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RESEARCH ARTICLE

Availability, affordability, and prescribing pattern of medicines in Sudan

Abdol Majid Cheraghali · Amjad Mohammed Idries

Abstract *Objective* To evaluate availability, affordability and prescribing pattern of medicines in both public and private health sectors of Sudan. *Setting* Availability, affordability, and rational use of medicines were evaluated in primary health care centers in six states of Sudan. *Methods* The survey followed the WHO guidelines for monitoring and assessing the pharmaceutical situation in countries. For this survey, a total of 36 public health facilities selected from the six geographic areas were identified. *Main outcome measure* The survey confirmed the good availability and acceptable affordability of essential medicines in the public health centers and private pharmacies. Despite acceptable stocking of the medicines in these facilities, storage quality of medicines was low. *Results* On average, 82% of the core medicines monitored were available in the centers and 85% of the medicines prescribed by the physician were dispensed to the patients. The average score for quality of storage in store room and dispensing were 56% and 65%, respectively. On average, a complete course of treatment of malaria in public centers costs 0.62 and for treatment of pneumonia in adults and children costs 3.13 and 0.57 days of the lowest government salary, respectively. The average number of medicines per prescription was 2.3. On average, the number of prescriptions containing at least one antibiotic was 66% and 27% of the prescriptions containing an injectable medicine. Adherence of prescribers to standard treatment guidelines for treating uncomplicated diarrhea and diarrhea was 45% and 64%, respectively. The acceptable medicine labeling criteria were met only in 50% of the prescriptions. *Conclusion* The overall availability of essential medicines in the public health centers and private pharmacies of Sudan was acceptable. Although affordability of medicines for some common diseases such as malaria and child pneumonia could be considered acceptable, it was much higher for some other conditions including adult pneumonia. Prescription of antibiotics was high and adherence to standard treatment guidelines for managing common and widely spread diseases such as diarrhea and malaria was low.

Keywords Affordability · Availability · Medicines · Rational use · Sudan

Impact of the findings on practice

- Availability, accessibility and affordability of essential medicines, along with their storage management are acceptable in the primary health care centers in Sudan.

- Prescription of antibiotics in Sudan is high and adherence to standard treatment guidelines for managing common and widely spread diseases such as diarrhea and malaria is low.

Introduction

Sudan (2.5 million km^2) is the largest country in Africa with a population over 34 million and 25 states. Sudan is

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governed by a Federal governmental System. GDP per captia in Sudan is about US$700 [1]. Sudan has a large population of internally displaced people: between 5.3 and 6.7 million, mainly in the south, around Khartoum, in Darfur and in the east of the country. Its epidemiological profile is marked by a burden of endemic diseases, including a growing threat from HIV/AIDS, and high risk of epidemics and natural disasters. Communicable diseases are a major concern, and the main causes of morbidity and mortality are infectious and parasitic diseases (tuberculosis, diarrhoea, malaria, measles, and acute respiratory infections). Maternal and infant mortality and fertility indicators are among the highest in the eastern Mediterranean region. Maternal mortality in Sudan is estimated at 5.9 per 1,000 live births and infant mortality at 62 per 1,000 live births; the fertility rate is estimated at 4.6 children per woman [1]. Malaria represents a major public health problem in Sudan. In Khartoum state, malaria accounts for 24% of all patients seen at outpatient departments and 13.4% of hospital admissions [2]. This means that malaria not only consumes the great share of the treatment-related expenditure of households but is also the cause of the highest loss of working days.

Sudan pharmaceutical sector

Sudan's national pharmacy and medicines regulatory authority was established in 1996. The National Medicine policy of Sudan was updated in 2005. Relative to its population, the total value of pharmaceutical market is low with the medicines market in 2005 estimated to be about US$192 million. Of this, 24% of medicines are produced by local manufacturers. Most of the locally produced medicines are generic medicines which include oral and topical dosage forms. However, the current share of local manufacturing in production of essential medicines is only 5%. At the federal level, the Federal Ministry of Health (FMOH) is responsible for regulation of the pharmaceutical sector. Central Medicine Supply (CMS), a body affiliated to the federal government, plays the major role in procurement of medicines. CMS, Revolving Medicine Fund Khartoum (RDF) and private sectors are the main suppliers of the pharmaceuticals in Sudan. Presently, there are about 1,500 pharmacies in Sudan.

RDF in Khartoum State is one of the largest single revolving medicine funds in the world with an annual turnover of £2 million and currently providing medicines to 3 million patients per year [3]. It has been in existence for nearly two decades and has been growing in scale and scope. The RDF was jointly initiated by the Khartoum Ministry of Health and Save the Children (UK) in the mid-1980s [3].

WHO tool for pharmaceutical sector assessment

Monitoring national medicines policies is a complex task. Due to lack of resources and culture of monitoring in developing countries, most of the time it is difficult to establish a sustainable system of regular monitoring. On the other hand, some monitoring tools included indicators that are difficult to collect. WHO has developed an assessment tool called "*Core indicators for monitoring and assessing country pharmaceutical situations*", a practical indicator-based tool that can be regularly implemented without investing large amounts of human or financial resources [4]. The package has been used extensively by the countries to collect data on their pharmaceutical sectors [5–9]. These core indicators measure the degree of attainment of the strategic pharmaceutical objectives of improved access, quality, and rational use. Access is measured in terms of the availability and affordability of essential medicines. Rational use of medicines is measured by examining prescribing and dispensing habits and the implementation of standard treatment guidelines (STG) and essential medicines lists (EML).

Aim of the study

The aim of the present study was to evaluate availability, accessibility, and prescribing pattern of medicines in both public and private health sectors of Sudan using WHO guideline and methodology.

Methods

The survey methods followed the WHO Essential Medicine Monitoring programme guidelines for monitoring and assessing the pharmaceutical situation in countries [4]. The major indicators used in this investigation and their method of calculation are summarized in Table 1. A list of 15 essential medicines was selected from the Sudan national medicines list. Items were those used mainly in primary health care to treat common diseases and included oral rehydration salts (ORS), Artesunate + Sulphadoxine + Pyrimethamin, Cotrimoxazole, Amoxicillin, Paracetamol, Ferrous sulfate + Folic acid, Mebendazole, Tetracycline (eye ointment), Povidone iodine, Clotrimazole, Metronidazole, Antacid, Diclofenac, Pyridoxine and Atenolol.

To collect most of the indicators for access, quality, and rational use, a total of 36 public health facilities selected from the six geographic areas were identified. Regions were selected according to their geographical distribution

Table 1 Major indicators used and their method of calculation

Indicator	Calculation method
% Availability of core medicines at facility	Number of key medicines available in a facility ÷ number of key medicines reviewed × 100
% Of prescribed medicines dispensed to patients	Number of medicine dispensed ÷ number of medicines prescribed × 100
Average stockout duration in facility	Number of days each medicine is out of stock × 365 ÷ number of days covered by the review for that medicine
Affordability of treatment (days of salary)	Total cost of treatment ÷ lowest daily government salary
Adequacy of conservation conditions and handling of medicines	The total number of "true" responses to items on the checklist ÷ 8 × 100
% Medicines adequately labeled	Total number of medicines adequately labeled ÷ total number of medicines dispensed × 100
% Patients know how to take medicines	Number of patients who know how to take medicines ÷ number of patients sampled × 100
Average number of medicines per prescription	Total number of medicines prescribed ÷ number of patient encounters reviewed
% Patients prescribed antibiotics	Number of encounters in which one or more antibiotics is prescribed ÷ number of patient encounters reviewed × 100
% Patients prescribed injections	Number of encounters in which one or more injection is prescribed ÷ number of patient encounters reviewed × 100
% Prescribed medicines on the essential medicines list	Number of prescribed medicines included on the EML ÷ total number of medicines prescribed × 100
% Medicines prescribed by generic name (INN)	Number of medicines prescribed by generic name ÷ total number of medicines prescribed × 100
% Tracer cases treated according to recommended treatment protocol	Number of cases prescribed each medicine ÷ number of cases × 100

and accessibility to the region. Due to accessibility difficulties and lack of any clearly structured health system especially in the pharmaceutical sector which could be evaluated through this investigation, the southern Sudan states have been excluded from this study. Therefore, Khartoum, River Nile, Red Sea, Northern Kordofan and Gadafir were the selected states for this study. However, due to its vicinity to north Sudan, Southern Darfur was also selected as a sample to compare its results with those of other states. In total, six public health centers and six private medicine outlets have been randomly chosen per geographic area. In each state, one central warehouse was also sampled. For each state, a responsible investigator was named. These investigators attended introductory workshops regarding data collection. Several other persons were therefore involved in data collection in the field. Data were collected during the year 2007, assembled in the states and then forwarded to FMOH in Khartoum for review, consolidation, and processing.

Results

Availability and affordability of medicines

Results of the accessibility indicators are summarized in Table 2. On average, 82% of the core medicines monitored were available in the health centre pharmacies. On average, 85% of the medicines prescribed by the physician were dispensed by the health centre pharmacy. The stock-out duration (i.e., the annual number of days during which a medicine from the list was unavailable in the pharmacy) was on average 18 days. Khartoum had the highest stock-out period. The average score for quality of storage in the store room and dispensing area were 56% and 65%, respectively. On average, a complete course of treatment for pneumonia in adults and children in public centers costs 3.13 and 0.57 days of the lowest government salary, respectively. Gadarif and North Kordofan had the highest value. However, malaria treatment costs on average 0.62 days of the lowest government salary with the highest value in Khartoum state (1.22 days). The cost of medicines for treatment of malaria in private pharmacies was substantially higher (Table 4).

Prescribing and dispensing practices

The average number of medicines per prescription was 2.3 ± 0.2 (Table 3). The number of prescriptions containing at least one antibiotic was on average 66%, and the average number of prescriptions containing an injectable medicine was 27%. Prescription of antibiotics and injectables were highest in North Kordofan among all states surveyed.

Table 2 Availability, affordability, and storage quality indicators for core medicines in public health facilities

Indicator	Khartoum	River Nile	Red Sea	North Kordofan	Gadarif	Southern Darfur	Mean ± SD
% Availability of core medicines at facility	79.14	76.7	93.33	93.5	87.78	61.68	82.02 ± 12.19
% Prescribed medicines dispensed to patients	71.18	83.05	85.48	90.55	93.34	68.94	84.72 ± 10.02
Stock out duration (days)	58.58	22.20	5.33	6.47	0	NA	18.52 ± 23.88
Adequacy of storage (%)							
Store room	46.00	58.42	NA	62.50	50.00	62.5	55.88 ± 7.52
Dispensing area	56.22	64.67	75.00	64.58	62.50	66.67	64.94 ± 6.11
Affordability (days of salary) of treatment for:							
Adult pneumonia	1.43	3.00	2.20	4.50	4.72	2.93	3.13 ± 1.28
Child pneumonia	0.58	0.38	0.74	0.62	0.66	0.43	0.57 ± 0.14
Malaria	1.22	0	0.32	0.70	0.83	0.63	0.62 ± 0.42

NA Not available

Table 3 Prescribing indicators in public health facilities

Indicator	Khartoum	River Nile	Red Sea	North Kordofan	Gadarif	Southern Darfur	Mean ± SD
Mean no. of medicines per prescription	2.14	2.43	2.57	2.07	2.17	2.44	2.30 ± 0.20
% Patients receiving antibiotics	64.14	60.8	63.33	75.53	60.87	70.43	65.85 ± 5.90
% Patients receiving injections	31.94	29.70	23.33	34.98	23.4	19.17	27.09 ± 6.05
% Medicines adequately labeled[a]	22.28	78.77	47.68	87.85	36.34	29.00	50.32 ± 27.06
% Patients know how to take medicines[b]	60.35	80.22	82.78	85.53	70.00	80.24	76.52 ± 9.51
% Prescribed medicines on EML	87.98	30.42	65.12	96.45	87.68	NA	73.53 ± 26.76
% Medicines prescribed by INN	42.06	40.52	37.92	44.47	52.5	50.12	44.60 ± 5.67
Treatment according to STG:							
Diarrhea (% prescribed medicine)							
ORS	60.00	78.33	22.00	46.67	32.50	30.60	45.02 ± 21.12
Antibiotics	54.00	50.00	63.00	80.00	40.00	84.80	61.97 ± 17.53
Other medicines	18.00	100	70.17	6.67	5.00	24.00	37.31 ± 38.84
Malaria (% prescribed medicine)							
First line medicine[c]	71.00	78.33	55.00	58.33	58.00	61.40	63.68 ± 9.05
Other antibiotics	41.00	28.33	31.33	66.67	36.00	45.60	41.49 ± 13.84

NA Not available

[a] An adequate label includes the name of the medicine, how much to be taken, and the frequency of administration

[b] Adequate knowledge includes knowing the appropriate dosage and duration of each medicine

[c] Artesunate + Sulphadoxine + Pyrimethamin

Adherence of prescribers to STGs showed on average only 45% of prescribers followed national guidelines for treating uncomplicated diarrhea and 64% for malaria. The quality of the patient information about medicine use was measured using quality of medicine labeling and patient knowledge indicators (Table 3). The acceptable medicine labeling criteria for prescriptions (medicine name, dosage, and expiry date) were met only in 50% of the prescriptions. The criteria for adequate patient knowledge about the dispensed medicines (able to recognize the medicine, knowing the appropriate dosage and duration of medicine use) were met in 77% of patients. This value was lowest in Khartoum (60%) and highest in North Kordofan (86%).

Assessment of private pharmacies and warehouses

A rapid assessment of private pharmacies and regional medicine warehouses showed that more than 94% of the core medicine list was available in private pharmacies (Table 4). On average, a complete course of treatment for pneumonia in adults and children in private pharmacies costs 3.67 and 0.68 days of the lowest government salary, respectively. However, malaria treatment costs on average 1.87 days of the lowest government salary. Table 5 shows availability of core medicines (mean 80%), stock-out duration (21 days) and conservation condition (71%) of medicines in surveyed central public warehouses.

Table 4 Accessibility and affordability indicators for core medicines in private pharmacies

Indicator	Khartoum	River Nile	Red Sea	North Kordofan	Gadarif	Southern Darfur	Mean ± SD
% Availability of core medicines at facility	96.67	93.27	98.88	100.00	86.65	90.00	94.25 ± 5.24
Affordability (days of salary) of treatment for:							
Adult pneumonia	1.82	3.78	3.20	4.60	4.40	4.20	3.67 ± 1.03
Child pneumonia	0.80	0.73	0.85	0.57	0.57	0.55	0.68 ± 0.13
Malaria	1.75	1.50	2.30	1.97	1.78	1.90	1.87 ± 0.27

Table 5 Availability and conservation quality of core medicines in public warehouses

Indicator	Khartoum	River Nile	Red Sea	North Kordofan	Gadarif	Southern Darfur	Mean ± SD
% Availability of core medicines	53.80	80.00	93.30	93.00	86.70	73.30	80.02 ± 14.98
Stock-out (days)	41.20	50.30	6.20	9.50	0	21.30	21.42 ± 20.29
% Conservation condition	62.50	75.00	62.50	100.00	75.00	50.00	70.83 ± 17.08

Discussion

Medicines are crucial component of any health care system, and in recent decades there have been a variety of investigations assessing pharmaceutical sectors especially in developing countries. The WHO indicators enable the evaluation of several aspects of the pharmaceutical sector such as patients' access to good quality medicines, rational prescribing and dispensing, availability of reference information in the primary care settings, as well as the quality of medicine warehouses and private pharmacies. Therefore, the WHO methodology has been used in this investigation to evaluate the pharmaceutical sector in north Sudan.

According to the results of this study, availability of essential medicines in the primary health centre pharmacies was acceptable and on average 82% of medicines on the survey list were available at the facility. This is confirmed by the finding that on average 85% of the medicines prescribed by the physician were dispensed by the health centre pharmacy. Stocks of surveyed medicines, except for Khartoum state with longer stock-out duration (59 days), were also satisfactory and no medicine on the list was unavailable for more than 3 weeks on average. Quality of medicine storage both in the store room and in the dispensing area were fairly low (Table 2). Most areas of Sudan face a harsh environment. Therefore, low quality of medicine conservation in public centers might create some concern regarding quality of medicines delivered to the patients. This ultimately may pose some health hazards to the patients. Interestingly, no expired medicine was found in pharmacies of either public or private sectors, or even in surveyed warehouses.

According to published data, 17% of the population of Khartoum State were unable to afford basic health care costs, and 24% could meet basic costs but were unable to meet "emergency" costs if they arose. It was found that 6% of the sick did not have treatment, and that 29% of those who do have treatment cannot afford to pay for it, resorting largely to borrowing or reduced treatment [3]. The results of this study also confirmed that at least some parts of Sudan population are not able to afford basic treatment for some important and common diseases in the country. There was considerable variation of affordability of basic treatment for pneumonia and malaria as examples of common and prevalent diseases in the country. On averages Sudanese have to pay 3.13 days of lowest government salary to treat adult pneumonia (by Penicillin Procaine) and 0.57 days for treatment of child pneumonia (by Amoxicillin). Malaria is a major concern in Sudan [2] and reasonable affordability for treatment is crucial for curbing this health challenge. Results of this study revealed that the average value for affordability of malaria treatment in Sudan, at least in public centers and despite of considerable variation among surveyed states, is acceptable. Except for Khartoum, Sudanese patients in other states surveyed are able to afford malaria treatment with less than one day of the lowest government salary.

Physicians' prescribing habits showed that the average number of medicines prescribed per prescription was 2.3 with little inter-state variation. This is lower than reported values for other developing countries both inside and outside Africa [5–8]. As in many other developing countries, in Sudan prescription of antibiotics was also high. On average, 66% of patient received at least one antibiotic on their visit to health centers. This indicates inappropriate use of antibiotics in surveyed health centers. However, interestingly, prescription of injectables in these health centers was lower than the values reported in some other countries [5–8, 10]. Considerably lower rates of injectables together with reasonable values for the average number of medicines per prescription are positive characteristics of prescribing

habits in health centers of Sudan and have to be encouraged. Considering the large variation in prescribing habits among regions, further in depth investigation on these reasonable practices may provide a practical tool to deal with poly-pharmacy and over-prescription of injectables in some other developing countries especially in the African region.

In this investigation, pharmacy dispensing practices were also assessed. According to the survey criteria, the label of a medicine was considered adequate if it stated the name, dosage, and expiry date of the medicine. These criteria were met on average in 50% of the monitored prescriptions. For assessing patients' knowledge about the dispensed medicines, it was considered necessary that the patient should be able to recognize the medicine, its dos-age, and duration of use. On average, these criteria were met for 77% of patients. Since literacy in Sudan is low [1] and on average half of patients are not able to read, clear verbal explanation of directions on how to use medicines by health center staff (e.g., prescriber and dispenser) is crucial for rational use of prescribed medicine. Although on average only 50% of the medicines had adequate labeling, more than 77% of the patients declared they know how to take their medicines. This indicates that staff of health centers rely more on verbal communication with patients compared to written directions. It is always diffi-cult to rely on patient memory especially for longer term use of medicines. Therefore, a combination of verbal and written directions would be the best practice for these centers. Although Sudan has a national EML, unfortunately this list was not available in most of the public health centers. Therefore, it is expected that physicians who practice in these centers are not aware of medicines on the national list. On average, only 74% of medicines pre-scribed for the patients were on the national EML. Most medicines were also prescribed by their brand name and less than 45% of medicines prescribed by their INN.

To measure quality of care for common conditions with recommended treatment protocols, adherence to the pro-tocols can be measured by checking if tracer diseases are treated appropriately. Such recommendations included use of ORS for watery diarrhea in children and first choice medicine to treat malaria. Despite the presence of some national protocols to treat common diseases (e.g. malaria), these documents were rarely available in the surveyed centers. The low adherence of physicians to standard treatment guidelines is disappointing. Results of this study showed only 45% patients with diarrhea received ORS and 62% of the patients received antibiotics. This of course very much contributed to the over-prescription of antibi-otics in Sudan. Only 64% of the patients with malaria received recommended first line medicine to treat the dis-ease. Due to the extent of malaria in the country, this could create difficulties in controlling the disease.

The medicines situation in the warehouses was also assessed. Average availability of core medicines was 80% with fairly short average stock-out duration (21 days). Conservation condition for medicines in warehouse was better than public centers, yet still far from optimal. This again may raise concerns about the quality of the medicines distributed to the public centers. It should be mentioned that, in Sudan, the mostly used mode of transportation to supply medicines to the public centers is truck (most often an open one) or even rented cars. Therefore, effects of both storage and transportation on the quality of the medicines should be investigated in a separate study.

Conclusions

The survey confirmed acceptable availability of essential medicines in the public health centers and private phar-macies. The management of medicines in these facilities (e.g., stock-out duration and presence of expired medi-cines), except for some shortcoming on storage quality of medicines, was acceptable. Medicine availability in some regions of the country needs to be improved and stock-out duration should be reduced. Some training in management, effective procurement systems, and organization of the public pharmacies should be considered in order to further improve quality of medicine storage in public health centers.

Affordability of medicines for some common diseases such as malaria and child pneumonia is acceptable but needs improvements in some other conditions including adult pneumonia. Compared with public health centers, availability of core medicines in private pharmacies was substantially higher (Table 4). However, affordability of medicines in private pharmacies to treat common diseases, except for malaria, was comparable with public centers. This may indicate the positive role of private pharmacies in the Sudan health care system. Despite acceptable average number of medicines per prescription and comparative rate of injectables prescribing, rational prescription of antibi-otics and, more importantly, adherence to STGs for managing common and widely spread diseases such as diarrhea and malaria should be promoted.

The knowledge of the patients concerning the medicines they received must be improved in order to guarantee rational use of medicines. Written information should always be provided with all necessary details (name, dos-age, duration of therapy) to assure proper use of medicines.

Further studies should be undertaken to investigate the reasons for the high rate of prescribing antibiotics and the poor adherence to STGs by physicians, and to explore intervention to further reduce the rate of injectables pre-scribing. Appropriate administrative and educational

strategies should be developed and implemented to improve prescribing habits.

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