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Perceptions of Health Care Providers about Medication Errors Outcomes

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Abstract

Background: Medication errors have been associated with serious consequences for patient and family, health care providers, and health care institutions. However, health providers' perceptions about the outcomes of medication errors in Botswana have not been studied. This paper reports health care providers' perceptions about the outcomes of medication errors in selected health facilities of Botswana.

Design: The study employed an explanatory mixed-methods design with 130 nursing, medical, pharmacy and anesthesiology personnel in multi-level health facilities across the major regions of the country. Data collection started in July 2015 and ended in November 2017.

Methods: The quantitative component of the study had 130 participants responding to a structured questionnaire whereas the qualitative component had 16 of the participants participating in semi-structured in-depth interviews. Descriptive statistics were used for quantitative analysis whereas qualitative analysis employed the content analysis method.

Findings: The study participants were only slightly concerned about the negative outcomes of medication errors. However, positive medication error presented an opportunity that could help them to prevent error recurrence. Gaps were poor error reporting and failure to attend to the psychological impact of medication errors on staff.

Conclusions: As medication errors rarely reached the patient and were rarely fatal, participants were not much concerned about their negative outcomes. However, positive error outcomes were usually an alert for increased staff's vigilance in handling medications. Findings of the study could guide improvement in medication error reporting, counseling for health care providers, and vigilance in managing medications. They could also guide strengthening continuing professional development for staff, and up-scaling the use of technology in managing medications.

Keywords: Medication Errors Botswana, Medication Errors Counseling, Medication Error Negative Outcomes, Medication Errors Outcomes, Medication Error Reporting, Medication Error Positive Outcomes

Introduction

The purpose of this paper is to share the results of a study addressing medication errors in Botswana. Whereas the study addressed several aspects of medication errors, the paper focuses on outcomes of medication errors. Sharing findings on the outcome of medication errors for patients and family, health care providers and health care facilities in Botswana and similar contexts could motivate managers of health facilities, health care providers, patients, policy actors, and the public at large for a collective effort in preventing medication errors. Findings could also inform future research on medication error for improved safety of care.

Background

Although only a few medication errors have fatal outcomes, they carry liability risk to health care institutions that involves loss of reputation with loss of actual and potential clients, financial loss, and demoralization of staff with decreased quality of care [1-4]. In the US, preventable adverse effects cause 4-6 extra days of patients' hospital stay at a cost of U$5,857 and ambulatory care mortality and morbidity at an annual cost of U$76.6 billion [1]. Analyzing adverse drug reaction data base reports, Winterstein, Hatton, Gonzalez-Rothi, Johns, and Segal found that certain drug classifications accounted for the majority of adverse events [5]. Such drugs included anticoagulants (heparin at 93.8% and warfarin at 28.7%) that accounted for over one third of preventable drug adverse events, the opiate agonists (morphine at 8.5% and miperidine at 1.9%), insulin (6.9%), midazolam (3.5%), digoxin (2.2%), phenytoin (2.2%), Cyclosporine (1.6%), and promethazine (1.6%). Psychoactive drugs including opiate agonists, benzodiazepines, antidepressants, hydantoins, skeletal

muscle relaxants, promethazine, and diphenhydramine were found to be involved in drug-drug interactions usually causing respiratory depression [5].

Medication errors can have serious consequences for patient and family, health care providers involved in the error, and health care institutions. In a study of adverse drug events in anesthetic practice, two near-fatal incidents involving intravenous administration of wrong medication and wrong dose caused by close similarities of medication ampoules/multiple dose vials were reported [6]. Consequences of medication error outcome for health care providers have been feelings of guilt, depression, and anxiety leading to job dissatisfaction, as well as lawsuits, and loss of the job [7,8]. Outcomes for medication errors for health care institutions have been loss of reputations with reduced patients' volume, and financial costs related to increased patients' stay, tests, treatment for adverse events and law suits [4,9]. All medication outcome studies reviewed have been in developed countries. No prior studies have investigated medication error outcomes in Botswana.

Design

The study employed an explanatory mixed-methods design with 130 health care providers usually managing medications comprising nursing, medical, pharmacy and anesthesiology personnel in multi-level health facilities across the major regions of the country. The quantitative component of the study had 130 participants responding to a structured questionnaire covering different aspects of medication errors, whereas the qualitative component had 16 participants selected from among those participating in the quantitative component participating in semi-structured in-depth interviews.

Methods

Both the questionnaire and the interview guide were developed by the researchers after a thorough review of literature on medication errors and were refined in a pilot study. Sampling for the study was multi-stage. First, the major geographical regions of the country were conveniently selected. Then different levels of hospitals (referral, district, and primary) based on the complexity of services rendered were also conveniently selected. Clinics and health posts within the catchment areas of selected hospitals were randomly selected. Potential study participants were stratified by cadre before they were randomly selected using proportional representation. The qualitative sample was purposely selected from the quantitative participants, based on their responses to the questionnaire that suggested that they could provide the researchers with some in-depth understanding of medication errors. An effort was made to sample from all categories of the personnel and all regions of the country represented in the quantitative sample.

The study's human subject protocol was approved by the researchers' employer, the government department responsible for health research matters, and the agencies at which the study participants were employed. The research protocol was piloted at a health facility similar to those sampled for the study. No audio and visual recordings were done; this helped ensure that data collection remained as unobtrusive as possible as the study was the first of its kind in the country on medication errors, a rather sensitive area.

Each interview was conducted by the primary interviewer and at least one other researcher concentrating in note taking. None of those approached declined being interviewed. Interviews were conducted in private rooms at the health facilities and they 45 minutes to 1-hour 20 minutes long. The 15 reviewed medication error incidents consistently involved wrong medication. The only incident that was different was that of an incomplete prescription record. The pattern of the health facilities' response to the errors was also consistent. After reviewing 13 incidents, already there was indication that data were saturated. Three additional incidents did not add much value to what had been reported. The researchers therefore concluded that the 16 reported incidents provided saturated data and that there was no need to identify additional participants for interviews.

The research question addressing medication error outcome read thus: "What are the consequences of medication errors on patient outcomes, health care providers and the health care system?" This question was responded to both quantitatively and qualitatively. Quantitatively, medication error outcomes were measured by a 12-item Likert scale with each item having 4 response options ranging from 0 (not at all through 1 (rarely), 2 (sometimes) 3 (often) to 4 (all the time). The negative sub-scale consisted of eight (8) items that elicited respondents' perceptions about the outcomes of medication errors for patient and family (3 items), health care provider (2 items), and the health facility (3 items). The items were labeled "negative" because they were undesirable actions or perceptions. The positive sub-scale consisted of 4 items that elicited participants' perceptions about the lessons learned from medication errors and they covered lessons for health providers (2 items) and lessons for the health facility (2 items). The items were labeled "positive" because they were desirable actions or perceptions. Responses for the two sub-scales were scored separately in order that they did not cancel out one another. The possible score for each of the two sub-scales was obtained by summing the responses; and the scores ranged from 0-32 for the negative outcome items and 0-16 for the positive outcome items. Correlations between sub-scales of the medication error outcome scale and between the subscales and other variables in the study were computed.

Qualitatively, each participant was asked to share an incident of medication error that they had witnessed or been involved in. They were asked to report the details of the incident including precipitating events, how it happened, type of health care provider involved, medication involved, stage of medication processing involved, and how the process evolved including reporting, error outcome, and the management's response. In order to enhance accuracy in the researchers' interpretation of the participants' responses, at intervals, and at the conclusion of each interview, interviewers validated interviewees' responses with each participant. Constant comparison was used to check the consistency and difference of responses across participants. This helped in identifying the role of contextual and demographic factors in participants' responses.

Quantitative analysis

Mean scores were computed for the entire sub-scales, for individual items, for health facilities categorized by levels, and for cadres of health care providers. Mean scores were then converted to percentages by dividing the obtained score by the highest possible score and multiplying by 100. Frequencies of responses for each item were computed. Internal consistency reliability of the sub-scales was also computed. Correlations of sub-scales and between the sub-scales and the incidents of medication errors were also computed. Frequencies were compared by level of health facility and type of provider.

Qualitative analysis

Participants' responses were subjected to content analysis using sentences as units of analysis. The primary interviewer transcribed and coded each participant's response. Field observation notes were also taken into consideration. Thereafter, the team met to consider coding, agree on the codes, proceed into the development of categories and sub-categories. The research questions were used to guide naming of themes, representing directed content analysis. However, the study participants were allowed freedom to discuss issues that they deemed important. Within each theme provided by the research question, participants' own voice was amplified (conventional content analysis). The analysis therefore accommodated both directed and conventional content analysis. Comparison of themes was made across levels of health facilities and type of health care provider. Trustworthiness of the qualitative findings was enhanced through a team-approach to data coding and analysis. Other mechanisms for ensuring trustworthiness of the findings were a detailed description of data collection and data analysis procedures, validation of the responses with participants, the use of constant comparison method, reconciliation of quantitative and qualitative results, and allowing participants to direct the flow of the discussion within each theme.

Integration of the mixed-methods findings

Findings from the two methods were integrated to arrive at the final conclusion about the study findings. For instance, it was determined whether high score on perceptions that medication errors resulted in law suits for staff was supported by reported incidents of medication errors that culminated in law-suits for staff.

Study Findings

Characteristics of the participants

A total of 130 participants from a total of 18 health facilities participated in the study. Sixteen of the participants provided data through in-depth interviews. Details about the demographic characteristics of the study participants are provided in Table 1.

Table 1: Demographic Characteristics of the Participants

No. of participants by type of health facility	General referral	48 (36.9%)
Levels of health facilities	Specialized referral	11 (8.4)
	District	10 (7.7)
	Primary	25 (19.2%)
	Clinics	7 (5.4%)
	Health posts	6 (4.6%)
Participants' functional area	Private	23 (17.7%)
	Total	130 (100%)
	Nursing	78 (60%)
	Medicine	23 (17.7%)
	Pharmacy	20 (15.4%
	Anesthesiology	9 (6.9%)
	Total	130 (100%)
Gender	Females	69 (53.4%)
	Males	61 (46.6%)
	Total	130 (100%)
Mean Age		38.3 Yrs (SD=9.8)
Mean work experience in Botswana		11.8 Yrs (SD=9.0)
Mean total work experience		13.6 Yrs (SD=9.15)

Validity, reliability, and correlations of the medication outcome sub-scales

The internal consistency reliability was .90 and .80 for the negative and the positive outcome sub-scales, respectively. Change of protocol as an outcome of medication error yielded the highest increase in alpha if deleted, increasing the alpha by .30 while deletion of the rest of the items decreased it by .10. The positive and negative subscales of medication error outcomes were correlated (CORR =.554**), suggesting that the more participants were concerned about the negative consequences of medication errors, the more they were cautious to avoid such errors. Negative error outcome also correlated with the perceived rate of occurrence of medication errors (CORR = .413**) and with contributing factors to medication errors (CORR = .488**). The significant positive correlations suggest that perception of the presence of factors likely to lead to medication errors was associated with perceptions of the negative consequences of medication errors. When participants perceived higher rates of negative outcomes they became more aware of the learning opportunities embedded in medication errors. The correlations were as expected and therefore provide evidence to the construct validity of the medication error outcome sub-scales.

General performance of participants on the scale items

The mean for the negative sub-scales was 11.10(7.2), translating to a 34% score on participants' perception that medication errors had negative outcomes on patients and family, health care providers, and the health facility. The positive items had a mean of 8.19(3.96), translating to 51% score on participants' perceptions that medication errors had positive outcomes for patients, health care providers, and the health facilities.

Response to the negative sub-scale items

Table 2 presents average levels of concern that participant had for each item, with each selecting from among five options being "not at all," "rarely," "sometimes," "often," and all the time." The results show that participants were generally either not at all concerned or only slightly or sometimes concerned. The item on psychological distress for concerned staff member seemed to be one area of concern for the participants; being even more worrisome than psychological distress for patient and family. In fact psychological distress was the only negative medication error item that had the overall mean exceeding 50%, being 53.5% for patient and family and 56.5% for staff.

Response to the positive sub-scale items

The same response options used for the negative outcome sub-scale were used in the positive outcome sub-scale, and the average score for each item is provided in Table 2. Scores were generally better than those for the negative sub-scale. The results show that participants generally considered incidents of medication errors as opportunities for learning and were taking action to prevent recurrence of errors. Except for change of protocol which had the overall item mean falling below 50%, item means for the positive outcome items exceeded 50% with the highest being for increased vigilance of staff at 63.3%.

Variability in the pattern of responses

Except for minor differences, the pattern of responses to medication error outcome items was not very different across personnel and across type of health facility. Concern about the negative outcomes of medication errors was generally low with overall mean on the negative items falling below 50%. However, the overall mean on positive medication error outcome tended to exceed 50% and could reach 80%, particularly for increased vigilance that was reported to occur following a medication error incident. Compared to hospitals, clinics and health posts tended to report less concern about the negative outcomes of medication errors. Pharmacy personnel tended to have higher scores on negative outcomes of medication errors, indicating more concern about error consequences than the rest of health care providers. Mean scores for individual scale items are presented in Table 2.

Table 2: Means Scores on Medication Error Outcome Items by Cadre of Healthcare Personnel

Item	Medical	Nursing	Pharmacy	Anesthesia	Overall Item Mean
1. Caused psychological distress for patient and/or family	60%	41%	62%	51%	53.5%
2. Necessitated treatment to counteract adverse effects of inappropriate treatment	36%	39%	49%	50%	43.5%
3. Resulted in physical injury/harm to the patient	28%	24%	41%	34%	31.8%
4. Caused psychological distress for concerned staff member	56%	45%	67%	58%	56.5%
5. Caused law suits for concerned staff member	25%	21%	25%	28%	24.8%
6. Led to prolonged patient hospital stay	31%	30%	42%	29%	33%
7. Increased the cost of care	46%	37%	51%	50%	46%
8. Caused law suits for the hospital	29%	25%	33%	34%	30.3%
9. Led to a change in the protocol related to medication management	31%	25%	39%	47%	35.5%
10. Led to increased vigilance of health care providers to prevent recurrence of errors	64%	61%	69%	67%	65.3%
11. Led to improved work conditions to reduce recurrence of errors	48%	52%	58%	71%	57.3%
12. Made staff to be more assertive in advocating for more resources	50%	56%	68%	69%	60.8%w

Qualitative responses

Of the 16 reported incidents of medication errors, there was one fatality (public general referral hospital) and three near-fatal (private health facility) outcomes. In the rest of the incidents in which patients presented with failure to respond to treatment, negative reaction to treatment, or overdose symptoms, active treatment was successfully instituted and patients/families were informed about the errors and counseled. Although three incidents prompted some threats of litigation, participants did not report any actual litigation that they could remember. In one incident, a health care provider was dismissed from work (private health facility). In another incident in which wrong treatment was issued based on wrong laboratory results (for a different patient) there was a threat of litigation; and a mechanism for reporting errors (not errors specific to medications but errors in general) was put in place. Whether they were reported or kept a secret, it appeared medication errors were a source of discomfort or anxiety for involved staff members; particularly at administration stage where errors were frequently discovered after the medications had been administered (incidents associated with reported fatal and near-fatal incidents).

Wrongly dispensed medications at out-patient department were potentially dangerous in that sometimes patients would start taking treatment, experience symptoms that they failed to associate with the treatment, and only later get concerned and seek help. Most error incidents were near-misses as they were intercepted before they reached the patient. Near misses were not usually reported or documented at medication administration level. Responding to medication error reporting, one participant said, "*often a nurse*

associated with a medication administration error secretly watches the patient for adverse effects and only has a sigh of relief when, with the passage of time, no obvious adverse effects are manifest." However, near misses occurring at the pharmacy, particularly at the private health facilities, were usually captured and staff were sensitized on such errors. A summary of reported incidents of medication errors is presented in Table 3.

Table 3: Summary of Selected Medication Error Incidents and Outcomes

Incident	Cause	Measures taken	Outcome
1. Out-patient dispensed same medication in two packages; came back after three days of taking double dose	Not reported	Patient reassurance and counseling. Issuing of right medication	No negative consequences reported.
2. Patient prescribed and dispensed wrong medication	Laboratory results guiding prescription for a different patient	Error corrected Mechanism for reporting errors was put in place	Patient threatened law suit
3. In-patient with diabetes administered 40 units of insulin instead of prescribed 4 units	Relatively new nurse from lower level health facility unfamiliar with syringe calibration	Incident report prepared. Disciplinary hearing took place	Patient went into coma but was successfully resuscitated Nurse dismissed from the job
4. Patient administered 40 units of insulin instead of the prescribed 14 units	Unknown	Patient monitored	No negative consequences reported.
5. Error in IV medication prescription	Information about re-constitution and dosing not provided	A follow-up for missing information done.	A near-miss
6. Ward ordered a stock of 50% potassium chloride and 50% water for injection Pharmacy issued a stock of 100% potassium chloride with 50% of that barcoded water for injection	Similar ampoules	Wrong stock returned Independent private investigation for root cause analysis	On-going case
7. Out-patient dispensed Nevirapine instead of Efavirenz	Unknown	Patient developed severe reaction (SJ syndrome) Error discovered when patient sought help from hospital	Intensive treatment instituted and patient recovered Patient threatened lawsuits but calmed down with counseling. Debriefing of all staff and re-commitment to patient safety
8. Ward received from pharmacy stock of lignocaine barcoded water for injection. Two ampoules used on untraceable patients	Similar ampoules	Pharmacy alerted and stock returned	No negative consequences reported.
9. Patient dispensed wrong medication, discovered the error on his/her way out, and returned to pharmacy to check	Unknown	Error was confirmed and right medication issued.	Case classified "Near-miss."
10. Out-patient dispensed Nevirapine instead of Efavirenz	Unknown	Staff apologized to patient, and treatment was withdrawn.	No negative consequences reported.
11. Patient was given a bolus dose of potassium chloride IV by a nurse instead of slow infusion in fluid by a doctor.	Unknown	Family was briefed and case was reported	Patient died instantly. Case on-going

12. Patient was dispensed Cotrimoxazole instead of Paracetamol	Unknown	Patient developed severe reaction (SJ syndrome). Intensive treatment was instituted.	Patient recovered
13. Patient with "allergic to penicillin" marked in his/her card was prescribed Pen V (two cases reported)	Failure to take history and review medical record on the part of prescriber and dispenser.	Patient developed severe reaction and was hospitalized and treated.	Patient recovered
14. In the course of his/her failure to respond to treatment as evidenced by viral load, a child was prescribed and commenced on wrong treatment.	Confusion of the child's and his/her sibling's treatment	Health team investigated the poor response and ruled out the wrong treatment as the cause.	Parent attributed child's poor response to the wrong treatment and threatened law-suit.
15. Patient was dispensed 100mg of chlopromazine instead of 50mg of the same medication that he/she took for 2 weeks before caregiver got concerned about over sedation	Similar vials of same medication in different strengths.	Error corrected	No negative consequences reported.

SJ syndrome = Steven-Johnson syndrome

Integration of quantitative and qualitative findings

There was consistency between quantitative and qualitative findings in that failure of the mean for the overall negative medication error outcome sub-scale to reach 50% was matched by the incidents reports that had only four of the reported 16 incidents being fatal or near-fatal. The tendency of the pharmacy personnel to report higher scores on negative items with means higher than 50% was matched by the personnel's active response to medication errors and near misses such as counseling affected patients, documentation of near-misses, and in the case of at least one private health facility, briefing all staff on the incidents of medication errors and instituting additional measures to prevent recurrence of errors. However, a discrepancy was observed in the high frequency of participants' concerns about staff's psychological distress related to medication errors and the absence of any action to attend to staff's potential or actual psychological distress in the reported incidents of medication errors. This is despite the finding that staff psychological distress appeared to worry the study participants even more than patients' psychological distress.

Discussion

Prior studies have also established that not only do most errors get intercepted before they reach the patient but that also, only a few that reach the patient have serious consequences [1-3]. However, participants believed that medication errors provided feedback to the system to ensure that errors did not recur. However, the feedback appeared to benefit individual health care providers rather than the whole system. Although the mean on improvement of working conditions exceeded 50%, that for improved protocol, which could be a more specific action toward reducing medication errors than improved working conditions, failed to reach 50%. The improved Cronbach's alpha that was seen with the deletion of the item on improved protocol suggests that the item was less important than the rest of the positive outcome items.

The disparity between the whole system and individual health care providers in responding to medication errors could be a result of poor reporting of medication errors that resulted in the errors being more of a private concern for health care providers. The system did not have a picture of the magnitude of medication errors that individual health care providers had. Reporting of medication errors would have led to a system-wide awareness about occurrence of medication errors and system-wide concern about the outcomes of such errors.

Under-reporting of medication errors appear to be a worldwide concern that deprives the system of learning and applying preventive measures [10, 1]. A number of factors found to hamper reporting of medication errors include fear of disciplinary action and the feeling that error carried a low risk of harm, the burden of preparing error reports, fear of being labeled incompetent by peers and being doubted by patients, and the tendency of management to be punitive to staff associated with errors [11-13].

In a work culture that fails to enforce medication error reporting, the incidents of medication errors reported by participants in this study and their outcomes thereof can be seen as a tip of the iceberg signifying a problem the magnitude of which remains unknown. From what we have learned from prior literature and from the study reported here, medication error reporting demands a change in both the institutional culture and individual health care providers' attitude and behavior. Tools such as guidelines and reporting forms must be developed that will make reporting standardized. Staff at the operational level and those in health care training institutions must be fully involved in the development of such tools. Beneficiaries of health care must be represented in committees that develop medication safety guidelines. Adopting a system approach to patient safety whereby all the various components are coordinated could yield effective interventions in preventing and managing medication errors.

It is important that the management of healthcare facilities take medication error reporting as a quality improvement measure rather than a way of catching and punishing staff involved in

errors. The study participants saw medication error reporting as not only a risky undertaking but also a tedious and humiliating process. In a related study, nurses have expressed preference for anonymous reporting as a way of reducing humiliation that goes with being associated with medication errors [11].

The low concern about the negative outcomes of medication errors may suggest that errors that occurred involved medications with less potentially serious adverse effects; and that only those with potentially more serious adverse effects were subjected to peer checking. This could be a coping mechanism in situations where human resources shortages were a problem. It makes sense that if serious medication error outcomes are rare, law suits will be uncommon. Prior studies have also established that not only do most errors get intercepted before they reach the patient but also that only a few that reach the patient have serious consequences [1, 3].

Staff's psychological distress associated with medication errors may partly be a result of failure to report medication errors, that leaves one feeling guilty and anxious about the error outcome. Health care providers involved in patient safety incidents have been reported to be at a high risk for burnout, problematic use of medications and job turnover and worry about loss of trust from colleagues, patient outcome, and lawsuits [14,8]. In another study, nurses were reported to often take blame for medication errors that were a result of system deficiency rather than their own [3].

Health providers associated with medication errors need to be supported though active structures put in place for the purpose; this can only happen if error reporting is also encouraged. Denham discussed 5-human rights that must be observed to support second victims or staff members involved in unintentional harm [15]. The rights cover the need for just and respectful treatment and support for the person's grieving, healing, and learning from the incident.

The findings suggest that individual health care providers learned from errors that occurred and made a conscious effort to prevent recurrence of such errors better than the institutions. The finding on positive error outcome for health care providers is an important contribution of this study to existing literature as not many studies have specifically investigated how error outcomes, even those that are known only to the individual, can positively influence medication safety.

Increased cost of care came third after staff's psychological distress and patients' psychological distress as an area of concern for the participants. It must be noted that patient prolonged hospital stay, treatment to counteract the effects of inappropriate medication, lawsuits for the health facility, and increased cost of care are all concerned with cost to the health facility. The researchers therefore conclude that the study participants did not believe that the health facilities were incurring any significant costs as a result of medication errors; and this points to the need to sensitize health care providers on the wider cost implications of medication errors.

Concern about the negative impact of medication errors was lower at the peripheral health facilities when compared to the district and referral hospitals. This could mean that medication errors were so uncommon at the health posts, for instance, that participants were not even thinking about lessons that could be learned from such errors. The rarity of medication errors at peripheral health facilities may also be explained by the fact that such health facilities were less involved with more error-prone medications. Certain medications have been reported to be more commonly associated with errors than others; and these include anticoagulants, opiate agonists, morphine, and psychoactive medications, as well as medications used in anesthesia [5,6]. Health posts mainly provide health promotion services such as well-child care that do not usually involve medications, and common ailments that do not require medications with potentially serious negative outcomes.

Except at one private hospital where they seemed to be more concerned about the negative impact of medication errors, doctors did not seem to respond differently from the rest of health care providers. A similar pattern was observed for nurses, albeit with some variations across health care facilities within and across levels. Pharmacy personnel tended to be more concerned about the negative impact of medication errors than the rest of the health care providers. This may be because medications are the core of their job such that they probably had more insight into the negative impact of medication errors on patients, staff, and the health facilities than other health care providers. However, like the rest of the health care providers, the responses for pharmacy personnel varied within and across levels of health facilities.

Prior studies have shown pharmacy personnel to be critical to the safety of medications. In one study, detection of errors improved from 34.6% to 77.7% when a pharmacist was added to a team involved in medication reconciliation process (checking the patient history and the medication currently taken against the new medications). In another study, omission errors increased during periods when the pharmacist was absent from the team handling medications [16]. Of all the health care providers participating in this study, only pharmacy personnel, notably in the private health care facilities studied, reported ever documenting near misses or "alerts" as they were often referred to. In a related study conducted in Malaysia, pharmacists reported both near misses and actual errors whereas doctors reported more actual errors than near misses [2].

It is evident from both the study findings and the literature that pharmacy personnel are critical to medication safety. Botswana health care facilities should therefore seriously consider strengthening their pharmacy personnel staffing and increasing the visibility of the cadre in in-patient departments. Participation of the pharmacy personnel could be in ward rounds, regular auditing of medication use in the wards, orientation of new staff involved in prescription and administration of medications, and in-patient medication counseling. Adequate staffing could also enable pharmacy personnel to audit medications in health posts and clinics as well as to be available "on-call" to attend to matters such as compounding of medications that came up as a concern to nurses in this study.

Health care providers need to introspect and re-consider their social and ethical responsibility and commit to providing care that is safe and ethical. Some medication error incidents reported in the study such as failure to inquire about patients' history of allergy to medicines and to review patients' records could easily be prevented. Report of errors involving dispensing the same medication in two packages suggests that the staff may be failing to pay full attention to one medication before proceeding to another. Incidents of sticking barcodes to a wrong medication may stem from staff fatigue, lack of concentration, or failure to use peer validation. It has been noted that even cross-checking

may not guard against errors if not done with full attention and concentration. For instance, the first person may over-rely on the second person and fail to fully apply themselves in checking; also, there may be a risk of confirmation bias whereby the second person uses information as confirming prior belief and fails to do actual cross-checking [17].

Some fatal and near-fatal medication error incidents reported in the study may suggest the need to enhance competency of staff on management of medication. For instance, administration of "high alert" or potentially lethal medications must make one think and check with others before acting. It was also evident that new staff members were often expected to find their way into systems that were completely different from where they had practiced before. Their failure to seek second opinion when in doubt could suggest that they were expected to perform as others they found in the system were performing.

Prior research provides evidence that the use of technology such as barcodes and computerized physician order entry (CPOE) system can reduce medication dose errors and incompatible medications [18]. Although there were reports of the use of barcodes especially in private health care facilities, it did not seem like Botswana public health care system had done much to exploit the opportunity that technology provides. However, Australia National Health and Medical Research Council cautioned against over-reliance on computerized systems as those often reduce human vigilance [19]. Incidents of errors with the use of barcodes in the study reported here provide evidence that human vigilance is still important even with the use of technology.

Future research could provide documentation of the cost of medication errors for institutions; especially when the patient's hospital stay has to be prolonged, when treatment to counter the effects of inappropriate medication is instituted, and when patients/families demand compensation through the legal process or otherwise. Appreciation of the cost of medication errors to institutions can help them tighten safety measures. Future studies could also go beyond self-reports to prospective record reviews that trace errors and their outcomes [20]. The study findings have pointed to the important part that, patients, especially those in out-patient units, play in intercepting medication errors. Future studies targeting medication users could provide insight into ways to bring patients and families aboard in the promotion of medication safety.

The generalizability of the findings is limited for a number of reasons. Even though we report responses by health facilities and cadres of health care providers, the number of participants in a given category was very small. In addition, the numbers were unequal as the sample size of categories was based on proportional sampling. Because of these limitations, we found it unrealistic to do analyses such as Chi-square and analysis of variance. The generalizability of future studies could be improved through using lager sample sizes that allow realistic comparisons across types of health care providers. Future studies could also estimate the monetary cost of medication errors as that could help in tightening medication safety measures. Self-reports could be augmented with observation of the medication management processes and retrospective record reviews, including incident tracking that could help in tracking medication error outcomes. Sampling consumers or users of medications could enhance the participation of health care users in preventing medication errors. The limitations notwithstanding, this being the first study of its kind in the country, and the medication error outcome sub-scales being used having no prior validity and reliability, the investigators thought the breakdown of the analysis would benefit future studies and strategies toward preventing negative medication outcomes and using the positive outcomes to feedback into system improvement.

Concerns that stand out from the findings include poor reporting of medication errors, lack of diligence in handling medications, lack of attention to the impact of medication errors on health care providers' emotional and psychological well-being, gaps in continuing professional development for staff, and limited visibility of the pharmacy personnel in in-patient departments and peripheral health facilities.

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Conflict of interest

The authors have no financial conflict of interest.

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