ASSESSMENT OF KNOWLEDGE, ATTITUDE AND PRACTICE REGARDING THE PROPER STORAGE OF MEDICINES AND DISPOSAL OF EXPIRED MEDICATIONS AMONG COMMUNITY PHARMACIES

Dr. Apoorva Dev. M[1], Deepjoy Das[2], Chaudhary Vivek Rajesh[3], Mrs. Anusree M.[4]

Department of Pharmacy Practice, East West College of Pharmacy, Bengaluru, Karnataka, India

ABSTRACT

Proper drug storage is essential for maintaining the safety, efficacy, and quality of medications in community pharmacies. Drugs are sensitive to environmental factors like temperature, humidity, and light, which can lead to degradation. Additionally, the disposal of expired medications is critical for public health and environmental safety, yet community pharmacists often face challenges due to unclear guidelines and limited resources. There is a lack of understanding regarding pharmacists' knowledge and practices related to expired drug disposal, underscoring the need for improved training and access to disposal facilities. This study aims to assess community pharmacists' knowledge, attitudes, and practices regarding proper medicine storage and the disposal of expired medications, as well as to determine the prevalence of proper drug storage practices among them. A prospective questionnaire-based study was conducted among 399 community pharmacists in and around Bengaluru, Karnataka, who met the inclusion criteria. Consent was obtained from all participants, and a KAP (Knowledge, Attitude, and Practice) questionnaire was distributed. Information leaflets on proper drug storage and safe disposal of expired medicines were provided. Data analysis was performed using SPSS version 27.

The study found significant gaps in knowledge and practices among community pharmacists, impacting patient safety and quality of care. Only 42.4% (n = 169) had average knowledge. Regarding attitudes, 47.9% (n = 191) had average attitudes and for practice, only 35.6% (n = 142) demonstrated average practices. Additionally, 48.4% (n = 193) reported storing medications appropriately, compared to 51.6% (n = 206) who did not.The study shows that many pharmacies do not follow GPP guidelines. To improve awareness of safe disposal techniques and proper medication storage, appropriate health education programs should be implemented. By organizing educational initiatives and providing training, we can enhance safe drug disposal practices, promote proper storage, and ultimately improve patient safety, medication efficacy, and pharmacists' compliance with regulations.

Keywords: Proper storage, disposal practice, expired medicines, community pharmacist

1. INTRODUCTION:

Pharmacy practice in India began during British rule, mainly as a business. Early practitioners were called dispensers or compounders, often unregulated. After independence, the Pharmacy Act of 1948 required pharmacists to be registered, with a D. Pharm or B. Pharm qualification. Despite regulations, many community pharmacies operate without qualified pharmacists, leading to poor practices, especially in drug storage.

Why Proper Storage Matters

- Maintains **drug safety, potency, and effectiveness**
- Prevents **contamination, spoilage, and health risks**

Storage Guidelines

- **Label** all medicines properly
- Maintain **correct temperature** and **humidity**
- Keep **controlled drugs** securely locked
- **Dispose** expired drugs safely

Key Issues

- Lack of trained staff
- Low enforcement of laws
- Poor infrastructure

Solutions

- Better training
- Regular inspections
- Encouraging professional ownership of pharmacies[1]

A pharmacy's storage is crucial for several reasons. First and foremost, all medications need to be kept between 36°F (2°C) and 140°F (60°C). This guarantees their stability and prevents them from deteriorating. Second, the relative humidity in pharmacies needs to be kept between 40% and 80%. This keeps moisture from accumulating inside the capsules or bottles, which could cause harm or spoiling. Thirdly, every medication needs to have a unique label that details its particular storage needs. The label should read Refrigerated next to the name of any medication that needs special refrigeration. Moisture Controlled should appear on the label next to the name of any medication that requires regulated humidity levels. Fourth, in order to appropriately dispose of products without endangering patient safety, pharmacists need to keep track of when they expire. Fifth, and perhaps most crucially, pharmacies need to have a well-organised system in place for storing their products so that they are easily accessible when needed[2].

Maintaining the safety, effectiveness, and quality of pharmaceuticals depends heavily on proper drug storage, which is an essential part of pharmaceutical care. As the main point of contact for patients, community pharmacies have a big part to play in making sure that medications are maintained according to rules and regulations. Suboptimal storage procedures,

however, might jeopardise drug stability, resulting in decreased potency, contamination, and perhaps dangerous patient outcomes.
The importance of proper drug storage cannot be overstated. Drugs are sensitive to environmental factors such as temperature, humidity, light, and physical stress, which can cause degradation, oxidation, hydrolysis, or other chemical reactions.

Improper storage can lead to:

2. Reduced efficacy: Decreased potency or effectiveness of medications.
3. Increased toxicity: Formation of toxic compounds or degradation products.
4. Contamination: Introduction of microorganisms, particles, or other substances.
5. Patient harm: Adverse reactions, treatment failures, or even fatalities.

Community pharmacists, as the custodians of drug storage, must possess the knowledge, attitude, and skills necessary to maintain optimal storage conditions. However, various factors can influence their ability to do so, including:

1. Lack of awareness: Insufficient knowledge about proper storage guidelines and regulations.
2. Inadequate training: Limited education or training on drug storage best practices.
3. Resource constraints: Inadequate facilities, equipment, or staffing.
4. Complacency: Overfamiliarity or lack of attention to storage details[3].

The project will investigate the types of expired medications disposed of, the disposal procedures, and the variables affecting disposal practices in community pharmacies. Through an analysis of community chemists' knowledge, attitudes, and behaviours around the disposal of expired medications, this study will pinpoint areas in need of improvement and guide the creation of focused interventions to encourage secure and ecologically responsible disposal methods.
Public health organisations, regulatory bodies, and community pharmacies will all be significantly impacted by the study's conclusions. We can lower the dangers associated with inappropriate disposal and create a safer and healthier environment by enhancing community chemists' understanding, attitudes, and practices around the disposal of expired drugs. Furthermore, this study will help create evidence-based policies and procedures for disposing of outdated medications, eventually safeguarding the environment and public health. In the end, our research will help create a medication management strategy in community pharmacies that is safer, more accountable, and more successful.

2. MATERIALS AND METHODS:

2.1 Study design:

A Prospective questionnaire-based study.

2.2 Place of study:

Community pharmacies of different areas of Bengaluru.

2.3. Study criteria:

a. Inclusion criteria:

- Pharmacists who were willing to participate and share information.
- Pharmacies that were licensed and registered with the relevant regulatory authorities.

b. Exclusion criteria:

- Pharmacists and pharmacy staffs who were not willing to participate or not provide information consent.
- Pharmacists who were not directly involved in dispensing medications (e.g., administrative staff).
- Pharmacies with limited staff, where participation in this study would have been time-consuming.

2.4 Sample size calculation:

Slovin's Formula:

$$n = \frac{N}{1 + Ne^2}$$

Where,
n = sample size
N = Population size (8000)
e = Margin of error (0.05)
Here, after substituting the N and e value in the above formula, the estimated sample size was found to be 380.

2.5. Materials:

- KAP Questionnaire
- Informed Consent form
- Participant Information Leaflet

2.6. Study procedure:

Following approval from the institutional ethics committee, a prospective questionnaire-based study was conducted in Bengaluru from May 2024 to October 2024, involving 399 participants. The self-designed questionnaire was prepared comprising 26 questions categorized into Sociodemographic (2), Knowledge (5), Attitude (5), Practice (8) and prevalence on proper Storage (6) sections and validated through face value and expert opinions. Underwent pretesting on ten participants.

The leaflet was created following a standard format and validated through process of face validation, content validation and readability scoring by field experts. The BALD criteria scored 24 for English version, 20 for Kannada version and the SMOG readability score was 18.01 and 16.02 for Flesch Reading-ease (FRE) and Flesch-Kincaid Grade level (FKGL) respectively, ensuring its effectiveness.

Survey forms were distributed across diverse community pharmacies in all areas of Bengaluru, accompanied by an attached informed consent form explaining the study objectives and assuring confidentiality to promote impartial responses, with consent provided. Filled survey forms were received and subsequently, participants were provided with a pre-designed and validated informative leaflet to update their knowledge.

This comprehensive approach, involving ethical considerations, rigorous questionnaire construction and validation processes, underscores the methodological robustness of the study conducted in the specified timeframe and location.

2.7 Statistical Analysis:

To describe data, frequency and percentage tables were used. Simple bar graphs and pie charts were utilized to present results. Chi-square test was used to determine the association between age and education qualifications to knowledge, attitude, and practice respectively. Additionally, the analysis of variance test (ANOVA-test) was employed to examine mean differences across different age intervals. Throughout these analyses, a 5% significance level was assumed, and the tests were conducted with an 80% power level.

2.8 Duration of the study:

The study was carried out for a duration of six months.

3. RESULTS AND DISCUSSION:

SOCIO-DEMOGRAPHICS

Table 1: Distribution of subjects according to age groups

Age groups	Frequency in no.	Percentage (%)
< 30 years	192	48.1
30-40 years	134	33.6
40-50 years	57	14.3
> 50 years	16	4.0
Total	**399**	**100.0**

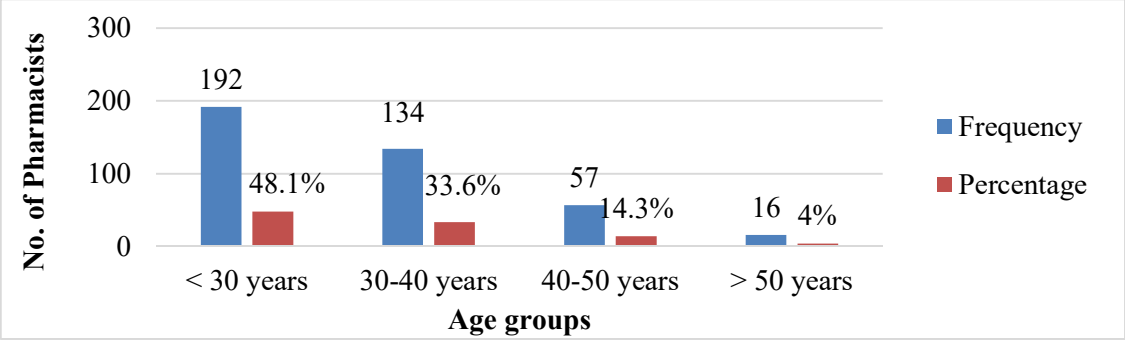

Figure 1: Distribution of subjects according to age groups

For age of participants, the majority 48.1% (n=192) were between the age of <30 years and 33.6% (n=134) were in the age group of 30-40 years and 14.3% (n=16) were in the age group of 40-50 years and 4% (n=16) were in the age group of >50 years

Table 2: Distribution of subjects according to Education Qualifications

Education Qualifications	Frequency in no.	Percentage (%)
D. Pharmacy	151	37.8

B. Pharmacy	248	62.2
M. Pharm	0	0
Pharm. D	0	0
Total	**399**	**100.0**

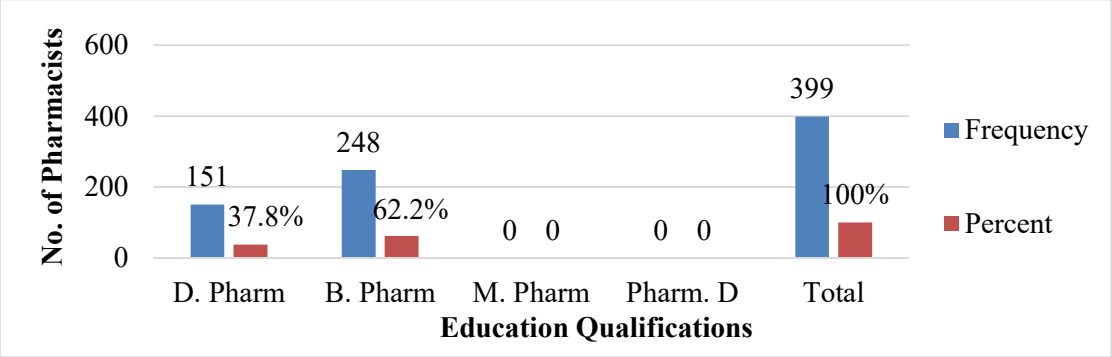

Figure 2: Distribution of subjects according to Education Qualifications

Out of 399 pharmacists, the majority was B. Pharm with 62.2% (n=248), D. Pharma 37.8% (n=151).

KNOWLEDGE, ATTITUDE, AND PRACTICE:

Table 3: The following table shows the overall knowledge assessment among study participants.

Knowledge	Frequency in no.	Percentage (%)
Below Average	230	57.6
Above Average	169	42.4
Total	**399**	**100.0**

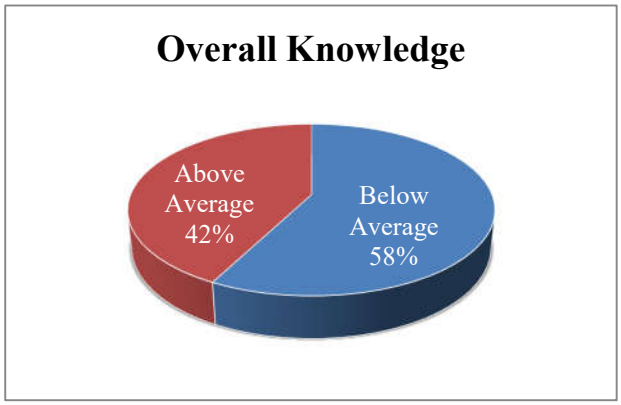

Figure 3: The overall knowledge assessment among study participants.

Out of 399 pharmacists, 42.4%(n=169) had above average knowledge out of all knowledge questions remaining 57.6% (n = 230) had below average knowledge out of all knowledge questions.

Table 4: The following table provides the knowledge assessment done in various age groups.

Age groups	Knowledge		Total
	Below Average	Above Average	
< 30 years	88	104	192
	45.8%	54.2%	100.0%
30-40 years	75	59	134
	56.0%	44.0%	100.0%
40-50 years	51	6	57
	89.5%	10.5%	100.0%
> 50 years	16	0	16
	100.0%	0.0%	100.0%
Total	**230**	**169**	**399**
	57.6%	**42.4%**	**100.0%**
chi-square statistic = 46.532, p-value<0.001 (significant association)			

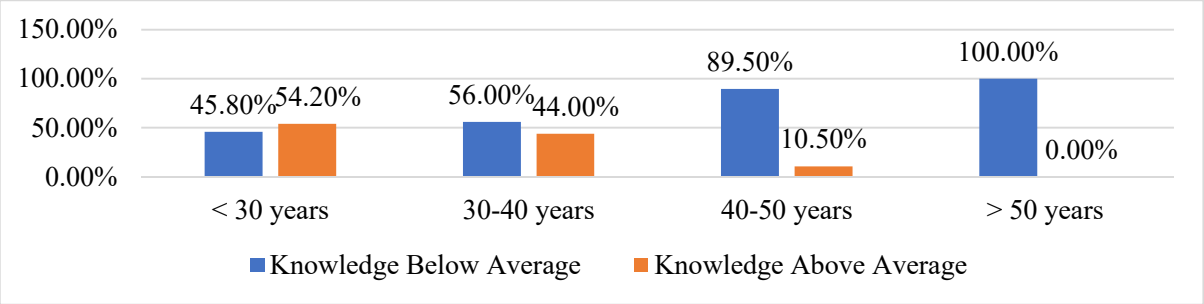

Figure 4: The knowledge assessment done in various age groups

From the distribution of subjects according to knowledge based on age, the age < 30 years had an above average knowledge of 54.2% (n=104) and below average knowledge of 45.8% (n=88) and age group between 30-40 years had an above average knowledge of 44% (n=59) and below average knowledge of 56% (n=75) and age group between 40-50 years had an above average knowledge of 10.5% (n=6) and below average knowledge 89.5% (n=51) and age group more than 50 years had an above average knowledge of 0% (n=0) and below average knowledge of 100% (n=16).

Table 5 The following table provides the knowledge assessment done in various Education Qualifications.

Education Qualification	Knowledge		Total
	Below Average	Above Average	
D. Pharmacy	105	46	151
	69.5%	30.5%	100.0%
B. Pharmacy	125	123	248
	50.4%	49.6%	100.0%
Total	230	169	399
	57.6%	42.4%	100.0%
chi-square statistic = 14.072, p-value<0.001 (significant association)			

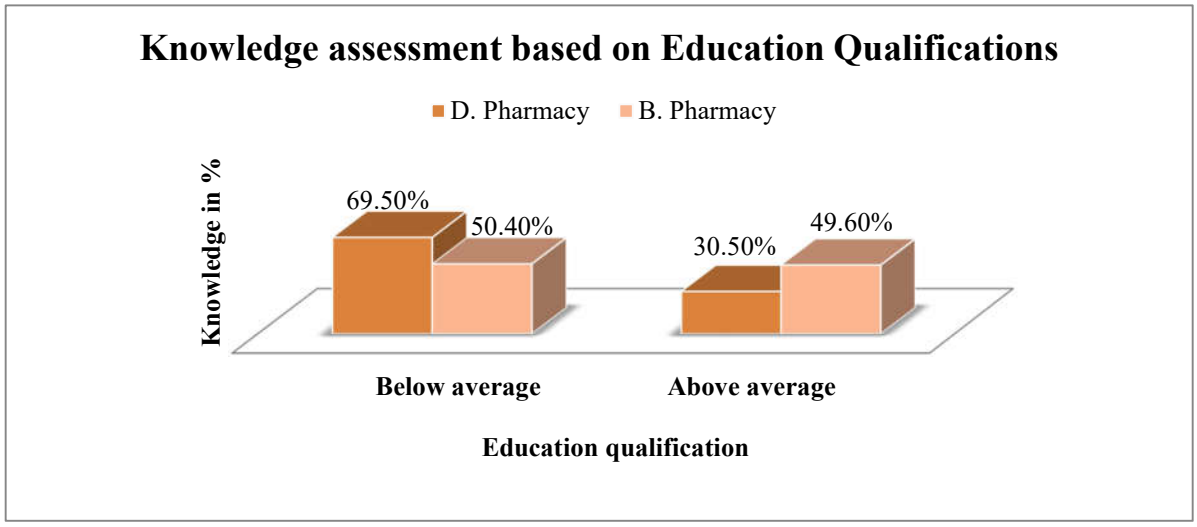

Figure 5: The knowledge assessment done among various qualifications.

From the distribution of subjects according to knowledge based on Education Qualification, D. Pharma had an above average knowledge of 30.5% (n=46) and below average knowledge of 69.5% (n=105) and B. Pharma had an above average knowledge of 49.6% (n=123) and below average knowledge of 50.4% (n=125).

Table 6: The following table shows the overall attitude assessment among study participants.

Attitude	Frequency in no.	Percentage (%)
Below Average	208	52.1
Above Average	191	47.9
Total	**399**	**100.0**

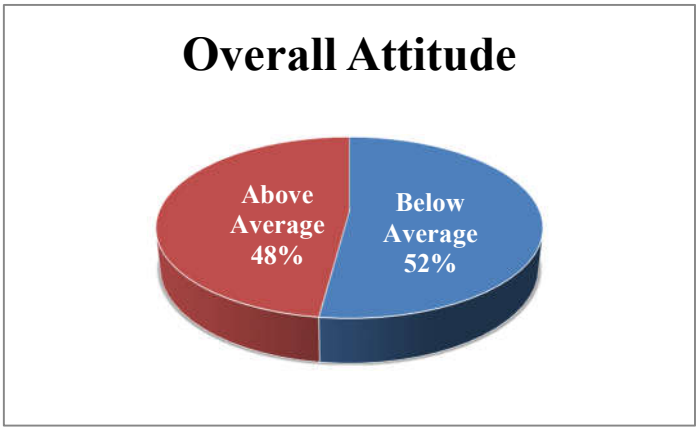

Figure 6: The overall attitude assessment among study participants.

Out of 399 pharmacists, 47.9% (n=191) had above average attitude out of all attitude questions, remaning 52.1% (n = 208) had below average attitude out of all attitude questions.

Table 7: The following table provides the attitude assessment done in various age groups

Age groups	Attitude		Total
	Below Average	Above Average	
< 30 years	111	81	192
	57.8%	42.2%	100.0%
30-40 years	44	90	134
	32.8%	67.2%	100.0%
40-50 years	37	20	57
	64.9%	35.1%	100.0%
> 50 years	16	0	16
	100.0%	0.0%	100.0%
Total	208	191	399
	52.1%	47.9%	100.0%
chi-square statistic = 40.899, p-value<0.001 (significant association)			

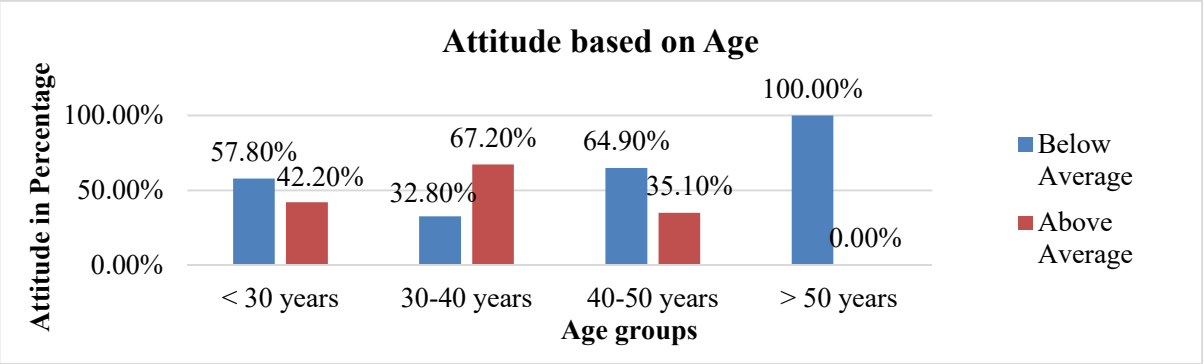

Figure 7: The attitude assessment done in various age groups.

From the distribution of subjects according to attitude based on age, the age < 30 years had an above average attitude of 42.2% (n=81) and below average attitude of 57.8% (n=111) and age group between 30-40 years had an above average attitude of 67.2% (n=90) and below average attitude of 32.8% (n=44) and age group between 40-50 years had an above average attitude of 35.1% (n=20) and below average attitude 64.9% (n=37) and age group more than 50 years had an above average attitude of 0.0% (n=0) and below average attitude of 100.0% (n=16).

Table 8: The following table provides the attitude assessment done among different Education Qualifications.

Education Qualification	Attitude		Total
	Below Average	Above Average	
D. Pharmacy	45	106	151
	29.8%	70.2%	100.0%
B. Pharmacy	163	85	248
	65.7%	34.3%	100.0%
Total	208	191	399
	52.1%	47.9%	100.0%
chi-square statistic = 48.538, p-value<0.001 (significant association)			

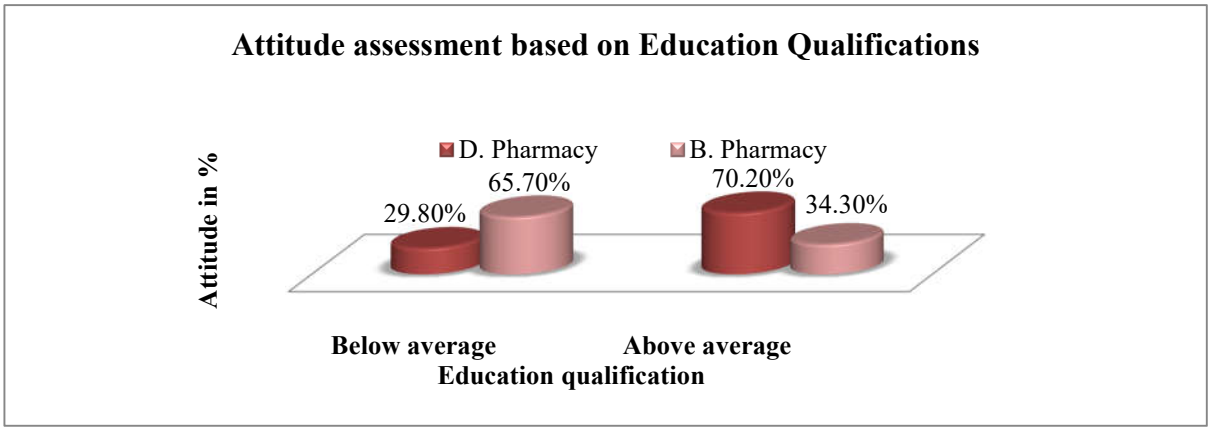

Figure 8: The attitude assessment done among different Education Qualifications.

From the distribution of subjects according to attitude based on Education Qualification, D. Pharm had an above average attitude of 70.2% (n=106) and below average attitude of 29.8% (n=45) and B. Pharma had an above average attitude of 34.3% (n=85) and below average attitude of 65.7% (n=163).

Table 9: The following table shows the overall practice assessment among study participants.

Practice	Frequency in no.	Percentage (%)
Below Average	257	64.4
Above Average	142	35.6
Total	**399**	**100.0**

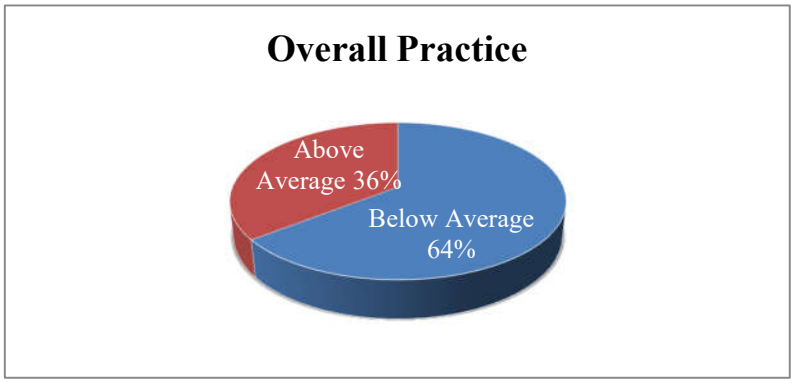

Figure 9: The overall Practice assessment among study participants.

Out of 399 pharmacists, only 35.6% (n=142) had above average practice out of all practice questions and remaning 64.4% (n = 275) had below average practice out of all practice questions.

Table 10: The following table provides the practice assessment done among different age groups.

Age groups	Practice		Total
	Below Average	Above Average	
< 30 years	113	79	192
	58.9%	41.1%	100.0%
30-40 years	114	20	134

	85.1%	14.9%	100.0%
40-50 years	14	43	57
	24.6%	75.4%	100.0%
> 50 years	16	0	16
	100.0%	0.0%	100.0%
Total	257	142	399
	64.4%	35.6%	100.0%
chi-square statistic = 75.873, p-value<0.001 (significant association)			

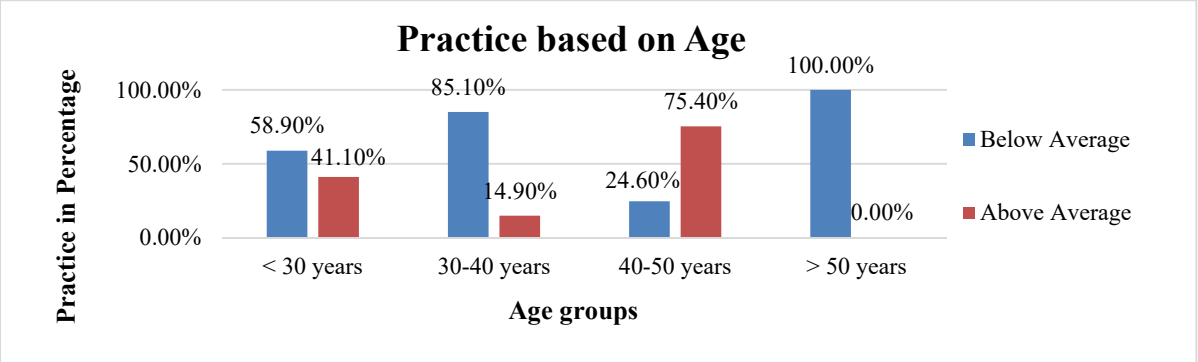

Figure 10: The practice assessment done among different age groups.

From the distribution of subjects according to practice based on age, the age < 30 years had an above average practice of 41.1% (n=79) and below average practice of 58.9% (n=113) and age group between 30-40 years had an above average practice of 14.9% (n=20) and below average practice of 85.1% (n=114) and age group between 40-50 years had an above average practice of 75.4% (n=43) and below average practice of 24.6% (n=14) and age group more than 50 years had an above average practice of 0.0% (n=0) and below average knowledge of 100% (n=16).

Table 11: The following table provides the practice assessment done among different Education Qualifications.

Education Qualification	Practice		Total
	Below Average	Above Average	
D. Pharmacy	110	41	151
	72.8%	27.2%	100.0%
B. Pharmacy	147	101	248
	59.3%	40.7%	100.0%
Total	257	142	399
	64.4%	35.6%	100.0%
chi-square statistic = 7.543, p-value<0.050 (significant association)			

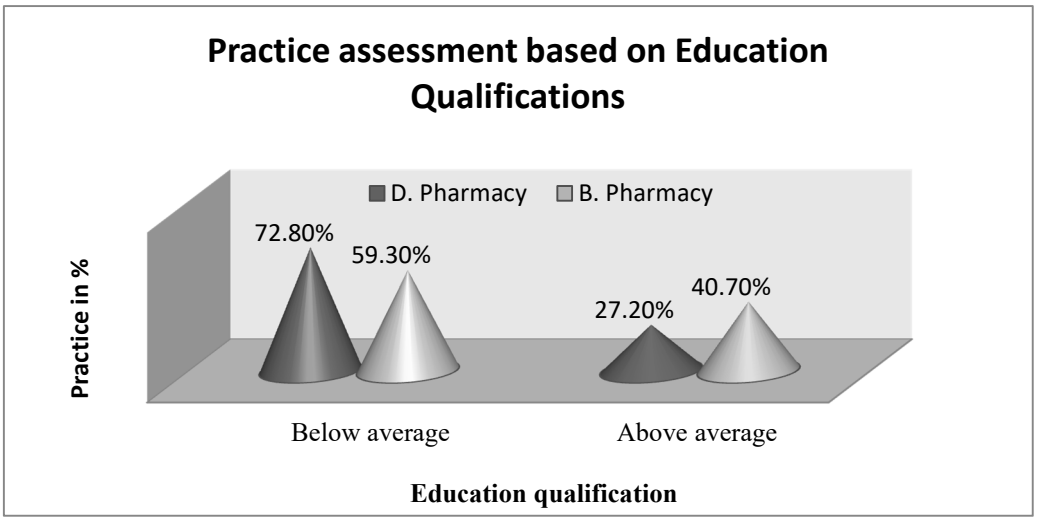

Figure 11: The practice assessment done among different Education Qualifications.

From the distribution of subjects according to practice based on Education Qualification, D. Pharm had an above average practice of 27.2% (n=41) and below average practice of 72.8% (n=110) and B. Pharm had an above average practice of 40.7% (n=101) and below average practice of 59.3% (n=147).

PREVALENCE ON PROPER DRUG STORAGE:

Table 12: The following table provides the overall Prevalence of proper drug storage.

Overall Prevalence	Frequency in no.	Percentage (%)
No Proper storage of drugs	206	51.6
Proper storage of drugs	193	48.4
Total	**399**	**100.0**

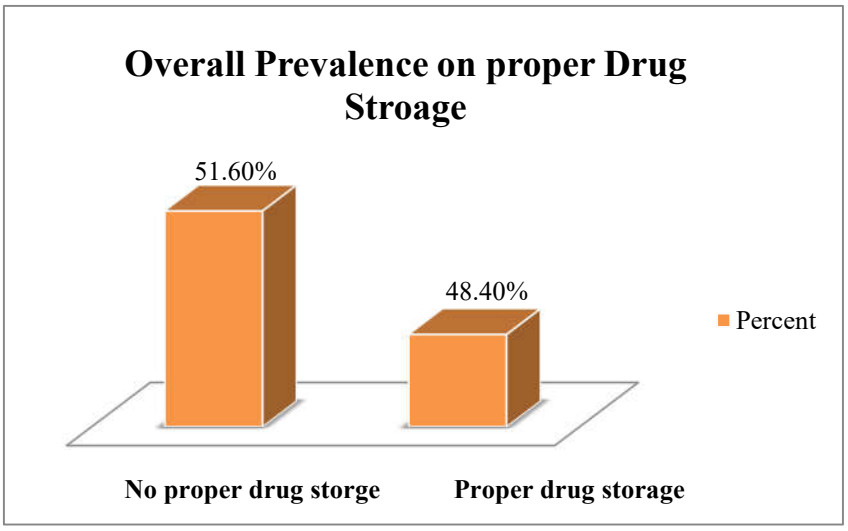

Figure 12: Overall Prevalence of proper drug storage.

Out of 399 participants, 48.4% (n=193) are storing drugs properly and remaining 51.6% (n=206) participants are not storing the drugs properly.

Table 13: The following table provides the overall prevalence on proper drug storage done among different age groups.

Age groups	Overall Prevalence		Total
	No Proper storage of drugs	**Proper storage of drugs**	
< 30 years	145	47	192
	75.5%	24.5%	100.0%
30-40 years	39	95	134
	29.1%	70.9%	100.0%
40-50 years	22	35	57
	38.6%	61.4%	100.0%
> 50 years	0	16	16
	0.0%	100.0%	100.0%
Total	**206**	**193**	**399**
	51.6%	**48.4%**	**100.0%**
chi-square statistic = 92.063, p-value<0.001 (significant association)			

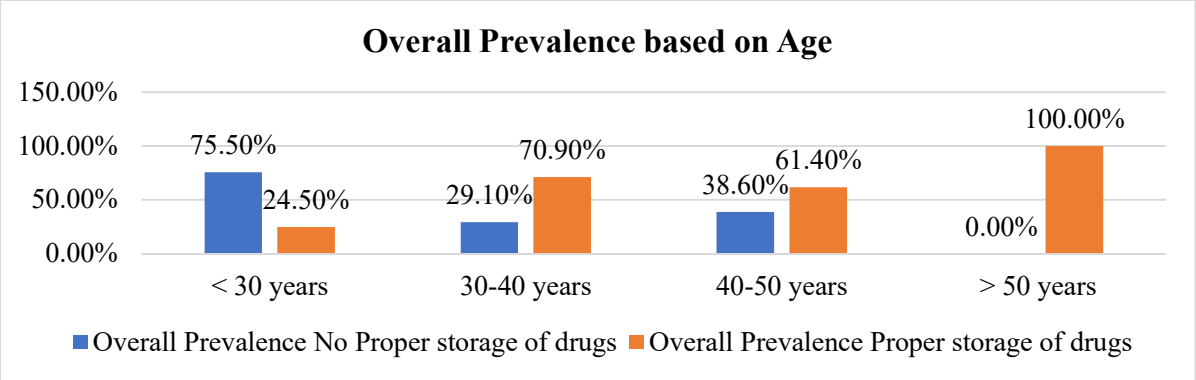

Figure 13: The overall prevalence on proper drug storage done among different age groups.

From the distribution of subjects according to practice based on age, the age < 30 years, 75.5% (n=145) are not storing drugs properly, 24.5% (n=47) are storing drugs properly and age group between 30-40 years, 29.1% (n=39) are not storing drugs properly, 70.9% (n=95) are storing drugs properly and age group between 40-50 years, 38.6% (n=22) are not storing drugs properly, 61.4% (n=35) are storing drugs properly and age group more than 50 years, 100% (n=16) participants are storing drugs properly.

Table 14: The following table provides the overall prevalence on proper drug storage done among different Education Qualifications.

Education Qualification	Overall Prevalence		Total
	No Proper storage of drugs	**Proper storage of drugs**	
D. Pharmacy	62	89	151

	41.1%	58.9%	100.0%
B. Pharmacy	144	104	248
	58.1%	41.9%	100.0%
Total	**206**	**193**	**399**
	51.6%	**48.4%**	**100.0%**
chi-square statistic = 10.867, p-value<0.001 (significant association)			

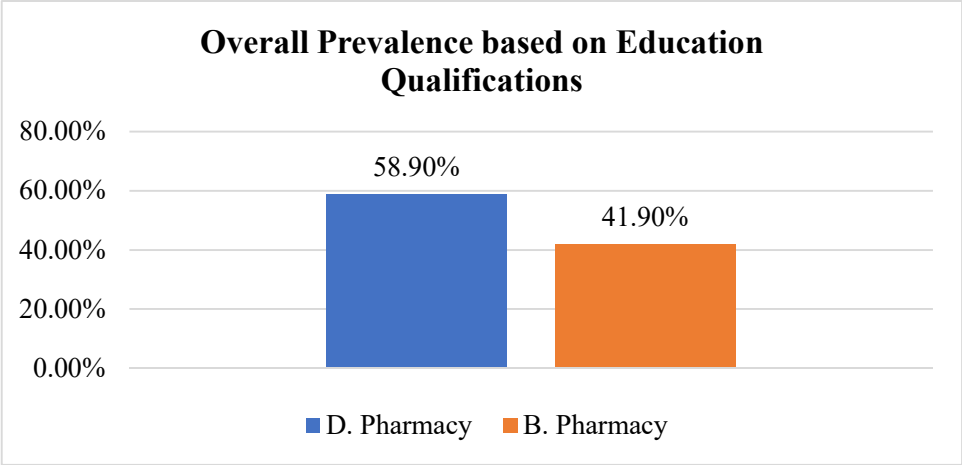

Figure 14: The overall prevalence on proper drug storage done among different Education Qualifications.

From the distribution of subjects based on Education Qualification, in D. pharm, 41.1% (n=62) participants are not storing drugs properly and remaining 58.9% (n=89) participants are storing drugs properly and in B. pharm, 58.1% (n=144) participants are not storing drugs properly and remaining 41.9% (n=104) participants are storing drugs properly.

Participant Information Leaflet (PIL)

Table 15: Panel of Expert Agreement on the items of the PIL

No. of Items	Items	No. in Agreement	Content Validity Index	Percentage (%)
1	Community Drug Drop Boxes	8	1	100
2	Do not flush medicines	8	1	100
3	Proper storage of medicines	8	1	100
4	Disposal of expired medicines	8	1	100
5	How to return to Source	6	0.75	75

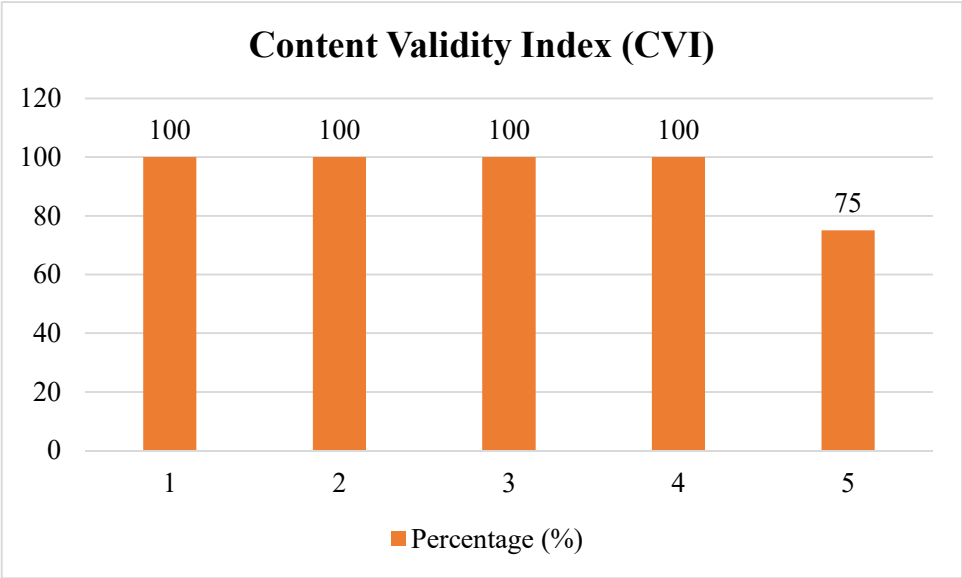

Figure 15: Panel of Expert Agreement on items of PIL

The above table no.16 shows that the frequency and percentage of the items on the participant information leaflet agreed by the experts for the evaluation of the content validity according to Lawshe's scale. CVI scores of item no. 5 was below 0.8 and hence were excluded form PIL.

Table 16: Information Leaflet Readability test score (Final Version)

Readability Tests	Sentences	Words	Syllables	Score	Grade
Flesch Reading-ease (FRE)	14	313	622	18.01	Graduate
Flesch-Kincaid Grade level (FK-GL)	14	313	622	16.02	College Graduate

Table no.16 represents the readability scores assessed using online readability calculator FRE and FK-GL. The best FRE score was above 18.01 and FK-GL score was 16.02.

Table 17: Design Characteristics of the PIL

	Values	
Design Characteristics	**English Version**	**Kannada Version**
Lines 50-89 mm long	1	1
Separation between lines	2	2
Lines Unjustified	1	1
Serif typeface	2	0
Type size	3	1
First line intended	1	1
Title lowercase	0	0
Italics	2	2
Positive advice	2	2
Headings standout	2	2
Numbers all Arabic	0	0
Boxed texts	1	1
Pictures	2	2
Number of colours	2	2
White space	0	0
Paper quality	3	3
Total	**24**	**20**

Table no. 17 represents the Baker able leaflet design (BALD) method used to assess the layout and design characteristics of the Information Leaflet. BALD index was 24 for English version, and 20 for Kannada version.

4. CONCLUSION:

The results of the study showed that participants' knowledge and behaviours were seriously lacking, which raises major concerns about patient safety and the general standard of care. Patient outcomes may suffer as a result of these gaps, which could result in improper medicine storage, insufficient disposal techniques, or a failure to understand the dangers of expired medications. For example, inadequate knowledge of appropriate storage conditions may cause medication deterioration, which may result in inefficient treatments or a higher risk of bad effects.

Inadequate instruction on proper disposal techniques may further increase environmental risks and community harm. Closing these gaps is essential to guaranteeing that medical personnel are prepared to uphold the highest standards of patient care quality and safety.
The significance of appropriate medicine storage and safe drug disposal procedures can be greatly increased by planning educational events and offering community chemists specialised training. With the help of these programs, chemists will be better prepared to handle drugs and make sure they are maintained in ways that preserve their safety and effectiveness. Furthermore, the course will address the legal and environmental requirements related to the disposal of drugs, enabling chemists to efficiently adhere to GPP rules. Patients will also gain from encouraging adherence to GPP laws, which will further solidify chemists' position as reliable healthcare professionals who protect the public from harm.

5. REFERENCE:

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