



Medication Errors Identification Rates by Healthcare Students

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Authors' contributions

This work was carried out in collaboration among all authors. Authors MSI and MZI designed the study, performed the initial statistical analyses, wrote the protocol and wrote the first draft of the manuscript. Authors NJA and MZI managed the refined analyses and revision of the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Medication errors caused devastating consequences affecting both the healthcare system and the patient's trust. Junior doctors, pharmacists, and nurses are prone to make these mistakes. Thus, this study served a purpose to evaluate the pharmacological knowledge of the healthcare students (HCSs) i.e. pharmacy, medical, and nursing students through detecting errors in the prescriptions, as this will reflect their performance once they come in real practice.

Methodology: A cross-sectional, descriptive study was conducted using a validated research tool consisting of demographics attributes (gender, race, duration of pre-university and age) as well as three prescriptions. The research tool was distributed to final year HCSs. Demographic data of the respondents were required to investigate the contributing factors in medication errors' identification. Data obtained were analyzed using descriptive and inferential statistics by using SPSS ver. 22.

Results: 197 students responded to this study. Findings show that pharmacy students yield high percentages compared to medical and nursing students in identifying errors in the prescriptions. 91.1% of pharmacy students were successful in recognizing the errors in prescription 1, 55.0% in

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prescription 2 whereas 96.2% in prescription 3. There was a significant association between the age of the respondents and their ability in identifying the errors ($p=0.012$). No significant relationship was observed between race, gender and duration of pre-university in identifying the mistakes in the prescriptions ($p>0.05$).

Conclusion: Pharmacy students had the highest percentage of medication error identification rates probably in light of the pharmacy curriculum focuses mainly on pharmacology and therapeutic monitoring. This study portrays the importance of additional clinical training in undergraduate programs to enhance student's pharmacological knowledge and their attitude towards patient safety practices.

Keywords: Medication errors; healthcare students; patient safety; pharmacy.

1. INTRODUCTION

A medication error is any preventable adverse event that can cause or lead to patients harm while the patients are under the supervision of a healthcare provider [1]. Types of medication errors include prescribing errors, medication administration errors, dispensing errors and patient compliance errors [2]. These errors can be due to lack of experience or knowledge about the medication, failure to apply the fundamental rule, misspelling a medication name and ignorance of important information such as patient allergy [3,4,5]. Undeniably, there is an urgent need to practically train the HCSs in how to screen the prescriptions appropriately, how to diminish prescription-related errors and avoid medication administration errors [6,7]. Though in the past, some of the studies counted the total number of dispensing errors by using self-reporting systems but these studies did not evaluate the clinical skills of the HCSs in medication error identification rates. In these studies, the total number of errors that occurred during medication dispensing was known because they only counted the number of dispensing errors, not their causes [8,9].

Medication errors can result in devastating consequences such as compromising patient confidence in the healthcare system, increase healthcare cost and may even result in serious mortality. It is the main cause of an adverse event in every 6.5% hospital admissions [10]. There had been several cases reported in which people being killed or paralyzed due to wrong drug administration by spinal injection since 1985 [11]. Besides that, a study shows that the medication error rate can be as high as 40% in Malaysia [12]. Drug safety is not a static concept. The current perception of the general public about healthcare providers has been changed perceiving them more equipped with evidence-based pharmacotherapeutics knowledge and improved clinical skills to minimize risks and

increase benefits [13]. Chances of occurrence of medication errors usually arise during dose calculations, dosage regimen changes, the route of drug administrations, and during the drug dispensing process. These errors could be caused by any healthcare professional i.e. the pharmacist, physician or nurse, and in both inpatients or outpatients [14,15].

A study done in Malaysia by Elkami et al. revealed that the majority of final year pharmacy students had a lack of knowledge about pharmacovigilance and adverse drug reactions [16]. In addition to that, it was found that physicians' trainees depend on the pharmacist to check all the medication errors in their prescriptions [17]. Even though drug treatments are the responsibility of both physicians and pharmacists, nurses are also involved when it comes to drug administration. According to Page and Mc Kinney, current pharmacology content is insufficient within the nursing program [18].

Hence, it is important to evaluate the rate of identifying medication errors among the HCSs as this will reflect their knowledge and skills after they practice as healthcare professionals. Information regarding the knowledge of students in this issue may provide data in formulating strategies to improve patients' safety. It was hypothesized that there will be significant differences in medication error identification rates among pharmacy, medical and nursing students. The main objective of this study was to compare the ability of HCSs in identifying errors, while the second objective is to explore factors that contribute to the differences in the rate of medication errors.

This study aimed to evaluate the rate of identification of medication errors among HCSs. Contributing factors such as gender, race, and duration of pre-university were further explored whether they affect medication error identification or not.

2. METHODOLOGY

A total of 243 final year pharmacy (semester 7), medical (semester 9) and nursing (semester 7) students from a public university in Pakistan were invited to participate in this study by distributing the vignettes. The numbers of respondents were 70 medical students, 123 pharmacy students, and 50 nursing students. Stratified sampling was utilized in this study. Inclusion criteria were final year medical, nursing and pharmacy students. The study was performed from July 2018 to November 2018.

In this descriptive cross-sectional study, the research tool was distributed to the final year pharmacy, medical and nursing students. The prescriptions used in this study were an adaption of Warholak et al. [18] study instrument which was used with permission. It had been validated and contextualized against the research objectives and medication availability in Pakistan. Respondents were informed about the objectives of this study using an explanatory letter attached to the vignettes. The research tool was made up of three prescriptions and supplementary patient data such as birth date, weight, drug allergies, current medications as well as a diagnosis were provided to aid in students' decision-making [17,19].

Prescription 1 contained a drug that sounds similar but had different indications. For example, Clotrimazole which is an antifungal drug is often confused with proton pump inhibitors such as pantoprazole. Prescription 2 contained a narrow therapeutic range drug but this prescription was made without error as quality control to check whether the answer chosen was due to knowledge or guesswork [17,19]. Prescription 3 was made with a wrong dosing calculation for high-risk groups such as pediatrics. For example, Paracetamol was given 15ml four times a day, which was higher than the recommended dose for infants which was 5ml four times daily. This will definitely lead to over dosage.

Once the respondents screened the prescriptions thoroughly, they identified whether the prescriptions contained errors or otherwise. If the respondents chose the answer option 'NO', they gave possible reasons, which may include drug allergy, wrong dosage, wrong dosage form as well as incorrect duration and indication.

Apart from that, respondents were required to fill up the demographic section, which included gender, age, course, duration of pre-

university and race. This was important in order to establish a relationship between demographic background and the student's ability in identifying medication errors. Approximately, each respondent took 10 minutes to complete the vignettes which were distributed in lecture halls.

This study was approved by the institutional review board of the university. All respondents who are willing to participate signed a consent form. The identities of the respondents were made anonymous and confidential throughout the study.

All statistical analyses were performed using the Statistical Package for Social Science (SPSS) version 22. The data obtained from the research tool were first summarized by using descriptive statistics such as frequencies and percentages to illustrate the respondent's demographic information. Next, inferential statistics i.e. univariate analysis using the Pearson chi-square test was conducted to analyze the association between the dependent and independent variables. Statistical significance for all tests was set at $p < 0.05$.

3. RESULTS

197 of 243 final years pharmacy, medical, and nursing students returned the vignettes, yielding an 81.1% response rate. Response rates for each of the professions were 61 of 70 medical students (87%), 103 of 123 pharmacy students (83.7%) and 33 of 50 nursing students (66%). The baseline characteristics of respondents are shown in Table 1. Respondents were primarily female (72.1%) and most of their age was between 20 to 30 years old (94.4%) for all the professions. Almost all (98.5%) of the respondents indicated having two or less than two years' duration of the pre-university study. The majority of the respondents were Punjabi (76.1%).

3.1 Medication Error Identification Rates

According to Fig. 1, the percentage of correctly identified medication errors varied among the groups. For prescription 1 (wrong drug indication) more pharmacy (91.1%) students were able to identify the medication errors. For prescription 2, which had no error, recorded the pharmacy (55.3%) students had the highest error identification rates compared to medical and nursing students. Similar results were also observed in which most of the pharmacy (96.2%) students were able to spot the error in prescription 3 (high-risk dose error).

Table 1. Characteristics of respondents

| Baseline characteristics (Categorical Variables) | Pharmacy (N ₁ =) N ₁ (%) | Medical (N ₂ =) N ₂ (%) | Nursing (N ₃ =) N ₃ (%) | Total surveyed (N ₃ =) N(%) |
|--|---|--|--|---|
| Gender | | | | |
| Male | 23 (11.7) | 30 (15.2) | 2 (1.0) | 55 (27.9) |
| Female | 80 (40.6) | 31 (15.7) | 31 (15.7) | 142 (72.1) |
| Age group (years) | | | | |
| 20-30 | 103 (52.3) | 61 (31.0) | 22 (11.2) | 186 (94.4) |
| Above 30 | 0 (0) | 0 (61.4) | 11 (5.6) | 11 (5.6) |
| Duration of pre-university | | | | |
| ≤ 2 years | 100 (50.8) | 61 (31.0) | 33 (16.8) | 194 (98.5) |
| >2 years | 3 (1.5) | 0 (0) | 0 (0) | 3 (1.5) |
| Race | | | | |
| Punjabi | 84 (42.6) | 45 (22.8) | 21 (10.7) | 150 (76.1) |
| Others | 19 (9.6) | 16 (8.1) | 12 (6.1) | 47 (23.9) |

*Total number of respondents are 197 students

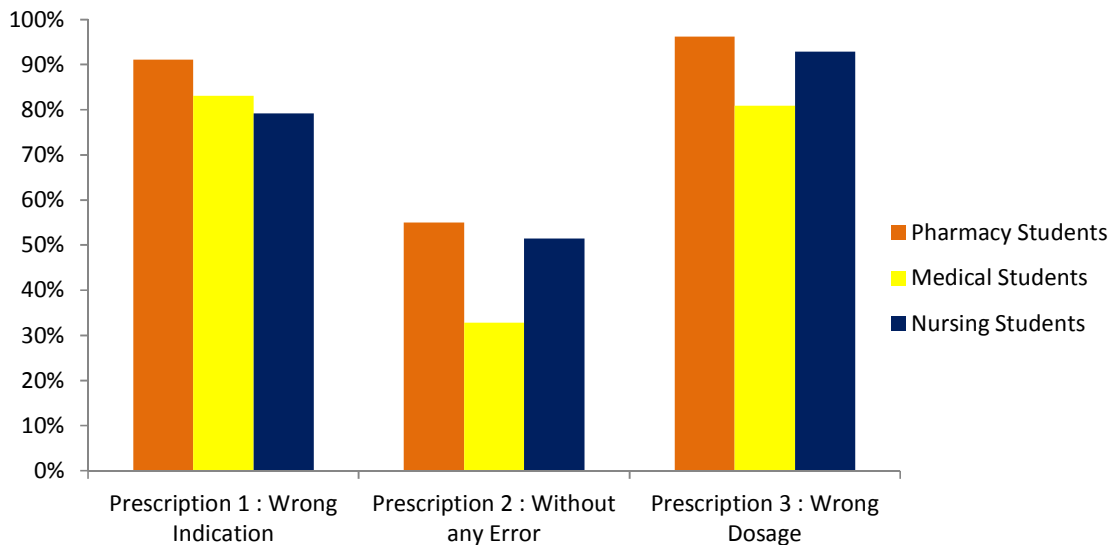


Fig. 1. Percentage of students in each course who correctly identified whether the prescription having or not having an error

3.2 Relationship between Variables

Association between demographic variables and the student’s ability in identifying medication errors were analyzed using Pearson’s chi-square. Table 2 shows there was a significant association between age and medication error identification rates ($p < 0.012$). Tables 3 and 4 indicate there was no significant association observed between the demographic background of the respondents (duration of pre-university, gender, and race) and error identification rates ($p > 0.05$).

4. DISCUSSION

Currently, there is limited research that assesses the ability of pharmacy, medical and nursing students in identifying medication errors in the prescriptions [18,19]. In the present study, an overall response rate of 81.1% was within the accepted range to represent the whole population of pharmacy, medical and nursing students in the studied university. The results obtained revealed that pharmacy students correctly identified more medication errors in the prescriptions compared to medical and nursing students.

Table 2. Association between age and medication error identification rates

| Questions | Age (years) | | | | |
|----------------|-------------|----------------|---------|-------|---------------|
| | 20-30 N (%) | Above 30 N (%) | P value | OR | 95%CI |
| Prescription 1 | 166 (89.2) | 7 (63.6) | 0.012* | 4.743 | 1.276 - 1.633 |
| Prescription 2 | 90 (48.4) | 4 (36.4) | 0.438 | 0.610 | 0.173 - 2.152 |
| Prescription 3 | 144 (77.4) | 10 (90.9) | 0.293 | 0.343 | 0.043 - 2.756 |

*Here, p-value of <0.05 was considered as significant

Table 3. Association between gender and medication error identification rates

| Questions | Gender | | | | |
|----------------|------------|--------------|---------------|-------|---------------|
| | Male N (%) | Female N (%) | P value N (%) | OR | 95%CI |
| Prescription 1 | 48 (87.3) | 125 (88.0) | 0.884 | 0.933 | 0.364 - 2.390 |
| Prescription 2 | 21 (38.2) | 73 (51.4) | 0.095 | 1.713 | 0.907 - 3.235 |
| Prescription 3 | 46 (83.6) | 108 (76.1) | 0.248 | 1.609 | 0.715 - 3.623 |

*Here, p-value of <0.05 was considered as significant

Table 4. Association between race and medication error identification rates

| Questions | Race | | | | |
|----------------|---------------|--------------|---------|-------|-------------|
| | Punjabi N (%) | Others N (%) | P-value | OR | 95%CI |
| Prescription 1 | 13 (87.3) | 42 (89.4) | 0.711 | 0.821 | 0.289-2.333 |
| Prescription 2 | 74 (49.3) | 20 (42.6) | 0.417 | 0.761 | 0.393-1.473 |
| Prescription 3 | 120 (80.0) | 34 (72.3) | 0.267 | 1.529 | 0.720-3.251 |

*Here, p-value of <0.05 was considered as significant

Similar to a study by Warholakand colleagues, this study evaluated the error identification rates among HCSs [18]. Undeniably, pharmacy students showed higher error identification rates due to the long hours they spent on pharmacology and pharmacotherapeutics subjects/content [17-21]. Although final year medical and nursing students had more experience due to clinical training in teaching hospitals and working experience respectively. On the other hand, the pharmacy school curricula mainly focus on medications and their dosage regimens as well as the mode of action compared to other professions.

Findings of a study conducted by Alefaniet al. [22] found that 75% of final year students in a university were satisfied with clinical pharmacy and pharmacotherapeutics subjects' contents whereas a study conducted by Page [11] and Shahrokhi [23] showed the majority of nursing students felt time allocated for pharmacology was insufficient [11,22,23]. Hence, it could be proposed that pharmacology has an inadequate profile within the nursing curriculum. From the medical curriculum perspective, it is needed to increase clinical pharmacology training in medical education as the majority of medical

graduates feel unready to prescribe medications after they graduate [24,25]. Most of the health care universities in Pakistan run two and a half years' preclinical phase of medical sciences and another two and a half years of clinical training [26]. However, to what extent the education in prescribing skills and patient safety practices were included in the syllabus is questionable.

All professions showed a higher percentage of students that were able to identify the error caused by look-alike and sound-like medications (LASA). This was probably due to familiarity since clotrimazole is widely used as an antifungal and not to treat gastro-oesophageal reflux disease (GERD). Probably due to working and practical experience together with personal experience, a high percentage of students chose the correct answer for prescription 3 that involved wrong dose calculation for the high-risk population. This type of error was included in this study because dosing error was found to be the most common type of prescribing errors [17,26]. Most of the students answered wrongly for prescription 2 that was written correctly because they might guess all the prescriptions contain an error.

It was expected that all pharmacy students could answer all three prescriptions correctly since they are known as drug-experts [19]. Although studies showed pharmacy students satisfied with the time allocated for the pharmacology syllabus, as Elkamiet al. [19] stated that the majority of final-year pharmacy students had a lack of knowledge about pharmacovigilance and adverse drug reactions [19]. Likewise, several studies also concluded that quantity and quality of medication errors' training are inadequate, therefore it is suggested that quality clinical education and practice skills are essential elements in overcoming knowledge deficits that lead to medication errors [20,27]. Thus, the exposure of pharmacy students in the clinical setting should start in the earlier semesters for them to gain experience after attending theory classes.

Regarding demographic characteristics, students who were between 20-30 years old had higher rates of medication error identification rates compared to students who were above 30. Nevertheless, the relationship was vague. Apart from that, the duration of pre-university, gender, and race did not influence the ability of the students to identify the medication errors in the prescription. This is consistent with Blegen et al. [27] who reported that no studies had demonstrated a strong relationship between students' characteristics and medication error identifications [28].

Continuous education programs for pharmacists, doctors, and nurses are imperative in reducing and preventing medication errors [17,29]. This study also emphasized the importance of incorporation of multi-disciplinary and inter-professional learning courses among HCSs in order to identify, address and prevent medication error occurrences [30]. This is because cooperation among healthcare professionals is essential to establish policies, strategies, and systems in reducing medication errors [29].

5. CONCLUSION AND RECOMMENDATION

Pharmacy students showed the highest rates of medication errors' identification compared to medical and nursing students. Extensive learning about pharmacology and therapeutic substances helped the students in choosing the right answers [17,18-21]. This study highlighted the early commencement of hospital attachments

following the pharmacological lectures for pharmacy students because early exposure to real-life patients can nurture their skills to improve their patient care. The outcomes of this study will act as a catalyst for future interventions and the development of educational tools for HCSs to maximize patients' safety [26].

6. LIMITATIONS

The selection of the respondents was limited to only one public university, the results were not generalized to all universities. It is recommended to extend this type of study to other universities to replicate findings. In addition, the research tool contained only three types of errors. Future studies should incorporate various other errors to obtain more precise and accurate results.

CONSENT

All respondents who are willing to participate signed a consent form.

ETHICAL APPROVAL

It is not applicable.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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