Adherence to prescription writing guidelines for outpatients in Southern Gauteng district hospitals

MMed Candidate: Jacques Gihana Nkera-Gutabara

Supervisor: Professor Laurel Baldwin-Ragaven

A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Medicine (MMed) in Family Medicine

Format: Article in submissible format to the *African Journal of Primary Health Care and Family Medicine* (AJPHCFM)

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Corrections following Examiners feed-back.

In the light of the two Examiners feed-back on my research report, I have prepared and completed the responses which I hereby submit.

Corrections Examiner 1		
Item Number	**Examiner's comments**	**Corrective action**
1	At the bottom of page 5, the second sentence in the section on "Study population" is incomplete. "Prescriptions were....."	Bottom of page 5, the incomplete second sentence in the section on "Study population" was a typographic error and has been corrected.
2	On page 7 line 5 - more clarity is necessary: For prescriptions requiring two signatures,(.....} the medical officer's signature was used to determine the prescriber. However in Table 2 under "Prescriber categories" one medical student is listed, 16 clinical associates and 33 medical interns are noted. All three of these categories of personnel require the prescription to be countersigned before it can be legally dispensed - and so these	On page 7 line 5, in Methods, more clarity is provided in the body of the text: "For prescriptions requiring two signatures (such as that of a medical student to be countersigned by a medical officer), the medical officer's signature will be used to determine the prescriber, unless there is no counter- signature, which would constitute a procedural omission. Further added on page 10 paragraph one in Results: "Of note, one prescription was signed for by a student and not counter-signed by a medical officer, and

	should either be ascribed to medical officers, or noted as omissions in procedure.	existing internal memos allow clinical associates and medical interns to write OPD prescriptions".
3	It is usual when a candidate submits a journal article as the work to be adjudicated, the submission guidelines for the chosen journal are included with the submission. This assists the examiner with the format in which the journal requires presentation. It does not seem stated - but check the convention that Tables are labelled at the top of the table - but Figures are labelled at the bottom of the figure (for Fig 1 and Fig 2}	Although this is not a specifically stated requirement in the guidelines of the *African Journal of Primary Care and Family Medicine* to which the article is intended to be sent, labels for Figure 1 and Figure 2 have been placed at the bottom of the figures as per Wits University style convention.
4	At the top of page 14, the point concerning the inverse association of number of prescribers with accuracy seems counterintuitive (in the light of the previous argument that the high workload increases the likelihood of a reduced GAS}. A sentence explaining why you think this happens could strengthen your argument.	Correction added on page 14 paragraph one in Results: The relationship between number of OPD prescribers (continuous variable) and global accuracy score indicates that an increase in the number of prescribers on a day was associated with an odds ratio of 0.73 in the likelihood of scoring between 80% - 100% (OR: 0.73). In other words, with every increase in the number of prescribers, there is a reduced likelihood of scoring between 80 -

		100%, or reaching the target goal. Although this seems counterintuitive in the light of the argument that high workload increases the likelihood of a reduced GAS, it suggests, using advanced statistics beyond the scope of this study, that it is possible to calculate optimal numbers of OPD prescriptions and OPD prescribers on any given day.

Corrections Examiner 2

Item number	Examiner's comments	Corrective action
1	The title of the study is misleading - it is not so much about "accuracy" of prescriptions than adherence of prescriptions to the South African regulatory framework. This should be changed.	The research title is changed from "Accuracy of prescription writing in Southern Gauteng district hospital outpatient departments" to "Adherence to prescription writing guidelines for outpatients in Southern Gauteng district hospitals"
2	Reference "3" is incorrect for this study. Government Notice R766 of 14 October 2013, does not have a regulation "28". R766 is an amendment of regulations 18 and 19 dealing with the period of validity of various licences and the renewal of licences. Although the regulated components of prescription	Reference 3 has been rectified from "South African Government. 2013. General regulations made in terms of the Medicines and Related Substances Act 101 of 1965, as amended. Government Gazette No. 36929 of 14 October 2013 (Published under Government Notice R766, Content item 28)"

	writing are correctly reflected in the study, the incorrect reference is used. This is a basic error which is not expected at an MMed level.	to "South African Government. 2013. General regulations made in terms of the Medicines and Related Substances Act 101 of 1965, as amended-Government Notice R510 in Government Gazette 24727 dated 10 April 2003. Commencement date: 2 May 2003 (regulation 28).
3	The use of the international phrase "controlled substances" is incorporated into the study without definition. No such entity exists in South African legislation. It is also not referred to in the South African guidelines referenced nor the WHO Guide to Good Prescribing. It is unclear as to <u>how</u> the researcher identified these so-called controlled substances in performing the study. It is also not clear why these are considered as a separate "type" of prescription separate from adult and paediatric prescriptions. How many of these "controlled substance" prescriptions were for adults and how many for children? The Medicines and Related Substances Amendment Act does however refer to and define "Schedules" of medicines. I would recommend either removing all mention of controlled	On page 7 in Methods-variables, "Controlled substances" meaning in this study and a new reference were provided as follows: "Controlled substances prescriptions were checked for full letter writing of dosages and quantities. In the South African context, this refers particularly to Schedule 5, 6 and 7 substances[1] which would be available in primary care facilities; and, necessitate both medical diagnosis and management, but also enhanced control of supply.[47] [1] Schedule 5 substances: have a low to moderate potential for abuse or dependence; example: benzodiazepines, tramadol. Schedule 6 substances (example: Pentazosine) and 7 (example: pethidine, morphine, tilidine): have a moderate to high potential for abuse or for producing dependence. There were small numbers of child and controlled substances prescriptions accessed: nine (9) and seven (7) respectively, and it will not be possible at this stage to determine how many of the

	substances and incorporating scheduled substances in their place depending on what "definition" was actually used in identifying the controlled substances; or removing all reference to them and "absorbing" them into the relevant components of the study write-up	controlled substances prescriptions were for adults and how many were for children.
4	On page 5, the word "recent" should be replaced with "a 2008 ... review".	On page 5, paragraph one, the word "recent" has been replaced by "2008 systemic reviews..."
5	Study Design: this is not a cross-sectional review, but a retrospective study. (page 5)	On page 5, **Study design:** "This is a cross-sectional review..." In the light of the fact that this study provides a one day snap shot of the adherence to guidelines in prescription writing, one day per surveyed OPD, it is felt that it is a cross-sectional review, and the potential poor data variability it may cause with regards to prescribers surveyed has been added as a limitation of the study.
6	The last sentence on page 5 is incomplete.	Bottom of page 5, the incomplete second sentence in the section on Study population "Prescriptions were..." was a typographic error and has been corrected.

7	On page 6, "Sampling", refers to random selection without stating the method of randomisation. The method should be clearly stated.	On page 6 **"Sampling":** The selection of the hospitals to be surveyed was randomised as follows: one hospital was randomly selected from each of the three health districts with more than one district hospital; the fourth district hospital is in a district with only one such hospital. The names of the hospitals were written on A4 size papers which were folded four times, placed in a bucket and a researcher's colleague would pick one from the bucket for districts where there was more than one hospital. The order the hospitals were visited in was from the furthest to the closest to Wits University Medical School. The section on sampling in Methods was refined in order to address the Examiner's concerns.

Adherence to prescription writing guidelines for outpatients in Southern Gauteng district hospitals

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Declaration

I, Jacques Gihana Nkera-Gutabara, student number 698989, declare that this Research Report is my own work. I furthermore declare that I contributed adequately towards the research findings submitted for publication to the *African Journal of Primary Health Care and Family Medicine* in the article titled "Adherence to prescription writing guidelines for outpatients in Southern Gauteng district hospitals" which is the substance of this research report.

Signature of student.....**Date: 2018 June 10**

Name of supervisor: **Laurel Baldwin-Ragaven**

Signature of supervisor **Date 2018 June 10**

Acknowledgments

Gratitude is hereby expressed to Professor Laurel Baldwin-Ragaven, for the kind attention and astute direction of this research in all its parts. Sincere thanks to Dr Zuberu Elabor, for his guidance in the initial phase of protocol development, to Mrs D Pretorius, Dr Jimmy Akii and the Johannesburg Health District Family Physicians for their facilitation and support. Special thanks to the CEOs and Pharmacists of South Rand, Bertha Gxowa, Yusuf Dadoo and Kopanong Hospitals for the permission to access their medical records. Special thanks also to the bio-statisticians from the Wits School of Public Health for their assistance with statistical analysis, particularly Mr E Ngamasana, Mr L Nyathi and Dr G Olorunfemi.

Title: Adherence to prescription writing guidelines for outpatients in Southern Gauteng district hospitals

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ABSTRACT

Background: Medical prescription writing is legally regulated in order to prevent errors that can result in patient harm. This study assesses prescriber adherence to such regulations in primary care settings.

Methods: A cross-sectional study of 412 prescriptions from four district hospital outpatient departments (OPDs) was conducted in March 2015. Primary outcome data were obtained by scoring prescriptions for accuracy across four categories: completion of essential elements; use of generic names of medications; use of approved abbreviations and decimals; and, legibility. Secondary outcome data sought associations between accuracy scores and characteristics of the OPDs that might influence prescriber adherence.

Results: Completion of the essential elements, including patient identifiers, prescriber identifiers, treatment regimen and date scored 44%, 77%, 99% and 99% respectively. Legibility, the use of generic names of medications and use of approved abbreviations and decimals scored 90%, 39% and 35% respectively. Only 38% of prescriptions achieved global accuracy score of between 80-100%. A significant association was found between lower global accuracy score and the number of prescriptions written per day ($p = 0.001$) as well as with the number of prescribers working on that day ($p = 0.005$), suggesting a negative impact on prescribers' performance due to workload pressures.

Conclusion: Low global accuracy scores indicate poor adherence to prescription writing regulations. Elements requiring substantial improvement include: completion of patient and prescriber identifiers; use of generic medication names; and, the use of approved abbreviations and decimals. This study provides baseline data for future prescription writing quality improvement initiatives.

Introduction

Medical prescriptions are often the endpoint of patient encounters with healthcare practitioners. Their writing is regulated by professional guidelines and the law.[1-3] Prescription inaccuracies may impact negatively on the quality of care and compromise patient safety; and, they may lead to medication errors that have significant social, financial and legal consequences.[4-7] Such errors can arise from medication prescribing, dispensing, administration or from patient compliance errors;[8,9] but, the majority of errors originate in medical prescription writing by health care professionals,[10] which can then have knock on effects such as delayed dispensing.[11] Prescription writing errors account for up to 70% of medication errors that could potentially result in adverse effects.[12]

Prescription writing standards

There have been international and domestic attempts at standard setting to determine the essential elements to be included when writing a prescription for medication. In South Africa, we are guided by the World Health Organisation's (WHO) "Guide to Good Prescribing",[1] the National Department of Health's "prescription writing" guidelines,[2] and the "General Regulations" of the Medicines and Related Substances Act 101 of 1965, as amended on 2003 May 02.[3] While there is a great deal of overlap between these three sets of guidelines, they are however not all the same. The essential elements from these three different sources are summarised and compared in Table 1, with the last column showing those that have been selected as indispensable for this study. The justification for inclusion, or not, is explained in Table 1 footnotes.

Despite the existence of these legal standards and professional norms, significant challenges to adherence by prescribers are reported in international literature.[10,12]

Table 1: Comparative summary of elements essential to a medical prescription, according to international and domestic best practice

	WHO[1]	EML- 2014[2]	Medicines and Related Substances Act 101 of 1965[3]	Included for audit in this study
Elements and components				
Date of prescription	+	+	+	+
Patient identifiers				
Names	+	+	+	+
File number		+		+
Address (†)	+	+	+	
Age	+	+	+	+
Sex			+	+
Weight (††)		+		+
Treatment regimen				
Medication name in full (either trade or generic) (†††)	+	+	+	+
Strength	+	+	+	+
Dosage	+	+	+	+
Frequency/ interval	+	+	+	+
Duration		+	+	+
Quantity (††††)	+		+	
Repeats		+	+	+
Use of medication generic name in full (†††)	+	+	+	+
Use of approved abbreviations and decimal points		+		+
Prescriber identifiers				
Name	+	+	+	+
Address (†)	+		+	
Qualification/degree			+	+
Professional registration number			+	+
Contact number (†)	+	+		
Signature	+	+	+	+
Legibility of handwriting		+	+	+
Permanent copy (†††††)			+	
Diagnosis (††††††)			+ (with patient's consent)	
Warnings (†††††††)	+			

(†) The patient and prescriber addresses and the prescriber contact number, although required, were not included for assessment in this study, as all prescriptions were dispensed internally via the hospital OPD where both the patient and prescriber are located; no outside prescription was considered.
(††) The patient's weight is mandatory for children; and, it is also required for the frail elderly and where dosing is weight dependant; it allows for a double check by the dispenser.
(†††) The medication name is scrutinised for full name use (not abbreviated) and separately for generic name use.
(††††) Quantity of medication was left out as the dosage, frequency and treatment duration are its equivalent; and, in most settings, the calculation of quantity of medication to dispense is a pharmacy function.
(†††††)A permanent copy of the prescription is kept by the pharmacy.
(††††††) The diagnosis is found in the patients notes to which the prescription is appended.
(†††††††) Warnings are delivered verbally by pharmacist at the time of dispensing.

Research on the reasons for poor quality of prescription writing investigate it from various perspectives, including the setting in which care is provided (from outpatient primary care to hospital wards to specialised intensive care units) as well as the professional profiles of prescribers (among students in different professional programmes to consultants and university faculty).[13-16] While generalising, there seems to be no single factor accounting for adherence or non-adherence to prescription writing guidelines.

Prescription writing errors

Indicators used to assess the accuracy of a medical prescription in compliance with writing regulations include: the completion of essential elements; the use of medication generic names; the use of approved abbreviations and decimal points; and, finally, script legibility if handwritten. The essential elements that must be completed are further broken down into: "the date of prescription", "the patient identifiers", "the treatment regimen", "the prescriber identifiers and signature".

Errors of omission or incompleteness in prescription writing are the most reported upon.[13-27] Other errors include the use of medication trade names rather than their generic equivalents and the use of non-approved abbreviations and decimal points[17, 28, 29] Handwritten prescriptions are consistently found to be more prone to errors than electronic ones.[17] Junior doctors are reported to make more prescribing errors, with contributing factors cited as insufficient knowledge and the work environment which includes heavy workload, time pressures and the influence of the prescribing habits of the seniors.[18,19] Handwritten script illegibility is also reported as a frequent cause of error.[27,30,31] Legibility has been assessed using different methods including optical computer software and subjective scales, with the legibility of letter words (such as drug names) being worse than that of numbers (such as frequency of dosage).[32-34] A validated tool, the Prescription Quality Index (PQI), provides indicators to measure legibility in chronic diseases using a three point Likert scale,

with scores of "0", "1" and "2" respectively for "illegible", "barely legible" and "legible".[35]

Assessing and reporting on the quality of prescription writing

The literature assesses and reports on the quality of prescription writing in various ways, including simple counts of present or missing elements of the prescription, graded scoring for the completion of elements (not completed, partially completed or fully completed) and classification into categories of acceptability according to scores realised.[35-38] Scaling and weighting have also been used in assessing the quality of a prescription; however, this is not required, nor is validation, for components which are purely descriptive in nature.[28, 29, 35-40] Various aspects of quality assessment and reporting have been incorporated into this study.

Prescription writing quality improvement

Improvement in the quality of medical prescription writing is achievable. Experience from other settings indicates, for example, that prescription audits in conjunction with education on rational pharmacotherapy improved the prescribing skills of fourth year medical students.[41] Serial audits and targeted interventions including educational strategies (such as feedback of audit results for prescribers on prescribing and medication errors) and changes to systems of practice (such as modifications to medication charts, publication of hospital-wide prescribing standards, an alert notification system and the implementation of electronic health records) have resulted in improvements to all of the indicators of medical prescription quality standards.[20,42] A modified out-patient prescription chart with prompts for all the required elements to reduce prescription errors has been recommended,[21] as were, in other studies, ongoing education programmes, follow-up reminders, regular audits and feed-back sessions, and the use of prescribers' self-inking stamps.[15,16] A sevenfold decrease in prescription errors was reported with the

introduction and adoption of electronic prescribing,[43] which is consistent with 2008 systematic reviews on this subject.[44,45]

To our knowledge, there is no published study on adherence to South African regulations for medical prescription writing in primary care settings. An unpublished 2014 in-house audit of prescription writing in the outpatient department (OPD) of one district hospital in Southern Gauteng raised concerns, providing the impetus for this study, when it was found that 83% of 400 prescriptions had only achieved less than a 40% global accuracy score, with the remaining 17% of prescriptions scoring between 40 to 80%, and 0% scoring between 80 to100% in compliance with prescription writing regulations.[46]

The purpose of this study therefore was to assess the adherence of prescribers across Southern Gauteng health districts to prescription writing regulations and examine potential barriers, in order to raise awareness and provide baseline data for future prescription writing quality improvement initiatives.

Methods

Study design: This is a cross-sectional study of the accuracy in prescription writing with regards to adherence to regulations among all levels of prescribers (medical students, primary health care nurses, clinical associates, medical interns, medical officers and medical specialists) working in a primary care setting who were blinded to the study.

Study site: The study was conducted in the outpatient departments of four district hospitals in Southern Gauteng, representing the University of the Witwatersrand Family Medicine training platform.

Study population: All medical prescriptions issued at the OPDs in Southern Gauteng district hospitals in March 2015, the day prior to the researcher's site visit.

Sample size: Considering the results of previous research that indicated a range of 1.3% to 85.9% of accurately written prescriptions, with a precision of 5% and 95% confidence level at a power of 80%, using Stata12® (Stata Corp, College Station, Texas), the calculated sample size was 374 prescriptions.

Sampling: The selection of the hospitals to be surveyed was randomised as follows: one hospital was randomly selected from each of the three health districts with more than one district hospital; the fourth district hospital is in a district with only one such hospital. The names of the hospitals were written on A4 size papers which were folded four times, placed in a bucket and a researcher's colleague would pick one from the bucket for districts where there was more than one hospital. The order the hospitals were visited in was from the furthest to the closest to Wits University Medical School. A convenient sampling of a minimum of 100 consecutive OPD prescriptions written for adult and child patients and dispensed the previous day was assessed per hospital to ensure reaching the calculated sample size.

Data collection instrument: Nineteen (19) essential elements of prescription writing were selected from existing regulations for this study (Table 1). These were compiled into a single data collection tool (Appendix 1), which was a Microsoft Excel™ spreadsheet, with variable codes and scoring. All data were manually extracted by the researcher (JGN) through a review of real prescriptions accessed from the pharmacies the day after all medications had been dispensed and kept in boxes by the pharmacist for this purpose.

Variables: For each prescription, the completion of the essential elements, the use of the medication generic names, the use of approved abbreviations and decimal points and, prescription legibility were evaluated; and, an accuracy score out of 38 total points was determined. Each element was assessed, with scoring assigned as "0", "1" or "2" for "not completed", "partially completed" or "fully completed" respectively. The use of medication generic names; and, the use of approved abbreviations and

decimal points were scored "0", "1" or "2" for "not used", "partially used" or "fully used" respectively. The medicine name was scored twice, but for different aspects: firstly, for full and correct writing (not abbreviated) with either the trade or generic name in the treatment regimen; and, additionally for the use of its recommended generic form. Legibility was scored according to the PQI[35] as "0", "1", or "2" for "illegible", "barely legible" or "legible" respectively, as subjectively determined by the researcher.

Prescriptions for children were particularly checked for the completion of age and weight. Controlled substances prescriptions were checked for full letter writing of dosages and quantities. In the South African context, this refers particularly to Schedule 5, 6 and 7 substances[1] which would be available in primary care facilities; and, necessitate both medical diagnosis and management, but also enhanced control of supply.[47]

For prescriptions requiring two signatures (such as that of a medical student to be countersigned by a medical officer), the medical officer's signature will be used to determine the prescriber, unless there is no counter- signature, which would constitute a procedural omission. Prescriptions by community service doctors and registrars were counted as medical officers as they could not be distinguished. Finally, other characteristics for each of the district hospital's OPD included: the average number of OPD prescriptions per day; and, the number and professional categories of prescribers present in OPD on the day the prescriptions were written.

Global accuracy score: A global accuracy score (GAS) for each prescription was determined by calculating the total percentage achieved out of 38 possible points for the nineteen (19) prescription elements considered (Appendix 1). Each GAS was then

[1] Schedule 5 substances: have a low to moderate potential for abuse or dependence; example: benzodiazepines, tramadol.
Schedule 6 substances (example: Pentazocine) and 7 (example: pethidine, morphine, tilidine): have a moderate to high potential for abuse or for producing dependence.

classified into one of four (4): "100%", "80-100%", "40-79%" and "less than 40%" respectively. The desired prescription writing accuracy score, or gold standard, is 100%; however, based on previous earlier findings,[46] its expected rate was negligible.

Accuracy score category ranges "80-100%", "40-79% and "less than 40%" were therefore used. These score ranges were purely descriptive, and are similar to the score ranges employed in the accreditation of health services by the Council for Hospital Services Accreditation of South Africa (COHSASA).[48]

Outcome measures

Main: The completeness of essential elements of a prescription; the use of the generic names of medications; the use of approved abbreviations and decimal points; the legibility of the prescription; and, a global accuracy score (GAS) for each prescription were determined.

Secondary: Calculated associations between the global accuracy score categories with:

- ✓ The average number of OPD prescriptions per day
- ✓ The number of OPD prescribers on that day
- ✓ The prescribers' professional categories, grouped either as allied health professionals: categories one (1) to three (3), or medical doctors: categories four (4) to six (6)
- ✓ The type of prescription (adult, child, controlled substance)

Data analysis: After electronic and direct entry on to the specially designed data collection tool in MS Excel, the data were then cleaned, sorted and exported for analysis into Stata 12® software. Descriptive analysis of the categorical data was done and results presented in tables as frequencies and percentages as well as in figures. For elements with multiple components, a mean score and standard deviation (SD) were also determined. Cross-tabulation was used to explore possible associations between primary and secondary outcomes using statistical tests including the Student's T, the Pearson's Chi^2, the Fisher's exact and the Kuskral-Wallis. A p value

of < 0.05 was considered statistically significant. Logistic regression analysis was carried out where associations were found.

Ethics and permission

Approval to conduct the study was granted by the Human Research Ethics Committee (Medical) of the University of the Witwatersrand: Clearance Certificate number M141179 (Appendix 2). The four hospital CEOs issued authorisation letters granting permission to access their facilities for purposes of the study. A further undertaking form was signed with each hospital records administrator to not record and to preserve at all times the anonymity of patient and prescribers.

Results

A total of 412 prescriptions was analysed across all districts, with each of the hospital sites contributing approximately 25% of the entire sample. Table 2 is a descriptive account of the specific characteristics for each district hospital OPD as well as for all Southern Gauteng districts combined. Significant differences were found between the health districts with regards to the average number of prescriptions per day, the number of prescribers on the day and the prescribers' professional category mix. The average number of prescriptions per day varied between 100 to over 300, and that of prescribers varied between six and eight on the days studied. Medical officers constituted 83.25% of prescribers overall. Adult patients accounted for 96.12% of all prescriptions written.

Figure 1 illustrates for Gauteng South the full completion in percentages of a prescription's 19 essential elements across the 412 prescriptions assessed; the raw count and percentages showing fully completed, partially completed and not completed elements of the prescription for Gauteng South and for each of the four health districts is included as Appendix 3. Of note, one prescription was signed for by a student and not counter-signed by a medical officer, and existing internal memos allow clinical associates and medical interns to write OPD prescriptions.

Prescribers achieved rates of 90% and over for completion of the date of the prescription, the treatment regimen, the prescriber's signature and handwriting legibility. The patient's file number was indicated in 83% of prescriptions. Lower rates were seen for the use of generic names of medications (39%), approved abbreviations and decimal points (34%), and for the other components of patients and prescribers'

Table 2: OPD site specific characteristics per district hospital and for all of Southern Gauteng

	Health district/ hospital sampled					
	COJ/ South Rand n=101 (24.51)	**West Rand/ Yusuf Dadoo n=105 (25.49)**	**Ekurhuleni/ Bertha Gxowa n=105 (25.49)**	**Sedibeng/ Kopanong n=101 (24.51)**		**Southern Gauteng total n= 412 (100%)**
Sites specific characteristics					**p value**	
Average N° of OPD prescriptions per day (†)	300+	100-200	201-300	201-300	0.001	
N° of OPD prescribers present on the day (††)	7	8	6	8	0.001	
Type of prescriptions: frequency (%)					0.2	
Adults	96 (95.04)	102 (97.14)	100 (95.23)	98 (97.02)		396 (96.12)
Paediatrics	4 (3.96)	1 (0.95)	4 (3.96)	0 (0.00)		9 (2.18)
Controlled substances	1 (0.99)	2 (1.90))	1 (0.95)	3 (2.97)		7 (1.70)
Prescriber categories: frequency (%)					0.001	
1- PHC nurses	0 (00)	6 (5.57)	0 (00)	7 (6.93)		13 (3.16)
2- Medical students	0 (00)	1 (0.95)	0 (00)	0 (00)		1 (0.24)
3- Clinical associates	0 (00)	7 (6.66)	4 (3.80)	5 (4.76)		16 (3.88)
4- Medical interns	19 (18.81)	4 ((3.80)	0 (00)	10 (9.52)		33 (8.01)
5- Medical officers	81 (80.19)	87 (82.85)	101 (96.19)	74 (73.26)		343 (83.25)
6- Specialists	1 (0.99)	0 (00)	0 (00)	5 (4.95)		6 (1.46)

(†) Source: Pharmacy statistics (††) Source: OPD Operational Managers

identifiers. Particularly low completion rates were seen for patients' sex (25%), age (34%) and weight (2%).

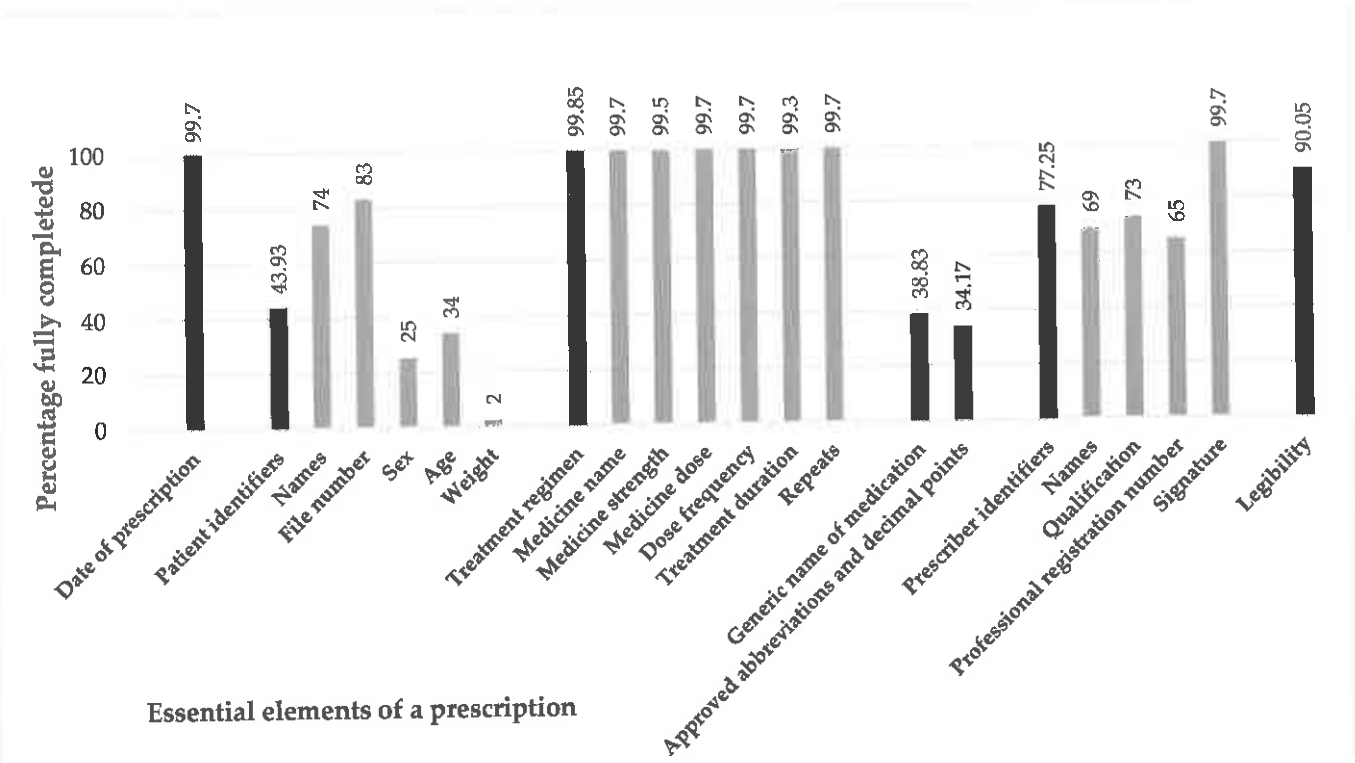

Figure 1: Scores for prescription completeness and accuracy across 19 essential elements (N = 412)

Table 3 is a compilation of Global Accuracy Scores: 37.52% of prescriptions scored "80-100%", whilst 62.38% scored "40-79%". The mean score out of 38 was 27.92 (73.38%) +/- 5.53 Standard Deviation (SD).

Table 3: Global accuracy scores per prescription and by elements

	Southern Gauteng n= 412 (%)	Health district/ district hospital				p value
		COJ/ South Rand n= 101 (%)	West Rand/ Yusuf Dadoo n= 105 (%)	Ekurhuleni/ Bertha Gxowa n= 105 (%)	Sedibeng/ Kopanong n= 101 (%)	
Global accuracy of prescriptions written: scores out of 38						0.001
100%	7 (1.69)	0	0	2 (1.90)	5 (4.95)	
80-100%	155 (37.52)	16 (15.84)	33 (31.43)	62(59.05)	44 (43.56)	
40-79%	257 (62.38)	85 (84.16)	72 (68.57)	43 (40.95)	57 (56.44)	
0-39%	0	0	0	0	0	
Score out of 38: mean (SD)	27.92 (5.53)	24.62 (4.97)	25.79 (5.39)	31.2 (4.28)	30.03 (4.49)	
Date of prescription						0.9
100%	411 (99.75)	101 (100)	105 (100)	105 (100)	100 (99.09)	
80-100%	411 (99.75)	101 (100)	105 (100)	105 (100)	100 (99.09)	
40-79%	0	0	0	0	0	
0-39%	1 (0.024)	0	0	0	1 (0.01)	
Patient identifiers						0.001
100%	8 (1.94)	0	0	2 (1.90)	6 ((5.94)	
80-100%	101 (24.51)	0	0	69 (65.71)	32 (31.68)	
40-79%	200 (48.54)	27 (26.73)	84 (80.00)	22 (20.95)	67 (66.34)	
0-39%	111 (26.94)	74 (73.27)	21 (20.00)	14 (13.33)	2 (1.98)	
Score out of 10: mean (SD)	4.39 (2.72)	2.25 (2.07)	3.54 (1.73)	6.27 (2.81)	5.47 (2.15)	
Treatment regimen						0.9
100%	410 (99.51)	101 (100)	104 (99.04)	104 (99.04)	101 (100)	
80-100%	410 (99.51)	101 (100)	104 (99.05)	104 (99.05)	101 (100)	
40-79%	2 (0,49)	0	1 (0.95)	1 (0.95)	0	
0-39%	0	0	0	0	0	
Score out of 12: mean (SD)	11.98 (0.24)	12 (0.00)	11.96 (0.39)	11.97 (0.29)	12 (0.00)	
Use of generic names of medications						0.3
100%	160 (38.83)	33 (32.67)	42 (40)	40 (38.09)	45 (44.55)	
80-100%	160 (38.83)	33 (32.67)	42 (40)	40 (38.09)	45 (44.55)	
40-79%	0	0	0	0	0	
0-39%	252 (61.16)	68 (67.32)	63 (60)	65 (61.90)	56 (55.44)	
Use of approved abbreviations and decimal points						0.06
100%	143 (34.70)	30 (29.70)	40 (38.09)	29 (21.61)	44 (43.56)	
80-100%	143 (34.70)	30 (29.70)	40 (38.09)	29 (21.61)	44 (43.56)	
40-79%	0	0	0	0	0	
0-39%	269 (65.29)	71 (69.30))	65 (61.90)	76 (72.38)	57 (56.43)	
Prescriber identifiers						0.001
100%	93 (22.57)	0	0	67 (63.80)	26 (25.74)	
80-100%	241 (58.50)	36 (35.64)	40 (38.10)	88 (83.81)	77 (76.24)	
40-79%	90 (21.84)	36 (35.64)	21 (20)	17 (16.19)	16 (15.84)	
0-39%	81 (19.66)	29 (28.71)	44 (41.90)	0	8 (7.92)	
Score out of 8: mean (SD)	6.18 (2.40)	5.17 (64.62)	4.82 (60,25)	7.67 (95,87)	7.06 (88,25)	
Legibility						0.001
100%	371 (90.05)	96 (95.05)	95 (90.48)	103 (98.1)	77 (76.24)	
80-100%	371 (90.05)	96 (95.05)	95 (90.48)	103 (98.1)	77 (76.24)	
40-79%	41 (9.95)	5 (4.95)	10 (9.52)	2 (1.90)	24 (23.76)	
0-39%	0	0	0	0	0	

The inability to achieve a desired GAS of ≥ 80% were noted for the following elements: patient identifiers (24.51%); the use of a medication's generic name (38.83%); the use of approved abbreviations and decimal points (34.70%); and, prescriber identifiers (58.50%). High GASs of ≥ 80% were noted for the following prescription elements: date of prescription (99.75%); treatment regimen (99.51%); and, legibility (90.05).

The distribution of the global accuracy scores categories across the health districts in Southern Gauteng is indicated in Figure 2. Only in Ekurhuleni did more than half (59%) of the audited prescriptions achieve a score of 80- 100%.

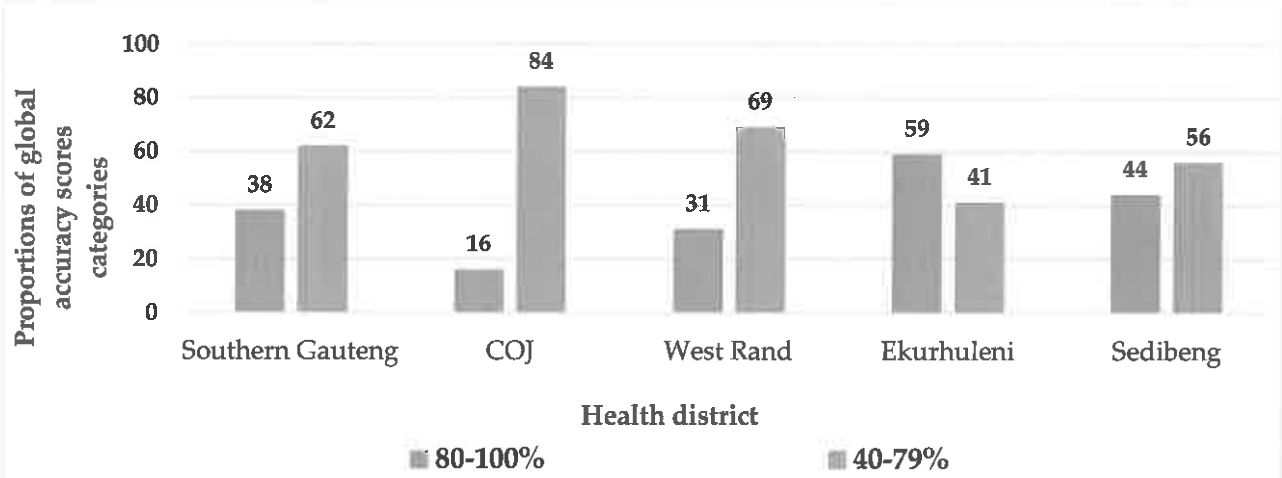

Figure 2: Distribution of GASs overall and per health district: those acheiving 80-100% vs 40-79%

We examined possible associations between specific characteristics of each OPD and prescription writing global accuracy scores, which are summarised in Table 4. Significant negative associations were found between the ability to achieve a global accuracy score of 80-100% and the number of OPD prescriptions per day ($p = 0.001$) and the number of OPD prescribers on the day ($p = 0.005$). No associations were found with the prescription type or prescriber category and adherence to prescription writing guidelines.

Table 4: Associations between OPD specific characteristics and prescription-writing global accuracy scores

OPD characteristic	Accuracy score 80- 100% n=155 (%)	Accuracy score 40- 79% n=257 (%)	Test & p-value
Number of OPD prescriptions per day			
100 – 200	33 (31.43)	72 (68.57)	Pearson's Chi² 0.001
201 – 300	106 (51.45)	100 (48.54)	
300+	16 (15.84)	85 (84.16)	
Number of OPD prescribers on the day: mean (SD)	**7.10 (0.08)**	**7.33 (0.05)**	Student's T 0.005
Prescriber professional category			Pearson's Chi² 0.107
Allied health professionals	18 (4.37)	137 (33.25)	
Medical doctors	45 (10.92)	212 (51.46)	
Prescription type			Pearson's Chi² 0.480
Adult	147 (35.68)	249 (60.44)	
Paediatric	4 (0.97)	9 (2.18)	
Controlled substances	3 (0.73)	4 (0.97)	

Seeking to understand the effects of the number of prescriptions written per day as well as of the variability in the number of providers on global accuracy scores, we conducted logistic regression analysis, which indicated that the number of OPD prescriptions per day and the number of OPD prescribers on the day were significant predictors of global accuracy scores (Table 5).

Table 5: Logistic regression model for predicting global accuracy scores

Variable (characteristics)	Odds Ratio & 95% C.I.	p-value
Number of OPD prescriptions per day		
100 – 200	Ref	
201 – 300	1.68 (0.95 – 2.98)	0.073
300+	0.30 (0.14 – 0.62)	0.001
Number of OPD prescribers per day	0.73 (0.55 – 0.96)	0.027

Significantly, the hospital with more than 300 OPD prescriptions per day, was 70% less likely to score "80% to 100%" compared to the hospital with 100 to 200 prescriptions per day (OR: 0.30; 95% C.I: 0.14 – 0.62).

The relationship between number of OPD prescribers (continuous variable) and global accuracy score indicates that an increase in the number of prescribers on a day

was associated with an odds ratio of 0.73 in the likelihood of scoring between 80% - 100% (OR: 0.73). In other words, with every increase in the number of prescribers, there is a reduced likelihood of scoring between 80 - 100%, or reaching the target goal. Although this seems counterintuitive in the light of the argument that high workload increases the likelihood of a reduced GAS, it suggests, using advanced statistics beyond the scope of this study, that it is possible to calculate optimal numbers of OPD prescriptions and OPD prescribers on any given day.

Discussion

To the best of our knowledge, this is the first effort in South Africa to develop a single tool that combines domestic regulatory and international best practice models to audit prescription writing accuracy in the country's primary care settings. The results of this study provide a baseline understanding of challenges with prescribers' adherence to prescription writing regulations. The results also suggest some possible reasons for omissions and inaccuracies in prescription writing that could guide future quality improvement initiatives.

While sampling was restricted to four district OPDs in Southern Gauteng, the required sample size for data collection was exceeded (374 intended; 412 actual), lending strength to the results. It was also apparent that not all the sites were in fact the same to start with, with statistically significant differences between the sites in relation to average number of OPD prescriptions per day, average number of providers and the professional category of prescribers (Table 2). These differences persisted in terms of global accuracy scores across the four sites, with interesting variations.

The composite GAS indicates that only seven (1.69%) of the 412 prescriptions assessed achieved the desired "100%", or gold standard; and, only 155 prescriptions (37.52%) scored 80-100%. In Ekurhuleni and Sedibeng health districts, 59% and 44% of the prescriptions achieved the global accuracy score of "80-100%" respectively, compared to 16% and 31% in COJ and West Rand health districts respectively. This is a significant difference (Kruskal-Wallis: $p = 0.001$), largely attributable to the higher scores achieved for completion of patient and prescriber identifiers which, if not counted, would bring all the four health districts to similar lower global accuracy scores (Kruskal-Wallis: $p = 0.9$).

Out of 38 total possible points, the mean score for all 412 prescriptions was 27.92 (73.38%) +/- 5.53 Standard Deviation (SD). In Ife, Nigeria, Erhuna et al.[13] reported global percentages of 1.3% and 85.9% of completely filled medical prescriptions respectively from a health centre and a teaching hospital; and, Fourgon et al.[24] reported in France 17% of fully accurate ambulatory patient prescriptions. Like in our settings, most of these deficiencies pertained to omission errors.

The main omissions found in this study related to patient identifiers and prescriber identifiers in 56% and 23% of prescriptions respectively. This may be explained by the practise of prescriptions being attached to the patient's file which already contains all of the patient's particulars, including: the address, telephone contacts and medical diagnostic information. The prescriber in a busy OPD would rarely take the time to re-transcribe these details from the file to the prescription; and, this omission also occurs it seems when it comes to writing his/her own identifiers.

Practises reported in the literature to enable improved completion of legally required identifiers are the consistent use of a sticker/label with the patient's details (with the birth date rather than the age) and the mandatory acquisition and consistent use of self-inking stamps with the required prescriber identifiers with only a signature required on the prescription.[22, 23] These would be low cost improvement measures as

the sticker/ label printing infrastructures already exist in the OPDs and self-inking stamps are not expensive.

High prescriber adherence to regulatory guidelines included completion of the treatment regimen (99%). This is possibly because of the dispensers who, as the last gate keepers, created an institutional culture that places higher emphasis on the treatment regimen writing aspect of the prescription. This is in contrast to other settings where omissions of various components of the treatment regimen have been reported, some up to 91% incomplete.[30]

Similarly, the score for the date of the prescription was present 99% of the time, this possibly because it is almost always stamped on the prescription chart by the clerk at the time of the patient's registration on the day. In contrast, the date of prescription was omitted in up to 18% of prescriptions in reported literature.[25]

Of note in this study is that the generic names of medications were not used for 61% of prescriptions; and, non-approved abbreviations and decimal points were used for 65%. Similarly high proportions of poor compliance in this regard are reported in the literature.[18,28] Education and individual prescribers' efforts can improve on this at little cost.[20]

As has been evidenced elsewhere, the adoption of an electronic health record with electronic prescribing that includes standardised fields with prompts for certain patient conditions may result in greatly improved accuracy in all prescription writing elements considered in this study. This may appear to be a high tech/ high cost measure, but may be worth the investment considering given its positive impact on quality and reducing medication error,[43-45] especially in our environment with increasing malpractice and adverse event litigation.

Significant differences were noted between the health districts for GASs and the essential elements of patient identifiers, prescriber identifiers and legibility. Although no association was found with the prescription type (noting the small

numbers of paediatric and controlled substances prescriptions) and the prescriber's professional category, performance differences have been reported between prescriber categories in the literature.[15-18] This also could have happened because not all categories of prescribers were present in the OPD on the day prior to data collection. Therefore, other prescribers at that facility would have been missed and potential differences never examined. Similarly, the significant difference in legibility scores may have been caused by one prescriber in a particular district on that day.

The negative associations found between global accuracy scores and the number of OPD prescriptions and prescribers per day are suggestive of a negative impact of a heavy workload on the accuracy in prescription-writing, as also reported by Ajemigbitse in Nigeria.[18] As suggested by the logistic regression model for predicting global accuracy scores in Table 5, it is possible to determine an optimal number of prescriptions and prescribers per day to minimise inaccuracies; and, performance may be even further enhanced if e-prescribing or computerised physician order entry (CPOE) system could be introduced,[43-45] notwithstanding its high cost, especially given that handwritten prescriptions are consistently found to be more prone to errors than electronic ones.[17] In limited resource settings, however, prescription writing quality improvement may still be achieved by simple low cost methods such as regular audits and feed-back sessions, and the use of prescribers' self-inking stamps as highlighted above.[15, 16]

Several limitations may restrict the generalisability of this study. The lack of diversity in prescription types was discovered only after data collection. It seems that paediatric medical records were kept in separate paediatric clinics within the OPDs and that "controlled substances" records were also usually separated from other records for the purposes of oversight; and, moreover, these same categories of patients attended OPD on particular days so their prescriptions may have been missed in the survey. An important additional type of prescription would be that of the elderly, which we

did not examine specifically. Importantly, the "correctness" of the medication as it correlated with the medical condition being treated as well as adherence to treatment guidelines by prescribers in their choice of medication were not assessed. Nor were prescriptions differentiated between new and repeats, or scripts for single vs multiple drugs. Also the snap shot/ one day survey may have reduced the variability among the prescribers; and, to understand the impact of the numbers of patients and prescribers, the sampling mechanism could be refined. Inclusion of these aspects may enhance the results of a future study.

The 90% legibility score observed in this study is at odds with the literature where much higher proportions of illegible scripts are reported.[15,18] Also in the assessment of legibility, all the scoring was done by the same person, the researcher alone. His familiarity with the OPD medicines and the environments could introduce a researcher bias. However, on site pharmacists anecdotally reported difficulty reading only less than one in ten scripts.

Conclusion and recommendations

This study found that in Southern Gauteng health districts, of 412 OPD medical prescriptions surveyed, one third achieved a global accuracy score of "80-100%", with two thirds scoring between 40-79% for compliance with prescription writing regulations. The most common deficiencies relate to the omission of patient and prescriber identifiers, with completion rates of 43.93% and 77.25% respectively. Also, medication generic names and approved abbreviations and decimal points were used in only 38.83% and 34.17% of prescriptions respectively. Associations were found between accuracy scores and the number of OPD prescriptions per day ($p = 0.001$) and the number of OPD prescribers on the day ($p= 0.005$), pointing to a negative impact of high patient volumes and multiple providers on reducing the accuracy of prescription writing.

A prescription writing quality improvement program would be an appropriate framework to implement recommendations pertaining to institutions/systems and individual prescribers. These recommendations include low cost/ low tech measures such as the consistent availing and use of pre-printed stickers with the patient's particulars on prescriptions and the mandatory use of self- inking stamps with the required particulars for prescribers. Reinforcement is also required regarding the consistent use of generic names of medications and being vigilant about recommended abbreviations and decimal points. E-prescribing, although a high cost endeavour for our limited resources settings, may be considered given its positive impact elsewhere on the quality of prescription writing and medication errors reduction.

Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Authors' contributions

Dr J G Nkera-Gutabara: main researcher, protocol development, data collection, analysis and write- up.

Prof L Baldwin-Ragaven: academic supervision, detailed critical review of the write-up with substantial conceptual and intellectual input at all stages.

References

1. De Vries T, Henning R, Hogerzeil H, Fresle D, Haaijer- Ruskamp F, van Gilst R. Guide to Good Prescribing: A practical manual. Geneva: World Health Organization Action Programme on Essential Drugs. 1994; 94 (11): 66-70. Available: http:www.who.int/iris/handle/10665/59001 [Accessed 22 March 2016]

2. Republic of South Africa. Essential Drugs Programme. Primary Healthcare Standard Treatment Guidelines and Essential Medicines List. 5th ed. Republic of South Africa: National Department of Health; 2014: xxi- xxii. Available: apps.who.int/medicinedocs/documents/s23015en/s23015en.pdf [Accessed 12 November 2017]

3. South African Government. 2013. General regulations made in terms of the Medicines and Related Substances Act 101 of 1965, as amended-Government Notice R510 in Government Gazette 24727 dated 10 April 2003. Commencement date: 2 May 2003 (regulation 28).

4. Phillips DP, Christenfeld N, Glynn LM. 1998. Increase in US medication- error deaths between 1983 and 1993. *Lancet* 351 (9103): 643-4. doi: 10.1016/S0140-6736(98)24009-8

5. Kohn LT, Corrigan JM, Donaldson MS. To Err Is Human: Building a Safer Health Care System. Report of the Institute of Medicine (US) Committee on Quality Health Care in America. Washington (DC): National Academies Press (US); 2000. doi: 10.17226/9728

6. Audit Commission. A Spoonful of Sugar- Medicines Management in NHS Hospitals. London: Audit Commission, 2001. Available:

ww.eprescribingtoolkit.com/wp-content/uploads/2013/11/nrspoonfulsugar1.pdf [Accessed 12 November 2017]

7. Department of Health. An Organisation with a Memory. Report of an Expert Group on Learning from Adverse Events in the NHS Chaired by the Chief Medical Officer. London, The Stationery Office, 2000. Available: https://www.aagbi.org/sites/.../files/Anorganisationwithamemory.pdf [Accessed 12 November 2017]

8. American Society of Hospital Pharmacists. ASHP guidelines on preventing medication errors in hospitals. *Am J Health-System Pharm*. 1993; 50: 305- 14. Available: https://www.ashp.org/Pharmacy-Practice/...Guidelines/.../Medication-Misadventures [Accessed 12 November 2017]

9. Miller MR, Clark JS, Lehmann CU. 2006. Computer based medication error reporting: insights and implications. *Qual Saf Health Care* 15: 208-13. doi: 10.1136/qshc.2005.016733

10. Dean B, Schachter M, Vincent C, et al. 2002. Prescribing errors in hospital inpatients: their incidence and clinical significance. *Qual Saf Health Care* 11 (4): 340- 4. doi: 10.1136/qhc.11.4.340

11. Hansen LB, Fernald D, Araya-Guerra R, et al. 2006. Pharmacy clarification of prescriptions ordered in primary care: a report from the applied strategies for improving patient safety (ASIPS) collaborative. *J Am Board Fam Med* 19: 24-30. doi: 10.3122/jabfm.19.1.24

12. Velo G, Minuz P. Medication errors: prescribing faults and prescription errors. 2009. *Br J Clin Pharmacol* 67 (6): 624-628. doi: 10.1111/j.1365-2125.2009.03425.x

13. Erhun WO, Adekoyab OA, Erhun MO, et al. 2009. Legal issues in prescription writing: a study of two health institutions in Nigeria. *International Journal of Pharmacy Practice* 17: 189-193. doi: 10.1211/ijpp.17.03.0010

14. Tayem YI, Ibrahim MA, Qubaja MM, et al. 2013. Compliance with the guidelines of prescription writing in a central hospital in the West Bank. *Eastern Mediterranean Health Journal* 19 (9): 802-6. Available: https://search.proquest.com/docview/1467532643?pq-origsite=gscholar [Accessed 19 June 2017]

15. Al Khaja KA, Al-Ansari TM, Sequeira RP. 2005. An evaluation of prescribing errors in primary care in Bahrain. *Int J Clin Pharmacol Ther* 43 (6): 294- 301. doi: 10.5414/CPP43294

16. Walson PD, Hammel M, Martin R. Prescription- writing by pediatric house officers. 1981. *Journal of Medical Education* 56 (5): 423-8. Available: http://pdfs.journals.lww.com/academicmedicine/1981/05000/Prescription_writing_by_pediatric_house_officers.7.pdf [Accessed 09 September 2017].

17. Marwaha M, Kumar R, Marwaha U, et al. 2010. A retrospective analysis on a survey of hand written prescription errors in general practice. *International Journal of Pharmacy and Pharmaceutical Sciences* 2 (2): 80- 82. Available: www.ijppsjournal.com/Vol2Suppl3/613.pdf [Accessed 09 September 2017]

18. Ajemigbitse AA, Kayode M, Omole MK, et al. 2014. Assessment of the knowledge and attitudes of intern doctors to medication prescribing errors in a Nigeria tertiary hospital. *Journal of Basic and Clinical Pharmacy* 5 (1): 7-14. doi: 10.4103/0976-0105.128244

19. Ross S, Ryan C, Duncan EM, et al. 2013. Perceived causes of prescribing errors by junior doctors in hospital inpatients: a study from the PROTECT programme. *BMJ quality & safety* 22 (2): 97-102. doi: 10.1136/bmjqs-2012-001175

20. Gommans J, McIntosh P, Bee S, Allan W. 2008. Improving the quality of written prescriptions in a general hospital: the influence of 10 years of serial audits and targeted interventions. *Intern Med J* 38 (4): 243-8. doi: 10.1111/j.1445-5994.2007.01518.x

21. Kennedy AG, Littenberg B. 2004. A modified outpatient prescription form to reduce prescription errors. *Joint Commission Journal on Quality and Patient Safety* 30 (9): 480-7. doi: http://dx.doi.org/10.1016/S1549-3741(04)30056-0

22. Meyer TA. 2000. Improving the quality of the order-writing process for inpatient orders and outpatient prescriptions. *American Journal of Health-System Pharmacy* 57 (4): 18-22. doi: 10.1.1.618.1469

23. Glisson JK, Morton ME, Bond AH, et al. 2011. Does an Education Intervention Improve Physician Signature Legibility? Pilot Study of a Prospective Chart Review. Perspect Health Inf Manag 8:1e. Available: https://www.ncbi.nlm.nih.gov/pubmed/21796267 [Accessed 09 September 2017]

24. Fourgon R, Vicrey C, Blanchon B, et al. 2005. The editorial quality of hospital drug prescriptions in the Ile de France area. A study by the Health Insurance. *Presse Med* 34 (3): 203-7. Available: https://www.ncbi.nlm.nih.gov/pubmed/15798530 [Accessed 12 July 2017]

25. Al Shahaibi NM, Al Said LS, Kini T, et al. 2012. Identifying errors in handwritten outpatient prescriptions in Oman. *J Young Pharm* 4 (4): 267-72. doi: 10.4103/0975-1483.104371

26. Desta Z, Abdulwhab M. 1996. Prescription writing in Gondar outpatient teaching hospital, Ethiopia. *East Afr Med J* 73 (2): 115-9. Available: https://www.researchgate.net/publication/14446716_Prescription_writing_in_Gondar_outpatient_teaching_hospital_Ethiopia [accessed Mar 29, 2017]

27. Makonnen E, Yoseph M, Berhane Y. 2002. Quality of prescription at a tertiary care pharmacy in Addis Ababa. *Ethiop Med J* 40 (3): 233-9. Available: https://www.ncbi.nlm.nih.gov/m/pubmed/12602247 [accessed 29 March 2017]

28. Afify MA, Shahzad N, Tawfik N, et al. 2015. Evaluation of drug prescribing practices in private and general hospitals in Makkah, Saudi Arabia. *Afr. J. Pharm. Pharmacol* 9 (39): 966-973. doi: 10.5897/AJPP2015. 4320

29. Relihan E, Harbison J, Silke B, et al. 2012. Audit and feedback to improve the quality of prescription writing. *International Journal of Clinical Pharmacy*. 34 (1): 256. doi: 10.1007/s11096-011-9602-2

30. Irshaid YM, Al Homrany M, Hamdi AA, et al. 2005. Compliance with good practice in prescription writing at outpatient clinics in Saudi Arabia. *La Revue de Santé de la Méditerranée Orientale* 11 (5): 922-8. Available: https://www.ncbi.nlm.nih.gov/pubmed/16761662. [Accessed 29 March 2017]

31. Kaushal R, Goldmann DA, Keohane CA, et al. 2010. Medication errors in paediatric outpatients. *Qual Saf Health Care* 19 (6): 30.

doi: 10.1136/qshc.2008.031179

32. Lyons R, Payne C, McCabe M, Fielder C. 1998. Legibility of doctors' handwriting: quantitative comparative study. *BMJ* 317 (7162): 863-4. doi: https://doi.org/10.1136/bmj.317.7162.863

33. Dharmadikari SD, Jaju JB, Pawar GR, et al. 2014. Retrospective analysis of completeness and legibility of prescription orders at a tertiary care hospital. *Natl J Physiol Pharm Pharmacol* 4: 165-7. doi: 10.5455/njppp.2014.4.011020131

34. Albarrak AI, Al Rashidi EA, Fatani RK, et al. 2014. Assessment of legibility and completeness of handwritten and electronic prescriptions. *Saudi Pharmaceutical Journal* 22 (6): 522-7. doi: 10.1016/j.jsps.2014.02.013

35. Hassan NB, Ismail HC, Naing L, et al. 2010. Development and validation of new Prescription Quality Index. *Br J Clin Pharmacol* 70 (4): 500–13. doi: 10.1111/j.1365-2125.2009.03597.x

36. Chaturvedi SK, Sinha P, Chandra PS, et al. 2008. Improving quality of prescriptions with clinical audit. *Indian J Med Sci* 62 (11): 461-4. doi: 10.4103/0019-5359.48460

37. Solanki ND, Shah C. 2015. Prescription audit in outpatient department of multispecialty hospital in western India: an observational study. *International Journal of Clinical Trials* 2 (1): 14- 19. doi: 10.5455/2349-3259.ijct20150203

38. Alagoa PJ, Mukoro DG, Yeibake WS. 2014. Audit of prescription notes from a tertiary health centre. *IOSR Journal of Dental and Medical Sciences* 13 (1): 79-82. doi: 10.9790/0853-13127982

39. Dyasanoor S, Urooge A. 2016. Insight into Quality of Prescription Writing- An Institutional Study. *Journal of Clinical and Diagnostic Research* 10 (3): 61-4. doi: 10.7860/JCDR/2016/18011.7472

40. Oborne CA, Batty GM, Maskrey V, et al. 1997. Development of prescribing indicators for elderly medical inpatients. *Br J Clin Pharmacol* 43: 91-7. doi: 10.1111/j.1365-2125.1997.tb00143.x

41. Akici A, Gören MZ, Aypak C, et al. Prescription audit adjunct to rational pharmacotherapy education improves prescribing skills of medical students. *Eur J Clin Pharmacol* 61 (9): 643-50. doi: 10.1007/s00228-005-0960-3

42. Ostini R, Hegney D, Jackson C, et al. 2009. Systematic review of interventions to improve prescribing. *Ann Pharmacother* 43 (3): 502-13. doi: 10.1345/aph.1L488

43. Kaushal R, Kern LM, Barrón Y, Quaresimo J, Abramson EL. 2010. Electronic prescribing improves medication safety in community-based office practices. *J Gen Intern Med* 25 (6): 530-6. doi: 10.1007/s11606-009-1238-8 . [Accessed 19 January 2018]

44. Eslami S, de Keizer NF, Abu-Hanna A. 2008. The impact of computerized physician medication order entry in hospitalized patients- A systematic review. *International Journal of Medical Informatics* 77 (6): 365-76. https://doi.org/10.1016/j.ijmedinf.2007.10.001 [Accessed 20 January 2018]

45. Ammenwerth E, Schnell-Inderst P, Machan C, Siebert U. 2008. The Effect of Electronic Prescribing on Medication Errors and Adverse Drug Events: A

Systematic Review. *Journal of the American Medical Informatics Association* 15 (5): 585–600. https://doi.org/10.1197/jamia.M2667 [Accessed 20 January 2018]

46. Nkera JG. Audit of medical prescriptions writing compliance with Essential Medicines List standards in the Outpatient Department of South Rand Hospital, Johannesburg: a quality improvement project. Department of Family Medicine, University of the Witwatersrand, Johannesburg; 2013 (Unpublished report).

47. Republic of South Africa. Medicines Control Council. Scheduling of Medicines. Guidelines for the Scheduling Committee of the Medicines Control Council. Republic of South Africa: National Department of Health; June 2014. Available: www.mccza.com/documents/a56714ff2.36_Scheduling_of_Medicines_Jun14_v1. [Accessed 08 June 2018].

48. The Council for Health Services Accreditation for Southern Africa. 2015. Healthcare Standards Development, Southern Africa/ Cohsasa. Available: www.cohsasa.co.za/health-care-standards-development [Accessed 19 August 2015].

Appendices

Appendix 1: Data collection tool

Appendix 1: Data collection Excel spread sheet- Study title: Adherence to prescription writing guidelines for outpatients in Southern Gauteng district hospitals
Variables coding and data scoring.

Hospitals:*		Number of prescription per day		Number of prescribers on the day		Prescription type		Prescriber's profe category		Prescription essential element completion scoring	
South Ran	1					Adult:	1	PHC Nurse:	1		
Yusuf Dad	2					Children:	2	Medical Stuc	2		
Bertha Gx	3	≤ 100:	1	Hosp	7	Controlled subst.:		Clinical Assc	3		
Kopanong	4	101-2	2	Hosp	8			Medical Inter	4	Not complete	0
		201-3	3	Hosp	6			Com. Serv. I	5	Partially com	1
		> 300	4	Hosp	8			Medical Offic	6	Completed:	2
								Medical Reg	7		
								Specialist:	8		

Legibility scoring		Use of generic name		Scoring per prescription	Scores
		None:	0	Essential elements:	
		Some	1	Completion	0 to 32
Illegible:	0	Yes:	2	Legibility	0 to 2
Barely legibl	1	Use of approved		generic names/ abbreviation	0 to 4
Legible:	2	abbreviation and		Total score= Accuracy	0 to 38
		decimals		Accuracy category: 1	100%
		None:	0	2	80-99%
		Some	1	3	40-79%
		Yes:	2	4	< 40%

	Hospitals characteristics					Patients' identifiers					Treatment regimen						Date	Prescribers' identifiers							Scores			
Prescription sheet number	Hospital	Number of OPD prescriptions per day	Number of OPD prescribers on the day	Prescription type	Prescriber's professional category	Patient's name	Patient's number	Patient's sex	Patient's age	Patient's weight	Medicine name	Medicine strength	Medicine dose	Dose frequency	Treatment duration	Repeats	Date of prescription	Prescriber's name	Prescriber's qualification	Prescriber's registration number	Prescriber' s signature	Legibility	Use of generic medicine name	Use of approved abbreviations	Score and % completion per prescription	Score and % legibility per prescription	Score and % use of generic names and approved abbreviations	Total score and % accuracy level per prescription
1																												
2																												
3																												
4																												
5																												

* There are four health districts in Southern Gauteng and seven district hospitals which are: South Rand and Bheki Mlangeni Hospitals in the City of Johannesburg (COJ), Yusuf Dadoo and Carletonville Hospitals in the West Rand, Bertha Gxowa Hospital in Ekurhuleni, Kopanong and Heidelberg Hospitals in Sedibeng.

Appendix 2: University of the Witwatersrand HREC clearance certificate

R14/49 Dr Nkera-Gutabara

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M141179

NAME (Principal Investigator) Dr Gihana Nkera-Gutabara

DEPARTMENT: Family Medicine
South Rand, Yusuf Dadoo, Bertha Gxowa and Kopanong Hospitals

PROJECT TITLE: Compliance of Written Medical Prescriptions at Outpatient Department of District Hospitals in Gauteng South with the Standard Treatment Guidelines and Essential Medicines List for South Africa, Hosital Level-Adults 2012

DATE CONSIDERED: 28/11/2014

DECISION: Approved unconditionally

CONDITIONS:

SUPERVISOR: Dr Z Elabor

APPROVED BY:

Professor P Cleaton-Jones, Chairperson, HREC (Medical)

DATE OF APPROVAL: 11/03/2015

This certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION BY INVESTIGATORS

To be signed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House, University.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and undertake to ensure compliance with these conditions. Should any departure be contemplated from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report.**

Principal Investigator Signature _____ Date _____

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix 3: Raw count and percentages of completion of essential elements and components of prescriptions- Southern Gauteng and health districts

Appendix 3: Raw count and percentages of completion of essential elements and components c prescriptions- Southern Gauteng and health districts

Essential elements and components	Southern Gauteng n= 412 (100%)	Health districts/ district hospitals			
		COJ/ South Rand n=101 (24.51)	West Rand/ Yusuf Dadoo n=105 (25.49)	Ekurhuleni/ Bertha Gxowa n=105 (25.49)	Sedibeng/ Kopanong n=101 (24.51)
Date of prescription: Frequency (%): number completed/ partially completed/ not completed					
Date of prescription	411/ 0/ 1 (99.76/ 0/ 0.24)	101/ 0/ 0 (100/ 0/ 0)	105/ 0/ 0 (100/ 0/ 0)	105/ 0/ 0 (100/ 0/ 0)	100/ 0/ 1 (99.1/ 0/ 0.99)
Patient's identifiers: Frequency (%): number completed/ partially completed/ not completed					
Name	307/ 2/ 103 (74.51/ 0.49/ 25)	30/ 0/ 71 (29.70/ 0/ 70.30)	86/ 2/ 17 (82.0/ 2.0 / 16.0)	91/ 0/ 14 (8.07/0/ 13.0)	100/ 0/ 1 (99.10/ 0/ 0.99)
File number	344/ 0/ 68 (83.5/ 0/ 16.5)	66/ 0/ 35 (65.34/ 0/ 34.66)	86/ 0/ 19 (82.0/ 0/ 18.0)	93/ 0/ 12 (89.0/ 0/ 11.0)	99/ 0/ 2 (98.1/ 0/ 1.98)
Sex	102/ 0/ 310 (24.76/ 0/ 75.4)	0/ 0/ 101 (0/ 0/ 100)	0/ 0/ 105 (0/ 0/ 100)	68/ 0/ 37 (65.0/ 0 /35.0)	34/ 0/ 67 (33.70/ 0/ 66.34)
Age	141/ 0/ 271 (34.22/ 0/ 65.75)	18/ 0/ 83 (17.82/ 0/ 82.18)	12/ 0/ 93 (11/ 0/ 89.0)	74/ 0/ 31 (70.0/ 0/ 30.0)	37/ 0/ 64 (36.64/ 0/ 63.40)
Weight	10/ 0/ 402 (2.43/ 0/ 97.57)	0/ 0/ 101 (0/ 0/ 100)	1/ 0/ 104 (0.95/ 0/ 99.05)	3/ 0/ 102 (2.86/ 0/ 97.14)	6/ 0/ 95 (5.94/ 0/ 94.10)
Treatment regimen: Frequency (%): number completed/ partially completed/ not completed					
Medicine name	411/ 0/ 1 (99.76/ 0/ 0.24)	101/ 0/ 0 (100/ 0/ 0)	104/ 0/ 1 (99.0/ 0/ 1.0)	105/ 0/ 0 (100/ 0/ 0)	101/ 0/ 0 (100/ 0/ 0)
Medicine strength	410/ 0/ 2 (99.51/ 0/ 0.49)	101/ 0/ 0 (100/ 0/ 0)	104/ 0/ 1 (99.0/ 0/ 1.0)	104/ 0/ 1 (99.0/ 0/ 1.0)	101/ 0/ 0 (100/ 0/ 0)
Medicine dose	411/ 0/ 1 (99.76/ 0/ 0.24)	101/ 0/ 0 (100/ 0/ 0)	105/ 0/ 0 (100/ 0/ 0)	104/ 0/ 1 (99.0/ 0/ 1.0)	101/ 0/ 0 (100/ 0/ 0)
Dose frequency	411/ 0/ 1 (99.76/ 0/ 0.24)	101/ 0/ 0 (100/ 0/ 0)	105/ 0/ 0 (100/ 0/ 0)	104/ 0/ 1 (99.0/ 0/ 1.0)	101/ 0/ 0 (100/ 0/ 0)
Treatment duration	409/ 0/ 3 (99.27/ 0/ 0.73)	101/ 0/ 0 (100/ 0/ 0)	104/ 0/ 1 (99.0/ 0/ 1.0)	105/ 0/ 0 (100/ 0/ 0)	99/ 0/ 2 (98.1/ 0/ 1.98)
Repeats	411/ 0/ 1 (99.76/ 0/ 0.24)	101/ 0/ 0 (100/ 0/ 0)	104/ 0/ 1 (99.0/ 0/ 1.0)	105/ 0/ 0 (100/ 0/ 0)	101/ 0/ 0 (100/ 0/ 0)

Use of medicines' generic names: frequency (%): number used/ not used:					
Medicines' generic names use	160/ 252 (38.83/ 61.17)	33/ 68 (32.67/ 67.33)	42/ 63 (40.0/ 60.0)	40/ 65 (38.0/ 62.0)	45/ 56 (44.55/ 55.44)
Use of approved abbreviations and decimal points: frequency (%): number used/ not used:					
Approved abbreviations and decimal points use	143/ 269 (34.71/ 65.29)	30/ 71 (29.70/ 70.30)	40/ 65 (38.0/ 62.0)	29/ 66 (28.0/ 63.0)	44/ 57 (43.56/ 56.44)
Prescriber's identifiers: Frequency (%): number completed/ partially completed/ not completed:					
Names	285/ 16/ 111 (69.17/ 3.88/ 26.94)	51/ 4/ 46 (50.50/ 3.96/ 45.54)	50/ 3/ 52 (47.62/ 2.86/ 49.52)	104/ 1/ 0 (99.0/ 1.0/ 0)	80/ 8/ 13 (79.30/ 7.92/ 2,90
Qualifications	299/ 2/ 111 (72.57/ 0.49/ 26.94)	57/ 0/ 44 (56.44/ 0/ 43.56)	49/ 0/ 56 (46.67/ 0/ 53.33)	104/ 1/ 0 (99.0/ 1.0/ 0)	89/ 1/ 11 (88.20/ 0.99/ 10.9
Professional registration number	267/ 3/ 142 (64.81/ 0.73/ 34.47)	50/ 0/ 51 (49.50/ 0/ 50.50)	48/ 0/ 57 (46.0/ 0/ 54.0)	88/ 1/ 16 (84.0/ 1.0/ 15.0)	81/ 2/ 18 (80.19/ 1.98/ 17.8
Signature	411/ 0/ 1 (99.76/ 0/ 0.24)	101/ 0/ 0 (100/ 0/ 0)	104/ 1/ 0 (99.0/ 1.0/ 0)	105/ 0/ 0 (100/ 0/ 0)	101/ 0/ 0 (100/ 0/ 0)
Legibility: frequency (%): number legible/ barely legible/ illegible:					
Legibility	371/ 41/ 0 (90.05/ 9.95/ 0)	96/ 5/ 0 (94.04/ 4.96/ 0)	95/ 10/ 0 (90.0/ 1.0/ 0)	103/ 2/ 0 (98.0/ 2.0/ 0)	77/ 24/ 0 (76.24/ 23.76/ 0)

Appendix 4: Change of approved title of research report

Appendix 5: Research protocol, August 2014. Title: Compliance of written medical prescriptions at Outpatient Departments of district hospitals in Gauteng South with the Standard Treatment Guidelines and Essential Medicines List for South Africa, Hospital Level- Adults 2012.

CANDIDATE'S SURNAME: Nkera-Gutabara	FIRST NAME/S: Gihana	STUDENT NUMBER: 6 9 8 9 8 9

CURRENT QUALIFICATIONS: MBChB

TEL: 0116812000	CELL: 0832915188	E-MAIL: jgnkera@gmail.com	FAX:

DEGREE FOR WHICH PROTOCOL IS BEING SUBMITTED: MMed/ Family Medicine

PART-TIME OR FULL-TIME: Full- time

FIRST REGISTERED FOR THIS DEGREE: 2012	TERM :	YEAR: 3

DEPARTMENT: Family Medicine

TITLE OF PROPOSED RESEARCH:

Compliance of written medical prescriptions at Outpatient Departments of district hospitals in Gauteng South with the Standard Treatment Guidelines and Essential Medicines List for South Africa, Hospital Level- Adults 2012

CANDIDATE'S SIGNATURE:	DATE: 28 August 2014
SUPERVISOR'S NAME: Prof L Baldwin Ragaven	% Supervision: 100%

SUPERVISOR'S QUALIFICATIONS: MD, FCFP

SUPERVISOR'S DEPARTMENT: Family Medicine

SUPERVISOR'S ADDRESS / TEL / E-MAIL: 0791625228/ Laurel.Baldwin-Ragaven@wits.ac.za

SYNOPSIS OF RESEARCH:

Medical prescription writing is a critical factor in medication error which is the commonest type of error affecting the patient's safety in general practice and in hospitals. Although multiple studies of medical prescription writing are available in international publications, none was found from a South African district hospital and primary care setting.

The aim of this study is to determine the levels of completeness and legibility of hand written medical prescriptions in district hospitals' Outpatient Departments in Gauteng South, in compliance with the Standard Treatment Guidelines and Essential Medicines List for South Africa, Hospital Level- Adults 2012.

This will be a descriptive cross sectional study of 400 Outpatient Departments' prescription charts from pharmacies at four district hospitals in Gauteng South. One hundred medical prescriptions will be conveniently sampled from one District Hospital in each of the four health districts. Levels of completeness and legibility of the following variables will be assessed: patient identifiers; prescriber identifiers and signature; date of the prescription and the treatment regimen. Possible associations between hospitals' Outpatient Departments' characteristics and levels of compliance will be described.

The findings of this study would provide baseline data for interventions to improve the quality of medical prescriptions writing in Outpatient Departments of district hospitals in Gauteng South and beyond, and contribute to medication error prevention.

ETHICS PENDING: Y ETHICS APPROVED: (circle appropriate symbol)	IF Y SUPPLY ETHICS CLEARANCE No:	
SIGNATURE OF SUPERVISOR/S:		
SIGNATURE PG OFFICE STAFF	REGISTERED (YES.) NO.....	STAMP

Table of content **Page**

I List of Annexures

II Abbreviations

CEO:	Chief Executive Officer
CHC:	Community Health Centre
DH:	District Hospital
DHS:	District Health System
HREC:	Human Research Ethical Committee
OPD:	Outpatients Department
PHC:	Primary Health care
PQI:	Prescription Quality Index
QIP:	Quality Improvement Project
SA EML:	Standard Treatment Guidelines and Essential Medicines List for South Africa, Hospital Level- Adults- 2012.
SRH:	South Rand Hospital
USA:	United States of America
WHO:	World Health Organisation

III Synopsis of the research

Medical prescription writing is a critical factor in medication error which is the commonest type of error affecting the patient's safety in general practice and in hospitals. Although multiple studies of medical prescription writing are available in international publications, none was found from a South African district hospital and primary care setting.

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Research Protocol

1 Title

Compliance of written medical prescriptions at Outpatient Departments of district hospitals in Gauteng South with the Standard Treatment Guidelines and Essential Medicines List for South Africa, Hospital Level- Adults 2012.

Dr Gihana Nkera-Gutabara

Student Number: 698989

August 2014

2 Introduction

2.1 Background

The District Health System (DHS) is recognized as the fundamental building block of South Africa's current health system.[1] The Gauteng Province has five health districts, out of a total of 52 in the country: Gauteng North includes the City of Tshwane and Metsweding health district; Gauteng South includes the City of Johannesburg, West Rand, Ekurhuleni and Sedibeng health districts. The Province has four academic hospitals, three tertiary hospitals, nine regional hospitals, 11 district hospitals, 392 clinics and 31 Community Health Centres (CHCs). [2]

The Department of Family Medicine of the University of the Witwatersrand is involved with Gauteng South as its Family Medicine and Primary Care training platform in the above mentioned 4 health districts which account for seven district hospitals.

The district hospital is administratively distinct from the Primary Health Care Facilities (CHCs and clinics), but it is conceptually and practically a part of the primary care setting where it offers undifferentiated generalist services covering the full range of level one services, especially in the Outpatient Departments (OPDs).[1]

Within these facilities, medical prescriptions are often the endpoint of the patient's encounter with the healthcare practitioners. The prescriptions are dispensed through the pharmacies, but in most CHCs and clinics, clinicians dispense directly from medicine cupboards in the consulting rooms.

There are comprehensive guidelines issued by the the National Department of Health for prescription writing,[3] These guidelines are in line with those of the WHO,[4] and are expected to be complied with by all prescribers.

2.2 Rationale

Medication errors mostly arise from prescribing, dispensing, drug administration or from patient compliance errors. While most serious errors originate in the prescribing decision, the majority of all errors have been found to originate in medical prescription writing.[5]

It is obvious that there is the risk that poorly written medical prescriptions can lead to medication errors. They can also cause other challenges to patients and the healthcare system as we often witness: patients will be sent back from the pharmacy to the prescribers for clarifications or rectifications, or the dispensers have to find the time to locate the prescribers for this. It leads to increased waiting times inconveniencing patients, caregivers and other constituents in the healthcare system.

An unpublished audit of medical prescription charts from the Outpatient Department in South Rand Hospital in 2013 showed that none fully complied with the SA EML guidelines for medical prescription writing. It was found that most deficiencies were omission errors pertaining to patient and prescriber's identification.[6] For the researcher, this created the impression that prescription writing was not given adequate attention and he wondered how it was in other district hospital's Outpatient Departments.

No published study could be found with data on the compliance of prescription writing with the guidelines in a South African primary care setting. Therefore, the researcher hopes to fill the knowledge gap in this regard. Thus, the study could contribute to raising awareness and serve as an incentive to initiate medical prescriptions writing quality improvement programs. It could contribute to improved service delivery in the district hospitals' Outpatient Departments by reducing delays related to medical prescription writing and reduce patient's waiting time, which is one of the Department of Health's focus areas in its drive to improve the quality of service. The study could also contribute to the prevention and reduction of medication errors.

2.3 Literature Review

Multiple publications have studied the compliance of medical prescriptions writing to existing guidelines and from various perspectives including: the medical prescriptions completeness, their legibility, the professional categories of prescribers and the care settings such as GP practices, clinics, hospital departments and wards.

Definitions: the medical prescription, the prescriber and the dispenser

According the World Health Organization (WHO) [4] a medical prescription is an instruction from a prescriber to a dispenser. It can be oral, hand-written, typed, and more frequently nowadays, an electronic prescription. The prescriptions in this study will all be hand-written. The prescriber is not necessarily a doctor but can also be a paramedical worker, such as a medical assistant, a medical student under supervision, a midwife or a nurse. Likewise, the dispenser is not always a pharmacist, but can be a pharmacy-technician, an assistant or a nurse.

Compliance with the guidelines for medical prescription writing

This study will look at writing errors which include omission errors such as 'incomplete prescriptions', the 'inappropriate writing' and 'use of abbreviations', and errors related to 'legibility'. Completeness and legibility are crucial factors in medication errors related to prescription writing. Every country has regulations for the minimum information required on a prescription, which drugs require one and who is entitled to write it. The prescription must therefore conform to a standard expected from and by all those concerned with it. Currently in South Africa, there are regulations governing prescription writing set by the South African National Department of Health in the Standard Treatment Guidelines and Essential Medicines List for South Africa, Hospital Level- Adults 2012 (EML),[3] and these are in line with the WHO medical prescription writing guidelines.[4] Similarly, key elements in the Prescription Quality Index

(PQI) developed for prescription writing for patients with chronic diseases include: legibility, patient's and prescriber's identifiers, medication's name and regimen.[7]

A summary of the basic requirements for a complete/ correctly written prescription sourced from the WHO, the South African EML and from the Prescription Quality Index study is presented in Table 1, in Annexure 1.

Medical prescriptions writing completeness and legibility

The notion of completeness of a medical prescription is understood as the prescription having all necessary parts or components; that of legibility is understood as easily readable by someone who is not familiar with the context examined.[8]

A study in Oman in 2012 identified the following errors in a sample of 900 outpatient prescriptions: omissions of patients age (72.44%) and gender (32.66%), 46% were incomplete on direction for use, 22% did not have information on dose and 23% omitted the dosage forms. 4% omitted the prescriber's signature and more than 18% omitted the date of prescription.[9]

In Ile de France (2005), a retrospective study of 500 outpatients' prescriptions by the health insurance industry found that only 17% complied with the required standards of including the identification elements for the patient, the practitioner and the health care facility.[10]

In 1996 a one-year retrospective study in Ethiopia of 19,119 consecutive prescriptions from the OPD of a teaching hospital found that age (36%), sex (16.8%), and chart number (12.4%) of patients were not recorded. 12%, 7%, 6.4%, 5.8% and 1.6% of the prescriptions did not indicate routes of drug administration, directions for drug use, frequency of drug administration, drug dose and duration of treatment, respectively. 10.8% of the cases date was omitted.[11]

In another Ethiopian study in 2002 conducted at a teaching hospital outpatient pharmacy on 2191 OPD prescriptions collected in one week, it was found that 50% did not have the patient's sex and age, and 15% of the prescriptions were not legible.[12]

In a 2005 study in Saudi Arabia of outpatient clinics prescriptions received over a one year period, it was found that the prescriber's name, address and signature were on 83.3%, 9.6% and 81.9% of prescriptions respectively. The patient's name, age and sex were on 94.6%, 77.3% and 51.3%. No prescription contained the patient's address and weight. Strength of medication and dose units were included in 26.6% and 55.6%. Most prescriptions (94.0%) had no quantity indicated and had only partial instructions for patient use (90.7%). The prescriber's handwriting was illegible in 64.3% of prescriptions.[13]

A 2010 prospective study of medication errors in six pediatric outpatients in Massachusetts-USA identified 1205 medication errors with minimal potential for harm and 464 potentially harmful medication errors. Overall, 94% of the medication errors with minimal potential for harm and 60% of the near misses occurred at the prescribing stage. The most frequent cause of errors was illegibility.[14]

Assessing legibility in medical prescriptions writing

Legibility has been assessed using different methods, including computer software not available to us. A 1998, quantitative comparative study of the legibility of doctors' handwriting in Brittan using computer software suggested that the poor legibility was confined to letters of the alphabet rather than numbers.[15]

More recently, different rating scales have been widely used. A Nigerian study done in 2009 comparing the utility of a rating scale with a visual analogue scale for the assessment of legibility in prescriptions used a '0', '1', '2', '3' and '4' scale respectively for 'completely illegible', 'barely legible', 'moderately legible', 'clearly legible and print'. The study's conclusion supports

the utility of both instruments in the assessment of handwriting.[16] A recent (2014) study in India analyzed the completeness and legibility of prescription at a tertiary care hospital by using a subjective scale to assess the legibility,[17] similar to one used in a 2014 study in Saudi Arabia.[18] They used a 3-point legibility score based on the Likert scale with '1', '2' and '3' scoring respectively for 'legible', 'legible with effort' and 'illegible'. The study in India found that legibility of numbers (such as frequency of dosage) was better than that of letter words (such as drug names).

The Prescription Quality Index (PQI) study[7] provides a valid, reliable and responsive tool to measure quality of prescription in chronic diseases. In this study, legibility will be assessed by the researcher using the legibility scoring scale that was validated in the PQI which used respectively '0', '1' or '2' for 'illegible', 'barely legible' and 'legible'.

Prescription errors and prescribers

A 2010 Indian retrospective analysis of handwritten prescription errors from 7 general practice physicians found that handwritten prescriptions were more prone to errors (than electronic prescriptions) and the proportion of these differed according to prescribers.[19] In a 2014 study from Nigeria, junior doctors were reported to make most of the prescribing errors in the hospital setting.[20]

A 2013 qualitative study of the causes of prescribing errors among junior medical doctors in a Nigerian in-patient setting found that junior doctors were influenced by the prescribing habits of their seniors.[21]

Significant differences in errors were found in prescriptions ordered by family physicians and general practitioners in a 2005 study in Bahrain that evaluated prescription errors in primary care: fewer errors were found in prescriptions by family physicians. [22]

Various proportions of errors were also found in a 1981 study of prescription writing skills of house officers (interns), residents and pediatricians in a pediatric outpatient clinic in Arizona. More deficiencies were found in prescriptions by house officers, but many were also reported in prescriptions from faculty members. [23]

The results of these studies indicate that there are deficiencies/errors in prescription writing among different professional categories of prescribers.

Medical prescription in different health care settings

In a 2009 study of OPD prescriptions from a teaching hospital and a health center in Ife Nigeria, the percentages of completely filled prescriptions were 1.3 and 85.9% respectively.[24] In this study, similarities were found in some attributes but generally prescriptions emanating from the primary healthcare facility were more often completed correctly than those from the tertiary health institution. No explanation was provided in the study for this difference.

A 2014 study in the West Bank, Palestine of prescription writing from various clinics (outpatients, emergency room, oncology, medical, orthopaedics, surgery, paediatrics and obstetrics/gynaecology) in a central hospital also found statistically significant differences in the completeness of prescriptions between the various clinics.[25]

All of the above literature suggests that there are deficiencies in prescriptions writing worldwide at different care level settings with various levels of compliance or lack of it, and among various professional categories of prescribers.

It is significant that no South African studies on compliance with prescription writing were found. This constitutes a gap in knowledge on this topic. Therefore, the purpose of this study will be to determine the compliance with the SA EML in writing medical prescriptions in Gauteng South district hospitals.

3 Aim and objectives

3.1 Aim

To determine the compliance of medical prescription writing with the South African EML guidelines at Outpatient Departments in district hospitals in Gauteng South.

3.2 Objectives

3.2.1 To describe the characteristics of the district hospitals' Outpatient Departments in terms of the daily average number of patients and prescribers professional categories.

3.2.2 To describe the level of completeness of medical prescriptions by determining the number of appropriately completed prescription charts as per South African EML guidelines, including script requirements for adults, children and controlled substances.

3.2.3 To describe the levels of legibility of medical prescriptions by the use of legibility scores.

3.2.4 To describe possible associations between district hospitals' Outpatient Departments overall compliance with the South African EML guidelines and their average daily patients numbers and prescribers' categories.

4 Hypothesis and Research Question

4.1 Hypothesis

Based on previous studies in international literature, the researcher hypothesizes that 17 to 35 % of prescriptions in Outpatients Departments of district hospitals in Gauteng South will comply with SA EML guidelines for medical prescriptions writing.

4.2 Research question

In the Outpatient Departments in district hospitals in Gauteng South, what is the level of compliance of prescriptions writing with the South African EML guidelines?

5 Methodology

5.1 Study design: a descriptive cross-sectional study.

5.2 Site of study

In the Outpatient Departments of four district hospitals in Gauteng South. The prescription charts will be collected from the pharmacies where they are kept after medicines have been dispensed.

There are 4 health districts in Gauteng South and 7 district hospitals which are: South Rand and Zola Jabulani Hospitals in the City of Johannesburg, Yusuf Dadoo and Carletonville Hospitals in the West Rand, Bertha Gxowa Hospital in Ekurhuleni, Kopanong and Heidelberg Hospitals in Sedibeng.

5.3 Study population

The study population consists of all the medical prescriptions issued at the Outpatient Departments in the Gauteng South district hospitals over the study period.

The study will be an anonymous review of patient's records. A sample of a medical prescription chart is in Annexure 2.

5.4 Study sample

5.4.1 Sample size

The literature considered[12, 13] showed a proportion of 17 to 35% of complete and legible medical prescriptions. With a precision of 5% and 95% confidence level at a power of 80%, using Stata12® (Stata Corp, College Station, Texas), the calculated sample size of prescription charts to sample was 374. For the purpose of this study and ease of calculations, the total sample size was rounded up to 400 prescription charts.

5.4.2 Sampling

One hospital will be randomly selected from each health district of Gauteng South to make the 4 district hospitals in the study. One hundred (100) consecutive prescription charts will be conveniently sampled per hospital to make 400 for the four hospitals.

The South Rand Hospital will be purposefully selected in the City of Johannesburg Health District. This is to see if the improvement achieved with an unpublished Quality Improvement Project (QIP) in 2013 had any sustained impact on improved quality of prescription writing in the OPD.[6] This QIP was conducted as a Wits University assignment and had shown an improvement in the quality of prescription writing one month after an audit of prescriptions was conducted and feedback given to prescribers.

5.4.3 Inclusion criteria

Hand written medical prescriptions issued during the study period by Outpatient Departments of the selected Districts Hospitals.

5.4.2 Exclusion criteria

- Medical prescriptions issued outside the study period.

- Prescriptions issued from other than Outpatient Departments.
- Prescriptions issued by institutions other than the selected hospitals
- Prescriptions that are not handwritten.

5.5 Data collection and measuring tools

5.5.1 Instruments

The checklist of the variables and elements with a coding explanation is in Annexure 3, and the Microsoft Excel spreadsheet for data capturing is in Annexure 4.

The checklist of variables on which data will be collected includes: 'Outpatient Departments' characteristics' (average daily patients number, prescribers categories available); the 'prescription type' (adult, pediatric or controlled substances), 'prescription completeness' (patients' identifiers, prescribers' identifiers including signature and professional category, date of prescription, treatment regimen) and 'legibility'.

The Outpatient Department's average daily patients' number will be scored '1', '2', '3' and '4' respectively for 'up to '100', '101 to 200', '201 to 300', and 'more than 300' average daily patients' number. The number of prescribers in the Outpatients Department will be classified and recorded per professional categories.

An enquiry will be made about the conduct of prescription writing improvement activities in the last two years in the OPD. The information will be used in the purpose of discussion of results: these activities will be scored 0 for 'none', 1 for 'simple lecture' and 2 for 'full QIP cycle'.

The elements of the prescription writing completeness will be scored '0' for 'not completed', '1' for 'partially completed' and '2' for 'fully completed'. Children's

prescriptions will be checked for the completion of 'age' and 'weight' elements; the prescriptions for controlled substances will be checked for full letters writing of dosage and quantities. For prescriptions with two signatures (such as a Medical Student's countersigned by a Medical Officer), the student's signature will be used to determine the prescriber.

Legibility will be scored '0' for 'illegible', '1' 'barely legible' and '2' for 'legible' as per Prescription Quality Index study (PQI).[7]

5.5.2 Duration

The data collection time is planned for one week per district hospital or until the data capturing from the selected 100 prescription charts is completed. One week is planned for first visits to the four district hospitals.

5.5.3 Process

Following Ethics Committee approval and after securing permissions from the provincial, health districts and district hospitals' authorities, the researcher will telephonically set up appointments with the relevant persons at the district hospitals (Clinical Managers and Pharmacy Managers) for a visit to the pharmacies and the Outpatient Departments. The purpose of this visit will be in order for the researcher to first introduce himself and to get to know the relevant people at the facilities and explain and clarify the study to them by answering their questions and concerns. Secondly, the researcher will get to see the set up and understand how the local systems work when patients are issued with prescriptions and, where these are kept and can be accessible and used for data-capturing after medicines have been dispensed. He will get advice about where he will get the charts from, where he will be able to sit and capture the data and where and to whom to hand back the charts to. Thirdly, days and dates to collect the

data will be agreed and set in a way to avoid clashes with the researcher's other activities. The researcher will have to plan and secure official leave from his normal work allocation while at the study sites. Lastly, the researcher will collect data on the four hospitals' Outpatient Department's characteristics in terms of average daily number of patients, the s mix of prescribers for the day and any prior activity aiming at improving prescriptions writing in the last two years.

On data collection days, the researcher will proceed to the pharmacy to meet the person in charge and ask to access the previous day's lot of Outpatients Department's' prescription chart or a Friday's lot if the data capturing day is on a Monday.

Data will be captured directly by the researcher on the data capturing sheet on his laptop. This information will be collected from all the included medical prescriptions charts as none is expected to be rejected. No personal details, such as names of patients or prescribers will be captured and no charts will be taken out of the hospitals. The charts captured will be piled up and returned to the designated person in charge and storing place.

5.6 Validity and reliability

The data collection tool is a valid instrument as it is based on the South African EML for the completeness variable and on the Prescription Quality Index study for the legibility scoring. As the data will be captured directly from prescription charts, there will be no question about reliability.

5.7 Data analysis

5.7.1 Outcome measures

- **Main:** Completeness and legibility of prescriptions.
- **Secondary**:

* Association of the overall compliance levels with the average daily number of patients at district hospital's OPD.
* Association overall compliance levels and available mix of prescribers.

5.7.2 Process

Help will be sought from the Biostatistician.

Data from the Microsoft Excel spread sheet will be cleaned and sorted. It will then be imported for analysis onto Stata 12® software. Descriptive analysis of categorical data will be done and results presented as frequencies and percentages. Cross-tabulations will be used to investigate possible associations between primary and secondary outcomes using the Chi-squared test. A p-value of <0.05 will be considered statistically significant.

5.8 Limitations

5.8.1 Prescribers professional categories

Data on these will constitute a limitation as the study will be on secondary data extracted from prescription charts: there will be no mean to obtain data on a prescriber's category when it is not provided on the prescription chart, without compromising the anonymity principle. Also, some prescribers work per rosters: data may be collected for a period when the prescriber is not working. Therefore, a comparison of completeness and legibility compliance scores between prescribers' categories may be carried out only on prescribers categories data provided on the prescription charts in the study.

5.8.2 Legibility

Although legibility of medical prescriptions will be assessed using a validated scale, it will be scored by the researcher alone. An element of subjectivity may exist and may constitute researcher bias that will be balanced by the consistency brought by the scoring being done by the same person.

6 Ethics

6.1 **Risks/ benefits to subjects:** this will be an anonymous patients' records review, with no risks or benefits to patients and prescribers.

6.2 **Confidentiality and management of data:** no personal or health information will be recorded about the patients or the prescribers. The professional category of prescribers will be allocated an anonymous code number; the prescription charts will not be taken out of the institutions and will be handed back to their storage place immediately after data capturing.

6.3 **Ethics application:** the ethics application form will be filled in and submitted to the University of the Witwatersrand's Human Research Ethics Committee (HREC). The study may start only after their approval.

6.4 **Participant's information sheet:** with the request for permission to conduct the study (Annexure 5), a detailed information sheet will be provided to provincial health, health districts and study hospitals authorities (Annexure 6). The study may proceed only after receipt of all their respective written authorizations.

6.5 **Informed consent:** there will be no contact with patients; none of their personal or medical information will be used and no prescriber personal information will be sought. There is therefore no requirement for informed consent.

7 Time line

Data collection is expected to be started after Ethic's approval by November 2014 and the write up completed by June 2015 as shown on the timeline diagram in Table 2, Annexure 7.

8 Funding:

This study will be at the researcher own funding as per budget estimate in Table 3, Annexure 8.

9 Problems

No problem anticipated, beside possible delays in securing all the required authorizations.

10 Potential Conflict of Interest: No conflict of interest envisaged.

11 References

1 McCoy D, Harrison D, Bamford L, Donohue S, Nxumalo Z, Radebe G. The Development of the District Health System in South Africa: Lessons Learnt from the Experience of ISDS. Technical Report #5. Health Systems Trust March 1998; p 47- 48.

2 Gauteng Department of Health [Internet]. Johannesburg: Gauteng Department of Finance; 2013 [Cited 25 July 2014]. Available from: http://www.health.gpg.gov.za.

3 National Essential Drugs List Committee. Standard Treatment Guidelines and Essential Medicines List for South Africa, Hospital Level Adults. 3rd edition, Pretoria: Department of Health (South Africa), 2012. p XIX-XX.

4 De Vries T, Henning R, Hogerzeil H, Fresle D, Haaijer-Ruskamp F, van Gilst R. Guide to Good Prescribing: A practical manual. Geneva: World Health Organization Action Programme on Essential Drugs 1994; 94 (11): 66-70.

5 Dean B, Schachter M, Vincent C, Barber N. Prescribing errors in hospital inpatients: their incidence and clinical significance. Qual Saf Health Care Dec 2002;11(4): 340- 4

6 Nkera JG. Audit of medical prescriptions writing in South Rand Hospital (Unpublished QIP Assignment). Johannesburg: Wits university; 2013.

7 Hassan NB, Ismail HC, Naing L, Conroy RM, Abdul Rashid Abdul Rahman AR. Development and validation of a new Prescription Quality Index. Br J Clin Pharmacol 2009; 70:4.

8 Mallet HP, Njikam A, Scouflaire SM. Evaluation of prescription practices and of the rational use of medicines in Niger. Sante 2001;11:185-93.

9 Al Shahaibi NM, Al Said LS, Kini T, Chitme H. Identifying errors in handwritten outpatient prescriptions in Oman. J Young Pharm. 2012 Oct; 4(4): 267-72.

10 Fourgon R, Vicrey C, Blanchon B, Vassort S, Blum-Boisgard C. The editorial quality of hospital drug prescriptions in the Ile de France area. A study by the Health Insurance. Presse Med. 2005 Feb; 34(3): 203-7.

11 Desta Z, Abdulwhab M. Prescription writing in Gondar outpatient teaching hospital, Ethiopia. East Afr Med J. 1996 Feb; 73 (2):115-9.

12 Makonnen E, Yoseph M, Berhane Y. Quality of prescription at a tertiary care pharmacy in Addis Ababa. Ethiop Med J. 2002 Jul; 40 (3): 233-9.

13 Irshaid YM, Al Homrany M, Hamdi AA, Adjepon-Yamoah KK, Mahfouz AA. Compliance with good practice in prescription writing at outpatient clinics in Saudi Arabia. La Revue de Santé de la Méditerranée orientale 2005; 11 (5): 922-8.

14 Kaushal R, Goldmann DA, Keohane CA, Abramson EL, Woolf S, Yoon C, et al. Medication errors in paediatric outpatients. Qual Saf Health Care 2010 Dec;19 (6): 30.

15 Lyons R, Payne C, McCabe M, Fielder C. Legibility of doctors' handwriting: quantitative comparative study. BMJ September 1998; 317.

16 Akoria OA, Isah AO. A comparison of two instruments for the assessment of legibility of prescriptions in a developing country. Tropical Journal of Pharmaceutical Research December 2009; 8 (6): 485-489.

17 Dharmadikari SD, Jaju JB, Pawar GR, Funde SK. Retrospective analysis of completeness and legibility of prescription orders at a tertiary care hospital. Natl J Physiol Pharm Pharmacol 2014; 4:165-167.

18 Ahmed I Albarrak AI, Al Rashidi EA, Rwaa Kamil Fatani RK, Al Ageel SI, Mohammed R. Assessment of legibility and completeness of handwritten and electronic prescriptions. Saudi Pharmaceutical Journal 2014.

19 Marwaha M, Kumar R, Marwaha U, Wadhwa J, Padi A. A retrospective analysis on a survey of hand written prescription errors in general practice. International Journal of Pharmacy and Pharmaceutical Sciences 2010 April; 2 (2): 80-82.

20 Ajemigbitse AA, Kayode M, Omole MK, Ezike NC, Wilson O. Erhun WO. Assessment of the knowledge and attitudes of intern doctors to medication prescribing errors in a Nigeria tertiary hospital. Journal of Basic and Clinical Pharmacy 2014 Feb; 5 (1): 7- 14.

21 Ajemigbitse AA, Omole MK, Osi-Ogbu OF, Erhun WO. A qualitative study of causes of prescribing errors among junior medical doctors in a Nigeria in-patient setting. Ann Afr Med 2013;12:223-31.

22 Al Khaja KA, Al-Ansari TM, Sequeira RP. An evaluation of prescribing errors in primary care in Bahrain. Int J Clin Pharmacol Ther. 2005 Jun; 43(6):294-301.

23 Walson PD, Hammel M, Martin R. Prescription- writing by pediatric house officers. Journal of Medical Education May 1981; 56: 423- 428.

24 Erhuna WO, Adekoyab OA, Erhunc MO, Bamgbade OO. Legal issues in prescription writing: a study of two health institutions in Nigeria. International Journal of Pharmacy Practice 2009; 17: 189-193.

25 Tayem YI, Ibrahim MA, Qubaja MM, Shraim RK, Taha OB, Shkhedem AE. Compliance with the guidelines of prescription writing in a central hospital in the West Bank. Eastern Mediterranean Health Journal 2013; 19 (9).

Annexure 1: Required written elements on a medical prescription

Table 1: Required elements on a written medical prescription from 3 sources: WHO, EDL and PQI.

Minimum information required on a written prescription as per WHO[4]	Required content of written prescription as per EDL[3]	Prescription Quality Index- validated criteria- PQI[7]
1. Name, address, telephone of prescriber 2. Date 3. Generic name of the drug, strength 4. Dosage form, total amount 5. Label: instructions, warnings 6. Name, address, age of patient 7. Signature or initials of prescriber	1. Written legibly in ink by the prescriber with the full name and address of the patient and signed with the date on the prescription form. 2. Specify the age and weight of the patient in the case of children. 3. Have contact details of the prescriber e.g. name and telephone number. 4. The name of the medicine or preparation should be written in full using the generic name. No abbreviations should be used due to the risk of misinterpretation. 5. Avoid unnecessary use of decimal points and only use where decimal points are unavoidable. A zero should be written in front of the decimal point where there is no other figure, e.g. 2 mg not 2.0 mg or 0.5 ml and not .5 ml. 6. Frequency: avoid Greek and Roman frequency abbreviations that cause considerable confusion such as qid, qod, tds, tid, etc. Instead either state the frequency in terms of hours (e.g. 8 hourly) or times per day in numerals (e.g. 3x/d). 7. State the treatment regimen in full: medicine name and strength, dose or dosage, dose frequency, duration of treatment (e.g. amoxicillin 250 mg 8 hourly for 5 days). 8. In the case of "as required" a minimum dose interval should be specified, e.g. every 4 hours as required. 9) Most monthly outpatient scripts for chronic medication are for 28 days; check that the patient will be able to access a repeat before the 28 days are up. 10..Sign the script, and as well as signing provide some other way for the pharmacy staff to identify you if there are problems (print your name, Use a stamp, or use a prescriber number from your institution's pharmacy).	1. Indication 2. **Dosage** 3. Effectiveness 4. Evidence-based 5. Correct administration 6. Practical administration 7. Drug-drug interaction 8. Drug-disease interaction 9. Adverse drug reaction 10. unnecessary duplication 11. **Duration of therapy** 12. Cost minimization 13. Generic prescribing 14. Formulary/essential drug list) 15. Compliance 16. **Medication name** 17. **Legibility** 18. **Prescriber's information** 19. **Patient's information** 20. Diagnosis 21. **Requirement for drug therapy** 22. Patient's improvement

Annexure 2: Medical prescription chart sample

Annexure 3

Variables check- list, elements and coding.

The following variables will be on the Microsoft Excel Spread sheet data capturing tool:

1) **Prescription writing completeness:**

The following elements will be scored 0, 1 or 2 respectively when not completed, partially completed or fully completed. Children's prescriptions will be particularly checked for age and weight elements completion, those for controlled substances will be checked for full letters writing of dosage and quantities. Prescription type will be coded as 1, 2 and 3 respectively for adults, children and controlled substances

- **Patient's identifiers:**

  Patient's number

  Patient's names

  Patient's sex

  Patient's age

  Patient's weight if child

- **Prescriber's Identifiers:**

  Prescriber's names

  Prescriber's professional qualification

  Prescriber's professional registration number

  Prescriber's professional category

  These will be captured as

  : 1: PHC Nurses

  2: Medical Students

  3: Clinical Associates

4: Medical Interns

5: Community Service Doctors

6: Medical Officers

7: Registrars

8: Family Physicians

9: Others

- **Prescriber's signature**
- **Date of prescription**
- **Treatment regimen**

  Medicine's name

  Medicine' strength

  Medicine dose

  Dose frequency

  Treatment duration

  Number of repeats

2) Legibility of prescriber's handwriting:

Scoring to be applied: 0, 1 and 2 respectively for illegible, barely legible and legible. Scoring will be done by the researcher personally.

3) District Hospitals:

The 4 District Hospitals will be captured as 1, 2, 3 and 4 respectively.

Annexure 4: Data collection tool sample

Annexure 3: **Data collection sheet:** Compliance of written medical prescriptions at Outpatient Departments of district hospitals in Gauteng South with the Standard Treatment Guidelines and Essential Medicines List for South Africa, Hospital Level- Adults 2012

Explanation of coding and scoring of data collected.

Hospital:
South Rand: 1
Yusuf Dadoo: 2
Bertha Gxowa: 3
Kopanong: 4

Average daily patients' number
≤ 100: 1
101 to 200: 2
201 to 300: 3
> 300: 4

Prescription writing improvement activity
None: 0
Lecture: 1
QIP: 2

Prescription type
Adult: 1
Children: 2
Controlled subst.: 3

Prescriber category
PHC Nurse: 1
Medical Student: 2
Clinical Associate: 3
Medical Intern: 4
Com. Serv. Dr: 5
Medical Officer: 6
Registrar: 7
Specialist: 8
Other: 9

Prescription elements completeness
Not completed:
Partially completed: 1
Completed: 2

Legibility
Illegible: 0
Barely legible: 1
Legible: 2

Prescription sheet number	Hospital	Daily average patients' numbers	Prescription writing improvement activity	Prescription type	Prescriber's category	Patient's names	Patient's number	Patient's sex	Patient's age	Patient's weight	Medicine name	Medicine strength	Medicine dose	Dose frequency	Treatment duration	Repeats	Date of prescription	Prescriber's name	Prescriber's qualification	Prescriber's registrationnumber	Prescriber' s signature	Completeness- Score per sheet	Legibility	Total score per prescription sheet	Compliance level per prescription sheet
1																									
2																									
3																									
4																									
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Annexure 5: Request for permission letter sample

Department of Family Medicine

University of the Witwatersrand

Johannesburg

01/07/2014

The Chief Director (Health),

XYZ Health District.

Dear Sir / Madam,

Request for permission to conduct a research in XYZ Health District

Good day

I am Dr J G Nkera, a 3rd year post graduate student in the department of Family Medicine, University of the Witwatersrand, Johannesburg.

As part of the requirement for the award of the degree of MMED Family Medicine, I am required to submit a research report to the department. To this end I would like to conduct a research on "Compliance of written medical prescriptions at Outpatient Departments of district hospitals in Gauteng South with the Standard Treatment Guidelines and Essential Medicines List for South Africa, Hospital Level- Adults 2012".

The purpose of the research is to determine the compliance with national guidelines for good practice in medical prescriptions writing in district hospitals in Gauteng South. Its findings could provide good baseline data for a quality improvement program in prescriptions writing. This could contribute to improved service delivery by reducing delays and patients' waiting times, one of the Department of Health's service quality improvement drive focus.

The study may be carried out only with approval from the Human Research Ethics Committee of the University of the Witwatersrand, the Research Officer in the Gauteng Department of Health and yourselves.

I therefore request your permission to carry out the study.

Thanking you for your attention,

Yours faithfully,

Dr J G Nkera

Annexure 6: Study information sheet

Dear Sir/ Madam

Good day

I am Dr J G Nkera, a post graduate student in Family Medicine at Wits University, Johannesburg.

This is an information sheet on a study to be conducted in XYZ district hospital Outpatient Department.

Title of the study: Compliance of written medical prescriptions at Outpatient Departments of district hospitals in Gauteng South with the Standard Treatment Guidelines and Essential Medicines List for South Africa, Hospital Level- Adults 2012.

The aim of this study is to determine the compliance of medical prescriptions writing with national guidelines in terms of completeness and legibility, in district hospitals' Outpatient Departments in Gauteng South. Its findings could provide good baseline data for a quality improvement program in prescriptions writing. It would contribute to improved service delivery by reducing delays and patients' waiting times; it would also contribute to the prevention and reduction of medication errors.

Expectations from the participating district hospital authorities.

This is a request for you to please facilitate the researcher's access to your pharmacy so that he may collect anonymous data on the completion and legibility of a sample of medical prescriptions from the Outpatient Department.

Confidentiality

No personal or medical information on the patient will be recorded. A code number will be used for the hospital and the prescriber's category, and a score for the written the elements of the prescription. No individual personal information will be recorded.

Risks or benefits to patients and the Hospital

No risk nor material or financial benefits are contemplated. The study findings may provide reliable baseline data for a service quality improvement and contribute to improve patient's safety by preventing and reducing medication error related to medical prescription writing.

For any further information, please contact the researcher

Dr J G Nkera, Family Medicine Registrar, Wits University.

Cell: 08329151 E-mail: jgnkera@yahoo.com.

Annexure 7: Study time line

Table 2: Study time line

	May 2014	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan 2015	Feb	Mar	Apr	May	Jun
Literature review														
Preparing protocol														
Protocol assessment														
Ethics application														
Collecting data														
Data analysis														
Writing up														
Writing up – paper														

Annexure 8: Study budget estimate

Table 3: Study budget estimate	
Budget item	**Cost (Rand)**
Transport and petrol	**1800**
Stationery and printing	**1500**
Miscellaneous	**700**
Total	**4000**

Appendix 6: Turnitin report_ 698989_ J G Nkera-Gutabara_MMed Research

698989:Nkera_MMed_Research_Draft_23_01_2018_for_Turnitin.docx

by Gihana Nkera-Gutabara

Submission date: 23-Jan-2018 01:55PM (UTC+0200)
Submission ID: 905748925
File name: 994638b08_Nkera_MMed_Research_Draft_23_01_2018_for_Turnitin.docx (129.68K)
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Appendice 7: African Journal of Primary Health Care and Family Medicine instructions for authors

African Journal of Primary Health Care and Family Medicine

Structure and style of your original research article

The page provides an overview of the structure and style of your original research article to be submitted to the *African Journal of Primary Health Care & Family Medicine*. An original article provides an overview of innovative research in a particular field within or related to the focus and scope of the journal, presented according to a clear and well-structured format (between 3500 and 7000 words with a maximum of 60 references).

When presenting your article in English. Please use British English, that is, according to the *Oxford English Dictionary*. Avoid Americanisms (e.g. use 's' and not 'z' spellings). Consult the *Oxford English Dictionary* when in doubt and remember to set your version of Microsoft Word to UK English.

- **Language:** Manuscripts must be written in British English or French.
- **Line numbers:** Insert continuous line numbers.
- **Font type:** Palatino
- **Symbols font type:** Times New Roman
- **General font size:** 12pt
- **Line spacing:** 1.5
- **Headings:** Ensure that formatting for headings is consistent in the manuscript.
  - First headings: normal case, bold and 14pt
  - Second headings: normal case, underlined and 14pt
  - Third headings: normal case, bold and 12pt
  - Fourth headings: normal case, bold, running-in text and separated by a colon.

Our publication system supports a limited range of formats for text and graphics. Text files can be submitted in the following formats only:

- Microsoft Word (.doc): We cannot accept Word 2007 DOCX files. If you have created your manuscript using Word 2007, you must save the document as a Word 2003 file before submission.
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For full details on how to ensure your manuscript adheres to the house style, **click here.**

The structure and style of your original article

Page 1

The format of the **compulsory cover letter** forms part of your submission, is on the first page of your manuscript and should always be presented in English. You should provide all of the following elements:

- **Full author details:** Provide title(s), full name(s), position(s), affiliation(s) and contact details (postal address, email, telephone and cellular number) of each author.
- **Corresponding author:** Identify to whom all correspondence should be addressed.
- **Summary:** Lastly, a list containing the number of words, pages, tables, figures and/or other supplementary material should accompany the submission.

Page 2 and onwards

Title: The article's full title should contain a maximum of 95 characters (including spaces).

Abstract: The abstract, written in **English and French**, should be no longer than 250 words and must be written in the **past** tense. The abstract should give a succinct account of the objectives, methods, results and significance of the matter. The structured abstract for an Original Research article should consist of six paragraphs labelled Background, Aim, Setting, Methods, Results and Conclusion. The journal can translate into French if this is difficult for you.

- **Background:** Summarise the social value (importance, relevance) and scientific value (knowledge gap) that your study addresses.
- **Aim:** State the overall aim of the study.
- **Setting:** State the setting for the study.
- **Methods:** Clearly express the basic design of the study, and name or briefly describe the methods used without going into excessive detail.
- **Results:** State the main findings.
- **Conclusion:** State your conclusion and any key implications or recommendations.

Do not cite references and do not use abbreviations excessively in the abstract.

The following headings serve as a guide for presenting your research in a well-structured original article. As an author you should include all first-level headings, but subsequent headings (second- and third-level headings) can be changed.

Introduction (first-level heading)
The introduction must contain your argument for the social and scientific value of the study, as well as the aim and objectives:

Social value: The first part of the introduction should make a clear and logical argument for the importance or relevance of the study. Your argument should be supported by use of evidence from the literature.

Scientific value: The second part of the introduction should make a clear and logical argument for the originality of the study. This should include a summary of what is already known about the research question or specific topic, and should clarify the knowledge gap that this study will address. Your argument should be supported by use of evidence from the literature.

Conceptual framework: In some research articles it will also be important to describe the underlying theoretical basis for the research and how these theories are linked together in a

conceptual framework. The theoretical evidence used to construct the conceptual framework should be referenced from the literature.

Aim and objectives: The introduction should conclude with a clear summary of the aim and objectives of this study.

Research methods and design (first-level heading)
The methods should include:

Study design (second-level heading): An outline of the type of study design.

Setting (second-level heading): A description of the setting for the study; for example, the type of community from which the participants came or the nature of the health system and services in which the study is conducted.

Study population and sampling strategy (second-level heading): Describe the study population and any inclusion or exclusion criteria. Describe the intended sample size and your sample size calculation or justification. Describe the sampling strategy used. Describe in practical terms how this was implemented.

Intervention (if appropriate) (second-level heading): If there were intervention and comparison groups, describe the intervention in detail and what happened to the comparison groups.

Data collection (second-level heading): Define the data collection tools that were used and their validity. Describe in practical terms how data were collected and any key issues involved, e.g. language barriers.

Data analysis (second-level heading): Describe how data were captured, checked and cleaned. Describe the analysis process, for example, the statistical tests used orsteps followed in qualitative data analysis.

Ethical considerations (second-level heading): Approval must have been obtained for all studies from the author's institution or other relevant ethics committee and the institution's name and permit numbers should be stated here.

Results (first-level heading)
Present the results of your study in a logical sequence that addresses the aim and objectives of your study. Use tables and figures as required to present your findings. Use quotations as required to establish your interpretation of qualitative data.

All units should conform to the **SI convention** and be abbreviated accordingly. Metric units and their international symbols are used throughout, as is the decimal point (not the decimal comma).

Discussion (first-level heading)
The discussion section should address the following four elements:

Key findings: Summarise the key findings without reiterating details of the results.

Discussion of key findings: Explain how the key findings relate to previous research or to existing knowledge, practice or policy.

Strengths and limitations: Describe the strengths and limitations of your methods and what the reader should take into account when interpreting your results.

Implications or recommendations: State the implications of your study or recommendations for future research (questions that remain unanswered), policy or practice. Make sure that the recommendations flow directly from your findings.

Conclusion (first-level heading)
Provide a brief conclusion that summarises the results and their meaning or significance in relation to each objective of the study.

Acknowledgements (first-level heading)
If, through your study, you received any significant help in conceiving, designing or carrying out the work, or received materials from someone who did you a favour by supplying them, you must acknowledge their assistance and the service or material provided. **Authors should always acknowledge outside reviewers of their drafts and any sources of funding that supported the research.**

Competing interests (second-level heading): A competing interest exists when your interpretation of data or presentation of information may be influenced by your personal or financial relationship with other people or organisations that can potentially prevent you from executing and publishing unbiased research. Authors should disclose any financial competing interests but also any non-financial competing interests that may cause them embarrassment were they to become public after the publication of the manuscript. **Where an author has no such competing interests, the listing will read as follows:** 'The authors declare that they have no financial or personal relationship(s) that may have inappropriately influenced them in writing this article.'

Authors' contributions (second-level heading): This section is necessary to give appropriate credit to each author, and to the authors' applicable institution. The individual contributions of authors should be specified with their affiliation at the time of the study and completion of the work. An 'author' is generally considered to be someone who has made substantive intellectual contributions to a published study. Contributions made by each of the authors listed can follow the example below (please note the use of authors' initials):

J.K. (University of Pretoria) was the project leader, L.M.N. (University of KwaZulu-Natal) and A.B. (Stellenbosch University) were responsible for experimental and project design. L.M.N. performed most of the experiments. P.R. (Cape Peninsula University of Technology) made conceptual contributions and S.T. (University of Cape Town), U.V. (University of Cape Town) and C.D. (University of Cape Town) performed some of the experiments. S.M. (Cape Peninsula University of Technology) and V.C. (Cape Peninsula University of Technology) prepared the samples and calculations were performed by C.S. (Cape Peninsula University of Technology).

References (first-level heading)

Begin the reference list on a separate page, and give no more than 60 references in all.

The *African Journal of Primary Health Care & Family Medicine* uses the **Vancouver referencing style**, details of which can be downloaded from the journal website. **Note: No other style will be permitted.**

Systematic reviews

Systematic reviews should follow the same basic structure as other original research articles as described above. The aim and objectives should specific the focused clinical question that will be addressed in the review. The methods section should describe in detail the search strategy, criteria used to select or reject articles, attempts made to obtain all important and relevant studies and deal with publication bias (including grey and unpublished literature), how the quality of included studies was appraised, the methodology used to extract and/or analyse data. Results should describe the homogeneity of the different findings, clearly present the overall results and any meta-analysis.