Household Storage of Medicines and Associated Factors in Tigray Region, Northern Ethiopia

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Abstract

Introduction
The presence of medicines in households is a risk factor for irrational drug use. This study aimed at investigating the prevalence and factors associated with home storage of medicines in Tigray Region, Ethiopia.

Method
A community based cross-sectional study was conducted in April 2013 in Tigray Region, Ethiopia. A total of 1034 participants were enrolled in the study. A multi-stage sampling method was employed to select households. Data were collected with the help of a pre-tested structured questionnaire and analyzed using descriptive statistics and bivariate and multivariate logistic regression.

Result
Of the total households visited, 293(29%) stored drugs. The mean number of drugs per household was 1.73. The most common classes of drugs found in households were analgesics 149(29%) and antibiotics 128(25%). Most of the medicines kept in households were used for ongoing treatments 316(62%) and available in tablet dosage form (70%). More than half of the medications kept at homes were not adequately labeled while drawer 180(36%) were reported as the main place of drug storage. The proportion of home storage of medicines in rural area (AOR = 0.56, 95% CI: 0.39–0.81) was lower than that of urban area. However, households having family member(s) working in health facilities (AOR = 2.03, 95% CI: 1.09–3.77) were associated with an increased home storage of medicines.

Conclusion
Most drugs kept at home were not appropriately labeled and stored in a safe place. Residence area (rural versus urban) and the presence of health professional(s) in the households...
affects household drug storage. Hence, public education campaign should be considered as an intervention to improve the storage condition of medicines in the households.

Introduction

Pharmaceutical research has steadily brought new drugs to the market, aimed at cure or palliation of numerous diseases. Their wide accessibility provides important benefits in reducing morbidity and mortality and alleviating pain and suffering [1]. However, improved availability, if combined with poor compliance by patients and inappropriate self-medication, may result in wastage of resources, increased resistance of pathogens, serious health hazards, adverse reactions, and, indeed, prolonged suffering [2, 3].

Worldwide in most households, medicines are kept for various purposes including emergency use and treatment of chronic or acute illnesses. Drug storage at home is a risk factor in relation to irrational drug use mainly due to the easy access, and improper storage. If the recommendations for storage are not followed, the drug stability can be affected which in turn leads to ineffective drug therapy [4, 5]. On the other hand, controlling the use of drugs stored at home is a great task especially from unintentional users such as children which increases the risk of accidental poisoning. Moreover, presence of medicines at home has also been associated with sharing of drugs which further increase the risk of inappropriate drug use and hence the emergence of antimicrobial resistance [4].

Many studies in Africa identified a high prevalence of drug storage at home. In Sudan, about 98% of investigated families had at least one drug product stored at home [6]. Study conducted in Uganda also showed that about 40% of the surveyed households kept medicines at home and 30% of identified antibacterials found in surveyed households were kept for future use [7]. In Ethiopia, a study conducted almost two decades ago in Addis Ababa revealed that 20% of the studied households were found hoarding drugs, and drug sharing was practiced by 17% of the respondents [8]. Apart from this study, little has been done to characterize drugs stored in households in Ethiopia. Therefore, this study aimed at generating data on the prevalence and factors associated with home storage of medicines in Tigray Region, Northern Ethiopia.

Methods and Materials

Study Area and Design

A community based cross-sectional study was conducted in April 2013 in Tigray Region, Northern Ethiopia. Tigray regional state consists of seven administrative zones: Western, Northwestern, Central, Eastern, Southeastern and Southern, and one special zone which is Mekelle. The capital city of the region is Mekelle which is located 783 kilometers north of Addis Ababa, the capital city of Ethiopia. Based on the 2007 Census conducted by the Central Statistical Agency (CSA) of Ethiopia, the Region has an estimated total population of 4,314,456 and 985,654 households with averagely 4.4 persons per household [9]. In each household, data were collected from the household head or any adult household member (≥18 years) present at home during the time of data collection.

Sample size determination and sampling procedure

To determine the sample size a formula for two population proportions based on the prevalence of medicine users in urban area 74% [8] and rural area 61.5% [10] was used. Using $\beta = 0.2$, 5%
margin of error at 95% confidence level, and considering 5% non-response rate and design effect of 2 the calculated sample size was 1034.

A multi-stage sampling method was employed to select the sample. In stage I, taking the homogeneity of population of seven zones into consideration, two Zones (Southern Tigray and Eastern Tigray Zones) were selected from the Tigray Regional state by simple random sampling technique. In stage II, one rural district and one urban administrative town (urban district) were selected from each of the selected Zones at random. In stage III, households were recruited for the study from the selected urban and rural areas by systematic random sampling and proportional to size allocation technique.

Data collection and analysis

Data on the presence of medicines in households and their utilization were collected trained pharmacists using a structured questionnaire (S1 File). To ensure quality of the data, the questionnaire was pretested in 50 households in similar setups before the actual data collection. Data on socio-demographic characteristics, sources of drugs, and reasons for stocking drugs at home were collected through interview and data about drug storage condition, dosage form, expiry date and situation of packaging material were collected by direct observation from each households included in the study.

Data were coded, checked for completeness and consistency. Data were entered using Epi-Data version 3.1 and analyzed using SPSS version 16.0 statistical software. Bivariate logistic regression analysis was performed between socio-demographic factors related to medications kept at home to identify risk factors related to home storage of drugs. Factors significantly associated with home storage of drugs in the bivariate analysis were included in a multivariate logistic regression model. All p values were two tailed with the significance level set at 0.05.

Ethical Considerations

The study was approved by the Health Research Ethics Review Committee of College of Health Sciences, Mekelle University. After approval for ethical issues, official letters of cooperation were obtained from Tigray Regional Health Bureau and given to the respective community leaders. The purpose of the study was explained to the study population, confidentiality was ensured and written consent was obtained before data collection.

Results

Socio-demographic characteristics

Overall, 1000 (97%) households responded to the interview, among them 504 urban and 496 were rural. The median family size of the households was 5 with just above half (52%) of the households had at least five family members. More than half (55%) of the households had no children less than five years while 34% had one child and the rest had at least two children. Two in five households had fathers with below primary education while about half (49%) of the households had illiterate mothers. Only 7% of the surveyed households had health professional(s) as a family member. Distribution of socio-demographic characteristics of the households is shown in Table 1.

Prevalence of home storage of medicines

Of the total households visited, 293 stored drugs. Higher proportion of households in urban (19%) stocked medicines at home as compared to that of the rural area (11%). The mean number of drugs found per household was 1.73.
Categories of medicines kept in households and their utilization are indicated in Table 2. The most common classes of drugs found in the households were analgesics (29%) and antibiotics (25%). Generally, more than half (62%) of the medications were used for ongoing treatment.

Table 1. Socio-demographic characteristics of households based on the prevalence of home storage of medicines in Tigray.

| Characteristics                  | Home storage of medicines | COR (95% CI) | p value | AOR (95% CI) | p value |
|----------------------------------|---------------------------|--------------|---------|--------------|---------|
|                                  | Yes, n (%)                | No, n (%)    |         |              |         |
| Residence                        |                           |              |         |              |         |
| Urban                            | 187 (37)                  | 317 (63)     | 0.46 (0.35, 0.61) | 0.0     | 0.56 (0.39, 0.81) | 0.0    |
| Rural                            | 106 (21)                  | 390 (79)     | 1       |              |         |
| Family size                      |                           |              |         |              |         |
| <5                               | 136 (28)                  | 348 (72)     | 0.46 (0.35, 0.61) | 0.0     | 0.56 (0.39, 0.81) | 0.0    |
| ≥5                               | 157 (30)                  | 359 (70)     | 1.12 (0.85, 1.47) | 0.4     |              |         |
| # of children < 5 years          |                           |              |         |              |         |
| 0                               | 162 (30)                  | 388 (71)     | 1       |              |         |
| ≥1                              | 100 (30)                  | 237 (70)     | 1.01 (0.75, 1.36) | 0.9     |              |         |
| # of people > 65 years           |                           |              |         |              |         |
| 0                               | 212 (29)                  | 530 (71)     | 1       |              |         |
| ≥1                              | 81 (31)                   | 177 (69)     | 1.14 (0.84, 1.56) | 0.4     |              |         |
| Father’s education level         |                           |              |         |              |         |
| Illiterate                      | 34 (23)                   | 145 (77)     | 1       |              |         |
| Read & write                    | 58 (27)                   | 161 (74)     | 1.22 (0.77, 1.91) | 0.4     | 0.97 (0.60, 1.57) | 0.9    |
| Primary education               | 36 (29)                   | 89 (71)      | 1.36 (0.82, 2.28) | 0.2     | 0.91 (0.50, 1.66) | 0.8    |
| Secondary education             | 34 (34)                   | 67 (66)      | 1.71 (1.00, 0.92) | 0.0     | 1.04 (0.54, 2.00) | 0.9    |
| Tertiary education              | 47 (45)                   | 58 (55)      | 2.73 (1.64, 4.57) | 0.0     | 1.59 (0.76, 3.31) | 0.2    |
| Mother’s education level         |                           |              |         |              |         |
| Illiterate                      | 114 (23)                  | 376 (77)     | 1       |              |         |
| Read & write                    | 50 (30)                   | 115 (70)     | 1.43 (0.97, 2.12) | 0.1     | 1.18 (0.72, 1.92) | 0.5    |
| Primary education               | 44 (34)                   | 85 (66)      | 1.71 (1.12, 2.60) | 0.0     | 1.40 (0.79, 2.49) | 0.3    |
| Secondary education             | 40 (40)                   | 60 (60)      | 2.20 (1.40, 3.45) | 0.0     | 1.55 (0.83, 2.89) | 0.2    |
| Tertiary education              | 37 (43)                   | 50 (58)      | 2.44 (1.52, 3.92) | 0.0     | 0.94 (0.44,2.03) | 0.9    |
| Presence of health professional in the family |                           |              |         |              |         |
| No                              | 262 (28)                  | 671 (72)     | 1       |              |         |
| Yes                             | 31 (46)                   | 36 (54)      | 2.21 (1.34, 3.64) | 0.0     | 2.03 (1.09, 3.77) | 0.0    |

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Table 2. Categories of medicines found in households.

| Category                      | Current use | Leftover | Anticipated future use | Total |
|-------------------------------|-------------|----------|------------------------|-------|
| Analgesics                    | 59 (12)     | 53 (10)  | 37 (7)                 | 149 (29) |
| Antibiotics                   | 70 (14)     | 54 (11)  | 4 (1)                  | 128 (25) |
| Antihypertensive drugs        | 49 (10)     | -        | -                      | 49 (10) |
| ART                           | 39 (8)      | -        | -                      | 39 (8) |
| Antacids                      | 22 (4)      | 14 (3)   | 2 (0)                  | 38 (8) |
| Antitussives                  | 11 (2)      | 5 (1)    | 4 (1)                  | 20 (4) |
| Minerals & vitamins           | 8 (2)       | 9 (2)    | 1 (0)                  | 18 (4) |
| Antidiabetics                 | 9 (2)       | 1 (0)    | -                      | 10 (2) |
| Hormonal drugs/ contraceptives| 10 (2)      | -        | -                      | 10 (2) |
| Antihelmentics                | 9 (2)       | -        | -                      | 9 (2) |
| Antiepileptics                | 4 (1)       | -        | -                      | 4 (1) |
| Others                        | 26 (5)      | 5 (1)    | 2 (0)                  | 33 (7) |
| Total (%)                     | 316 (62)    | 141 (28) | 50 (10)                | 507 (100) |

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Dosage form of medicines kept in households is shown in Fig 1, most (70%) of the medicines were available in the form of tablets. Source of medicines and their labeling status, situation of primary package, situation of expiry date and storage place of medications kept at home are indicated in Table 3.

Multivariable logistic regression of the predictors of home storage of drugs

Results of logistic regression analysis are shown in Table 1. Although educational status of the fathers and mothers of the households was significantly related to home storage of drugs in the bivariate analysis, they were retained in the multivariate model as confounders of residence and presence of health professionals in the family. Results from the multivariate logistic regression analysis indicated that the residence of the people was significantly associated with home storage of drugs. Households found in urban area had high chance of storing drugs in comparison to rural area households (AOR = 0.56, 95% CI: 0.39–0.81). On the other hand, households with family member(s) working in the health facilities (AOR = 2.03, 95% CI: 1.09–3.77) were more likely to store medicines at home.

Discussion

Taking drugs at home without prescription has become a habit that is often encouraged in the community [6]. The result of this study revealed that 29% of the visited households stored
drugs. This value seems to be more or less similar to the findings of the previous studies done in Ethiopia [8, 11] and it is less prevalent as compared to the studies done elsewhere [4, 5, 9]. The lower prevalence of home drug storage in Ethiopia could be attributed to the fact that substantial number of Ethiopians are relying on traditional medicine [12, 13].

The majority of medicines present at homes were mostly for ongoing treatments (62%) in this study. This is in agreement with other studies done in Uganda [4] and Iraq [14]. In agreement with other studies [14, 15, 16], significant proportion of drugs (28%) found in the households were left over from the previous illness in this study. People may keep leftover drugs because of initial excessive prescribing for treatment, inadequate adherence to treatment and anticipated future use [14]. For instance, in the present study, 10% of the medicines were stocked in the home anticipating future need. The same reason was also reported in different studies [2, 6, 14]. Frequent drug stock outs and inaccessibility of adequate health care in developing countries like Ethiopia might be the possible explanation [4,17].

The mean number of drugs per household was 1.73 in this study. Other studies [3,4,6,14] reported a higher number of drugs in each household. Storage of large quantities of medications at home could lead to medication administration error, accidental poisoning, adverse drug reactions, and waste of resources [3]. Residence of the people and presence health professional as a family member were significantly associated with home storage of drugs in the current study. People living in rural areas were less likely to store drugs at home. Less coverage of modern health care facilities in developing countries and dependency on traditional medicine could explain the lower home drug storage in rural area [13]. On the other hand, high

| Table 3. Factors related to medications kept at home. |
|---------------------------------|----------|----------|
| Description                     | Frequency| Percentage|
| Source of medicines             |          |          |
| Hospital                        | 176      | 35       |
| Health center                   | 162      | 32       |
| Pharmacy or drug store          | 140      | 28       |
| Self, family or friend          | 13       | 3        |
| Others                          | 16       | 3        |
| Labeling                        |          |          |
| Adequately labeled              | 209      | 41       |
| Not Adequately labeled          | 298      | 59       |
| Situation of primary package    |          |          |
| Primary package OK              | 446      | 88       |
| Primary package not OK          | 61       | 12       |
| Situation of expiry date        |          |          |
| Not expired                     | 442      | 87       |
| Expired                         | 23       | 5        |
| Not known                       | 42       | 8        |
| Storage place                   |          |          |
| Drawer                          | 180      | 36       |
| Cupboard                        | 177      | 35       |
| Table/Shelf                     | 100      | 20       |
| Bag                             | 30       | 6        |
| Refrigerator                    | 20       | 4        |

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proportion of home drug storage in families with health professional as a household member might be due to improvement of health seeking behavior which in turn leads the households to take drugs and control their health.

Analgesic and antibiotics were the most frequently stored categories of the drug at home in this study similar to other surveys [4, 18, 19]. Particularly, the storage of antibiotics was reported in significant number of studies [6, 14] including the present study. This has to be considered seriously because uncontrolled and excessive antibiotic use resulted from home drug storage could lead to antimicrobial drug resistance [20]. Therefore, appropriate educational campaign has to be in place to raise the awareness of the society on the appropriate utilization of antibiotics, the avoidance of leftover antibiotics, the correct disposal of leftover drugs, and harmful effects of consuming non-prescribed antibiotics [21].

Majority of home stored dosage forms were tablets followed by capsules. This was in accordance with the studies conducted in Northern Uganda [4] and Philippines [22]. High availability and ease of administration could contribute to the highest consumption rate of these dosage forms [6]. According to WHO, the medicine is considered to be adequately labeled if the label displays patient name, drug name, dose, frequency and duration of treatment [23]. Accordingly, the present study showed that majority of the drugs (59%) kept at home were not adequately labeled. This value is lower than the value (92.0%) reported in study done in Oman [17] and it is comparable with the value (59%) of the study done in Kenya [24].

In this study, majority of the drugs were stored in a drawer (36%) and cupboard (35%). This finding is in agreement with the findings reported in Palestine [15]. From this, it can be easily understood that the place and condition of storage of drugs were not appropriate and in fact the storage places were accessible to children which can lead to accidental ingestion of oral drugs by children. The expiry date of a medicine is valid if the medicine stored at the proper conditions. Around 5% of the drugs were expired in this study. Similar findings on storage of expired drugs were reported in different studies [6, 16, 19]. Lack of knowledge on expired drugs and their method of disposal could be put as possible reasons for the households to keep expired drugs [25]. Public education regarding the nature and risk of expired drugs and disposal of unused medication are needed to reduce the impact of expired drugs on the health of the community [25].

The main limitation of this study was that a cross sectional study was employed which might suffer from temporal relationship establishment with some variables and could not provide much more substantial evidence of causality, unlike a longitudinal design.

**Conclusion**

The prevalence of household drug storage in Tigray region was 29%. Analgesics and antibiotics were found to be the most commonly stored drugs. Most drugs kept at home were not appropriately labeled or stored at a safe place. Residence (rural versus urban) and the presence of health professional(s) in the households were found to be associated with drug storage at home. Therefore, appropriate educational campaign has to be in place to raise the awareness of the society on appropriate utilization of drugs, avoidance of leftover drugs, correct disposal of leftover drugs and harmful effects of consuming non-prescribed antibiotics.

**Supporting Information**

S1 File. Questionnaire used to assess the presence of medicines in households and their utilization.

(PDF)
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Author Contributions

Conceived and designed the experiments: AW BD. Performed the experiments: AW FM BD AA SA WM. Analyzed the data: TE AW FM BD. Wrote the paper: FM TE AW BD AA SA WM.

References

1. Wasserfallen J, Bourgeois R, Büla C, Yersin B, Buclin T. Composition and Cost of Drugs Stored at Home by Elderly Patients. Ann Pharmacother. 2003; 37: 731–737. PMID:12708953
2. Kyiying KS, Lauwo JA. Drugs in the home: danger and waste. World Health forum. 1993; 14 (4): 381–384. PMID: 8185788
3. Kheir N, El Hajj MS, Wilbur K, Kaissi RML, Yousef A. An exploratory study on medications in Qatar homes. Drug Healthc Patient Saf. 2011; 3: 99–106. doi: 10.2147/DHPS.S25372 PMID: 22279414
4. Ocan M, Bbosa GS, Waako P, Ogwal-Okeng J, Obua C. Factors predicting home storage of medicines in Northern Uganda. BMC Public Health. 2014; 14: 650. doi:10.1186/1471-2458-14-650 PMID: 24964746
5. WHO. World Health Organization. The world medicines situation, 2004. Available: http://www.searo.who.int/LinkFiles/Reports_World_Medicines_Situation.pdf. Accessed 17 September 2010.
6. Yousef MA. In-home drug storage and utilization habits: a Sudanese study. East Mediterr Health J. 2002; 8: 422–31. PMID: 15339133
7. Ministry of Health, The republic of Uganda. Access to and use of medicines by households in Uganda. 2008.
8. Amare G, Gedif T, Alemayehu T, Tesfahun B. Pattern of drug use in Addis Ababa community. East Afr Med J. 1997; 74(6): 362–7. PMID: 9487397
9. CSA. Summary and Statistical Report of the 2007 Population and Housing Census Results., Central Statistical Agency of Ethiopia. 2008. Available: http://www.csa.gov.et/pdf/Cen2007_firstdraft.pdf/ Accessed 22 August 2012.
10. Shankar PR, Kumar P, Theodore AM, Partha P, Shenoy N. A Survey of Drug Use Patterns in Western Nepal. Singapore Med J. 2003; 44(7): 352–356. PMID: 14620727
11. Mariam TG. Assessment of knowledge and practice on appropriate use of drugs in urban and rural communities in Jimma Zone, South West Ethiopia. Ethiop J Health Sci. 1998; 8(2): 89–97.
12. Wolde B, Gebre-Mariam T. Household herbal remedies for self-care in Addis Ababa: A preliminary assessment. Ethiop pharm j. 2002; 20: 59–70.
13. Gedif T, Hahn HJ. The epidemiology of herbal drugs use in Addis Ababa, Ethiopia. Pharmacoepidemiol Drug Saf. 2002; 11: 587–591. PMID: 12462136
14. Jassim A. In-home Drug Storage and Self-medication with Antimicrobial Drugs in Basrah, Iraq. Oman Medical Journal. 2010. 25 (2): 79–87.
15. Sweileh WM, Sawalha AF , Zyoud SH, Al-Jabi SW, Bani Shamseh FF, Khalaf HS. Storage, utilization and cost of drug products in Palestinian households. Int J Clin Pharmacol Ther. 2010; 48(1): 59–67. PMID: 20040340
16. Directorate of rational use of medicines ministry of health muscat, Sultanate of Oman. Household Survey on Medicine Use in Oman, Report of survey conducted in 2009.
17. AluboSo:drugging the Nigerian people: the public hazards of private profits. Third World Soc. 1987;1985:89–113.
18. Federal Ministry of Health, Nigeria. Access to and rational use of Medicines at the household level. Abuja, Nigeria. 2010. Available: apps.who.int/medicinedocs/documents/s16887e/s16887e.pdf. Accessed 22 August 2012.
19. Tourinho FSV, Bucaretchi F, Stephan C, Cordeiro R. Home medicine chests and their relationship with self-medication in children and adolescents. J Pediatr. 2008; 84(5): 416–422.
20. Stratchoukonski LS, Andreeva IV, Ratchina SA, Galarkin DV, Petrochenkova NA, Demin AA, et al. The Inventory of Antibiotics in Russian Home Medicine Cabinets. Clin Infect Dis. 2003; 37: 498–505. PMID:12905133
21. Hu J, Wang Z. In-home antibiotic storage among Australian Chinese Migrants. Int J Infect Dis. 2014; 26: 103–106. doi: 10.1016/j.ijid.2014.04.017 PMID: 25046273

22. Lee See G, Arce F, Deliman Y. Household storage of medicines among residents in Barangay Talamban, Cebu City. IJPTP. 2014; 5(1): 916–921.

23. WHO Action Programme on Essential Drugs and Vaccines. How to investigate drug use in health facilities: selected drug use indicators. Geneva, World Health Organisation. 1993.

24. Ministry of Medical Services and Ministry of Public Health and Sanitation. Access to Essential Medicines in Kenya: A Household Survey. Nairobi, Kenya. 2009. Available: apps.who.int/medicinedocs/documents/s18695en/s18695en.pdf. Accessed 22 August 2012.

25. Atinafu T, Takele A, Kassie A, Yehualaw A, Tesfaw G, Desseno T, et al. Unused Medications Disposal Practice: The case of Patients Visiting University of Gondar Specialized Teaching Hospital, Gondar, Ethiopia. IJPSR. 2014; 5(12): 999–1005.