Medication Errors in Ethiopia: Systematic Review and Meta-Analysis

Aklilu Endalamaw (yaklilu12@gmail.com)
Bahir Dar University https://orcid.org/0000-0002-9121-6549
Getnet Dessie
Bahir Dar University
Henok Biresaw
Bahir Dar University
Amare Belachew
Bahir Dar University
Desalegn Amare
Bahir Dar University
Yinager Workineh
Bahir Dar University
Minyichil Birhanu
Bahir Dar University
Getaneh Mulualem Belay
University of Gondar
Amare Wondim
University of Gondar
Chalachew Adugna Wubneh
University of Gondar
Yeneabat Birhanu
University of Gondar
Yared Asmare
Debre Birhan University
Fasil Wagnew
Debre Markos University
Biniam Minuye
Debre Tabor University
Demoz Kefale
Debre Tabor University
Zelalem Nigussie
University of Gondar
Tesfa Dejenie Habtewold
University Medical Center Groningen

Research

Keywords: Administration, Error, Medication, Prescription, Ethiopia

Posted Date: June 17th, 2020

DOI: https://doi.org/10.21203/rs.3.rs-35808/v1

Abstract

Background: The caution of medication prescription and administration are the main physician and nursing services though there was no study to show medication error at the nation level in Ethiopia. Therefore, we estimated the national prevalence of medication errors.

Methods: A systematic review of studies searched in PubMed, Scopus, African Journal of Online, and Google Scholar was done. Newcastle-Ottawa quality assessment scale was used to assess the quality status of the included studies. We employed Galbraith plot and Egger's regression test to assess publication bias. The national prevalence of medication errors was estimated using a random-effects model meta-analysis. Moreover, subgroup analysis and meta-regression analyses were done to explore the reason of statistical heterogeneity.

Results: A total of 14 studies with 5,552 administered medications and 5,661 prescription sheets were included. The overall prevalence of medication error in Ethiopia was 57.6% (95% CI: 46.2, 69.0). The pooled burden of medication administration and prescription error was 58.4% (95% CI: 51.4, 65.5) and 55.8% (95% CI: 27.0, 84.6), respectively. Omission error (38%), wrong dose (38.5%), and the wrong combination of drugs (28.7%) were highly reported types of prescription errors, whereas missed doses (57.0%), technical errors (47.0%), wrong time (35.0%), and wrong dose (30.0%) were frequently observed medication administration errors.

Conclusions: Medication errors were very common in Ethiopian hospitals whereby at least one out of two medications were wrongly prescribed and administered. Our review provided a shred of up-to-date evidence for clinicians, regional, and national healthcare policymakers to appraise and improve the quality of hospitals' inpatient care.

Trail registration: The protocol is registered in the Prospero database with a registration number of CRD42019138125.

Background

To achieve the United Nations Sustainable Development Goals of prioritizing healthy lives and well-being for all [1], healthcare services are striving throughout the world to offer high quality care to their patients. Hence, with caution medication prescription and administration are the main responsibilities of physician and nurse in a clinical setting that helps for good prognosis of a diseased person [2]. Any medication prescription and administration error will lead to undesirable outcomes, including adverse drug reactions, drug-drug interactions, lack of drug efficacy, suboptimal patient adherence, poor quality of life, and death [3]. In 2016, medical errors are the third leading cause of death in hospitals [4], which may have significant health and economic consequences. Patient engagement, providing training and education for healthcare workers, evaluation of patients' medication, medication reconciliation, writing medication information on discharge notes, and application of electronic tools (automated information systems) [5-8] are relevant interventions to prevent medication errors.

Medication administration and prescription errors are becoming common problem in the healthcare system. Out of 700 prescriptions of medical intensive care unit patients in India, 17.8% and 22.4% prescriptions found to have medication administration and prescription errors, respectively [9]. In Iran, a systematic review study revealed that 31.8% overall medication error, 44.8% prescription error, and 38.8% administration error [10]. Likewise, medication errors were reported with varieties of findings in Ethiopia. For instance, medication prescription error reported from the range of 32.3 % [11] to 95.2 % [12] and medication administration error was fall in the range between 46.1% [13] and 89.9% [14].

Medication error could be associated with numerous factors, such as poor coordination of care, cost-related barriers, multi-morbidity, increasing days of hospitalization, childhood and older age, lack of training, inadequate knowledge, inadequate perception of risks, overworked healthcare professionals, distractions, lack of standardized protocols, and

insufficient resources. Medication packaging problem, poor nurse-physician communication, and problem in recruiting competent professional were also the suggested reasons [15].

In Ethiopia, there is no nationwide study that determines the national burden of medication administration and prescription errors. Thus, we aimed to estimate the national burden of medication administration and prescription errors in Ethiopia.

Methods

Protocol and Reporting

The protocol is registered in the Prospero database with a registration number of CRD42019138125. The reports of this systematic review and meta-analysis are reported with the standard flow of Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guidelines [16].

Literature Search

The literature search was done using PubMed, Scopus, African Journal of Online databases, and Google Scholar. Additional unpublished research works were retrieved from Addis Ababa University, Ethiopia online research repository library. We further reviewed the reference lists of all included studies.

The search terms or phrases were medication error, prescribing error, dispensing error, administration error, documentation error, preparation error, medication mistake, drug error, drug administration error, drug mistake, prescribing mistake, administration mistake, preparation mistake, wrong medication, wrong drug, wrong dose, wrong route of administration, wrong calculation, and Ethiopia. Search strings were established by using “AND” and/ “OR” Boolean operators. For instance search string for Scopus was: (medication AND administration AND error[mesh AND terms]) OR (drug AND administration AND error) OR (medication AND prescribing AND errors) OR (drug AND prescribing AND errors) OR (drug AND preparation AND errors) OR (medication AND mistake) OR (drug AND mistake) OR (prescribing AND mistake) OR (administration AND mistake) OR (preparation AND mistake) OR (documentation AND error) OR (wrong AND drug) OR (wrong AND route AND of AND administration) OR (wrong AND medication) OR (wrong AND dose) OR (wrong AND calculation) AND (Ethiopia) AND (LIMI-TO (AFFILCOUNTRY , "Ethiopia")) AND (LIMIT-TO (SUBJAREA , "MEDI") OR LIMIT-TO (SUBJAREA , "PHAR") OR LIMIT-TO (SUBJAREA , "IMMU")) AND (LIMIT-TO (LANGUAGE , "English")).

Inclusion and exclusion criteria

Studies were included if they have reported proportion of either overall medication error, administration error, or prescription error in Ethiopia and published in English.

Qualitative studies and studies without full-text were excluded.

Measurement of variables

1. Medication administration error: Occurrence of at least one of the following errors [12-14, 17-21]
2. Omission error: Failure to administer an ordered dose to a patient [14, 17, 18, 22]
3. Wrong time: Administration of medication without adhering a predefined time interval from its scheduled administration time (if there is greater than 30 minute or 1-hour difference between the ordered time and the time of medication is administered) [14, 17, 19, 20, 22]

4. Wrong dosage-form: Administration of a drug product to the patient in a different dosage form than ordered by the prescriber [14, 22]
5. Deteriorated drug error: Administration of a drug that has expired or for which the physical or chemical dosage-form integrity has been compromised [22]
6. Wrong dose: Administration a dose that is greater than or less than the amount ordered by the prescriber [17-20, 22]
7. Non-adherence: Inappropriate patient behavior regarding adherence to a prescribed medication regimen [22]
8. Wrong route: Includes order written for the wrong route and medication administered to a patient using a different route than ordered [17-20, 22]
9. Unauthorized drug error: When the prescriber did not authorize the administered medication [14, 17, 18]
10. Wrong patient: When a medication of one patient is wrongly given to another patient [17, 19, 20]
11. Documentation error: Medication that is administered to the patient but not documented in the medication administration record sheet or incorrectly documented [18, 19]
12. Wrong administration technique: Exclusion or incorrect performance of a procedure ordered by a prescriber immediately before administration of each dose of medication [14]
13. Wrong drug preparation: A drug product which formulated incorrectly or manipulated before administration [19]
14. Wrong drug: Medications administered to the patient that was not on the patient's medication chart [19, 20]
15. Prescription error: the deviation of medication prescription from the standard practices. It includes the following errors [11, 23-25].
16. Wrong combination: Drug interactions and therapeutic duplications [23, 24]
17. Omission error: Medications ordered without specifying dose or type of dosage form or frequency or route [23-25]
18. Wrong frequency: Drugs prescribed with a frequency greater or less than what is recommended [23, 25]
19. Wrong dose: If the ordered dose is higher or lower than what is recommended [23, 25]
20. Wrong route: Medication was prescribed to be given in a route other than the recommended route [23, 25]
21. Wrong indication: The presence of inappropriate indications and contradictions which were not noted by the prescribing physician [23-25]

Quality assessment

The quality of included articles was evaluated by using the Newcastle-Ottawa quality assessment scale for a cross-sectional study. Two independent reviewers assessed the quality of included studies. Discrepancies between the two reviewers were resolved through discussion with the interference of the third reviewer.

Data extraction

Microsoft Excel 2010 worksheet (Microsoft Corporation, Redmond, WA, USA) was used for data extraction. The first author, year of publication, study patient unit or ward, study design, sample size (number of prescription and/or administration), data collection method, response rate, source of fund, and proportion with 95% confidence interval were extracted. The authors estimated proportion from available information using the recommended statistical formula.

Data analysis

Using Microsoft Excel, authors calculated the logarithm of proportion and standard error from the extracted observed data. Then, the stored data from Microsoft Excel 2010 worksheet were imported to STATA 14 statistical software for Windows for further analysis. Galbraith plot and Egger's regression test were used to assess the presence of publication bias [26, 27]. I-square statistics was used to assess heterogeneity of studies. The pooled national medication error was

estimated using a random-effects meta-analysis model [28]. Subgroup-analysis based on the types of medication error (administration versus prescribing error) was done. We also applied meta-regression analysis to see the effect of sample size and year of publication on statistical heterogeneity [29].

Results

Search findings

Based on our search, 93 studies were accessed in PubMed, 130 in Scopus, 317 in African Journals Online, 53 in Google Scholar, and 11 in Addis Ababa University Ethiopia's online research repository library. After rigorous screening and selection, 14 studies were included in the meta-analysis (Figure 1).

Characteristics of studies

All the included studies were conducted cross-sectionally and reported prescribing errors (n=4) [11, 23-25], both prescribing and administration errors (n=1) [30], and the medication administration errors (n=9) [12-14, 17-22]. Medication administration errors were collected through a prospective approach using the observational checklist, whereas prescribing errors were collected through reviewing patents medical charts and prescription sheets. A total of 5,552 medications were found to be administered and 5,661 prescribed sheets were included. Details on the study characteristics are presented in Table 1. We found that none of the studies below the acceptable quality status (additional file).

Meta-analysis

Medication errors

The overall medication error in Ethiopia was found to be 57.6% (95% CI: 46.2, 69.0). The magnitude of medication administration and prescription error was 58.4% (95% CI: 51.4, 65.5) and 55.8% (95% CI: 27.0, 84.6), respectively (Figure 2).

Types of prescription errors

Different types of prescription errors were estimated using the overall prescribing error as a baseline. Illegible handwriting (99.4%) is the commonest problem of prescription error though it was reported only by one study. Omission error (38%), wrong dose (38.5%), and the wrong combination of drugs (28.7%) were also frequently reported types of prescription errors (Table 2).

Types of administration errors

Of the reported administration errors, 57.0% were missed doses, 47.0% were technical error, 35.0% were wrong time, and 30.0% were wrong dose (Table 3).

Publication bias and meta-regression

All the reported proportions from primary studies are plotted within the estimated confidence interval as shown in the Galbraith plot below (Figure 2). We also carried out Eggers' regression test and declared that there was no publication bias (p-value=0.998). The meta-regression analysis showed that neither sample size nor year of studies significantly contributed to between study heterogeneity.

Discussion

To achieve the WHO (World Health Organization) five years strategy to reduce medication-related errors by 50% throughout the world [31], subsequent (inter)national data generation is important. Hence, we assessed the national burden of medication errors in Ethiopia.

The overall medication error in Ethiopian hospitals was 57.6%. From medication administration and prescription perspectives, the estimated error was 58.4% and 55.8%, respectively. This finding was higher than a national survey study in Nigeria (47%) [32]. This discrepancy might be due to medication errors were recorded based on professionals report in case of a study in Nigeria, but data were collected through observation and assessing the prescribed sheets in all included studies of the current meta-analysis. Likewise, the result of this meta-analysis was higher than the report in Iranian hospitals (31.8%) [10] and United states or United Kingdom (2-14%) [33], which relatively well-established and equipped health systems are available in developed countries. They also implement a web-based error reporting surveillance system [34]. Strengthening the error reporting system is important to encourages safe medication administration and prescription practices, and improve the quality of clinical care services [35]. In Ethiopia, however, error reporting trend needs improvement given that only 57.4% medication administration errors were reported [36].

Furthermore, in Ethiopia, one study showed that only 30.4% of medical doctors adhered to the code of ethics [37] though 75.7% of medical doctors have good knowledge about code of ethics [38]. Non-adherence to professional ethics might lead to medication errors that cause harm to the patient, person who made the error, and/or healthcare system at large [39]. In addition, health professions who make errors may feel a variety of adverse emotions after medical errors. It is thought that the pervasive culture of perfectionism and individual blame in health disciplines plays a considerable role in these negative feelings [40]. This may further provoke them to make subsequent medication errors.

Healthcare providers should the standard guideline to minimize harms caused by errors [41]. However, the high proportions of medication prescription and administration errors in Ethiopian hospitals are most likely committed by physicians and nurses, respectively. In this meta-analysis, we showed that, illegible handwriting (99.4%), error of omission (38%), wrong dose (38.5%), and wrong combination of drugs (28.7%) were common prescription errors made by physicians. In addition, missed doses (57.0%), technical error (47%), wrong time (35.0%), and wrong dose (30.0%) were frequent medication administration errors most likely made by nurses. These might also be due to high work load, distraction, absence of medication preparation room, unavailability of medication administration guideline, lack of job site training, and inappropriate health worker to patient ratio [17, 18, 20].

Lack of motivation of health workers, unfavorable working environment, working at various health facilities simultaneously, low public awareness about medication errors, lack of integration of medico-legal issues course in to the country education system, weak system in reporting unethical conducts, absence of standardized monitoring tool, and weak collaboration among key stakeholders might have their own contribution to the high proportion of medication error in Ethiopia. Furthermore, WHO recommended measures [42], like establishing well-standardized infrastructure (electronic networks, information technology-based reporting and communication systems for prospective use (computerized physician prescription systems), barcode medication administration, and medical-chart oriented error registration are still a big problem in Ethiopia. Nurse-physician communication is low as a single study showed in Ethiopia [43].

Quality improvement and patient safety intervention strategies for the prevention and management of medication errors are necessary for Ethiopia [44]. For instance, strong medico-legal rules, inter-and intra-professional communication, job aids system based reminders, computerization and automation, shift-to-shift handoffs [45], and wristband bar-code medication scanning could decrease medication errors [46], which are less likely to be implemented in Ethiopia.

Generally, medication errors are common in Ethiopia though there are great opportunities to reduce these events. Appointing qualified and capable inspectors, implementing advanced medication administration and prescription technologies, providing continues sensitizing training to clinician, developing culture of error reporting habit, and improving prescribers' hand writing skill are some of practicable interventions in Ethiopia. Clinicians, researchers, and policy makers need to collaborate to minimize errors committed during medication prescription and administration phase.

Strength and limitations

No differences based on study country, study design, and no study with poor quality. Besides, we did subgroup analysis for further potential sources of variation. However, I-square showed the presence of statistical heterogeneity across studies though possible sources of heterogeneity resolved in the meta-analysis.

Conclusions

Medication errors were highly common in Ethiopian hospitals. In both medication administration and prescription errors, committed errors are very sensitive to further deteriorate and complicate the health of the patients. This finding has a policy implication to review the workforce of healthcare teams.

Abbreviations

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-analysis

WHO: World Health Organization

Declarations

Ethics approval and consent to participate

Not applicable

Consent to publish

Not applicable

Availability of data and materials

All data generated during this study are included in this manuscript.

Competing interests

The authors declare that they have no conflict of interest.

Funding

No fund was received for this study.

Authors' Contributions

AE developed the protocol and write the draft of the manuscript. AE and TDH did statistical analysis. AE and TDH contributed to draft the manuscript. GD, ZN, YB, and MB contributed to assess the quality of included studies. GMB,

CAW, AW, and YA help to search literature. FW, HB, DK, and BM contribute on data extraction. AB, DA, and YW participated at the first revision phase of the manuscript. All the authors edit the manuscript and approve for submission.

Acknowledgements

Not applicable

Authors' Information

AE, AB, DA, YW, MB: Department of Pediatrics and Child Health Nursing, School of Health Sciences, College of Medicine and Health Sciences, Bahir Dar University, Bahir Dar, Ethiopia; GD, HB: Department of Adult Health Nursing, School of Health Sciences, College of Medicine and Health Sciences, Bahir Dar University, Bahir Dar, Ethiopia;GMB, AW, CAW: Department of Pediatrics and Child Health Nursing, School of Nursing, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia; YB: Department of Surgical Nursing, School of Nursing, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia; YA: Department Nursing, College of Medicine and Health Sciences, Debre Birhan University, Debre Birhan, Ethiopia; FW: Department Nursing, College of Medicine and Health Sciences, Debre Markos University, Debre Markos, Ethiopia; BM, DK: Department Nursing, College of Medicine and Health Sciences, Debre Tabor University, Debre Tabor, Ethiopia; ZN: Department Reproductive health, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia; TDH: University of Groningen, University Medical Center Groningen, Department of Epidemiology, Groningen, the Netherlands

References

1. Assembly G. sustainable Development goals. SDGs), Transforming our world: the. 2015;2030.
2. Fogarty GJ, Mckeon CM. Patient safety during medication administration: the influence of organizational and individual variables on unsafe work practices and medication errors. Ergonomics. 2006;49(5-6):444-56.
3. Glavin R. Drug errors: consequences, mechanisms, and avoidance. British journal of anaesthesia. 2010;105(1):76-82.
4. Stokowski LA. Who believes that medical error is the third leading cause of hospital deaths. Medscape May. 2016;26.
5. Santell JP. Reconciliation failures lead to medication errors. Joint Commission journal on quality and patient safety. 2006;32(4):225-9.
6. Leotsakos A, Zheng H, Croteau R, Loeb JM, Sherman H, Hoffman C, et al. Standardization in patient safety: the WHO High 5s project. International journal for quality in health care. 2014;26(2):109-16.
7. Hoffmann B, Rohe J. Patient safety and error management: what causes adverse events and how can they be prevented? Deutsches Arzteblatt International. 2010;107(6):92.
8. Porcelli P, Waitman L, Brown S. A review of medication reconciliation issues and experiences with clinical staff and information systems. Applied clinical informatics. 2010;1(04):442-61.
9. Eisa-Zaei A, Hiremath SRR, Prasad S. Comprehensive evaluation of medication errors incidence at a tertiary care hospital. International journal of pharmaceutical sciences and research. 2018;9(12):5315-9.
10. Taghizadeh A, Moosazadeh M, Nesami MB, Esmaeili R. Determination of the prevalence of medication errors in iranian hospital: a systematic review and meta-analysis. Acta Medica Mediterranea. 2016;32:1525-33.
11. Fekadu G, Abdisa E, Fanta K. Medication prescribing errors among hospitalized pediatric patients at Nekemte Referral Hospital, western Ethiopia: cross-sectional study. BMC research notes. 2019;12(1):421.

12. Tsegaye D. Medication administration error and associated factors among nurses in referral hospitals, Amhara, Ethiopia. 2019.
13. Fekadu T, Teweldemedhin M, Esrael E, Asgedom SW. Prevalence of intravenous medication administration errors: a cross-sectional study. Integrated pharmacy research & practice. 2017;6:47.
14. Feleke Y, Girma B. Medication administration errors involving paediatric in-patients in a hospital in Ethiopia. Tropical Journal of Pharmaceutical Research. 2010;9(4).
15. Hammoudi BM, Ismaile S, Abu Yahya O. Factors associated with medication administration errors and why nurses fail to report them. Scandinavian journal of caring sciences. 2018;32(3):1038-46.
16. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. Annals of internal medicine. 2009;151(4):264-9.
17. Baraki Z, Abay M, Tsegay L, Gerensea H, Kebede A, Teklay H. Medication administration error and contributing factors among pediatric inpatient in public hospitals of Tigray, northern Ethiopia. BMC pediatrics. 2018;18(1):321.
18. Feleke SA, Mulatu MA, Yesmaw YS. Medication administration error: magnitude and associated factors among nurses in Ethiopia. BMC nursing. 2015;14(1):53.
19. Wondmieneh A. Assessments of magnitude and contributing factors of medication administration error among nurses in tertiary hospitals, addis ababa, ethiopia. 2018.
20. Alemu W, Belachew T, Yimam I. Medication administration errors and contributing factors: A cross sectional study in two public hospitals in Southern Ethiopia. International journal of Africa nursing sciences. 2017;7:68-74.
21. Agalu A, Ayele Y, Bedada W, Woldie M. Medication administration errors in an intensive care unit in Ethiopia. International archives of medicine. 2012;5(1):15.
22. Dedefo MG, Mitike AH, Angamo MT. Incidence and determinants of medication errors and adverse drug events among hospitalized children in West Ethiopia. BMC pediatrics. 2016;16(1):81.
23. Agalu A, Ayele Y, Bedada W, Woldie M. Medication prescribing errors in the intensive care unit of Jimma University Specialized Hospital, Southwest Ethiopia. Journal of multidisciplinary healthcare. 2011;4:377.
24. Sada O, Melkie A, Shibeshi W. Medication prescribing errors in the medical intensive care unit of Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia. BMC research notes. 2015;8(1):448.
25. Zeleke A, Chanie T, Woldie M. Medication prescribing errors and associated factors at the pediatric wards of Dessie Referral Hospital, Northeast Ethiopia. International archives of medicine. 2014;7(1):18.
26. Galbraith R. A note on graphical presentation of estimated odds ratios from several clinical trials. Statistics in medicine. 1988;7(8):889-94.
27. Sterne JA, Egger M. Regression methods to detect publication and other bias in meta-analysis. Publication bias in meta-analysis: Prevention, assessment and adjustments. 2005:99-110.
28. Hedges LV, Vevea JL. Fixed-and random-effects models in meta-analysis. Psychological methods. 1998;3(4):486.
29. Thompson SG, Higgins JP. How should meta-regression analyses be undertaken and interpreted? Statistics in medicine. 2002;21(11):1559-73.
30. Fekadu H. Assessment of Prescribing and Adminstration Errors in Pediatric Inpatients in Black Lion Specialized Hospital and Zewditu Memorial Hospital, Addis Ababa, Ethiopia: Addis Ababa University; 2013.
31. World Health Organization. WHO launches global effort to halve medication-related errors in 5 years. Geneva/Bonn Available online: http://www who int/mediacentre/news/releases/2017/medication-related-errors/en/(accessed on 08 August 2019). 2017.
32. Ogunleye OO, Oreagba IA, Falade C, Isah A, Enwere O, Olayemi S, et al. Medication errors among health professionals in Nigeria: a national survey. International Journal of Risk & Safety in Medicine. 2016;28(2):77-91.

33. Lewis PJ, Dornan T, Taylor D, Tully MP, Wass V, Ashcroft DM. Prevalence, incidence and nature of prescribing errors in hospital inpatients. Drug safety. 2009;32(5):379-89.
34. Askarian M, Ghoreishi M, Haghighinejad HA, Palenik CJ, Ghodsi M. Evaluation of a Web-based Error Reporting Surveillance System in a Large Iranian Hospital. 2017.
35. Elden NMK, Ismail A. The importance of medication errors reporting in improving the quality of clinical care services. Global journal of health science. 2016;8(8):243.
36. Jember A, Hailu M, Messele A, Demeke T, Hassen M. Proportion of medication error reporting and associated factors among nurses: a cross sectional study. BMC nursing. 2018;17(1):9.
37. Tiruneh MA, Ayele BT. Practice of code of ethics and associated factors among medical doctors in Addis Ababa, Ethiopia. PloS one. 2018;13(8):e0201020.
38. Tiruneh MA, Ayele BT, Beyene KGM. Knowledge of, and attitudes toward, codes of ethics and associated factors among medical doctors in Addis Ababa, Ethiopia. Medicolegal and Bioethics. 2019;9:1.
39. Kalra J, Kalra N, Baniak N. Medical error, disclosure and patient safety: A global view of quality care. Clinical biochemistry. 2013;46(13-14):1161-9.
40. Robertson JJ, Long B. Suffering in silence: medical error and its impact on health care providers. The Journal of emergency medicine. 2018;54(4):402-9.
41. Emanuel L, Berwick D, Conway J, Combes J, Hatlie M, Leape L, et al. What exactly is patient safety? Advances in patient safety: new directions and alternative approaches (Vol 1: Assessment): Agency for Healthcare Research and Quality; 2008.
42. World Health Organization. Promoting safety of medicines for children. 2007. Geneva: World Health Organization. 2014.
43. Hailu FB, Kassahun CW, Kerie MW. Perceived Nurse—Physician Communication in Patient Care and Associated Factors in Public Hospitals of Jimma Zone, South West Ethiopia: Cross Sectional Study. PloS one. 2016;11(9):e0162264.
44. Hughes RG. Tools and strategies for quality improvement and patient safety. Patient safety and quality: An evidence-based handbook for nurses: Agency for Healthcare Research and Quality (US); 2008.
45. Mardis T, Mardis M, Davis J, Justice EM, Holdinsky SR, Donnelly J, et al. Bedside shift-to-shift handoffs: a systematic review of the literature. Journal of nursing care quality. 2016;31(1):54-60.
46. Khammarnia M, Kassani A, Eslahi M. The Efficacy of Patients' Wristband Bar-code on Prevention of Medical Errors. Applied clinical informatics. 2015;6(04):716-27.

Tables

Table 1: Studies characteristics

First Author	Study setting (Health institution)	Ward/ Population	Error type	Prescription /administration frequency	Response rate with percentage	Source of fund
Agalu A et al/2012 (Agalu et al., 2012)	Jimma university specialized hospital	ICU	Administration	1,200	100	Jimma University
Agalu A et al/2011 (Agalu et al., 2011)	Jimma university specialized hospital	ICU	Prescribing	398	100	Not reported
Baraki Z et al/2018 (Baraki et al., 2018)	Public Hospitals in Tigray	Pediatrics patient	Administration	1,251	100	Aksum University
Dedefo MG et al/2016 (Dedefo et al., 2016)	Nekemte Hospital	Pediatrics patient	Administration	1,115	100	Jimma University
Fekadu G et al/2019 (G. Fekadu et al., 2019)	Nekemte Hospital	Pediatrics patient	Prescribing	1,596	100	None
Fekadu T et al/2017 (T. Fekadu et al., 2017)	Ayder Hopital	all patient	Administration	366	100	None
Sada et al/2015 (Sada et al., 2015)	Tikur Anbesa Hospital	Medical ICU	Prescribing	882	100	Addis Ababa University
Feleke SA et al/2015 (S. A. Feleke et al., 2015)	Felege-Hiwot Referral Hospital	Inpatient department	Administration	360	100	University of Gondar
Zeleke A et al/2014 (Zeleke et al., 2014)	Dessie Referral Hospital	pediatrics ward	Prescribing	384	100	Jimma University
FelekeY, Girma B/2010(Y. Feleke & Girma, 2010)	Jimma University Specialized Hospital	Pediatrics inpatient	Administration	218	100	
Wondimieneh A/2018(Wondmieneh A, 2018)	Addis Ababa Tertiary care hospitals	Medical, surgical and emergency department	Administration	298	98.3	Not reported
Alemu W et al/2017 (Alemu et al., 2017)	Two public hospitals in southern Ethiopia	All patients	Administration	130	92.2	Jimma University
Fekadu H/2013 (H. Fekadu, 2013)	Tikur Anbesa & Zewuditu	Pediatrics ward	Prescribing	2,401		Addis Ababa University

	Memorial Hospital				95.2	
Fekadu H/2013 (H. Fekadu, 2013)	Tikur Anbesa & Zewudito Memorial Hospital	Pediatrics ward	Administration	200	100	Addis Ababa University
Tsegaye D/2019 (Tsegaye D, 2019)	Public Hospitals in Amhara	All wards	Administration	414	98.1	Amhara Health office

Table 2: Types of drug prescription errors with their reported proportion (p)

Types of drug prescribing errors	P (95% CI)
Omission (G. Fekadu et al., 2019; Sada et al., 2015; Zeleke et al., 2014)	37.986 (15.195, 60.776)
Wrong dose (Agalu et al., 2011; G. Fekadu et al., 2019; H. Fekadu, 2013; Sada et al., 2015; Zeleke et al., 2014)	38.482 (15.213, 61.750)
Wrong dosage-form (Zeleke et al., 2014)	7.170 (5.346, 8.994)
Wrong frequency (Agalu et al., 2011; H. Fekadu, 2013; Sada et al., 2015; Zeleke et al., 2014)	8.042 (4.957, 11.127)
Inappropriate indication (Agalu et al., 2011; T. Fekadu et al., 2017; Sada et al., 2015; Zeleke et al., 2014)	6.380 (1.982, 10.777)
Wrong combination of drugs (Agalu et al., 2011; H. Fekadu, 2013; Sada et al., 2015)	28.707 (24.856, 32.559)
Wrong duration (Agalu et al., 2011)	3.400 (1.909, 4.891)
Wrong abbreviation (Agalu et al., 2011; Sada et al., 2015)	7.821 (3.027, 18.669)
Wrong route of administration (Agalu et al., 2011)	1.900 (0.817, 2.983)
Drugs with incorrect instruction (G. Fekadu et al., 2019)	6.200 (5.045 ,7.355)
Illegible handwriting (H. Fekadu, 2013)	99.400 (98.820, 99.98)

Table 3: Types of drug administration errors with their reported proportion (p)

Types of drug administration errors	P (95% CI)
Wrong time (Agalu et al., 2012; Alemu et al., 2017; Baraki et al., 2018; Dedefo et al., 2016; H. Fekadu, 2013; S. A. Feleke et al., 2015; Y. Feleke & Girma, 2010; Wondmieneh A, 2018)	34.992 (21.491, 48.493)
Omission of drugs (Agalu et al., 2012; Baraki et al., 2018; Dedefo et al., 2016; H. Fekadu, 2013; S. A. Feleke et al., 2015; Y. Feleke & Girma, 2010)	15.021 (5.827, 24.216)
Missed doses (Agalu et al., 2012; T. Fekadu et al., 2017)	57.036 (18.912, 132.985)
Wrong route (Agalu et al., 2012; Alemu et al., 2017; Dedefo et al., 2016; S. A. Feleke et al., 2015; Wondmieneh A, 2018)	17.030 (8.084, 25.975)
Wrong dose (Agalu et al., 2012; Alemu et al., 2017; Baraki et al., 2018; Dedefo et al., 2016; H. Fekadu, 2013; T. Fekadu et al., 2017; S. A. Feleke et al., 2015; Y. Feleke & Girma, 2010; Wondmieneh A, 2018)	30.007 (8.970, 51.044)
Unauthorized drug (Agalu et al., 2012; Y. Feleke & Girma, 2010)	2.787 (2.097, 3.477)
Wrong rate of infusion (Agalu et al., 2012)	1.400 (0.945, 1.855)
Wrong dose and rate (Agalu et al., 2012)	3.900 (2.989, 4.811)
Wrong drug (Alemu et al., 2017; Dedefo et al., 2016; Wondmieneh A, 2018)	27.334 (11.961, 42.707)
Wrong patient (Alemu et al., 2017; Wondmieneh A, 2018)	26.890 (8.840, 62.620)
Wrong dosing schedule (Dedefo et al., 2016)	1.800 (1.139, 2.461)
Deteriorated drug (Dedefo et al., 2016)	14.600 (13.202, 15.998)
Wrong dosage form (Dedefo et al., 2016)	1.200 (0.831, 1.569)
Non-adherence (Dedefo et al., 2016)	4.500 (3.447, 5.553)
Monitoring error (Dedefo et al., 2016)	8.400 (7.151, 9.649)
Technique error (S. A. Feleke et al., 2015; Y. Feleke & Girma, 2010)	46.995 (4.160, 98.150)

Unauthorized error (S. A. Feleke et al., 2015)	1.100 (0.671, 1.529)

Figures

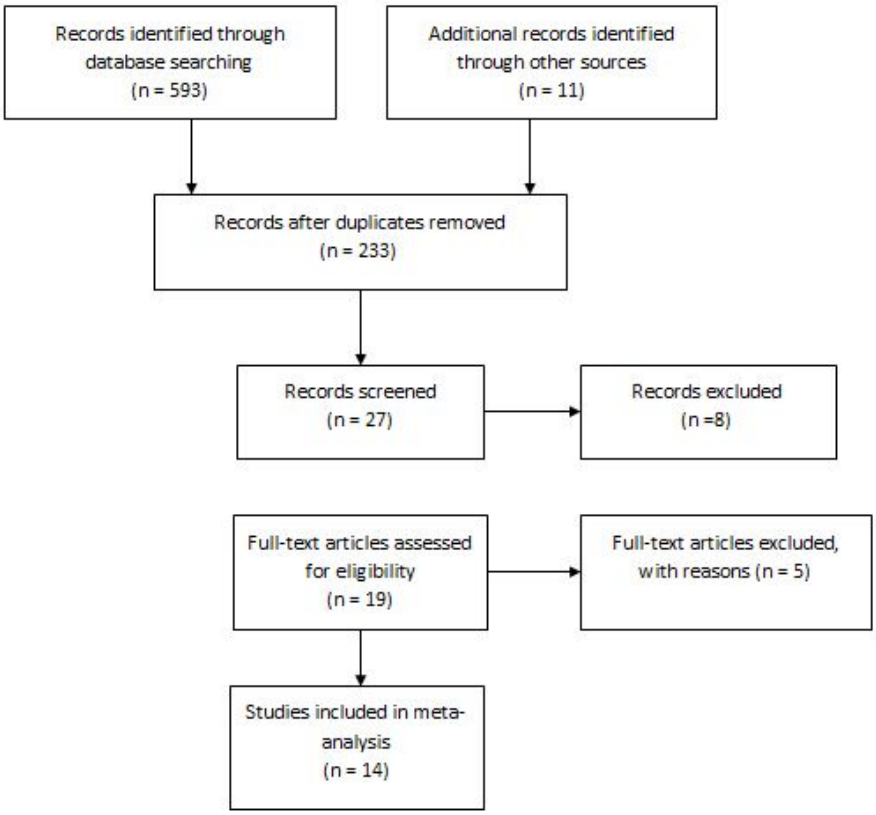

Figure 1

PRISMA diagram of article searching process.

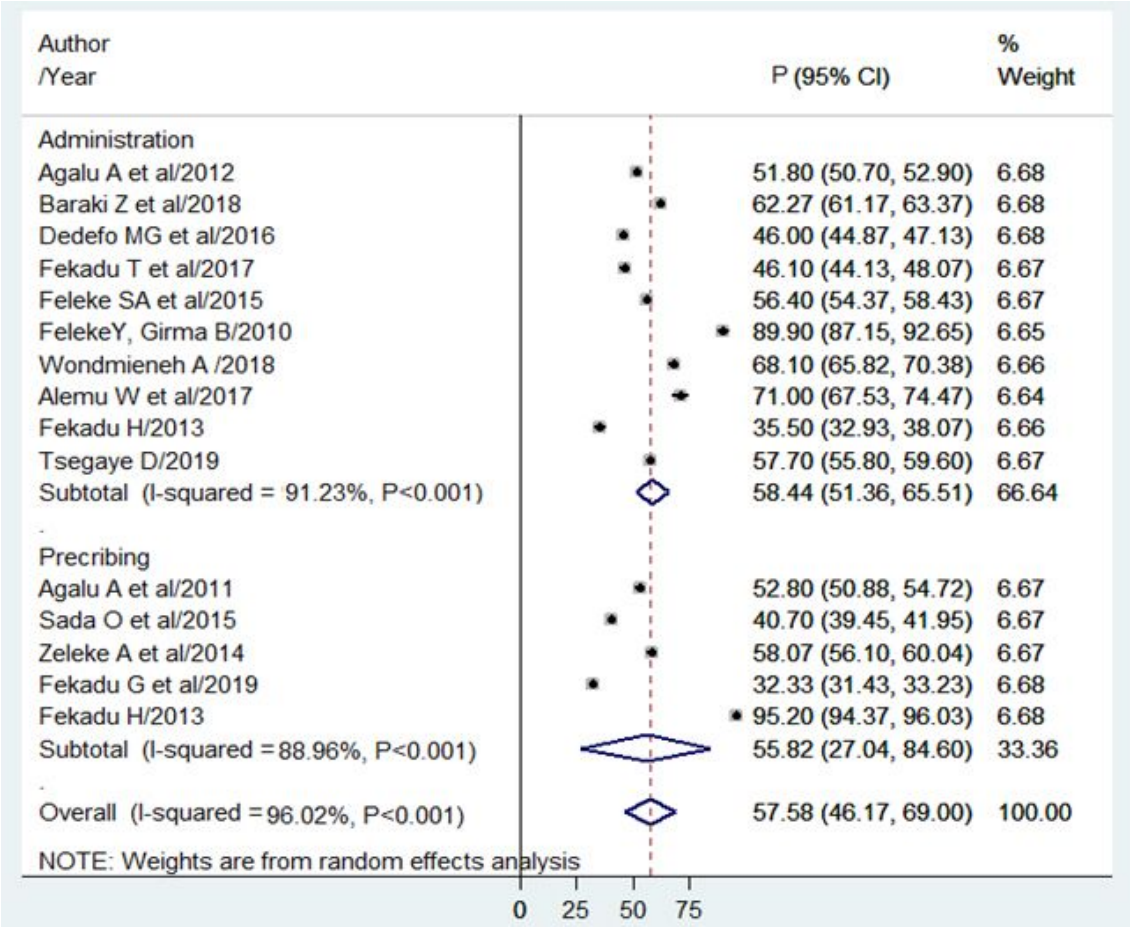

Figure 2

Forest plot presentation of a medication error, medication administration and prescribing error.

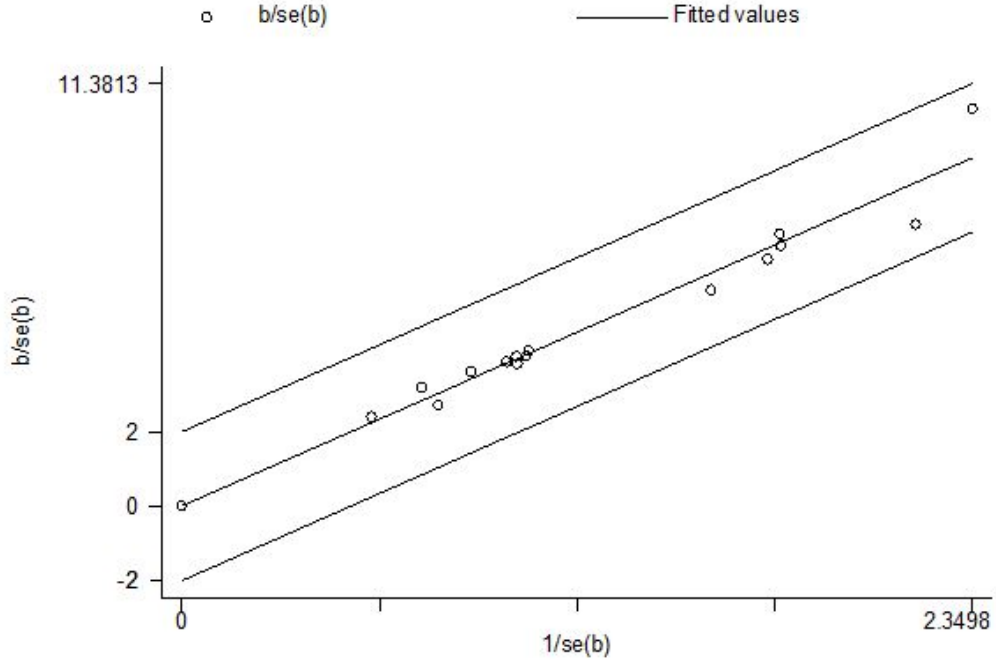

Figure 3

Galbraith plot with inverse standard error (1/se (b)) and standardized effect size (b/se (b)).

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Additionalfile.docx
- Personalcoverletter.docx