

Causes of Medication Errors in Intensive Care Units from the Perspective of Healthcare Professionals

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INTRODUCTION

Patient safety is a priority for healthcare organizations worldwide,^[1] and it is a key step in providing a high quality of care.^[2] Patient safety is an attempt to assure that a course of medical treatment will proceed correctly and provide the best possible chance to achieve the desired outcome.^[3] In the Intensive Care Units (ICUs), patients are most vulnerable to being exposed to incidents as a result of high complexity in care, severe illness, underlying disease, and providing life-sustaining treatment.^[4,5]

Among patient safety issues such as patient identification, transfusion error, and falls, medication safety has been considered as a major indicator of healthcare quality.^[6] Medication error refers to any preventable

event at each stage of pharmacotherapy process, such as prescription, transcription, distributing medication, and administration,^[7] which can lead to improper use of medicines or harm to the patient.^[8]

Approximately 1 in 10 patients are harmed by healthcare.^[9] In the ICUs, on average, patients exposed to 1.7 errors per day and medication errors account for 78% of serious medical errors.^[10] Detailed statistics of medical errors is not available in Iran,^[11] but in a survey carried out by Farzi *et al.* to examine the rate of medication errors in the ICUs, 80% of participants reported the occurrence of at least one medication error per month.^[12]

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ABSTRACT

Objective: This study was conducted to explore and to describe the causes of medication errors in Intensive Care Units (ICUs) from the perspective of physicians, nurses, and clinical pharmacists. **Methods:** The study was conducted using a descriptive qualitative method in 2016. We included 16 ICUs of seven educational hospitals affiliated to Isfahan University of Medical Sciences. Participants included 19 members of the healthcare team (physician, nurse, and clinical pharmacist) with at least 1 year of work experience in the ICUs. Participants were selected using purposeful sampling method. Data were collected through semi-structured individual interviews and were used for qualitative content analysis. **Findings:** The four main categories and ten subcategories were extracted from interviews. The four categories were as follows: “low attention of healthcare professionals to medication safety,” “lack of professional communication and collaboration,” “environmental determinants,” and “management determinants.” **Conclusion:** Incorrect prescribing of physicians, unsafe drug administration of nurses, the lack of pharmaceutical knowledge of the healthcare team, and the weak professional collaboration lead to medication errors. To improve patient safety in the ICUs, healthcare center managers need to promote interprofessional collaboration and participation of clinical pharmacists in the ICUs. Furthermore, interprofessional programs to prevent and reduce medication errors should be developed and implemented.

KEYWORDS: *Intensive Care Units, medication errors, nurses, patient safety, pharmacists, physicians*

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Patients hospitalized in the ICUs receive more drugs than patients in the other units. Because of drowsiness or unconsciousness, ICU patients are not able to monitor and report the drug side effects: thus, in this unit, medication errors occur more often and have serious consequences.^[10] Intensities of medication errors are minor, severe, and life threatening leading to death.^[13] Medication errors lead to an increase in the duration of hospitalization^[14] and disability and death in up to 6.5% of hospital admissions.^[15]

In Iran ICUs, patients' medical records are on paper available to the healthcare team. Physicians enter medication orders in the patient's record, and nurses transcribe them into a Kardex. Nurses send requests for prescription medications to the pharmacy. Upon inspection, medicines were forwarded to the ICUs by the pharmacy.

In various studies, the phenomenon of medication errors has been discussed separately from the perspective of physicians or nurses. Due to the complex and stressful nature of the ICUs and the necessity of providing interprofessional care in this unit,^[16,17] improving patient safety requires participation and commitment of all members of the healthcare team.^[18] Thus, to explore the underlying causes of medication errors, the necessity of conducting a study through an interprofessional approach was felt by the researchers. Since we can understand a deep and thorough comprehension of the phenomenon medication errors and their cause through qualitative studies, this study was conducted to explore and describe the causes of medication errors in the ICUs from the perspective of the healthcare team.

METHODS

This paper presents the findings from part of a dissertation. The larger study employed a sequential mixed-methods design to develop an interprofessional program to prevent and to reduce medication errors in the ICUs. To achieve such an aim, first, healthcare professionals' experiences and perceptions about the causes of medication errors were examined through a descriptive qualitative method. The goal of qualitative descriptive studies is to provide a comprehensive summary in terms of everyday events; these studies are less interpretive than other qualitative approaches, such as the ones based on phenomenological or grounded theory.^[19]

We included 16 internal, surgical, poisoning, burn, and cardiac ICUs of seven educational hospitals affiliated to Isfahan University of Medical Sciences (IUMS) located in central Iran with a total of 190 beds. The data were collected from September to October 2016 using semi-structured individual interviews with

the participants. All interviews were conducted in a private room at the hospital or faculty. The time and place of the interview were determined with the participants' consent. The interviewer, while presenting a definition of medication error – any preventable event at each stage of pharmacotherapy process, such as prescription, transcription, distributing medication, and administration^[7] – asked the participants to express their experiences in this regard. The interviews were in-depth and semi-structured and began with general questions and continued with the main research questions, including:

“Has medication error ever occurred in your ward?”

“Why does medication error occur? Please explain?”

“Please give your experience of medication error.”

The interview duration was 30–60 min. Selection of participants and data analysis continued to reach a saturation point where no new concept emerges from data analysis. Data saturation refers to the repetition of discovered information and confirmation of previously collected data.^[20] Sampling stops when no new information and categories obtained.^[21] All interviews were performed with the written consent of the participants and conducted and recorded by one of the researchers (SF).

Participants of the study were selected from among physicians, nurses, and clinical pharmacists with at least 1 year of work experience in the ICUs and interested in participating in the study. Participants were selected using purposeful sampling method. In purposive sampling, researchers deliberately selected participants using two criteria: the fit between their experience and the research questions and the characteristics of being a “good informant.”^[21] Sampling was performed with maximum variation by considering the characteristics of participants regarding age, gender, work experience, and their perspectives and experiences.

This study used inductive qualitative content analysis, so we employed the qualitative content analysis method of Graneheim and Lundman for data analysis.^[22] The interviews were transcribed verbatim by SF followed by capturing the participants' perceptions. First, SF independently selected all the meaning units (sentences or paragraphs extracted from the participants' statements) and condensed the meaning units of three selected manuscripts (one physician, one nurse, and one clinical pharmacist). After that, the authors discussed the meaning units; after resolving discrepancies, SF extracted the condensed meaning units from the remaining transcripts and reviewed them with AI and MS. Subsequently, SF, AI, and MS assigned codes to the condensed meaning

units, reflecting the participants' words in a more abstract manner. Finally, similar codes were grouped into specific subcategories using an inductive process involving constant comparison, reflection, and interpretation by SF.

This study employed confirmability, credibility, dependability, and transferability to achieve the various aspects of rigor indicated by Guba.^[23] To enhance the confirmability and to facilitate the audit, detailed information was explicitly expressed for different stages of data gathering, analysis, and inference. To obtain the credibility, information was approved by peer debriefing and reviews of the data, codes, subcategories, and categories. The extracted codes and results were retrieved and shared with the participants to validate the congruency of the codes with their experiences. Dependability was achieved by engaging more than one researcher in data analysis (SF, AI, and MS). Recruiting participants with different demographic characteristics enhanced the transferability of the findings.

The Ethics Committee of IUMS approved the study (IR. REC.1395.3.267). Verbal and written informed consent was obtained from participants. After the introduction of the researcher and stating the importance and the objectives of the survey, the allowance of participants to interview was obtained. Participants confided that the information would remain confidential. We used numeric codes in place of personal names to secure the confidentiality of the interviews. The participants were free to withdraw from the study anytime.

RESULTS

Participants in this study included 19 members of the healthcare team (nurse, physician, and clinical pharmacist). Means and ranges of age and work experience of participants were 38 (25–56) and 11 (2–28) years, respectively [Table 1]. After analyzing the interviews, four main categories and ten subcategories had emerged [Table 2].

Low attention of healthcare professionals to medication safety

This category is composed of three subcategories: the low attention of physicians to medication safety, the low attention of nurses to medication safety, and the low attention of pharmaceutical technicians to medication safety. The experiences of participants indicated

medication errors in various stages of medication therapy due to the low attention of healthcare team to medication safety. Illegible and incomplete medication orders of physicians, including failure to write the drug dose or special care a drug needs, have caused medication errors at the prescription stage. One of the nurses said: "... in many cases a lot of physician's handwriting is illegible or their medication orders are incomplete. In fact, we cannot read the medication orders; for example, is it ceftriaxone or ceftizoxime? They do not write the exact dosage. We should contact them and ask them what it is that you wrote? What drug do you mean? How much is its dosage? Physicians do not usually write the considerations required while taking medication. Well, medication errors happen as a result."

Physician's inattention to the duration of medications including antibiotics has caused the patient to receive too much medicine. In this regard, one of the nurses said: "... It often occurs that the physician may not be paying attention and so the patient has been getting antibiotics more than *ten* days. Moreover, if the nurse does not remind the physician when they visit, antibiotics still goes on."

In addition, physician's insufficient medication knowledge leads to medication errors such as medication interactions and wrong medication orders. One of the physicians stated in this regard: "... The error can start from the doctor's wrong medication order which has different causes, including inadequate pharmaceutical knowledge: It causes them to write wrong medicine orders."

About one-thirds of nursing tasks involve medication administration, and any disregard for the medication safety can threaten patient safety. Participant's experiences show that a part of the medication errors in administration stage is caused by nurse's drowsiness, fatigue, talking, and interruptions while they are administering medicine. These lead to wrong pharmaceutical calculations and wrong dosages. Furthermore, other causes of medication errors are disregards for patient's similar names, lack of medication preparation at the patient's bedside, and lack of monitoring patients after giving them the medicine. One of the nurses said: "... While I was administering medication, the in-charge nurse interrupted my task and simply made me do another thing. One of my patients

Table 1: Participants' characteristics

Characteristics	Mean age (years)	Gender	Education	Mean work experience (years)	Job status
Physician	47	Male: 5	Specialist: 5	14	Anesthesiologist: 5
Nurse	34	Male: 2	Bachelor: 9	9	Nurse: 11
		Female: 11	Master: 4		Head nurse: 2
Clinical pharmacist	36	Female: 1	Specialist: 1	3	Clinical pharmacist: 1

Table 2: Categories and sub-categories of causes of medication errors

Categories	Subcategories
Low attention of healthcare professionals to medication safety	Low attention of physician to medication safety Low attention of nurse to medication safety Low attention of pharmaceutical technician to medication safety
Lack of professional communication and collaboration	Weak interprofessional interaction (physician and nurse) Weak interprofessional interaction (among physicians) Weak interaction of doctor and nurse with the patient and family
Environmental determinants	The nature of ICUs and patients Equipment and structure of ICUs
Management determinants	Insufficient management staff Lack of clinical pharmacist in ICUs

ICUs=Intensive Care Units

had to take clindamycin, another one pantoprazole, but I got distracted by his questions and answers, and so, I mistakenly gave the patient a shot of clindamycin instead of pantoprazole and infused pantoprazole instead of clindamycin for the other patient. Just think of it for a moment, to shoot clindamycin.”

Moreover, lack of the nurse’s pharmaceutical knowledge leads to dilute a drug in an incompatible solution, failure to observe the pharmaceutical storage time after solving, and multiple drug interactions as a result of giving patients the drugs together. In this regard, a clinical pharmacist said: “... The drug is often diluted in an improper solution and is given to the patient with an inappropriate rate. While administrating the medicine, nurses may not know these two drugs might interfere in case they are mixed or taken together; well, and thus the errors occur. The result may be an increase or decrease in something or even really dangerous. Giving the medication with an improper serum also occurs frequently. For example, 500 mg of vancomycin has to be infused in 100 ml of normal saline at least for 60 min. However, we see that they infuse the medicine more quickly. Many points are not taken adequately seriously and are just ignored such as after dissolution, how long the medication can be stored; or after the medication is poured into serum, how long it can be used.”

A part of medication errors is the result of failure to observe pharmaceutical safety in pharmacy, for example, sending oral medications with no labels on them. The lack of labeling has led the drug names to be unknown for nurses, and many of them administrate the medications just based on speculations and apparent similarities of drugs, this has caused errors. A nurse said: “... the cause of many errors originates from the pharmacy. I can see

medicines have been snipped at the pharmacy without any labels attached. Moreover, it is not clear what kind of drug they are. You see a small pill and are not sure what it is and you know, there are so many similarities of medication names! Well, when administrating medication, nurses look at medicinal shelf; the drug is not labeled! Well, then they look at the Kardex and see, for example, ranitidine, and one just think this pill must be ranitidine!”

Lack of professional communication and collaboration

This category is composed of three subcategories: weak interactions among the professionals (physicians and nurses), weak interactions within a profession (among physicians), and weak interactions between doctors and nurses with patients and their families. Experiences of participants indicated a lack of communication and collaboration among healthcare team. When visiting patients, some physicians do not provide nurses with sufficient data and information is not adequately exchanged between them. Doctor’s inappropriate reactions to nurse’s questions asked to clarify the medication orders provide the ground for multiple medication errors in the stage of prescription, transcription, and even for wrong medication administration. About this issue, a nurse said: “... Over and over, again the physician’s handwriting has been illegible, and we have had doubts about the exact medicine, but we have refused to call the physician and ask them because they usually get angry and think we are careless. Thus, we just transcript the same drug as we guess which has proved to be wrong many times...”

In the ICUs, according to the patient’s conditions, physicians with different specialties visit the patients on a daily basis or when required. The participants’ experiences show that physicians usually do not pay attention to each other medication orders, and this neglect and inconsistency among various medical specialties cause medication interactions, and prescribing the duplicate drugs or medications with adverse effects. One of the physicians, in this respect, stated: “... The neurosurgery service only checks medicines administered by themselves and does not have anything to do with drugs prescribed by the internal service, and so medication interactions may occur here. We often have medication duplication in prescriptions, and a patient simultaneously receives two drugs with the same effect but prescribed by two different services; this also causes medication errors...”

A part of medication errors originates from the lack of physician and nurses’ communication with patients or their families. Due to their underlying diseases, many patients may take various medicines in the house. In case of hospitalization of these patients in the ICUs

and if physicians are unaware of the patients' previous medication history, numerous medication errors such as medication interactions, weakening, or intensification of pharmacological effects may occur. About this issue, a physician said: "... when the patient admitted here; we often do not know what medications they have taken so far or have constantly been taking at home; that is why there would be problems in the treatment process. I had a patient in the treatment process; I encountered problems. The recovery process was not seen in him. I guessed he must have had a thyroid problem and decided to ask his family. They said he had been taking levothyroxine for years and as his physician, I was not informed. We should have a good relationship with patients and their families to get aware of the medications they might have been using at home."

Environmental determinants

This category is composed of two subcategories: (1) the nature of ICUs and patients and (2) equipment and structure of the ICUs. Data analysis showed that the nature of the ICUs, the patient's condition, and facilities of this unit had paved the way for medication errors. The participants stated that stress and heavy workload have caused them to give wrong medication, unintentional omission of a drug, and cases alike. To clarify this issue, a nurse said: "... the workload in the ICUs is high, and the patients here are ill. Three patients in the ICUs need as much care, and attentions as 20 patients do in general unit. There are high sensitivity and stress in ICUs. The patients make us busy. Very often, medications are not given to patients on time, or medication may even omit unintentionally..."

Patient's complex conditions, multiple underlying diseases, and the number of patient's drugs have caused medication interactions, low dosage, or giving the medication at a wrong time. In this regard, a physician said: "... in the ICUs many patients are hospitalized for a long time, and their various organs are disordered. The patients here very often have multiple underlying problems such as hypothyroidism and diabetes, and these make the situation more complicated. They take many drugs and thus, serious medication interactions happen frequently."

Facilities of the unit, including insufficient light and disorderly drug shelves due to the large number of medicines, result in the nurses making medication mistakes. About this problem, a nurse said: "... the environment plays a major role in the occurrence of errors. Lack of light in the ICUs can cause errors. There is not enough light at the site of patients' drug shelves. When picking up medicines from the shelves, we need to turn on the overhead lights to avoid mistakes. Well,

however, we do not want to disturb the patients' comfort and do not turn on the light, especially at 06:00 or 24:00. The wrong medication is often picked up by the nurse and given to the patient..."

Management determinants

This category is composed of two subcategories: (1) Staffing's insufficient management and (2) lack of clinical pharmacist in the ICUs. An inadequate number of nurses and increased working shifts lead to multiple medication errors, including administration of wrong medication and giving the medication with the wrong solution. One of the nurses said: "There are few and insufficient nurses in the ICUs. When a nurse has to take care of 3 patients in the ICUs, it is clear that they will get exhausted and may make mistakes. We often have long shifts. Long shifts make us tired and we, consequently, make mistakes when administering medication to the patients."

The absence of clinical pharmacist leads to medication errors in various stages of medication therapy including prescription and administration. In this regard, a physician said: "... one of the leading causes of the medication error is that we do not have clinical pharmacist to comment on the medication interactions alongside the intensive care specialists in the ICUs or the specialists of main service such as surgery or internal..."

Lack of a consistent prescription format in the ICUs has caused the physician to use a combination of Persian and English as the written language of the prescriptions. This style of writing has caused nurses to make mistakes when transcribing. In this regard, a physician said: "... medication errors occur because of the type of language used by a doctor in prescription. Point in Persian is exactly like slash in English, and it may be confused with the number 1 in English and thus, the dosage of medication may transcribe mistakenly."

DISCUSSION

The findings of this study have provided a clear understanding of the causes of medication errors in the ICUs of the educational hospital in Isfahan, Iran, from the perspective of healthcare professionals. Little attention to the medication safety by the care providers has led to multiple medication errors such as giving wrong medication, drug interactions, drug infusion at an inappropriate rate, and so forth. The participants reported the following as the causes of medication errors: Incomplete medication orders including failure to write the dosage or route to use a drug and illegible medication orders. These findings coincide with the result of Ammenwerth *et al.*, Néri *et al.*, and Ebrahimpour *et al.*'s studies.^[24-26] Manual prescription is one of the causes of

medication errors.^[27] Hence, computerized prescription order entry can improve communication between healthcare team to reduce the occurrence of mistakes.^[28]

The nurses, participating in the interviews, considered interruptions or talking while administering medication or doing pharmaceutical calculations as the causes of giving patients erroneous drugs or the wrong dosage. Westbrook *et al.* stated that interruption increases the chances of errors in nursing work so that any interruption increases medication errors by 12.5% and the severity of the errors increases with the number of interruptions.^[29] If the nurse gives the drugs without being interrupted, the probability of error decreases to 2.3%.^[30] Furthermore, the participant's experiences indicated that the lack of physicians and nurse's pharmaceutical knowledge causes medication interaction and wrong dosage. In the study of Cheraghi *et al.*, the leading cause of medication error was the lack of pharmaceutical knowledge and false medication calculations of nurses.^[31] In addition, in this respect, Cleary-Holdforth and Leufer stated that due to the role the lack of pharmaceutical knowledge plays in error occurrence, education concerning drug and medication safety is the most important strategy to prevent such errors.^[32]

Inadequate collaboration between healthcare professionals, the lack of physician and nurse's communication with patients, and receiving a defective medical and nursing history cause a broad range of medication errors at the stage of physician's prescription including medication interactions, medication duplication, and intensifying or weakening effects of medications taken by patients and also at the stage of nurses' transcription such as recording the wrong drug or wrong dosage. The nurse-physician relationship is significant, and the main objective of these two related professions is to provide safe and high-quality care for patients.^[33] Any conflict between members of the healthcare team can threaten patient safety and reduce the quality of care.^[34] Martin *et al.* stated that, according to JCAHO, failure of communication among the members of the healthcare team is responsible for 60% of adverse events with potential adverse effects on clinical outcomes and by increasing cooperation between professions; their relations can be improved.^[35] Interprofessional collaboration is a process in which different professions work together as a team to achieve a common goal (improving healthcare).^[36] Therefore, with respect to patient safety, the lack of human resources, and effective and efficient care, interprofessional collaboration is a top priority in healthcare.^[37]

Lack of coordination among physicians and ignorance to patients and their families in the treatment process have led to inaccurate medication reconciliation in the ICUs.

Medication reconciliation is a formal process done by the collaboration of healthcare providers, patients, and their families to guarantee the coherent transmission of accurate and adequate medication information. It requires a regular, systematic, and comprehensive review of a patient's drug to ensure accurate assessment before stopping, changing, or ordering new medicines. Active involvement and effective participation of patients and their families in the process of medication reconciliation is the key strategy to reduce prescribing errors and thus to prevent any harm to the patient.

Unsuccessful medication reconciliation seen in 67% of the hospitalized patients mainly occurs as a result of imperfect information about the patients' medications, and 11%–59% of the wrong medication reconciliation is accompanied by the risk of harm to the patient.^[38] Patients are the cornerstone of healthcare services, and in the team-oriented care, patients, their families, and companions are involved in the care team.^[39] Patient centeredness should be taken into consideration in interprofessional collaboration.^[36] Therefore, medication reconciliation is a useful tool that requires serious attention by healthcare team to prevent serious medication events.^[38] Obtaining patient's drug history from them, their families or caregivers, and the healthcare team can avoid medication interactions or duplications.

Due to the sensitive and complex conditions such as regular monitoring of the critically ill patient's status, higher mortality rate, and more occupational stress in the ICUs compared to other units, there can be errors in the process of providing care to patients.^[12] Participants mentioned heavy workload, fatigue, stress, and insufficient light in the ICUs as factors affecting the occurrence of errors. The role of these factors is approved in other studies. Jones and Treiber listed the working conditions and the environment in which medication therapy takes place as the main causes of the errors.^[40] In studies by Leufer and Cleary-Holdforth and Farzi *et al.*, nurse's distractions and interruptions due to busy work environments and high workload caused medication errors.^[14,41] In another study by Mahmood *et al.*, the participants stated the lack of light and excessive noise as the causes of the errors.^[42]

The incidence of medication errors is not merely due to the lack of healthcare team's skills, but management problems are also involved in medication errors and poor quality of care. An insufficient number of nurses and a large number of patients, in other words, noncompliance between the ratios of nurses to patients, was mentioned as one of the underlying causes of medication errors; these findings coincide with the result of studies done by Wilkins and Shields, and Gonzales. In these studies too,

the low ratio of nurses to patients was involved in the causes of medication errors.^[43,44]

Furthermore, the participants reported the absence of clinical pharmacist as one of the reasons for some medication errors such as medication interactions at the prescription stage. Studies show that the presence of hospital pharmacist causes a significant reduction in medication errors at the prescription stage and preventable adverse drug events.^[45] Participants noted the lack of a unique prescription-writing style as another cause of the medication errors. The lack of adequate supervision by managers of healthcare centers on physicians' prescription method has caused them to use a mixture of Persian and English writing. For instance, a point in Persian is exactly like slash (/) in English and also it may be confused with the number 1 in English, and thus, the dosage of medication may be transcribed mistakenly. Thus, an identical format for prescription writing (only English or only Persian) must be notified by managers to the healthcare teams, and there must be adequate supervision of its implementation process.

Although it is the nature of qualitative studies, the limitation of this study is the low number of participants that may reduce its generalization to different places.

Medication errors in the ICUs of the educational hospital in Isfahan, Iran, occur as a result of multiple factors including little attention to medication safety, lack of professional communication and collaboration, and management and environmental factors. The healthcare team's weak interactions with patients and their families have led to unsuccessful medication reconciliation, resulting in medication errors which threaten the patient safety in the ICUs. Appropriate interactions with patients and their families and creating electronic records for them can help improve patient safety and successful medication reconciliation. Therefore, increasing interprofessional collaboration and using information technologies such as electronic medical records and computerized prescription order entry can play an essential role in solving this problem, preventing and reducing medication errors and improving patient safety. It requires serious attention of Iranian managers and policy makers in the health field.

AUTHORS' CONTRIBUTION

Study concept and design, Sedigheh Farzi, Alireza Irajpour, Mahmoud Saghahi, Hamid Ravaghi; Analysis and interpretation of data, Sedigheh Farzi, Alireza Irajpour, Mahmoud Saghahi, Hamid Ravaghi; Drafting of the manuscript, Sedigheh Farzi, Alireza Irajpour, Mahmoud Saghahi, Hamid Ravaghi; Revision of the

manuscript for important intellectual content, Sedigheh Farzi, Alireza Irajpour, Mahmoud Saghahi, Hamid Ravaghi; Study supervision, Alireza Irajpour, Mahmoud Saghahi, Hamid Ravaghi.

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Conflicts of interest

There are no conflicts of interest.

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