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ORIGINAL ARTICLE

Public Awareness on the Rationale Consumption and Appropriate Disposal Methods of Unused and Expired Medications in Kanchipuram District, Tamilnadu, India

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Abstract

Background/Aim: Improper drug disposal methods are a threat to the nature and its ecosystem by accumulation of active compounds included in these pharmaceuticals. Aim of this study was to assess the knowledge, attitude and practice (KAP) on the rationale consumption and appropriate disposal methods of unused and expired medications among common public in Kanchipuram district, Tamilnadu, India.

Method: KAP questionnaire was prepared to get responses from all participants who had volunteered for the study. Questionnaire had queries pertaining to the personal information about the respondent and respondent's knowledge, practice and attitude concerning drug usage, the disposal methods of unused and expired medicines and their awareness and knowledge towards drug take back programme.

Results: In this study 37.91 % out of the 807 participants had excellent knowledge on the rationale consumption and appropriate disposal of unused/expired medications, 48.94 % had average knowledge, but only 6.56 % of the total participants had more positive attitude and 66.66 % had positive attitude. Only around 45.84 % of the participants were following the good practices.

Conclusion: Guidelines, policies and strict vigilant actions need to be initiated by government of India for safe utilisation of pharmaceutical products and disposal of unused/expired medications to safeguard our ecosystem from some of the major treats like antimicrobial resistance.

Key words: Drug contamination; Environmental medicine; Environment; Public healthcare.

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Introduction

Rationale use of medication is defined as "Patients receiving medicines appropriate to their clinical condition with individualised doses for an adequate period of time and at cost affordable to them and their community".[1]

Medications are the integral part of healthcare. People use medications for one or other purpose due to the increasing incidence and prevalence of diseases. They include antibiotics, analgesics, anti-inflammatory drugs, steroids, cardiovascu-

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lar drugs, drugs acting on central nervous system etc. A great proportion of these drugs are available even without prescription leading to irrational use of medicines. Special focus towards sale of antimicrobial in pharmacies without prescription needs to be curtailed to stop antibiotic resistance.[2] This predisposes to unnecessary consequences such as inappropriate treatment, antibiotic resistance, medication errors and drug wastage.

Furthermore, the patients most often do not use all of the medicines prescribed due to adverse effects, medication reaching the expiry date or early recovery. Literature also suggests that for the last two decades supply and issuing of free medications for the public has decreased from 17.8 % to 5.9 % in outpatients setting, quantifying the out of the pocket payments for medications among the households in India. Storage and disposal of unused as well as expired medications in houses creates a potential threat to humans, environment and wildlife.[3-6] Also in a study done among the communities of Kathmandu, self-medication practice and methods of safe medicine disposal was not known by half of the participants.[7] General public and surprisingly even healthcare professional used unsafe methods of drug disposal.[8,9] This raises a concern to have a clear guidance about the usage and disposal methods of unused as well as expired medications among patients, healthcare professionals and the community in general.[10]

The unused and expired pharmaceuticals are usually disposed as solid municipal waste, or as solid sewage and liquid sewage or as gaseous waste as the result of burning the pharmaceutical waste in home. These improper drug disposal methods are a threat to the nature and its ecosystem by accumulation of active compounds included in these pharmaceuticals. The toxic and persistent nature of these active compounds and their potential for causing pollution can lead to development of various microbial resistant strains towards drugs.[11]

Previous studies have suggested presence of increased levels of residual drugs in water sources of Hyderabad City causing drug resistance.[12] Evidence shows antibiotics presence in water sources has led to antibiotic resistance.[13] The above evidences and reports suggest that improper drug disposal methods are some of the reasons contributing to treatment failure.

The United States Food and Drug Administration (FDA) initiated the national drug take back programme on 25th September 2010 to prevent the dangerous consequences of improper drug disposals and aimed at responsible, safe and convenient means of disposing prescribed drugs. They also insisted upon educating and creating awareness among public about the potential danger regarding abuse of medicines. This programme helps in safeguarding the environment and ecosystem from medicines altering the ecosystem. In India, the drug take back programme is not functioning efficiently, being one of the reasons for improper drug disposal.

Aim of this study was to assess the level of the public awareness towards the drug usage and disposal of pharmaceuticals.

Methods

This was an observational and cross-sectional study conducted at the rural and urban areas of Kanchipuram district for a duration of two months from April to May 2021. Inclusion criteria were age group above 18, which includes general public from all layers of society and who were local residing population at Kanchipuram, regardless of their cultural identity or their employment.

A sample size of 807 had been reached by using the non-probability sampling technique / convenience method. Questionnaire was prepared based on literature review.[14-16] The questionnaire consisted of two sections. Section one included various personal information about the respondent.

Section two of the questionnaire included respondents practice and attitude concerning drug usage, the disposal methods of unused/expired medicines and their awareness regarding drug take back programme. Twenty-two questions were framed, in which six were knowledge-based questions, eight attitude-based questions and eight were practice-based questions. These questions were related to the over-the-counter medication, drug prescriptions, unused medications leftovers at home, their reason for storage of expired and unused medicines, people responsible for creating awareness of disposal methods and

their perspective towards drug disposal and environmental hazards. The participants were asked to choose any one of the given options provided that would best illustrate their practices in day-to-day life. The questions were prepared in English and in the local language (Tamil) to make it more comprehensible.

The investigators had explained the purpose of this study to all the respondents before administering the survey questions. Participation was purely voluntary. Nominal data was collected and analysed. All answered survey questionnaire were cross-checked and then the data were filled in an Excel spreadsheet Dataset. Statistical Package for Social Science (SPSS) version 23 was used for analysis. Descriptive statistics and Pearson chi-square test was also employed.

Results

Eight hundred seven participants completed the survey questions during two months of study period. Out of them, there were 311 (38.5 %) males and 496 (61.5 %) females. The majority of the participants (357) belong to the age group of 18-20 years. The 72.3 % of the survey participants had finished under graduation. There were 423 (52.4 %) rural and 384 (47.6 %) urban residents as shown in Table 1.

Table 1: Demographic profile of the participants

Variable	N	%
Gender		
Male	311	38.5
Female	496	61.5
Age		
< 20	357	44.2
20-40	351	43.5
40-60	91	11.3
> 60	8	1.0
Education		
Illiterate	42	5.2
Primary education	73	9.0
High school	70	8.7
Undergraduate	584	72.3
Postgraduate	38	4.7
Residential area		
Urban	384	47.6
Rural	423	52.4
Total	**807**	**100.0**

Knowledge-based questions

The majority of the participants (47.3 %) purchased the medicine on prescription. Furthermore, most of the respondents (88.8 %) knew the indication for which they were prescribed medicines. The study indicates that pain was the most common condition for which respondents received treatment, followed by hypertension / diabetes mellitus, respiratory tract infections and gastrointestinal problems. Nonetheless, 76.5 % of the participants had checked the drug expiry date before procuring medicines.

Consequently 67.8 % of participants were unaware of drug take back programme followed in various countries. In addition to this, 56.3 % of the respondents had appropriate knowledge about safe drug disposal methods of unused/expired household medications.

The knowledge, attitude and practices (KAP) of the respondents were compared with their place of residence, gender, age and education. Knowledge level was good towards the rationale drug consumption and appropriate disposal of unused/expired medications among 218 participants belonging to urban residents, 95 among rural residents, younger participants of age less than 40 years and graduates. Knowledge based score was categorised into excellent, average and poor based on the number of the correct responses given by the participants and compared with demographical data. Except for their gender, there was a statistical significance of association of their demographic parameters and knowledge as shown in Table 2.

Attitude-based questions

A large count of respondents (84.15 %) believed that doctor's prescription was mandatory for the management of common diseases. Interestingly more than 565 respondents (70.0 %) thought that the cost spent for the prescriptions on chronic diseases were suitable for their economic status. A big proportion of respondents (69.9 %) perceived that the pharmacist explained correctly to them about storage and method of intake of medicines. Predominantly most of them (79.4 %) used to check drug expiry date of unused medications. Almost 52.5 % of the respondents said that there were no unused/expired medications in their home. However, 110 (47.5 %) of the respondents said that they were having expired/ unused medications stored in their home. The

Table 2: Participant's knowledge related to their demographic parameters

Variable	Knowledge based score			N	Chi-square test
	Excellent	Average	Poor		
Place of residence					χ^2: 143.79; p < 0.001
Urban	218 (56.77 %)	156 (40.62 %)	109 (28.38 %)	384	
Rural	95 (22.45 %)	213 (50.35 %)	115 (27.18 %)	423	
Gender					χ^2: 0.864; p = 0.649
Male	124 (39.87 %)	136 (43.72 %)	51 (16.39 %)	311	
Female	189 (38.10 %)	233 (46.97 %)	74 (14.91 %)	496	
Age					χ^2: 160.119; p < 0.001
< 20	189 (38.10 %)	233 (46.97 %)	74 (14.91 %)	496	
20-40	81 (23.07 %)	181 (51.55 %)	89 (25.35 %)	351	
40-60	14 (15.38 %)	53 (58.24 %)	24 (26.37 %)	91	
> 60	1 (16.66 %)	6 (75.00 %)	1 (16.66 %)	8	
Education					χ^2: 83.283; p < 0.001
Illiterate	1 (2.40 %)	24 (58.53 %)	16 (39.02 %)	41	
Primary education	11 (15.06 %)	37 (50.68 %)	25 (34.24 %)	73	
Secondary education	20 (28.16 %)	35 (49.29 %)	16 (22.35 %)	71	
Undergraduate	267 (45.17 %)	255 (43.66 %)	62 (10.61 %)	584	
Postgraduate	14 (36.84 %)	18 (47.36 %)	6 (15.78 %)	38	

Table 3: Participant's attitude related to their demographic parameters

Variable	Attitude based score			N	Chi-square test
	More positive	Positive	Negative		
Place of residence					χ^2: 1.185; p = 0.388
Urban	23 (5.90 %)	250 (65.10 %)	111 (28.90 %)	384	
Rural	30 (7.09 %)	288 (68.08 %)	105 (24.82 %)	423	
Gender					χ^2: 1.475; p = 0.478
Male	22 (7.07 %)	213 (68.48 %)	76 (24.43 %)	311	
Female	31 (6.25 %)	325 (65.52 %)	140 (28.22 %)	496	
Age					χ^2: 3.617; p = 0.307
< 20	21 (5.88 %)	237 (66.38 %)	99 (27.77 %)	357	
20-40	28 (7.97 %)	236 (67.23 %)	87 (24.78 %)	351	
40-60	4 (4.39 %)	59 (64.38 %)	28 (30.76 %)	91	
> 60	0 (0.00 %)	6 (75.00 %)	2 (25.00 %)	8	
Education					χ^2: 8.621; p = 0.132
Illiterate	3 (7.31 %)	27 (65.85 %)	11 (26.81 %)	41	
Primary education	4 (5.47 %)	48 (65.75 %)	21 (28.76 %)	73	
Secondary education	2 (2.81 %)	42 (59.15 %)	27 (38.02 %)	71	
Undergraduate	43 (7.36 %)	395 (67.63 %)	146 (25.00 %)	584	
Postgraduate	1 (2.63 %)	26 (68.42 %)	11 (2.88 %)	38	

reasons for storage of unused medications were: 42 % of the respondents wanted to reuse, 26 % to donate to hospitals, 21 % to give it to needy and 19 % stored since they were not aware of the disposal method. Further 72.2 % of the survey participants thought that improper drug disposal methods can cause danger and affect environment and health. Lastly around 28 % of them believed that the government is also responsible to create awareness among common public for proper disposal methods of unused and expired medicines, 15 % by the pharmacist, 12 % by public themselves, 9 % by pharmaceutical industries and 36 % by all.

Attitude of the respondents were classified into more positive, positive and negative based on the responses given by them on comparison to expected attitude towards general public. Positive attitude was observed among rural population, females, aged less than 40 years. Even though the positive attitude were more among study population, there is still a lack in development of more positive attitude as shown in Table 3. Association among the demographic parameters and attitude was statistically not significant.

Table 4: Comparison of participant's practice-based score with their demographic parameters

Variable	Practice based score		N	Chi-square test
	Bad	Good		
Place of residence				χ^2: 0.4885; p = 0.265
Urban	203 (52.86 %)	181 (47.13 %)	384	
Rural	234 (54.92 %)	189 (44.68 %)	423	
Gender				χ^2: 0.141; p = 0.381
Male	171 (54.09 %)	140 (45.01 %)	311	
Female	266 (53.62 %)	230 (46.37 %)	496	
Age				χ^2: 3.617; p = 0.138
< 20	196 (54.09 %)	161 (45.09 %)	357	
20-40	195 (55.55 %)	156 (44.44 %)	351	
40-60	41 (45.05 %)	50 (54.94 %)	91	
> 60	5 (62.50 %)	3 (3.75 %)	8	
Education				χ^2: 8.467; p = 0.412
Illiterate	23 (56.07 %)	18 (43.90 %)	41	
Primary education	29 (39.72 %)	44 (60.27 %)	73	
Secondary education	40 (56.33 %)	31 (43.66 %)	71	
Undergraduate	322 (55.13 %)	262 (44.86 %)	584	
Postgraduate	23 (60.52 %)	15 (39.74 %)	38	

Practice-based questions

Almost 80.5 % of the respondents had purchased all the drugs prescribed by a doctor. Out of 807 respondents 590 consumed the medicines exactly for the prescribed period, however 217 respondents stopped the medicines before prescribed period. Among them 120 stopped due to early recovery, alternate medicine used (37), allergy to the medicines (32), worsening of symptoms (28). Interestingly over 79.9 % of the respondents stored the medication according to the storage conditions mentioned in label. Also, 44.7 % of them store their medications in their living room. Surprisingly 71.6 % of the respondents said that the storage areas of unused/expired medications were not accessible to the children. The statistical result among this study showed that the most predominant method chosen for the disposal of pharmaceutical waste were to throw with household garbage (64.6 %), followed by burial in the soil (13.3 %), burn (13.1 %), dump in garden (9 %). At the end 39.2 % of the respondents suggested government initiation for biomedical waste disposal as the best way of dealing unused/expired medicines in household for better ecosystem.

Practices among were grouped as good and bad as per the responses given by the respondents towards the correct practice expected from them. Results in present study suggested, that good practices were lacking even among educated participants and there was no statistical significance among the good practices and demographic parameters as shown in Table 4.

Discussion

The expeditious increase in the production and usage of the medication had resulted in the excretion and discarding of these medications into the environment. In presented study 37.91 % out of the 807 participants had excellent knowledge on the rationale consumption and method of appropriate pharmaceuticals disposal and 48.94 % had average knowledge but only 6.56 % of the total participants had more positive attitude and 66.66 % had positive attitude. Only around 45.84 % of the participants were following the good practices compared to similar studies done by Kahsay et al.[17]

In this study, even though 77 percent of the respondents were graduates around 67.8 % of the respondents were unaware of the drug take back programme which was consistent with the previous studies done in Bangladesh (96.8 %), Malaysia (93.6 %) and Harar City (66 %).[16, 18, 19] Education plays a crucial role for having a better knowledge about proper consumption and safe disposal of the drugs. The lack of proper awareness and knowledge regarding the self-medication can cause dreadful effects on people and in addition to it in a long run, it may be the initiation of the habit of storing of unused medication and purchase of medication over the counter. Around 48 % of mentioned stored unused medicines at their home. Study by Sivasankaran et al showed that 58.3 % of the survey participants had unused and expired pharmaceutical preparations

at their home, which was in correspondence with presented study.[14] Contrast to the above is the studies done in India - 87 %, 95 % in Indonesia, 70.6 % in Malaysia.[20-22] The percentage seems to be lower than the study conducted in Kuwait.[23] The difference among the countries would have been due to different educational agenda and approaches followed in each country. Several studies done across world also suggests the same attitude of public towards disposing the unused and expired medications in municipal bins, down the sewer.[24] Around 48 % of the respondents said that the major reason for the discontinuation of the medications was early recovery which is similar to study done by Manocha et al.[10]

According to the study done by AlAzmi et al 70 % of the respondents wanted to dispose the left-over medication by returning it to the healthcare facility.[15] In contrary to the present study 81 % of the respondents suggested that disposing of pharmaceutical household waste could be done by biomedical waste disposal and drug take back programmes. Unused and expired medicines, unsafe methods of disposal become a major global problem especially in low- and middle-income countries like India. Deficit in health sector regulations and improper setup of drug disposal methods attribute to this problem.[25]

Ninety-five percent of participants in this study had a minimum of at least primary education, out of which only 50 % respondents had knowledge about safe disposal method. Present study shows that the public had almost good knowledge when compared with the different demographic profiles like their place of residence, age and education. But their attitudes and practice were not to that extent in creating a safe environment for future generations. This might be due to the lack of guidelines, policies or lack of strict vigilant actions in utilising and disposing of the pharmaceutical products. A lacuna had been created among the educated people regarding the safe disposal methods. Pharmaceutical companies and pharmacy need to educate common people regarding the safe disposal systems of unused drugs. This could be achieved by campaigns conducted at local clinics and pamphlet distributed at pharmacies available in clinic and nursing homes.

Other important steps which should be taken are creating even more awareness by advertising through social media, print media and also by conducting seminars and awareness programmes by the drug control agencies of our country. This could be initiated on a first hand by creating medicine banks at government hospitals and pharmacies for reusing the unused medicine and also by dumping the expired medicines in a collect bin at the same premises, which could be sent for disposal through pharma companies.

Limitations of the present study could be attributed to 5 % of the illiterate participants, who were not able to read the questionnaire. Volunteers of the study explained the questions and ticked the answers replied by the participants included in survey. This study could be done in a larger population to know the exact status of household pharmaceutical disposal methods.

Conclusion

Respondents perceived that proper and safe disposal of the unused/expired pharmaceuticals is necessary. There is still a space for educating the general public regarding the proper disposal techniques which will surely pave a way for minimising the hazards caused by the medication on the environment. However, it is apparently true that there is requirement for creating guidelines for the safe disposal of expired and unused medications in India. Majority of the respondents were unaware of the drug take back programme followed in various countries. The Drug Controller General of India (DGCI) has to make policies and legal framework for implementing the drug take back programme nationwide and also for promoting proper and safer disposal methods of unused/expired medications.

Ethics

The study was approved by the Ethics Committee of the Meenakshi Medical College Hospital and Research Institute, Registration No: ECR/1184/Inst/TN/2019; Decision No: 93/UG/IEC/2020, dated 12 April 2021.

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Conflicts of interest

The authors declare that there is no conflict of interest.

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Data access

The data that support the findings of this study are available from the corresponding author upon reasonable individual request.

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