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ORIGINAL ARTICLE

ACUTE KIDNEY INJURY: SIMULATED DOSING ERROR IDENTIFICATION BY PHARMACY STUDENTS

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Summary

Pharmacists are responsible for dispensing drugs and protecting the patient by making sure that they use drugs appropriately. They play an important role not only in the overall cost implications of healthcare but also in the concerns about patient safety when using medication. The scope of this paper was to evaluate the practice of navigation of medical resources among pharmacy students through a simulated event of acute kidney injury using a prospective research methodology. A sample of 65 students was used, among which 2 failed to identify the error in dosing (3.1%) while 56 (86.2%) responded with the presence of error in renal dosing and recommended correctly. Only 7 (10.8%) of the study population had an incomplete recommendation. Even though a greater percentage of the student populations were able to identify dosing errors, there were a few that were unable to identify the errors. Even though this percentage is small, it is much significant when placed in various healthcare institutions and is likely to have a significant impact on patient safety.

Key words: dosing errors; medication error; mock-up training; pharmacy student

Introduction

A pharmacist is a healthcare professional tasked with the responsibility of dispensing medication and guaranteeing patient safety through the appropriate use of medication. The general objective of pharmacy practice is to provide medicine together with many other healthcare services to help people and the society make the most suitable use of their medicine. The World Health Organization/ International Pharmaceutical Federation (WHO/FIP) best summarize the role of the pharmacist as that of a caregiver, teacher, decision-maker, communicator, manager, lifelong learner, and leader. According to WHO, pharmacists provide care that seeks to "optimize patient outcomes and is key to the effective, rational and safe use of medicines" (1).

Despite the above definition, the existing role of pharmacists should be modified to include concepts in pharmaceutical care. Some of these concepts surround the identification and prevention of drug-related issues. For instance, it is noted that the role description of pharmacists should be able to include the identification of safe and cost-effective medications. Most of the interventions these professionals make should be as a result of adjusting the dose or monitoring the patient in the laboratory. Unfortunately, most pharmacists inclined to dispensing windows miss

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the chance to examine the problems presented by the patients and reduce their ability to help the physicians in making rational prescriptions. This is the same case with on-call pharmacists who may not be effective in this regard since they are far-away from the process of making decisions. The additional responsibilities placed on pharmacists are meant to improve the safety of medication and reduce potential errors (2).

As a result of the shortcoming in their role description, pharmacy students experience similar challenges as those of other medical students in the implementation of the acquired theoretical knowledge. One of the challenges observed by one research involves the lack of experience. Most pharmacists often lack different areas to practice in. Pharmacists at the consolidation level believed that their years of practice, adaptability, experience, as well as involvement at a level higher than at registration supported their level of practice. The research also revealed that the lack of specific training or qualifications was the key reason pharmacists thought they were incapable of practicing at an advanced level (3).

At the moment, the National Coordinating Council for Reporting Medical Error (NCCMERP) has suggested certain recommendations to minimize medical errors. These suggestions surround determining if a proper dosage was given and if the dosing guidelines were followed appropriately. The recommendations surround the use of technology in the delivery of healthcare. According to the NCCMERP, the use of technology is appropriate as long as its effectiveness is evaluated on a regular basis. While technology can result in a reduction in medication errors and promote patient safety, it has the potential to result in new forms of unintentional errors. Top recommendations are as follows. Orders that appear incomplete or illegible or seem to have certain concerns need to be clarified using a proven process before administering any drugs. Pharmacists are expected to use patient-safety technology, such as bar codes, computer order entry, and smart pumps where appropriate to promote the safe administration of medication. Another recommendation is that firms provide pharmacists with enough training on the administration of medicine and monitor or rather verify that users of technological devices show competency on the operation and limitations of devices (4).

Since healthcare revolves around the administration of medication, the real prescription presents substantial risks (5). For instance, recent research on the extent of medical errors in Australia revealed that the percentage of all hospital admissions that were related to medication were between 2 and 3%. The research sought to assess the number of medication errors and serious drug reactions that happen along an individual's journey through their stay at the hospital in Australia. The authors carried out a search of databases and online resources to determine published literature on medication safety in acute care settings in Australia, for the period ranging between 2008 and 2013. The findings provided the best available evidence from current research and indicated that errors were likely to happen in an estimated 9% of medication administrations in the hospital. These outcomes imply that medication safety is a significant issue at different stages in a patient's journey through acute care (6). Similar research was carried out in the UK to examine prescription errors in the National Health Services. The authors argued that prescription errors were the most popular form of avoidable medication errors. The outcome revealed that prescription errors could be corrected by introducing the multidisciplinary examination of practice, developing standardized prescription charts for all pharmacists to follow, and revision of existing clinical training protocols governing the prescription process (7).

Due to increasing errors in medication, pharmacy students must have a strong understanding of an ideal process for managing medication. This includes having knowledge on how to manage medication in different settings, whether in hospital or community sectors (8). The Australian Council for Safety and Quality in Health Care indicated that healthcare practitioners need to understand the processes involved in the administration of medication to identify what can go wrong. That means that they must understand the medicines management pathway, which details how consumers take medicines. The pathway involves nine steps and three background processes. The steps include – decision to treat and prescribe; record medicine order; review of medicine order; issue of medicine; provision of medicine information; distribution and storage of medicine; administration of medicine; monitor for response, and the transfer of verified information. On the same note, background processes involve procurement of medicines and management of materials; reporting and quality safety audit review; and communication (8).

These skills can be gained through hospital placements designed to impart important knowledge, attitudes, and skills that enable them to practice pharmacy at a higher level. In most pharmacy schools, clinical placements happen

mostly in community pharmacy with less exposure to hospital pharmacy. However, the exposure to community and hospital practice in some of the schools is more neutral due to greater access to sites of hospital placement. Unfortunately, most of the higher learning institutions in the UK find it more difficult to follow through with hospital placements for all their students pursuing a pharmacy program (9).

Appropriate medical administration practices by healthcare professionals are the foundation of achieving optimal health outcomes. It is therefore necessary for health systems to enhance the drug management process and provide healthcare professionals with appropriate training. Training would ensure that medical professionals have outstanding skills to appropriately administer medication, thereby reducing the risk of any arising issues related to medical health. It is suggested that pharmacists can be included in a healthcare team taking care of patients. While in this team, the pharmacist receives special training to identify medication-related problems MRP. Pharmacists practice pharmaceutical care services to deal with MRPs, improve compliance with medication, provide information on drugs, and raise awareness of unsuitable practices of prescribing medication. Such training could increase the number of patients receiving appropriate standard of care (10).

A number of studies have presented simulations as a suitable means of reproducing an ideal world experience (11-16). For instance, one research evaluated the accuracy of the self-assessment skills of learners. The authors defined simulation-based learning as an approach to discovery that involves standardized participants. The research involved a group of 8 students together with one pharmacist-assessor and one standardized patient. It was carried out for a duration of 10 weeks, where each learner was allowed to role-play the duty of a pharmacist and deal with a different standardized patient every week. Towards the end of the course, each learner had taken part in a minimum of 8 varying clinical simulations. The participants also received verbal and transcribed feedback from their peers, pharmacist-assessor, as well as the standardized patient (17).

Another recent research also sought to show evidence of the significance of simulations in training pharmacists. According to the authors, there is increasing interest in learning programs based on simulation to minimize medication errors. The prevailing assumption is that simulation training can enhance the knowledge, attitudes, and skills of pharmaceutical staff. As such, they analyzed the existing state of evidence in the field concerning the impact of human simulation on medical errors by conducting a systematic review on Medline for the period ranging between 2000 and 2015. The authors identified primary elements needed for effective simulation-based learning to prevent medical errors. These elements included scenarios design, perception assessment, and debriefing. The implication of these findings was that suitably controlled simulation was a good means to train staff in exceptionally occurring events and standard daily activities. Besides, training simulations seemed to be effective in preventing risks related to medical errors (18).

The renal system is responsible for eradicating medications through the urine in an unaffected format or as metabolites. A large proportion of medications are eradicated through the kidneys, and the decline in the function of the kidney serves as a risk factor for the accumulation of drugs and the development of serious effects. Controlling the dose of medications released through the renal system is important for guaranteeing medication safety and promoting improved health outcomes among patients with weakened kidney function (2, 19). Consistent with the above review of past scholarly work, the aim of this paper is to evaluate the practice of dealing with medical resources to achieve the most appropriate renal dosing among third-year pharmacy students.

Materials and methods

A complete pharmacy program takes a minimum of five years. The study enrolled pharmacy students in their third year, who had registered for the "Integrated Patient Care Laboratory 2 CPP 342" course during the 2020 academic calendar. A total of 65 pharmacy students were enrolled in the study. The selection of study participants was based on the fact that renal course topic was first introduced during the third year of the Pharm D program. The research was carried out in a simulated laboratory session. The students were asked to work in pairs on a set of acute kidney injury (AKI) cases that were previously revised and approved by an expert in the course of disease control and management. The lab facilitators then reviewed the answers to the cases with the students in small groups consisting of 5 students/group.

Management

Doses of renally eliminated drugs were lowered among patients with renal dysfunction. The doses were adjusted based on clinical trials. Since most clinical trials use the Cockcroft-Gault to assess renal function, it was used in the current study as well for this same function. The Cockcroft Gault equation was used to determine creatine clearance (2,19). A CrCL greater than or equal to 50 ml/min was regarded as normal. The specified dose of IV drugs was equated with the right dose based on the Cr Cl of the patient with the help of the Lexicomp-Clinical Drug information website.

Instrument

The study participants were asked to assess drug prescriptions according to the renal function status for accuracy and appropriateness (see appendix section). The answers were evaluated by a laboratory facilitator using a rubric for participation. An error was recognized, where present and the right recommendation pointed out showing confidence during the counselling process. Descriptive statistics were carried out to analyse and provide an explanation of the results. The descriptive statistics included percentages and means, which were used to describe demographics and clinical features of the study participants.

Result and Discussions

The results showed that a total of sixty-five students in their third year participated in the study. From the total number of participants, 2 were unable to identify any error in dosing. The 2 students had registered for the course "Integrated Patient Care Laboratory 2 CPP 342" and represented 3.1% of the overall number of students registered for the course. The students registered for the course are expected to graduate in 2023. Upon graduation, this same percentage of students are expected to get into actual practice. In the long run, these study participants are likely to subject patients into prescription errors. An error in prescription translates into increased cost of healthcare as well as prolonged stay in the hospital. Above all, it leads to wastage of the scarce medical resources available which might expose individuals to the strains of drug resistant species of disease-causing microorganisms. These findings are consistent with past research (10-11) indicating that medical related problems continue to occur among patients due to issues related to pharmacy prescriptions. On the other hand, 63 of the student participants were able to identify an error in dosing which represents 97%. Among these, only 7 (10.8%) students proposed incomplete recommendations. In sum, the findings of this study demonstrated that pharmacists do not always identify appropriate doses or provide help that can help prevent errors in prescription. So far, there are limited studies quantifying the ability of pharmacists to recognize and prevent possible medication errors. Hence, it is not easy to compare the performance of respondents in the current study with that of previous estimates. These results are summarized in Table 1 with illustrated chart in Figure 1 below.

Table 1. Participation Rubric Summary Results

Participation Criteria	Max points for each criterion	Total points for each criterion from 56 (86.2%) students	Total points for each criterion from 7 (10.8%) students	Total points for each criterion from 2 (3.1%) students
Is prepared for lab activities	2	2	2	0
Is actively engaged in lab activities	2	2	2	0
Adds a high-quality level of contribution to the activities (i.e., relevant, appropriate answers and questions)	2	2	1	0
Displays confidence during lab session	2	2	2	0
Total points	8	8 out of 8	7 out of 8	0 out of 8

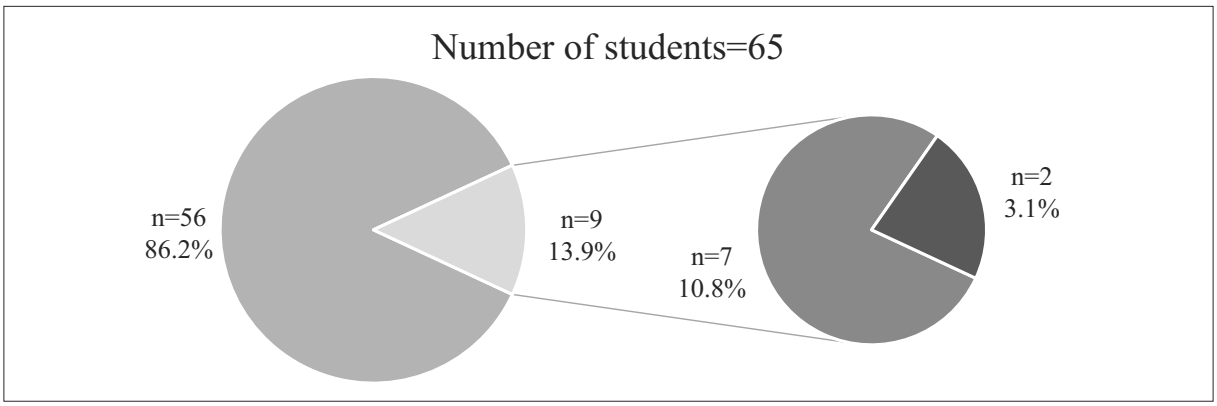

Figure 1. Participation Rubric Summary Results

Conclusions

The objective of the research was to evaluate the practice of dealing with medical resources to achieve the most appropriate renal dosing among third-year pharmacy students. The study was based on the fact that the renal system is responsible for eradicating medications through the urine in an unaffected format or as metabolites. The study findings showed that a majority of the students were able to identify and recommend the correct renal dosage based on the functioning status of the kidney. While a greater percentage of the student populations were able to identify dosing errors, there was some percentage that was incapable of identifying the errors. Even though small, this percentage is much significant that when placed in various healthcare institutions is likely to have a significant impact. Some of the learning limitations that might expose weaknesses in the training process used in pharmacy need to be addressed.

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Conflict of interest

The author declares that she has no conflict of interest.

Ethics approval

Considering national legislation regulating the safety of human subjects in accordance with institutional review board and bioethical standards (IRB Registration Number with KACST, KSA: H-01-R-059).

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Appendix

Participation Criteria	Max points
Is prepared for lab activities	2
Is actively engaged in lab activities	2
Adds a high-quality level of contribution to the activities (i.e., relevant, appropriate answers and questions)	2
Displays confidence during lab session	2

Case 1

History of present illness:
GK 55-year-old white male who presents to the ED with a CC of "SOB and chest pain."

Pulmonary embolism:
Significant findings include: dyspnea at rest that developed over the past 24-48hrs.

Review of system:
Cardiovascular: Tachycardic, R/R/R
Pulmonary: Diminished breath sounds in both lung fields
Extremities: left lower limb swollen below knee, red and very warm to the touch

Assessment & Plan
1. Admit patient.
2. Spiral CT to rule out pulmonary embolism (PE).
3. Administer IV radiocontrast dye prior to CT.
4. Bilateral lower extremity ultrasonography to rule out DVT.

Case 2

History of present illness:
AH is a 64-year-old female who is hospitalized for IV antimicrobials for treatment of infective endocarditis due to Enterococcus faecalis.

Review of system:
(-) fever, (-) chills, (+) decreased appetite, (+) light-headed when she got out of bed this morning.

Vital signs:
BP 112/54 mmHg; HR 105 bpm; RR 16 bpm; Temp: 99.8°F; O2 sat 99%

Pulmonary embolism:
Cardiovascular: NSR, +murmur, S1, S2
Pulmonary: CTA
Neuroolgy: A&Ox3, CN II-XII intact
HEENT: EOMI, PERRLA, dry mucus membranes, no jvd
Abdomin: soft, NTND, BS present
GU: deferred
Extremities: C/D/I no clubbing, cyanosis or edema.

Assessment and Plan:
1. Infective endocarditis. Continue IV antimicrobials
2. HTN: blood pressure slightly lower today, patient dizzy. Check vital signs Q2 hours.
3. Continue bowel regimen and VTE prophylaxis.

Inpatient medications: vancomycin 1g Q24 hrs, gentamicin 200 mg IV qday; enoxaparin 40 mg subcut Qday, Ramipril, hctz, atorvastatin, senna, Colace, acetaminophen 650 mg po Q4 hours PRN fever > 101F

Laboratories

Na 140 mEq/L	BUN 33 mg/dL	Hct 36.6%	Mag 1.9 mEq/L
K 4.1 mEq/L	SCr 1.5 mg/dL	WBC 9,300/mm3	BUN:SCR = 22
Cl 99 mEq/L	Glucose 111 mg/dL	Plts 356,000/mm3	CrCl 36.8 ml/min
HCO3 23 mEq/L	Hgb 12.2 g/dL	Phos 3.5 mg/dL	