Acheampong et al. Safety in Health (2016) 2:15
DOI 10.1186/s40886-016-0050-5

Safety in Health

RESEARCH ARTICLE Open Access

Drug-related problems and their clinical interventions in a Ghanaian teaching hospital

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Abstract

Background: Errors occur frequently in the use of medicines. Pharmacists play a key role in error identification and make appropriate interventions as they work with other healthcare professionals. These error recovery roles of pharmacists contribute to patient safety. This study was to evaluate the clinical interventions made to drug-related problems at a tertiary care setting.

Method: This involved a retrospective review of clinical intervention reports submitted by pharmacists working over the period January 2011 to December 2013.

Results: The 24 pharmacists submitted 529 handwritten reports; of these, 448 reports had complete data. The most frequently reported drugs with error were warfarin (9.5%), potassium chloride (6.0%) and potassium citrate (5.5%). The pharmacists made 1019 clinical interventions and recommendations. The average intervention per report was 2.5 (S.D ± 0.67). The interventions and recommendations made were categorised as drug regimen change (76.1%), monitoring required (13.0%), communication (5.4%), counselling required (5.0%) and adverse drug reporting (0.6%). Majority (90.5%) of the recommendations and interventions made by pharmacists were accepted and implemented. Monitoring-required based interventions were significantly more likely to be accepted (130 vs 38; p <0.0001).

Conclusion: Pharmacists played a role in drug error recovery and prevented medication errors from reaching patients. These error mitigation efforts of pharmacists can serve as a priority in patient safety strategy.

Keywords: Medication errors, Patient safety, Pharmacist, Clinical interventions, Ghana

Background

A substantial proportion of hospitalised patients experience medication-related harm that is preventable [1]. Drug errors have been estimated to account for over a quarter of causes of adverse drug events [2]. Strategies to prevent such problems are being developed. One such strategy is the structured review of patient medication by pharmacists to identify patients with medication errors that may lead to harm. The advantage is that the complete clinical status of each patient is taken into account when identifying problems [3]. In a study, clinical pharmacists performed better than the decision support system in identifying drug–drug interactions clinical interventions [4]. The authors realised that clinical pharmacists looked at individual administration intervals and drug sequence to determine the clinical relevance of the interactions.

The Harvard Medical Practice Study analysed error recovery, i.e. the circumstances under which errors were detected and corrected. The study acknowledged the important role pharmacists play in identifying and correcting drug errors from reaching patients.

The Institute of Medicine's report includes recommendations for health systems to implement error reporting reviews [5]. In the inpatient setting, clinicians have used various drug event reporting programs to better understand and prevent drug errors [6, 7]. The interception of medication errors is thus essential for improving patient safety. The aim of the study was therefore to evaluate the clinical interventions of hospital pharmacists.

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Methods

The study was a retrospective review of reports, which had no names, nor personal information of patients. No consent was taken from patients since they could not be traced to any reports.

Study setting

The study took place at Korle Bu Teaching hospital which is a 2000 bed tertiary teaching hospital located in the capital city of Ghana. At the time of the study, the hospital had about 80 pharmacists. The main pharmacy services provided in the hospital were dispensing, clinical, drug information, research and small scale manufacturing. There were about 30 pharmacists who actively undertake clinical duties across the various wards of the hospital.

Data collection

To evaluate the clinical interventions of pharmacists working in the hospital, copies of reports for the period January 2011–December 2013 were made and relevant data extracted using a specially designed data collection sheet. Pharmacists had previously identified drug errors and manually reported the clinical interventions. The pharmacist interventions accepted and the actions taken were reported on the submitted manual reports. Pharmacists had discovered drug errors during their normal duties from review of patient medical records, laboratory reports, interactions with other health care professionals, patients, caregivers or family members.

Data analysis

The extracted clinical intervention data was entered into and analysed using SPSS (Statistical Package for Social Sciences) version 16 for Windows. Descriptive analysis was performed on all the data to obtain the frequency of clinical interventions, drug characteristics and pharmacist characteristics. Aggregate data were tabulated and summarized using frequency statistics such as count, range, mean and standard deviation. Descriptive analyses of all drug error types and related interventions were also tabulated. Pharmacist Clinical intervention data were compared between drug classifications, drug error types and whether pharmacist interventions were accepted or not using Chi square test dichotomous variables. Any $p < 0.05$ was considered as statistically significant.

Results

Study participants

The evaluation revealed that 24 pharmacists made 529 paper-based reports over the 3 years. Majority of them were female (70.8%) and more than half had less than 10 years experience (53.3%). The basic characteristics of pharmacists who made the reports are presented in Table 1.

Table 1 Characteristics of pharmacists involved in reporting ($N = 24$)

Characteristic	Number	Percent
Sex		
Male	7	29.2
Female	17	70.8
Experience in practice (years)		
0–5	6	25.00
>5–10	8	33.33
>10–15	3	12.50
>15–20	5	20.83
>20	2	8.33
Education & training		
MSc in clinical pharmacy	8	33.3
MSc Clinical Pharmacy (student)	3	12.5
BPharm	13	54.2

Drug error reports

Of the 529 paper-based drug error reports, 448 contained complete information and hence were included in the study. Reasons for not including the 79 were no drug name ($n = 67$), no reason for error ($n = 6$) and no recommendation ($n = 6$). Drug errors were reported from all the units of the hospital that pharmacists worked; surgery (24%), medicine (22%), paediatric (21%), obstetrics and gynaecology (17%) and others (16%). Pharmacists discovered drug errors from review of patient medical records (74%), from other health care professionals (10%), laboratory reports (8%), patients (6%), caregivers (1%), and other unspecified sources (3%). The frequently occurring therapeutic drug categories with errors were cardiovascular (44.4%), infections (22.8%), nutrition (12.9%) and musculoskeletal (6.6%). Table 2 describes the therapeutic drug categories and the degree of acceptance. The five most frequently reported classes of drugs associated with drug errors were antibiotics (20.2%), anticoagulants (19.9), iron supplement (16.3%), diuretics (9.4%) and non-steroidal anti-inflammatory drugs (4.4%). The most frequently reported drugs with error were warfarin (9.5%), potassium chloride (6.0%) and potassium citrate (5.5%). The drug error types identified were categorised as prescribing, dispensing/implementing, administering/patient receiving and monitoring (see Table 3). Majority of reported drug errors were due to prescribing (70.9%) and least due to dispensing/implementing (2.0%). The most frequently reported drugs associated with prescribing errors included cardiovascular (42.6%), anti-infectives (22.9), and nutritional agents (10.5%). During dispensing or implementation, the frequently reported drug errors were anti-infectives (50.0%), endocrine (35.0%) and cardiovascular (15.0%).

Table 2 Therapeutic category of drugs with intervention reports

Drug category	Indication	Number of recommended interventions		*p-value
		Accepted	Not accepted	
Cardiovascular (*n* = 451[44.3%])	Anticoagulant	181	22	0.053
	Diuretic	87	9	<0.001
	Calcium channel blockers	16	8	<0.001
	Beta blockers	20	2	0.037
	ACE inhibitors	14	2	0.003
	Statin	17	3	<0.001
	Antiplatelet	15	1	0.001
	Nitrates	4	0	0.061
	Angiotensin receptor blockers	3	0	<0.001
	Others	41	6	0.004
Infections (*n* = 231[22.7%])	Antibiotics	180	18	0.019
	Antimalarials	26	0	0.009
	Antivirals	5	0	0.101
	Antifungal	2	0	0.023
Nutrition (129 [12.7%])	Iron supplement	106	13	0.037
	Others	10	0	<0.001
Musculoskeletal (70 [6.9%])	NSAIDS	52	3	0.010
	Systemic Corticosteroids	11	0	<0.001
	Others	4	0	<0.001
Central Nervous System (51[5%])	Opiod analgesic	39	3	<0.001
	Sedatives	6	0	<0.001
	Antiepileptic	2	1	0.122
Gastro-Intestinal (50 [4.9%])	Proton pump inhibitor	27	3	0.027
	Antacid	7	0	0.980
	Laxative	5	0	0.001
	Others	6	2	0.001
Endocrine (14 [1.4%])	Oral antidiabetics	9	1	0.076
	Insulin	4	0	0.001
Respiratory (11 [1.1%])	Inhalational steroids	10	0	0.530
	Antihistamine	1	0	0.890
Others (12 [1.2%])		12	0	<0.001

*Cross tabulation (χ^2 test) between accepted and not accepted interventions for each Indication and the rest

The most frequently reported drug category associated with administration or patient receiving included anti-infectives (45.5%), cardiovascular (22.7%) and central nervous system (15.2%). The common reasons pharmacists provided for drug errors included untreated indication (18.9%), wrong dose prescribed (12.5%), wrong drug prescribed (11.4%), medicine interactions (10.7%) and duplication of therapy (9.8%).

Clinical interventions

The twenty most frequently drugs occurring in intervention reports and their potential risk are presented in Table 4. The pharmacists made 1019 interventions and recommendations in 448 handwritten reports. The average intervention per report was 2.5, standard deviation (±0.67), range (2–4), and mode (2). The interventions and recommendations made have been categorised as drug regimen change (76.1%), monitoring required (13.0%), communication (5.4%), counselling required (5.0%) and adverse drug reporting (0.6%). The intervention types have been summarised in Table 5. Monitoring-required based interventions were significantly more likely to be accepted (130 vs 38; p <0.0001). Drugs involving drug regimen adjustment by pharmacists included potassium citrate (n = 56), enoxaparin (n = 54), warfarin (n = 42), diclofenac

Table 3 Drug error types and reasons

Error type	Reasons	Number
Prescribing ($n = 721$)	Untreated indications	174
	Wrong dose prescribed	127
	Wrong drug prescribed	116
	Medicine interactions	93
	Duplication of therapy	84
	Contraindications	78
	Side effects	50
	Failure to stop order	44
	Omitted lab test	18
	Others	15
Dispensing/implementing ($n = 20$)	Wrong drug dispensed	14
	Wrong label	5
	Others	1
Administering/patient receiving ($n = 66$)	Unavailability of drug	19
	Wrong dose administered	16
	Duplication	16
	Failure to discontinue	7
	Others	4
	Wrong drug administered	3
	Wrong dosage form	1
Monitoring ($n = 212$)	Laboratory test omitted	91
	Blood glucose not monitored	77
	Side effects not monitored	40
	Others	19
	Medicine-disease interactions not monitored	16
	Culture and sensitivity omitted	14
	BP not checked	11

($n = 40$), and morphine ($n = 37$). Monitoring required interventions were made for potassium chloride ($n = 46$), frusemide ($n = 22$), warfarin ($n = 20$), gentamicin ($n = 19$) and metolazone ($n = 14$). Drugs requiring counselling included warfarin ($n = 44$), iron supplement ($n = 12$), inhaled steroid ($n = 6$), insulin ($n = 4$), and lamivudine ($n = 3$). Drugs involving communication between pharmacist and other healthcare professionals included frusemide ($n = 31$), diclofenac ($n = 18$), iron supplement ($n = 16$), warfarin ($n = 11$) and antacid ($n = 7$). Majority (90.5%) of the recommendations and interventions made by pharmacists were accepted by prescribers and other healthcare professionals (see Table 5). These interventions were communicated via the following means: verbal (76.4%), write in patient medical notes (16.3%), acted upon by reporting pharmacist (6.1%), prepare formal note (0.7%) and prescribe/procure for patient (0.5%).

Discussion

This part of the study evaluated the clinical intervention reports submitted by pharmacists working in a tertiary hospital. The pharmacists identified drug related problems in the management of patients and made interventions to prevent these errors from reaching patients. Twenty-four pharmacists made 1019 clinical interventions in 448 handwritten reports. Majority of the interventions related to drug therapy changes. Though this study evaluated handwritten reports, it is comparable to evaluations done on electronic incident reports [8, 9].

The categories of drugs most often associated with drug error reports were similar to those reported from previous studies and included cardiovascular agents [10, 11], anti-infectives [11, 12], and central nervous system agents [10, 13], suggesting that future strategies for reducing drug errors could target these agents. This study also found challenges with the use of nutritional supplements. Most of the challenges with nutritional supplements had to do with untreated anaemia, which physicians had overlooked. Iron deficiency anaemia is a serious nutritional problem in developing countries given its impact on increased mortality or serious morbidity in patients [14].

The frequently reported drug was warfarin as found in other studies [15]. The use of warfarin presents substantial safety concerns for patients. Adverse events associated with warfarin therapy are common [16]. This will require prevention strategies targeted at the prescribing and monitoring stages of warfarin management.

Though this study concentrated on pharmacists identifying inpatient drug errors as in other studies, results are comparable with studies conducted in outpatients [11, 17–20]. The drug errors assessed in this study were reports from only pharmacists although physicians [11, 21], nurses [22, 23] and others [24, 25] had reported drug errors in other studies.

The most frequently reported drug errors found in our study were drug regimen change and originated from drug prescribing. This finding is consistent with findings from other studies conducted in clinical centres [26], tertiary [27], hospital inpatient [28] and ambulatory care settings [11]. Inappropriate prescribing predicts the risk of adverse drug events [29]. The most commonly reported prescribing drug error was untreated indication. This was followed by prescribing wrong dose as seen in other studies [11, 30]. Children are particularly at risk of wrong dose errors [31].

The top two most frequently reported drug type associated with prescribing, dispensing and administration errors were cardiovascular and anti-infective agents. The most commonly reported dispensing error was dispensing wrong drug. Previous studies have reported dispensing wrong drugs in all types of

Table 4 Drugs most frequently occurring in intervention reports and their potential risk

Drug	Number in reports, n (%)	Examples of potential risk	Outcome of intervention	
			Accepted	Not accepted
Warfarin	97 (9.5)	Bleeding	89	8
Slow K	61 (6.0)	Electrolyte imbalance	56	5
Gentamicin	60 (5.9)	Tinnitus	45	15
Potassium Citrate	56 (5.5)	Electrolyte imbalance	41	15
Enoxaparin	55 (5.4)	DVT	46	9
Diclofenac	43 (4.2)	Gastrointestinal bleeding	40	3
Heparin	39 (3.8)	Bleeding	34	5
Morphine	38 (3.7)	Respiratory depression	35	3
Frusemide	37 (3.6)	Electrolyte imbalance	29	8
Iron Supplement	37 (3.6)	Anaemia	34	3
Clindamycin	27 (2.6)	Diarrhoea	25	2
Metolazone	26 (2.6)	Electrolyte imbalance	26	0
Omeprazole	24 (2.4)	Gastrointestinal bleeding	21	3
Atenolol	20 (2)	Heart block	19	1
Hydrochlorthiazide	18 (1.8)	Electrolyte imbalance	18	0
Metronidazole	16 (1.6)	Increased hospital cost	14	2
Rosuvastatin	15 (1.5)	Cardiovascular event	15	0
Cefuroxime	13 (1.3)	Severe diarrhoea	13	0
Ciprofloxacin	13 (1.3)	Muscle weakness	13	0
Lisinopril	13 (1.3)	Neonatal mortality	11	2

inpatient settings [25, 32–35]. Omission due to drug unavailability was also a common error identified. Drug unavailability is common and poses a major challenge to healthcare systems in transitional and developing countries [36, 37]. In addition to drug omissions, administering wrong drug followed by duplication were common reported administration errors. The most commonly reported monitoring error was omitting relevant laboratory test. Monitoring errors had been previously reported [11].

Table 5 Types of pharmacist clinical interventions and degree of acceptance

Intervention type	Method	Number of reports	Acceptance	
			Yes, n (%)	No, n (%)
Drug regimen change (n=775[76.1%])	Verbal	643	730 (94)	45 (6)
	Write in medical notes	109		
	Acted on by pharmacist	20		
	Prescribe/procure for patient	3		
Monitoring required ($n = 132$ [13%])	Verbal	82	130 (98)	2 (2)
	Write in patient medical notes	49		
	Write formal note	1		
Counselling required ($n = 52$ [5.1%])	Verbal	9	49 (94)	3 (6)
	Acted on by pharmacist	42		
	Prescribe/procure for patient	1		
Communication ($n = 54$[5.3%])	Verbal	45	50 (93)	4 (7)
	Write in medical notes	8		
	Prescribe/procure for patient	1		
Adverse drug reporting ($n = 6$ [0.6%])	Write formal note	6	6 (100)	0 (0)

More than 90% of interventions and recommendations by pharmacists were accepted and implemented. Over 70% of the interventions involved drug regimen change. Studies have reported prescribing errors as a major contributor to patient harm in hospitals [10, 26, 28, 29, 38]. Most (76%) of the interventions were communicated verbally. This would require an operational collaborative working relationship between pharmacists and other healthcare professionals to enhance patient care [39]. Previous studies reported that pharmacists in a collaborative team in hospitals helped reduce adverse drug events by 30–86% [19, 40–42]. Pharmacists' close proximity with physicians provides opportunity for timely verbal communications on error interceptions. Some of the potential risk prevented by pharmacists included bleeding, anaemia, nephrotoxicity, electrolyte imbalance, severe diarrhoea etc.

Moreover, other interventions by pharmacists in this study related to patient counselling. It has been reported that patient counselling prevents adverse drug events during and after hospitalisation [43].

The study had some limitations. The study evaluated voluntary incident reports. Voluntary reports could be underreported and did not provide the actual frequency of the total denominator of errors that were detected and ameliorated. Secondly, reports did not contain information on whether errors reached patients and the effects of any harm. Moreover, the study could not assess the outcomes of the interventions performed by pharmacist.

Conclusions

Hospital pharmacists identified a lot of drug use challenges and subsequently prevented errors from reaching patients. Majority of pharmacist interventions and recommendations to prevent or ameliorate drug errors were accepted and implemented.

Acknowledgements
Not applicable.

Funding
The study did not receive any external funding.

Availability of data and materials
Please contact author for data requests.

Authors' contributions
FA was involved in conceptualization, research design, data collection, data analysis, statistical analysis and drafting of manuscripts. FAN was involved in data analysis and reviewing and editing of manuscripts. BPA was involved in study conceptualization, and editing of final manuscript. All authors read, reviewed and edited the final manuscript and approved the final manuscript in its current state.

Competing interests
The authors declare that they have no competing interests.

Consent for publication
Not applicable.

Ethics approval and consent to participate
The work was reviewed by the Internal Review Board of the Public Health Unit of Korle Bu Teaching Hospital and the Ethical and Protocol Review Committee of the University of Ghana Medical School (MS-Et/M.3-P3.1/2013-2014).

Informed consent
It was a retrospective review and did not require informed consent. However, codes were used to refer to patients such that the identity of participants were not known.

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Received: 24 October 2016 Accepted: 10 November 2016
Published online: 30 November 2016

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