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Study of the Management and Disposal Practices of Unused or Out-of-Date Medicines by Households in the Municipality of Ouagadougou, Burkina Faso

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Abstract

Introduction: Not all medicines that pass-through consumers' hands are used, and some often expire in households. These health products can be sources of accidental risks and pollution when they are not properly disposed of. In Burkina Faso, there are as yet no guidelines for the disposal of unused medicines in households. The aim of this study was to estimate the extent of household possession of unused or expired medicines, and to describe attitudes and disposal practices. Methods: This was a descriptive cross-sectional study covering households in the Ouagadougou commune conducted from June to August 2021. Two-stage stratified sampling was used: selection of Enumeration Zones (EZs) and selection of households, with each EZ comprising several households. Data collection was based on direct interviews using a structured questionnaire. Data were processed using Epi Info software version 7.2.4.0. Results: In total, 417 household residents were surveyed out of the planned 423 households, corresponding to a completion rate of 98.58% compared with the initial sample. Among the respondents, 79.62% had unused and/or expired medicines in their household. A total of 2562 drug packaging units were counted, for a total weight of 121.90 kg. Nearly 75% were aware that improper disposal was a danger to the environment. Some respondents kept their unused medicines at home until they expired (43.41%), and disposed of them mainly by throwing them in the household garbage (75.58%). The majority (79%) were in favor of the government set-

ting up a take-back program for these medicines. Conclusion: The introduction of a take-back program for unused or out-of-date medicines will ensure safer disposal of medicines, and better protection for households and the environment.

Keywords

Unused Medicines, Expired Medicines, Disposal, Household, Risk

1. Introduction

The supply of medicines is one of the six pillars of any healthcare system, according to the World Health Organization (WHO) [1]. Medicines consumption has increased over the years due to the rising incidence and prevalence of disease, growing public interest in healthcare products and population growth [2] [3] [4] [5]. As a result, a large volume of pharmaceutical products is used every year for the diagnosis, treatment or prevention of health problems [6]. For example, a 2007 study by Kindermans *et al*. showed that approximately 314.5 million treatments of artemisinin-based combination therapies in adult doses would be needed to manage malaria in adults in Africa each year [7].

However, not all the healthcare products that pass into the hands of consumers are used, and some often expire in households [8]. In Nigeria in 2011, a study reported a household drug retention rate of 94.1% [9]. The presence of these medicines in households represents a danger for children because of the risk of accidental ingestion. The most common practices for disposing of medicines worldwide are to throw them away in household waste or down the toilet [10]. These practices are dangerous and can lead to the pollution of surface water and groundwater, limiting the quality of drinking water, damaging the soil for agriculture and causing damage to aquatic life and life in the soil, with risks to human, animal and environmental health [11]. To overcome this problem of drug disposal, several countries have set up systems and organizations for the collection and recovery of unused and out-of-date medicines, such as Cyclamedin France. Cyclamedis a French association approved by the public authorities, bringing together the entire pharmaceutical profession with the aim of limiting the health and environmental risks of medicines. Its mission is to collect and recycle unused medicines for human use, whether expired or not, brought back by patients to pharmacies [12].

In Burkina Faso, there are as yet no clear guidelines on how households should dispose of unused or expired medicines, and to our knowledge no study has yet been conducted on household disposal practices for unused and expired medicines in Burkina Faso.

The aim of this study was therefore to take stock of the extent to which households hold unused and expired medicines and to describe people's current

attitudes and practices regarding the disposal of unused or expired medicines.

2. Methods

2.1. Setting, Type and Period of Study

This was a descriptive cross-sectional survey conducted from June to August 2021 in the municipality of Ouagadougou, the capital of Burkina Faso. It had 502,938 households according to the 2019 general population and housing census (RGPH) [13]. Data were collected through direct household interviews using a questionnaire.

2.2. Study Population, Inclusion Criteria and Sampling

The source population consisted of all households in the municipality of Ouagadougou. Households in the commune of Ouagadougou selected for the study were included in the survey. A single respondent was chosen per household. The respondent was chosen from among the members of the selected household who were present at the time of the interview and by nomination by the members of the household. Households where the only residents present were under the age of 18 or physically incapable were excluded from the study.

To calculate the sample size, the following formula was used: $N = PQ\varepsilon^2/\alpha 2$, with N (number of households), P (proportion), Q (1 − P = probability of failure or probability of negative outcome), ε (confidence level) and α (margin of error) [14]. A pvalue of 50% was assumed due to the absence of a previous similar study on the issue, a margin of error α of 5%, a confidence interval of 95%. Assuming a non-respondent rate of 10%, the sample size was estimated at 423 households.

The sampling frame was the list of 2,193 enumeration zones (EZs) compiled by the National Institute of Statistics and Demography, each EZ comprising several households. Due to financial constraints, not all EZs could be included, and only 15 EZs were selected for the study.

A two-stage stratified sampling was carried out for the study: the first stage consisted of selecting 15 EZs using the systematic random sampling technique, and the second stage consisted of selecting the concessions of the households to be surveyed. This stage involved going to several crossroads in the selected EZs and following an axis at random, using sketches of the EZs with their GPS coordinates supplied by the National Institute of Statistics and Demography. The concessions were selected randomly on the axis by rotating a pen.

2.3. Data Collection Technique and Tools

The interviews were conducted using a questionnaire that had been validated beforehand on the basis of a pre-test of 20 households. The variables were related to the socio-demographic characteristics of households and respondents, the extent to which medicines were held in households, participant's attitudes and practices with regard to the disposal of unused or expired medicines. Elec-

tronic scales with a minimum range of one gram and a maximum range of 50,000 grams were used to measure the mass of unused or expired medicines found in respondents' homes. The types of drug packaging were counted manually.

2.4. Ethical Considerations

Prior to carrying out this study, authorization was obtained from the mayor of the municipality of Ouagadougou (N°2021-676/CO/M/SG/DGSA/DAGCA/SAA of March 18, 2021). Informed consent was obtained from each respondent before the questionnaire was administered. All data collected were treated anonymously and confidentially.

2.5. Data Processing and Analysis

The data collected were processed using Epi Info software, version 7.2.4.0. The data were analyzed using Excel 2016 to generate descriptive statistics, which were represented as percentages. Comparisons were made using the Kih2 test at the 5% alpha threshold.

3. Results

In total, 417 household residents were surveyed out of the planned 423 households, corresponding to a completion rate of 98.58% compared with the initial sample.

3.1. Socio-Demographic Characteristics

Of the 417 household respondents, 274 (65.70%) were female, with a sex ratio of 0.52. The 25 to 35 age group was the most represented at 42.44%. The average household size was 5.82 ± 3.66 persons. In terms of educational level, 300 of the respondents (71.95%) had at least attended school and 36.7% had secondary education (Table 1).

3.2. Extent of Household Holdings of Unused or Out-of-Date Medicines

Of the respondents, 332 (79.62%) had unused or expired medicines in their households at the time of the survey. Level of school education ($p = 0.51$) and household size ($p = 0.49$) did not significantly influence whether respondents had unused or expired medicines.

Unused or out-of-date medicines in households amounted to 2562 packaging units, with an average of 6.14 +/− 5.99 units per household. The total mass of unused or expired medicines held by households was 121.90 kg, or an average of 0.29 kg per household.

The majority of unused or expired medicines came from households whose members had secondary education (842 of the units), as well as from households of more than 5 people (1952 of the units) (Table 2).

Table 1. Socio-demographic characteristics of 417 respondents from households in the Ouagadougou commune surveyed.

Socio-demographiccharacteristics		Numbers	Percentage (%)
Age (in years)	18 - 24	79	18.95
	25 - 35	177	42.44
	>35	161	38.61
Level of education	Out of school	117	28.05
	Primary	67	16.07
	Secondary	153	36.70
	University	80	19.18
Household size	≤2	48	11.52
	]2 - 5]	186	44.60
	>5	183	43.88

Table 2. Extent of ownership of unused or out-of-date medicines by the 417 households surveyed.

Socio-demographic characteristics		Medicines present (n = 332) (%)	No medicines (n = 85) (%)	Packaging units (N = 2562)	Mass of medicines (Kg) (N = 121,90)
Level of education (p = 0.51)	Out of school	94 (28.31)	23 (27.06)	710	37.68
	Primary	51 (15.36)	16 (18.82)	424	24.41
	Secondary	119 (35.85)	34 (40.00)	842	30.4
	University	68 (20.48)	12 (14.12)	576	29.41
Household size (p = 0.49)	≤ 2	37 (11.15)	11 (12.94)	76	0.51
	]2-5]	91 (27.41)	18 (21.18)	534	1.20
	>5	204 (61.44)	56 (65.88)	1952	120,19

3.3. Reasons for Discontinuing Use of Medicines

Among the reasons for stopping the use of medicines, 290 (87.35%) of the respondents who had unused medicines in their household stated that improvement in their condition was the main reason for stopping the use of medicines found in their household (Figure 1). There was therefore no statistically significant association between the respondents' level of education and the reasons for stopping the use of medicines (p = 0.43).

3.4. Public Attitudes towards Unused or Out-of-Date Medicines

The significance of the expiry date of medicines was known by 78.42%. However, 6.96% were convinced that medicines could still be taken after the expiry date. Nearly 4% of respondents said that they had received instructions on how to dispose of medicines when they were prescribed or purchased. Moreover, 74.58% of respondents said that they were aware of the potential environmental hazards associated with the improper disposal of unused or expired medicines.

The majority of respondents (79%) were in favor of implementing a take-back program for unused or expired medications (Table 3).

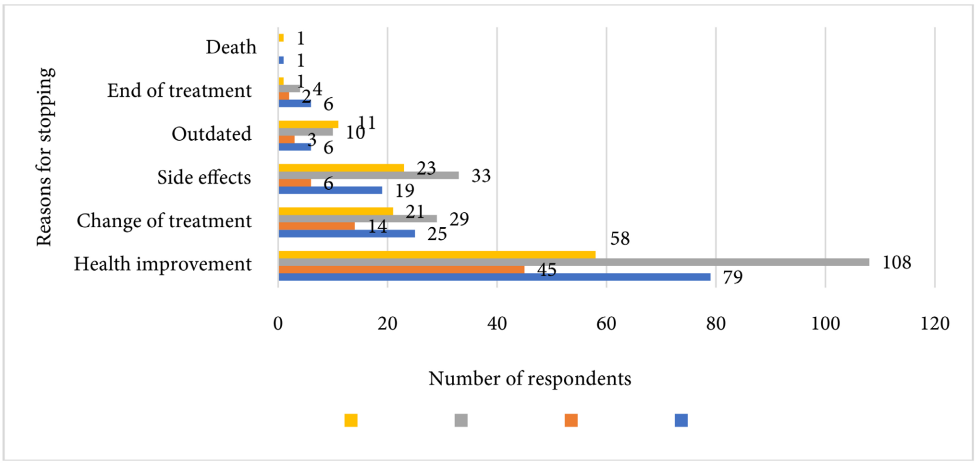

Figure 1. Frequency of reasons for stopping use of medicines use according to respondent's level of education in the 332 households surveyed.

Table 3. Respondents' attitudes towards unused medicines, by level of education.

Level of education	Out of school	Primary	Secondary	University	Total	Percentage (%)
Knowing the meaning of the expiry date p = 0.0042						
Meaning known	69	46	132	80	327	78.42
Meaning not known	48	21	21	0	90	21.58
Total	117	67	153	80	417	100.00
Perception of potential danger to the environment p < 0.001						
Danger	81	36	123	71	311	74.58
No danger	17	11	10	2	40	9.59
Neutral	19	20	20	7	66	15.83
Total	117	67	153	80	417	100.00
Checking the expiry date p < 0.001						
Effective verification	57	37	123	75	292	70.02
Audit not effective	60	30	30	5	125	29.98
Total	117	67	153	80	417	100.00
Use after expiry p < 0.001						
Use	4	2	18	5	29	6.96
No use	71	43	112	74	300	71.94
Neutral	42	22	23	1	88	21.10
Total	117	67	153	80	417	100.00
Reuse of medicines in the home p = 0.0051						
Reusable	56	33	102	52	243	73.20
No Reusable	35	17	17	15	84	25.30
Don't know	2	1	1	1	5	1.50
Total	93	51	120	68	332	100.00

3.5. Disposal Practices for Unused or Out-of-Date Medicines

The main way respondents acquired medicines was by prescription (96.16%). The main method of disposing of unused or out-of-date medicines was to throw them away with household waste (75.58%). Table 4 shows that there is a statistically significant association between the level of education of respondents and the method of disposal of unused or expired medicines in households (p = 0.0057).

Table 4. Disposal practices for unused or expired medicines by level of education.

Level of education	Out of school	Primary	Secondary	University	Total	Percentage (%)
Disposal of unused medicines (p = 0.0057)						
Disposal with the rubbish	57	30	57	35	179	42.93
Dispose of in toilets or washbasins	33	13	28	12	86	20.62
Donate to a friend	10	4	23	8	45	10.79
Keep until expiry	35	31	72	43	181	43.41
Burning	11	2	12	3	28	6.75
Landfill	3	0	3	0	6	1.44
Disposal of expired medicines (p = 0.094)						
Disposal with the rubbish	89	52	110	60	311	75.58
Dispose of in toilets or washbasins	30	14	46	19	109	26.14
Donate to a friend	3	1	4	1	9	2.58
Keep at home	3	2	5	5	15	3.60
Burning	14	9	22	8	53	12.71
Landfill	3	1	3	0	7	1.68

4. Discussion

The aim of this study was to determine the extent of unused or expired medicines in the household and to identify disposal practices.

The majority of respondents (79.62%) had unused or expired medicines in their households at the time of the survey. This result corroborates that of Randria L. *et al.* in Madagascar in 2018, who found that 84.7% of people kept stocks of medicines at home [15]. Other studies have shown the same trend: 95.3% in Afghanistan (2017), 94.1% in Nigeria (2011), and 66% in Ethiopia (2018) [6] [9] [16]. These differences could be explained by the difference in the size of the sample chosen for each study, the difference in socio-demographic and economic characteristics specific to each country but above all the level of awareness of the populations and the existence of a program for the management and dis-

posal of unused or expired medicines.

In the present study, 2562 unused or out-of-date medicines were found in households, with an average of 6.14 +/− 5.99 units per household and a total weight of 121.90 kg. These results are comparable to those of a study carried out in Nigeria in 2011 by Auta *et al*., which found 2,904 unused medicines, or 6.8 medicines per household [9]. This high number of medicines in households could be explained by the fact that they do not keep an inventory of their medicine cupboard and, above all, by the fact that there is no program to raise awareness and take back unused or out-of-date medicines.

Among the reasons for stopping the use of medicines, 87.35% of respondents who had unused medicines in their household said that improved health was the main cause. This result is supported by other studies conducted in Ghana and Indonesia in 2020, where the presence of unused or out-of-date medicines was mainly due to improved health, with 81% and 53.31% respectively [17] [18]. Excessive prescribing and patient non-compliance could contribute to this situation. Hence the importance of raising people's awareness of the importance of completing their treatment in order to avoid therapeutic failures in the first place, and then to minimize the risks associated with keeping unused medicines in households.

The main method used by respondents to dispose of out-of-date medicines was to throw them away with household waste (75.58%). These results are comparable to those of Bashaar M. *et al*. in Afghanistan in 2017, who found 77.7% [16]. The same trend was observed in Indonesia in 2020 by Insani WN. *et al*. who found 82.1% [18]. This high rate of this non-recommended practice for disposing of medicines indicates a very low level of awareness of pharmaceutical waste management at home, but also the absence of precise national guidelines on the disposal of unused or expired medicines. The second most common method of disposal was to flush expired medicines down the toilet or sink (26.14%). Bashaar M. *et al*. in Afghanistan in 2017 showed that more than 10% of respondents disposed of unused medicines using the same practice [16].

All this shows that the management of unused and/or expired medicines is still an uncontrolled health phenomenon worldwide. Fortunately, the majority of respondents in this study (79%) were in favor of setting up a government program to take back unused or expired medicines. This would make it easier to dispose of them more safely than the current methods of disposal.

Of all the respondents with unused medicines in their households, 73.20% were in favor of reusing their stocks of medicines. A comparable rate of 84.5% was found in Madagascar in 2018 [15]. These unused medicines kept at home for personal reuse or to give to others are not without danger. Failure to control the storage conditions of medicines that have been kept for a long time in households could contribute to their deterioration and could be a cause of their ineffectiveness or toxicity.

More worryingly, 6.96% of respondents were convinced that medicines could be consumed after the expiry date. This situation could be linked to a lack of

awareness of the shelf life of medicines and the associated risks.

As far as instructions for disposing of unused or out-of-date medicines are concerned, only 3.84% of respondents said that they had received them when they were prescribed or purchased. This rate is much lower than that of Ayele Y. *et al*. in Ethiopia in 2018, who found 38.8% [6], and that of Insani WN. *et al*. in Indonesia in 2020, who found 79.5% [18]. The absence of national directives concerning the disposal of medicines present in households and the non-existence of a medicines take-back program in Burkina Faso could explain this relatively low rate compared with other countries with regulations on unused medicines present in households, such as Ethiopia [6].

The significance of the expiry date of medicines was known by 78.42% of respondents in our study, while 70.02% of respondents checked the expiry date of medicines before use. The same observation was made by Insani WN. *et al*. in Indonesia in 2020 (72.8%) [18] and Bashaar M. *et al*. in Afghanistan in 2017 (97%) [16]. This situation could be explained by the different socio-demographic characteristics of the populations in each study. It is essential to be vigilant about product expiry dates in order to ensure the efficacy and safety of medicines and avoid treatment failure.

The doctor and the pharmacist were respectively proposed by 50.36% and 44.84% of respondents as the preferred channel for raising awareness about the management of unused or expired medicines, behind television (54.44%). These results are different from those of Ayele Y. *et al*. in Ethiopia in 2018 according to which the best source was electronic media, only 24.50% of respondents had mentioned doctors [6]. This difference is thought to be due to the beliefs and values that respondents place on health workers and the accessibility of respondents to communication platforms.

Among the respondents, 74.58% said they were aware of the potential environmental hazards associated with improper disposal of unused or expired medicines. These results are lower than those of Ayele Y. *et al*. in Ethiopia in 2018 [6] and Bashaar M. *et al*. in Afghanistan in 2017 who found 86% and 98% respectively [16]. However, they are higher than those of Insani WN. *et al*. in Indonesia in 2020, who found 53.1% [18]. This disparity could be explained by the absence of specific programs to raise awareness of the potential dangers associated with inappropriate disposal of medicines.

In addition to the danger to the environment, 94.72% confirmed the greater vulnerability of children to the risks associated with keeping medicines in households. The results of the present study confirm those obtained by Ayele Y. *et al*. in Ethiopia in 2018 with a slightly lower rate of 61.7% of people who "strongly agreed" that children are more at risk from unused and expired medicines [6]. These results could be explained by the fact that there are many cases of children accidentally swallowing medicines in households [19].

5. Limitations of the Study

This study has certain limitations. Firstly, as our data collection tool was a ques-

tionnaire, it is possible that participants provided subjective or incorrect answers to the various questions due to a possible recall bias. This would have led to under-reporting or over-reporting of household holdings of unused medicines. As a result, the extent of the holding of unused or out-of-date medicines could differ somewhat from the true population measure. To reduce this bias, the survey was conducted by interviewers who understood the local languages, and respondents were given explanations for questions they found incomprehensible. Also, the results of this study cannot be generalized to the entire population of Burkina Faso, given the size of the sample, which is not representative of the general population.

Despite these limitations, this pioneering study has made it possible to estimate the extent to which unused or out-of-date medicines are held in households in the city of Ouagadougou, and to understand that disposal practices do not comply with applicable good practice, which entails risks for human and environmental health.

6. Conclusions

This study assessed the management and disposal practices for unused or out-of-date medicines in households in the Ouagadougou commune. The data were collected by means of a household survey. The study, which was carried out in 417 households in the Ouagadougou commune, revealed that the management of medicines in households is a real health problem.

A high rate of storage of medicines in households is a danger for the family, especially children. Poor disposal of medicines can also be a source of danger for soil, water and animals, hence the importance of ensuring that unused or out-of-date medicines are disposed of properly. This involves both raising public awareness of the problem and setting up initiatives to collect and dispose of medicines in households.

These results could serve as a guideline for future studies. Ideally, the study sites should be extended to other towns in Burkina Faso. It would be interesting, for example, to check the impact of poor disposal of medicines on the environment.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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