8 million dollars of additional health spending each year (Simon et al., 2005).

Research on the occurrence of adverse events (AE) can help to identify the most prevalent types of errors, the step in the process during which errors most commonly occur, the underlying causes of errors, and potential strategies to improve patient safety.

2. Theoretical framework

In Chile, Law 20.584 regulates patient rights and responsibilities. Section II, Article 4, Paragraph 1 of this law stipulates that “in any environment where a medical service takes place, every person has the right to healthcare providers and healthcare facilities that comply with applicable national norms and established protocols on patient safety and quality of care, including commonly-accepted practices designed to reduce intrahospital infections, patient identification, accidents, healthcare errors, and other avoidable adverse events” (Norma et al., 2019).

In the chapter on Quality of Care, the General Technical Norms published by the Ministry of Health defines an adverse event as “an unexpected situation or occurrence associated with healthcare that has or may have negative consequences for the patient and that is not related to the natural course of the disease.” This same document defines a sentinel event as “an unexpected event that results in death or serious physical or psychological sequelae or carries the risk of such consequences” (MINSAL, 2012).

Promoting a culture of patient safety is fundamental for healthcare institutions, especially within the nursing team. Because these professionals typically make up the greatest share of the healthcare staff in a hospital setting and provide a large portion of the hands-on care, nursing staff have an elevated exposure to committing errors. Therefore, the professional performance of nurses has a direct effect on the health outcome of patients as well as on institutional quality indicators.

Most academic institutions that train nurses and other healthcare professionals address the issue of patient safety, with the concepts of patient safety and quality of care as educational priorities. According to a study by Stevanin (Stevanin et al. 2015), nursing students are susceptible to committing errors in the clinical setting, underlining the importance of emphasizing patient safety during training.

The literature suggests that medication errors are the most common type of error (Reid-Searl et al., 2010c) as well as the principal cause of errors committed by nursing students during clinical rotations (Brady et al., 2009; Wolf et al., 2006; Hewitt et al., 2015). This type of error may have a serious impact on patient safety, quality of care, and students' perception of their own professional competence (Reid-Searl et al., 2010).

According to the literature, there are three major areas that contribute to the occurrence of adverse events involving students:

a) Issues with clinical systems and processes:

The aforementioned study by Stevanin et al. (2015) indicates that 46.9% of students perceive their clinical learning environments as unsafe. Possible causes of this perception were analyzed by Anna-Marie

Brady (Brady et al., 2009), in a literature review of factors contributing to medication errors committed by nursing students during clinical rotations. This author emphasizes that the numerous interruptions and distractions to which students are subjected while preparing and administering medications, along with the frenetic environment of the clinical service, tends to lead to errors (Hewitt et al., 2015).

Another element that may exacerbate this problem is poor communication among health professionals. In a study on improving comprehension on medication safety among nursing students, Hewitt (Hewitt et al., 2015) found that misreading the instructions, misinterpreting the order, and illegible handwriting contribute significantly to the propensity to commit medication errors. Another contributing factor was confusion between medications with similar names or labels. Finally, verbal prescriptions increased the likelihood of error, not just for medication administration, but for all types of procedures.

b) Elements associated with the academic training of nursing students

Academic institutions play a fundamental role in educating future nursing professionals on pharmacological safety, including ensuring that students possess the basic mathematical skills needed to perform the calculations to administer medications safely. Many studies have suggested that nursing students are inadequately prepared to calculate doses, which increases the probability of committing medication errors (Reid-Searl et al., 2010c; Wolf et al., 2006). Lack of pharmacological knowledge among students also contributes to the risk of committing a medication error (Reid-Searl et al., 2010c). A study of student perspectives by Mojtaba et al. (Vaismoradi et al., 2014) indicated that students felt that their education left them vulnerable to committing such errors.

Insufficient supervision by professional and teaching staff, inadequate communication between the academic and clinical institutions, and issues with quality of instruction may also play a role in this type of adverse event. Some studies have shown that professional nurses prefer not to have nursing students under their supervision and that levels of oversight are often inadequate, potentially contributing to the occurrence of medication errors committed by nursing students. On the other end of the spectrum, “oppressive” levels of supervision may leave a student feeling “over-supervised,” resulting in errors attributable to anxiety or nervousness (Minsal, 2012; Reid-Searl et al., 2010). In addition, the activities assigned during the clinical rotation are not always consistent with the objectives of the academic curriculum, sometimes because the professional nurses do not have a clear idea of the program's expectations. This problem, therefore, is attributable to inadequate communication between the academic and the clinical institutions (Reid-Searl et al., 2010).

c) Qualities associated with the student role

Students in the first years of study lack sufficient maturity to contextualize all of the factors must that come together to ensure excellent care. As a result, students may not perceive external factors, such as systemic and process-related issues, that may lead to errors (Latimer et al., 2017). Nichols et al. (2008) noted that errors committed by students are influenced by at least one extrinsic factor, and that inexperience may lead students to miscalculate the risks associated with the process of administering medications.

Another aspect of the student role is a potential lack of preparation and knowledge. When coupled with an incautious or overconfident attitude, students may make clinical decisions that fall outside their competence, occasioning unnecessary risk. On the other end of the spectrum, anxious students may avoid patients, resulting in errors of omission (Montgomery et al., 2014).

After conducting an exhaustive review, we have found plenty of international evidence regarding adverse events committed by nursing

students; however in Chile, at present, apparently this phenomenon has not been studied. Only the study by Moreno and Febré (Moreno Lobos and Febré Vergara, 2017) has been found, where they give an account of the effect of an educational intervention program about patient safety in nursing undergraduate students, highlighting the importance of clinical safety in nursing education.

This study aimed to analyze the adverse events reported by first-through fifth-year students from a private university in Santiago, Chile during nursing clinical rotations, as well as the factors associated with the errors, in order to generate our local evidence that will allow us to identify the main sources of error to establish risk management strategies in the drug administration process.

3. Methods

3.1. Study design

Quantitative cross-sectional descriptive study. This study was designed to characterize adverse events involving nursing students at Universidad de los Andes and to determine the major risk factors associated with these errors, in order to develop strategies to improve the culture of safety at the associated clinical and academic institutions.

3.2. Study population

The study universe was all first- through fifth-year nursing students at the Universidad de los Andes, representing roughly 550 undergraduate students. The unit of analysis was the Adverse Events Notification Form submitted by students. The total number of adverse events reported was 68, committed by a total of 53 students during the period between April 2012 and December 2018.

3.3. Data collection

In 2012, the School of Nursing implemented an Adverse Events Notification Form to report and monitor the occurrence of adverse events associated with students. The goal of this system was to identify areas of instruction associated with patient safety that might be deficient and to address these shortcomings in a timely manner. This form could be submitted on paper or via the school's website (Fig. 1).

3.4. Data analysis

The data were entered into an Excel spreadsheet and then analyzed using STATA 14 software. The mean and standard deviation was calculated for quantitative variable, and frequency distributions were calculated for qualitative variables. The chi-square test was used to determine whether or not there was a statistically significant difference between the classification of the hospitals and the types of errors committed and the contributing factors. Differences with a p value < 0.05 were considered significant.

3.5. Ethical considerations

This study was approved by the Scientific Ethics Committee of the Universidad de los Andes. To safeguard the identity of the students, results were coded.

4. Results

From 2012 to December 2018, a total of 68 adverse events involving nursing students during clinical rotations were reported. The incidence of adverse events has remained constant between 2012 and 2017, ranging between 1.1% and 0.4%, with a significant increase in 2018, reaching 6% (Table 1). The highest number of reports of adverse events was in the fifth year during internship with a total number of 50 cases

(73.5%). The reported number of adverse events by second through fourth year students remained similar with an average of 6 notifications per year. During the first year of the career, there were no notifications in the period of this study (Fig. 2).

The subjects with clinical practices that reported adverse events in this period were, Clinical Nursing II (fourth semester) with 10.3%, Adult Nursing (fifth or sixth semester) with 8.8%, Emergency Nursing (seventh or eighth semester) with 7.4% and Internship, in the ninth or tenth semester of the career with 72.1%.

Those events occurred in Medical-surgical services (55.9%), Emergencies (7.4%), Adult critical care units (4.4%), Palliative care unit (4.4%) Pediatric services (20.6%), Pediatric critical care units (5.9%) and Vaccination unit (1.5%).

The highest number of reports of adverse events comes from students who attend their practices in public hospitals ($N = 49$; 72.1%) compared to private hospitals ($N = 19$; 27.9%). There were no statistically significant differences in types of error (p -value 0.805) as well as in the contributing factors between public and private hospitals (p -value 0.391) (Fig. 3).

Given the total errors reported ($N = 68$), 94.1% were classified as adverse events ($N = 64$), and 2.9% as near miss and sentinel events respectively ($N = 2$). Among the adverse events that occurred, the most frequent was associated with the administration of an incorrect dose of medication (27.9%), followed by the administration of an incorrect medication (17.6%) and in third place, the administration of the medication to the incorrect patient (16.2%). Among the near miss, the most frequent were associated with the incorrect dilution of medication and the omission of the administration record. Sentinel events reported were due to patient fall and the performance of an incorrect technique (Table 2).

Among the factors that contributed to the occurrence of the error, the most common cause is the omission to check the "10 rights of drug administration" (85.3%), the lack of critical judgment, system errors, unpredictable outcome and inadequate supervision (Table 3). As can be seen in Fig. 2, the highest percentage of adverse events occurs in the fifth year of the career during internship, where the incorrect dose, the incorrect medication and the incorrect patient are the main errors, therefore, failure to check the "10 rights of drugs administration" is the first associated contributing factor in its occurrence.

5. Discussion

This study found that the most common types of error committed by nursing students are associated with medication administration. This finding is consistent with the literature, which suggests that this type of error is the most common cause of adverse events associated with undergraduate students (Hewitt et al., 2015; Vaismoradi et al., 2014; Fothergill and Caswell, 2014; Dich et al., 2000; Reid-Searl et al., 2010c; Stolic, 2014; Robinson Wolf et al., 2006; Reid-Searl et al., 2010; Simonsen et al., 2014). This situation may be attributable to inadequate computational skills on the part of the student, leading to inaccurate calculation of dosage, incorrect drug preparation, or erroneous conversion of units of measurement. A lack of mathematical competence is a risk factor for adverse events associated with medication administration. Pharmacology is another crucial area of knowledge to ensure patient safety. Nursing schools must constantly review and update their pharmacology curriculum to include relevant and practical information and competencies, as a basic or theoretical understanding of pharmacology will not provide the necessary training to integrate knowledge into practice (Vaismoradi et al., 2014).

Taking the time to reflect and review is undoubtedly a crucial step in administering medication. We propose that the capacity of the student to properly reflect is dependent on two components: the characteristics of the student, and the characteristics of the environment. An incautious student is more likely to commit errors than a student with a more developed critical judgment. Moreover, a stressful and hectic

Adverse Event Notification and Form							
<p>Introduction: This notification form is intended to learn about medication errors or other adverse events in which our students participate or incur during their clinical practices, as also to know about the circumstances surrounding this situation. This form is confidential; it is not intended to establish punitive sanctions towards students, but rather to reach a real knowledge of weak areas in which they must intervene, in order to reduce or prevent their occurrence. Please fill in clearly the requested items, ensuring precision and honesty in the data provided.</p> <p>Student's name:</p> <p>Year of career: Semester: Date of event:</p> <p>Health institution: Unit/service:</p> <p>Direct supervision from clinical teacher: YES ... NO...</p> <p>If YES, indicate clinical teacher's name:</p> <p>How would you categorize this event?</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">Near miss</td> <td style="width: 50%;"></td> </tr> <tr> <td>Adverse event</td> <td></td> </tr> <tr> <td>Sentinel event</td> <td></td> </tr> </table> <p>Specify the type of adverse event occurred:</p> <p>Was the institution notified? YES...NO...</p> <p>If YES, who received the notification?</p> <p>What were the actions followed by health institution</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>Briefly explain the circumstances surrounding the event</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>	Near miss		Adverse event		Sentinel event		<p>From what happened, mention how might this situation be prevented in the future</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>Student's signature:</p> <p>Date of report:</p>
Near miss							
Adverse event							
Sentinel event							

Fig. 1. Adverse event notification form.

Table 1
Incidence of adverse events reported by nursing students from 2012 to 2018.

Study year	Number of adverse events	Total number of students in clinical rotations	Incidence (%)
2012	4	371	1.1
2013	2	376	0.5
2014	7	415	1.7
2015	9	444	2.0
2016	10	480	2.1
2017	2	510	0.4
2018	34	571	6.0

environment, which is unfortunately characteristic of many clinical services, makes it more difficult for a student to concentrate and carefully review instructions. [Fothergill and Caswell \(2014\)](#) emphasized the importance of instructing students to review the “8 rights” of medication administration. We suggest that the learning process should include instruction that reflection and review revolve around the action; that is, that the process involves careful thought before, during and after the action.

As in our study, [Stevanin et al. \(2015\)](#) found that students were more likely to commit errors during their second through fifth years of study than during their first year. Our study also shows that errors appeared in the second year with a significant increase in the fifth year. This could be explained as the learning of first year nursing students is focused on the knowledge of basic sciences, spending most of the time in class and because they have very few clinical hours to learn basic patient care techniques. On the contrary, fifth-year students reported

the highest number of adverse events, probably related to the number of clinical hours that progressively increase as the level is higher.

Moreover, these final-year students are expected to act with greater autonomy and to undertake more complex procedures, increasing susceptibility to incurring errors.

Another possible explanation for this finding, as suggested by [Reid-Searl et al. \(2010c\)](#), is that final-year students exhibit a greater degrees of confidence regarding their knowledge and skills, which may influence the level of supervision that they receive. These students may become accustomed to being treated like a professional nurse, allowing them to lose sight of the fact that the clinical rotation is another stage of their education and that their acquisition and execution of competencies and skills should be undertaken gradually. A study by Kerry Reid-Searl et al. reported that students who commit errors often report having received inadequate supervision by the professional nurse. Our study confirmed this finding, as 70.6% of the errors reported occurred when the professional clinician was not present [Reid-Searl et al. \(2010c\)](#).

An alternative explanation for the higher rate of reported errors by fifth-year students is that these more mature students are more aware of the impact of failing to report an adverse event. In our study, the rate of reported events increased steadily after implementation of the Adverse Events Notification Form in 2012. This increase may be attributable to the school's increasing emphasis on honest, accurate, complete and timely reporting of adverse events committed by students.

During 2018, there was a significant increase in the number of adverse events reported. The causes of this phenomenon can be multiple. In 2012, the Nursing School decided to incorporate quality and safety contents in all clinical subjects throughout the career. In 2014, special

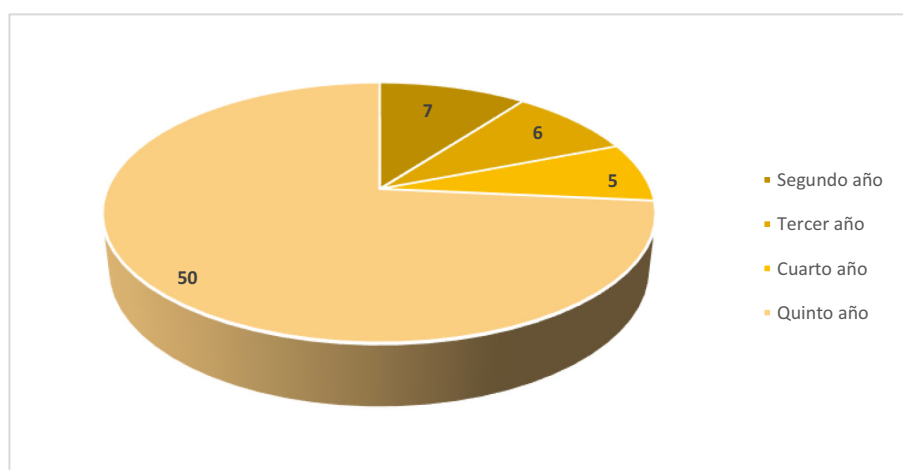


Fig. 2. Notification of adverse events according to the year of the career.

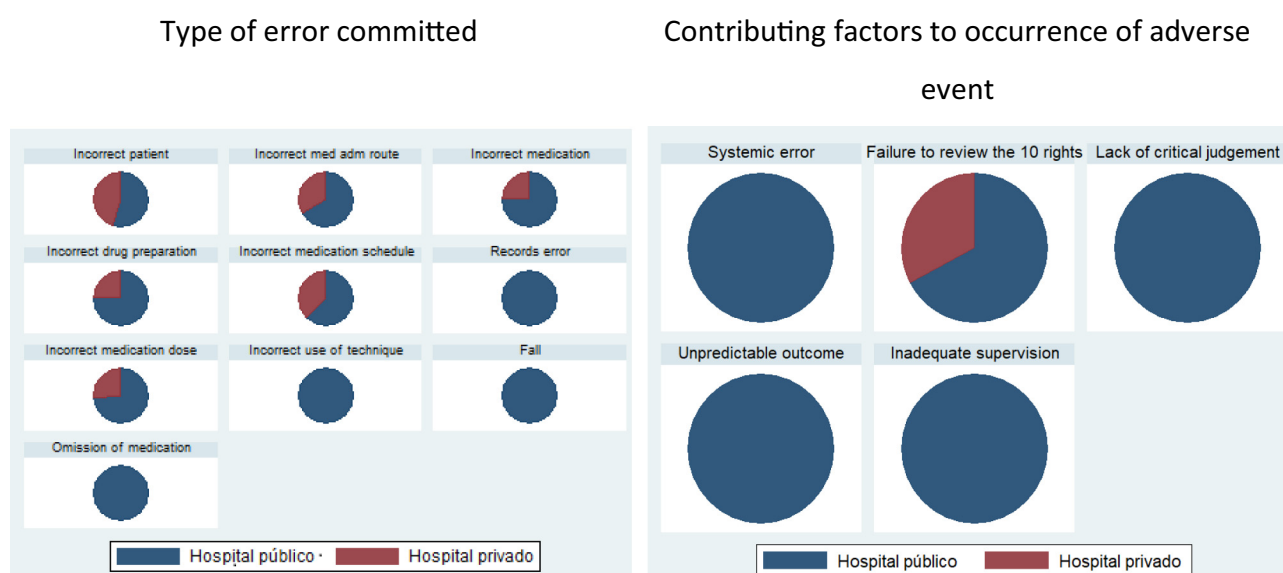


Fig. 3. Type of error and contributing factors according to hospital classification.

elements related to safety in health care and medication administration were introduced in the student's clinical evaluation guidelines. The importance of timely notification was also reinforced with the creation of the form to report adverse events in 2012. In addition, the increase in the requirements for the accreditation of health centers in the country triggered a series of measures to ensure patient safety and timely notification of adverse events, especially in clinical centers that

train health professionals. Another element related to the permanence of the teachers in the same clinical unit for longer periods of time, allows improving communication and establishing trust between the teacher and the clinical nurse to inform the events that occurred with the students. All these efforts, both from the School of Nursing and the health centers, may have influenced students to feel more motivated and secure when notifying an adverse event, which could justify the rise

Table 2

Types of errors occurred during the clinical practice of students from second to fifth year of nursing career, from 2012 to 2018.

Types of errors	N	%	2 year		3 year		4 year		5 year	
			N	%	N	%	N	%	N	%
Incorrect medication dose	19	27.9	0	–	1	5.3	1	5.3	17	89.5
Incorrect medication	12	17.6	3	25.0	0	–	0	–	9	75.0
Incorrect patient	11	16.2	2	18.2	1	9.1	0	–	8	72.7
Incorrect medication schedule	8	11.8	0	–	2	25.0	0	–	6	75.0
Incorrect medication administration route	6	8.8	2	33.3	0	0	3	50.0	1	16.7
Incorrect drug preparation	4	5.9	0	–	1	25.0	1	25.0	2	50.0
Omission of medication	4	5.9	0	–	0	0	0	–	4	100.0
Incorrect use of technique	2	2.9	0	–	1	50.0	0	–	1	50.0
Record error	1	1.5	0	–	0	–	0	–	1	100.0
Patient fall	1	1.5	0	–	0	–	0	–	1	100.0

Table 3
Contributing factors for the commission of adverse events.

Contributing factor	N°		2 year		3 year		4 year		5 year	
	68	100.0	N	%	N	%	N	%	N	%
System error	2	2.9	0	–	0	–	0	–	2	100.0
Failure to check the “10 rights of drug administration”	58	85.3	7	12.1	5	8.6	5	8.6	41	70.7
Lack of critical judgment	5	7.4	0	–	1	20.0	0	–	4	80.0
Unpredictable outcome	1	1.5	0	–	0	–	0	–	1	100.0
Inadequate supervision	2	2.9	0	–	0	–	0	–	2	100.0

in notification in 2018.

This study found that the most common type of medication-related error was incorrect dose (27.9%), followed by incorrect administration route (17.6%); the greatest contributing factor to these types of errors was failure to review the “10 rights of medication administration”. These results are similar to the findings published by Robinson Wolf et al. (2006), who reported that the most common medication-related error was incorrect dose, and that the major contributing factor was an erroneous action on the part of the student, attributable to lack of skill or knowledge. These issues are closely related to the underlying causes of error identified in our study, in which 86.7% of the errors committed were associated with failure to review the “10 rights of medication administration” and 7.5% with lack of critical judgment, both factors that fall under the category of erroneous action by the student.

Interestingly, the rate of errors was significantly higher in public than private institutions. While this issue does not seem to have been addressed by previous studies in the literature, we suggest that this finding may be attributable to two factors. First, public hospitals treat approximately 80% of the patients in the country, resulting in a greater demand for healthcare services and a significantly greater number of patients per nursing staff. This situation reduces the level of supervision that nursing students may receive during clinical rotations, especially during the final year of study. Moreover, the greater numbers of patients may produce a frenetic and exhausting environment for the student, with little space to reflect and pause to assess safety. This concept is consistent with findings from other studies (Brady et al., 2009; Nichols et al., 2008; Reid-Searl et al., 2010; Simonsen et al., 2014). Second, public healthcare facilities offer greater numbers of clinical rotation slots than private facilities, and therefore a greater number of students perform their clinical practice in public hospitals.

One limitation of this study is the possibility that adverse events were under-reported by students during these years. Although this aspect is difficult to control, it has not been an impediment to show the reality of the phenomenon under study. Our task as a School of Nursing is to be constantly emphasizing the importance of the notification of adverse events. A second limitation is related to the Adverse Event Notification Form used, because in some of its items the student must describe the incident, making difficult for researchers to group the data. This makes us rethink the need to modify the instrument for collecting information to facilitate future reading and analysis of data.

6. Conclusion

Ensuring patient safety and excellence of care is a moral and legal obligation of healthcare providers. The responsibility for mitigating the risk of healthcare errors falls not only on the facilities that treat patients but also on the academic institutions that train future professions. Therefore, academic programs for nursing students must cover the key elements necessary to ensure sound professional decision-making and excellence of care, such as mathematics, pharmacology, professional ethics, and critical thinking. This study found that nursing students are susceptible to committing medication-related errors, with a sharp

increase in error rate during the last year of the program. This finding is concerning, given that final-year students are expected to have integrated the tools necessary to deliver care safely by this stage of their training. Therefore, we suggest a re-evaluation of the learning and teaching strategies employed at the school of nursing, with a renewed emphasis on the individual learning styles of students and teaching styles of instructors. In addition, systems to ensure adequate notification, follow-up, and communication regarding adverse events associated with nursing students should remain a focus of attention within the clinical and academic setting in order to reinforce a culture of safety.

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Ethical approval

This study has been approved by the ethical committee of the Universidad de los Andes dated November 6, 2018.

Declaration of competing interest

Not applicable.

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