



History:

Received: December 2, 2016
Revision: January 21, 2017
Accepted: January 27, 2017
First Published: January 28, 2017
Collection year: 2017
Confirmation of publication: Published

Identifiers and Pagination:

Year: 2017
Volume: 9
First Page: 01
Last Page: 14
Publisher ID: JAppPharm-9-1
DOI:<http://dx.doi.org/10.21065/19204159>

Corresponding author:

Azhar Hussain, B.Pharm, M.Pharm,
PhD., Dean, Faculty of Pharmacy,
Hamdard University, Pakistan. Email:
azharhussain10971@gmail.com

Citation:

Hussain A, Malik M, Iram R. Medicine storage trends & practices: a literature review. J App Pharm 9. p 01-14

Review Article

MEDICINE STORAGE TRENDS & PRACTICES: A LITERATURE REVIEW

Azhar Hussain, Madeeha Malik, Rabia Iram

Hamdard Institute of Pharmaceutical Sciences, Hamdard University, Islamabad, Pakistan.

Keywords: Medicines, storage, trends, practices.

Introduction

Medicines are useful for provision of better health among consumers. Safe use of medicines is still a major issue for healthcare system in developing countries [1]. Medicines are stored at home during or after their use. It is a common practice that consumers take medicines from pharmacies for treating their various forms of illness at home [2]. The effectiveness of treatment is ensured only when consumers are able to use safe and effective medicines during the whole course of treatment because the quality and efficacy of medicines is maintained when medicines are properly stored at home [4]. Knowledge of consumers is important for making decisions before, during and after using medicines along with what to do with the leftover medicines [5]. Lack of knowledge regarding storage of medicines at home promotes inappropriate storage patterns of consumers [6, 7, 8]. The inappropriate storage and use of medicines leads to the wastage of resources. Therefore, special attention must be given to consumers as they are the ultimate users of medicines and their beliefs and attitudes affect the way they use their medicines at home [9]. There is an increased trend towards purchasing both prescription and over the counter medicines from community pharmacies among consumers in developing countries [10]. In order to preserve quality of medicines, attempts are made to avoid exposure to temperature, light and humidity to maintain appropriate storage conditions according to regulations both at point of manufacture and distribution of medicines [10]. Further safe storage of medicines at point of use requires multidisciplinary approach including provision of information to consumers, addressing their beliefs and attitudes and controlling unnecessary storage of medicines through regulatory restrictions on sale of medicines [11]. The most important is the information that can be provided in counseling during dispensing process [12]. The main objective of this paper is to systematically review medicine storage trends and practices around the globe.

Methodology

The data was retrieved from electronic databases Pub Med, Google Scholar and Science direct from searched articles published from 1999 to 2016. The keywords 'medicines storage', 'consumers', 'unused medicines', 'medicines wastage' and 'medication disposal' were used for searching full research papers and abstracts. The bibliographies of the retrieved references were also searched. The features that describe the storage of medicines are the place of storage of medicines, duration for which medicine is being stored, the type of medicine stored and disposal of unused medicines stored at home [4]. Therefore, 82 studies covering any of these areas were included both from developed and developing countries. Data obtained from the studies included the study population demographics, knowledge and patterns of respondents regarding storage of medicines at home and potential health outcomes associated with storage of medicines. The methodologies used and target populations in some studies is summarized in (Table 1).

Editorship:

Prof. Dr. Cornelia M. Keck,
 Fachbereich Pharmazie, Institute of
 Pharmaceutical Technology and
 Biopharmaceutics, Philipps-
 Universität Marburg, Robert-Koch-Str.
 4, D-35037 Marburg, North Rhine-
 Westphalia, Germany.

Funding:

The authors received no direct
 funding for this research.

Competing Interests:

The authors declare no competing
 interests

Additional information is available at
 the end of the article.

Table 1 Methodology of studies from some developing countries

Year of study	Author	Country	Methodology
2016	Al-Shareef F, et al	Saudi Arabia(Riyadh	Twelve hundred patients were randomly selected from King Khalid University Hospital (KKUH), and King Saud University (KSU).A paper-based questionnaire with self-enumeration was used to collect data.
2015	Wondimu, A., et al	Northern Ethiopia (Tigray Region)	Multistage sampling was used; 1000 households were selected using systematic random sampling from randomly selected cultures of districts and regional states from Tigrey.By using structured questionnaire, the trained pharmacists collected data from adult household member (18 years) at time of data collection
2014	Mahmoud S. Al-Haddad, Qasem Mahmoud Aref Abdallah	Saudi Arabia	Trained data collectors distributed questionnaire among 1446 university students who were conveniently sampled from public areas of campus
2014	Gerard Lee See, Florencio Arce, Jr, Yolanda Deliman	Philippines (Barangay Talamban, Cebu City.)	A written interview questionnaire was distributed among 101 households who were sampled by systematic random sampling
2011	Kheir et al	Qatar	A list of telephone numbers was generated from Qatar's telephone directory using a systematic sampling method. Individuals consenting to participate were interviewed by 25–30-minute structured telephone interview carried out by two research assistants.
2011	Auta, A., et al	Nigeria	An interview questionnaire was used to collect data from 650 households selected by systematic random sampling,
2010	Ansam Sawalha	Palestine	Trained data collectors used structured interview questionnaire, also inspected medicines in cabinets from 465 households
2009	Abdo-Rabbo, A et al	Oman	A patient exit interview by using close ended questionnaire was used to collect data from 6,675 patients or their carers on exit from randomly selected 75 primary health care centers
2007	Abahussain, E.A. and Ball.D.E,	Kuwait	The data was collected by Questionnaire and face to face interview, inspection of medicines from two groups of households (total sample size 214)

Results and Discussion

Place of storage of medicines

The most common places of medicine storage such as bedrooms, kitchens and bathrooms were reported among families of Qatar, Sudan, Saudi Arabia, and New Zealand during household surveys and inventory of home medicine cabinets [4, 5, 13]. It was identified that consumers preferred such places because it was convenient for them as they find it easy to place medicines at places where they can frequently visit at any time in routine, or intend to take medicine at meal times of their 'personal judgments' guided

their choice of storage place [14]. Refrigerator was identified as the most common place of medicine storage in household survey in Oman, Saudi Arabia and households of Jordan as consumers wanted to protect medicines from high temperature [4, 12, 15]. A study conducted in Nigeria reported that majority of the respondents placed medicines at places including bags, dining table, at the top of refrigerator and glove compartments of car [16]. Medicine cabinets were reported as common storage place among majority of the respondents of Croatia and Northern Arab Emirates [17,8]. Likewise, cabinets and pill containers were the most common storage location among households of Philippine [18]. Medicines storage in cabinets and cupboards was also reported from studies from Saudi Arabia and Palestine stored medicines in [4, 10]. Although, these places do not comply with the recommended storage conditions as medicines have a definite chemical nature different storage conditions are required to store different dosage forms but still [3-5,12,17,18]. Some medicines such as insulin and liquid preparations of oral antibiotics must be stored in refrigerator for maintaining their stability during shelf life [19]. Similarly, suspensions must also be stored in refrigerator [4]. However, poor storage of liquid formulations which were not refrigerated, rather placed at open shelves demonstrating the patterns of inappropriate storage was reported in Sudan [5]. Humidity, temperature and light can affect the stability and quality of stored medicines [6]. Thus, medicines placed at such locations are at risk of degradation due to exposure to high temperature in kitchen [20]. Beside this, storing medicines at multiple locations increases the chances of missed doses of medicines [17].

The safety concerns are increased if medicines are placed in access of children, even though stored in medicine cabinets [12]. Children are curious by nature and they express their curiosity at homes by roaming freely and exploring everything that can capture their attention. The appearance of medicines, particularly their colors such as pink and orange greatly attracts children [7]. Consequently; they make efforts to ingest medicines considering them as candies which actually are poisons for them. This form of unintentional poisoning is one of the major reasons for injuries among young children [21]. Different studies conducted Ethiopia, Qatar, Saudi Arabia, Palestine and Brazil reported medicines stored at home in reach of children [4,17,18,21,23]. A hospital based study conducted in Pakistan on childhood cases of unintentional poisoning concluded that majority of the children were admitted to hospitals as a consequence of ingesting medicines that were in their access [24]. The risk of poisoning could be increased if medicines are placed at height of storage places which are less than two meters, unlocked cabinets in bedrooms, kitchens and bathrooms and in the reach of young children with less than five years [25-26]. Another study conducted in Pakistan revealed that intake of medicines such as benzodiazepines, opioids, acetaminophen, aspirin and antihistamines and lack of awareness of parents regarding safe storage of medicines at home caused poisoning among young children [7].

Duration of storage

The duration of use through which the use of medicine offers claims of maximum efficacy and safety is limited and is specified on labels of containers by manufacturers as expiry date [27]. The studies conducted in Northern Uganda and Ethiopia and households of Palestine revealed that medicines at home were not adequately labelled, were having unclear expiry dates and without original containers [2,18,28]. On the contrary, findings from Malaysia revealed that majority of the respondents had stored medicines in original packages, but occasionally checked expiry dates of medicines [29]. However, the pattern

of checking expiry date of medicines regularly was reported from consumers of Malaysia, Saudi Arabia, and Northern Arab Emirates [4,8,30]. A study was conducted by pharmacy personnel in New Zealand with the aim to collect unused and expired medicines from consumers and to find out the extent of storage of expired and unused medicines at home. The presence of unused medicine was reported to be 62% of the collected medicines [31]. Another study from Mexico revealed that 90% of the collected expired and unused medicines stored at home were prescription only medicines [32]. Similar studies from Serbia, Ireland and United States revealed that large amounts of expired or unused medications were stored by respondents at their homes [23,33,34]. The prevalence of expired or leftover medicines at home was reported from other countries as well. In 2006, a questionnaire based survey in Kuwait revealed that 97.5% respondents had medicines stored at home which were not required [35]. In 2007, the study from households of Kuwait revealed that about 52% of the collected medicines were expired, out of which major proportion was of cough syrups [36]. Similarly, surveys investigating medicines stored among households of Croatia, Saudi Arabia, Jordan, Northern Uganda, Iraq and Malaysia, Palestine and Nigeria [2,27,28,10,33,37].

Types of medicines stored at home

The most common types of medicines encountered during surveys (Saudi Arabia, Iraq, Croatia, Jordan and Northern Uganda, Nigeria) were analgesics (paracetamol, aspirin and antibiotics) both in large amounts [2,3,4,22,28,38]. The studies conducted in Iraq, Sudan and Qatar have highlighted that large amounts of over the counter medicines and antibiotics were stored among surveyed households [3,5,17]. However, the most common medicines stored among consumers of Qatar were analgesics followed by allergy, cough and cold medicines. It was further reported that comparatively less availability of antibiotics is attributed towards strict legislations on sale [17]. In addition to analgesics and antibiotics, consumers in Malaysia and Oman also stored herbal medicines [39,40]. The other types of medicines in different households are shown in (Table 2).

Table 2 Storage and utilization patterns of medicines at home

Study	Setting	Storage of medicines at home			
		Number of medicines	Utilization patterns of stored medicines	Most common types of medicines	Risks associated with storage of medicines
		Total of 4279 with average household possessed 14.26 products ,range was 1-72 per household	Current use (31%) Leftovers (45%) Medicines kept for future use (23%)	Antibiotics (26.43 %), Antipyretic/analgesics (19.58%), NSAIDs (11.45%)	Self –medication (78%), poor compliance , use of drugs that have been kept beyond their expiry date
Sweileh, W.M., et al,2010	415 households in Palestine	Total of 5505 medicines , mean ± SD was 13.3 ± 7.8.	Regular use (35.8%) When needed (30.4%) Unused drug products (32.7%), Expired	Alimentary tract drug category (18.52%) Musculoskeletal (14.2%) ,respiratory categories	Wastage of medicines (19 million USD estimated nationwide drug wastage),

			(17.7%) No clear expiry date (11%)	(13.6%).	
Abdo-Rabbo, A et al,2009	1050 household s in Sultanate Oman	Average 6 medicines per household (95% surveyed household had medicines)	Unused medicines (31.64%), Future use (61.31%) Expired medicines(12. 41%)	Musculosket al/joint medicines (24.91%), respiratory medicines (14.60%) cardiovascula r system medicines (12.05%). Antibiotics (45.83%)	Self medication , informal channels of obtaining medicines; abundance of expired, unused or deteriorated medicines in the households, absence of proper labeling or clear instructions
M.A Yousif,2002	469 household s in Sudan	Total medicines were 2079, mean per household unit was 4.4	Current use (52.8%), Future use (47.2%), Unused (18.8%), Expired (15.2%)	Antibiotic (22%) Analgesic (11%) Antimalarial (10.4%)	Self- medication(46.9%), sharing of medicines(59.3%) repeated use of unfinished stored medicines(55%), poor compliance(71.25)
Sharif, S.I., et al,2010	300 household s inNorthern United Arab Emirates	The average number of drugs per household unit was 6 items	Expired medicines kept but not used (13%) Disposed of expired (87%)	NSAIDs (74%) Antidiabetics (14%) Antihistaminic s (44%) Antihypertensi ve (26%) Antidiarrheal (20%)	Self medication (45%) Exchange rate (86%)
Ocan et al,2014	892 household s in Northern Uganda	Average number of medicines was 6,and 68.1% had medicines 8- 10	Ongoing treatment (48%) Unused/leftov er (30.5%) Future use (21.6%)	Antibacterial (40.1%)	Self-medication (76%)
Ali, S.E., M.I. Ibrahim, and S. Palaian,2010	481 female students in USM Malaysia	Medicines were stored by 93.1% students	Emergency use(77.1%) future use (10.4%)	analgesics& antipyretics (30.2%), ear, nose & throat drugs (10.8%),vitam ins & minerals (10.8%), GIT drugs (8.5%), anti-infections (7.3%) and herbal medicines (3.5%).	self- medication(80.9%), unsafe disposal practices

Al-Azzam, S., et al,2012	435 households in the North of Jordan	Total medicines 2835	Current use(65.3%) Unused (34.7%) Expired (5.8%)	Nervous system medicines (25.2%), anti-infective agents (17.4%). Musculoskeletal agents (13.4) Respiratory system agents	Medication wastage(The total cost of unused medications in Jordan was estimated as 6,326,000 JD)
Abou-Auda, H.S.,2003	1641 households from Saudi Arabia and other Gulf countries	Total of 12,463 were found with mean (SD) number of medicines per household 8.0 (4.3)	mean (SD) number of drug products unused, deteriorated, or expired was 2.2 (2.7) and 2.7 (1.9) per household Unused medicines (4.26%)	Respiratory medications (16.8%), Central nervous system agents (16.4%) Antibiotics (14.3%)	Wastage(US \$150 million) self-medication(43.5%) sharing(20.9%) Non compliance

Disposal of medicines

The medicines which have passed their expiry date are not suitable for use; it is advisable to dispose off such medicines [41]. The most common methods of disposal of unused medicines stored at home among consumers of Kuwait, Qatar, Arab Emirates, Saudi Arabia, Oman, Nigeria and Malaysia were reported as throwing medicines down to toilet or in household waste [39,17,8,12,42,43]. These are unsafe disposal practices because active ingredients of medicines which were being flushed down the sink or toilet by consumers were not processed through water treatment plants and were added as traces in water table thereby posing risks to environmental safety [44-46]. Similarly, medicines thrown in garbage are leached through landfills and become part of ground water [47]. Sudanese families disposed medicines by giving them to friends or relatives [5]. Unsafe disposal of used sharps and needles of insulin directly to waste bins among diabetic consumers has also been reported [44,45]. A comparatively safe method of disposal was suggested and followed during studies to collect unused and expired medicines. It included returning medicines to pharmacies which could be destroyed through incineration at high temperature and is less detrimental to environmental safety [48-49]. For this purpose, consumers of New Zealand, Mexico, Kuwait, were provided with collection bags for collecting unused medicines and returning to pharmacies encouraging safe disposal practices [42,41,46]. The investigation of factors that influenced disposal practices revealed that the consumers, who were aware of the detrimental effects of disposing unused medicines on environment, were more likely to return medicines to pharmacies as reported from Swedish surveys [50-52]. A study was conducted to investigate the practices and perceptions of consumers towards disposal of medicines by using questionnaire among customers visiting pharmacies of Kuwait. It was found that some consumers returned medicines to pharmacies because they thought it would be better to be used by someone else while others did so as they were convinced by the

appropriateness of this method [45]. The respondents of a study from USA reported that they considered it appropriate to flush medications down to sink or toilet; however, the respondents who were counseled earlier on safe disposal of medicines were of the opinion to return medicines to the pharmacies [44]. Some consumers considered type of dosage form being important when they were going to dispose of medicines. Therefore, an online survey conducted in New Zealand identified that respondents preferred to dispose of liquid formulations to water systems, while tablets and capsules were more likely to be returned to the pharmacies [41]. In a review study regarding disposal of unused medications it was highlighted that lack of legislations and guidelines regarding disposal of unused medicines is a barrier towards safe disposal of medicines which ultimately completes the cycle of safe use of medicines among households [52]. The impact of legislations and guidelines was emphasized to improve safe disposal practices of medicines stored at home [46,8,12].

Risks associated with unsafe storage of medicines at home

Unsafe storage can result in poisoning, increased risk of toxicity, unsafe disposal to environment [42]. The researchers both from developed and developing countries conducted population based surveys to investigate the magnitude of medicine storage among consumers and concluded that significant amounts of medicines were stored at homes and associated risk factors were also found [2-5,18]. A high percentage (82%) of customers attending pharmacies of Tabriz, Iran reported the presence of medicines stored at home constituting mainly analgesics and antibiotics indicating trend of self-medication among consumers [26]. Both household surveys and medicine inventory modules among consumers of rural areas of Crete, Greece, Brazil, Serbian, Belgium, Switzerland revealed that large amounts of medicines stored at home were found along with indications of unsafe storage practices such as self-medication and wastage of resources [19-25]. In a study from Arab Emirates, respondents reported that they use medications from stock of medicines stored at their homes [8]. The availability of leftover medicines at homes indicates the consumer intentions for future use without seeking consultation that may result in reduced quality and effectiveness of therapy [47]. Such patterns of self medication were reported from Ethiopia, Croatia, Iraq and Northern Uganda, [2,3,18,22,43,]. The female consumers from Palestine (school teachers), from Veitnam (mothers) and from Malaysia (university students) stored leftover antibiotics for treating cough and diarrhea in future [16,39,53]. In Saudi Arabia, it was found that suspensions ,meant to be discarded, were also kept for future use [4]. In Pakistan, it was found that self-medication with OTC and analgesics was associated with acquiring medicines from friends, family or using medicines previously stored at home medicine cabinets [54]. Given, the storage of large amounts of analgesics and antibiotics at home, it is quite predictable that consumers are at risks of adverse events and interactions that are inherent with concomitant unsupervised use of medicines. For example, chronic use of analgesics can cause renal failure [39]. Overuse of antibiotics results in antimicrobial resistance [3]. Using OTC medicines such as NSAIDS and antibiotics frequently and without consultation of physician increases risks of adverse effects such as hemorrhagic duodenitis and emergence of antibiotic resistance [39,55,56,57]. Unintentional exposure of such medicines to children can be a significant risk factor of accidental poisoning [23,48].

Significant relation of ethnicity was observed among Malay students who shared medicines more frequently as compared to other students from Chinese origin in Malaysia [39]. A common practice of sharing was found in children and adults with more likeliness

among girls especially for treating acne problems [59]. Sharing of medicines poses many risks to the health of consumers [60]. The reason being that a consumer would give medicine to friend or relative without dose instructions, precautions and sharing warnings associated with its safe use [59,60,61]. Some medicines have teratogenic effects, therefore, the sharing of medicines with pregnant women may cause serious complications for mother and fetus [62]. The main factor that influenced the extent of sharing medicines was that the consumers in Kuwait considered sharing medicines from household stock as an acceptable behavior [45].

Wastage of resources resulting from improper storage of medicines

As medicines constitute significant proportion of health expenditure, the unused medicines at home that are not fully consumed are considered as wastage of resources spent on them which may reach up to billions of dollars [28,63]. Globally, the studies investigated the extent of wastage from unused medicines stored at home and presented a quantified estimate of wasted resources from unused medicines at home and its economic impact [52]. A study was conducted at tertiary care hospitals of Oman with the objective to investigate value and type of medicines returned by patient. The estimated wastage was reported as Omani Rials (OR) 20,140 which comprised largely of anti-infective and cardiovascular medicines [48]. Similarly the reports of estimated wastage were found from Saudi Arabian homes as national medication wastage of USD 150 million, from households of Egypta total cost of 49507.2 LE (8348.5 \$) was reported, from Palestine it was about 19 million USD nationwide [64-65]. Another survey in Palestine investigated wastage with antibiotics stored at home. The estimated total cost of antibacterial agents found in the study was \$4,769, approximately \$11.5 cost per household. The total wastage on antibacterial agents was reported as \$2,790 making it to approximately \$6.7 per household [33]. Similar study was conducted among households of Jordan. It was found that a cost of 6,326,000 JD was incurred on unused medicines stored at home, while expired medicines constituted an estimated cost of 1,267,000 JD [28]. A potential medication wastage of 53.8% was found among households of Iran with medications stored at home [9].

Factors affecting storage of medicines at home

There are some factors that affect the storage of medicines at home. These include demographics of respondents, perceptions and beliefs, knowledge regarding storage. An increased pattern of unsafe storage of medicines was found among elderly consumers, consumers with low education level as in households of Iraq, Sudan, Nigeria and Northern Uganda, higher level of education among Palestinian, Malay and Saudi Arabian consumers [10,39,4,66,67]. However, in Arab Emirates, level of education of consumers had no influence on storage of medicines at home [8]. The studies from United Kingdom, Malaysia and Saudi Arabia showed that younger individuals and females were more likely to store medicines at home [39,68-72]. Mothers from Iranian households and Rural communities of Vietnam, having dominating role of mothers in managing health related issues at home stored antibiotics for future use [9,16,73]. It was reported from various studies that unsafe storage of medicines was found to be associated with noncompliance of consumers, when consumers stop taking medicines either because of side effects or when they feel better from illness [74-75].

Another factor reported was overprescribing of antibiotics by physicians, change in regimen or treatment modifications as reported by the respondents Egypt, and Kuwait [76-

78],

In developing countries, there is an increased trend among consumers towards purchasing both prescription and over the counter medicines from community pharmacies, which is considered as convenient and economical source for supply of medicines [13]. The unchecked sale of medicines to the consumers with inadequate knowledge raises the possibility of medicines to be part of home medicine cabinets which later becomes source of treatment for households indicating self-medication [47,79]. The availability of free of charge medicines in some countries may also cause an increased number of stored medicines at home such as in Oman and Kuwait [45,48].

The safe storage of medicines is largely affected by the quality of information provided to the consumers [15,16]. It includes both written such as labels of medicines and verbal source of information such as counseling by physician and pharmacists [12, 80]. It was found in Ethiopia that respondents following inappropriate storage patterns were not having knowledge of recommended storage conditions [18]. The respondents from Nigeria and India were aware of the fact that improper storage of medicines badly affects their quality and thus makes medicines unfit for subsequent use by consumers yet inappropriate patterns were followed because of lack information regarding proper storage of medicines at home [31,74]. The results of household surveys investigating storage of medicines at home revealed patterns of improper storage of medicines among consumers of Qatar, Iran, and Philippine, even though, physicians were reported as major source of information regarding storage [17,26,32]. However, some (29%) of the respondents identified pharmacists as source of information regarding storage among families of Saudi Arabia [4]. Lack of information regarding safe disposal practices was reported from Kuwait Nigerian families and Saudi Arabia [31,46,82]. It was recommended that public education involving pharmacists should provide necessary information regarding storage of medicines at home and safe disposal practices to consumers [18,32,4,5,31,17]. In fact, it is the responsibility of pharmacist to provide instructions on storage of medicines to consumers [32]. It must be ensured that consumers understand well the instructions on label regarding medicine use [79]. For example, pharmacist must explain that what it means by instruction "keep at cool place". The places at home should be identified where conditions of cool temperature are fulfilled. It should also be elaborated that placing medicines in windows expose them to sunlight. The instructions regarding safe storage can also prevent cases of poisoning [7]. Further, the term "keep away from reach of children" should be explained by suggesting that keeping medicines should be kept at height and in locked cabinets. Pharmacist should warn consumers to place caps of bottles after use, never leave medicines unsupervised to avoid cases of accidental poisoning. The physicians assume that patients will receive instructions from pharmacist, while pharmacist must not assume that customer has knowledge regarding quality use of medicines [81-82]. In some countries the educational campaigns were conducted and the role of pharmacists was acknowledged in promoting safe storage of medicines at home. These educational campaigns included displaying posters in waiting areas in hospitals having information and instructions regarding safe disposal of medicines by returning them to pharmacies [82]. Student facilitated education program on the knowledge of patrons attending community pharmacies in Scotland [65]. Pre and post intervention for pharmacist were found as an effective tool in promoting appropriate use of medicines and thus preventing the wastage [71]. Moreover, drug use assessment programs and comprehensive evaluation of national policies can reduce wastage from medicines stored

at home [9].

Conclusion

The review concluded that consumers store a good number of medicines inappropriately at different places including bedroom, kitchen, on shelves and in reach of children at home. This reflects that consumers are not well informed regarding proper storage of medicines at home even at point of purchase. Such inappropriate practices could also lead to irrational drug use like accidental poisoning by children, self-medication, sharing of medicines, unsafe disposal harming environment resulting in wastage of resources spent on medicines from manufacture to delivery. There is strong need to provide legislative support in terms of restriction on sale of POM medicines. Participative role of pharmacist can help improve safe storage and use of medicines at home and ensure effectiveness of therapy.

References

1. Hardon, A., C. Hodgkin, and D. Fresle, *How to investigate the use of medicines by consumers*. 2004, World Health Organization and University of Amsterdam Switzerland.
2. Ocan, M., et al., *Factors predicting home storage of medicines in Northern Uganda*. BMC public health, 2014. **14**(1): p. 1.
3. Jassim, A.-M., *In-home drug storage and self-medication with antimicrobial drugs in Basrah, Iraq*. Oman Medical Journal, 2010. **25**(2): p. 79-87.
4. Al-Haddad, M.S. and Q.M.A. Abdallah, *Medication storage among university students in Saudi Arabia*. Health MED, 2014. **8**(10): p. 1169-1178.
5. Yousif, M.A., *In_ home drug storage and utilization:a Sudanese study*. Eastern Mediterranean Health Journal, 2002. **8**: p. 422-431.
6. Hussain, A., MohamedI.M.Ibrahimc, and Zaheer-ud-DinBaberd, *Compliance with legal requirements at community pharmacies: a cross sectional study from Pakistan* International Journal of Pharmacy Practice 2012. **20**: p. 183–190.
7. Manzar, N., et al., *The study of etiological and demographic characteristics of acute household accidental poisoning in children - a consecutive case series study from Pakistan*. BMC pediatrics, 2010. **10**(1): p. 1.
8. Sharif, S.I., et al., *Trends of Home Drug Storage and Use in Different Regions across the Northern United Arab Emirates*. Medical Principles and Practice, 2010. **19**(5): p. 355–358.
9. Zargarzadeh, A.H., N. Tavakoli, and A. Hassanzadeh, *A survey on the extent of medication storage and wastage in urban Iranian households*. Clinical therapeutics, 2005. **27**(6): p. 970-978.
10. Sawalha, A.F., et al., *Analysis of prescriptions dispensed at community pharmacies in Nablus, Palestine*. East Mediterr Health Journal, 2010. **16**(7): p. 788-92.
11. WHO, *Encouraging appropriate medicine use by consumers*. 2012, Management health Sciences.
12. Abdo-Rabbo, A., et al., *The Use of Medicines in Oman Public Knowledge, Attitudes and Practices*. Sultan Qaboos Univ Med J, 2009. **9**(2): p. 124-131.
13. Butt, Z.A., et al., *Quality of pharmacies in Pakistan: a cross-sectional survey*. International Journal for Quality in Health Care 2005. **17**(4): p. 307–313

14. Azhar, S., et al., *The role of pharmacists in developing countries: the current scenario in Pakistan* Human Resources for Health 2009. **7**(54).
15. Hussain, A. and M.I.M. Ibrahim, *Medication counselling and dispensing practices at community pharmacies: A comparative cross sectional study from Pakistan*. International journal of clinical pharmacy, 2011. **33**(5): p. 859-867.
16. Okumura, J., S. Wakai, and T. Umenai, *Drug utilisation and self-medication in rural communities in Vietnam*. Social science & medicine, 2002. **54**(12): p. 1875-1886.
17. Kheir, N., et al., *An exploratory study on medications in Qatar homes*. Drug, Healthcare and Patient Safety, 2011. **3**: p. 99-106.
18. Wondimu, A., et al., *Household Storage of Medicines and Associated Factors in Tigray Region, Northern Ethiopia*. PloS one, 2015. **10**(8): p. 1-9.
19. Tsiligianni, I.G., et al., *A household survey on the extent of home medication storage. A cross-sectional study from rural Crete, Greece*. European Journal of General Practice 2012. **18**(1): p. 3-8.
20. Carvalho, M.F.d., et al., *Utilization of medicines by the Brazilian population, 2003*. Cad. Saúde Pública 2005. **21**: p. 100-108.
21. Mastroianni, P.D.C., et al., *Household storage and use of medications in a population served by the family health strategy in Brazil*. Revista Panamericana de Salud Pública, 2011. **29**(5): p. 358-364.
22. Aljinoviæ-Vuèiæ, V., V. Trkulja, and Z. Lackoviæ, *Content of Home Pharmacies and Self-Medication Practices in Households of Pharmacy and Medical Students in Zagreb, Croatia: Findings in 2001 with a Reference to 1977*. Croat Med J, 2005. **46**(1): p. 74-80.
23. Kusturica, M.P., et al., *Home pharmacies in Serbia: an insight into self-medication practice*. International journal of clinical pharmacy, 2015. **37**(2): p. 373-378.
24. Bolle, L.D., et al., *Home Medication Cabinets and Self-Medication: A Source of Potential Health Threats?* Annals of Pharmacotherapy, 2008. **42** (4): p. 572-579
25. Wasserfallen, J.B., et al., *Composition and cost of drugs stored at home by elderly patients*. Annals of Pharmacotherapy, 2003. **37**(5): p. 731-737.
26. Sahebi, L. and R.G. Vahidi, *Self-Medication and Storage of Drugs at Home Among the Clients of Drugstores in Tabriz*. Current Drug Safety, 2009. **4**(2): p. 107-112.
27. Abou-Auda, H.S., *An economic assessment of the extent of medication use and wastage among families in Saudi Arabia and Arabian Gulf countries*. Clinical therapeutics, 2003. **25**(4): p. 1276-1292.
28. Al-Azzam, S., et al., *An assessment of the Extent of Medication Wastage among Families in Jordan*. Jordan Journal of Pharmaceutical Sciences, 2012. **5**(1).
29. Ganguly, S. *The Importance of Proper Storage of Drugs Illustrated by the Example of the Latest SSRI Drug*. 2007 30 March, 2016]; Available from: <http://ezinearticles.com/>
30. Hewson, C., et al., *Personal medicines storage in New Zealand*. Journal of Primary Health Care, 2013. **5**: p. 146-150.
31. Obitte, N.C., et al., *Survey of drug storage practice in homes, hospitals and patent medicine stores in Nsukka Nigeria*. Sci Res Essay, 2009. **4**: p. 1354-9.
32. See, G.L., F. Arce Jr, and Y. Deliman, *Household storage of medicines among residents in Barangay Talamban, Cebu City*. International Journal, 2014. **5**(1): p. 916-921.

33. Sweileh, W.M., et al., *Storage, Utilization and Cost of Drug Products in Palestinian Households* International journal of clinical pharmacology and therapeutics, 2010. **48**(1): p. 59.
34. Hyder, A.A., et al., *Global childhood unintentional injury surveillance in four cities in developing countries: a pilot study*. Bulletin of the World Health Organization, 2009. **87**(5): p. 345-352.
35. Abbas, S.K., S.S. Tikmani, and N.T. Siddiqui, *Accidental poisoning in children*. J Pak Med Assoc, 2012. **62**(4): p. 331-334.
36. Hassan, O.u., H. Qadri, and U.M. Ahmed, *Unintentional childhood poisoning, epidemiology and strategies for the prevention and policy change in Pakistan*. J Ayub Med Coll Abbottabad 2013. **25**(3): p. 90-3.
37. NHS. *Guidance on Storage of Medicines and Expiry Dates*. 2004 August 2014[30 March,2016]; Available from: <http://www.neneccg.nhs.uk>.
38. Kiyingi, K.S. and J.A. Lauwo, *December. Drugs in the home: danger and waste*. In World health forum, 1992. **14**(4): p. 381-384.
39. Ali, S.E., M.I. Ibrahim, and S. Palaian, *Medication storage and self-medication behaviour amongst female students in Malaysia*. Pharmacy Practice (Internet) Pharmacy Practice (Internet), 2010. **8**: p. 226-232.
40. Hassali, M.A., et al., *Patterns and Predictors of Non-Prescription Medicine Use among Malaysian Pharmacy Patrons: A National Cross Sectional Study*. Plos one, 2013. **8**(4).
41. Braund, R., G. Gn, and R. Matthews, *Investigating unused medications in New Zealand*. Pharmacy World & Science, 2009. **31**(6): p. 664-669.
42. Gracia-Vásquez, S.L., et al., *An analysis of unused and expired medications in Mexican households*. International Journal of Clinical Pharmacy, 2015. **37**(1): p. 121-126.
43. Vellinga, A., et al., *Public practice regarding disposal of unused medicines in Ireland*. Science of the Total Environment, 2014. **478**: p. 98–102.
44. Seehusen, D. and J. Edwards *Patient practices and beliefs concerning disposal of medications*. J Am Board Fam Med., 2006. **19**(6): p. 542-547.
45. Abahussain, E.A., D.E. Ball, and W.C. Matowe, *Practice and opinion towards disposal of unused medication in Kuwait*. Medical Principles and Practice, 2006. **15**(5): p. 352-357.
46. Abahussain, E.A. and Ball.D.E, *Disposal of unwanted medicines from households in Kuwait*. Pharmacy World & Science, 2007. **29** (4): p. 368-373
47. Hassali, M.A., et al., *Self-medication practices among adult population attending community pharmacies in Malaysia: an exploratory study*. International journal of clinical pharmacy, 2011. **33**(5): p. 794-799.
48. Al-Siyabi, K. and K. Al-Riyami, *Value and types of medicines-returned by patients to Sultan Qaboos University Hospital Pharmacy, Oman*. SQU Med J, 2007. **7**: p. 109-16.
49. Chowdhury, N., et al., *Prevalence of self medication of antibiotics among people in Bangladesh*. International Journal of Pharmacy Teaching & Practices 2013. **4**(1): p. pp.504-510.
50. Ruhoy, I.S. and C.G. Daughton, *Beyond the medicine cabinet: an analysis of where and why medications accumulate*. Environment international, 2008. **34**(8): p. 1157-1169.
51. Chan, G.C. and S.F. Tang, *Parental knowledge, attitudes and antibiotic use for*

- acute upper respiratory tract infection in children attending a primary healthcare clinic in Malaysia.* Malaysian Family Physician, 2012. **2**(1): p. 5.
52. Ibrahim, S.Z., H.M. Mamdouh, and I.Z. El-Haddad, *Analysis of medications returned to community pharmacies in Alexandria, Egypt.* Life Science Journal 2012.(2): p. 746-751
53. Tong, A.Y.C., B.M. Peake, and R. Braund, *Disposal practices for unused medications around the world* Environment International 2011. **37**: p. 292–298.
54. Sawalha, A.F., *Self-medication with antibiotics: A study in Palestine.* International Journal of Risk & Safety in Medicine, 2008. **20**(4): p. 213-222.
55. Amin, S., et al., *A cross sectional study on self-medication with analgesics among pharmacy students of lahore, Pakistan.* Science International, 2014. **26**(3).
56. Schmiedl, S., et al., *Self-medication with over-the-counter and prescribed drugs causing adverse-drug-reaction-related hospital admissions: results of a prospective, long-term multi-centre study.* Drug safety, 2014. **37**(4): p. 225-235.
57. Stevenson , R., et al., *Mortality during the winter flu epidemic--two cases of death associated with self-medication.* Scott Med J, 2001. **46**(3): p. 84-6.
58. Liu, Y.C., et al., *Inappropriate use of antibiotics and the risk for delayed admission and masked diagnosis of infectious diseases: a lesson from Taiwan.* Archives of internal medicine, 2001. **161**(19): p. 2366-2370.
59. Beyene, K.A., J. Sheridan, and T. Aspden, *Prescription medication sharing: a systematic review of the literature.* American journal of public health, 2014. **104**(4): p. 15-26.
60. Ellis, J. and J. Mullan, *Prescription medication borrowing and sharing: risk factors and management.* Australian family physician, 2009. **38**(10): p. 816.
61. Daniel, K.L., M.A. Honein, and C.A. Moore, *Sharing prescription medication among teenage girls: potential danger to unplanned/undiagnosed pregnancies.* Pediatrics, 2003. **111**(1): p. 1167-1170.
62. Goldsworthy, R.C., N.C. Schwartz, and C.B. Mayhorn, *Beyond abuse and exposure: framing the impact of prescription-medication sharing.* American Journal of Public Health, 2008. **98**(6): p. 1115-1121.
63. Petersen, E.E., et al., *Prescription medication borrowing and sharing among women of reproductive age.* Journal of Women's Health, 2008. **17**(7): p. 1073-1080.
64. Reed, J., et al. (2003) *Diabetes self-management: how are we doing?* PractDiabInt**20**.
65. Govender, D. and A. Ross, *Sharps disposal practices among diabetic patients using insulin.* SAMJ 2012. **102**(3).
66. Abrons, J., et al., *Encouraging safe medication disposal through student pharmacist intervention.* Journal of the American Pharmacists Association, 2010. **50**(2): p. 169-173.
67. Barnes, K.K., et al., *Pharmaceuticals and other organic waste water contaminants within a leachate plume downgradient of a municipal landfill.* Groundwater Monitoring & Remediation, 2004. **24**(2): p. 119-126
68. James, T.H., M.L. Helms, and R. Braund, *Analysis of Medications Returned to Community Pharmacies.* Annals of Pharmacotherapy, 2009. **43**(10): p. 1631-1635.
69. Persson, M., E. Sabelström, and B. Gunnarsson, *Handling of unused prescription drugs—knowledge, behaviour and attitude among Swedish people.* Environment

- international, 2009. **35**(5): p. 771-774.
70. Laste, G., et al., *The role of the community health agent in control of the in-house stock of medication in communities served by the family health strategy*. Ciênc. Saúdecoletiva 2012. **17**(5).
71. Jarvis, C.I., et al., *Educational campaign for proper medication disposal*. Journal of the American Pharmacists Association, 2009. **49**(1): p. 65-68
72. Copeland, C., *Prescription drugs: issues of cost, coverage, and quality*. EBRI issue brief/Employee Benefit Research Institute 1999 (208): p. 1-21.
73. Auta, A., et al., *Unused medicines in Nigerian households: Types and disposal practices*. Journal of Pharmacology and Pharmacotherapeutics, 2011. **2**(3): p. 195-196.
74. Prabhu, V.A., et al., *A survey on medicines safety and usage in community pharmacy*. Journal of basic and clinical pharmacy. Journal of basic and clinical pharmacy, 2013. **5**(1): p. 24.
75. McNulty, C.A., et al., *Antimicrobial drugs in the home, United Kingdom*. Emerging infectious diseases, 2006. **12**(10): p. 1523
76. Abahussain, N.A. and A.Z. Taha, *Knowledge and attitudes of female school students on medications in eastern Saudi Arabia*. Saudi medical journal, 2007. **28**(11): p. 1723-1727.
77. Halfvarsson, J., et al., *Knowing When but Not How!—Mothers' Perceptions and Use of Antibiotics in a Rural Area of Viet Nam*. Tropical doctor, 2000. **30**(1): p. 6-10.
78. Barat, I., F. Andreasen, and E.M.S. Damsgaard, *The consumption of drugs by 75-year-old individuals living in their own homes*. European journal of clinical pharmacology, 2000. **56**(6-7): p. 501-509.
79. Larson, E. and L. Grullon-figueroa, *Availability of antibiotics without prescription in New York City*. Journal of Urban Health, 2004. **81**: p. 498.
80. Vinker, S., V. Eliyahu, and J. Yaphe, *The effect of drug information leaflets on patient behavior*. The Israel Medical Association Journal, 2007. **9**(5): p. 383-386.
81. Abdo-Rabbo, A., et al., *Household Survey on Medicine Use in Oman, 2009*, Ministry of Health Muscat, Sultanate of Oman
82. Al-Shareef F, et al., *Investigating the disposal of expired and unused medication in Riyadh, Saudi Arabia: a cross-sectional study*. International Journal of Clinical pharmacy, 2016. **38**(4): p. 822-8.



© 2016 The Author(s). This open access article is distributed under a Creative Commons Attribution (CC-BY) 4.0 license.

You are free to:

Share — copy and redistribute the material in any medium or format. Adapt — remix, transform, and build upon the material for any purpose, even commercially. The licensor cannot revoke these freedoms as long as you follow the license terms. Under the following terms: Attribution — You must give appropriate credit, provide a link to the license, and indicate if changes were made. You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use. No additional restrictions. You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits