RESEARCH ARTICLE

Extent of storage and wastage of antibacterial agents in Palestinian households

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Abstract *Objective* Inappropriate use of antibacterial agents may lead to drug wastage and potential therapeutic failures in the future. The objective of this study was to investigate the extent of storage, and wastage of antibacterial agents in households in Palestine. *Method* This was a cross sectional, questionnaire-based study of households in northern Palestine. Any antibacterial agents present in the surveyed households were investigated and family members were interviewed. *Main outcome measure* Number and type of antibacterial agents stored in each household. *Results* The total number of antibacterial agents in the 465 surveyed households was 641, constituting 11.3% of the total stored medications. The average number of antibacterial agents was 1.4 ± 1.74 per household. The most common antibacterial agents encountered were amoxicillin (29.5%) and amoxicillin/clavulanic acid (11.6%). Family size ($P < 0.001$), total number of stored medications ($P < 0.001$), and presence of elderly residents (>65 years) ($P < 0.001$) were significantly associated with the presence of antibacterial agents. Furthermore, the level of parental education was significantly and positively ($P = 0.009$, $r = 0.128$; $P = 0.013$, $r = 0.122$ for father and mother respectively) correlated with the number of antibacterial agents found in the households. More than one-third (37.4%) of antibacterial agents were stored within the reach of children. Wasted antibacterial agents, defined as those which had expired or those with no clear expiry date were 16.4 and 10.1%, respectively. The percentage of antibacterial agents that were not currently in use was 69.3%. Estimated total value of antibacterial agents found in the study was $4,769, approximately $11.5 per household. The total wastage of antibacterial agents was valued at $2,790, approximately $6.7 per household. *Conclusion* Antibacterial agents were commonly encountered in Palestinian households, and a relatively large percentage was being wasted.

Keywords Antibacterial agents · ATC system · Cost · Household · Palestine · Storage · Utilisation · Wastage

Impact of findings on practice

- A survey of stored antibacterial agents is useful in drawing attention to drug wastage and the potential risk of future therapeutic failure due to inappropriate use of such drugs.
- Analysis of antibacterial agents can help health-policy makers in drawing plans to minimise drug related national health costs.
- Awareness regarding dispensing, utilisation, and self-medication with antibacterial agents needs to be improved in Palestine.

Introduction

There are four main for health care providers in Palestine: Palestinian Ministry of Health (MOH), Palestinian non-governmental organizations (NGO), the United Nations Relief and Works Agency (UNRWA), and the private sector [1, 2]. Health services are financed through taxes,

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health insurance premiums and co-payments. Additional sources of funding include out-of-pocket payments, local community financial and in-kind donations, and loans and grants from the international community. Reviews of the health sector estimated that the total health expenditure in 2002 was 8.6% of gross domestic product (GDP) and per person expenditure was $135 in 2005 [3]. Consequently the Palestinian MOH is trying to reduce unnecessary expenditure including those pertaining to consumption and wastage of medications. Wastage can be defined as storage of medications beyond their expiry date, with no clear expiry date or those left unused at the end of treatment.

Antibacterial agents are very commonly used and prescribed in Palestine and worldwide [4]. Antibacterial agents do not represent a medical risk when used appropriately. However, the frequent and inappropriate use of antibacterial agents might have profound adverse health outcomes for individuals and society [5–9]. Many people tend to store different types of antibacterial agents at home for future self-medication [10]. Such practices impose health risks and economic loss both at individual and national levels. A Spanish study concluded that the storage of antibiotics in households is an important factor which increments the cost, reduces the efficiency and decreases the quality of antibiotic treatment at the community level [11]. A similar study carried out in Russia, showed that antibiotics were widely stocked among the general population and people used antibiotics in an uncontrolled and imprudent manner [12]. Therefore, the objective of this study was to explore the extent of storage, and to estimate the value of antibacterial agents wasted in a sample of households in Palestine.

Methodology

Study population

This is a descriptive cross-sectional study of the characteristics of domestic storage and wastage of antibacterial agents in the northern part of West Bank, Palestine. This is the first study of its type in Palestine. The study took place during January and February 2009 as part of the assigned pharmacy research course for the fifth-year pharmacy students at An-Najah National University in Nablus, Palestine. Approval of the research ethics committee was obtained before the initiation of the study. For the purpose of this study, antibacterial agents were defined as those listed under the J01 category of the Anatomical Therapeutic Chemical (ATC) Classification System (http://www.whocc.no/atc ddd/indexdatabase). The J01 category represents antibacterial agents for systemic use and includes: tetracyclines, amphenicols, beta lactam antibacterials (Penicillins), other

beta lactams, sulfonamides and trimethoprim, macrolides, aminoglycosides, quinolones, combinations of antibacterials, and other antibacterial agents.

Study tool: the questionnaire (see Appendix 1)

A 3-page questionnaire written in Arabic (native language) was developed for this study. The questionnaire was administered by the students who each received 4 weeks of training on how to conduct the research to minimise inter student variability in collecting data. The questionnaire was administered through personal interview settings. Pilot-testing of the questionnaire was carried out during October and November 2008 in more than 50 households. Based on the preliminary results from the pilot study, the questionnaire was modified and finalised. Cronbach alpha index was carried out to establish internal consistency and reliability. Results of Cronbach alpha index were above 0.7 for all variables. The study was designed to include at least 1% of the households in Nablus district ($\sim$40,000 household). Households to be included in the study were each student's own family and four of their closest neighbors. Exclusion criteria included families that were not willing to cooperate. Students were asked to inspect all the medications and to administer the questionnaire with the household member(s) present at the time of interview. The medicines inspected were taken from pharmacy cabinets, kitchens, bathrooms, and other potential places in which medications could be stored in the home. On the basis of the inspection and interview, the students recorded the number of the medications stored at home, in the space allocated for this purpose in the data collection form. The students also completed the 22 questions in the questionnaire during the interview. These questions were of varied format: checklists, open and closed-ended questions. The first section of the questionnaire included questions about: (1) age of the interviewee, (2) educational level of the father and mother, (3) number of family members and their ages, (4) presence of any type of medical insurance, (5) presence of any healthcare provider in the household, (6) place of residence and income, (7) presence of any family member with a chronic disease, and (9) total number of stored drugs including antibacterial agents. The second section included: (1) correct knowledge of the therapeutic use of the stored medications, (2) the original source of the drug, (3) utilisation frequency of the stored drugs, and (5) whether the drug was obtained by a prescription or not. The third section of the questionnaire completed by the student and the researcher included: (1) therapeutic class and dosage form of stored drugs, (2) monetary value, (3) expiry date, (4) number of drugs stored in original packaging, and finally (5) place of storage in the home (refrigerator, kitchen, and other places). In this study, each drug was

considered as a separate item. For example, amoxicillin 250 mg capsules and amoxicillin 250 mg suspension were counted as two different items.

Data analysis

Responses to each question were coded individually, and the data were analyzed using the Statistical Package for Social Sciences (SPSS) version 16 for windows (SPSS Inc., Chicago, Illinois). Parametric and non parametric statistical tests were used when appropriate. The analysis included frequencies of discrete variables and descriptive statistics (mean ± SD) for continuous variables. Association between categorical variables was carried out using Chi-square (χ^2) test. Spearman Rho test was used to assess correlation whenever appropriate. Answers to the open ended questions regarding therapeutic uses of the antibacterial agents were assessed by a group of licensed and practicing pharmacists who decided whether the response given was correct this was then was entered in the SPSS. A P value of less than 0.05 was considered significant throughout the analysis. For each household, the stored antibacterial agents were classified according to the Anatomical Therapeutic Chemical (ATC) code (http://www.whocc.no/atcddd/indexdatabase).

Results

More than 90 students participated in the study. A total of 465 households were surveyed and interviewed. Fifty families were excluded from the study because of lack of full cooperation with the researchers for example by refusal to show all medications at home or to answer all questions. The final sample was 415 households, giving a response rate of 89%. The total number of drug items present in the 415 households was 5,505 with an average of 13.3 ± 7.8 per household. Of the 415 families surveyed, 70.1% had at least one item belonging to J01 class stored at home. A total of 641 items belonging to J01 class were present in the surveyed families. This constitutes approximately 11.6% of the total stored medications. The average number of antibacterial drug items per household was 1.5 ± 1.74 (range: 0–13). The amount of antibacterial drug items present is shown in Table 1. The 641 antibacterial items stored belonged to a total of 33 different types of antibacterial agents. The majority (191, 29.8%) of antibacterial drug items were amoxicillin, followed by amoxicillin + clavulanic acid (81, 12.6%) and cephalexin (48, 7.5%) (Table 2).

The demographic and socioeconomic characteristics of families are shown in Table 3 based on the number of antibacterial drug items stored. No significant relationship was found between the presence of antibacterial drug items in households and the following variables: presence of children

Table 1 Number of antibacterial drug items by number of households

Number of antibacterial agents stored	Number of households ($n = 415$)	%
0	124	29.9
1	128	30.8
2	82	19.8
≥3	81	19.5
Total	415	100

Table 2 Types of antibacterial agents encountered in households

ATC code	Drug name	Frequency	%
J01CA04	Amoxicillin	191.0	29.8
J01CR02	Amoxicillin and enzyme inhibitor	81.0	12.6
J01DB01	Cefalexin	48.0	7.5
J01EE01	Sulfamethoxazole and trimethoprim	44.0	6.9
J01CR50	Combinations of penicillins	39.0	6.1
J01DC02	Cefuroxime	34.0	5.3
J01MA02	Ciprofloxacin	28.0	4.4
J01FA09	Clarithromycin	27.0	4.2
J01FA01	Erythromycin	24.0	3.7
J01CE02	Phenoxymethylpenicillin	14.0	2.2
J01DB05	Cefadroxil	14.0	2.2
J01FA10	Azithromycin	14.0	2.2
J01MA01	Ofloxacin	11.0	1.7
J01AA02	Doxycycline	9.0	1.4
J01FF01	Clindamycin	9.0	1.4
J05AB01	Aciclovir	9.0	1.4
J01XD01	Metronidazole	7.0	1.1
J01AA07	Tetracycline	6.0	0.9
J01DD15	Cefdinir	4.0	0.6
J01FA06	Roxithromycin	4.0	0.6
J01CA01	Ampicillin	3.0	0.5
J01CF05	Flucloxacillin	3.0	0.5
J01MA12	Levofloxacin	3.0	0.5
J01DD08	Cefixime	2.0	0.3
J01MA06	Norfloxacin	2.0	0.3
J01MB02	Nalidixic acid	2.0	0.3
J01XE01	Nitrofurantoin	2.0	0.3
J02AC01	Fluconazole	2.0	0.3
J01CE08	Benzathine benzylpenicillin	1.0	0.1
J01DD04	Ceftriaxone	1.0	0.2
J01FA02	Spiramycin	1.0	0.1
J01MA15	Gemifloxacin	1.0	0.2
J02AB02	Ketoconazole	1.0	0.2
Total		641	100.0

(<6 years) ($P = 0.3$); medical insurance coverage ($P = 0.2$); presence of family members with chronic diseases ($P = 0.7$); and the presence of health care provider in the

Table 3 Variables associated with antibacterial agents' storage

Variable	Households with no antibacterial agents	Households with ≥1 antibacterial agents	P
Family size	5.1 ± 2.6	6.5 ± 2.3	<0.001
Chronic disease			0.7
Yes	53 (42.7%)	119 (40.9%)	
No	71 (57.3%)	172 (59.1%)	
Children <6 years			0.3
Yes	48 (38.7%)	127 (43.6%)	
No	76 (61.3%)	164 (56.4%)	
Elderly >65 years			<0.001
Yes	35 (28.2%)	37 (12.7%)	
No	89 (71.8%)	254 (87.3%)	
Health care provider in household			0.5
Yes	18 (14.5%)	50 (17.2%)	
No	106 (85.5%)	241 (82.8%)	
Medical insurance			0.2
Yes	75 (60.5%)	196 (67.4%)	
No	49 (39.5%)	95 (32.6%)	
Father's education			0.009
Elementary school	40 (32.3%)	59 (20.3%)	
High school/college	84 (67.7%)	232 (79.7%)	
Mother's education			0.013
Elementary school	46 (37.1%)	94 (32.3%)	
High school/college	78 (62.9%)	197 (67.7%)	
Total number of stored medications	9.2 ± 4.7	15 ± 8.2	<0.001

family ($P = 0.5$). However, there was a significant relationship between the presence of antibacterial drug items and the following variables; presence of elderly ($P = 0.001$); family size ($P < 0.001$); total number of other stored medications ($P < 0.001$). There was also positive significant correlation between the presence of antibacterial drugs stored and the level the father's or the mother's education ($P = 0.009$, $r = 0.13$; $P = 0.013$; $r = 0.122$) (Table 3).

Of the 641 antibacterial drug items found, 293 (45.7%) were stored in pharmacy cabinets, 108 (16.8%) in the refrigerator, and 240 (37.4%) in other places inside the house to which children might have access (kitchen and bedrooms). It was also found that approximately two-thirds (424, 66.1%) of the antibacterial drug items were in their original container. When the interviewees were asked about the current status of use for the stored antibacterial drug items, the answers were as follows: 197 (30.7%) were being currently used, while 444 (69.3%) were not being currently used. When the interviewees were asked about the therapeutic uses of antibacterial drug items, with permission to consult with other family members or the leaflet, 546 (85.2%) of their answers were correct, while 95 (14.8%) were incorrect. The most common dosage forms of stored antibacterial drug items were oral solid dosage forms (506, 78.9%), followed by oral liquid dosage forms 126 (19.7%), and the others were

parenterals (9, 1.4%). Approximately 65 (10.1%) of the stored antibacterial drug items were initiated by self therapy while 576 (89.9%) were initially dispensed based on physician prescription or pharmacist advice.

After inspection, 105 (16.4%) of the stored antibacterial drug items were expired while 471 (73.5%) were not, and 65 (10.1%) had no clear expiry date. Approximately, two-thirds (80/105, 76.2%) of the expired antibacterial drug items were not being currently used, and 28/105 (26.7%) of these expired drugs were not in their original containers. It was also found that, 35 (33.3%) of the expired antibacterial drug items were stored in places around the house like bedrooms, bathroom and kitchen.

The total value of the 641 antibacterial drug items was ~$4,769, an average of $11.5 per household. Of this amount, 58.5% was wastage, defined as the total value of expired drugs; drugs with no clear expiry date and those not being currently used. This gave a total wastage value of $2,790, an average of $6.7 per household (Table 4).

Discussion

The objective of our study was to investigate the storage and wastage of antibacterial agents in a sample of

Table 4 Storage and value characteristics of antibacterial agents

Variable	Total (in the 415 household)	Average (per household)
Number of stored medications	5505	13.3 ± 7.8
Number of antibacterial drug items	641	1.5 ± 1.74
Value of antibacterial drug items	$4,769	$11.49
Value of antibacterial drug items wasted	$2,790	$6.7

Palestinian households. Our study showed that antibacterial agents constituted 11.3% of the total stored medication. This is higher than that reported in Belgium (2%), lesser than that reported in Sudan (22%), and closer to that reported in Iran (13.6%) and Saudi Arabia (14.3%) [13–16]. Such differences might reflect different health seeking habits, different supply routes of antibacterial agents in different countries, and different attitudes toward antibacterial agents among different societies. Several factors could be cited to explain the storage of antibacterial agents in Palestinian households. The excessive prescribing of antibacterial agents by physicians is one important reason. A study carried out in Palestine by Sawalha et al. [4] to investigate the contents of prescriptions dispensed at community pharmacies showed that antibacterial agents were the most common type of medications (40%) dispensed. A second reason for the levels of storage of antibacterial drug items is the ease of access to such drugs by the public from community pharmacies without prescriptions. A study about self-medication in Palestine indicated that antibacterial agents (19%) were the most common type of medications selected for self therapy [17]. Another study carried out in Palestine has found that the 80% of the general public have positive attitude toward medications in general. This positive attitude is considered a strong motive for self-medication [18]. Consequently, public education regarding self-medication in general and with antibacterial agents in particular is needed. A third possible reason is the continuous political conflict in the area, the curfews and the road blocks that may make people more inclined to keep medications at their homes in case they need them in emergency conditions.

Pharmacists are in a position to play a key role in this regard. The poor implementation of pharmacy regulations, lack of patient education and counselling are also major contributors to inappropriate self-medication practices with antibacterial agents. A study carried out among Palestinian governmental employees had also shown similar inappropriate self-medication practices with antibacterial agents [10]. Interventional measures aimed at lowering or preventing self-medication with antibacterial agents should include educational programs for the general public. In addition health-care providers should ensure that they clearly advise their patients to finish the full prescribed course of antibiotics and not to keep them for future use.

In this study, the number of antibacterial agents stored was significantly associated with family size, levels of parental education, and presence of elderly (>65 years) residents in the household. These results were expected since families with a large number of members would be expected to consume more medications including antibacterial agents. The association between antibacterial agents and parental education might suggest that educated people have a higher tendency to self-medicate and to store antibacterial agents for future use. The association between the higher number of antibacterial agents and people over 65 years of age could suggest a lack of compliance among this patient group: treatment courses not being completed, which in turn leads to higher numbers of unused antibacterial agents being stored at home. Our results showed that amoxicillin was the most common antibacterial agent stored. This was expected given that there are more than 15 different brand names of amoxicillin marketed in Palestine with much lower prices than other antibacterial agents.

In our study, approximately one out of six antibacterial agents (16.4%) had passed the expiry date while 10.1% had no clear expiry date. Aside from reduced activity, reports about expired drugs causing harmful effects are rare except for tetracycline [19]. Approximately 10% of antibacterial agents were self initiated while 90% were dispensed according to physician or pharmacist advice. We expect that this particular result could be susceptible to bias as interviewees might have given us scientifically and socially desirable responses regarding self therapy. The results obtained here can be used to estimate the wastage of antimicrobial agents from households.

Conclusion

In conclusion, antibacterial agents were commonly encountered in Palestinian households, and a relatively large percentage was being wasted. Rational prescribing and dispensing of antibacterial agents is needed to decrease wastage and potential harm that could result from the practice of stockpiling such medications.

Appendix 1: The questionnaire used in the investigation of stored medications

1. Name of the interviewee
2. Age of the interviewee
3. Education of the father

(1) College
(2) Third grade—High school
(3) Illiterate

4. Education of the mother

(1) College
(2) Third grade—High school
(3) Illiterate

5. Place of living

(1) City
(2) Village/suburbs

6. Income

(1) High
(2) Middle
(3) Low

7. Number of family members
8. Number of family members <6 years of age
9. Number of family members >65 years of age
10. Any member in the family with chronic disease?
11. If yes, what is the chronic disease
12. Any member in the family who works as a health care provider.
13. Is there a medical insurance for the family?
14. If yes, what type of insurance?
15. Fill in the following table for each medication stored at home

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Brand name of the medication

Pharmaceutical dosage form

Quantity of the medication present

Who is using the medication now

Do you know the therapeutic use of the medication

Frequency of use of the medication

Expiration date of the medication

Is the medication in its original package?

Where the medication is stored

What is the source of the medication

Price of the medication

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