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Research Article

Management of Unused Medicines in Households in Cotonou in 2022

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ABSTRACT

Background: The adequate management of Unused Medicines (UNM) is a major public health issue because their availability in households poses problems of health safety (self-medication, misuse, antibiotic resistance, accidental domestic poisoning) and environmental (contamination of surface water and underground chemicals). They also represent a societal cost. In addition, since the drug is not a trivial product, it must be used under very specific conditions and disposed of according to specified procedures to ensure health and environmental safety.

Objective: The general objective of this study was to study the management of unused or expired medicines by households in Cotonou and the associated health and environmental safety problems in 2022.

Settings and methods: This was a descriptive and analytical cross-sectional study conducted over a period of 4 months in the city of Cotonou. Our sample size was 402 households selected using multistage probability sampling. Data were collected using a digitized questionnaire on a smartphone using CSPro version 7.7 software and data analysis was performed using R version 4.1.3 statistical software.

Results: A total of 402 households responded to our survey questionnaire. Respondents from surveyed households were on average 42.66 years old (± 12.5 years). The minimum age was 18 while the maximum recorded age was 85. There were 247 men (61.44%). Ninety five point seventy seven percent (95.77%) of households had MNU in their possession, which was mainly represented by antiinflammatories/antipyretics, vitamins and antibiotics. The majority of respondents (88.49%) checked the expiry date of the MNU before reuse. However, 5% of respondents did not check the expiry date before reuse. A proportion of 93.77% of households disposed of MNU through household waste and 95% of household representatives surveyed had never received training or information on the proper management of MNU. It was declared 8.50% of cases of drug poisoning due to MNU. In addition, more than half (78.11%) of respondents were unaware that improper disposal of MNU could have a negative impact on the environment. Age and male gender were the factors favoring the possession of MNU within households. When the age of the head of household increases by one year, he is 0.9 times more likely not to store UMNs in his household. In addition, households headed by a man are 7 times more likely to have unused materials stored at home compared to households headed by a woman. The majority of respondents also felt that safe disposal of MNU, the establishment of a collection structure and raising awareness of the general public on the proper management of MNU were necessary.

Conclusion: The study showed that most households had MNU on them, sometimes with reuse without checking the expiry date and disposal *via* household waste. This situation poses health and environmental safety problems that require the implementation of strategies to strengthen the management of pharmaceutical waste.

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Keywords: Unused drugs; Health and environmental security; Households; Environmental safety problems

INTRODUCTION

Home storage of drugs is a public health problem worldwide, due to the misuse of drugs and/or non-compliance with drug treatments. This therefore affects health, the environment and health care services. While timely access to medicines is essential, there are global concerns about unnecessary storage, inappropriate use of medicines and the dangerous disposal of leftover medicines.

The drug is a particular product whose handling must be controlled and traced from its manufacture to its destruction. Its use must be rational in order to preserve health and not harm it. The management of Unused Medicines (UNMS) is a major public health issue. In France, pharmacists have an obligation to collect for free unused medicinal products for human use reported by individuals [1]. Since 1 January 2009, the humanitarian redistribution of UNMS is no longer allowed. All UNMS must be destroyed by incineration with energy upgrading [2]. In 2020 in France, 78% of French people reported that their unused medicines were deposited with the pharmacist. Of these 57% report doing so systematically [3].

Considering the regulatory framework in force in Benin, the medicine is subject to rigorous and permanent monitoring, on the scientific, medical, technical and administrative levels, legal and economic from its production in the pharmaceutical industries to its dispensing to the patient. This usual pharmaceutical circuit can be summarized as laboratory manufacturer distributor wholesaler's dispatchers pharmacy patient. The drug, like any product, has a period of validity during which it can be consumed. After this period, it becomes hazardous to the health of the consumer and must therefore be removed and destroyed in accordance with current regulatory procedures.

MATERIALS AND METHODS

Few studies have been conducted on the public's habits in managing drug surpluses. There is also a lack of communication on good management practices for unused, damaged or expired medicines. The purpose of this study is to collect and analyze the different habits of households in Cotonou with regard to the management of unused medicines. It also addresses health and environmental safety issues arising from the management of drugs not used in households [4].

Research questions

The purpose of this study was to answer the following questions:

- How often are UNMs present and reused in Cotonou households?
- What are the therapeutic classes and galenical forms of UNMS stored in the households of Cotonou?
- What do households know about UNMS management?
- What are the factors favoring UNMS storage in Cotonou households?

Research assumptions

H_1: Home storage of UNMs promotes self-medication.

H_2: Socio-demographic and economic factors are associated with the storage of UNMs in households.

Study objectives

Objectives: The overall objective was to study the management of drugs not used in households in Cotonou.

More specifically, it involved:

- Determine the frequency of the presence of unused drugs in Cotonou households;
- Determine the frequency of the reuse of unused drugs in Cotonou households;
- Identify the therapeutic classes and pharmaceutical forms of unused drugs available in Cotonou households;
- Determine the knowledge of households on the management of unused medicines;
- Identify sociodemographic or economic factors that favor the storage of unused medicines in Cotonou households.

Explanation of the conceptual framework: The proper management of UNMS in households presents several challenges on several levels (health, environmental) and also represents a cost. Several factors are associated with the presence of UNMs in households; this ultimately results in health problems (self-medication, misuse, domestic drug intoxication, antibiotic resistance) and environmental problems (contamination of surface and ground water). It is therefore a public health problem that must be taken with the greatest importance in order to limit the inconvenience. Among the factors that frame the presence and management of UNMs in households we note those related to the Beninese health system and factors related to patients.

Factors related to the Beninese health system

From a regulatory point of view, there is a lack of texts governing the management of UNMs in the Republic of Benin. It should therefore be noted that there is a lack of mechanisms for informing the population on how the UNMs present must be managed in households. In Benin, the absence of such a body also contributes to the insecure management of UNMs in households. The WHO considers that the combination of five drugs constitutes a threshold at which we can speak of polymedication [5]. There is no consensus on the definition of polyprescription or polymedication. In the literature, it is described by a prescription containing 3 to 5 drugs [5,6]. Its repercussions are multiple including the increased risk of potentially dangerous drug interactions, including iatrogenia; decreased patient adherence and the risk of confusion in drug

intake; the increase in the cost of taking over; increasing the number of inappropriate treatments and increasing the amounts of drugs not used in households. On top of that, we can also note prescriptions where the number of prescription boxes far exceeds the prescription period. This also increases the amount of UNMS stored in family medicine cabinets. In addition, the poor quality of marketed drugs could lead to ineffective treatments and thus to therapeutic failure. This would result in the existence of UNMs within households. This aspect of the problem could not be studied during the study.

Patient factors (Population

The lack of information on what to do about the management of UNMs contributes to the storage of these drugs. On the other hand, the socio-economic level of some families means that they very often tend to keep surplus unused drugs for reuse when one of the family members will have symptoms similar to the previous ones. This contributes to self-medication. It will encourage them to take decisions that will allow them to better monitor the problem through the establishment of a mechanism to inform the population about the right attitude to adopt in the management of UNMS. It will also allow the establishment of an eco-agency responsible for collecting UNMs from the population and a well-defined regulatory framework for the management of UNMs in Benin.

Definition of concepts

Drug: According to the WHO, a drug is defined as: any substance or composition presented as having preventive or curative properties with respect to human or animal diseases, as well as any product that can be administered to humans or the animal with a view to establishing a medical diagnosis or restoring, correcting or modifying their physiological functions.

Its manufacture is done according to good manufacturing practices in order to guarantee the three fundamental qualities of the drug, namely quality, efficacy and safety.

With regard to UNMS, there are various definitions in the literature. We will retain that of Olivier Ballu in his report on the status of the UNMS which seems to be the most complete; this is any medicine acquired with or without a medical prescription and not used [7].

According to the WHO, we speak of the rational use of medicines when patients receive treatments appropriate to their medical needs, at doses that correspond to their individual characteristics, for an appropriate duration and at the lowest cost for them or their community.

Drug misuse: The public health code defines misuse as the intentional and inappropriate use of a drug or product that does not comply with its Marketing Authorization (MA) or good practice recommendations. (Article R5144-4 Public Health Code).

Self-medication: According to the WHO, self-medication consists in the fact that an individual has recourse to a drug, on his own initiative or that of a loved one, with the aim of treating a condition or a symptom that he has himself identified, without having recourse to a health professional. Medicines all contain one or more active substances which can become toxic at high doses or if taken inappropriately. Drug poisoning is therefore defined as poisoning caused by one or more drugs. It can be voluntary, as part of a suicide attempt or accidental. In the latter case, it mainly concerns children and the elderly. It also refers to all disorders due to inappropriate or excessive intake of one or more medications [8].

Deprescribing: Already in 1806 deprescribing was defined as follows: "It is not an art of little importance to prescribe medicines correctly, but it is an art of much greater difficulty than to know when to stop them or not to prescribe them." [9]. The term deprescribing is a neologism cited in the literature as early as 2004 as being "the act aimed at voluntarily stopping a prescription" or "the action of removing a useless, inappropriate or dangerous treatment" [10].

State of knowledge

The management of unused drugs has several challenges in terms of domestic health safety, environmental safety but also financially because they represent a societal cost. Used in conditions not indicated or outside its period of validity (after the expiry date), the drug can become a danger to human health. Improper storage and disposal of unused pharmaceuticals could have adverse consequences by leading to cases of accidental drug poisoning, which can pose a health threat [11]. When they are thrown in the trash cans as household waste, they can contaminate surface or ground water. Hence the need for better management of UNMS for their clean and safe disposal. Therefore, the destruction of UNMS must be done according to a precise procedure [12]. Otherwise disposed of, they can contaminate the environment in general and surface and ground water in particular; which ultimately represents a danger to the health of the population. It is therefore for this purpose that unused medicines should be returned to the pharmacy where they were purchased for clean and safe disposal. Until 2009, unused drugs were redistributed to poor countries. In Benin, to date no regulatory provision stipulates how drugs not used by the population should be managed for clean and safe disposal. No regulatory text makes the collection of said drugs compulsory for the community pharmacist. We also note the lack of a body responsible for collecting unused drugs.

Domestic health security: UNMSs can be at the origin of abuses, such as taking non-prescribed treatments, with consequences that can impact public health. Indeed, having UNMS at your disposal facilitates self-medication which can be a source of domestic accidents. Self-medication has been advocated.

Environmental safety: Drug residues are found in the environment. Their presence is explained by a natural excretion of the active ingredients and derived metabolites in the urine and faces of the human population, diffuse pollution on the production sites as well as the elimination of unused drugs *via* waste water (sinks/toilets) or landfills (soil and water pollution). Most of the time, we observe an irresponsible attitude of consumers who find it easier to throw unused medicines in the

trash cans or toilets rather than bring them back to the pharmacy. Concentrations of drugs are mainly found in surface or underground water, waste water or in sludge from treatment plants; they vary from nanogram to microgram per liter [13]. Some medicinal substances can have a significant impact on flora and fauna, particularly in terms of antibiotic resistance or endocrine modulation which can occur at low doses. However, such ecological impacts, at low concentrations and especially in combination, have been insufficiently assessed to date.

The human risk would consist of a transfer to humans of these residues after spreading on the soil *via* food plants and/or livestock. The possibility of this health risk for humans, due to the exposure of populations to residues of medicinal substances, is not yet sufficiently documented and their presence in surface and underground water, or even in tap water, does not doesn't seem worrying. Exposure to such residues by water intended for human consumption depends both on the quality of the resources used and the effectiveness of their drinking water treatment. Traces of medicinal substances belonging to around forty therapeutic classes have been detected in surface water at the outlet of wastewater treatment plants in France. It has been demonstrated that the rate of destruction or retention in the sludge of waste water from wastewater treatment plants varied greatly according to the therapeutic classes and, within the same class, according to the substances (from 30 to more than 90%). It has also been demonstrated that wastewater treatment plants can transform certain substances and restore them to a biologically active form. In order to anticipate the presence and impact of drug residues, the main idea would be to turn to the prescriber in order to promote the reduction of the dosage of drugs during the prescription and consequently the environmental effects (natural excretions including when bathing, improper disposal of excess medication).

The advantages of this change in practice are numerous according to the authors with, among others the maintenance of the medical benefit with a reduced dose likely to limit drug residues in the environment as well as the risk of adverse effects, drug diversion, poisonings, a reduction in health care costs and a limitation of unused drugs likely to be discarded [14]. In addition, there is a classification of specialties that would allow doctors to favor the prescription of active substances compatible with the environment according to the concept of drug design. The environmental impact of drugs is already taken into consideration by the regulations for marketing authorizations for drugs for human or veterinary use. Nevertheless, these regulations do not consider all the ecological consequences, in particular in the long term, of the discharges of residues of these medicinal substances and their metabolite or other derivatives (Table 1).

Table 1: Environmental impact of active substances according to drug design criteria.

Drug design criteria	Environmental impact
100% oral absorption	Lower excretion
Metabolization into inert substances	Discharge of inert residues
Effective on all patients treated	Reduced use
Specific receptors	No effects on healthy receptors
No other effects than expected	No side effects

Source: Kummerer ed: Green and sustainable pharmacy

Societal cost of unused medicines

- **In France, UNMS are supported by the Cyclamed association:** Cyclamed is financed by pharmaceutical laboratories at the rate of a contribution of 0.22 euros per box of drugs sold in pharmacies. This financial support by pharmaceutical laboratories responds to the principle of extended producer responsibility [15] which was introduced into French law in 1975. This is an operational variation of the "polluter pays" principle in the field of waste management

Management of unused medicines in other countries: Cyclamed is an association established by law and responsible for the collection of unused medicines in France. Created in 1993, it brings together all professionals in the drug chain and is under the supervision of the French order of pharmacists.

Operational since 1994 and approved by the public authorities, this system was set up in response to the obligation imposed on manufacturers "to be able to or to contribute to the elimination of household packaging waste" from the products they market. This system for the collection and destruction of unused medicines was set up in accordance with European directive 2004/27/EC of 31 March 2004. "Member States shall ensure that appropriate collection systems are set up for unused or out of date medicines. The decree of March 3, 2009 approves the organization of the waste management system for unused medicines by the Cyclamed association [16]. Decree 2009-718 of June 17, 2009 specifies the procedures for the collection of unused medicines and the procedures for the destruction of these medicines, which are the responsibility of pharmaceutical companies operating medicines in application of the principle of extended producer responsibility (article L. 541-10 of the environmental code). The financial responsibility is the responsibility of the manufacturers: "the operators contribute or

provide for the taking in charge of the collected unused medicines" (Figure 1).

Figure 1: Operation of the Cyclamed device.

On the other hand, receptacles (boxes) are given free of charge to pharmacies. The unused medicines are placed in a box marked with the Cyclamed logo. Once the box is full, it must be identified with the name of the pharmacy before being given to the delivery person of the wholesale distributor. The wholesale distributor, who has collected the boxes, stores them for a time in a specific container. When the container is full, the professional contacts a service provider responsible for transporting the pharmaceutical waste to the nearest approved incineration site. The drugs and their packaging are burned at 850°C. The household waste incineration plants selected by Cyclamed comply with the strictest environmental standards. These centers are not only dedicated to medicines, but also to various types of household waste. The energy recovered is used for lighting and heating buildings

In France, there are fifty five incineration centers spread throughout the country to dispose of unwanted medicines in an environmentally friendly manner and to recover energy in the form of heat and/or electricity [17]. The whole process, from the boxes to the destruction, is financed by a contribution from the pharmaceutical industry of a few euro cents per box sold. The pharmaceutical industry has preferred to create a waste collection system for the following reasons:

- The drug is not a product like any other, it is subject to many controls and is under the responsibility of a pharmacist from its production until it is delivered to the patient;
- To preserve public health by avoiding that medicines are deposited on the public highway or remain in the medicine cabinets, within the reach of all (prevention of domestic accidents, reduction of the risks of involuntary or voluntary intoxication, prevention of drug addiction);
- To participate in the protection of the environment;
- The distribution of pharmacies in the territory allows reaching the whole population, the presence of the pharmacist and the daily deliveries by the wholesaler form a safe and efficient system for the collection of the M.

Study framework and method

Study setting: Covering an area of 79 km^2, the city of Cotonou is located in the south of Benin, between 2°26' and 2°41' East longitude and 6°22' and 6°27' North latitude. The city extends over 10 km in length and 6 km in width and is limited to the East by the town of Sèmè-Podji and to the West by the town of Abomey-Calavi, to the North and to the South, respectively by Lake Nokoué and the Atlantic Ocean. It represents the Littoral department and has 13 districts subdivided into 144 neighborhoods.

Demography: The population of Cotonou was estimated at 320,348 inhabitants in 1979 according to the 1st General Census of Population and Housing (RGPH1) and rose to 536,827 inhabitants in 1992, representing an intercensal growth rate of 4.05%. In 2002, according to the RGPH3, the population of Cotonou was estimated at 665,100 inhabitants, representing a growth rate of 2.07%. It had 679,012 inhabitants in 2013 (INSAE, 2013). In 2021, its population is estimated at 679,121 according to the intercensal growth rate of 0.2% (INSAE, 2013). In addition, it is important to note that the populations of the surrounding regions come to increase the population of Cotonou during the day in the exercise of their activity (civil servant, merchant). This justifies the choice of this city for our study because of its cosmopolitan character, with several ethnic groups and different socio-cultural habits (Figure 2).

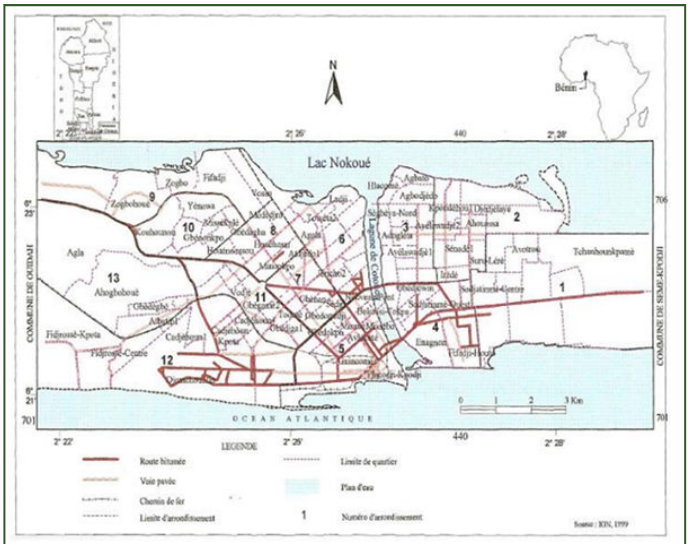

Figure 2: Map of Cotonou.

In addition, the majority of pharmacies in Benin are located in Cotonou, 107 out of 311 nationwide. The pharmacies are owned by a doctor of pharmacy with a state diploma. He obtains his supplies from state approved wholesale distributors who import the drugs according to the procedures in force. The pharmacist dispenses medicines to the population at prices approved throughout the national territory by the State. Thus, any individual can go to a pharmacy to obtain a drug either on presentation of a medical prescription given by the pharmacist

or on request for certain family medication or on the advice of the pharmacist. At the same time, in the markets or even in some homes in Cotonou, there is still an informal drug distribution circuit. These distributors obtain their supplies illegally, thereby facilitating access to counterfeit medicines.

Study methods

Type of study: This was a descriptive and analytical cross-sectional study.

Study period: Our study took place over a period of four (04) months from November 1st 2021 to February 26th 2022.

Study population: The study population consisted of households in Cotonou.

Sampling: Sample size.

To determine the sample size we used the Schwartz formula.

According to the Schwartz formula,

$n=t^2 \times p \times (1-p)/m^2$ with

n: the sample size;

t: the confidence level (the standard 95% confidence level value will be 1.96)

p: proportion of households keeping unused medicines. As it is not known, we have considered 50%.

m: margin of error (usually set at 5%)

Since we have no preexisting data on the issue, the proportion of households keeping unused medicines will be estimated at 50%.

Thus:

$n=1.962 \times 0.5 \times 0.5/0.052$

n=384.16 households

Or n=385 households

Selection of participants

Inclusion criteria

The following were included in the survey Any household located in the commune of Cotonou, The presence of a representative of the household aged at least 18 years was necessary to answer the questions.

Exclusion criteria

All households for which incomplete information was collected were excluded from the study.

Sampling Method and Technique

A probability sampling procedure was used in this study. The sampling technique was a multi-stage random survey. Seven of the 13 districts of Cotonou were randomly selected. In each selected district, we randomly selected 25% of the neighborhoods.

According to the demographic weight of each selected neighborhood, the number of households to be surveyed per neighborhood was determined. From the largest crossroads in the selected neighborhood we proceeded to throw a pen in the air and then follow the direction indicated by the cap. The concessions were numbered on the direction.

The number of the first concession to be selected was determined randomly and the following successive concessions were visited to identify the households. If the expected number of households was not reached in the selected direction, we returned to the center of the neighborhood to select a new direction. In each concession only one household was selected. If a concession had several households, one household was selected at random. To respect the gender aspect, when a woman was surveyed in a household n, a man was surveyed in a household n+1 if possible.

Variables under study

Dependent variable:

- The existence of UNMs
- The management of UNMs

Independent variables: These were variables related to the health system and those related to individuals.

Variables related to the health system:

- Variables related to the regulations governing the management of UNMs in Benin: regulatory texts governing the proper management of UNMs, structure established by law responsible for collecting UNMs from the population.
- Variables related to the population's knowledge of good practices in the management of UNMs: the population's information system on the safe management of UNMs; the population's access to consistent information on the safe management of UNMs.
- Variables related to prescribing: overprescribing, advice on use.

Variables related to individuals: Demographic variables: age, gender, occupation and education level.

Organization of data collection

The interviewers were trained on data collection: They were trained on

- The subject.
- The information to be collected.
- The definition of questions.
- How to contact the interviewee.
- Techniques for conducting a survey.
- Ethics of health research.
- Application of exclusion and inclusion criteria.
- The application of survey steps.
- The use of digital collection tools.

During the training, interactive sessions with role plays were organized. If necessary to facilitate understanding of the interviewees, the questionnaire was translated into local Fon and Goun languages. The study was supervised by the researcher to ensure that the methodology was followed.

Pre-testing of the questionnaire: A pre-test phase was organized in the commune of Abomey-Calavi to ensure that the questions were well understood and to make any necessary corrections.

The questionnaire was digitized on smartphones using the CSPro version 7.7 software.

Data processing and analysis

Data processing: The smartphone based questionnaire allowed for real time control of the consistency of the information in order to ensure its reliability, completeness and exhaustiveness. The collected data were recoded as needed to facilitate interpretation. Unavailable values (the case of omissions or refusals to answer) were replaced by the average for quantitative variables and by the mode for qualitative variables.

Data analysis

Descriptive statistics: The data are presented mainly in the form of graphs and tables. Quantitative variables are presented by their means with their standard deviations. Categorical variables are presented as percentages with total numbers.

Statistical inference: Neyman and Pearson's chi^2 test was used to measure the association between categorical variables while Student's t test was used to measure the comparative association of means.

Logistic regression was used to measure the effect of the different explanatory variables on the explained variable: household ownership of UNMs. The different analyses were performed in the statistical software R version 4.1.3.

Administrative aspects and ethical considerations

Administrative aspects: An authorization for data collection was requested from the City Council, which was granted under the reference number:

N°138/MCOT/SG/SGA/DEPP/DAEPP/SEPUZA/CDPUZA.

Risks and minimization strategies

Risks: Potential risks for participants in this study include; breach of confidentiality, psychological discomfort and loss of time related to the individual's participation in the study.

In this study, breach of confidentiality may occur if private or sensitive information attributed to a participant is obtained by persons not involved in the research project.

The specific risks associated with breach of confidentiality are as follows:

- Psychological risk, due to the sensitive nature of the questions asked of respondents
- Psychosocial risk due to the intrusion into the privacy of participants.

Strategies to minimize risk: All data and information from the study are managed in the most confidential and anonymous manner possible. All data from this study have been aggregated. Thus, no participant can be identified from the data.

Participants' rights: Study participants are informed of all the risks and protections associated with free and informed consent. They are also informed of their rights not to answer any question they are not comfortable with.

In addition, no compensation (gadgets, money, etc.) is provided for participation in this study.

Data: All data from this study were aggregated. No individual participant will be identified.

Data collection procedures: During interviews, participants are informed of the confidentiality of the information collected to protect their privacy.

Against psychological risk: During the interview, the interviewer should remind the respondent as he/she goes along that he/she has the option of interrupting or choosing not to answer the question. The interviewer should allow the respondent to recover before continuing the interview.

Against inconvenience: The interviewer will inform the respondent in advance of the approximate length of the interview (30 minutes).

Benefits of the study:

- No financial or material benefits are expected for the participants in this study. However, they were given the opportunity to give their opinions on what they think about the subject eventually.
- The benefits that are linked to this study are of a general nature, for all Beninese in the sense that if we manage to take into account the suggestions resulting from this study and that effective measures are taken, it will be for the health security of all and for the preservation of the environment in which we live.

RESULTS

In this chapter, we have presented the results of the analysis of the survey data according to the specific objectives formulated. First (quantitative aspect), after a presentation of the socio-demographic and professional characteristics of the surveyed population, we described the frequency of the presence and reuse of unused medicines by households in Cotonou. Then, the therapeutic classes and galenic forms of unused medicines available in the households were described. In a second step (qualitative aspect), we presented the knowledge of households with regard to the management of these medicines; the conditions of storage of these medicines in households. Finally, we looked at the factors that encourage the storage of unused medicines in households.

Description of the study sample

Four hundred and two households were registered during the survey itself in seven randomly selected districts of Cotonou.

Table 2 below presents the neighborhoods, the number of households sampled and the average number of children present in the households by arrondissement in the commune of Cotonou.

Table 2: Distribution of households surveyed by neighborhood and borough.

Boroughs	Neighborhoods sampled	Number of households surveyed	Average number of children per household ± ET
2nd	Lom'nava	10	1,91 ± 1,10
	Kpondehou I	28	
	Irede	19	
3rd	Agbodjedo	26	1,94 ± 0,94
	Ayelawadje II	21	
	Adogleta	18	
5th	Wlacodji Kpodji	6	2,09 ± 2,21
	Mifongou	5	
	Nouveau Pont	4	
	Guincome	8	
6th	Gbedjromede	5	2,29 ± 1,46
	Hinde I	16	
	Aidjedo III	20	
	Ahouansori Agata	14	
	Vossa	5	
11th	Allobatin	8	1,70 ± 1,02
	Gbegamey II	10	
	Gbegamey IV	15	
12th	Fiyegnon I	30	1,4 ± 1,07
	Fidjrosse Centre	37	
	Vodje Kpota	19	
	Cadjehoun 3	9	
13th	Missite	20	2,06 ± 1,06
	Houenoussou	47	

The average age of respondents in the surveyed households was 42.66 ± 12.5 years. The minimum age was 18 years while the maximum age recorded was 85 years. In addition, most of the respondents surveyed were between 30 years to 39 years old. There were 247 men (61.44%). According to their status within the household, there were 235 (58.46%) heads of households, 143 (35.57%) respondents who were spouses of the head of household, 14 (3.48%) children/nephews/nieces of the head of household and 10 (2.49%) brothers/sisters/cousins of the head of household.

Considering the professional category of the respondents, we noted 147 (36.57%) merchants/vendors, 82 (20.40%) craftsmen/apprentices, 56 (13.93%) professionals, 29 (7.21%) carriers, 41 (10, 20%) government or private employees, 12 (2.99%) retired, 10 (2.49%) students/pupils, 7 (1.74%) entrepreneurs, 6 (1.49%) farmers/farmers, 4 (0.99%) fish farmers/breeders and 8 (1.99%) respondents who are not active.

Table 3 below presents the socio-demographic and professional characteristics of the respondents in the households surveyed.

Table 3: Socio-demographic and professional characteristics of respondents in the surveyed households.

	Number	Percentage (%)	Mean ± Et (Min, Max)
Age (in years)			
18-29	48	11,94	
30-39	145	36,07	42,66 ± 12,50 years
40-49	102	25,37	(18 years, 85 years)
50-59	63	15,67	
60 and over	44	10,95	
Gender			
Male	247	61,44	
Femal	155	38,56	
Status of the respondent			
Head of household	235	58,46	
Spouse of head of household	143	35,57	
Children/nephews/nieces of head of household	14	3,48	
Brothers/sisters/cousins of head of household	10	2,49	
Respondent's occupation			
Merchants/vendors	147	36,57	
Craftsmen/apprentices	82	20,40	
Liberal profession Transporters	56	13,93	
Transporters	29	7,21	
Government or private employee	41	10,20	
Retired	12	2,99	
Students/Pupils	10	2,49	
Contractors	7	1,74	
Farmers/farmers	6	1,49	
Fish farmers/breeders	4	0,99	
No activity	8	1,99	

Presence of unused medicines in households

Of the 402 households surveyed, 385 (95.77%) had unused medicines in their possession, while 17 (4.23%) did not have any at the time of the interview or in the last three months. Figure 3 shows the overall frequency of presence of unused medicines in the surveyed households.

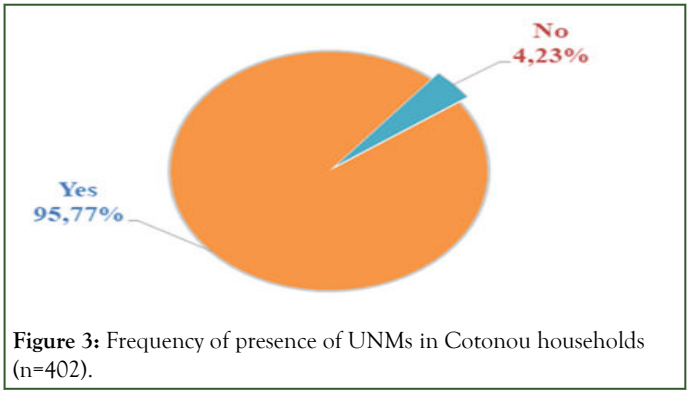

Figure 3: Frequency of presence of UNMs in Cotonou households (n=402).

Table 4 below presents the frequency of presence of UNMs in surveyed households by arrondissement.

Table 4: Presence of UNMs in households by district.

Variables	Numbers	Percentage (%)	Average number of drugs ± Et
Districts			
2nd district	48	12,46	1,67 ± 1,02
3th district	65	16,17	1,52 ± 0,50
5th district	20	4,98	2,15 ± 0,88
6th district	62	15,42	2,05 ± 0,89
11th district	33	8,21	1,67 ± 0,65
12th district	89	22,14	2,15 ± 0,68
13th district	68	16,92	2,01 ± 1,01
Total/Average number of UNMs per household	385	95,77	1,90 ± 0,85

In the 2nd district, the frequency of presence of unused medicines was 12.46%, in the 3rd district 16.17%, in the 5th district 4.98%, in the 6th district 15.42%, in the 11th district 8.21%, in the 12th district 22.14% and in the 13th district 16.92%. The average quantity stored was 1.90 ± 0.85.

Sources of supply of unused medicines by households

Of the 385 households with unused medicines, 283 (73.51%) of the respondents reported having purchased them from the pharmacy with a prescription, 110 (28.57%) had obtained them from the pharmacy on the advice of a health care provider, 137 (35.58%) from the pharmacy on request, 7 (1.82%) had received them from a friend/other person, 3 (0.78%) had purchased them from the informal system.

Table 5 below summarizes the different sources of supply of unused medicines found in the surveyed households. Most of the unused medicines available in the households were purchased from the pharmacy with a prescription.

Table 5: Sources of supply of unused medicines in Cotonou households (n=402).

Sources of supply of unused medicines	Number	Percentage (%)
At a pharmacy with a prescription	283	73.51
At a pharmacy on the advice of a health care provider	110	28.57
At the pharmacy at your request	137	35.58
Received from a friend/other person	7	1.82
Drugs not sold at a pharmacy	3	0.78

Reasons for the existence of unused medicines

There were various reasons for the presence of unused medicines in the households surveyed. Indeed, 378 (98%) of the respondents stated that the medicines were no longer used because the patient's health had improved, 8 (2%) stated that the patient was pregnant, 38 (10%) said that the instructions for use were not clear, 23 (6%) were due to non-compliance with treatment, 23 (6%) were related to the death of the patient, 23 (6%) were due to the drug being out of date, 38 (10%) were related to the doctor changing the current treatment and 1 (0.26%) due to the occurrence of allergic reactions (Figure 4).

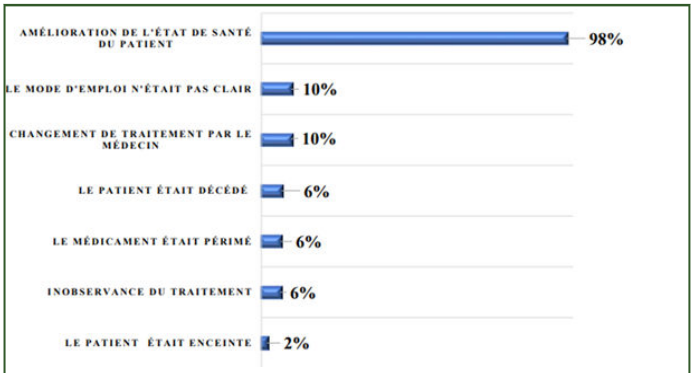

Figure 4: Reasons for the existence of MNUs in Cotonou households (n=402).

Reasons for keeping the UNMs

Most of the respondents stated that they kept the UNMs for future reuse (80%, 308 out of 385 respondents). Sixty two respondents or 16% kept them in case a friend or acquaintance needed them and 15 respondents (about 4%) did not know how to dispose of them. Figure 5 below presents the reasons for keeping the UNMs.

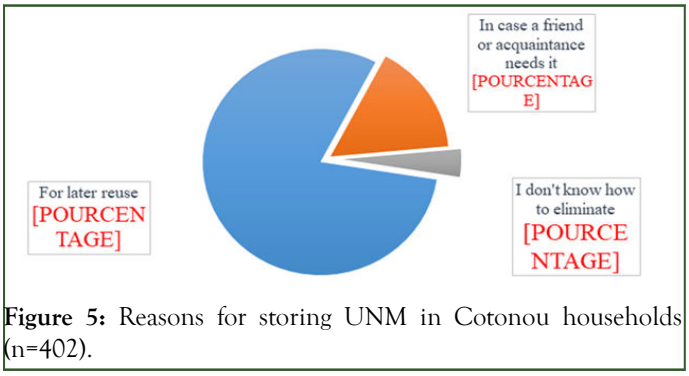

Figure 5: Reasons for storing UNM in Cotonou households (n=402).

Precautions before reuse of UNMs

Before any reuse of UNMs, 19 (5%) of the respondents did not take any precautions, 323 (88.49%) checked the expiration date, 98 (26.85%) checked the color to make sure that there was no change in color before administration of the medicine. One hundred and thirty respondents (35.62%) check before reuse, 89 (24.38%) check the smell of the medicine and 1 (0.27%) respondent declared to go back to his doctor before any reuse of UNM (Figure 6).

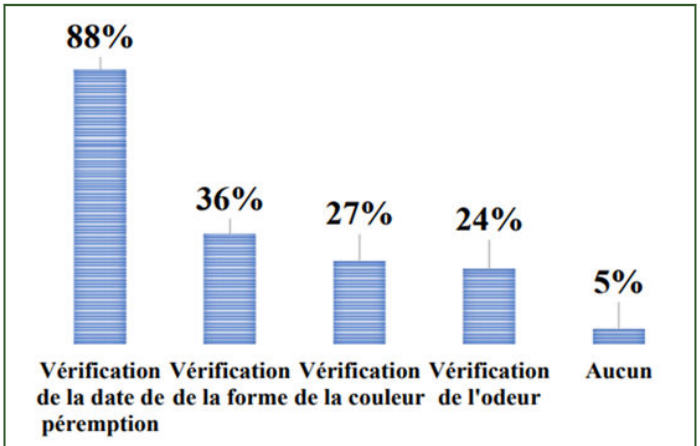

Figure 6: Precautions taken before reuse of MNU by households in Cotonou (n=402).

Thus, we note that the most common precaution taken by the surveyed population before any reuse of UNMs is to check the expiry date of the UNMs.

The pathologies or symptoms motivating the storage and reuse of UNMs

The diseases for which the households surveyed stored and reused the UNMs were represented by 52.73% by malaria, 22.60% by infections, 5.45% by nausea/vomiting, 50.91% by fever/chills/headaches, 12.73% by diarrhea, 34.03% by cold/flu, 35.58% by pain, 8.05% by parasitosis, 2.60% by High Blood Pressure (HBP), 1.04% by anxiety and anemia and 0.26% by diabetes.

Table 6 below presents the different pathologies or symptoms motivating the reuse of UNMs.

Table 6: Diseases or symptoms motivating the storage and reuse of UNMs in Cotonou households.

Diseases	Number	Percentage (%)
Malaria	203	52.73
Infections	87	22.6
Nausea/vomiting	21	5.45
Fever/chills/headache	196	50.91

Diarrhea	49	12.73
Cold/flu	131	34.03
Pain	137	35.58
Parasitosis	31	8.05
HTA	10	2.6
Anxiety	4	1.04
Anemia	4	1.04
Diabetes	1	0.26

Cases of drug intoxication linked to the reuse of unused medicines

Thirty one or 8.50% of the respondents reported having had cases of household drug poisoning related to reuse of UNMs while 334 (91.50%) reported never having had such cases. Figure 7 below presents the number of cases of domestic drug poisoning related to the reuse of UNMs (in %).

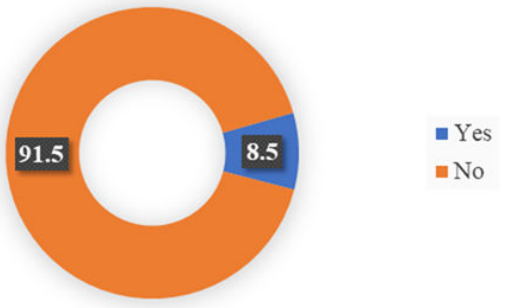

Figure 7: Cases of drug poisoning related to the storage and reuse of unused medicines in Cotonou households (n=402).

Therapeutic classes of UNMs available in households

During our study, different therapeutic classes were listed in the households surveyed. These were 46 (11.95%) anti-diabetics, 163 (42.34%) vitamins, 147 (38.18%) antibiotics, 48 (12.47%) anti-helminthics, 18 (4.68%) anti-hypertensives, 274 (71.17%) anti-inflammatory/antipyretics, 1 (0.26%) anti-ulcer, 12 (3.12%) anti-malarial and 1 (0.26%) laxatives (Figure 8).

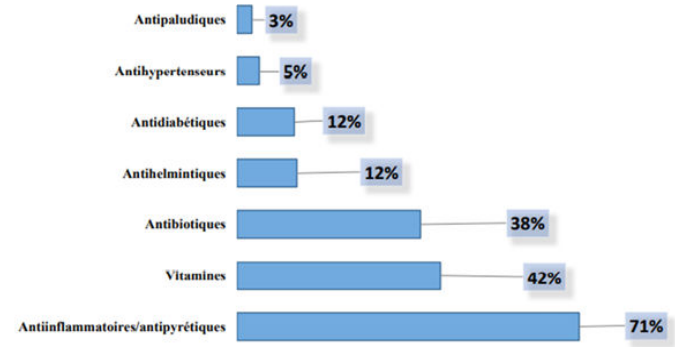

Figure 8: Therapeutic classes of drugs available in households from Cotonou (n=402).

Galenic forms of UNMs available in households

Various galenic forms of UNM were found in the households we surveyed during our study. These included 7.27% suspensions, 52.73% syrups, 2.60% suppositories, 93.51% tablets, 0.26% eye drops, 1.04% nasal drops, 0.26% ear drops, 3.64% creams/ointments, 1.82% injectables and 6.75% capsules (Figure 9).

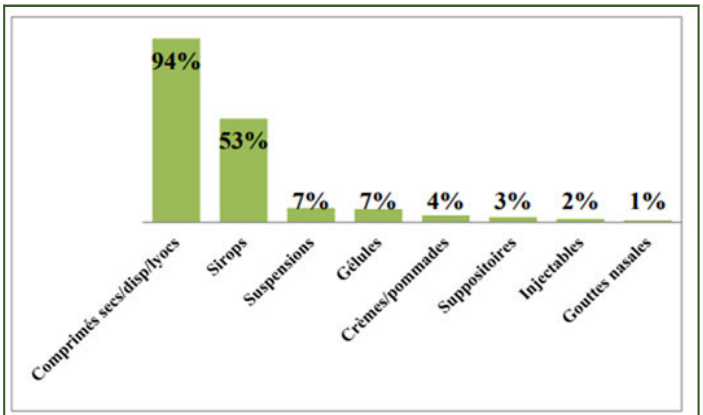

Figure 9: Galenic forms of unused drugs found in the Cotonou households (n=402).

Household understanding of the term "unused medicine

Regarding the understanding of the households surveyed of the term "unused medicine", 86 (21.39%) said that it meant "expired medicine", 327 (81.34%) said that it meant any "medicine that is not used" and 24 (5.97%) said that it meant "leftover medicine from the current treatment".

Figure 10 below shows the different understandings of the term "unused or expired medicine" by households.

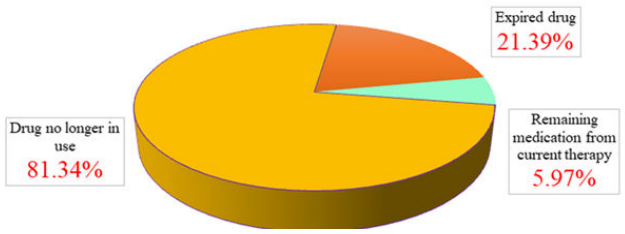

Figure 10: Understanding of the term "unused medication" by households in Cotonou (n=402).

Training or information received on the management of unused medicines

When asked if the respondents had ever been trained on the management of unused medicines, only 2 respondents (0.5%) said they had received training, while 99.50% had never received any training. The trainers reported were the medical officer and Non-Governmental Organizations (NGOs).

As for information on the management of unused medicines, 15 (3.73%) of the respondents reported having received it while 387 (96.27%) had never received it. The sources of information were the media, 13 (3.23%) and health workers 2 (0.5%).

Table 7 below presents the number of people who have received training or information on the management of UNMs, as well as the sources of this training or information.

Table 7: Training or information received on UNM management by households in Cotonou.

	Number	Percentage (%)	Sources
Training on UNM management			Medical advisor NGO
Yes	2	0.5	
No	400	99.5	
Information sur la gestion des UNMS			Media Health Officer
Yes	15	3.73	
No	387	96.27	

Knowledge of the risks associated with the storage and reuse of UNMs

A variety of responses were recorded during our study. The majority of the respondents stated that home storage of unused medicines and their reuse posed a risk to children and would facilitate irrational consumption of medicines. Also, the medicine could expire at home and become a danger to children. To a lesser extent, some respondents stated that there was a risk of poisoning or drug poisoning (Figure 11).

Figure 11: Knowledge of the risks associated with storage and reuse MNU by Cotonou households (n=402).

Households' perception of the adequacy of UNM management

Knowledge of the effects of improper disposal of UNMs on the environment: The majority of the respondents understood that improper disposal of unused medicines had negative consequences on the environment, 314 (78.11%) of the respondents while 88 (21.89%) did not know.

When asked about the possible environmental consequences they were aware of, various responses were recorded. Among them, the ones that came up the most were that medicines are chemicals that can pollute the environment, be toxic to animals, pollute water. Table 8 below shows the most frequent responses recorded during the survey.

Table 8: Impact of UNMs on the environment according to households in Cotonou (n=402).

Terms	Frequencies
Chemicals that can contaminate the earth	121
Can pollute nature	48
Can make animals infertile	26

Need for safe disposal of unused medicines: When asked if there is a need for a collection structure for UNMs from the public, the majority of the respondents stated that it was necessary 340 (84.58%) while 62 (15.42%) did not consider it necessary. Regarding the reasons for the need for safe disposal of UNMs, there were several responses. The majority of the respondents said that it would prevent the dispersal of UNMs in the environment, avoid the danger of storing UNMs in the home for children. It would also prevent environmental pollution. Table 9 below shows the most frequent responses recorded during the survey.

Table 9: Reasons for the need for safe disposal of medicines.

Terms	Frequencies
It is necessary to avoid throwing away everywhere because it can lead to health problems in animals and humans	179
Improper disposal can be a hazard to nature	100

Need to set up a structure for the collection of unused medicines from the general public: The majority of respondents said that it would be very useful to set up a collection structure for UNMs from households, i.e., 267 (66.42%), while 135 (33.58%) did not think it was necessary. In addition, various reasons were given by those who felt it was necessary.

Among these reasons, it was mainly noted that the establishment of a structure for the collection of unused medicines from the public would allow for good traceability of medicines, better management of unused medicines, better awareness of the population and avoidance of the risks associated with the storage of unused medicines. Table 10 below presents the most frequent responses recorded during the survey.

Table 10: Reasons for the need to establish a collection agency for unused medicines from the public.

Terms	Frequencies
To better inform and educate households	120
To draw the attention of the population	79
On the importance of the subject	81
For a better management	17

Need to educate the general public about the management of unused medicines: When asked whether it is essential to raise awareness among the general public on the management of UNMs, the majority of the respondents *i.e.,* 342 (85.07%) said

that it was necessary. Table 11 below presents the summary of household perceptions for proper management of UNMs.

Table 11: Cotonou households' knowledge of proper UNM management.

Variables	Number	Percentage (%)
Impact of improper disposal of unused medicines on the environment		
Yes	314	78.11
No	88	21.89
Need for safe disposal of unused medicines		
Yes	340	84.58
No	62	15.42
Need to set up a structure for the collection of unused medicines from the public		
Yes	267	66.42
No	135	33.58
Need to educate the general public on the proper management of unused medicines		
Yes	342	85.07
No	60	14.93

Storage and disposal conditions for unused medicines in Cotonou households

Channels for household disposal of unused medicines: The most common way of disposing of UNMs was through household waste; 361 (93.77%) of the respondents reported disposing of the UNMs in their possession through this channel. Twenty respondents (5.19%) said that they dispose of UNMs by burning them at home, 9 (2.34%) dispose of them by giving them to relatives or friends, 58 (15.06%) dispose of them *via* toilets or washbasins and 2 (0.52%) do not know how to dispose of them. Table 12 below shows the different channels of disposal of UNMs used by households.

Table 12: Different channels of disposal of UNMs by households in Cotonou (n=402).

Disposal Channels for UNMs	Number	Percentage (%)
Throw in the garbage/underground	361	93,77
Burn	20	5,19
Give to relatives/friends	9	2,34
Dispose of *via* toilet or sink	58	15,06
Don't know how to dispose	2	0,52

Securing medicines: Regarding the security of UNMs in households, 380 (98.70%) said that they kept them in a secure place such as a locked cupboard, or in a locked cupboard to which the head of the household has the key, while 5 (1.30%) said that the UNMs they had in their homes were in a locked place to which only adults had access. This is illustrated in Figure 12 below.

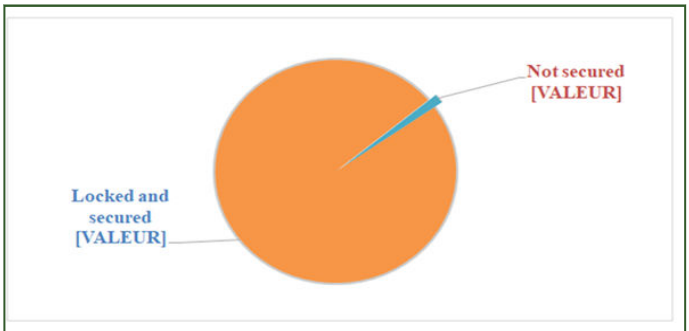

Figure 12: Storage of available UNMs in households by location (n=402)

Various conditions for proper storage of medicines at home were recorded in our study. Most said that they should be kept away from children, heat and humidity. Table 13 below presents a summary of the responses recorded.

Table 13: Good storage conditions for UNMs available in Cotonou households (n=402).

Terms	Frequencies
Keep out of reach of children	278
Protect from heat and moisture	153
Keep in a dry and humid place	51
Keep away from children to avoid poisoning	188

Factors promoting the storage of unused medicines in Cotonou households

Possession of UNMs according to borough: Possession of unused medicines was significantly related to household location (p-value<0.0001).

UNM ownership and socio-demographic and occupational characteristics: There was an association between household possession of unused medicines and respondent age (p-value<0.0017) and gender (p-value<0.0010).

UNM ownership and household size: There was an association between possession of unused medicines and the number of children living in the household (p-value=0.0363). Households with a higher average number of children tended to own more UNMs (42.8 *vs.* 28.5).

Possession of UNMs and knowledge of their management: There was a statistically significant association between possession of UNMs and knowledge of the dangers of storing UNMs at home (p-value=0.0139).

At the 1% significance level, the variables gender and age have a fairly significant impact on the presence of UNMs in households. The sign of the coefficient of the age variable from the regression is negative (Tables 14-17).

Table 14: Association between possession of UNMs and sampled borough.

Boroughs	Possession of UNMs				
	No		Yes		
	n	%	n	%	p
12	5	5.32	89	94.68	<0.0001
2	9	15.79	48	84.21	
5	3	13.04	20	86.96	

Table 15: Association between possession of UNM and socio-demographic and occupational characteristics of respondents.

Variables	Possession of UNMs				
	No		Yes		
	n	%	n	%	p
Age (in years)					
Min, Max	28/85		18.0/84.0		0.0017
Median	59 (46.2; 69.2)		40 (35; 49)		

Mean	56.2 ± 18.2		42.1 (11.9)		
N	16 (1)		385 (0)		
Gender					
Female	13	8.39	142	91.61	0.001
Male	4	1.62	243	98.38	
Professional activity					
Farmer/Marketeer	1	16.67	5	83.33	0.16
Craftsman/Apprentice	3	3.66	79	96.34	
Shopkeeper/Vendor	9	6.12	138	93.88	
Student/Pupil	1	10	9	90	
Liberal profession	1	1.79	55	98.21	
Retired	2	16.67	10	83.33	
Level of education					
None	7	5.43	122	94.57	0.2153
Primary	1	91	109	99.09	
Secondary	6	5.22	109	94.78	
University	3	6.67	42	93.33	

Table 16: Association between NIM ownership and household size.

Variables	**Possession of UNMs**		
	No	**Yes**	
	n	**n**	**p**
Number of persons living in the household			
Min, Max	01 Aug	0/17	0.8076
Median	5.0 (4; 6)	5.0 (3; 6)	
Average	4,5 (2,1)	4,6 (2)	
N	17 (0)	385 (0)	
Number of children living in the household			
Min, Max	0/100	0/100	0.0363
Median	17 (0; 50)	50 (33; 60)	

Average	28.5 (32.4)	42.8 (22,6)
N	17 (0)	382 (3)

Table 17: Association between possession of UNMs and knowledge about their management.

	Possession of UNMs				
	No		Yes		
	n	%	n	%	p
Have received training on the management of UNMs					1
Yes	0	0	2	100	
No	17	4.25	383	95.75	
Have received information on the management of unused medicines					0.5058
Yes	1	6.25	15	93.75	
No	16	4.15	370	95.85	
Knowledge of the dangers of storing ELDs at home					0.0139
Yes	3	23.08	10	76.92	
No	14	3.6	375	96.4	
Be aware that UNMs can cause undesirable effects					1
Yes	16	4.35	352	95.65	
No	1	2.94	33	97.06	

The sign of the coefficient of the gender variable from the regression is positive. This suggests that male headed households are more likely to have UNMs in their homes than female headed households (the reference modality for the gender variable is "female").

To better refine the model and better appreciate the effect of the independent variables on the dependent variable, we will remove all the variables that are not significant at the 10% threshold from the model. We thus obtain a new model which is summarized in Table 18.

Table 18: Logistic regression between the independent and dependent variables.

Variables	Odds ratio	p-value
Male gender	6.573169	2.98.10-05
Age	0.92125	0.00229

By calculating the odds ratio using the coefficients, we can say that:

- When the age of the head of household increases by 1 year, he/she is 0.9 times more likely to have UNMs stored in his/her household
- Male headed households are 7 times more likely to have UNMs stored in their households compared to female headed households

The discussion centered around three points:

- Achievement of the study objectives.
- The quality and validity of the results.

• The comparison of the results with those of other studies.

Achievement of the study objectives

The overall objective of our research was to study the management of unused medicines by households in Cotonou. At the end of the study, it was found that 5% of the population surveyed did not take any precautions before reusing the unused medicines, 8.50% had had cases of intoxication related to the unused medicines, 93.77% disposed of the unused medicines *via* household waste and 15.06% *via* toilets or sinks. The therapeutic class of drugs most frequently stored was anti-inflammatory/antipyretic drugs, while the galenic form most frequently found was the compressed form. The average number of UNMs found in households was 2. In addition, associations were found between the possession of UNMs and the sampled districts, socio-demographic and professional characteristics, household size and household knowledge of UNM management. In addition, a logistic regression was performed between the variables that showed a statistically significant relationship with the possession of UNMs to reassess the degree of significance. In addition, a lack of knowledge about the management of UNMs was noted, as well as a lack of information for households on the proper management of UNMs. In view of the results obtained, we can affirm that the objectives set have been achieved.

Quality and validity of results

Taking into account the elements of the methodology and the sensitivity of the subject, some limitations can be noted. These include the subtleties surrounding the drug with the dismantling of the informal circuit, which makes the population very hostile to any subject related to the drug.

To ensure reliability, we adopted a contact method that consisted in approaching the heads of the districts concerned by the study in order to obtain the contacts of the district heads selected for the survey. The latter enabled us to reassure the population, which allowed us to conduct the interviews in a climate of trust and fair play. However, as some of the questions asked were likely to be biased, the respondents were reassured that the anonymity and confidentiality of the data collected would be respected and that it would be used strictly for research purposes. The tools used for data collection were pretested to ensure that the questions were correctly understood and to make any necessary corrections. This allowed us to limit the rate of non-response and/or missing data. Once the data had been collected, a data cleaning phase was necessary in order to carry out the preliminary processing required for the actual data analysis phase.

Faced with these various constraints mentioned above, strategies were put in place to reduce the effect they could have on our results. They do not call into question our results as a whole. Our results therefore remain valid.

Comparison of results with other studies

Socio-demographic and professional characteristics of the respondents: In our study, the majority of respondents were male (61.44%), most were between 30 and 39 years old (36.07%). Most of the respondents were illiterate and the most represented occupation was traders/salesmen. A study conducted by Insani in Indonesia had arrived at results where the majority of respondents were female (73.66%), the modal age group was 18 years to 30 years (85.3%), the most represented level of education was secondary school (65.60%) and of which most of the respondents were pupils/students (69%) [6].

Another dissertation study conducted at the University of Nairobi reported that the majority of respondents had secondary education (51% of the total) [18].

These observed variations could be explained by the contextual varieties and methodologies used.

Availability of unused medicines in households: In terms of availability of unused medicines in households, 95.77% of the respondents interviewed had UNMs at home. This result is similar to that obtained during the study conducted by Bashaar in Kabul, Afghanistan where 95% of respondents claimed to have UNMs in their households [19]. This availability of over the counter medicines in households could encourage self-medication and misuse of medicines. Also, studies conducted by Wondimu A, et al. [20] in Ethiopia and Marwa, [21] in Tanzania reported respectively 29% and 70.19% availability of UNMs in the surveyed households.

These variabilities may be due either to differences in sample size or to the realities of each country with the level of information of the populations on the dangers of storing UNMs at home.

In addition, the average number of UNMs found in households in our study was 1.90 ± 0.85. This result is similar to that reported by Wondimu A [20] in Ethiopia where the average number of UNMs recovered was 1.73.

Sources of supply of medicines that have become unused: Various sources of supply of medicines were noted during our study. Seventy three point fifty one percent (73.51%) of the UNMs found in households were obtained from the pharmacy with a doctor's prescription while 35.58% were obtained from the on demand pharmacy (OTC). A study conducted by Bashaar in Kabul, Afghanistan had observed a rate of 14.6% of UNMs obtained on OTC compared to 83.4% obtained from the pharmacy with a medical prescription [19]. Also, Manocha in India had arrived at results that 58.7% of the UNMs present in households were obtained on medical prescription while 31.8% were OTC [22]. Sonowal in Zambia had obtained similar results with 60.50% of UNMs obtained from medical prescription and 31.8% which were OTC medicines [23].

The variations observed in terms of higher percentage of medicines obtained on demand (OTC medicines) in our study could be due to contextual disparities.

The very low percentage of medicines not sold in pharmacies (0.78%) obtained in our study could be explained by the Beninese government's policy of dismantling the informal circuit, especially in the Commune of Cotonou, which has

already spread to several other localities in Benin. This low rate could also be explained by the fact that in the informal circuit, it is possible to buy medicines by the unit (possibility of buying two or five tablets or a blister pack).

The difficulties linked to the management of unused medicines are due to the context of the informal market, which still exists, the donation of medicines to all and the fact that the cost of destroying these medicines has not yet been clearly defined.

Reasons for the existence of unused medicines: The improvement of the patient's health remains the most important reason why medicines are not used and stored in households (98%).

This means that there is a high level of non-compliance with the duration of medical prescriptions and this fact, in the context of antibiotic therapy for example, can favor the selection of resistant germs.

Also, Insani in Indonesia had obtained a similar result where 82.7% of the respondents had declared that the reason for not using drugs was the improvement of the patient's health condition [6]. Similar results were obtained by Manocha, Lagishetty R [22,24].

Moreover, since the drug is an asset acquired by the patient at his own expense, it is difficult for him to dispose of it. This leads more easily to the storage of UNMs.

Precautions before reuse and cases of domestic drug poisoning: The majority of respondents in our study claimed to check the expiration date of UNMs before reuse, 88.49% of the total respondents. Also, Bashaar in Kabul had found that almost all the respondents check the expiration date before reuse [25]. Similar results were also obtained by Shah A in India and Insani in Indonesia [26].

Furthermore, in our study, 5% of the respondents did not take any precautions before reuse of the UNMs. This poses a health safety problem because they may consume drugs that have already expired or are already altered, thus exposing themselves to drug poisoning. This could also be explained by the lack of information or training of the population (more than 90% of the population surveyed) on the proper management of unused medicines and the right attitudes to have when dealing with unused medicines.

Eight point five percent (8.50%) of the respondents interviewed stated that they had experienced cases of drug poisoning related to UNS. This confirms the problem of insufficient information on the proper management of UNMs and the right attitudes to have towards them.

Pathologies or symptoms motivating storage and reuse of UNMs: The pathologies causing storage and reuse found in the majority of cases in our study, from the highest to the lowest frequency, were malaria, fever/chills/headache and pain.

This could be explained by the fact that we are in a malaria endemic area and that the population is predominantly working class. Also, the symptoms of fever, chills, headache and pain are commonly found in the symptomatology of several diseases.

Therapeutic classes of UNMs available in households: The most common therapeutic classes of UNMs found in households were anti-inflammatory/antipyretic (71.17%), vitamins (42.34%) and antibiotics (38.18%). Insani in Indonesia reported similar results with a preponderance of the non-steroidal anti-inflammatory class (74.85%) followed by vitamins (43.26%) and antibiotics (34.42%) [6].

The preponderance of the anti-inflammatory/antipyretic class confirms the hypothesis previously put forward that the majority of the population is working class and for the proportion that works in public or private administration, the adoption of bad work postures makes them prone to acute rheumatic problems (back pain and lumbago).

Moreover, the presence of antibiotics in households can be subject to irrational use and thus favor the selection of antibiotic resistant germs.

Antibiotic resistance is a major public health problem nowadays and many awareness raising actions on the rational use of drugs target the antibiotic class as well as other therapeutic classes such as antimalarials and antihypertensives.

Channels of disposal of UNMs: In our study, we noted a low level of knowledge among the population about the correct disposal of unused medicines, as 93.77% of respondents said that they disposed of unused medicines in household waste. Insani had reported in a study in Indonesia that 82.10%of the respondents disposed of medicines through household waste [6]. Also, a study conducted in Serbia by Paut, et al. had reported a similar result as Insani, et al. [6,27]. Other studies conducted in the United States by Law, et al. and in Saudi Arabia by Alazmi reported 63% and 73%disposal of UNMs by household waste, respectively [28,29].

These observed variations could be explained by contextual variability and would be justified by the fact that the number of people who did not receive information on the management of UNMs would be lower (79.50%) in the study conducted by Insani compared to over 95% in our study. This means that more people have information on the management of UNMs than in our context [6]. Hence the incidence of disposal of UNMs through household waste is lower in these studies.

Disposal of UNMs in household waste could result in contamination of surface or groundwater, or even tap water if the water treatment methods used are not very effective. This method of disposal therefore has a negative impact on the environment and represents a risk to the balance of the ecosystem.

None of the respondents reported returning the UNMs to the pharmacies where they were purchased. This state of affairs is due to the lack of information and awareness among the population on the correct attitude to adopt when in possession of an UNM. This is confirmed by the high rate of respondents who said they had never received training or information on the proper management of UNMs.

Training or information on the management of UNMs: In our study 99.50% of respondents had never received training on the management of UNMs and 96.27% had never received

information on their management. The government and health professionals should be proactive in educating the public on the use, storage and disposal of pharmaceuticals. This study can provide a reference for the relevant authorities to implement a system and policy that urges the public to dispose of UNM safely. In addition, conducting relevant and continuous training for health professionals, doctors, pharmacists, nurses and students should be strongly encouraged as recommended in the studies conducted by Ayele and Bashaar [32,33].

Socio-demographic and economic factors leading to household storage of UNMs: In the course of our study, we found that two factors influence the storage of UNMs in households: age and male gender. Considering age, this could be explained by the fact that the older the individual is, the more he becomes aware of the importance of taking care of his health and consequently better observes medication treatments, especially by respecting the duration of the treatment. For example, when you live with a senior citizen and you are ill, you will often notice that he or she is very strict about the time of taking medication and the duration of the treatment [34]. Concerning the male gender, this could be explained by the fact that the man naturally displays authority. As a result, when he starts taking medication and feels some improvement, he is more likely to say that he is better and consequently gives up the treatment, which increases the risk of UNM. This could be explained by the fact that in our societies, the man is the one who is responsible for the expenses related to the management of household diseases. Therefore, when the head of the household is a man, the more the household buys medicines and consequently this increases the risk of stockpiling of UNMs in the household [35]. A study by Martins in Brazil reported male gender as a factor favoring the storage of UNMs in households with an ords ratio=1.729 *vs* 6.573 obtained in our study [36].

DISCUSSION

Problems related to the difficult economic accessibility of UNMs were not assessed in our study. In addition, other elements related to contextual variability regarding health policy in each country would favor the storage of UNMs within households. In fact, the European health system has a social security system and thus two-thirds of the expenses are covered by the State, whereas in the Beninese context, health expenses are paid by the population. Secondly, we have the difficulty for the population to give up their dearly acquired UNMs to a collection structure. This could explain the fact that 135 (33.58%) respondents did not think it was necessary to set up a structure to collect UNMs from the population [37].

CONCLUSION

The study showed that most households carried UNMs, with reuse sometimes without checking the expiration date and disposal *via* household waste. Disposal of unwanted pharmaceuticals by an environmentally hazardous route was common among respondents. There is also a lack of awareness of the impact of inappropriately discarded medicines on the ecosystem. This poses health and environmental safety issues that require strategies to strengthen pharmaceutical waste management.

LIMITATIONS

This study has certain limitations, namely

- The views of dispensing pharmacists, the regulatory authority (Beninese Agency for Pharmaceutical Regulation) and wholesale distributors regarding the recovery of unused medicines were not collected in this study
- Some of the data collected were declarative.

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