ASSESSMENT OF OUTPATIENTS' MEDICAL PRESCRIPTIONS' LEGIBILITY, COMPLETENESS, AND RATIONAL US OF MEDICINES: SUDAN STUDY.

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ABSTRACT

Medication prescriptions have to be legible, complete and rational. Many studies in Sudan and globally, proved otherwise. This study main objectives the assessment of the legibility, completeness and rationality of outpatient prescriptions in Sudan. Materials and Methods: Three hundreds and ninety five [395] randomly selected prescription from different parts of Sudan were studied. Results: the overall average recorded result for prescriptions legibility was 273 [69.27%], patient's demographic elements33[8.44%], prescriber's identification elements were 167[42.78%],inscription elements were 240 [60.77%], the results for the rationality of medicines prescribing based on World Health Organization [WHO] indicators, revealed that antibiotics /prescription[55.8%], and prescribing in generic names [47.6%] were both out of advised WHO limits. The use of injections [21.51%] and the number of medicines/ prescription [1.22] were however within the WHO optimal cut-off limits [1.4-1.8] and [24.1%] respectively. Pearson Chi-Square Test revealed significant correlations between the use of medications' trade names and: the number of drugs per prescription [P= 0.019], the use of the metric system [P=0.000], the number of prescribed antibiotics [p= 0.001], and the legibility of handwritten prescriptions [p= 0.10]. The prescriber's specialty showed significant correlation with the use of the metric system in prescriptions [p = 0.005], and injections prescribing [p=0.02], respectively. Printed prescriptions were significantly correlated with private sector prescription [p= 0.022].Conclusion: Studied prescriptions were incomplete, not satisfactorily

legible, and were only partially rational. All Prescribers, especially the juniors, shall be well and continuously trained on prescribing. Proper prescribing guidelines shall be instituted and enacted.

KEYWORD: Outpatients, Medical Prescriptions, legibility, Completeness, Rational Prescribing, Sudan.

INTRODUCTION

Pharmaceuticals represent major players in the management of the different diseases or ailments complained of by patients to the different members of the healthcare team, mainly the physicians, pharmacists and nursing staff.[1, 2] The prescription is a lawful health-care program that governs the plan of care for the patient. It usually is either a written, verbal, or electronically produced order from authorized medical practitioners, or designated agents [medical assistants, nurse, midwife] to a pharmacist, or nurse, for a particular medication[s] for a specific patient.[3-6] Improper and/or incomplete, and/or illegibly handwritten prescriptions may accordingly, convey deficient, inadequate, erroneous information to the pharmacists, nurses and patients; and that may lead to harm to patient. Accordingly, the prescription must be clearly written[legibility and language terminology], and complete to convey, or communicate the full identity of the prescriber [full name , full address, specialty, and registration number], the full identity of the patient and his/her demographics [name, age, gender, weight, address, diagnosis, allergies], and details of the medication[s] prescribed; name of medication [generic and/or brand name], dosage form, dose magnitude, strength, dose frequency, how to use, for how long, which foods or drinks to avoid, allowing for substitution or otherwise, and informing of any planned refills. All of those prescription elements must be clearly written in legible handwriting in indelible ink,[7,8] free from non-official abbreviations, be signed by the prescriber him/herself to satisfy the legality of the prescription, and ease communication and contact [Telephone number very important] between the involved healthcare team members, when need arises.[9,10] Illegible or omitted prescriber's address and/or signature may make it almost impossible to contact him/her to clarify the prescription order. It was reported that such cases had even led to death of a patient, and the prescriber was held accountable for that act. [11] Outpatient medications' errors frequently detected in handwritten prescriptions are mostly due to poor or inappropriate prescribing. Those detected medication errors were primarily due to illegibility, incompleteness, and irrational prescription writing.[12, 8, 13] Handwritten prescriptions' illegibility may lead to loss of basic information, confuses the

pharmacists, nurses, and patients, and may ultimately compromises the patient's care at large, or may even lead to death.[14, 15]

According to Samaranayake, 2016, ''reading *and interpreting hand-written prescriptions has become a challenging task to the pharmacist in Sri Lanka. Most prescriptions that reach the pharmacist are illegible, incomplete and contain unapproved and unclear abbreviations''.* [16]Prescription errors are either due to omissions or commission. Omissions [incompleteness] in the prescription, which are quite common, might be a source of medication errors, poor treatment outcomes, and the possible ensuing adverse drug events. The most frequently omitted prescription element involve the patient's age, gender, weight , dose magnitude, dose frequency, and duration of treatment course, despite their significant importance in patients' health outcomes and safety.[17,18] An Indonesian study reported that incomplete prescription orders were the most encountered prescribing errors.[19] Prescriptions' incompleteness, irrationality, and illegibility are a global phenomenon which was reported by many studies in Sudan, and other countries.[20-22,12,5,23-26] Alyamanietal, 2009; reported an extremely low rate [0.5%] of handwritten prescription legibility.[27] To ensure patients' safety and actualize the planned and the intended health outcomes, the handwritten prescriptions, which are the most dominant in Sudan, must be complete, clear and legible to the intended readers, and ensure the rational use of medicines. Many organization and studies had pointed to and stressed on the importance of the rational use of medicines in both the developed and developing countries.[28-30]

Though there are no global standards for the prescriptions format, and every country has its own regulations or guidelines, yet the legal requirements for a valid complete prescription generally follow the underneath pattern.

1. Should state the full name, specialty, and the full address of the prescriber, including his/her telephone number?
2. Should give the prescriber's registration number.
3. Should be written in indelible ink pen [if handwritten]
4. Should be signed by the prescriber him/herself.
5. Should give particulars if the prescriber is dentist, veterinarian or otherwise.
6. Should be dated.
7. Should advise number of refills, when applicable.

8. Should be in the prescriber's own handwriting [electronic prescribing can be used when feasible]

9. Should state the full name and address of the individual patient

10. Should state the age, gender, diagnosis, and weight of the patient [especially for children].

11. Should state the name[s] of the medicine[s], its/their strength, dosage form [route of administration], the dose magnitude, frequency of doses, and how expressed, [use of as directed, is not acceptable], total number of doses, duration of treatment, and should state the total quantity [amount] of the prescribed medication[s], or the number of dose units to be supplied. Should clearly state the medication's use regarding concurrent food, and/or beverages intake or otherwise [possible matching, or food-drug interactions].

12. The handwritten prescription should be easily legible and clear.

13. Should state if substitution is allowed or otherwise.

14. Should adopt rational use of medications as advised by the World Health Organization [WHO] medicines prescribing and use indicators: prescribed solely and fully in generic names only, avoid unnecessary poly-pharmacy and avoid the excessive and unnecessary use of injections and antibiotics.

15. Should be closed by a vertical marking or line on the space between the last line of prescription text and the prescriber's signature [to secure prescription against any possible amendment or forging].

16. Shall be headed with the historical symbol Rx.

17. Should be written in a language understandable to patient, pharmacists and nurse. [Official language].

18. Should avoid all forms of possible drug-interactions, and advise patients' accordingly.

19. Should use the metric system, especially in oral liquid and injectable.

20. Should avoid the use of Latin abbreviations.

21. Should inform whether the prescription is from the public or private sector medical settings.[31, 18,32]

Poor prescription writing, [omissions and or/commissions] leading to incomplete prescriptions is a known contributor to medication errors, and is a worldwide public health problem. [33, 34, 23, 35, 18, 36]

An Indonesian study reported that out of two hundred and twenty six [226] detected medication errors, 99.12% were due to prescribing errors. [19]Medication errors are a global public health problem.[37]

It quite frequently occurs in both in general medical practice and hospitals prescriptions. Their occurrence rate was estimated to vary from 2 to 514/1000, for prescriptions by junior doctors.[38-41] Poor prescribers' handwriting [illegible] endangers patients' health, as it distorts the prescriber's communication with the pharmacists and nursing staff. Many studies reported poor illegible prescription's handwriting reaching up to 50% in some studies. Illegible or hard to read prescription text, may lead to misinterpretation of medication's name, dosage, and other important information that help in the correct dispensing and information to patients. It can create confusion, cause serious adverse events, or even death.[42-44]

A study from the Philippines, reported that the majority of medication errors can be attributed to poor doctors' handwriting, and that poor or illegible handwriting had no relation to their specialization.[45] Recent guidelines by the Medical Council of India mandated that, handwritten prescription must be written in capital letters, to be correctly interpreted.[15]

According to some earlier studies, this unwelcomed phenomenon of prescription illegibility ranges between 16% to 50%, and that compared to other healthcare professionals, physicians had the worst handwriting.[46-49] Recent studies confirmed the phenomenon of prescription illegibility and arrived at quite similar results.[23,24] Moreover, to help patients reach their intended health outcomes, medications should be very carefully chosen after a very thorough and articulate evaluation of their benefits and risks, including cost effectiveness to individual patients and their communities. The various factors that may help promoting patients' affordability, easy access to their needed medications, and adherence shall be respected and observed. This falls within the provisions of rational use of medicines, and sticking to selection of medications from the country's adopted and approved Essential Medicines List [EML].[50-52]

Based on the above, the World Health Organization[WHO] advised that rational use of medications[RUM] should be highly observed in all prescriptions, as it an important component of effective, safe, and an economic health system.[53]For prescribers to stick to and respect the rational use of medicines [RUM] they need to follow its basic stipulated provisions that:

''Patients receive medications appropriate to their clinical needs, in doses that meet their own individual requirements, for an adequate period of time, and at the lowest cost to them and their Community''. WHO had recommended standard indicators for the prescribing and the use

of medicines to investigate and evaluate the overall trends of rational prescribing and use of medicines in, both the public, and private medical health facilities?[54]Those indicators are:

1. Average number of medications /prescription 1.4 - 1.8.

More than two clinically unnecessary and inappropriate medications in one prescription is poly-pharmacy. *"Poly-pharmacy is a problem of substantial importance, in terms of both direct medication costs and indirect medication costs resulting from drug-related morbidity. Poly-pharmacy increases the risk of side effects and drug-interactions"*. [55, 56]

2. Antibiotic prescription 20-27%.

Excessive or unnecessary use [irrational] of antibiotics might promote resistance which is detrimental to both the patients and their communities. Antimicrobial resistance is an important and major concern for the public health authorities at global level. [57-59, 40]

3. Injectable medicines 13.4 -24.1 %.Excessive and unnecessary use of injections, when other convenient oral dosage forms are available, increases the overall cost of treatment, and may cause some side effects, including bleeding, atrophy, nerve injury, and possible hypersensitivity reactions, not to mention the patient's personal inconvenience.[60]

4. Fully prescribing by generic names, and from the country's approved Essential Medicines List [EML], 100%.Generic pharmaceutical is bioequivalent to their branded counterparts but are more economic and available.

A generic drug is defined as "a drug product that is comparable to reference /brand listed drug product in dosage form, strength, route of administration, quality and performance characteristics, and intended use". It also has to be bioequivalent to its originator/reference brand counterpart.[61]As the health care expenditure is globally continuously escalating, and patients, especially in the developing countries, are struggling for basic essential medicines The World Health Organization [WHO],recommended the use of generic pharmaceuticals [bioequivalent], as effective, safe, accessible, available and affordable substitute to their highly expensive branded counterparts.[62,63] The World Health Organization, [WHO] reported that around one third of the world population has no access to their needed essential medicines.[64] Generic pharmaceuticals are highly needed by developing countries like Sudan where the Pharmaceutical expenditure accounts for 2.2% of the total GD,P which makes up to 36% of the total health expenditure. The budget for pharmaceuticals represents an economic burden to both individual patients and their communities.[65] To solve the problem of the needed medicines' availability, accessibility and affordability to patients and their communities .The World Health Organization recommended the use of generics and the Essential Medicines List

[EML], where a list of selected medicines [EML] of known quality, and cost that covers the majority needs of the population, is to be formed by experts considering the disease patterns prevailing in that specific country or region. Even rich countries are now adopting EML to reduce cost of treatment.[64,62,66,63] The use of generic medicines in addition to the adoption of the EML, secures the availability, accessibility and affordability to both patients and their communities.[67] Irrational prescribing is a global problem where almost all countries and healthcare settings. The World Health Organization estimates that" *more than half of all medicines are prescribed, dispensed or sold inappropriately and half of all patients fail to take their medicines correctly".* [68] Irrational Use of Medicines has been related to poor prescribers experience and skills, poor therapeutic knowledge, high load of patients, poor medical practice settings' environments, inefficient or poor medical investigations laboratories competences, prescribers' poor diagnosis skills, inadequate therapeutic teaching and training in undergraduate courses lack of continuing medical education, the negative impact of pharmaceutical promotion, total lack of or poor enactment of prescribing standard treatment guidelines and therapeutic committees stipulations[7]Irrational use of medicines usually appears in many faces: 1/ The use of Poly-pharmacy leading to possible increases adverse drug reactions [ADRs], drug - interactions, poor adherence, and poor health outcomes, in addition to the toll of the cost on patients and their community**.** [40, 69, 26]

Inappropriate use of antimicrobials when not indicated, their use in lower doses or longer durations or shorter ones, in addition to other factors, leads to increased antimicrobial resistance, which is detrimental to individual patients' health, and to their communities, alike. Main reasons behind antibiotic resistance are: Repeated and improper uses of antibiotics.

Using antibiotics when they are not needed [Flu].Not taking antibiotics at the doses and times that a doctor prescribes — this allows time for the bacteria in your system to become resistant.[59,57,58] *"The resistant bacterial diseases lead to the high cost, increased occurrence of adverse drug reactions, prolonged hospitalization, the exposure to the second- and third-line drugs like in MDR-TB and XDR-TB that leads to toxicity and deaths as well as the increased poor production in agriculture and animal industry and commercial ethanol production".* [70] In Sudan, antibiotics are even frequently sold over the counter without a prescription, while the same occurs with injections that are occasionally sold over the counter. [21]Generally in Sudan, irrational use of medicines is quite prevalent and is well documented.[20,21,71-73,22,74, 75, 44,76-79]When the results of three studies by Sudanese authors dating from 2007- to 2014 were

matched against the WHO indicators for rational Use of medicine [RUM] they confirmed the prevalence of irrational use of medicines in Sudan.

1. the average number of medications /prescription reported in three studies were 2. 25; while the WHO optimal recommended average is 1.4-1.8.
2. Antibiotic prescription average of three studies was 70 %optimal recommended is 20-27%
3. Injectable medicines average of three studies was 14.7% while the recommended optimal average is13.4 -24.1 %. It was within the recommended level.
4. Prescribing by generic names 45.6% [optimal 100 %]. [71, 73, 80]

It, accordingly, becomes extremely important that prescribers respect the national health policies and stick to writing complete prescription and respect the rational use of medications from EML in their prescriptions.

Poor prescribing [prescribing faults and prescription errors] is one of the main causes of medications' errors. It is worth mentioning that prescription errors encompass those errors related to the act of writing a prescription, where the particulars of the prescription deviate from the known standards of the legal prescription. Incomplete prescription is an example. Prescribing faults, from the other hand, encompass irrational prescribing. [81, 38] Prescription errors and irrational prescribing together constitute improper prescribing and may put the patient at great risks.[40]

Irrational prescribing is a global problem in almost all countries and healthcare settings. The World Health Organization estimates that" *more than half of all medicines are prescribed, dispensed or sold inappropriately and half of all Patients fail to take their medicines correctly".*[68]Many Sudanese studies reported much of prescription errors, and prescribing faults that include irrational prescribing.[20,22,44,77]

Improper prescribing may lead to medication errors which may put the patient on great risks of harm in addition to the economic burden.[82]

A medication error is defined as ''Any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care provider, patient or consumer''.[83]

Prescription errors are part of medication errors. [84]

Medication errors which are mainly due to inappropriate prescribing usually stem out from:-

1- Improper dose, accounting for ………………..41%.

2- Prescribing the wrong medication……………16%.

3- Using the wrong route of administration ……..16%.

4- Illegible other prescription's details.

Many Sudanese studies, from 2006-2014, on the completeness and rationality of the medical prescriptions, arrived at conclusions that their studied medical prescription were mostly deficient, inappropriate and poorly rational. As they all, except one [From Northern Kordofan, Elobied], were geographically limited to specific areas or institutions [hospitals] in central Sudan [Khartoum and Gezira State].[20, 44, 77]

It is worth mentioning that in one study and after screening 2000 prescriptions, Yousif et al; 2011, reported that only one[0.05%] prescription out of the 2,000 studied prescriptions, was ideal ![22]

This study is based on prescriptions for outpatients, which were collected from different parts of the Sudan. It is basically intended to assess any possible positive improvements in the legibility, completeness and rationality of the medical prescription writing, from ambulatory medical settings, in a broader area [different regions] in Sudan. It is given the following title: Assessment of the legibility, completeness and rationality of medicines prescribing in outpatients' medical prescriptions: Sudan study.

MATERIALS AND METHODS

This is a prospective, cross-sectional, exploratory, research study. Two thousands and four hundred medical prescription [2400] were collected from community pharmacies and out-patient clinics from different parts of the Sudan during the period from April 2016 to September 2016.

Based on 95% confidence level and 5% confidence interval, and considering the limitless number of prescriptions issued and the phenomenal lack of statistical data in developing countries, three hundred and ninety five [395] prescriptions were randomly selected[instead of 384] out of that total [sample size], and analyzed to match their legibility, completeness and rationality with the above mentioned particulars [check list of standard parameters of legibility, completeness and rational medications prescribing] of the model prescription format. That

sample size was decided to be increased from [384] to three hundred and ninety five [395], so as to cater for any possible exclusions [mainly damaged ones]. None was excluded.

A veteran registered pharmacist of very good experience in community pharmacies job and assessment of different prescriptions, was assigned to checked all the selected prescription for completeness, and rational prescribing, and were further doubled checked by the main researcher.

The prescription elements we mainly checked for were that the prescription must be:
1. Should state the full name, specialty and address of the prescriber, including telephone number.
2. Should give the prescriber's registration number.
3. Should be written in indelible ink.
4. Should be signed by the prescriber him/herself.
5. Should state the full name and address of the individual patient.
6. Should state the age, gender, and weight of the patient [especially for children].
7. Should state the full address of the prescriber, contact address is important [Telephone number].
8. Should give particulars if the prescriber is dentist, veterinarian or otherwise.
9. Should be dated.
10. Should advise number of refills, when applicable.
11. Should be in the prescriber's own handwriting [electronic prescribing can be used when feasible].
12. Should state the name[s] of the medicine [s], its / their strength, dosage form [route of administration], the dose magnitude, frequency of doses, and how expressed, [use as directed is not acceptable], total number of doses, duration of treatment, and 13- Should state the total quantity [amount] of the prescribed medication[s], or the number of dose units to be supplied and the duration of treatment.
13. Should clearly state the medication's use regarding concurrent food intake or otherwise [possible matching, or food-drug interactions].
14. Upon the prescriber's decision, and/ or patient's request and/or agreement, the diagnosis shall be included.
15. The handwritten prescription should be easily legible and clear.
16. Should state if substitution is allowed or otherwise.

17. Should adopt rational use of medications [prescribed solely in generic names, avoid unnecessary poly-pharmacy and excessive unneeded use of both injections and antibiotics].

18. Should be closed by a mark on the space between the last line of prescription text and the prescriber's signature [to secure prescription against any possible amendment or forging].

19. Shall be headed with the historical symbol Rx.

20. Language used, should be understandable to patient, pharmacists and nurse [use of official first language is advisable].

21. Should avoid all forms of drug-interactions as much as possible, and advise and warn patients, accordingly.

22. Should use the metric system, especially in oral liquid and injectable.

23. Should avoid the use of Latin abbreviations.

24. Whether the prescription is from the public or private sectors medical settings.

RESULTS and DISCUSSION

Results were expressed in both frequencies and percentages. Statistical Package for Social Sciences [SPSS] version fifteen [15] was used in the analysis of data. Chi-Square Test was used in cross tabulation. Significance was judged when p, is = 0r less than 0.05. Tables were presented and used to aid understanding of results data.

Table, 1. General Prescription Elements.

Prescription Elements	Frequency Recorded	% age	Missing
The symbol Rx	190	48.2 %	2 [0.6 % missing]
Closing the prescription	123	31.1 %	3 [0.76 %]
Prescription from public medical setting	78	19.8 %	4 [1 %]
Prescription from private medical setting	313	79.4 %	4 [1 %]
Language used English Only	110	27.8 %	-
Language used Arabic Only	3	0.8 %	-
Language used Both English & Arabic	280	70.87 %	-
Prescription was dated	280	71.07 %	1 [0.3 %]
Prescription was Handwritten	332	84 %	1 [0.3 %]
Prescription written in indelible ink	188	47.6 %	-
Prescription was Printed	62	15.7 %	1 [0.3 %]
Handwriting was legible	230 / 332	69.58 %	-
Latin abbreviations used	20	5.07 %	-
Metric system used	140	35.45 %	-
Metric system use in pediatric prescriptions	75	88.2 %	[Total 85]
Prescriber allowed substitution	1	0.3 %	-
Prescriber allowed refills	3	0.8 %	-
Prescriber advised about food intake	53	13.4 %	-
Drug – Interactions detected	5	1.3 %	4 [1 %]

Prescription was signed by prescriber.	303	76.9 %	1 [0.3 %]

The prescription symbol Rx stands for Latin word recipe = to take. [85]It represents the superscription that precedes the inscription. In all our studied prescriptions it was only present in 48.2%. In comparison, it was completely not included in three previous [2006-2014] Sudanese studies about prescriptions.[20, 44, 78]

Out of the 395 studied prescriptions, 19.8% were from the public sector medical outpatients settings, and 79.4% were from the private sector medical settings. Many a times outpatients from public medical settings who fail to find their prescribed medications in the public sector outpatients' pharmacies, [86] usually reside to the private sector pharmacies where medicines are more available. [87, 88] The prescribers used both English and Arabic languages in the studied prescription writing [71.1%], while Arabic alone or English alone were used in 0.8 % and 27.9%, respectively. In Sudan it is legally and conventionally allowed to write prescriptions in both languages, each alone or combined as they are the principal and official languages of the country. English which is the official language of Sudan colonizers [British] is still the dominant language of medicine, in Sudan.[89-91]However, by using English alone [27.9%] in the full prescription text, the medication name and the instructions for the medication use may be completely unknown to the patients who usually keep the prescriptions for ongoing reference.[92-94] That may lead to possible medication errors, as Sudanese pharmacist don't usually counsel patients[20,95-98] and the dispensing time that they allow for patients, according to one study, is extremely short [46.3 seconds].[21]

Moreover, 60.4% of the package inserts of the branded, branded generics, and plain generic medicines, and the outer and inner packs texts of the registered small packs medicines in Sudan, are written in English only. Less than 40% are written in both Arabic [the native language] and English. None of them was written in Arabic only. English is, however, still the main language for medicine education in Sudan.[99, 90,100] Being a legal document, the prescription is supposed to communicate the exact and clear message [instructions] of the prescriber to the pharmacist or nurse without any ambiguity, or omissions. In brief, for the medical prescription to meet its intended purpose, it has to be legible, clear, understandable, dated, signed, complete, and rational in choice of medications. Out of the 394 studied prescriptions, only 70.8% were dated. The date of prescription's issuance is important for the proper and legal documentation and referencing. The date on the prescription greatly decided its validity. Some patients keep the prescription for future use, refill it, when the use of those

prescribed medication might be in appropriate or even dangerous. Same applies for prescriptions containing controlled substances. [101, 102, 20] Three hundred and three 333 [84%], of the total studied [395] prescriptions were handwritten, while only 62[15.7%] were printed. Printed prescriptions were significantly correlated with private sector medical settings [p= 0.022].

As regards the legibility of the hand written prescriptions [230] in all the studied prescriptions, it was [69.58%], of which, 56.8% were written in indelible ink pen, which is strongly recommended, especially when prescribing controlled substances. These results are fairly good. [103, 96] Illegibility of handwritten prescriptions is a worldwide phenomenon. It is worth noting that in 1998 a study in the British Medical Journal [BMJ] reported that, compared to different healthcare professional and administrators, doctors had the worst handwriting! [104,105] The majority of those detected medication errors in prescriptions were primarily due to illegibility, incompleteness, and irrational prescription writing. The poor legibility of handwritten prescriptions may cause loss of basic information, confuses the pharmacists, nurses, patients, and may ultimately compromises the patient's care, at large, or may even lead to death, regardless of the completeness of the prescription.[25, 24, 15, 45, 16] The High rates of illegibility and use of Latin abbreviations may ultimately make it difficult for the pharmacist or nurse to interpret the prescription accurately and correctly.

In this Study Latin abbreviation were used in only 5.1% of the studied prescription. This reflects a positive decision from the prescribers' parts and may help reducing pharmacists' and nurses' possible confusion, promotes patients' safety, and reduces the possibility of medication errors.[16, 45,106] It is worth mentioning that the prescribers are legally liable for any degree of their prescriptions incompleteness, and any possible ensuing harm to patients.[107]

Table, 2. Patients' Demographics Identification Prescription Elements.

Patients' demographic prescription elements	Frequency Recorded	% age	Missing
Patient's full name [3 names]	155	39.2 %	-
Patient's full address, including contact address.	Zero	0 %	-
Sex of patient [Gender]	Zero	0 %	-
Age of patient	10	2.5 %	-
Weight of patient	3	0.8 %	-
Patient's diagnosis	32	8.1 %	-

As shown in Table 2, the highest [91.58%] rates of prescription elements omissions [deficiencies] were recorded in this part [Patients' demographic identification elements], despite their importance.

Patient's full name [3 names], and contact address [including telephone number] are extremely important for any follow up procedure, for example when a wrong medication was handed over [dispensed] to the patient, advise of wrong dose, wrong number of doses, wrong route of administration, and/or for checking on adherence or reminding of due refills. Omission of patient's name and/or address from the prescription is considered to be a serious deficiency. Especially in Sudan, it is advisable to write the full name of the patient[3 names], as names can quite frequently be confused because many do sound alike and due to the dominating Islamic culture, many names dominate [Mohammad, Ahmad, Ali, Mahmoud , Abdurahman, Abdallah, Ibrahim, Osman, Idris, Yousef, Salih, Omer, Mousa, ect.[108-110,18] The patients' weight, especially for children, is pivotal for dose calculation, safe medication management, and monitoring. In Charanil e al, 2015; study results, the weight of patient was omitted in 46% of the studied prescriptions. But still, it is much better than the result of same in our study, where patients' weight was omitted in [99.2%] of prescriptions.[111-114] In developing countries the weights and age of children mostly lack congruence. Then, the weight stands as the most important factor for dose calculation.

Age is an important determinant for dose calculation as children, and particularly the neonates, show different response to medication as compared to adults. It was reported that errors in dose calculation were the most frequently cited. Patient's age is also important in case of elderly patients. Patients' age was omitted in 97.5% in this study.[115,102] Likewise, the patient's gender [Sex], though it is a very important prescription element to record, yet it was completely missing [100%] from all the studied prescriptions.

It is now proven that some drugs react faster and better with females than their male counterparts'. That is mainly referred to difference between males and females in the pharmacokinetics and pharmaco-dynamics, the slower gastrointestinal motility, and renal clearance of medications in females. Moreover, women are proved to encounter more adverse drug reactions than men.[17,116-118] Recording patient's gender is also a very important information for considerations of pregnancy and breast feeding females, as it is the case in multiethnic and multicultural communities.[119, 120, 24,] Patient's diagnosis [indications] which greatly, if not exclusively, decides the selection of the medication course of treatment, was

missing in 91.9% of our studied prescriptions. In one Sudanese study, Yousif et al, 2006; reported that the patient's diagnosis was missing in 94% of the prescriptions they studied. But, Abdellah et al, 2012; reported a very high [85.2%] rate of recording of patient's diagnosis in their studied prescriptions, from pediatric hospitals in Khartoum, Sudan. [20, 44]

Some medications are quite often used for different diseases or ailments [indications], and their dose magnitude [strength], frequencies and duration of treatment course can differ for different diagnosis [indications], e.g. Bevacizumab, Antimycotics, Valsartan, Chloquine, Metroniazole, lisinopril, Dapsone, and Antibiotics. [121]Another example is Metformin, which is used for diabetes type 2, weight loss, and for polycystic ovary syndrome, but with different patterns of doses magnitude and frequencies .This confirms the importance and appropriateness of recording the patient's diagnosis in the prescription.[122-125]

Michael R. Cohen, RPh, MS, ScD, FASHP, president of the Institute for Safe Medication Practices once said "But *putting the diagnosis on every prescription could do wonders for patient safety"*, He even added that: *"Pharmacists are working without enough information,"* *"If we're going to get serious about 100,000 being hospitalized, billions of dollars wasted every year from medication errors, pharmacists need access to lab values, to patient health information, to diagnoses. It is a serious weakness in our health system*".[126] when both the diagnosis and age of the patient are written in the prescription, the dispensing pharmacist or nurse will be able to justify poly-pharmacy or negate its appropriateness. It is worth mentioning that, medications are commonly prescribed for off-label indications [indications unapproved by the regulatory authorities], which are not legalized in all countries. Though it is common [20%], but it entail much of risks, since the rate of side effects is reported to be 44% higher than when the medication is used for its approved indications.[127-129] When the diagnosis is recorded in the prescription, the dispensing pharmacist can easily detect any off-label prescribing, that is not included in the scientific data sheet of that specific medication.[130,129]

Table, 3. Prescriber's Identification Prescription Elements.

Prescribers' Identification Prescription Elements.	Frequency Recorded	% age	Missing
Full name of prescriber	198	50.1 %	-
Specialty	193	48.9 %	-
Full address including Tel. number	149	37.7 %	-
Prescriber's registration number	1	0.3 %	-

Results of prescriber's identification prescription elements [Table, 3] showed that in all the studied prescriptions, omissions [absence] percentage rates average was 65.8%. These omitted prescription elements are important as they confer authority on the prescription and are very important for pharmacists and patients for ordinary or emergency contact of the prescriber, when need arises.[131-133,102,134] The prescriber's telephone number was omitted in 62.2% of the prescriptions. This omission makes it very difficult for both the pharmacist and patient to get quick access to the prescriber for clarification of many important issues related to the medication identification, use or emergency reporting, when need arises. A study from Nigeria, reported that only 13.33% of their respondent doctors endorsed its importance.[102] The prescriber's signature and his/her registration number, are basic and very important prescription elements, as they confer legality, authority, and official mandate on the prescription and the prescriber, alike.[135,136,7,52,137] Sometimes the prescriber's signature itself is illegible, this can lead to some legal litigations for the prescriber, when identified. [138]

The prescriber's specialty showed significant correlation with the use of the metric system [p = 0.005], and prescribers use of injections [p=0.02] respectively.

Table , 4. Prescription Elements of the Inscription part.

Prescription elements	Frequency Recorded	% age	Missing
Name of Medication prescribed	395	100 %	-
Dosage form	343	86.8 %	1 [0.3 %]
Dose Strength	261	66.42 %	2 [0.5 %]
Dose frequency	311	78.74 %	-
Total amount of doses	171	43.3 %	-
Duration of treatment	138	35.03 %	1 [0.3 %]

It is well known that any omissions [average 31.6 %] in this part of the prescription may lead to harmful, or even fatal, medication errors to patients, and may altogether compromise the targeted patients' health outcomes. Fifty [50%] of fatalities due to medication errors mostly occur in people above 60 years. Such serious medication errors mostly stem from:-

1- Improper dose accounting for ……………………………40.9 %

2- Administering the wrong medication……………………16%.

3- Using the wrong route of medication of administration…16%

Fatal medication errors account for 10% of reported medication errors.[139-142]

According to a Sudanese study by Awad and Himad, 2006; the medication strength and the quantity to be dispensed were completely omitted from the prescriptions they studied.[21] The

inscription contains the dosage form and the directions for use of the prescribed medication, [dose, time, frequency and route of administration]. Any omissions in this part of the prescription and/or the use of a language, terminology or abbreviation not easily understandable by the patient may lead to great harm and compromise the targeted patient's healthcare outcomes. Our study results showed that the dose frequency expression by the prescribers was only 54.4%. This is quite deficient. It was reported that the average primary care physician spends less than 60 second discussing the directions for use of the medications prescribed, with patients. [143] accordingly, the patient may at least be partially reliant on what is written in the prescription as regards how to use the medication. His / her knowledge may be very poor especially when he/she is not familiar with language used and when he/she has a low level of general or health literacy, as it the case in developing countries.[144-146]

According to Keith, 1992;*''Indeed, the most useful way to view a prescription product may not be as a tablet or an ointment standing alone , but as a composite , the physical product bonded with the information''*.[147,148]The dosing instructions statement given to patients by prescribers, dispensers and nursing staff, is one of the big issues leading to medication errors. In one study nearly half of the patients did not understand dosing instructions. [149-151]According to Davis et al., *2006"The physician and the pharmacist may assume that their patients can read, understand, and act on brief instructions found on prescription medication labels, but this may not be the case'.*[149,150]

The results of many studies concluded that the dosing instructions to patient, especially those with low health literacy, lower cognitive functions, and/or higher number of medications, should state the number of doses per day and not in hourly timed dosing patterns. In this study, the dose frequency was expressed in times /day in 74.1% and expressed in hours in only 15.2%. [152,153] Pharmacists and physicians shall also avoid tagging medication doses to meals, as poor people, those with special familial gathering arrangement around meal's tables, and those whose jobs keep them moving [long distances trucks or buses drivers], may not be able to strictly keep to fixed meals' times. Even if, then intervals between meals may not be equal. Moreover, scheduling or tagging of doses to meals may elicit food-drug interaction and consequently compromise medication safety and/or effective ness. This issue needs to be carefully studied. Prescribers have to avoid vague dosing intervals like twice daily, every 8 hours etc. They better punctuate dose frequency on morning, midday, and evening which are better known, convenient and most understandable by patients.[154] Researcher advised that

fitting the dose frequency to the individual patient's daily program, most preferred by him/he, is most conducive to understanding, remembering and adhering to the medication dosing regimen. At the same time, the prescribers and pharmacists must give consideration to drug-interactions at large, and the general health status of patient, especially if old[over 60 years] or confused. The relatively high rates of omissions [31.6%] of the studied prescription elements and their level of legibility [69.58%], clearly point to their incompleteness, and relatively poor legibility. Studies from different parts of the world, namely Sudan, Italy, Brazil, The Sultanate of Oman, Nigeria, India, Pakistan, The West Bank, Ethiopia, South East Asian Countries, Bangladesh, Nepal, Egypt and Ghana, reported varying degrees of prescription in completeness. [20, 107-109, 5,102,110, 23, 25, 111, 112, 18,113, 114, 24,115-119]

The inclusion or recording of both the number of doses to be dispensed and the prescribed duration of treatment are basically important for adherence improvement, and the targeted health outcomes. Moreover, the number of doses to be dispensed helps matching to the prescribed duration of treatment and Vice Versa. [108]

Table, 5.Rational Medicines Prescribing and Use, Prescription Elements based on World Health Organization [WHO] Indicators.

Prescription elements	Frequency Recorded	% age	WHO Indicators cut–off-limits
Average number of medicines per prescription	1.22	-	1.6 – 1.8
Average for injectable prescribing	85	21.52 %	13.4 – 24.1 %
Average for Antibiotics prescribing	220	55.7 %	20 - 26.8 %
Average for prescribing in generic name only	207	52.41 %	100 %

As regards the rational medicines' prescribing indicators set by the World Health Organization [WHO], the screened prescriptions of our study had shown clear cut irrationality in two out of four indicators. Those World Health Organization [WHO] recommended standard medication prescribing and use indicators in both public and private sectors medical settings are.

1- Number of medications /prescription ……..1.6-1.8,

2- Antibiotic prescription …………………….20- 26.8%,

4- Injectable medicines ………………………13.4 -24.1 %,

5- Prescribing by generic names and from Essential Medicines List[EML………..100%.[52, 167]

The average number of medications prescribed per prescription in this study is 1.22, even less than the WHO recommendations limit for rational prescribing [optimal is 1.4-1.8]. Compared to the results of four previous [2006-2015] Sudanese studies, where the average prescribed medication per prescription was 2.19, the result of this study reflects rational prescribing,

which will reflect positively on patients' safety which would have been hampered by poly-pharmacy. As known, Poly-pharmacy doesn't only increase the possibility of adverse drug reactions, and drug- interactions, but it may even invites poor or non-adherence, and increases the cost of treatment. The varying rates of poly-pharmacy reported by Dwyer et al, 2010, Rambhade et al, 2012; 40% and 8.73%, respectively were evidently relatively high percentages. [168, 55]

Drug-interactions are closely related to poly-pharmacy.[169]Thus, the average results of those previously mentioned four Sudanese studies, for the four basic WHO prescribing indicators were:

Average number of drugs prescribed/ prescription…………..2.19,

Average for antibiotics / prescription……………………….68.77%,

Average use of injections per prescriptions………………….13.94 %,

Average prescribing in generic names/ prescription ………..45.35%

Safe for the average results of the use of injections which were within limits; all the other three average results exceeded the WHO indicators set limits. Moreover, they all showed clear prevalence of poly-pharmacy in Sudan [2006-2015]. [21, 170, 78, 80]

In comparison, the results of this study showed a very low rate [1.3%] of drug-interactions. We were, however, expecting a higher rate of drug interactions, as Sudanese doctors don't usually take time to counsel patients about the other prescription medications they may be using, or the OTC medications, food supplement and/or herbal medicines which may lead to interactions. One Sudanese study reported that the average clinical encounter duration between the patients and doctors was 4.6 minutes! The small average number of medication per prescription [1.22] might explain the low percentage [1.3%] of drug -interactions result of this study.[21]Add to that, other previous Sudanese studies' results showed a higher prevalence for drug-interactions in the prescribed medications.[171]The results of an unpublished study by Alsaid and Idris, 2016;showed that the total score of correct answers of all participants' doctors in Gezira State, central Sudan, regarding their knowledge of all forms of drug -interactions was very poor [21.5%].With such a low awareness and knowledge of drug-interaction, it was expected that this study will show higher rates. In Wad Medani, Sudan, Yousif et al, 2011;showed that 14.0% of their tested prescriptions contained potentially interacting medications' combinations.[22] Pirmohamed et al [2004] reported that harmful drug–drug interactions are of

special importance as they cause 10–20% of the adverse drug reactions requiring hospitalization, though they are preventable.[172]

Food is known to interact with medications by its physical and chemical [nutrients] contents, as it slows down gastric emptying.[173]when taken with drugs, food is known to lead to many physical and physiological changes that may affect the amount of drug absorbed as it increases the blood flow to the gut, release of bile, and change in the pHof the gut medium. Only 13.5% of the prescriptions in this study contained prescribers' advice about concurrent use of the prescribed medications and food. Drug – interactions detection and correction is one of the core responsibilities of the dispensing pharmacists. The Sudanese pharmacists' knowledge about drug-interaction was reported by some researchers to be poor.[174.175]

Doctors and pharmacists' awareness and knowledge about drug- interactions can greatly minimize risks to patients' safety, quality of live, and avoidance of its economic burden on both the individual patients and their communities, and helps promoting the needed adherence.

The results of this study showed that antibiotics constituted an average of 55.8%of the medications per prescriptions. Compared to WHO optimal recommended rates [20%-26.8%], it is more than double the higher optimal limit. This result strongly confirms the irrational use of antibiotics in Sudan. Compared to results of other previous Sudanese studies [2005-2015], the result of this study points to some improvement in antibiotic use.[176, 80,177,178]The result of an Ethiopian study about antibiotic prescribing rate, [58.1%] is slightly above our study figure for same.[179] Inappropriate use of antimicrobials, when not indicated, their use in lower doses, longer or shorter durations, may mostly lead to increased resistance, which is detrimental to individual patients' health and to their communities, alike. Counterfeit antibiotics circulating in developing countries are thought to contribute substantially to antibiotic resistance as they, at their best, only provide suboptimal doses that contribute to antibiotic resistance. [180]The rate of the emergence of resistant bacteria is well documented in the literature, and is worldwide increasing.[181, 182, 60,183,184]In Sudan the emergence of resistant bacterial strains is mainly due to the excessive use of antibiotics.[185-187] The results of this study clearly confirm the irrational use of antibiotics in Sudan.

As for the use of injection in our study prescriptions, the rate was 21.51% which is almost approaching the WHO recommended upper optimal limit [24.1%], but still not exceeding it. It is a rational move. Compared to the results of four previous Sudanese studies on the unnecessary and excessive use of injections, which showed an average rateof 27.64 %%, while

the WHO indicator optimal is 13.4-24.1%. Those results strongly confirm the irrational use of injections.[74, 21, 79]

Results for the use of antibiotic from one Ethiopian Study [38.1%] were higher than ours.[173] The results of this study showed that prescribing in generic names was [52.5%], while the recommended optimal is 100%, from the approved and adopted ELM. It means that 47.5% of the prescribers were loyal to the brands which they prescribed. That may be attributed to the active but uncontrolled pharmaceutical promotion, as till date there is no law or act governing the ethics of pharmaceutical promotion. It is worth mentioning that the exclusive majority [84%] of the generics in Sudan are registered as branded - generics, of which around 70% are imported. [188, 189] In comparison to the results of generic medicines share in the private sectors of 19 low and middle income countries [70-80%] our results [52.4%] are rather low.[190] A study by Ofori et al; 2016 of medicines prescribed in generic names in eleven[11] sub-Saharan African countries reported an average of 68%., which is higher than the result of our study [52.4%].[191] In England the share of the generics in 2012 was 83.6%.[192] The World Health Organization [WHO] advice for the use of generics is basically after securing the availability, accessibility and affordability of the needed medication for patients in both the developed and developing countries. As health care expenditure is continuously escalating, and the budget for pharmaceutical is equally soaring up, especially in developing countries, generic pharmaceuticals help securing the needed availability, affordability and accessibility of patients to their essential medicines.[64,193] Increased use of generic pharmaceuticals becomes of paramount importance, especially for the developing countries, like Sudan. Generics are worldwide taking over the global market of pharmaceuticals. The Intercontinental Marketing Statistics [IMS Health] research on generic showed that in 2010, when a patent expires, the generics capture 80% of the US market share within just six month; compared to only 55% in 2006.[194] It is worth mentioning that the generic medications are finding a worldwide acceptance and represent an average of around 64.8% [by volume] of the pharmaceutical prescriptions in Germany, The UK, New Zealand, Denmark , Slovak Republic. That is because generics and branded generics pharmaceuticals selected on basis of bioequivalence are same in effectiveness and safety measures to their branded counterparts, but are 20 % - 90% less expensive than their innovator brands counterparts.[195]

According to Mahmoud and Ali, 2013; generic drugs can greatly increase the availability, affordability and appropriate use of medications.[196]Astonishingly enough, physicians fail to

appreciate the cost of medications as an important factor when prescribing expensive originators' brands though patients were reported to have negative attitudes towards generics, despite their availability ,accessibility and affordability.[197,198] Some studies however, showed that doctors do appreciate the basic advantages of generic medications, but are still prescribing them sub-optimally.[199] However, other researchers had reported negative perception of a meaningful proportion of physicians, about generic pharmaceuticals.[200-202]

Worldwide, physicians are under pressure from the pharmaceutical industry promotion, which represent their main source of medication information.[203,204, 99, 205-211] At the same time Health Care Providers [HCPs] especially in developing countries don't have easy access to independent medication information, as the independent drug information centers, themselves, are scanty and lack the well trained, clinically skilled and managerially fit personnel, and adequate budgets.[212,206]More prescribing and use of generics are thought to be associated with increased adherence to therapy, as they offer 30-80% discount in cost compared to their brand name equivalents. This is especially valid for the, poor, the elderly patients, and those patients suffering chronic medical conditions [diabetes, hypertensionect].[213- 215]

Studies from Turkey .Bulgaria, Saudi Arabia, Ireland, Brazil, and Sudan reported negative attitude and perception o of that patients about generic pharmaceuticals and some even equated the low prices of generics to their inferior quality," low price low quality".[216- 223,219] Of interest is that generic names are usually more complicated and harder to remember than brand names which are catchy and more easily remembered and easy in spelling. Examples for difficult to remember generic names include; Methylprednisolone, cyclopentanoperhydrophenanthrene, bevacizumab, dexachlorpheneramine, medroxyprogesterone. Brand names often suggest a characteristic of the drug. E.g. Cotrimoxazole for Septrin, Capoten for captopril, Tenormin for atenolol.

" Vivactil is an antidepressant that might make a person more vivacious, Glucotrol controls high blood sugar [glucose] levels, and Skelaxin relaxes skeletal muscles".[224]

The results of many previous Sudanese studies [1994-2015] showed rather staggering results for generics prescribing. The results showed a range from; 37.2%, 43.6%; 49.3%; 19.5%; 11.8%; 51.2%, which were evidently suboptimal [An average of 42.3%], while the recommended optimal is 100%]. Compared the average of the previous studies, the results of this study [52.4%] showed an improvement in generic prescribing.[224, 225, 74, 21, 162, 78-80] It is

worth mentioning that the prescribers of the 395 studied prescription did not allow for any substitution or otherwise in 99.7% of the prescriptions. Which means dispense as it is.

Though the prevailing Sudanese Pharmacy and Poison Act, and regulations & orders 2001, in its article No.51, strictly stipulates that in all the public health settings, only generic names are to be used in prescribing, dispensing and/or advertising for medications, yet, Trade names were used in an average of [47.59 %] of the prescription in this study.[142] This would mean that Act or law is poorly enacted, as almost one fifth of our studied prescriptions were from public sector medical outpatient settings, which should have been bearing only generic names.[146,226] It is worth mentioning that, the results of this study showed significant correlations between the use of medications' trade names and: the number of drugs per prescription [P= 0.019], the use of the metric system in prescribing [P=0.000], the number of prescribed antibiotics per prescription [p= 0.001], and the legibility of the handwritten prescriptions [p= 0.10], respectively.

The results of this study for the use of the metric system in prescribing for oral liquids medications were 89% [Prescription for pediatric use were 85]. This is a very good and positive result, which reflects the prescribers' awareness and practice, adoption and sticking to the use of the internationally accepted and advised metric system which is the legal standard in Sudan since its independence in 1956.[227,228] According to Cohen M, 2011; doctors, pharmacists, parents and caregivers quite often mix up teaspoons and tablespoon, and milliliters.[229] This confusion may put babies and children at a great risk of medication errors of dose magnitude. The consistent use of the metric system may represent the solution, and is strongly recommended.[230] What makes adoption and use of the metric system in liquid medicines dosing is that almost all small packs in Sudan are accompanied with measuring devices, mainly spoons, calibrated in milliliter [ml]. However, at the same time the pharmaceutical manufacturers of liquid oral medication, safe for very few exceptions, usually advice doses in tea or table spoons!

The importance of the use of the metric system in prescribing is well documented in the literature. When the prescribers and administrators of medication do not use the metric system especially for oral liquid medications that may result in 3-fold increase in medication errors. This is especially valid for parents or caregivers with low health literacy. [231]

As regards notification about substitution and refills, the results of this study showed that only 0.3% and 0.8% of the prescriptions contained an advice about substitution or refills, respectively.

Only 123 [31.2%] of the prescribers closed the prescription to guard against any possible forged additions to the prescribed medicines or the instructions or advice. The use of addictive substances including controlled medicines is on the rise in Sudan, especially among the youth and the university students in particular. Accordingly, all possible precautions should be taken into account to minimize any possible prescriptions' forgeries.[232-234]

CONCLUSION

The results of this study clearly proved that the majority of studied prescriptions [395] were incomplete, not up to the needed level of legibility, and the irrational prescribing of medicines was dominating. However, still an improvement in prescription writing is recorded in this study as compared to the results of previous Sudanese studies of same.

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REFERENCES

1. Kennedy, J.G. Doc, ''tell me what I need to know'' a doctor's perspective. BMJ, 2003; 327[7419]: 862 – 863.

2. Nicolson D, Knapp, P, Raynor DK, Spoor, P. 2009. Written information about individual medicines for consumers. Cochrane Database of Systematic Review Issue 2.Art No: CD 002104.Doi:10.   1002/14651858.CD   002104   pub3.Available   at: www.mrw.interscience.wiley.com/cochrane/clsyrev/articles/CD002104/frame.html. [Accessed 15th June 2016].

3. Conroy NS,McIntyre N J.Pharmacy Therapeutic Subcommittee and the Department of Pharmaceutical Care Guidelines : a systematic review. Drug Saf, 2004; 27: 661-670.

4. Belknap SM, Moore H, Lanzoti SA, Yarnold PR, Getz M, et al. Application of software design principles and debugging methods to an analgesia prescription reduces risks of severe injury from medical use of opoids. ClinPharmacol Therap, 2008: 84[3]: 385-92.

5. Al Shahaibi NMS, Al Said LS, Kini TG, Chitme HR. Identifying Errors in Handwritten Outpatient Prescriptions in Oman. JYP J, 2012; 4: 267-272.

6. Ather A, Neelkantreddy P, Anand G, et al. A study on determination of prescription writing errors in outpatient department of medicine in a teaching hospital. Indian J Pharmacy Pract, 2013; 6: 21-24.Available at: http://www.ijopp.org/article/165.

7. de Vries TPHM, Henning RH, Hogerzeil HV, Fresle DA .Guide to Good Prescribing-A Practical Manual WHO Department of Essential Drugs and Medicines Policy. WHO /DAP/94.11. Available at: Apps.who.int/meicinesdocs/and/jwhozip23e.

8. Hartel MJ, Staub LP, Roder C, Eggli S. High incidence of medication documentation errors in a Swiss university hospital due the handwritten prescription process. BMC Health Serv Res, 2011; 11: 199.

9. British National Formulary. Guidance on Prescribing. British Medical Association [BMA]. Royal Pharmaceutical Society [RPS] of Great Britain. British National Formulary. London.UK: BMA, RPS: PP52, 2006.

10. Medical Council of New Zealand., Good prescribing practice. September 16, 2016. Available at: https://www.mcnz.org.nz/assets/News-and-Publications/Statements/Good-prescribing-practice.pdf.

11. Stevens GE. Illegible handwriting and professional negligence. Med Trial Tech Q, 1981: 424-431.

12. Sanguansank T, Morley MG, Yospaiboon Y, et al. The impact of preprinted prescription forms on medication prescribing errors in an ophthalmology clinic in northeast Thailand: a non-randomized interventional study. BMJ Open,2012;eooo539.doi:10.1136/bmjopen-2011-000539.

13. Mohammad IS, Khan HMS, Akhtar N, et al. Significance of Prescription Elements and Reasons of Prescription Errors in South Punjab, Pakistan. WASJ, 2015; 33[4]: 668- 672. DOI:10.5829/idosi-wasj.2015.33.04.131.

14. Leo P. Tracing the root of illegible handwriting. PPG, 2006.Available at: http://www.post-gazzette.com/pg/06103/681741-294.stm.

15. Borah NC. Doctor's illegible handwriting creating confusion, causing death. The Economic Times. April 20, 2015. Available at: http://health . economictimes.indiatimes.com/health-files/doctor-s-illegi.

16. Samaranayake N. When words can become a matter of life and death. MediScene. The Sunday Times Sri Lanka, 15, May, 2016.

17. Anderson GD. Gender differences in pharmacological response. Int Rev Neurobiol, 2008; 83:1-10.doi:10.1016/S0074-7742 [08]00001-9.

18. Inamdar SZ, Rucha K, Kotnal RB, KulkarniRV,et al. Assessment of Nonconformity to Prescription Writing requirements and Prescription Errors : A Community Based Study. IJOPP, 2014; 7[3]: 36-41.

19. Perwitasari DA,Abror J, Wahayuningsih L. Medication Errors in Outpatients of A Government Hospital in Yogykarta , Indonesia.IJPSRR, 2010; 1[1]: 8-10.

20. YousifE, Ahmed A. M, Abdalla ME, Abdelgadir MA. Deficiencies in medical prescriptions in a Sudanese hospital. EMHJ, 2006; 12[6]: 915-8.

21. Awad AI, Himad HA. Drug –use practices in teaching hospitals of Khartoum State, Sudan. Euro J ClinPharmacol, 2006; 62: 1087-1093.

22. YousifMA , Nizar S , Elmustafa MO, Mustafa MI , Bella MM. Investigation of medication prescribing errors in WadMedani, Gezira, Sudan. Int J Risk Saf Med, 2011; 23[1]: 11-6. Doi: 10.3233/JRS-2011-0520.

23. Tayem YI, Ibrahim MA, Qubaja MM,Shraim RK, et al. Compliance with the guidelines of prescription writing ina central hospital in the West Bank. EMHJ, 2013; 18[9]: 802-806.

24. Biswas M, Roy DN, Islam M, Parvez GMS, et al. Prevalence and nature of handwritten outpatients' prescription errors in Bangladesh. Int J Pharm PharmSci, 2014; 6[5]: 126-130.

25. Albarrak AI, Al RashdiEA, Fatani RK, Mohammed SR,et al. Assessment of legibility and completeness of handwritten and electronic prescriptions. Saudi P J, 2014; 22[6]: 522-527. Doi: 10.1016/j.jsps.2014; 02: 013.

26. Supakankunti S, Yousif BME. Factors Influencing the General Practitioners' Number of Prescribed Drugs in National Health Insurance at Gezira State, Sudan.IJBSSnet.com, 2016; 7[1]: 213-219.

27. Alyamani NA, Hopf Y, Williams DJ. Prescription quality in an acute medical ward. Drug Saf, 2009; 18[12]: 1 158- 1165.

28. Reiedenberg MM. Can the selection and use of essential medicines decrease inappropriatedrug use? Clin PharmacolTher, 2009; 85: 581-3.

29. Adriaenssens N, Coenen S, Tonkin –Crine S , et al. on behalf of the ESAC Project Group. European Surveillance of antimicrobial Consumption [ESAC]: disease-specific quality indicators for outpatient antibiotic prescribing. BMJ QualSaf, 2011; 20: 764-72.

30. Choonara I. rational prescribing is important in all settings. Arch Dis Child, 2013;08:720.doi:10.1136/archdischild-2013-304559.

31. Thompson JE, Davidow LW. A Practical Guide to Contemporary Pharmacy Practice. Third Edition. NewYork, WaltersKlwer/Lippincott Williams& Wilkins; 2009; PP: 5-6.

32. Sudan Medical Council .Sudan National Formulary. 2013. Khartoum. Sudan Currency Printing Press. 2013; 10-13.

33. Akoria OA, Isah AO. Prescription writing in public and private hospitals in Benin City, Nigeria: the effects of an educational intervention. Can J ClinPharmacol, 2008 summer; 15[2]: e295-305.

34. Kumari R, Idris MZ, Bhushan V, Khanna A, et al .Assessment of prescription pattern at public health facilities of Lucknowdistrict. Indian J Pharmacol, 2008; 40[6]: 243-247. Doi:10.4103/0253-7613.45148.

35. Grisinger M, Alghamdi D. Omission of High-Alert Medications: A Hidden Danger. Pa Patient SafAdvis, 2014; 11[4]: 149-155.

36. Shelat PR, Kumbar SK. Analysis of Out Door Patients' Prescriptions According to World Health Organization [WHO] Prescribing Indicators Among Private Hospitals in Western India. JClinDiagnRes, 2015; 9[3]: FC01–FC04.doi:10.7860/JCDR/2015/12724.5632.Epub2015 Mar 1.

37. National Coordinating Council for Medication Error reporting and Prevention. http://www.nccmerp.org/aboutmedErrors.html.

38. Dean B, Vincent C, Schachter M, Barber N. The incidence of prescribing errors in hospitals inpatients: an overview of the research methods. Drug Saf, 2005; 28:891-900.

39. Kuo GM, Phillips RL, Graham D, Hickner JM. Medication errors by US family physicians and their office staff. QualSaf Health Care, 2008; 17: 286-90.

40. Velo GP, Minuz P. Medication errors: prescribing faults and prescription errors. Br J Clin Pharmacol, 2009; 67[6]: 624-628.DOI:10.1111/j.1365-2125.2009; 03425.x.

41. Lewis PJ, Ashcroft DM, Doran T, Taylor D,et al. Exploring the causes of junior doctors' prescribing mistakes; a qualitative study. Br J ClinPharmacol, 2014; 78[2]: 310-9. Doi:10.1111/bcp.12332.

42. Luo J. Handhelds: A cure for illegible prescriptions? Curr Psychiat, 2003; 2[3]: 1-1.

43. Caplan J. Death: Sloppy Doctors. Monday Jan 15, 2007. Available at: http://content.time.com/time/health/article/0,8599,1578074,00.htm

44. Abdellah AE, Abdelrahman SMK. Prescription writing quality in Pediatric teaching hospital in Khartoum .Sudan J Pediatr , 2012; 12[1]: 64-69.

45. Cerio AAP, Mallare NALB, Tolentino RMS. Assessment of the Legibility of the Handwriting in Medical Prescriptions of Doctors from Public and Private Hospitals in Quezon City, Philippines. Procedia Manufacturing, 2015; 3: 90-97. Doi:10.1016/j.promt.07.112.

46. Anonymous .A study of physicians' handwriting as a time waster. JAMA, 1979; 242[22]: 2429-2430.

47. White KB, Beary JF. Letter to the editor: Illegible handwritten records. NEJ Med, 1986; 314[6]: 390-391.

48. Berwick DM, Winikoff DE. The truth about doctors' handwriting: a prospective study. BMJ, 1996; 313: 1657-1658.

49. Lyons R, Payne C, McCabe M, Fielder C, et al. Legibility of doctors' handwriting: Quantitative comparative study. BMJ, 1998; 317: 863-844.

50. Reich MR, Essential drugs economic and politics in international health. Health Policy, 1987; 8: 39 – 57.

51. Tucker V. Drugs and Distortion of Health Priorities in developing countries. Trocaire Development Review, 1990: 87 – 104.

52. WHO, action program on essential drugs. How to investigate drugs use in health facilities .Geneva, Switzerland: WHO; 1993: 9-31.

53. Khan M, Ara N. Promoting rational prescribing among medical practitioners. Bangladesh Med J, 2014; 40[2]: 6-7.

54. World Health Organization [WHO].The Rational Use of Drugs: report of the conference of experts, Nairobi, 25-29 November1985.Geneva: World Health Organization; 1987.

55. RambhadeS, Chakarbooty A, Shrivasrtava A,Patil UK,et al. A Survey on Polypharmacy and Use of Inappropriate Medications.ToxicolInt, 2012; 19[1]: 68-73.

56. Salwe KJ, Kalyansundaram D.A Study on Polypharmacy and Potential Drug-Drug Interactions among Elderly Patients Admitted in Department of Medicine of a Tertiary Care Hospital in Puducherry. J ClinDiagn Res, 2016 Feb; 10[2]: FC06–FC10.

57. Laxaminarayan R, Duse A, Wattal C, Zaidi K, et al. Antibiotic resistance – the need for global solution. WWW.thelancet.com.Infection, 2013; 13[12]: 1057–1098, DOI: http://dx.doi.org/10.1016/S1473-3099[13]70318-9.

58. Johnson AP, Woodford N. Global spread of antibiotic resistance: the example of New Delhi metallo –B – Lactamase mediated Carbapenem resistance. J Med Microbiol, 2013; 62:499-513. Doi: 10.10991/jmn.0.052555.

59. Elsiddi HA. Irrational use of antibiotics among people residing in Almamoura. SJPH, 2010; 5[1]: 50-53.

60. Ventola CL. The Antibiotic Resistance Crisis. PT, 2015; 40[4]: 277-283.

61. Choi KH, Park SM, Lee JH, Know S, et al. Factors affecting the prescribing pattern of antibiotics and injections. J Korean Med Sci, 2012; 27[2]: 120-127. Doi:10.3346/jkms.2012.27.2.12.

62. Haas J S, Phillipis KA, Gerstenberger EP, Seger AC. Potential Savings from Substituting Generic Drugs for Brand-Name Drugs: MEPS, 2005; 142[11]: 891—897.

63. Borger C, Smith S, Truffer C, Keehan S, Sisko A, Poisal J, Clemens MK. Health spending projection through 2015: changes on the horizon. Health Aff, 2006; 25[2]: w61-w73.

64. Hassali MA, Alrasheedy AA, Mc Clachlan A, Nugyen TA,et al.The experience of implementing generic medicines policy in eight countries : A review and recommendations for a successful promotion of generic medicines use. Saudi Pharm J, 2014 In press .doi:10.1016/jsps.2013.12.017.

65. WHO medicines strategy: framework for action in essential drugs and medicines policy 2000-2003, Geneva, World Health Organization, 2000 [WHO/EDM/2000.1].

66. Annual Pharmaceutical Statistical Report. Sudan: MOH; 2006-2007.65-WHO medicines strategy: framework for action in essential drugs and medicines policy 2000-2003, Geneva, World Health Organization, 2000 [WHO/EDM/2000.1].

67. Millar TP, Wong S, Odeima DH, Bero LA. Applying the Essential Medicines Concept to US Preferred Drug List. Am J Public Health 2011; 101: 1444-1448? Doi:10.2015/AJPH/2010.300054.

68. Kanavos P. Do generics offer significant saving to the UK National Health Service? CurrMedRes Opin, 2007; 23[1]: 105-116.

69. Holloway K, van DijkL. The World Medicines Situation 2011, Rational Use of Medicines. World Health Organization.

70. Guthrie B, Makubate B, Hernandez-Santiago V, Dreischulte T. The rising tide of polypharmacy and drug-drug interactions: population database analysis 1995-2010. BMC Medicine, 2015; 13: 74DOI:10.1186/s12916-015-0322-7.

71. Bbosa, G., Mwebaza, N., Odda, J., Kyegombe, D. and Ntale, M. Antibiotics/antibacterial drug use, their marketing and promotion during the post-antibiotic golden age and their role in emergence of bacterial resistance. Health, 2014; 6:410-425. Doi: 10.4236/health.2014.65059.62:1087-1093.

72. Awad AI, Ball DE, Altayeb IB. Improving rational Drug use in Africa: the example of Sudan. EMHJ, 2007; 13[5]: 1202-11.

73. Cheraghali AM, Idries AM. Availability, affordability, and prescribing pattern of medicine in Sudan.Pharm World Sci 2009; 31[2]: 209-15.doi:10.1007/s11096-009—9282-3.Epub2009Mar5.

74. Alfaki ASMH. Assessment of antibiotic prescription in hospitalized patients at Alobeid hospital, Sudan. SJMS, 2009: 4[3]: Available at: http://www.ajol.info/index.php/sjms/article/view/48321

75. Salih MS, Eltayeb IB, Awad AL, Dafa AMA, Ahmed MB, Ogail MA, et al; Assessment of the drug therapy for sexually transmitted diseases in the White Nile State-Sudan.SudanJMS , 2011; 6[4]: 257-260.

76. Hussein L, Elkheir HK. The Impact of Drug Promotion Practices on Health Professional Prescribing in Teaching Hospitals, Khartoum State. SJRUM, 2012; 8-9.

77. MustafaIMA.The pattern of medicine use in Sudan: A cross- sectional study at National Health Insurance Fund setting, in 2012. TropEd Master Programme in International health, July 2013.

78. Mahmoud RK, Kheder SI, Ali HM. Prescribing rationality in Khartoum state, Sudan: An update.Sudan Med Monit, 2014; 9[2]: 61-65.

79. Atta ElmannanA ,Almardi KA, Idris YA, Spector JM , et al. Anti-malarial prescribing practices in Sudan eight years after introduction of artemissinin-based combination therapies and implications for development of drug resistance. BMC Pharmacol Toxicol, 2015; 16:3 doi: 10.1186/s40360-015-0002-4.

80. Ahmed FMO. Evaluation of prescribing pattern in pediatric out-patient at Albuluk pediatric hospital [Sudan].IJIPSR, 2015; 3[4]: 244-252.

81. Ibrahim Y, Sultan R, Abd Alatif KB, Al-Abed AA, et al. Poor adherence to antiretroviral therapy as associated factors among people living within Omdurman city, Sudan. MJPHM, 2014; 14[1]: 90-101.

82. Lesar TS, Bricel and L, Stein DS. Factors related to errors in medication prescribing. JAMA, 1997; 277: 312–7.

83. Dobrazaneski S, Hammoud I, Khan G, HoldsworthH. The nature of hospital prescribing errors.Br J Clin Govern, 2002; 7: 187-193.

84. Aronson JK. Medication errors: definition and classification.Br J Pharmacol, 2009; 67[6]:599-604. Doi:10.1111/j.365-2125. 2009. 03415.x.

85. Lewis VA. Prescription writing and drug regulation. Pharmacology and Therapeutics for dentistry.in: Yogiela JA, Dawod FJ, Neidle EA.5^{TH}ed; Mosby Publishers ,2005; 865-79.

86. Elhassan SM, Elhassan GO, Alfadl AA, Sirelkhatim SA, et al. Evaluation of Drug Affordability in Khartoum State, Sudan . J Pharmacovigil, 2016; 4; 191. doi;10.4172/2329-6887.1000191.

87. Musa MYA. Medicines Prices, Availability and affordability in Sudan. Partial fulfillment of M. Sc of health economics and health care management, Chulalongkorn University, Bangkok, Thailand, May 11, 2013.

88. Kherder SI, Ali HM. Evaluating medicines prices, availability, affordability and price components in Sudan. Sudan MedMonit, 2014; 9[1]: 19-30. DOI: 10.4103/1858-50000.144655.

89. Sandell L. English Language in Sudan: A History of its teaching & Politics [Sudanese Studies], December, 1982. London. It hacapress.

90. Ahmed AM. Medical Education in Sudan. Emerging Issues and Acute Needs. SJPH, 2012; 7[2]: 5664.

91. Babikr HBO, Ahmed ME, Osman WN .English language level in relation to academic performance among undergraduate medical sciences students at Karari University. IJRSR, 2016; 7[1]: 8306-8311.

92. Twedt EL. How language barriers can affect safe medication use. Safe Medication. Available at: http://www.safemedication.com/safemed/PharmacistsJournal/Language.

93. Singleton, K., Krause, E. "Understanding Cultural and Linguistic Barriers to Health Literacy" OJIN: Online J Issues Nurs, 2009; 14[3], Manuscript 4.DOI: 10.3912/OJIN.Vol14No03Man04.

94. Okrainec K, Booth GL, Hollands S, Bell CM. Impact of Language Barriers on Complications and Mortality among Immigrants with Diabetes: A Population-Based Cohort Study. Diabetes Care, 2015 Feb; 38[2]: 189-196. http://dx.doi.org/10.2337/dc14-0801.

95. Wolf MS, Davis TC, Shrank W. A critical review of FDA –approved Medication Guide. Pat Educ Council, 2006; 62: 316-322.

96. Wolf MS, Shekelle P, Choudhry NK,Agneu- Blais J, Parker RM, et al. Variability in Pharmacy Interpretation of Physician Prescriptions. Med Care, 2009; 47[3]: 370- 373. Doi: 10.1097/MLR.0B013e3181af 91a.

97. Ibrahim A, Scott J. Community pharmacists in Khartoum State, Sudan: their current roles and perspective on pharmaceutical care implementation. Int J ClinPharmacol, 2013; 35: 236.doi: 10.1007/s11096-012-9736-x.

98. Ballal RE, Elkhawad AO. Awareness of Community Pharmacist and Patients about the Drug Related Problems. WJPPS, 2015; 4[11]: 143-166.

99. Idris KAMA, Yousif MA, Elkhawad AO. Medication package inserts' usefulness for Sudanese pharmacists and patients: pharmacists' perspective. IJBCP 2014; 3[5]: 884-888. Doi: 10. 5455/2319-2003.ILBCP, 20141032.

100. Paul LM, Simon GF, Fenning CD. Ethnologue: Languages of the world, Nineteenth Edition, 2016. Dallas, Texas: SIL International. ISBN-13:978-1556714023, ISBN-10:1556714025.

101. Christensen B. How to write prescriptions clearly and concisely.PCON,February , 1997.Available at: http://www.healio.com/optometry/therapeutics/news/print/primary-care.

102. Ajoke AB, Christina EU. Study of completeness of prescriptions in pediatrics emergency section of a tertiary hospital in Lagos, Nigeria.JAPS, 2013; 3[5]: 75-79. DOI: 10.7324/JAPS.2013; 3514.

103. Whitburn S. Consultation skills-writing the perfect prescription, 23 July 2009.Available at: www.g poline.com/consultation-skills-writing-perfect prescription/article/921305.

104. Lynos R, Payne C, McCabe M, Fielder C. Legibility of doctors' handwriting: quantitative comparative study. BMJ, 1998; 317: 863-844.

105. Arshaid YM , Al Homrany M, Hamadi A, Adjepon-Yamoah KK, et al. Comparison with good practice in prescription writing at outpatient clinic in Saudi Arabia. EMHJ, 2005; 11[5-6]: 922-8.

106. Anderson L. Medical Abbreviations on Pharmacy Prescriptions. Drugs.com, Jan 05, 2016. Available at: http://www.drugs.com/article/prescription-abbreviations.html.

107. Judith G.Edersheim J.D, Stern TA. Liability Associated With Prescribing Medications. Prim Care Companion J Clin Psychiatry. 2009; 11[3]: 115–119.

108. Teichman PG, CaffeeAE. Prescription Writing to Maximize Patient Safety. FamPractManag, 2002 Jul-Aug; 9 [7]: 27-30.

109. Alam K, Mishra P, Parbhu M, Palaian S, et al. A study on rational drug prescribing and dispensing in outpatients in a tertiary care teaching hospital of WestrenNepal,. Kathmandu Univ Med, 2006; 16: 436-443.

110. Fernández-Liz E, Modamio P, CatalánA, Lastra C F,et al. Identifying how age and gender influence prescription drug use in a primary health care environment in Catalonia, Spain.Br ClinPharmacol, 2008;65[3]: 407-417. doi: 10.1111/j.1365-2125.2007.03029.x.

111. Cella M, Knibbe C, Danhof M, Pasqua OD.What is the right dose for children? Br J ClinPharmacol, 2010 Oct; 70[4]: 597–603.doi: 10.1111/j.1365-2125.2009.03591.x.

112. Medication Errors: Significance of Accurate Patient Weights. Pa Patient SafAdvis, 2010; 7[3]: 112.

113. Charanil E, Gharbil M, Hickson M, Othman S, et al. Lack of weight recording in patients being administered narrow therapeutic index antibiotics: a prospective cross-sectional study. BMJ Open, 2015; 5:e006092 doi: 10.1136/bmjopen-2014-00609.

114. Pan S-D, Zhu LL, Chen M, Xia P, Zhou Q. Weight –based dosing in medication use: what should we know. Patient Prefer Adherence, 2016; 10: 549-560.

115. How to ensure patient safety in drug dose calculation. Nurs Times, 12 October, 2012. Available at: http://www.nursingtimes.net/how -to--ensure-patient-safety-in-drug-do.

116. Whiteley H P, Lindsey W. Sex –Based Differences in Drug Activity. AmFamPhys, 2009; 80[11]: 1254-1258.

117. Carrasco-Portugal M C. Flores-Murrieta FJ. Gender Differences in the Pharmacokinetics of Oral Drugs. PharmacolPharm, 2011; 2: 31-41 doi:10.4236/pp.2011- 21004.

118. Ratto N. Know How. The FDA Blog. Taking Gender into Account in Drug Metabolism and Dosing. Corporate Perspective, FDA, 2014.

119. Soldin OP, Chung SH,Mattison DR. Sex differences in drug disposition. J Biomed Biotechnol , 2011;2011:187103. doi: 10.1155/2011/187103.

120. Bartkowiak-Wieczorek J, Kujawski R, Ozarowski M, et al. Gender-specific implications for pharmacology in childbearing age and in postmenopausal women.GinekolPol , 2015;86: 143-149. DOI: 10.17772, gp/2002.

121. Carrol A.OneDrug, Many Uses. Biotechnol Health, 2005; 2[50]; 56-61.

122. Rojas LBA, Gomes MB. Merformin: an old but still the best treatment for type 2 diabetes. Diabetol & Metab Syndr, 2013; 5[1]: 6. DOI: 10.186/1758-5996-5-6.

123. Gebhart F.OIG calls for diagnosis information on prescriptions. Drug Topic, 2012.Availableat:http://drugtopics.modernmedicine.com/drug topics/news/modernmedicine/modern-medicine-news/oig-calls-diag.

124. O'Shea T. 10 Surprising Off-Label Uses for Prescription Medications. Pharmacy Times, January 05, 2016.

125. Eguale T, Buckeridge D, Verma A, Winslade NE , et al. Association of off-label drug use and adverse drug events in adult population.JAMA Inter Med,2016 ;176 [10;55-63.

126. Stafford R. Regulating Off-Label drug Use- Rethinking the Role of the FDA. NEJ Med, 2008358: 1427-1429.

127. Dresser R, FraderJ. Off-label Prescribing: a call for Height end Professional and Governmental Oversight. J Law Med Ethics, 2009; 37[3]: 476-396. DOI: 10.1111/J-1748X.2009.00408.X.

128. Haiiar J, HabraMA, Naing A. Metformin: an old drug with new potential. Expert OpinInvestig Drugs, 2013; 22[12]: 1511-1517. http://dx.doi.org/10.1517/13543784.2013. 833604.

129. Ogbru O. Marks J. Indications for drugs [uses], approved VS Nonapproved. MedicineNet.Com, 2014. Available at:
    http://www.medicinenet.com/script/main/art.asp?articlekey=20732.

130. Jang D, Lee S, Lee J, Kim K, Lee D. Inferring new drug indications using complementarity between clinical disease signature and drug effect. J Biomed Inform, 2016; 59:248-257. http://dx.doi.org/10.1016/j.jbi.2015;12: 003.

131. General Prescribing Guidance. Patient. Available at: http://patient.info/pdf/462.pdf.

132. Engen RM, Marsh S, Van Booven DJ, McLeod HL.Ethnic differences in pharmaco-genetically relevant genes.Curr. Drug Targets, 2006; 7[12]:1641-8.

133. Allen RV. Remington. An introduction to pharmacy. London. Pharma Press, 2013.pp: 385-388.

134. Kumar S, Haider S, KashyabV,Singh SD. A study on patterns of prescription writing practices at Rajendra Institute Medical Sciences, Ranchi. Indian J PrevSocMed; 2014; 45[1-2]: 100-104.

135. Ibrahim SO, Mahmoud AS, Yahia AY. Republic of Sudan, Federal Pharmacy & Poisons Board. The Pharmacy & Poisons Act, and Regulations& Orders, Khartoum; 2008, PP 7-9.

136. Anderson SO, Beurling C. Prescriptions, prescription-writing errors and patient safety. UgeskrLaeger, 1997; 159: 1454-8.

137. Panchbhai A. Rationality of Prescription Writing. IJPER, 2013; 47[4]: 7-15.DOI:10.5530/ijper.47.4.2.

138. Charatan F. Family compensated for death after illegible prescription. BMJ, 1999; 319: 1456.

139. Phillip J, Beam S, Brinker A, Holoquist C, et al. Retrospective Analysis of Mortalities Associated with Medication Errors. Am J Health SystPharm, 2001; 58[1]: 1835-41.

140. Roy V, Gupta P, Srivastava S. Medication Errors: Causes & prevention. Health Administrator, 2005; XIX [1]: 60-64.

141. Aronson JK.What they are, how they happen, and how to avoid them. QJ MED, 2009; 102: 513-521.DOI:10.1093/qjmed/hcp.052.

142. Jane JA, Carthey J,Cope J, Pitt M. Medication Errors :Causes , prevention and reduction. Br J Haematol, 2002; 116[2]: 225-265.DOI:10.1046/j.1365-2141. 2002; 03272.x.

143. Wilkins S. Patient non- adherence – A rational reaction to sub-optimal physician –patient communication. The doctor weighs in 2014.Available at: doctorsweighsin.com/patient-non-adherence-rational –reaction/.

144. Graham S, Brookly J. Do Patients Understand? Perm, 2008; Summer; 12[3]: 67–69.

145. Perera T, Ransinghe P, ConstatineGR.Knowledge of prescribed medication information among patients with limited English proficiency in Sri Lanka.BMC Res Notes,2012; 5: 658 doi:10.1186/1756-0500-5-658.

146. Nair SC, Satish KP, SreedharanJ, Ibrahim H. Assessing health literacy in the eastern and middle-eastern cultures. BMC Public Health, 2016; 16[1]: 831-838. DOI: 10.1186/s12889-016-3488-9.

147. Keith A. The benefits of pharmaceuticals promotion: An economic and health perspective. In: Promotion of Pharmaceuticals Issues trends, options [Pathak, D.S.: Escovitz, A. ; Kucukarslan, S.], eds; The Haworth Press. Binghamton: 1992; 121 – 133.

148. Warner A, Menachemi N, Brooks RG. Health literacy, medication errors and health outcome: is there a relationship? Hosp Pharm, 2006; 41: 542-551.

149. Metlay JP, Cohen A, Polsky D, Kimmel SE, Koppel R, Hennessy S. Medication safety in older adults: home-based practice patterns. J Am Geriatr Soc. 2005; 53: 976-82.

150. Davis TC, Federman AD, Wolf MS, Lopez A, et al. Improving   Patient Understanding of Label Instructions. J Gen Intern Med 2009; 24 [1]: 57-62.

151. Bailey SC, Wolf MS, Lopez A,et al. Expanding the Universal Medication Schedules : a patient –centered   approach.   BMJ Open 2014; 4:e003699.doi:10.1136/bmjopen-2013-003699.

152. Marvanova M, Roumie C, Eden SK, Kripalani S, et al. Health Literacy and Medication Understanding   among Hospitalized Adults. J Hosp Med, 2011; 6 [9]:488-493. Doi:10.1002/jhm.925.

153. TerefeA, Chanie T. Assessment of patients misunderstanding of dosage regimen instructions among adolescent and adult outpatients in Ethiopia: The case of a primary hospital. IJPSR, 2014; 5[8]: 446-453.

154. USP NF 37-32 General Chapter <17>, Prescription Container Label, 2014.

155. Gimenes FRE, Teixera TCA, Silva AEBdC, Optiz SP, et al. Influence of the writing of the medical order on the administration of medications at the wrong schedule time. Acta Paul Enferm, 2009; 22[4]: 380-4.

156. Calligaris L, Panzera A, Arnoldo L,Londero C, Quattrin R, et al. Errors and omissions in hospital prescriptions : A survey of prescription writing n a hospital. BMC Clin Pharmacol, 2009; 13 [3]; 9:9.doi: 10.1186/1472-6904-9-9.

157. Mendonca JM, Lyra DP, Rabelo JS,Siqueira JS, Balisa-Rocha BJ, et al. Analysis and detection of dental prescribing errors at primary health care units in Brazil. Pharm World Sci, 2010; 32:3035.

158. Sunitha J, Raja SW, Parthiba S, Azharuddin SM, et al. Assessment of prescriptions for its completeness in India-A Prospective Study. Int J Pharmacother, 2013; 3[1]: 34-38.

159. Dharmadikari S, Jaju J, Pawar G, Funde F ,et al. Retrospective analysis of completeness and legibility of prescription orders at a tertiary care hospital. Nat J Physiol Pharm Pharmacol,2014; 4[2]: 165-167.

160. Raz UA, Khursheed T, Irfan M. Abbas M, Irfan UM, et al. Prescription patterns of general practitioners in Peshawar, Pakistan. Pak J Med Sci, 2014; 30[3]: 462-465.

161. Dyasanoor S, Urooge A. Insight into quality of prescription writing .An institutional study. J Clin Diagn Res, 2016: 10[3]:ZC61-ZC64. DOI:10.7860/JCDR/2016/18011.7472.

162. Kebede TM, Kassie GM. Assessment of Prescribers' Adherence to the Basic Standards of Prescription Order Writing in Jimma University Specialized Hospital, Southwest Ethiopia. The Experiment, 2014; 19[1]: 1316-1329.

163. Nesar S, Shoaib MH, Rahim N, Iffat W. Prescription Writing Practices and Errors in Prescriptions Containing Cardiovascular Drugs Especially ACE Inhibitors in Karachi, Pakistan. AJPCR, 2015; 8[4]: 53-55.

164. Salmasi S, Khan TM, Hong TH, Minig LC, et al. Medication errors in Southeast Asian Countries: A systematic Review. PloSONE, 2015; e0136545. Doi:10.1371/journal.pone.0136545.

165. Haque MU, Abdul Barik SM, Bashar S, Islam R, et al. Errors , omission and medication patterns of handwritten outpatient prescription in Bangladesh : a cross-sectional health survey. JAPS, 2016; 6[6]: 42-46. DOI;10.7324/JAPS.2016.60608.

166. Devine B. Bad Writing, Wrong Medications. Patient Safety Network [PSNet], 2010.Available at: http://psnet.ahrq.gov/webmm/case/215/bad-writing-wrong-medication.

167. Fadare JO, Agboola SM, Alabi R. Quality of Prescriptions in a Tertiary Care Hospital in South-West Nigreia.JAPS, 2013; 3[9]: 81-84. DOI;10.7324/JAPS.2013.3915.

168. Dwyer LL, Han B, Wood well DA, Rechtsteiner FA. Poly pharmacy in nursing home residents in the United States: results of the 2004 National Nursing Home Survey. Am J Geriatr Pharmacother, 2010; 8[1]:63-72. doi: 10.1016/j.amjopharm.2010; 01: 001.

169. World Health Organization and University of Amsterdam. How to investigate the use of medicines by consumers, Geneva, Switzerland: World Health Organization and University of Amsterdam; 2004.

170. Ahmed AM, Awad AI. Drug use practices at pediatric hospital of Khartoum State, Sudan. Ann Pharmacother, 2010; 44[12]: 1986-30.

171. Mudawi MME, Babiker SK, Khalil EN, Yassin AYA. Evaluation of drug interactions in renal failure centers. IJPPDR, 2014; 4 [1]: 4-7.

172. Primohamed M, James S, Meakin S, Green C, et al. Adverse drug reactions as a cause of admission to hospital: prospective analysis of 18820 patients. BMJ,2004;329:15.http://dx.org/10.1136/bmj.329.7456.15

173. McLachlan A, Ramzan I. Meals and Medicines. AustPrescr, 2006; 29: 40-2. DOI:10.18773/austprescr.2006.026.

174. Mohamed SS, Mahmoud SS, Ali AA. Sudanese community pharmacy **practice** and its readiness for change to patient care. Int JPharmPract, 2014; doi:10.1111/IJPP.12156.

175. Ali AA, AbdallahAA. Evaluation of attitude of the community pharmacists toward warfarin interactions. Sudan Med Monit, 2014; 9[1]: 35-28

176. Elsalahi SH, MudawiMME , Ahmed AAE. Evaluation of prescribing patterns in primary health care centers of Khartoum State, Sudan.Int J of Advin Pharm Sci, 2014; 5[4]: 2242-2247.

177. Hamdan HZ, Kubbara E, Adam I. Urinary tract infections and antimicrobial sensitivity among patients at Khartoum ,Sudan. Ann ClinMicrobiolAntimicrob , 2015; 14:26.DOI 10.1186/s 12941-015-0082-4.

178. Khalid FA, Hamid ZA, Mukhtar MM. Tuberculosis drug resistance isolates from pulmonary tuberculosis patients ,Kassala State , Sudan.Int JMycobact, 2015;4[1]:44-47.doi:10.1016/j.ijmyc.20.

179. Desalegn AA. Assessment of drug use pattern using WHO prescribing indicators at Hawassa University teaching and referral hospital, South Ethiopia: a cross-sectional study. BMC Health Serv. Res, 2013; 13:170. Available at: http://www.biomedcentral.com/1472-6963/13/170.

180. Abubakar EMM. Antimicrobial susceptibility pattern of pathogenic bacteria causing urinary tract infections at specialists hospital, Yola , Adamawa state, Nigeria. J Clin Med Res 2009; 1 [1]:1-8.

181. Reardon S. Antibiotic resistance sweeping developing countries. Nature, 2014; 509:141-142.

182. Swan L. Is over-prescribing really to blame for antibiotic resistance? MultiBriefs, 2014.Available at: exclusive.multibriefs.com/content/is-overprescribing-really-to-be – blame-for-antibiotic-resistance/food-beverages.

183. Pullen LC. Alarming Antibiotic Resistance Discovered in China. Medscape October, 26, 2016. Available at: http://www.medscape.com/viewarticle/854711.

184. Liu YY, Wang Y, Walsh TR,ZihangR,et al. Emergence of plasmid-mediated colistin resistance mechanism MCR-1 in animals and human beings in China: a microbiological and molecular biological study.Lancet Infect Dis,2016; 16[2]: 161–168. DOI: http://dx.doi.org/10.1016/S1473-3099[15]00424-7

185. Mekki AH, Hassan AN,ElsayedDM. Extended spectrum beta lactamase among multidrug resistant Escherichia coli and Klebsiellaspecies causing urinary tract infections in Khartoum .J Bacteriol Res, 2010; 11[3]: 18-21.

186. Kheder SI.Cephalosporin usage and resistance trends in Sudanese surgical wards. J Pharm BiomedSci, 2011;11[3]: 1-7.

187. Elhag KM. Diversification of antibiotics as a means to control antimicrobial resistance and improve treatment options in Sudan. Sudan Med J, 2013; 49 [3]: 128- 135.

188. Nur AO, Mahmoud AB, Osman ZA, Abdelmageed ME. Implementation of Bioequivalence Studies for Approval of Generic Drug Products in Sudan: Current Status. WJPPS , 2015; 4[9]: 77-88.

189. Babar ZU, Stewart J, Reddy S, Alzaher W, et al. An evaluation of consumers' knowledge, perceptions and attitudes regarding generic medicines in Auckland. Pharm World Sci. 2010; 32[4]:440–448.doi: 10.1007/s11096-010-9402-0.Epub201.0 Jun18.

190. Kaplan WA, WirtzVJ , Stephens P. The Market Dynamics of Generic Medicines in the Private Sector of 19 Low and Middle Income Countries between 2001 and 2011: A Descriptive Time Series Analysis .PLoS ONE, 2013; 8[9]: e74399. doi:10.1371/journal.pone.007439.

191. Ofori – AsensoR,Brhlikova R, Pollock AM.Prescribing indicators at primary health centers with the WHO African region: A systematic Analysis [1995-2015].BMC Public Health, 2016;724.DOI:10.118/S 12889-016-3428-8.

192. Moe-Byrne T, Chambers D, Harden M, McDaid C.Behavior change interventions to promote prescribing of generic drugs: a rapid evidence synthesis and systematic review. BMJ Open, 2014;4:e004623.doi:10.1136/bmjopen-2013-004623.

193. Mousa MME, Idris KAMA. Patients knowledge , attitude and perception about generic pharmaceuticals in KhartoumNorth , Town center, Sudan.WJPR,2016;5[4]:410429.DOI:10.20959/wjpr2016-6015.

194. Brendt ER. Brand loyalty, generic entry and price competition in pharmaceuticals in the quarter century after 1984 Waxman –Hatch legislation.Sptember 9, 2010. Available at: https://faculty.fuqua.duke.edu/~dbr1/pharma/Berndt-Aitken.pdf.

195. El Attug M, Ammar A, Ben Ahmed A, Alborawy H et al. Pharmaceutical assessment of five different generic brands of prednisolone tablets in Lybian market.WJPR,2015; 4 [10] : 1-18.

196. Singal GL, Nada A, Kotwani A. A Comparative evaluation of price and quality of some branded versus branded-generic medicines of the same manufacturer in India. Indian J Pharmacol,2011;43[2]:131-136.doi:10.4103/0253.7613.77344.

197. Mahmoud RK, Ali HM. Analysis of price discrepancies and its impact on rational use ofmedicines.Sudan Med Monit, 2013; 8: 189-193.

198. Piette R, Heisler M, Wagner TH. Cost-related medication under use; do patients with chronic illness tell their doctors? Arch Intern Med 2004;164; 1749-55.

199. Bate R, Jin GZ, Mathur A, Attaran A. Poor quality drugs and global trade.NBER, 2013; 25[8]: 20-29.

200. El-Dahiyat F, Kayyali R, Bidgood P. Physicians' perception of generic and electronic prescribing : A descriptive study from Jordan. J Pharm Policy Pract, 2014;7:7 Available at: http://www.joppp.org/content/7/1/7.

201. Lagarce L, Lusson-Brisset C, BruhatC,Diquet B, Laine-CessacP.How practitioners view generic drugs: an opinion study from general practitioners in Maine-et-Loire, France.Theralie , 2005; 60[1]: 67-74.

202. Shrank WH, Liberman JN, Fischer MA, Girdish C, et al. Physician perception about generic drugs. Ann Pharmacotherapy, 2011; 45[1]: 31-8.doi:10.1345/aph.IP 389. Epub 2011 Jan 4.

203. Zaoui S, Hakkou F, Filali H. Generic drugs in Morocco ; survey of physician.Therapie, 2011; 66[6]: 499-506. DOI:http://dx.doi.org/10.2515/therapie/2011067.

204. Vancelik S, BeyhunN,Acemoglu H ,Calikoglu O. Impact of pharmaceutical promotion on prescribing decision of general practitioners in Eastern Turkey. BMC Public Health, 2007; 7: 122 doi: 10.1186/1471-2458-7-1.

205. Taneja G. Impact of pharmaceutical industry promotion mix on doctors prescribing behavior. Asia – Pac Bus Rev, 2008; 4[4]: 83-95.

206. Spurling GK, Mansfield PR, Montgomery B D,Lexchin J, et al. Information from pharmaceutical companies and the quality, quantity, and cost of physicians' prescribing: A Systematic Review.PLoS Medicine 2010; 7[10]: e1000352.

207. Oshikoya KA,Orgeaba I, AdeymiO.Sources of drug information and their influence on the prescribing behavior of doctors in a teaching hospital in Abadan, Nigeria. Pan Afr Med J, 2011; 9:13.

208. Alssageer MA, Kowalski SR.Doctors' opinion of information provided by Libyan pharmaceutical company representatives'. Libyan J Med. 2012; 7: 19708- http://dx.doi.org/10.3402/ljm.v7i0.19708.

209. Jamshid SQ et al. Perception and attitude of general practitioners regarding generic medicines in Karachi, Pakistan : A questionnairebased study. South Med Rev, 2012; 5[1]: 22-30.

210. Narendran R, Narendranathan M. Influence of pharmaceutical marketing on prescription practices of physicians.JIMA, 2013; 111[1]: 47-50.

211. Kumar R. Hassali MA, Abdul Kader MA SK, Wong ZY,et al. Knowledge and perception of physicians from private medical centers towards generic medicines: a nationwide survey from Malaysia. J Pharm Pol Pract, 2015; 8:11 Doi: 10.1186/s40545-010031-9.

212. Vidotti C C F. Drug information centers in developing countries and the promotion of rational use of drugs: A viewpoint about challenges and perspectives. Int J Pharm, 2004; 18[1]: 21-25].

213. Elzubair AG, Suleiman HIA, Hamid ZA.Drug compliance among hypertensive patients in Kassala, Eastern Sudan.EMHJ, 2000; 6: 100-105.

214. Kalyango JN, Owino E, Nambuya AP. Non –adherence to diabetes treatment at Mulago Hospital in Uganda : prevalence and associatedfactors. Afr Health Sci, 2008; 8[2]: 67-73.

215. Theodorou M, Tsiantou V, Pavlakis A, Maniadakis N, et al. Factors influencing prescribing behavior of physicians in Greece and Cyprus : results from a questionnaire based survey. BMC Health Serv Res, 2009; 9: 150. DOI: 10.1186/1472-6963-9-150.

216. Basaran NF, Akici A. Patients' experience and perspectives on the rational use of drugs in Turkey: a survey study.Patient Prefer adherence, 2012; 6: 719-724.

217. Lebanova H, Manolov D, Getov I. Patients attitude about generics-Bulgarian perspective. Marmara Pharm J ,2012; 16: 36-40.

218. Albarraq AA. Consumers' perception on generic medicines in Taif city, Saudi Arabia.Saudi J Health Sci, 2013; 2: 18-22.

219. Dunne S, Shanon B, Cullen W.Patient Perception of Generic Medicines: A Mixed Method Study. The Patient, 2014; 7[2]: 177-185. Doi: 10.1007/s40271-013-042-z.

220. Nardi EP, Ferraz MB, Pinheiro GR, Kowalski SC, Sato EI. Perception of the population regarding generic drugs in Brazil: a nationwide survey. BMC Public Health, 2015; 15:117.doi:101186/s12889-015-1475-1.DOI: 10.4081/jphia.2014.242.

221. Mousa MME, Idris KAMA,. Patients' knowledge, attitude, and perception of about generic pharmaceuticals in Khartoum North, Town Center, Sudan ,WJPR, 2016;5 [4] : 410-429. Doi: 10.20959/wjpr20164-60015.

222. Colgan S, Faase K, Petrie KJ, et al. Perception of generic medication in general population , doctors and pharmacists : a systematic review. BMJ Open,2015;eoo8915.doi:10.1136/bmjopen-2015-008915.

223. Vivian E M. Overview of generic drugs and drug naming. Merck Manual, Consumers version. Available at: http://www.merckmanuals.com/home/drugs/brand-name-and-generic-drugs/overview-of-generic-drugs-and-drug.

224. Ali HM, Humaida MMA, Eltayeb IB, A/KarimFI.Generic versus brand prescribing in six main hospitals in Sudan capital region. Sudan Med J, 1994; 32[1]: 87-97.

225. Berry L. Sudan: a Country Study: Sudan. Federal Research Division/ Library of the Congress, 5th ed., First Printing: 2015. Available at: http://www.loc.gov/rr/frd/cs/pdf/CS_Sudan.pdf.

226. Gail, T. [Ed.].World mark encyclopedia of the nations. 12th ed [Vols. 1-4]., Boston, MA: Gale Publications: 2006,Available at : http://www.goodreads.com/book/show/11140476-worldmark-encyclopedia-of-the-nations.

227. Cohen M. We need to go metric to prevent errors with oral liquids. PhillaInq, October24, 2011. Available at: http://www.philly/blogs/healthcare/we-need-to-go-metric.

228. Nellist CC. Go metric: No more Liquid medication via teaspoon, the AAP says. FamPract News, March 30, 2015. Available at; http://www.mdedge.com/familypracticenews/pediatrics.

229. National Councilfor Prescription Drug Programs [NCPDP], white paper. Standardize the Dosing Designations on prescription container Labels for Oral Liquid Medications, 2014: 1-61. Available at: http://ncpdp.org/Education/Whitepaper.

230. Rapaport L. Measure kids' medicines in metric units, not spoonfuls, doctors say. Reuters Health, March 30, 2015.

231. Yin HS, Paker R M, Sanders L M, Dreyer BP,et al. Liquid Medication Errors and Dosing Tools: A Randomized Controlled Experiment. Pediatrics, 2016; 138[4]: e 20160357.

232. Za'za' B. Employee accused of impersonating doctor to get drugs. Gulf News and Courts, November16, 2015.Defendant accused offering prescriptions to purchase tramadol and meprobamate [anxiolytic]. Available at:http://gulfnews.com/news/uae/courts/employee-accused-of-impersonating-doctor-to-get-drugs-1.1472706.

233. Buppert C. What Should I do about forged prescription? Medscape, February 22, 2016. Available at: http://www.medscape.com/viewarticle/85897.

234. Osman T, Victor C, Abdulmoneim A ,Mohammed H,et al. Epidemiology of Substance Use among University Students in Sudan. J Addict, 2016, Article ID 246164, 8 pages. Http://dx.doi.org/10.1155/2016/2476164.