

# Knowledge on Pharmaceutical Wastage Management and Factors Influence on It among Pharmacy Personnel at Private Pharmacies in Jaffna Municipality Area, Sri Lanka

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# KNOWLEDGE ON PHARMACEUTICAL WASTAGE MANAGEMENT AND FACTORS INFLUENCE ON IT AMONG PHARMACY PERSONNEL AT PRIVATE PHARMACIES IN JAFFNA MUNICIPALITY AREA, SRI LANKA

**Abstract:** Improper pharmaceutical waste management is one of the reasons for environmental hazards and affects all living organisms in the world. Pharmacy working personnel's knowledge on pharmaceutical waste management plays important roles in the provision of proper wastage management to secure the ecosystem in the country. Aim of the study was to assess the knowledge of pharmaceutical wastage management and influence of socio-demographic and work-related factors among personals working at private pharmacies in Jaffna Municipality Area, Sri Lanka. A descriptive cross-sectional study was conducted in private pharmacies. Pre-tested and validated self-administered questionnaire was used to collect data. Knowledge level of participants was categorized as good, adequate and poor. Data were analyzed using SPSS version 23. Chi-square test was performed to analyze the variable and 95% confidence interval was set for the test and results were significant if p value <0.05. Respondent rate of pharmacy personnel was 78.71% (n = 122) and most of them were female 59% (n = 72). Majority of the participants (67.2%, n = 82) were pharmacy assistants. In this study, most participants (76.2%, n = 93) had poor knowledge on pharmaceutical waste management. 10.7% (n = 13) had good knowledge and 13.1% (n = 16) had adequate knowledge. Age, marital status, educational level, position in the pharmacy and work experience (p < 0.001) had statistically significant influence on level of knowledge. Continuous education programs should be initiated and periodically conducted among pharmacy personnel to improve knowledge of pharmaceutical waste management. Existing guidelines should be strengthened and monitored for implementation by regulatory authorities.

**Keywords:** Pharmaceutical waste management, Private pharmacies, Pharmacy personnel, Knowledge

## Introduction

Pharmaceuticals are synthetic or natural chemicals found in over the counter, prescription medicines and veterinary drugs which consists active ingredients that intended to use in diagnosis, mitigation, treatment or prevention in human and animals (WHO, 2012.). Pharmaceutical wastes include expired, contaminated and damaged pharmaceutical products which are no longer used. It also includes genotoxic waste, disposable items used in the handling of pharmaceuticals, such as boxes or bottles or vials with pharmaceutical residues, gloves, masks and connecting tubes. Pharmaceutical wastes are one category of health care waste (Chartier, Y. ed., 2014, WHO). Pharmaceutical waste management (PWM) includes the process of collection, segregation, storage, transport and safe disposal of pharmaceutical waste (Chartier, Y. ed., 2014, WHO).

In developing countries, priority for pharmaceutical waste management is not given and this makes the path to investigate the opportunity for pharmaceutical waste management (Bataduwaarachchi *et al.*, 2016). Practices of pharmaceutical waste management and engagement level with the proper management are a quality indicator of health care system of a country (Thormodsen *et al.*, 1997).

However, Sri Lanka consists of impressive health indicators and certain shortcomings in health care systems. The certain shortcomings include unequal distribution of resources, lack of funds, long term political and

bureaucratic commitment towards health issues and poor macro and micro health planning. Process of waste management should be safe, effective and eco-friendly manner to secure human beings from accidental exposure (Haniffa, R., 2011). In Sri Lanka, Central Environmental Authority (CEA) is responsible for the regulations of waste management. Improper disposal of health care waste is an offense, even though still it is a problematic area.

Pharmacists and working personnel's in the pharmacy can play an essential part of the well-being and health care system to make the environment free from such pollution and make them physically fit (Daughton & Ternes 1999). So it is mandatory to supervise the pharmaceutical waste that comes out from the pharmacies (Medhi & Sewal 2012).

The World Health Organization (WHO) suggest that, in general, expired pharmaceuticals do not represent any harm to human or environment, but improper disposal of this wastages may be hazardous and contaminate the water resources. Also suggest that unwanted medicines should be always considered as pharmaceutical wastages and should never be used (WHO, 1999).

Long term entry of pharmaceutical into environment affects human and animals in which newborns, children and pregnant woman are the vulnerable group (Radhakrishna *et al.*, 2014). Number of reports from past two decades reveal the presences of pharmaceuticals in aquatic environment includes lakes, ground water, river and drinking water (Glassmeyer *et al.*, 2009) ; (Smith, C.A., 2002). Detected compounds include estrogen, antidepressants and antibiotics which cause abnormalities in aquatic life (Ortner *et al.*, 2010).

Effluent water from the waste water treatment plant was analyzed by a study in 2004 in United Kingdom and acetylsulfamethoxazole, dextropropoxyphene, diclofenac, erythromycin, ibuprofen, mefenamic acid propranolol and trimethoprim were identified (Ashton *et al.*, 2004). Recent discovery says that vultures in Asia died because of the consumption of cattle which contain low concentration of diclofenac drug (Oaks *et al.*, 2004). Presences of oral contraceptive compound ethinyl estradiol in rivers produced an impaired sexual development and increased feminization in fishes (Jobling *et al.*, 2005).

Even though some developed countries have proper and established systems for disposal of pharmaceutical wastages, no such guidelines and monitoring systems in developing countries (Bataduwaarachchi *et al.*, 2016).

Objectives of this study are to assess the knowledge of pharmaceutical wastage management and influence of socio-demographic and work related factors on it in private pharmacies in Jaffna Municipality Area.

## **Material and methods**

This is a descriptive cross sectional study conducted among community pharmacies in Jaffna Municipality Area. Pharmacy personnel in the community pharmacies in Jaffna Municipality Area were included in this study. Pharmacy personnel include proprietors, pharmacists and pharmacy assistants. There were total 31 community pharmacies in which 155 working personal worked there. All working personnel working in the community pharmacies were included in the study. This study was conducted from November of 2016 to September of 2017.

Self-administered questionnaire was used to assess knowledge among pharmacy personal working in the pharmacies. Questionnaire was designed based on the World Health Organization - Guidelines for safe healthcare waste management and safe disposal of unwanted pharmaceuticals and other related published studies (Aditya & Rattan, 2014; Braund *et al.*, 2011; Tabash *et al.*, 2016). Questionnaire was validated with the

help of experts in the relevant fields. Pretest was done for the appropriateness and understanding of the questionnaire.

The maximum score given for knowledge level was 40. The overall knowledge level was classified into good, adequate and poor. The score obtained above 25 was considered as good knowledge. The score obtained between 20 to 25 was considered as adequate knowledge. The score obtained below 20 was considered as poor knowledge.

The purpose and the procedures of this study were explained to the participants. Data was collected without disturbing the pharmacy routine activities. Data were entered and analyzed using SPSS 23 version (Statistical Package for Social Sciences). Data was presented as proportions, percentages and results were represented as tables and figures. Influence of factors on knowledge of pharmaceutical waste management was calculated by using Chi-square test and statistical significance was set at  $p < 0.05$ . The approval for this study was obtained from Ethical Review Committee, Faculty of Medicine, University of Jaffna. Permission for data collection was obtained from Regional Directorate of Health Service of Jaffna. The purpose and procedure of this study was explained to participants in details. An informed consent form was attached to each questionnaire which was read and signed by the participants.

## **Results**

The response rate of pharmacy personals was 122 (78.71%).

### ***Socio-demographic factors and work-related factors***

Table 1 depicts a descriptive summary of participants' socio-demographic characteristics. Among the participants majority was female 59.0% ( $n = 72$ ). Participants' mean age was  $35.87 \pm 16.20$  years. Most of the participants' ( $n= 83$ , 68.0%) age in the range of 19 – 39.

*Table 1: Distribution of socio-demographic factors among the participants*

Socio-demographic factors	Response	Frequency (n)	Percentage (%)
Sex	Male	50	41.0
	Female	72	59.0
Age in years	19 – 39	83	68.0
	40 – 60	24	19.7
	> 60	15	12.3
Marital status	Married	51	41.8
	Unmarried	71	58.2
Educational level	Ordinary level	35	28.7
	Advanced level	59	48.4
	Diploma in pharmacy	21	17.2
	Degree in pharmacy	2	1.6
	Diploma in management courses	5	4.1

Table 2 depicts a descriptive summary of the work-related characteristics of the participants. Most of the participants ( $n = 82$ , 67.2%) were pharmacy assistants. Among the participants, 3 (2.5%) were owner as well as pharmacist of the pharmacies. 3 (11.54%) pharmacies were managed without a pharmacist. 62 (50.8%) participants had less than four years of experience with a mean experience of 9 ( $SD \pm 10.6$ ) years.

Table 2: Distribution of work-related factors among the participants

Work-related factors	Response	Frequency (n)	Percentage (%)
Position in pharmacy	Proprietor	17	13.9
	Pharmacist	20	16.4
	Pharmacy assistant	82	67.2
	Proprietor and pharmacist	3	2.5
Work experience in years	< 4	62	50.8
	> 4	60	49.2

### Knowledge on pharmaceutical waste management among pharmacy personals

In this study, 13 (10.7%) participants had good knowledge, 16 (13.1%) participants had adequate knowledge, and 93 (76.2%) participants had poor knowledge of pharmaceutical waste management.

## Distribution of Knowledge level

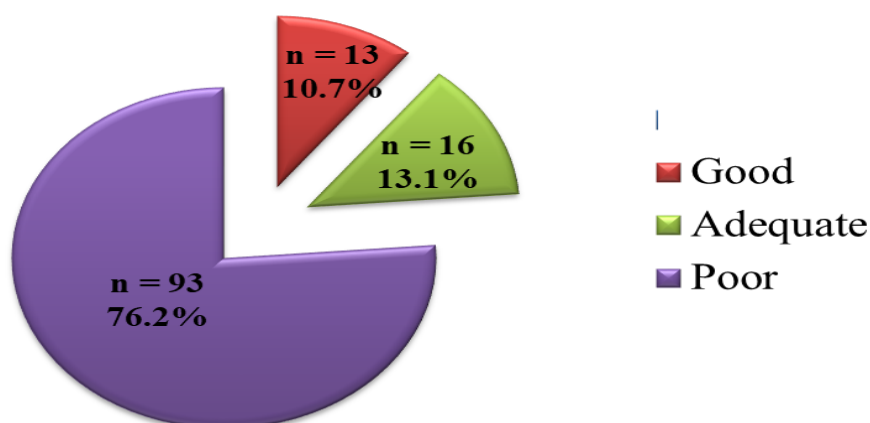


Figure 1: Distribution of knowledge level

### Description of knowledge on pharmaceutical waste and its handling

Table 3 depicts the knowledge on pharmaceutical waste and its handling. The majority of participants, 103 (84.4%), provided a correct and incomplete response to pharmaceutical waste knowledge. 67.2% (n = 82) conferred the wrong answer to the steps of PWM. More than one-third of participants (n = 85, 69.7%) knew that the PW needs to be sorted before disposal. The majority of the participants (n = 121, 99.2%) did not know the WHO recommended color code and type of container for PW. The majority of the participants (n = 119, 97.5%) knew that the PW should be stored separately. Majority of the participants (n = 110, 90.2%) knew that the waste handlers need to wear personal protective clothing during the waste handling.

Table 3: Knowledge on pharmaceutical waste and its handling

Knowledge items	Response	Frequency (n)	Percentage (%)
Meaning of pharmaceutical waste	Correct	1	0.8
	Partially correct	103	84.4
	Wrong	18	14.8
Steps of pharmaceutical waste management	Correct	1	0.8
	Partially correct	39	32.0
	Wrong	82	67.2
Sorting of pharmaceutical waste before disposal	Correct	85	69.7
	Wrong	37	30.3
WHO recommendation for color code and type of container for segregation of pharmaceutical waste	Correct	0	0
	Partially correct	1	0.8
	Wrong	121	99.2
Separate storing place for pharmaceutical waste	Correct	119	97.5
	Wrong	3	2.5
Need of wearing personal protective clothing during the waste handling	Correct	110	90.2
	Wrong	12	9.8

**Description of knowledge on environmental impact and disposal of pharmaceutical waste**

Table 4 depicts the knowledge on environmental impact and disposal of pharmaceutical waste. The majority of the respondents (n = 118, 96.7%) knew that throwing a large quantity of solid/ semi-solid wastages into the garbage affects the environment. Fifty-six participants (45.9%) knew that liquid medicines' disposal into sink/toilet affects the water system. The majority of the participants (n = 111, 91.0%) did not know that incineration is the best and eco-friendly method for waste disposal. Seventy-two participants (59.0%) did not know the advantage of the highly engineered sanitary landfill. The majority of the participants (n = 121, 99.2%) knew that the controlled substances, antineoplastic and anti-infective agents need special care during handling and disposal. Most of the participants (n = 92, 75.4%) knew that consumer returns of unused medicines to pharmacies minimize the consumers' improper disposal. Most of the participants (n = 116, 95.1%) knew that the public need to be educated on safe disposal methods. All of the participants knew that environmental protection from improper disposal is their responsibility.

Table 4: Knowledge on the environmental impact of pharmaceutical waste

Knowledge items	Response	Frequency (n)	Percentage (%)
The large quantity of solid/semi-solid pharmaceutical waste thrown into garbage affect the environment and ecosystem	Yes	118	96.7
	No / Do not know	4	3.3
Disposal of liquid medicines into sink/toilet affect the water system	Yes	56	45.9
	No / Do not know	66	54.1
Incineration is the best and eco-friendly method for waste disposal	Yes	11	9.0
	No / Do not know	111	91.0
The high engineered sanitary landfill has the top priority to minimize water contamination	Yes	50	41.0
	No / Do not know	72	59.0
Controlled substances, antineoplastic and anti-infective agents, need special care during waste handling and disposal	Yes	121	99.2
	No / Do not know	1	0.8
consumer return of unused pharmaceuticals to the pharmacy will minimize the improper disposal practice by consumers	Yes	92	75.4
	No / Do not know	30	24.6
Education of public on safe disposal methods of pharmaceuticals	Yes	116	95.1
	No / Do not know	6	4.9

Responsibility of pharmacists to protect the environment from improper disposal of wastages	Yes	122	100.0
	No / Do not know	0	0

Table 5 depicts the knowledge on disposal of types of pharmaceutical wastages. among the participants, 70 (57.4%) stated correct and incomplete answer for the disposal of solid and powders. 72 (59.0%) participants stated correct and incomplete answer for the disposal of semi-solids wastages. Wrong answer was provided by most of the participants for the disposal of liquids (n = 93, 76.2%), ampoules (n = 97, 79.5%), aerosol containers (n = 106, 86.9%), antineoplastic agents (n = 101, 82.8%), controlled substances (n = 102, 83.6%) and disinfectants (n = 102, 83.6%).

Table 5: Knowledge on disposal of pharmaceutical waste

Types of pharmaceutical waste	Response	Frequency (n)	Percentage (%)
Solids and powders	Wrong answer	52	42.6
	Correct and incomplete	70	57.4
	Correct and complete	0	0
Semi-solids	Wrong answer	50	41.0
	Correct and incomplete	72	59.0
	Correct and complete	0	0
Liquids	Wrong answer	93	76.2
	Correct and incomplete	29	23.8
	Correct and complete	0	0
Ampoules	Wrong answer	97	79.5
	Correct and incomplete	25	20.5
	Correct and complete	0	0
Aerosol containers	Wrong answer	106	86.9
	Correct and incomplete	16	13.1
	Correct and complete	0	0
Antineoplastic agents	Wrong answer	101	82.8
	Correct and incomplete	21	17.2
	Correct and complete	0	0
Controlled substances	Wrong answer	102	83.6
	Correct and incomplete	20	16.4
	Correct and complete	0	0
Disinfectants	Wrong answer	102	83.6
	Correct and incomplete	20	16.4
	Correct and complete	0	0
Packaging materials	Wrong answer	26	21.3
	Correct and incomplete	96	78.7
	Correct and complete	0	0

#### Knowledge on preventive measures of pharmaceutical waste generation

Table 6 depicts the knowledge on preventive measures of pharmaceutical waste generation. Returning of short expiry was stated by 114 (93.4%) participants, 100 (82.0%) participants stated good inventory control, 120 (98.4%) participants stated proper storage conditions, careful handling of packages was stated by 121 (99.2%) of participants and follow FEFO method was stated by 105 (86.1%) of participants.

Table 6: Knowledge on preventive measures of pharmaceutical waste generation

Types of pharmaceutical waste	Response	Frequency (n)	Percentage (%)
Solids and powders	Wrong answer	52	42.6
	Correct and incomplete	70	57.4
	Correct and complete	0	0
Semi-solids	Wrong answer	50	41.0
	Correct and incomplete	72	59.0
	Correct and complete	0	0

Liquids	Wrong answer	93	76.2
	Correct and incomplete	29	23.8
	Correct and complete	0	0
Ampoules	Wrong answer	97	79.5
	Correct and incomplete	25	20.5
	Correct and complete	0	0
Aerosol containers	Wrong answer	106	86.9
	Correct and incomplete	16	13.1
	Correct and complete	0	0
Antineoplastic agents	Wrong answer	101	82.8
	Correct and incomplete	21	17.2
	Correct and complete	0	0
Controlled substances	Wrong answer	102	83.6
	Correct and incomplete	20	16.4
	Correct and complete	0	0
Disinfectants	Wrong answer	102	83.6
	Correct and incomplete	20	16.4
	Correct and complete	0	0
Packaging materials	Wrong answer	26	21.3
	Correct and incomplete	96	78.7
	Correct and complete	0	0

### *Influence of socio-demographic and work-related factors of working personnel on knowledge of pharmaceutical waste management*

Among the socio-demographic factors, age ( $p < 0.001$ ), marital status ( $p = 0.001$ ), educational level ( $p < 0.001$ ) had a statistically significant association with the knowledge level of participants. Sex ( $p = 0.078$ ) did not influence the knowledge level of participants. Among the work-related factors, position in the pharmacy ( $p$ -value  $< 0.001$ ) and work experience ( $p = 0.003$ ) had a statistically significant association with the knowledge level of participants.

### **Discussion**

The pharmaceutical waste becomes a growing concern as volumes of pharmaceuticals dispensed increases annually. This study was conducted on 122 working personnel in the pharmacies. Most of the participants were female (59.0%,  $n = 72$ ), among them 62 (50.82%) were pharmacy assistants. Most participants' ages (68.0%,  $n = 83$ ) within the range of 19 to 39 years, with a mean age of 35.87 (SD  $\pm$  16.20) years. In this age range, 60.66% ( $n = 74$ ) of participants were pharmacy assistants. Most of the participants were unmarried (58.2%,  $n = 71$ ). In terms of educational level, 48.4% of participants ( $n = 59$ ) were found to have an advanced level, in which 47 (38.52%) participants were pharmacy assistants. 17.2% ( $n = 21$ ) of participants had diploma in pharmacy and 1.6% ( $n = 2$ ) of participants had degree in pharmacy. Among the participants, 2.5% ( $n = 3$ ) participants were owners and pharmacists of the pharmacies. Among the pharmacies, 11.54% ( $n = 3$ ) of pharmacies were managed without a pharmacist. 50.8% ( $n = 62$ ) of participants had work experience of fewer than four years.

A study was conducted in North India by Aditya & Rattan stated that most of the participants were male (98%,  $n = 82$ ). 38% of the respondents ( $n = 32$ ) were aged 41-50 years. Among the participants, 82% ( $n = 69$ ) were found to have a pharmacy diploma, and 11% ( $n = 9$ ) had a degree in pharmacy (Aditya and Rattan, 2014). An interventional study was conducted in Gaza, Palestine by Tabash et al. stated most of the respondents were male (56.2%,  $n = 298$ ). Most of the respondents were aged less than 40 years, with a mean age of 32.4 years (SD  $\pm$  8). In terms of educational level 54.1% ( $n = 287$ ) of participants were found to have degrees, 30.4% ( $n = 161$ ) had diploma and 15.5% ( $n = 82$ ) had graduated from secondary school. 26.8% ( $n = 142$ ) of participants had less than five years of experience, and 31% ( $n = 164$ ) of respondents had greater than ten years of experience.

This study revealed that 76.2% ( $n = 93$ ) of participants had poor knowledge, and 13.1% ( $n = 16$ ) had adequate knowledge of PWM. This poor knowledge may be due to a lack of educational programs on PWM. Only 10.7% ( $n = 13$ ) of participants had good knowledge. Among the participants, 84.6% ( $n = 11$ ) of pharmacists have good knowledge, and 63.93% ( $n = 78$ ) of pharmacy assistants have poor knowledge of PWM. In the previous study in North India, 58% ( $n = 48$ ) of pharmacists had inadequate knowledge about drug disposal and the



environmental impact of pharmaceutical waste (Aditya & Rattan, 2014). In the previous study in Palestine, 41.4% of poor level knowledge was detected in the pre-intervention phase. After the immediate completion of the educational program the knowledge level was increased to a fair level of 63%, and a satisfactory level of 77% in the follow-up test conducted six months later (Tabash *et al.*, 2016).

In this study, 83.3% (n = 60) of females have poor knowledge than 66.0% (n = 33) of males. There is no statistical significance on knowledge with sex (p-value 0.078). With increasing age, the level of poor knowledge is reduced. Age has statistically significant on knowledge (p-value < 0.001). Among the participants 88.7% (n = 63) of unmarried participants have poor knowledge than 58.8% (n = 30) of married participants. Marital status has statistically significant on knowledge of pharmaceutical waste management (p-value = 0.001). Participants who had a degree in pharmacy (100%, n = 2) have good knowledge than participants who had advanced level (1.7%, n = 1). Educational level has statistical significance on knowledge.

Pharmacy assistants (95.1%, n = 78) have poor knowledge than others. There was statistically significant knowledge with the position in the pharmacy (p-value < 0.001). Participants with work experience less than four years (88.7%, n = 55) had poor knowledge than participants with work experience more than four years (63.3%, n = 38). There was statistically significant knowledge with work experience (p-value 0.003).

### **Conclusion**

Only 10.7% of participants have good knowledge of pharmaceutical waste management. Age, marital status, educational level, position of the personnel in the pharmacy and work experience have statistical significance on knowledge of pharmaceutical waste management (p-value < 0.05).

Extending this study by including other parts of Sri Lanka needed to generalize our findings. Continuous professional programs, including PWM and awareness programs should be conducted to improve their knowledge of PWM. Existing guidelines for PWM should be strengthened and implemented strictly by regulatory authorities. Also, awareness programs among the public should be conducted.

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## References

- Aditya, Suruchi and Aditya Rattan. "Minimizing Pharmaceutical Waste: The Role of the Pharmacist." *Journal of Young Pharmacists*. 2014; 6:14-19..
- Ashton D, Hilton M, Thomas KV. Investigating the environmental transport of human pharmaceuticals to streams in the United Kingdom. *Sci Total Environ*. 2004 Oct 15; 333(1-3):167-84. doi: 10.1016/j.scitotenv.2004.04.062.
- Bataduwaarachchi VR, Weeraratne CL. Global medication waste management practices: Challenges and opportunities in developing countries. *Int. J. Basic Clin. Pharmacol*. 2016; 5:2290-4.
- Chartier Y, editor. Safe management of wastes from healthcare activities. World Health Organization; 2014.
- Daughton CG, Ternes TA. Pharmaceuticals and personal care products in the environment: agents of subtle change?. *Environ Health Perspect*. 1999; 107 Suppl 6(Suppl 6):907-938. doi:10.1289/ehp.99107s6907.
- Susan T. Glassmeyer, Elizabeth K. Hinchey, Susan E. Boehme, Christian G. Daughton, Ilene S. Ruhoy, Octavia Conerly, Rebecca L. Daniels, Lisa Lauer, Meg McCarthy, Todd G. Nettesheim, Kathy Sykes, Virginia G. Thompson, Disposal practices for unwanted residential medications in the United States, *Environment International*, Volume 35, Issue 3, 2009, Pages 566-572, ISSN 0160-4120, <https://doi.org/10.1016/j.envint.2008.10.007>.
- Haniffa R. Management of health care waste in Sri Lanka. *Ceylon Medical Journal*. 2011 Aug 12; 49(3).
- Jobling S, Williams R, Johnson A, Taylor A, Gross-Sorokin M, Nolan M, Tyler CR, van Aerle R, Santos E, Brighty G. Predicted exposures to steroid estrogens in UK rivers correlate with widespread sexual disruption in wild fish populations. *Environmental health perspectives*. 2006 Apr; 114(Suppl 1):32-9.
- Medhi B, Sewal RK. Ecopharmacovigilance: an issue urgently to be addressed. *Indian Journal of Pharmacol*. 2012;44(5):547-549. doi:10.4103/0253-7613.100363.
- Oaks JL, Gilbert M, Virani MZ, Watson RT, Meteyer CU, Rideout BA, Shivaprasad HL, Ahmed S, Chaudhry MJ, Arshad M, Mahmood S. Diclofenac residues as the cause of vulture population decline in Pakistan. *Nature*. 2004 Feb; 427(6975):630-3.
- Ortner P, McCullagh M. Hospice nurses and drug disposal: The convergence between nursing practice and the environment. *Journal of Hospice & Palliative Nursing*. 2010 Jan 1; 12(1):15-26.
- Radhakrishna L, Nagarajan P, Vijayanandhan SS, Ponniah T. Knowledge, Attitude and practice (KAP) towards disposal of medicines: a qualitative study among health care professionals in South India. *Wld J Pharm Res*. 2014 Jun 28; 3:1955-63.
- Smith CA. Managing pharmaceutical waste. *Journal of the Pharmacy Society of Wisconsin*. 2002 Nov; 5:17-22.
- Tabash MI, Hussein RA, Mahmoud AH, El-Borgy MD, Abu-Hamad BA. Impact of an intervention programme on knowledge, attitude and practice of healthcare staff regarding pharmaceutical waste management, Gaza, Palestine. *Public Health*. 2016 Sep; 138:127-37. doi: 10.1016/j.puhe.2016.04.001.
- Thormodsen M, Fonneløp H, Rytter E, Tørisen HM. Returned medicines as quality indicator for pharmacotherapy--what is left? *Tidsskrift for den Norske Laegeforening: Tidsskrift for Praktisk Medicin, ny Raekke*. 1997 Oct 1; 117(24):3517-20.
- Tong A, Peake B, Braund R. Disposal practices for unused medications in New Zealand community pharmacies. *Journal of primary health care*. 2011; 3(3):197-203.
- World Health Organization. Health21: the health for all policy framework for the WHO European Region. World Health Organization. Regional Office for Europe; 1999.

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