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Pharmaceutical Waste Management in Private Pharmacies of Kaski District, Nepal

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Abstract:- The main aim of the study is to know the current status of pharmaceutical waste management and its practices in the community pharmacy of Kaski district. The study design was cross-sectional study. The study population was the pharmacist of Kaski district who were running the private community pharmacies. The sample size was 119 pharmacies. Out of 119 respondents, majorities (71.4%) were male, 79% were owner of their business, almost equal percentage were below and above median age(34years) and 45.4% pharmacy experience above median experience(10 years). About 95% were trained in pharmacy profession with mostly trained on diploma and Community Medical Auxiliaries (CMA and Orientation). Among all the respondents 59.6% had adequate knowledge and practices of pharmaceutical waste management. About 95.8% percent had PW collecting container but only 28.6% had use color coding and labeling system for segregation of pharmaceutical waste. The results showed that there was insufficient knowledge and practices of pharmaceutical waste management by the community pharmacists. The findings showed that knowledge on PWM had strong association with its practices.

Keywords:- *Pharmaceutical Waste Management, Pharmacy, Waste, Expired Medicines, Knowledge, Practices, Disposal, Nepal.*

I. INTRODUCTION

A. Background of the Study

The World Health Organization (WHO) definition of pharmaceutical waste includes pharmaceuticals that are expired or no longer needed and items containing pharmaceuticals.[1]

Expired products, dispensed drugs that are unwanted or discontinued, and contaminated medicines is known as pharmaceuticals wastes(PW).[2]When the medicines are prescribed according to the illness of a patient ,the active ingredients of medicines is only metabolized but the non-metabolized parent compound as well as the metabolites enters the water system and harms the aquatic system and pollute the water system. Also the improper disposal of the unused medicines also causes the environmental pollution as well.[2]

Pharmaceutical products were not recognized as environmental pollutants until the 1980s. Inadequate disposal of unused pharmaceutical products results pollution which is very challenging issues since their structure consists of thousands of different active molecules that are parts of different therapeutical groups with different physicochemical properties and chemical structures which behave differently in the environment and have different stability.[3]Since these components have been found in wastewaters, in the soil and in drinking water, they have become even bigger issues.[4] Pharmaceutical products have been used and produced in large amounts nowadays in diversified nature. The household medicine supplies can vary in different countries, but they can all become a potential source of poisoning, most often for children, and can also cause reactions like confusion in elderly persons.[5]

In South East Asian regions like Malaysia, Bangladesh, North India, South India, Western Nepal (Pokhara), Pakistan and Thailand have improper practice of pharmaceutical waste management where Nepal and Bangladesh does not have any official guideline for pharmaceutical waste management. So, urgent consideration is needed in the South East Asian Regions to reduce the problem of improper Pharmaceutical waste management(PWM).[6]

Researchers have considered many human and veterinary pharmaceutical compounds at high concentrations in drinking water resources contribute to environmental pollution. So, emphasis is also given on pharmacist role in proper disposal of unwanted and expired medicine makes a significant impact on the environment as well as it prevents accident, poisoning and intentional violence , which will lead to the welfare of society and directs towards achieving goal of health for all.[5]

B. Problem Statement

Pharmaceutical compounds are being used for several beneficial purposes in our modern society. But the increasing number of the pharmacies haphazardly contributed to improper handling and management of pharmaceutical substances like drugs, vaccines etc.

Pharmaceutical compounds may enter the environment by different routes such as discharge of treated wastewater, seepage from landfills sites, sewer lines, runoff from animal wastes etc.[7, 8]Although various physical and biological processes occurring in aquatic system cause reduction of many pharmaceutical compounds but the trace concentrations of human and

veterinary pharmaceutical compounds as well as their metabolites have been detected in different water bodies like surface water, groundwater which may cause adverse effects to the human and animals.[9-11]Waste disposal practice in most community pharmacies of Pokhara valley was not satisfactory. They lacked the space and infrastructure such as proper sanitary landfill, private or public burial site, well maintained incinerator etc. for the proper disposal of their medical waste.[12]

In context of Nepal, there is also poor management of pharmaceuticals wastes in different pharmacies, medicals and hospitals. Open-air burning of pharmaceutical waste carries risk to staff, communities, and the environment, it is not recommended by the WHO[13] but the practices is prevalent in the Nepal as well as in Pokhara also.[12]

The disposal of waste by community pharmacies in the municipal waste collection system in a haphazard and unsafe manner in Pokhara, and i.e. 52.36%.[12] In situations where no other options for the safe disposal of pharmaceutical waste are available, disposal in sanitary land-fills or municipal land-fill sites while taking precautions like use of Personal protective equipment(PPE) could be an acceptable option only for small quantities of pharmaceutical waste.[13, 14] Also US-Food and Drug Administration recommended that disposal of small quantities of pharmaceutical waste in a municipal waste disposal system can be accepted.[15] This method can be considered as a short-term measure, which should be changed to attain ideal or real disposal practice methods in the future.[16]

For the proper disposal of pharmaceutical waste, the role of pharmacists is well recognized in developed countries.[17, 18]Nepal does not have official guidelines or practices to involve community pharmacies and pharmacists in the proper disposal of their pharmaceutical waste. Nepal have two proposed guidelines for health care waste management (i.e. National health care waste management guideline 2002 A.D and National guideline for health care waste management 2064 B.S) but not implemented properly. Also these guidelines doesn't focus on pharmaceutical wastes management separately[19, 20]In Nepal, the Solid Waste Management Act of 2011, the only act dealing with waste management, assigned legal and financial responsibility for the safe management of solid waste to the person or institution generating that waste.[21]

Recently on September 2017 DDA Nepal has prepared the proposed draft of pharmaceutical waste management guideline to establish proper management of pharmaceutical wastes throughout country in pharmacy level. This proposed guidelines is prepared according to the basis of WHO but it will take more time to implement and enact these policies.[22]

C. Rationale of the Study

Pharmaceutical waste management is of public health concern due to the various health and environmental risks posed by poorly managed pharmaceutical wastes such as acute and chronic cell damages [23, 24], behavioral changes [25, 26], accumulation in tissues[27], reproductive damage[28] and inhibition of cell proliferation[29] and damaged to the aquatic life regarding their reproduction with toxicological effects.[30, 31] The risk of drug abuse and/or poisoning may result due to open dumps as well as from stored household pharmaceutical waste is another concern. The effect of long term low level exposure to active pharmaceutical ingredients (APIs) like Abiraterone acetate, Acamprosate Calcium Amoxicillin Trihydrate, Bosentan monohydrate, Nimesulide, Ramipril, Oxacillin Sodium etc.[32] from water sources through drinking or bathing is largely unknown but cannot be entirely ignored due to its toxic effects on the environment.[33] Incineration of pharmaceuticals waste, particularly waste containing polyvinyl chloride at low incineration temperature may cause the release of substances that are harmful to public health into the environment.[34]

In context of Nepal, there is also poor management of pharmaceuticals wastes in different community pharmacies due to lack of training knowledge and education about waste management. Absence of proper segregation, color coding and disposal is seen more in most of the community pharmacies. Open-air burning of health care waste carries risk to staff, communities, and the environment, it is not recommended by the WHO [13] but the practices is prevalent in the Nepal as well as in most of the community pharmacies of the Pokhara valley.[12] According to the study by Sudesh Gyawali and his team, proper and safe management of pharmaceuticals wastes in different community pharmacies is absence in Kaski district i.e.52.36% are doing improper practices of PWM. Kaski district includes largest metropolitan city where increasing urbanization along with the increased number of private pharmacies in high rate may lead to improper management of pharmaceutical waste. So, the research studies relating with such issues are important. Therefore, the particular causes of these problems should be find out to develop and improve the pharmaceutical waste management system of the area.

D. Objectives

- *General*

To describe the current status of knowledge, practices and associated factors regarding pharmaceutical waste management in Kaski district.

- *Specific*

To assess the knowledge and practice of pharmacist in pharmaceutical waste management.

To determine whether pharmacists were suitably qualified to practice sound PWM.

To examine the availability of infrastructures that support sound PWM.

E. Hypothesis

- H1. The knowledge of PWM among pharmacist is associated with their qualification.
- H2. The practice of PWM in Community pharmacies is associated with knowledge of PWM among pharmacist.
- H3. The practice of PWM in community pharmacies is associated with availability of infrastructure that supports sound PW disposal.
- H4. The socio demographic factors of the pharmacist and community pharmacies are associated with the knowledge and practice of PWM.

II. MATERIALS AND METHOD

A. Study Design

Primary data was collected at single point of time so the study design was cross sectional study design. Since the study observed the relationship between variables so the study was analytical.

B. Study Method

Quantitative method was carried out in this study.

C. Study Area

The study area was Kaski district of Nepal.

D. Study Population

The study population was defined as a manager or an employee of Pharmacy located within Kaski district including Pokhara Metropolitan and Four other rural municipalities. For the purposes of this study, a pharmacy manager or employees were responsible for the day today management of the pharmacy, regardless of their legal or educational status.

E. Inclusion and Exclusion Criteria

Those pharmacies which were included in the study sample meet two criteria. The first was privately owned pharmacy providing retail pharmacy services to the community. The second was it should lies under the Kaski district. Those facilities that met the inclusion criteria were excluded because the Pharmacy manager or employees disagree to take part and some of the pharmacy closed during the period of the study was also excluded. Those pharmacies which were not registered in the NCDA and DDA(Department of Drug Administration), Nepal were also excluded. Also hospital based pharmacies and employees who were recently recruited(less than one month) were also excluded in the study.

F. Study and Sampling Unit

Each private pharmacy of Kaski district providing retailer services was defined as the study unit in this research whereas individual pharmacist (employee or manager) in each pharmacy was known as sampling unit.

G. Sampling Strategy

Total 119 Pharmacies (37% of total) were selected from different areas of Kaski district randomly. Simple random sampling was carried out to select these pharmacies from different areas. Sampling frame was the list of private pharmacies registered on Nepal chemist and drugs association (NCDA) from which required number of samples were drawn. This data was made from the office of NCDA, Gandaki Zone Branch, Kaski, and Pokhara (Accessed date: 2017 August 17)

The sample size was determined using the formula,

$$n = \frac{Z^2 pq}{d^2}$$

Where,
Z= standard normal variate, with value 1.96 at 95% confidence interval
d= allowable error with value 0.05
Sample size calculation:
Sample size can be calculated as:

$n = \frac{Z^2 pq}{d^2}$ for infinite population,

$n = \frac{1.96^2 * 0.52 * 0.48}{0.05^2}$

n = 383

Prevalence of improper pharmaceutical waste management in western Nepal was 52.36% and it was taken from the research article titled "Improper Management of Pharmaceutical Waste in South and South-East Asian Regions".[6]

Also,
Total number of private pharmacies (retailers) (N) = 17
Sample size for finite population (n) was calculated by using following formula

$$n = \frac{n_0}{1 + n_0/N}$$

$$= \frac{383}{1 + \frac{383}{174}}$$

=119

Sample Size for finite population was 119

H. Sampling Techniques

The total number of pharmacies was around 320 (including wholesale pharmacies and pharmacies attached to nursing homes and hospitals) in the Kaski district, and all these pharmacies were registered in DDA and NCDA.

Around 83 Pharmacies were run as wholesaler's pharmacies and supplies drugs and medicines to their retailers. Also, according to the information from NCDA Kaski almost 63 pharmacies were nonfunctional, which was only registered and renewed their registration certificate annually but they didn't involve in buy and sells of pharmaceuticals. So, in this study these part of samples were excluded i.e. 174 were taken as total running

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community pharmacies providing retailer services in Kaski district.

For this purpose firstly different number was assigned to all the community pharmacy individually and then required random number (i.e. 120) was taken out by one using Random number table in MS excel. During the conditions when the randomly selected pharmacies was non-functional or wholesaler, then the random numbers were drawn until the inclusion criteria was satisfied. The pharmacies were selected without considering their size, the number of people working in them, or the gender of the pharmacist.

I. Data Collection Techniques and Tools

The informed consent form was signed by the participant then the questionnaire was filled up by taking interview with the respondents. After filling complete questionnaire, observation checklist was used. Questionnaire and observation checklist was prepared by the help of different article reviewed and some modifications was done to make context matched.

S. No	Techniques	Tools
1	Interview Method	Structured Questionnaire
2	Observation Method	Observation Checklist

Table 1:- Data collection techniques and respective tools

J. Pre-Testing of Tools

Pre-testing of data collecting tools was conducted in randomly selected Pharmacies from the list of Private pharmacies outside the study area. 10 % of the total units were being pretest. Pre testing of the study tools was done in Vyas Municipality, Damauli Tanahun District. After pretesting changes some changes were done as per need of objectives.

K. Validity and Reliability

Validity refers to correct measurement and reliability refers to consistency in measurement. For validity and reliability of our study, following measures were taken in consideration.

a) Pretesting of the tools was done.
b) Simple and understanding language was used as far as possible to get true response from the people.
c) Every filled questionnaire was rechecked and cross editing was done.
d) Guidance from supervisor and other reviewer was taken continuously.
e) Corrections were made as per suggestions from supervisor.
f) Operational definition was strictly implemented.

L. Data management and analysis

In this study information was collected through interview and observation method. Before collecting information, at first informed consent form was signed for taking permission from the respondents. Then after taking permission a set of structured questionnaire was filled up by asking questions. Structured questionnaire was used for pharmacy manager or employee in assessing all the information's. Observation checklist was used to assess the status of cleanliness, infrastructure, practices and waste management resources present in the pharmacy.

All collected data was managed and processed manually. Relationship among different study variables was studied analytically in EPI DATA Version 3.1 and these data was transferred to SPSS V.22 for further analysis.

Knowledge of PWM was measured through a test consisting of eleven questions (part II of questionnaire). Using an adaptation of the NMRQ)Nicholson McBride Resilience Questionnaire)tool, each correct response was allocated a score of 2 while other responses such as no or not sure was allocated as zero score.[35] The maximum score was 22 and the minimum score was 10.So the median knowledge score was "18". Hence, the score was categorized on the basis of median score. The score which were less than the median value was categorized into inadequate knowledge (score<18) and the score which were greater or equal to median value was categorized into adequate knowledge (score≥18). Similarly practices of PWM were measured through a test consisting of 12 questions (part III of questionnaire). Similar score system was applied; where maximum score was 24and minimum score was 12. The median practices score was "18". Hence, the score was categorized on the basis of median score. The score which were less than the median value was categorized into inadequate practices (score<18) and the score which were greater or equal to median value was categorized into adequate practices (score≥18). The detailed questionnaire and expected correct responses of knowledge and practices sections were provided in appendix 2(part II & part III).

The questionnaire framework for scoring system regarding knowledge and practices parts was shown below:

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S. No.	Questionnaire	Correct response`s score	Incorrect response`s score
	Knowledge on Pharmaceutical Waste Management	2	0
1	Are dumped pharmaceuticals environmentally hazardous?	2	0
2	Is it necessary to collect expired pharmaceuticals separately from sellable stock? If yes, then why?	2	0
3	Is there any relationship between development of resistance to anti-bacterial compounds and unsound management of pharmaceutical waste?	2	0
4	Is there any effect of pharmaceutical waste to effective sewage treatment in the environment?	2	0
5	Do you consider return of unsold pharmaceuticals to the suppliers a good way of minimizing pharmaceutical waste?	2	0
6	Does burying of pharmaceutical waste prevents pollution of water sources with pharmaceutical compounds?	2	0
7	Does burning of pharmaceutical waste may lead to production of harmful persistent organic pollutants (POPs)?	2	0
8	Is encapsulation of pharmaceutical waste is necessary before land filling during disposal process?	2	0
9	Does inertization reduce/delay the release of active pharmaceutical compounds into the aqueous environment?	2	0
10	How the supplier or manufacturer treat and dispose the returned pharmaceuticals?	2	0
11	Is personnel protective equipment (PPE) is necessary during Pharmaceutical waste handling? If yes then why/	2	0
	Practices on Pharmaceutical Waste Management		
1	Do you have any guideline/Policy regarding pharmaceutical waste management which every worker at the pharmacy follow?	2	0
2	Do you have a separate container for storage of expired or damaged pharmaceuticals in your pharmacy?	2	0
3	Practices of having color coded or labelled container for waste collection	2	0
4	Do you or your pharmacy regularly return unsold stocks to your suppliers?	2	0
5	Do you or your coworker usually treat of waste containing pharmaceuticals by burning it?	2	0
6	Practices of throwing PW on municipal truck(noninfectious)	2	0
7	Do you or your pharmacy regularly treat pharmaceutical waste by incinerating it?	2	0
8	Do you or your coworker regularly dispose of pharmaceutical waste by burying it?	2	0
9	Is your premises connected to municipal sewage system?	2	0
10	Is your premises connected to a septic tank?	2	0
11	Do you or your coworker dispose of liquid pharmaceutical waste by flushing it down the toilet?	2	0
12	Do you regularly wear Personnel protective equipment (PPE) i.e. gloves, mask etc. during Pharmaceutical waste handling?	2	0

Table 2:- Questionnaire regarding knowledge and practices score

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Variables	Causal relationship	Measurement	Univariate	Bivariate
Practice	Dependent	Ordinal	Percentage	CHI-SQUARE TEST/ OTHER TEST AS PER THE TYPES OF VARIABLE AND THEIR ASSOCIATION
Socio demographic				
Age grouping	Independent	Continuous	Percentage	
Sex	Independent	Nominal	Percentage	
Education status	Independent	Ordinal	Percentage	
Working Experience in Pharmacy	Independent	Continuous	Percentage	
Ownership Status	Independent	Nominal	Percentage	
Duration of establishment Year	Independent	Continuous	Percentage	
Qualification				
Training status	Independent	Nominal	Percentage	
Pharmacy council registration		Nominal	Percentage	
Professional body registration		Nominal	Percentage	
Continuous medical measures education status		Nominal	Percentage	
Knowledge				
Knowledge	Independent	Ordinal	Percentage	
Infrastructure				
Infrastructure	Independent	Ordinal	Percentage	

Table 3:- Data Analysis Plan

Questionnaire was properly pretested outside the Kaski district before doing research or applying in the study area. The everyday collected data was reviewed strictly and compulsory at the end of the data collection. By this process the day to day mistake was analyzed and corrected in the next day of data collection. The data entered in the EPI DATA version 3.2 was manually checked i.e. 10% of the data was randomly checked for minimizing error. After entering data if the error occurs more than 1% then the data was reentered. Also when the errors occur 5% and more, then the entered data will be rechecked. For understanding association between variables chi square test, fisher-exact test was used and for Univariate analysis, percentage of different variables individually was calculated. During analysis, symmetric measures like Cramer`s value was also used to understand the association between the variables. Tabular and graphical presentation of the data with its proper interpretation was done.

M. Ethical Consideration

Advanced permission was taken from selected pharmacies after getting approval from SHAS Pokhara University, Institutional Review Committee, IRC, Pokhara University and Nepal chemist and drugs association (NCDA), Gandaki Zone Branch Office.

This study was non-interventional and data collected did not expose the participants to any risk of harm. Also there existed no any harm to the community and the people. The study and its findings were beneficial to the communities and by contributing to improvement in pharmaceutical waste management. The participants were allow freely to participate without any pressure and force. Full Information about the nature of the study was provided to the participants including the title, introduction, objectives and expected benefits. . Informed consent was taken from participants by taking signature on the form before starting interview and filling up questionnaire. Confidentiality and privacy of pharmacy was maintained closed. No any personal information was taken and data was used only for the research purpose.

III. RESULTS

This section contains analysis and interpretation of the study findings. Data analysis was done after transferring the data entered in EPI DATA version 3.2 to SPSS version 20 as per the objectives. The data were presented using tables, figures, and statistical statements by each objective. All computations were based on 95% level of confidence. The response rate was 100%. Mainly Chi-square test was applied to check for the significant associations between the variables. Symmetric measures like Cramer`s value was also used to find out the strength of association. Sometimes Fisher-exact test was also used in the analysis procedure according to the conditions.

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A. Socio-Demographic Characteristics

Variables	Frequency(N=119)	Percent (%)
Age category		
34 years and below	60	50.4
Above 34 years	59	49.6
Median=34years(max=67,min=18) ,IQR=14		
Gender		
Male	85	71.4
Female	34	28.6
Ownership		
Owner	94	79
Partner	2	1.7
Employee	23	19.3
Pharmacy working experience		
10 years and below	65	54.6
Above 10 years	54	45.4
Median=10(max=36min=0.15), IQR=11		
Years since establishment		
0-5 years	47	39.5
6-10 years	26	21.8
11-15 years	19	16
More years	27	22.7
Level of Schooling		
Secondary	24	20.2
Below Bachelor	48	40.3
Bachelor degree/above	47	39.5

Table 4:- Socio demographic characteristics of respondents

Table 4 shows the socio-demographic characteristics of the respondents. This characteristic includes age category, sex, highest level of schooling, pharmacy working experience, years since establishment and pharmacy business ownership status. Of the 119 respondents, 85(71.4%) were male and 34(28.6%) were female. Respondents were ranging age between 18 and 67 (median=34years), where 34 years and below aged were 60(50.4%) and 59(49.6%) were above 34 years of age.

Out of 119 participants, majorities of the respondents i.e. 94 (79%) owned the pharmacies in which they worked. Another 23 (19.3%) were employees while only 2(1.7%) were in partnership. So, this represents that, out of 119 pharmacies only two pharmacies were run in partnership.

About 54.6% respondents had 10 and below 10 years of experiences on pharmacy profession while remaining 45.4% had above 10 years of experiences (median=10years).

Among 119 pharmacies, 47(39.5%) pharmacies were established five or less than five years prior to the date of study conducted. Similarly 27(22.7%) pharmacies were established 15 years before, 26(21.8%) were started between 6-10 years and 19(16%) were started between 11-15 years before the study.

About 39.5% were schooled up to their bachelor degree and above whereas 40.3% were below bachelor and remaining 20.2 % attained their secondary level of schooling.

B. Qualification Related Factors of Respondents

Variables	Frequency (N=119)	Percent (%)
Pharmacy training status		
Trained	113	95
Untrained	6	5
Level of Training		
Degree	7	5.9
Diploma	41	34.5
Community medical Axillury(CMA) and orientation	40	33.6
Health Assistant(HA) and orientation	15	12.6
Others	10	8.4
Untrained	6	5
Pharmacy Registered in DDA&NCDA	119	100
Registered	119	100
Unregistered	0	0
Regularity of continuous medical measures education		
Yes	96	80.7
No	23	19.3
Belonging to other professional body		
Yes	6	5
No	113	95

Table 5:- Qualification factors of respondents

This part presents the findings related with the qualification factors of respondents (pharmacists) which includes pharmacy training status, level of training, registration of pharmacy in DDA and NCDA, regularity of attaining continuous medical measures education and belonging to the professional body other than NCDA.

Out of 119 respondents, 113(95%) were trained in pharmacy profession while 6(5%) had no any pharmacy training .The untrained categories indicates staff nurses, medical lab technicians, and other normal people who were unaware of drug dispensing. Of the total respondents, majorities were trained in diploma pharmacy i.e. 41(34.5%), while 40(33.6) were trained in combine CMA and orientations. Similarly 15(12.6%) had their training on HA with orientation course for dispensing the medicines whereas 7(5.9%) were trained on Bachelor in pharmacy course and 10(8.4%) had trained on orientation courses only but the remaining 6(5%) were untrained in these profession.

C. Knowledge of pharmaceutical waste management

Knowledge	Frequency (N=119)	Percent (%)
Inadequate Knowledge	48	40.3
Adequate Knowledge	71	59.7

Table 6:- Knowledge of pharmaceutical waste management

Knowledge of PWM was measured through eleven questions and scoring system was used, where each correct response was allocated a score of 2 while other responses such as no or not sure was allocated as zero score. The maximum score was 22 and the minimum score was 10.So the median knowledge score was “18” (IQR=6). Hence, the score was categorized on the basis of median score. The score which were less than the median value was categorized into inadequate knowledge (score<18) and the score which were greater or equal to median value was categorized into adequate knowledge (score≥18). Table 4.3 shows the level of knowledge regarding pharmaceutical waste management, where out of total 119 respondents, 71(59.7%) respondents have adequate knowledge and 48(40.3%) have inadequate knowledge.

D. Practices of pharmaceutical waste management

Practices	Frequency(N=119)	Percent (%)
Poor practices	48	40.3
Good practices	71	59.7

Table 7:- Practices of pharmaceutical waste management

Similarly practices of PWM were measured through a test consisting of 12 questions (part III of questionnaire). Similar score system used in assessing knowledge was applied; where maximum score was 24and minimum score was 12. The median practices score was “18” (IQR=4). Hence, the score was categorized on the basis of median score. The score which were less than the median value

was categorized into inadequate practices (score<18) and the score which were greater or equal to median value was categorized into adequate practices (score≥18).

Above table shows the level of practices regarding pharmaceutical waste management. Out of total 119 respondents, 71(59.9%) were fall into the category of good practices and remaining 48(40.3%) were categorized as poor practices.

Practices characteristics	Frequency (N=119)	
	Yes	No
Practices of regularly returning unsold pharmaceuticals to suppliers	112(94.1%)	7(5.9%)
Respondents who usually treat all PW by burning method	15(12.6%)	104(87.4%)
Respondents who usually treat all PW by burying method	7(5.9%)	112(94.1%)
Practices of treating PW by incineration method	44(37%)	75(63%)
Respondents who throw PW on municipal truck(noninfectious)	91(76.5%)	28(23.5%)
Respondents who dispose liquid PW by flushing it down the toilet	6(5%)	113(95%)

Table 8:- Practices related aspects

Above table shows the main characteristics related with practices of PWM such as practices of returning unsold practices to suppliers, treating PW by burning, burying method and incineration, practices of throwing PWon municipal truck(for non-infectious waste) and practices of disposing liquid PW by flushing it down the toilet. Out of 119 respondents majorities of the pharmacists about 94.1 %(112) had practices of returning unsold and expired pharmaceuticals to the suppliers but few about 5.9 %(7) had absence of such practices. Only 76.5 %(91) pharmacies throw their noninfectious PW to municipal truck but remaining 23.5 %(28) throw all the types of PW also.

About 87.4 %(104) had responded that they usually didn't treat all the types of PW by burying method but remaining 12.6 %(15) had responded that they regularly use burning method for treating all the types of PW. Among 119 respondents, 5.9% regularly used burying method to treat all the types of PW whereas 94.1% didn't had practices of burying .Minimal percentage of pharmacies had practices of incineration method i.e. 37%, this includes incineration within the pharmacies as well as pharmacies who supplied their PW to the hospital for incineration. Over 63 % of pharmacies hadn't practices the method of incineration.

Similarly in the practices aspects, respondents were asked whether they had the practices of flushing liquid PW down the toilet or not, where about 95% responded that they didn't flush their liquid waste down the toilet. But some 5% responded that they had the practices of such methods as well.

E. Infrastructures used for pharmaceutical waste management

Variables	Frequency (N=119)	Percent (%)
Pharmaceutical waste collecting container		
Present	114	95.8
Absent	5	4.2
Cleanliness of container		
Present	114	95.8
Absent	5	4.2
Segregation of PW with color coding/labeling		
Present	34	28.6
Absent	85	71.4
Incinerator and disposal of ashes		
Present	18	15.1
Absent	101	84.9
Burial pit without liner		
Present	18	15.1
Absent	101	84.9
PPE use		
Present	114	95.8
Absent	5	4.2
Access to Landfill(Municipal level)		
Present	111	93.3
Absent	8	6.7

Table 9:- Infrastructures used for pharmaceutical waste management

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Above table shows the distribution of pharmacies according to their access of pharmaceutical waste disposal infrastructure. Infrastructure in pharmacy level includes pharmaceutical waste collecting container with its cleanliness and color coding/labeling, incinerator and private burial pit. In municipal level, pharmacy should be access to their municipal landfill site.

Out of 119 pharmacies, most the pharmacies i.e. 114(95.8%) had pharmaceutical wastes collecting container and also had same percentage of cleanliness and PPE use. Although most of the pharmacies had waste collecting container, but only 34(28.6%) pharmacies had use the system of color coding and labeling for the segregation of waste.

Regarding incineration facilities and burial pit, only 18(15.1%) had access while 101(84.9%) had didn`t access to these facilities. The pharmacies who had reported the presence of private burial pit at their own premises didn't have fence and liner enclosed inside the pit. In municipal level most of the pharmacies i.e. 111(93.3%) had access to the landfill for pharmaceutical waste disposal.

F. Opinions regarding necessity of training/guidelines regarding PWM and positive attitude of suppliers

Characteristics	Frequency (N=119)	Percent (%)
Necessity of providing related training/guideline at local level by GON		
Yes	114	95.8
No	5	4.2
Necessity of PWM guideline at Pharmacy level		
Yes	116	97.5
No	3	2.5
Necessity of positive attitude of suppliers for returning unsold items		
Yes	119	100
No	0	0

Table 10:- Opinion regarding necessity of guidelines, training and supplier's attitude

Above table shows opinions and views of all the 119 respondents regarding necessity of providing training or guidelines related with pharmaceutical waste management in local level as well as in pharmacy level by the government or (DDA) where 95.8%(114) says that there is necessity of guideline or training in local level and 97.21%(116) says that it is necessary in pharmacy level too. Lastly, all the respondents expressed their opinion that there is a necessity of positive attitude of suppliers while returning their unsold pharmaceuticals items.

G. Association between variables

This section presents associations in between various variables i.e. dependent and independent both the statistical test used was mainly Chi square test was used to understand the association between the variables but in case of any expected cell count less than five in 2*2 contingency tables Fisher-Exact test was also used to understand the association. Symmetric measures like Cramer's value was also used to determine the strength of association after testing through Chi square test. Cramer`s value categorized the strength of association into three groups i.e. mild (Cramer's value: 0.1 to .29), moderate (Cramer`s value: 0.3 to 0.49) and strong (Cramer`s value: 0.5 to above).

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Characteristics	Knowledge		Chi square(X^2)	P-Value
	Inadequate	Adequate		
Age category				
34 years and below 34	25(41.7%)	35(58.3%)	0.089	0.765
Above 34 years	23(39%)	36(61%)		
Gender				
Male	28(32.9%)	57(67.1%)	6.760	0.009*
Female	20(58.8)	14(41.2%)		Cramer`s V =0.238
Ownership				
Owner	34(36.2%)	60(63.8%)	6.059	0.048*
Partner	0(0%)	2(100%)		Cramer`s V =0.226
Employee	14(60.9%)	9(39.1%)		
Pharmacy working Experience				
10 years and below	29(44.6%)	36(55.4%)	1.090	0.296
Above 10 years	19(35.2%)	35(64.8%)		
Years since establishment				
0-5 years	22(46.8%)	25(53.2%)	3.274	0.351
6-10 years	7(26.9%)	19(73.1%)		
11-15 years	9(47.4%)	10(52.6%)		
More years	10(37%)	17(63%)		
Level of Schooling				
Secondary	16(66.7%)	8(33.3%)	14.611	0.001*
Below Bachelor	22(45.8%)	26(54.2%)		Cramer`s V =0.350
Bachelor degree/above	10(21.3%)	37(78.7%)		

Table 11:- Association between socio demographic variables and level of knowledge
** indicates having association i.e. P-value<0.05*

Above table shows the association between socio-demographic factors of respondents including age category, gender, and level of schooling, ownership of business, pharmacy working experiences and years since establishment with knowledge. The statistics showed no association between level of knowledge and respondent's age category (p=0.768). Similarly there was no association of knowledge and pharmacy working experiences (p=0.296) and also knowledge and years since establishment (p=0.351). But the knowledge was found to be associated with the level of schooling (p=0.001), gender (p=0.009) and ownership of pharmacy (p=0.048), where we had understand that "bachelor degree and above" qualified respondents had more percentage of adequate knowledge than others groups. Likewise, participants who were owner and partners had more score of knowledge on PWM than employees. While measuring the strength of association, level of schooling showed moderate association (Cramer's value=0.35) whereas ownership and gender showed mild association (Cramer`s value<0.3). Hence, the null hypothesis stated "there is no association between knowledge and socio demographic characteristics" was rejected.

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Characteristics	Practices		Chi square value	P-Value
	Inadequate	Adequate		
Age category				
34 years and below 34	21(35%)	39(65%)	1.432	0.231
Above 34 years	27(45.8%)	32(54.2%)		
Gender				
Male	30(35.3%)	55(64.7%)	3.143	0.076
Female	18(52.9%)	16(47.1%)		
Ownership				
Owner	39(41.5%)	55(58.5%)	1.418	0.492
Partner	0	2(100%)		
Employee	9(39.1%)	14(60.9%)		
Pharmacy working				
10 years and below	25(38.5%)	40(61.5%)	0.209	0.647
Above 10 years	23(42.6%)	31(57.4%)		
Years since establishment				
0-5 years	19(40.4%)	28(59.6%)	4.380	0.223
6-10 years	7(26.9%)	19(73.1%)		
11-15 years	11(57.9%)	8(42.1%)		
More years	11(40.7%)	16(59.3%)		
Level of Schooling				
Secondary	16(66.7%)	8(33.3%)	10.064	0.007*
Below Bachelor	19(39.6%)	29(60.4%)		Cramer`s V =0.291
Bachelor degree/above	13(27.7%)	34(72.3%)		

Table 12:- Association between socio demographic variables and level of practices

** indicates having association i.e. P-value<0.05*

This part describes the association between practice of PWM and the respondents' socio-demographic factors. Table 4.8 shows that only respondent`s "level of schooling" was associated with practice (p=0.007) and had mild association since the Cramer's value was less than 0.30. Others characteristics like age category (p=0.231), gender (p=0.076), ownership (p=0.492), years since establishment (p=0.223) and pharmacy working experiences (p=0.647) showed no any association with the practices since their value appeared greater than p=0.05.

Characteristics	Knowledge		Chi Square	P-Value
	Inadequate	Adequate		
Pharmacy training status				
Trained	44(38.9%)	69(61.1%)	1.820	0.219#
Untrained	4(66.7%)	2(33.3%)		
Level of Training				
Degree	1(14.3%)	6(85.7%)	9.000	0.109
Diploma	11(26.8%)	30(73.2%)		
CMA+orientation	20(50%)	20(50%)		
HA +orientation	7(46.7%)	8(53.3%)		
Others	5(50%)	5(50%)		
Untrained	4(66.7%)	2(33.3%)		
Regularity of continuous medical measures education				
Yes	32(33.3%)	64(66.7%)	10.121	0.001*
No	16(69.6%)	7(30.4%)		Cramer`s V =0.292
Belonging to other professional body				
Yes	1(16.7%)	5(83.3%)	1.471	0.399#
No	47(41.6%)	66(58.4%)		

Table 13:- Association between Qualification and level of knowledge

** indicates having association i.e. P-value<0.05*

 # indicates Fisher Exact test value in 2x2 contingency table (for expected cell count<5)

The qualification factors were pharmacy training status, level of training, regularity of continuous medical measures education and belonging to other professional body. Table 4.9 represents the association between qualification factors and knowledge of pharmaceutical waste management. It shows that the pharmacy training status (p=0.219), level of training (p=0.109) and belonging to other professional body (p=0.399) were not associated with

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knowledge but the "regularity of continuous medical measures education" was associated with the level of knowledge (p-value=0.001) and the strength of association was mild (Cramer's value<0.29). Hence, the null hypothesis stated "there is no any association between qualification factors and knowledge" was rejected.

The qualification factors were pharmacy training status, level of training, regularity of continuous medical measures education and belonging to other professional body. Below coming table represents the association between qualification factors and practices of pharmaceutical waste management. Statistics showed level of training (p=0.003) and regularity of continuous medical measures education (p=0.007) was associated with practices of pharmaceutical waste management. Symmetric measures indicated that level of training had moderate association (Cramer`s value<0.5) and regularity of continuous medical measures education had mild association (Cramer`s value<0.30) with the level of practices. Findings clears that pharmacist trained on degree level had adequate practices of PWM than low level training groups. Others remaining characteristics was not associated with the practices of pharmaceutical waste management since there p-value was greater than 0.05.

Characteristics	Practices		Chi Square	P-Value
	Inadequate	Adequate		
Pharmacy training status				
Trained	45(39.8%)	68(60.2%)	0.245	0.684#
Untrained	3(50%)	3(50%)		
Level of Training				
Degree	1(14.3%)	6(85.7%)	17.64	0.003*
Diploma	10(24.4%)	31(75.6%)		Cramer`s V=0.385
CMA+orientation	19(47.5%)	21(52.5%)		
HA +orientation	12(80%)	3(20%)		
Others	3(30%)	7(70%)		
Untrained	3(50%)	3(50%)		
Regularity of CMME(Continuous medical measures education)				
Yes	33(34.4%)	63(65.6%)	7.334	0.007*
No	15(65.2%)	8(34.8%)		Cramer's V=0.248
Belonging to other professional body				
Yes	1(16.7%)	5(83.3%)	1.471	0.399#
No	47(41.6%)	66(58.4%)		

Table 14:- Association between qualification and level of practices

**indicates having association i.e. P-value<0.05*

 # indicates Fisher Exact test value in 2x2 contingency table (for cell count<5).

Characteristics	Practices		Chi Square	P-Value
	Inadequate	Adequate		
Pharmaceutical waste collecting container				
Present	44(38.6%)	70(61.4%)	3.412	0.156#
Absent	4(80%)	1(20%)		
Cleanliness of container				
Present	44(38.6%)	70(61.4%)	3.412	0.156#
Absent	4(80%)	1(20%)		
Segregation of PW with color coding/labeling				
Present	5(14.7%)	29(85.3%)	12.993	0.000*
Absent	43(50.6%)	42(49.4%)		Cramer`s V=0.330
Incinerator and disposal of ashes				
Present	1(5.6%)	17(94.4%)	10.660	0.001*
Absent	47(46.5%)	54(53.5%)		Cramer`s V=0.299
Burial pit(without liner)				
Present	10(55.6%)	8(44.4%)	2.041	0.153
Absent	38(37.6%)	63(62.4%)		
Access to Landfill(Municipal level)				
Present	42(37.8%)	69(62.2%)	4.282	0.060#
Absent	6(75%)	2(25%)		

Table 15:- Association between infrastructures and level of practices

** indicates having association i.e. P-value<0.05*

 # indicates Fisher Exact test value in 2x2 contingency table (expected cell count<5)

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Above table shows the summary of association between level of practices of PWM and infrastructures. The availability of color coded pharmaceutical waste collecting container was associated with the level of practices (p=0.000) where statistics showed that more percentage of adequate practices in the group of pharmacists who had color coded container. Incinerator and disposal of ashes was also associated with the level of practices (p=0.001). Pharmacies having incinerator and who disposed output ashes had more adequate percentage of PWM practices than that of pharmacies who didn't had incinerator. Others infrastructure such as burial pit access (p=0.153) and landfill in municipal level (p=0.060) were not associated with the level of practices. The null hypothesis stated that there is no association with availability of infrastructure and practices of PWM. Cross tabulation between availability of infrastructure and practices of PWM in table no.4.11 shows that there was association existed so the null hypothesis was rejected.

Knowledge	Practices		Chi Square	P-Value
	Inadequate	Adequate		
Inadequate	38(79.2%)	10(20.8%)	X^2 = 50.405	0.000*
Adequate	10(14.1%)	61(85.9%)		Cramer`s V =0.651

Table 16:- Association between level of knowledge and practices
** indicates having association i.e. P-value<0.05*

It shows the summary association between knowledge and practices of pharmaceutical waste management .Above table represented that there was strong association of level of knowledge with the level of practices. (P value=0.000) and the strength of association was also strong (Cramer`s value>0.50). Hence, the alternative hypothesis that there was association between knowledge and practices of PWM was accepted.

IV. DISCUSSION

The main objective of this study was to describe the current status of pharmaceutical waste management in Kaski district, Nepal. In this study, the overall pharmaceutical waste management was determined by socio demographic characteristics of pharmacists, qualification of pharmacists, access to infrastructure, and knowledge of PWM and practice of PWM. The discussions are presented into different sections according to the objectives of the study.

A. Socio demographic characteristics

Out of the 119 respondents, 71.4% were male and 28.6% were female. Similar results were shown by the study conducted by Sudesh Gyawali on "Pharmacy practice and injection use in community pharmacies in Pokhara city, Western Nepal".[12] In that study, 87% were male and 13% were female. Another study from Kenya and Kuwait also reported that more percentage of male were involved in the pharmacy profession than female.[35, 36] The study from Kenya also reported more percentage of male (84.1%) had adequate knowledge than in female (72.4%).[35] Similar results were obtained in our study where 67.1% male adequate knowledge and 41.2% female had adequate knowledge on PWM. Also while comparing male and female with considering same level of schooling education, male had more percentage of knowledge on PWM than female. Similarly while comparing male and female with same group of ownership and regularity of training, male respondents had more percentage of adequate knowledge than female respondents. This study reveals low percentage of female involvement in pharmacy business so the statistics showed low percentage of knowledge on PWM in female respondents.

The demographic characteristics of the present study revealed that only 39.5% of respondents were educated up to Bachelor degree education, whereas 40.3% diploma or higher secondary level and remaining 20.2% were educated up to secondary level of schooling. In Pakistan, 55% of Community pharmacist had only secondary school education while only 9.5% were educated to degree level.[37] A study on pharmaceutical waste management in Kenya also revealed low level of school education in the group of pharmacists i.e. only18.6% were schooled up to Degree education but 63.4% were educated up to diploma level.[35]So all these above discussed reported more percentage of diploma level education in the pharmacist as similar with our study. But in Saudi Arabia the statistics were different, where 96% of community pharmacists had a Bachelor of Science degree; over 2% had Doctor of Pharmacy (Pharm. D), over 1% Master of Science and about 0.6% had Doctor of Philosophy degrees.[38]In our study, knowledge on PWM was found more on pharmacist educated up to "Bachelor and above" (78.7%) than comparison with the group educated "below bachelor" (54.2%) and up to secondary level (33.3%). Similar result was found on Kenya where 92.2% pharmacist with degree level schooling had adequate knowledge on PWM and 53.2 % pharmacist with below diploma level education had adequate knowledge on PWM.[35]

In this study about 72.3% of pharmacist with bachelor degree education adequate level of practices on PWM. Similar result was reported from the study of Kenya where 72.5% of degree level educated pharmacist had adequate practices on PWM.[35]

B. Qualification of the pharmacist

Among 119 pharmacists, most of them had adequate knowledge and practices of pharmaceutical waste management who were educated with degree level of pharmacy education than lower level groups i.e. diploma, CMA, HA. Out of total respondents 85.7% had adequate

practices on PWM who were educated in degree. Also high percentage of adequate practices and knowledge was also seen in the pharmacists engaged on the professional body (83.3%).Similarly; around 65%of pharmacists attaining regular CMME had adequate practices and knowledge on PWM. Similar results was reported from the study of Kenya.[35] Continuous medical measures education as an intervention was found to improve the knowledge of pharmacists regarding PWM in the US.[39]It would be expected that regular CMEE with relevant content would be more fruitful as an educational intervention for increasing the level of knowledge and practices on PWM.

After analysis and comparing with these reports it can suggested that increasing the numbers of highly qualified pharmacists having characteristics like pharmacy degree, bachelor level of schooling, engaged in professional body and regularly attaining CMME can improve the status of PWM significantly.

C. Knowledge and practices on pharmaceutical waste management

In this study about 59% of the respondents demonstrated adequate knowledge on pharmaceutical waste management. In Nairobi, Kenya 79% of the pharmacist was demonstrated with 'adequate knowledge' of PWM.[35] Also this study of Kenya had almost same knowledge and practices assessing criteria (score, questionnaire, study population) with this study. This was similar to Kuwait where over 80% of public sector pharmacists were aware of the environmental impact of unsafe disposal of PW.[36]But the Kuwait study was differ with the current study in consideration of study population. In contrast, both the discussed area Nairobi and our study area represent the developing countries but their level of knowledge on PWM was found significantly different.

In this study, over 90% of the respondents are aware of "environmentally hazardous dumped pharmaceutical wastes", "separation of expired drugs", "impact of mixing unwanted pharmaceuticals on effective sewage treatment" and "harmful effects of persistent organic pollutants produced during open burning of pharmaceutical waste".

About 60% had incorrectly answered that burying PW could prevent pollution of water sources and around 70% correctly answered that need of encapsulation and inertization before landfill for reducing pollution of water sources. All the respondents answered correctly about the uses and benefits of personnel protective equipment during handling of pharmaceutical wastes.

About 59% of participating pharmacies were categorized as having 'adequate practice' of PWM. Among 119 pharmacies nearly 13% of respondents burned their PW usually as compared to New Zealand where less that 1% of community pharmacies burned their PW. [40]In Tanzania, 31% usually burned their PW in open air. In context to Nairobi, Kenya, where 66% had good practices of PWM and 36% had open burning practices for PW treatment.[41]This suggests that the open burning method is practiced more commonly in low socio economic countries.

Similarly, in this present study, 76.5% gave PW to municipal garbage truck but they didn't give expired medicine and infected wastes to them. Whereas out of remaining 23.5% respondents, some discard infectious wastes and expired medicines into municipal garbage truck by mixing with general waste and some respondents simply discarded all types of PW into the garbage dump available around their premises. In Kenya 21% of pharmacist discarded PW into garbage dumps while 23% gave it to informal waste collectors.[35] A similar results was reported in Tanzania where about two thirds of private pharmacies in Dar es Salaam either dumped PW or drained it through the sink.[41] But in context with New Zealand where 3.9% and 24.6% disposed of solid and semi-solid PW respectively with regular rubbish as like other household waste.[40]

This study reported only 16.3% of pharmacists in Kaski district (Nepal), were aware about guideline of PWM and very few were using color coded system for segregation of PW (29.4%).

A survey based research was conducted in Kuwait to assess the practice, awareness and opinion of pharmacists toward disposal of unwanted medications in Kuwait which show that 73% of the pharmacy throws the unwanted medications in the trash directly without any treatment and only 23 pharmacists (out of 144), disposed their unwanted medicines according to the guidelines of Ministry of Health, Kuwait.[36]

The system of returning unused and expired medicines have been established in developed countries such as Canada, Australia, Italy, France and Spain as in USA and UK.[42]About 94.1 % respondents had practices of returning back of their unsold items regularly to the suppliers but they repeatedly reported that some items were refused to return back due to various reasons like "halved used packets", "broken items", "medicines very near to expiry date" etc.

D. Infrastructures

In primary phase of PWM, returning unusable drugs for safe disposal by the suppliers or manufacturer is an important aspect. In this study all the respondents were retailer and reported that they were directly interact with suppliers groups only. So the private retailer pharmacies returns their unusable drugs to the suppliers and suppliers finally return back that expired or unusable drugs to manufacture company for the safe disposal. The practices of returning unusable pharmaceutical items were seen in 94.1% pharmacies.

In the current study, only about 15.1% of the respondents had access to incinerator at their own pharmacies but the practices of incineration was seen in 37% of pharmacies. This is because, some of the pharmacists who work in the hospital or pharmacies located nearer to the hospital sites, provide their PW for incineration. Most of the pharmacies had sharps incinerator

at their own premises for treating sharps items. There was absence of municipal level of incineration facilities for treating PW in Kaski district. This study found that only landfill facilities was provided by the Pokhara Lekhnath Metropolitan to collect and dispose general (non-infectious) wastes from the community pharmacies but some pharmacies provide infectious wastes by mixing with general wastes. In Tanzania 46% of government health facilities in Dar es Salaam cited lack of incinerators.[41] Similar case were reported in Nairobi, Kenya where 45% of pharmacies had no access to incinerators.[35]

In Tanzania, 72% of public health facilities in Dar es Salaam buried their PW at the city's public dumpsite due to the lack of sanitary landfills.[41] Similar case was seen in our study area, as over 90% of respondents had access to municipal landfill operated by Pokhara Lekhnath Metropolitan for disposing general wastes only but there is an absence of separate sanitary landfill site for medical waste disposal. Due to absence of separate sanitary landfill site for medical waste disposal some pharmacies provide their all kinds of pharmaceutical wastes including antibiotics, toxic and infectious waste to the municipal garbage truck where only general waste were collected .This causes mixing of general and other kinds of pharmaceutical wastes in same place by which transmission of infection from scavengers may occurred. Some respondents also had access to private burial pit (15%) for the disposal of pharmaceutical waste but the respondents who had reported presence of burial pit didn't had liner inside that pit.

About 60 % of pharmacies had contracted waste handlers, an alternatives mode which was more popular in New Zealand, where over 80% of solid PW and over 60% of liquid PW from community pharmacies was disposed of by this method.[40]The same mode was widely used in the US and others countries like Canada, Australia, Italy, France and Spain.[42] But in our study area there was no any provision of contracted waste collectors or associations responsible for treatment and disposal of PW.

In this present study, pharmacies having proper facilities of infrastructures had practice pharmaceutical waste management in proper way in comparison with the pharmacies that doesn't have adequate infrastructure. Pharmacies alone cannot be able to have access of various infrastructures. So government should develop policy for the adequate availability of infrastructures in cooperation with municipality and other stakeholders. The availability of infrastructures plays an important role in creating improved PWM so necessity of infrastructures should be take into account while opening new pharmacies and municipal level infrastructures should also be introduced to treat PW separately in large scale.

E. Limitations of the study

Some factors had created obstacles on the study to achieve its required objectives. The study fails to get required functional list of retailer pharmacies. So, sometimes the randomly selected pharmacies were wholesaler or non-functional. Some pharmacy managers were unavailable during the data collection period while a few others declined to take part, a factor which may have caused selection bias, possibly affecting the representativeness of the final sample. Some pharmacies were closed during the duration of data collection. Mostly rural municipalities' pharmacies were not registered in NCDA and DDA so they were unable to include in the study which may create problem in generalization of the study results. Similarly, it is possible that the potential participants who declined to take part were more likely to have inadequate knowledge of PWM, poor practice of PWM or r both.

V. CONCLUSION AND RECOMMENDATIONS

❖ *Conclusion*

The results showed that there was insufficient knowledge and practices of pharmaceutical waste management by the community pharmacists. Only 59% of pharmacist had adequate knowledge and practices of waste management. The findings showed that knowledge on PWM had strong association with its practices.

Knowledge of PWM was associated with the level of schooling and continuous medical measures education of respondents. Level of knowledge and practices were strongly associated with each other which clarifies that respondents who had adequate knowledge on PWM had adequate practices of PWM.

Practices of PWM was associated with the main characteristics of pharmacist`s qualification which were pharmacy training status and continuous medical measures education status. Also it was found associated with the level of schooling of the respondent`s. Most of the pharmacies around 94.6% practices returning or take back system of expired pharmaceuticals and also improper methods of PW disposal such as discarding with municipal waste or through informal waste collectors like scrap purchasers (Kabadis)were being practiced in some pharmacies.

The disposal infrastructure like color coded PW collecting containers, small incinerator, was also absence in most of the pharmacies. Only 15% of pharmacies had their own sharps incinerator in their own premises. About 15% respondents reported that they had their own private burial pit but their pit was absence of fence and liner. Color coded and labeling method of segregation was also absent in 70% of the pharmacies. Most of the pharmacists didn't have documented guidelines of pharmaceutical waste management and also unaware about that aspects. So, infrastructures like incinerator, burial pit (with liner and fence), sanitary landfill site for medical waste disposal, medical waste collecting vehicles are necessary in municipal level.

In conclusion, the practices of PWM is not satisfactory in the Kaski district .It can be considered as public health and environmental health issues because the poor practices may lead to the negative impact on the environment and public health . So, quality of practice of PWM should be

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improved by improving the knowledge of PWM among community pharmacists, adequate access of PW disposal infrastructure inside and outside the pharmacy premises and providing effective guidelines for PWM in proper way.

❖ *Recommendations*

The DDA should enhance law enforcement to ensure that only suitably qualified pharmacists can work in the pharmacy business. Mostly pharmacy owner recruit employee who were untrained in pharmacy profession and some of them were unaware about dispensing of medicines. So periodic inspection and supervision should be done by the DDA and environmental organizations on these issues. The professional association should also be equally responsible for carrying out this activities.DDA had previously developed "Good pharmacy practice policy" which should be periodically updated according to the increasing standard of health facilities. Government should emphasize in the development of infrastructures like incinerator, burial place (with liner and fence) and other large scale disposal infrastructures. The NCDA and DDA should provide ways of encouraging suitably qualified pharmacy managers for improving learning opportunities for them. Secondly, they should focus to organize CMME with PWM content for their members on a regular basis. Recently on September 2017, DDA had developed draft guidelines for the proper pharmaceutical waste management in Nepal with the coordination from the WHO guidelines standard. So, it is recommended that the guidelines should be enact as possible as sooner for eliminating the different issues/challenges which were existed in pharmaceutical waste management. Government should encourage national study or research to demonstrate the magnitude of improper pharmaceutical waste management throughout the country. Comparative research study should be carried out between private and public pharmacies and health facilities for updating and reforming the guidelines and policies regarding PWM.

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REFRENCES

[1]. World Health Organization, International Pharmaceutical Association, International Solid Waste Association, UNICEF. Guidelines for safe disposal of unwanted pharmaceuticals in and after emergencies. 1999.
[2]. Fram MS, Belitz K. Occurrence and concentrations of pharmaceutical compounds in groundwater used for public drinking-water supply in California. Science of the Total Environment. 2011;409(18):3409-17.
[3]. Bound JP, Voulvoulis N. Household disposal of pharmaceuticals as a pathway for aquatic contamination in the United Kingdom. Environmental health perspectives. 2005:1705-11.
[4]. White JR, Belmont MA, Metcalfe CD. Pharmaceutical compounds in wastewater: wetland treatment as a potential solution. The scientific world journal. 2006;6:1731-6.
[5]. Kadam A, Patil S, Patil S, Tumkur A. Pharmaceutical Waste Management An Overview. Indian Journal of Pharmacy Practice. 2016;9(1):3.
[6]. Nipa N, Ahmed S, Shahariar M, Rahman M, Haider B. Improper Management of Pharmaceutical Waste in South and South-East Asian Regions. J Environ Stud. 2017;3(1):7.
[7]. Glassmeyer ST, Furlong ET, Kolpin DW, Cahill JD, Zaugg SD, Werner SL, et al. Transport of chemical and microbial compounds from known wastewater discharges: potential for use as indicators of human fecal contamination. Environmental science & technology. 2005;39(14):5157-69.

[8]. Wu M, Atchley D, Greer L, Janssen S, Rosenberg D, Sass J. Dosed without prescription: preventing pharmaceutical contamination of our nation's drinking water. Natural Resources Defense Council White Paper. 2009;60.
[9]. Bruce GM, Pleus RC, Snyder SA. Toxicological relevance of pharmaceuticals in drinking water. Environmental science & technology. 2010;44(14):5619-26.
[10]. Kolpin DW, Furlong ET, Meyer MT, Thurman EM, Zaugg SD, Barber LB, et al. Pharmaceuticals, hormones, and other organic wastewater contaminants in US streams, 1999− 2000: A national reconnaissance. Environmental science & technology. 2002;36(6):1202-11.
[11]. Benotti MJ, Brownawell BJ. Microbial degradation of pharmaceuticals in estuarine and coastal seawater. Environmental Pollution. 2009;157(3):994-1002.
[12]. Gyawali S, Rathore DS, Adhikari K, Shankar PR, KC VK, Basnet S. Pharmacy practice and injection use in community pharmacies in Pokhara city, Western Nepal. BMC health services research. 2014;14(1):190.
[13]. WHO. Management of waste from injection activities at the district level: guidelines for district health managers. 2006.
[14]. Pruss A, Emmanuel J, Rushbrook P, Zghondi R, Stringer R, Pieper U, et al. Safe management of wastes from health-care activities. Geneva, Switzerland: WHO Press, World Health Organization; 2013.
[15]. Disposal of unused medicines: What you should know.http://www.fda.gov/drugs/resourcesforyou/consumers/buyingusingmedicinesafely/ensuringsafeuseofmedicine/safedisposalofmedicines/ucm186187.htm.
[16]. WHO. Aide-Memoire for a national strategy for health-care waste management. Available from: http://who.int/occupational_health/activities/2amhcw_en.pdf.
[17]. Tong AYC, Peake BM, Braund R. Disposal practices for unused medications in New Zealand community pharmacies. J Prim Health Care. 2011;3.
[18]. Return unwanted medicines (The RUM project). Available from: http://www.returnmed.com.au/.
[19]. National Health Care Waste Management Guidelines [cited 2017 September 9]. Available from: http://nhrc.org.np/wp-content/uploads/2017/02/National-Health-Care-Waste-Management-Guidelines.pdf.
[20]. A Rapid assessment study on health care waste management in Nepal [cited 2017 September 9]. Available from: http://library.nhrc.gov.np:8080/nhrc/handle/123456789/166.
[21]. Solid waste management Act 2011. Available from: http://swmtsc.gov.np/sites/default/files/news/Solid%20Waste%20Management%20Act,%202011%20(English)_1.pdf.
[22]. Department of Drug Administration(Nepal). Draft of National Guideline for Pharmaceutical Waste Management. 2017.
[23]. Crane M, Watts C, Boucard T. Chronic aquatic environmental risks from exposure to human pharmaceuticals. Science of the total environment. 2006;367(1):23-41.
[24]. Quinn B, Gagné F, Blaise C. An investigation into the acute and chronic toxicity of eleven pharmaceuticals (and their solvents) found in wastewater effluent on the cnidarian, Hydra attenuata. Science of the total environment. 2008;389(2):306-14.
[25]. Gaworecki KM, Klaine SJ. Behavioral and biochemical responses of hybrid striped bass during and after fluoxetine exposure. Aquatic Toxicology. 2008;88(4):207-13.
[26]. Stanley JK, Ramirez AJ, Chambliss CK, Brooks BW. Enantiospecific sublethal effects of the antidepressant fluoxetine to a model aquatic vertebrate and invertebrate. Chemosphere. 2007;69(1):9-16.
[27]. Brooks BW, Turner PK, Stanley JK, Weston JJ, Glidewell EA, Foran CM, et al. Waterborne and sediment toxicity of fluoxetine to select organisms. Chemosphere. 2003;52(1):135-42.
[28]. Nentwig G. Effects of pharmaceuticals on aquatic invertebrates. Part II: The antidepressant drug fluoxetine. Archives of environmental contamination and toxicology. 2007;52(2):163-70.
[29]. Pomati F, Castiglioni S, Zuccato E, Fanelli R, Vigetti D, Rossetti C, et al. Effects of a complex mixture of therapeutic drugs at environmental levels on human embryonic cells. Environmental science & technology. 2006;40(7):2442-7.
[30]. Sanderson H, Johnson DJ, Reitsma T, Brain RA, Wilson CJ, Solomon KR. Ranking and prioritization of environmental risks of pharmaceuticals in surface waters. Regulatory toxicology and pharmacology. 2004;39(2):158-83.
[31]. Patneedi CB, Prasadu KD. Impact of pharmaceutical wastes on human life and environment. Rasayan Journal of Chemistry. 2015;8(1):67-70.
[32]. Product list of active pharmaceutical ingredients (API) Mumbai,India: Unimark Remedies Pvt.Ltd; 2017. Available from: http://www.unimarkremedies.com/PRODUCT%20LIST.pdf.
[33]. O.A.H. Jones NV,J.N. Lester. Human Pharmaceuticals in the Aquatic Environment a Review. Environment Technology 2001;22(12):1383-94.
[34]. Twinch E. Medical waste management. International committee of the Red Cross (ICRC), Geneva, Switzerland. 2011.
[35]. Mugumura JR. A situational analysis On pharmaceutical Waste management in Nairobi county, Kenya: University of Nairobi; 2015.
[36]. Abahussain E, Waheedi M, Koshy S. Practice, awareness and opinion of pharmacists toward disposal of unwanted medications in Kuwait. Saudi Pharmaceutical Journal. 2012;20(3):195-201.
[37]. Aslam N, Bushra R, Khan MU. Community pharmacy practice in Pakistan. Archives of pharmacy practice. 2012;3(4):297.

ISSN No:-2456-2165

[38]. Khojah HM, Pallos H, Tsuboi H, Yoshida N, Abou-Auda HS, Kimura K. Adherence of Community Pharmacies in Riyadh, Saudi Arabia, to Optimal Conditions for Keeping and Selling Good-Quality Medicines. Pharmacology & Pharmacy. 2013;4(05):431.
[39]. Jarvis CI, Seed SM, Silva M, Sullivan KM. Educational campaign for proper medication disposal. Journal of the American Pharmacists Association. 2009;49(1):65-8.
[40]. 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.
[41]. Matiko D. Managing disposal of unwanted pharmaceuticals at health facilities in Tanzania: A case of Dar es Salaam region public health facilities: Muhimbili University of Health and Allied Sciences; 2011.
[42]. Bellan N, Pinto TdJA, Kaneko TM, Moretto LD, Santos Junior Nd. Critical analysis of the regulations regarding the disposal of medication waste. Brazilian Journal of Pharmaceutical Sciences. 2012;48(3):507-18.

APPENDICES

Appendix I: Map of study area (Kaski District, Nepal)

Appendix II: Ethical Approval

पोखरा विश्वविद्यालय
POKHARA UNIVERSITY
Kaski, Nepal

चलानी नं. /Ref.No. 87/074175

10/23/2017

Mr. Eknaran Paudel
Principal Investigator
School of Health and Allied Sciences
Faculty of Health Sciences
Pokhara University

Ref: **Ethical Approval of Research Proposal** entitled ***"Pharmaceutical waste management in Private Pharmacies of Kaski District"***

Dear Mr. Eknaran Paudel

It is my pleasure to inform you that the above mentioned proposal has been approved by Pokhara University Research Center (PURC) and Institutional Review Committee (IRC).

As per IRC rules and regulations, the investigator has to strictly follow the protocol mentioned in the proposal. Any change in objective(s), problem statement, research questioner hypothesis methodology, implementation procedure, data management and budget that may be necessary in course of the implementation of the research proposal can only be made so and implemented after prior approval from this center. Thus, it is compulsory to submit the detail of such changes intended or desired with justification prior to actual change in the protocol.

Further, the researchers are directed to strictly abide by the IRC during the implementation of their research proposal and submit progress report and full copy of summary report upon completion.

If you have any questions, please contact the IRC Section at PURC.

Thank You.

GMKhan

Associate Professor Gulam Muhammad Khan
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URL: www.pu.edu.np Tel.:+977-61-560639/561046, +977-01-4486905, Fax: +977-61-561047/560392

Appendix III: Certificate from Pokhara University Research Centre

पोखरा विश्वविद्यालय
POKHARA UNIVERSITY
Kaski, Nepal

चलानी नं.:/Ref. No.

Research Center

Friday, January 26, 2018

To whom it may concern

This is to certify that ***Mr. Eknaran Paudel*** has submitted the hard copy/soft copy of the project work/thesis entitled ***"Pharmaceutical Waste Management in Private Pharmacies of Kaski District, Nepal"*** to the Institutional Review Committee (IRC) of Pokhara University Research Centre (PURC).

The project work/thesis work was conducted with the ethical approval of Institutional Review Committee (IRC) of Pokhara University Research Centre (PURC) and the work was conducted fulfilling all the prescribed requirements.

Thanking You.

.....

Associate Professor Gulam Muhammad Khan
Executive Director Pokhara University Research Centre (PURC)
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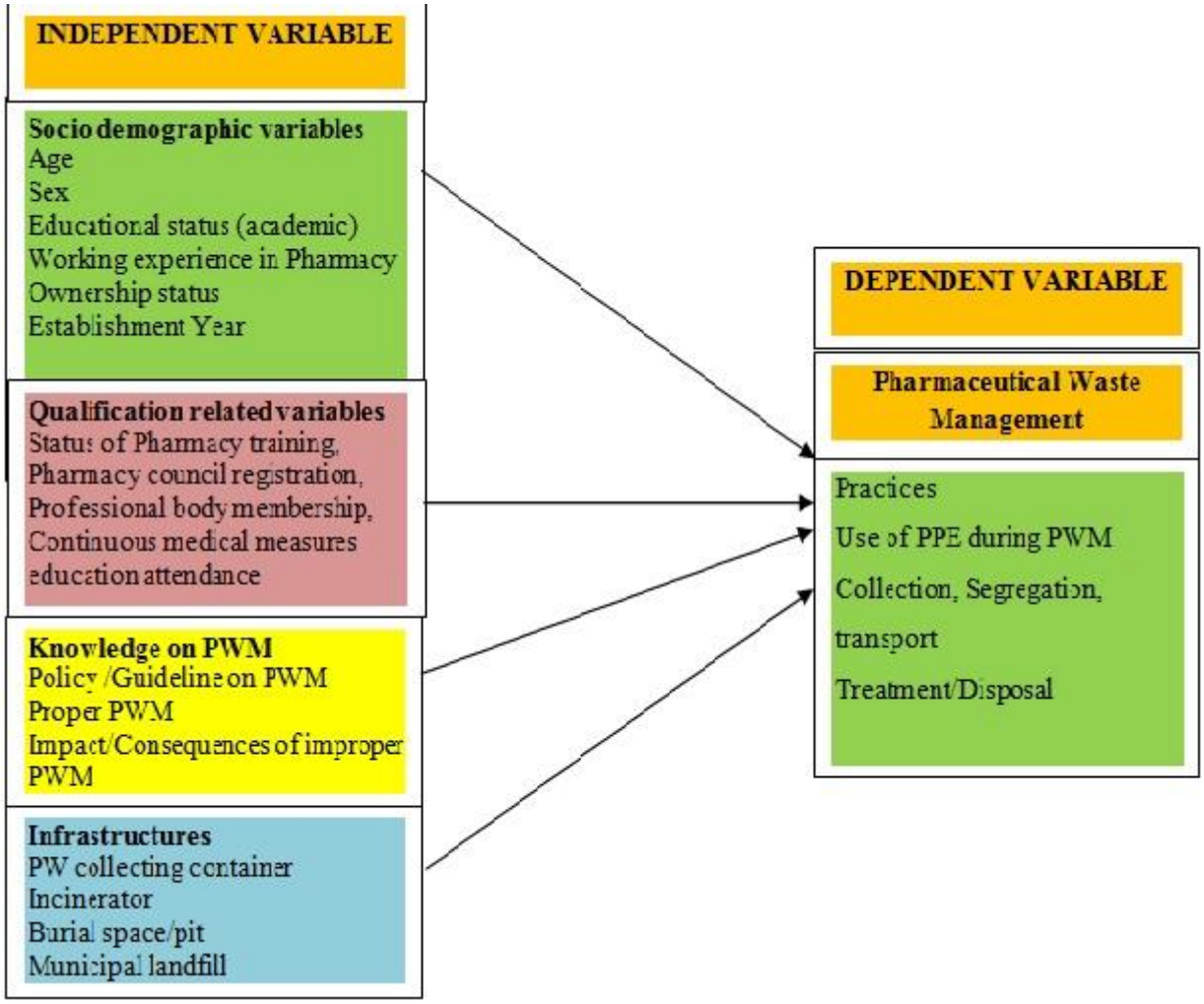
Appendix IV: Conceptual Framework



Conceptual Framework

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Appendix V: Pictures taken during research period

Improper collection and segregration of wastes

Few pharmacies have practices of using electric needle cutter for syringes disposal

Data Collection Period