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## An Online Survey to Estimate the Knowledge, Attitude, and Practice among People in Odisha on Proper Drug Disposal Methods along with their Opinion on the Use of E-pharmacy and Drones as Future Dispensing Models for Medicines

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### ABSTRACT

**Background:** Utilizing and disposing of expired drugs improperly can adversely affect patients, healthcare systems, economy, and environment. Thus, creating awareness about it is highly necessary.

**Objectives:** Carry out an online survey to understand the knowledge, attitude, and practice among people of Odisha on proper drug utilization and its disposal along with their opinion on future dispensing models for medicines.

**Method:** A questionnaire was designed after determining the criteria to participate in this cross sectional study. The sample size was estimated to get 95% CI. The Chi-square test for independence was chosen to analyze: the relationship between education and drug disposal behavior; and the relationship between the number of unused and expired medications and the age of the participants. Data was collected by sharing the questionnaire link through G-Mail, LinkedIn, Whatsapp, and Instagram.

**Results:** 181 people (113 males and 68 females) completed the survey. 87.8% of participants agreed that improper drug disposal would damage human health and the environment. 65.8% agreed to share medication with others for similar symptoms. 66.2% disposed household unused and expired medications in the dustbin. 75.13% showed interest in having E-Pharmacy and drones as smart-medicine delivery technology systems. The study showed no relationship either between education and drug disposal behavior; or between the number of unused and expired medications and the age of the participants.

**Conclusion:** Participants lacked knowledge to use and dispose (expired) medications. Large-sample studies are required to get a clear picture of people's opinions on smart drug-dispensing models.

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### Introduction

Medicinal products have a significant impact on human and animal life. The ingredient that makes any substance a medicine is Active Pharmaceutical Ingredient (API). The API market is worth \$11806.93 million in financial year (FY) 2021 and will likely grow at a rate of 12.24% till FY 2027 [1]. Growth in API market is due to rise in lifestyle and chronic diseases; and rise in drug research and manufacturing units. More than a thousand tons of drugs are sold globally, both through prescription and over the counter (OTC) [2-4]. However, the number of medications

sold is not equal of medications consumed. Patients may not take all the medications they buy for multiple reasons such as early relief, change in treatment plan, hoarding or adverse event. As a result, a vast amount goes unused or expired [4,5]. The prevalence of unused home medication has dramatically increased in recent decades. Studies show that in Ethiopia, Kuwait, UK, and the USA expired medications have been disposed of in the garbage as the patients are unclear of how to dispose of the medications safely and correctly [8-11]. People generally dispose their medicinal waste in dustbin, open garbage, sewers, toilet flush. They end up in landfills, water supplies and drains that lead to rivers and seas. Traces of hormonal drugs, cytotoxic drugs, antibiotics, CNS drugs have been detected in soil, air, ground water and surface water [4,5,12]. Lack of knowledge in proper use and disposal of medicines result in an increase in pharmaceutical

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waste. These pharmaceutical wastes affect humans and environment. For example: (1) Improper disposal of antibiotics compromises their efficacy and increase their resistance either through horizontal gene transfer or by modifying targets [13]. (2) Population of white-backed vultures has decline from 2000-2003. The reason for 86% of death was kidney failure due to "diclofenac" present in the skins of livestock [14]. (3) Nash JP *et al.*, discovered that contraceptive pill (Ethinylestradiol), detected in water, and impaired the reproduction of the fish [14-16].

Thus, there is a lack of understanding and awareness among people on the outcomes of improper utilization of pharmaceuticals.

**AIM OF THE STUDY**

The aim of our study was to carry out an online survey to understand the knowledge, attitude, and practice among people of Odisha, India on proper drug utilization and its disposal along with their opinion on future dispensing models for medicines.

**METHODOLOGY**

**Target Population**

The target population for this study was the residents of the State Odisha living in any of its 30 districts with age ≥ 18.

**Inclusion Criteria**

The inclusion criteria to participate in the study include:

- Participants must be 18 years and above
- Participants should be literate in English or Odia
- Participants should be from Odisha or should have lived in Odisha for a period of not less than seven years
- Participants must have a valid Gmail Id and a Smartphone /Laptop/ Desktop/Tablet with Wi-Fi or internet access to participate in the survey.

**Determining the required sample size**

A sample of 150 was estimated taking standard deviation (SD) 0.5, allowable margin of error 8%, and Z-score 1.96 (95% Confidence Level) in the formula:

$$\text{Estimated Sample Size} = \frac{(Z\text{-score})^2 \times (SD \times (1\text{-SD}))}{(\text{Margin of error})^2}$$

**Study Design and Setting**

This was a cross-sectional study to understand the knowledge, attitude, and practices of proper drug utilization and disposal among the people of Odisha. The study collected the information on the knowledge and attitude of participants on properly utilizing medications and handling unused and expired medications. The study also collected the opinion of the participants on different future dispensing model for medicines.

With the help of Google Forms, 18 questions, in English and Odia language, were designed that suited the aim and objectives of the study. All participants had to digitally sign the consent form and had the option to withdraw if they please. The form was designed in such a manner that a person choosing English as a medium to respond the survey questions, will never stump upon Odia questions and vice-versa.

Hello! Welcome to the online survey. This survey is done to assess your knowledge, attitude, and practices on the safe disposal of unused and expired medications. Along with this, the survey will take your opinion on the use of F-Pharmacy and Drones as advanced technology in safe delivery of medications.

The results of this survey will be published as an article in a scientific journal. The title of the article will be "AN ONLINE SURVEY TO ESTIMATE THE KNOWLEDGE, ATTITUDE, and PRACTISE AMONG PEOPLE IN ODISHA ON PROPER DRUG DISPOSAL METHODS ALONG WITH THEIR OPINION ON THE USE OF E-PHARMACY AND DRONES AS FUTURE DISPENSING MODEL FOR MEDICINES."

Please be assured that this survey will not collect your name, email address, home address, mobile number, bank details, or any other social security information. Your identification will be anonymous. You need to be 18 years and above to participate in the survey.

This survey form contains 18 questions. Each question has multiple options. You are requested to answer every question and mark any one of the options against the particular question. Kindly answer the question honestly.

Please read the below paragraph to get a glimpse of the objective of the survey. Kindly provide your consent.

The questionnaire link was shared among known friends, colleagues, and relatives using various social media platforms like Whatsapp, LinkedIn, Instagram, and G-Mail. Those participants were requested to share the survey link further.

Questionnaires of the survey form		
<p><b>1. What is your age?</b></p> <ul style="list-style-type: none"> <li>• Between 18-29 years</li> <li>• Between 30-49 years</li> <li>• Age ≥ 50 years</li> <li>• Below 18 years</li> </ul>	<p><b>2. Have you spent 7 or more years of your life in Odisha?</b></p> <ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>	<p><b>3. What is your gender?</b></p> <ul style="list-style-type: none"> <li>• Male</li> <li>• Female</li> <li>• Do not want to disclose</li> </ul>
<p><b>4. What is your highest education qualification?</b></p> <ul style="list-style-type: none"> <li>• Matriculation</li> <li>• College</li> <li>• Diploma</li> <li>• Graduate</li> <li>• Post Graduate</li> <li>• Did not complete matriculation</li> </ul>	<p><b>5. How do you prefer to procure medicine?</b></p> <ul style="list-style-type: none"> <li>• Visit a pharmacy shop and ask for medicine</li> <li>• Visit a doctor, get advice and a prescription, and then purchase medicine from pharmacy showing the prescription.</li> <li>• Ask medicine from a friend</li> <li>• Take advice of parents or relatives before purchasing medicine from pharmacy</li> </ul>	<p><b>6. Do you check the expiry date of the medicine before purchasing?</b></p> <ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> <li>• I do not have any idea about expiry date</li> </ul>
<p><b>7. Choose the correct definition of "Expired Medicine" from the below options:</b></p> <ul style="list-style-type: none"> <li>• Expired Medicine is a medicine that is given to dead people.</li> <li>• Expired Medicine is a medicine whose last date of use has passed away making it unsafe or inefficient for human consumption.</li> <li>• Expired medicine is a medicine that is added to foods to make it tastier.</li> </ul>	<p><b>8. If your friend is suffering from severe headache and you have Saridon tablets with you, should you give it to your friend?</b></p> <ul style="list-style-type: none"> <li>• Yes, I will give</li> <li>• Yes, I will give but before that I will check the expiry date of the medication</li> <li>• No, I will not give him Saridon and advise him to visit a doctor and then take medicine as prescribed by the doctor.</li> <li>• Both 2nd and 3rd option is correct</li> </ul>	<p><b>9. What do you do with the unused and expired medications at your home?</b></p> <ul style="list-style-type: none"> <li>• Store them in my cupboard</li> <li>• Burn them in fire in open ground</li> <li>• Flush them down in the toilet</li> <li>• Throw them in the dustbin</li> <li>• Return the unused and expired medication to my nearest pharmacy shop</li> <li>• Return them to a doctor</li> <li>• Donate the unused and expired medicines to old age homes and orphanages.</li> </ul>
<p><b>10. Do you have asthma and do you use inhaler to control asthma attack?</b></p> <ul style="list-style-type: none"> <li>• Yes, I have asthma and I use inhaler to control asthma attack</li> <li>• Yes, I have asthma but I do not use inhaler to control asthma attack</li> <li>• No, I do not have asthma</li> </ul>	<p><b>11. What do you do with the inhaler once the canister becomes empty?</b></p> <ul style="list-style-type: none"> <li>• Store the inhaler in my cupboard</li> <li>• Burn the inhaler in fire in open ground</li> <li>• Flush the inhaler down in the toilet</li> <li>• Throw the inhaler in the dustbin</li> <li>• Return the empty inhaler to my nearest pharmacy shop</li> </ul>	<p><b>12. What medicines you keep at your home for emergency use? Just write the names</b></p>

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<p><b>13. How many unused medications at present do you have at your home?</b></p> <ul style="list-style-type: none"> <li>• 0</li> <li>• 1-5</li> <li>• 6-10</li> <li>• 11-15</li> <li>• More than 15</li> </ul>	<p><b>14. How many expired medications at present do you have at your home?</b></p> <ul style="list-style-type: none"> <li>• 0</li> <li>• 1-5</li> <li>• 6-10</li> <li>• 11-15</li> <li>• More than 15</li> </ul>	<p><b>15. Do you wash empty medicine bottles and use them to store salt, oil, or any food items?</b></p> <ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> <li>• Occasionally</li> </ul>
<p><b>16. Do you think improper disposal of unused and expired medications will damage the environment and human health?</b></p> <ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> <li>• Difficult to answer</li> </ul>	<p><b>17. Have you ever received advice from a physician, or pharmacist, or a nurse on how to properly dispose unused, and expired medications?</b></p> <ul style="list-style-type: none"> <li>• Yes, I have received</li> <li>• No, I have not received</li> </ul>	<p><b>18. Would you like to have E-pharmacy and drones as a medicine dispensing method in near future? Please write Yes or No, and then mention few statements in support of your decision.</b></p>

Please note the objective of question:  
 (q) 1-4 is to get basic information about the participants,  
 (q) 5-7 is to assess the knowledge of the participants,  
 (q) 8-14 is to assess the practice and attitude of participants towards utilizing medications and disposing household pharmaceutical wastes,  
 (q) 15-17 is to assess awareness among study participants related to proper drug utilization and disposal of household pharmaceutical wastes, and  
 (q)18 is to get opinion from the participants about E-pharmacy and drones as future models of drug dispensing.

**Choosing the right statistical test**

We understood that the data collected in this survey will be nominal by nature and will be represented as frequencies, proportions, or percentages. Also, we wanted to check if our data sets are dependent or can be paired to create an inference [31]. Thus, **chi-square test for independence** was carried out as a statistical analysis test to answer the following questions:

1. Is there any relationship between the education levels of participant to their action towards disposal of household pharmaceutical wastes?
2. Are the numbers of unused and expired medications at home dependent on the age of patient?

**STUDY RESULTS**

**Basic information about the participants**

A total of 191 participants took the survey, of which 181 completed the survey successfully. A total of 10 participants did not complete the survey, 4 (2.09%) did not give consent and 6 (3.2%) had spent <7 years in Odisha. The study involved 113 males and 68 females.

The distribution table of the age of participants for both English and Odia is mentioned below in **Table 1**:

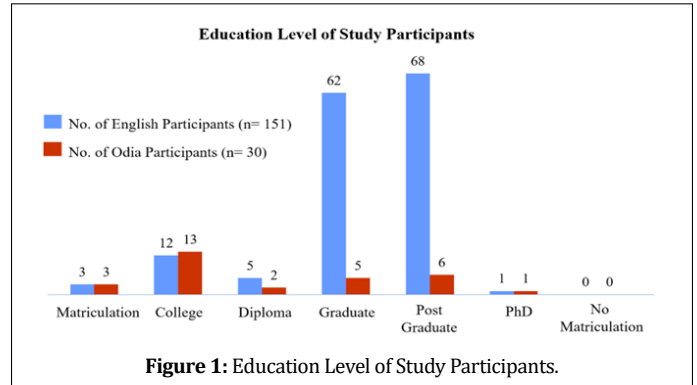
Age of the participants	English Participants	Odia Participants
Between 18-29 years	122	16
Between 30-49 years	23	12
Age ≥ 50 years	12	2

Among the English participants, the maximum were postgraduates followed by graduates. In contrast, the maximum number of Odia participants in the survey had education till college. The education level of English and Odia participants is depicted below in **Figure 1**.

**KNOWLEDGE OF THE PARTICIPANTS ABOUT MEDICINE**

**1. How do you prefer to procure medicine?**

About 85.08% (154 out of 181) of the participants responded that they prefer purchasing medicine from a pharmacy after getting advice and a prescription from a registered physician. The preference of participants to purchase medicine is presented in **Table 2** as follows:



**Figure 1:** Education Level of Study Participants.

Preferences on purchasing medicine	English participants	Odia participants	Total participants
Visit a pharmacy shop and ask for medicines	13	3	16
Visit a doctor, get advice and a prescription, and then purchase medicine from pharmacy showing the prescription	128	26	154
Ask medicine from a friend	1	0	1
Take advice of parents or relatives before purchasing medicine from pharmacy	9	1	10

**Table 2:** Preference of Study Participants to Purchase Medicine.

**2. Do you check the expiry date of the medicine before purchasing?**

The survey results showed that 97.2% (176 out of 181) of the participants agreed that they check the expiry date of the medicine before purchasing from a pharmacy.

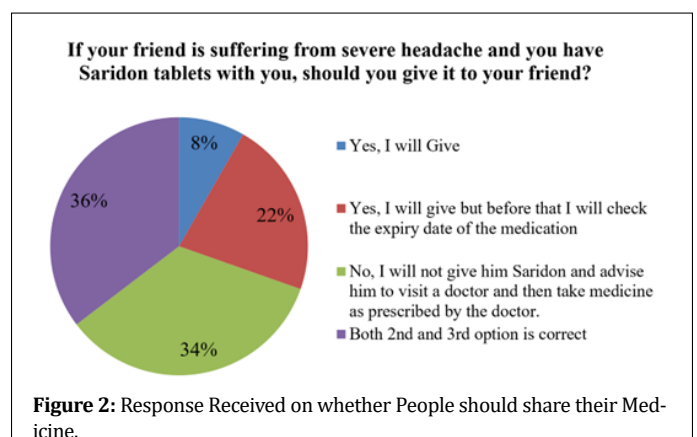
**3. Choose the correct definition of "Expired Medicine" from the below options**

The survey results showed that 96.6% (175 out of 181) of the participants chose the correct definition of "Expired Medicine" from the given options.

**Practice and attitude of participants towards utilizing medications and disposing household pharmaceutical wastes**

**4. If your friend is suffering from severe headache and you have Saridon tablets with you, should you give it to your friend?**

The result of this question was quite interesting (**Figure 2**). About 34.25% (62 out of 181) of the participants responded that they will not give their medicine to their friend, and will suggest taking medicine as per their physician's prescription. About 30% (55 out of 181) said that they will give their medicine. And 36% (64 out of 181) consider both practices to be correct. If we look at the numbers, about 66% of the sample population has no problem sharing their medicine.



**Figure 2:** Response Received on whether People should share their Medicine.



**5. What do you do with the unused and expired medications at your home?**

About 66% (120 out of 181) of participants dispose of their unused and expired medicine in the dustbin. Other actions on unused and expired medicine are presented in **Table 3** below.

Action on unused and expired drugs at home	English Participants	Odia Participants	Participants
Throw in the dustbin	97	23	120
Return the unused and expired medication to my nearest pharmacy shop	21	2	23
Burn the unused and expired medications at home in fire in open ground	16	4	20
Flush down in the toilet	10	1	11
Store them in the cupboard	7	0	7
Return the expired and unused medications to the doctor	0	0	0
Donate the unused and expired medicines to old age homes and orphanages	0	0	0

**Table 3:** Response Received on Action Taken by Participants on unused and Expired Medications at Home.

**6. Do you have asthma and do you use inhaler to control asthma attack? What do you do with the inhaler once the canister becomes empty?**

The study found that 7.73% (14 out of 181) of participants had asthma, of which 50% (7) use inhalers. Only a few of the participants (14.2%, n=2) return the empty inhaler to their nearest pharmacy shop and an equal number of patients responded that they burn the inhaler in an open ground.

**7. What medicines you keep at your home for emergency use? Just write the names**

The reply from the participants (**Table 4**) showed that Analgesics and Antipyretics are the most common drugs to be present in the house of maximum participants for emergency use.

**8. How many unused medications at present do you have at your home?**

A majority of the participants (38.6%, 70 out of 181) responded that they have somewhere between 1-5 unused medications at their home. And 37.5% (68 out of 181) participants responded that they do not have any unused medications in their homes (**Figure 3**).

**9. How many expired medications at present do you have at your home?**

The majority of the study participants (71.8%, 130 out of 181) responded that they do not have any expired medications at their homes (**Figure 4**).

The distribution of participants with different quantities of unused and expired medication in their homes is presented below.

**Awareness among study participants related to proper drug utilization and disposal of household pharmaceutical wastes**

**10. Do you wash empty medicine bottles and use them to store salt, oil, or any food items?**

About 85.6% (155 out of 181) of the participants responded that they do not wash medicine bottles and use them to store salt, oil, or any other food items (**Figure 5**).

**11. Do you think improper disposal of unused and expired medications will damage the environment and human health?**

About 87.8% (159 out of 181) of the participants responded that "Yes," improper disposal of unused and expired medications will damage the environment and human health (**Figure 6**).

**12. Have you ever received advice from a physician, or pharmacist, or a nurse on how to properly dispose unused, and expired medications?**

The majority of the participants (72.4%, 131 out of 181) replied that they have not received advice from a physician, pharmacist, or nurse on how to properly dispose of unused and expired medications. And 27.6% (50 out of 181) of the participants replied "YES" to have received the same advice.

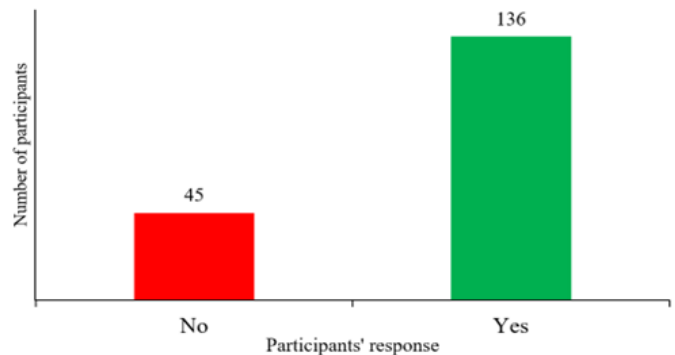
**Opinion from the participants about E-pharmacy and drones as future models of drug dispensing**

**13. Would you like to have E-pharmacy and drones as a medicine dispensing method in near future? Please write Yes or No, and then mention few statements in support of your decision.**

As depicted in **Figure 7** below, 75.13% (136 out of 181) of the participants showed interest to have E-Pharmacy and drones as medicine delivery technology.

The points participants gave in support of E-pharmacy and drones are that it is time and cost-effective, safe, hassle-free, usable in remote and logistically challenged location needing immediate aid (rural areas, natural disasters), and can also be used for no-contact delivery.

**Response from participants on the question " Would you like to have E-pharmacy and drones as a medicine dispensing method in near future?"**



**Statistical analysis of the survey data**

In the 1st case, we wanted to investigate whether the participant's educational qualifications and the action taken by them to dispose of household pharmaceutical wastes were related. So, the null hypothesis ( $H_0$ ) was - educational qualification and action taken to dispose of the household pharmaceutical waste are independent (non-related), and the alternate hypothesis ( $H_A$ ) is that they are related. Chi-square test for independence was carried out using MS Excel [21]. The  $\chi^2 = 17.67$ , Critical Value (CV) = 31.41, and p-value = 0.609137 was obtained. Since the chi-square value < CV and the p-value > 0.05, we fail to reject  $H_0$ . Thus, we can say that the educational qualification of participants is not related to the actions they take to dispose of household pharmaceutical waste.

In the 2nd case, we wanted to investigate if there is a relationship between the age of the study participants and the number of unused medications in their homes.  $H_0$ : no. of unused medications at home and participant's age are non-related and  $H_A$  is that they are related. Chi-square test for independence was carried out using MS Excel.  $\chi^2 = 3.26$ , CV=15.50 and p-value = 0.916998. Since the Chi-Square value < CV and the p-value > 0.05, we fail to reject the null hypothesis. Thus, we can say that the number of unused medications at home is not related to the age of the study participants.

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Drug category	Name of the drug	No. of participants (n=181)
Analgesics and Antipyretics	Paracetamol, Dolo 650, Calpol 650, Crocin	154
Antihistamines	Chlorpheniramine maleate, cetirizine, Levocetirizine, Montina-L	35
NSAIDs	Aceclofenac, Diclofenac, Disprin, Aspirin, Nimesulide, Zerodol-SP, ManCold, NamCold, Combiflame, Intagesic gel, Meftal 500	32
Drugs for Peptic Ulcer and Gastritis	Pantoprazole, Pentac 40, Omeprazole, Ranitidine, Razo-D	32
Antibiotics	Ornidazole, Amoxicillin, Azithromycin, Roxid 150, Ofloxacin, Norfloxacin, Metronidazole	30
Medicine for cough and cold	Cozy Plus, Benadryl cough syrup, Sinaresst	30
Antacids	Divol, Digene	16
Antiasthmatic	Salbutamol, Montelukast	4
Antiemetics	Domperidone, Ondansetron	4

Table 4: List of the Commonly Stored Drugs for Emergency use Responded by Participants.

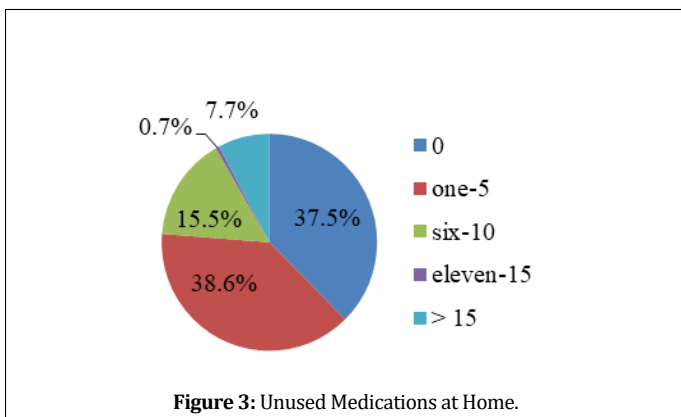


Figure 3: Unused Medications at Home.

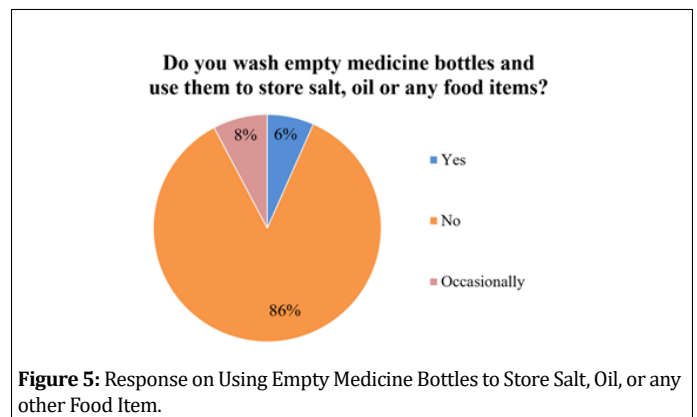


Figure 5: Response on Using Empty Medicine Bottles to Store Salt, Oil, or any other Food Item.

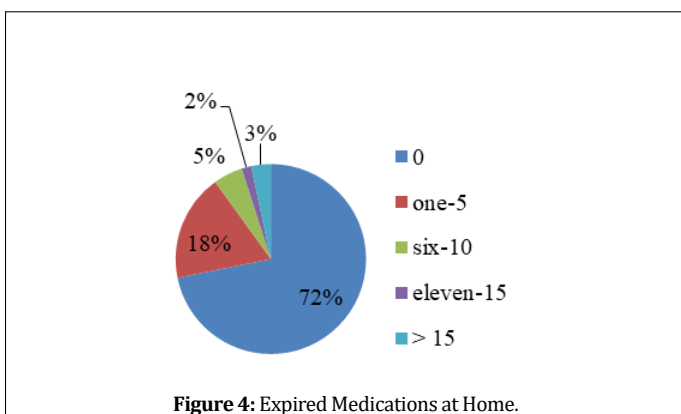


Figure 4: Expired Medications at Home.

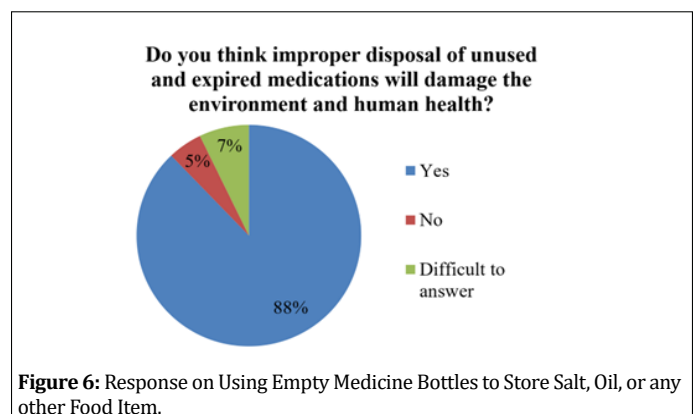


Figure 6: Response on Using Empty Medicine Bottles to Store Salt, Oil, or any other Food Item.

## DISCUSSION

Presence of unchanged pharmaceuticals concentrations in water and soil, reports of death due to consumption of unused or expired medications, rapid rise in the growth of API market, and reported information of hoarding medicines during COVID-19 from the literature survey showed that there is a lack of understanding and awareness among people on what impact does medicinal products has on environment and human life when they are improperly utilized and improperly disposed after their expiry. The literature review also showed that there can be many ways of improper utilization of prescribed and OTC medications as mentioned by the World Health Organization<sup>[6]</sup>. Thus, conducting an environmental pharmacology study was a valid approach to meet our aim which was to assess the knowledge, attitude, and practice among people on proper utilization of medicines and proper disposal of unused and expiry medicines [4,7,9-11].

To meet our aim during the time of COVID-19, we decided to conduct a web-based or internet-based population study. The idea was to develop a contact less data collection channel or medium that removes the risk of physical interaction during the time of COVID-19. A well set of questionnaires with informed consent form was designed to collect data during the survey. An internet-based population survey had the following advantages:

- Higher probability to access unique population
- It saves time
- It is eco-friendly as its saves paper and is also cost-effective.
- It is contactless and has zero chances of spreading COVID-19
- Statistical analysis and overall analysis of results obtained through an online survey is easy and less tedious.

Thus with the help of Google Forms, we developed a set of questionnaires online and shared it among colleagues and family using the help of social media platform like Whatsapp, LinkedIn, G-Mail, and Instagram. The chances of getting more participants in the survey depended on the participants sharing the survey link among their friends and family thus creating a chain [22].

Our study's purpose and results need analysis through the optics of a larger context. For example, people and patients' improper disposal of unused and expired pharmaceuticals may only account for a small part of the total pharmaceutical pollutants that enter the environment through various channels but yet with the compounding effect over time, may result in severe damage to the environment and human health.

Our study had a sample size of 181 which shows that to achieve a 95% CI our margin of error was  $\pm 7.29\%$  which was in the acceptable range. However, if more people would have participated in the online survey, then the margin of error could have gone down to 5%. This was a challenge that we faced during the study [20].

Conducting web-based surveys among the older population is a challenge. The present study faced similar challenges of having an equal distribution of study participants. Out of the 181 participants present in the study, the majority (76.2%, n=138) were between 18-29 years of age. This was followed by participants falling in the range of 30-49 years (19.3%, n=35) and finally older participants of 50 years and above (7.73%, n=14). Although our study does not imply any cause as to why there was a low interest among the older population of 50 years and above, a research study published in the BMC Medical Research Methodology found that older people who did not wish to participate in a survey unless they got a paper questionnaire [23].

The Gray and Hagemeyer study showed that women in the majority took interest in the drug take-back program and had awareness about the environmental damages and poisoning effects associated with improper disposal of unused and expired medications. In contrast to this, in our study findings, more male participants took part in the survey. Although the majority of the participants acknowledged that they were aware of the damages to the environment caused due to improper disposal of household medical wastes, but still the primary way of disposal found in the study was throwing the medications in the dustbin which does not align with safe disposal practices [24,25].

Our aim was to assess the knowledge and attitude of the participants towards safe utilization of medications and disposal of unused and expired medications.

The affirmative responses of 97.2% of participants about checking the expiration date before purchasing medicine and 87.8% agreeing about the environmental effect of improper disposal of unused and expired medications show that people know how to buy medicine and are aware of its environmental impact.

One should not share their prescribed medications to others. Medications when shared without proper advice from physician can be associated with risk factors like polypharmacy and multiple-chronic comorbidity<sup>[18]</sup>. In our study, to a situation based question where we asked the participants what they will do if they have a Saridon tablet and their friend is having a bad headache, majority of the participants responded that they will check the expiry date before giving their Saridon tablet to their friend. Some also responded that they would advise their friend to visit a doctor and take medicine after proper diagnosis. Participants saying they will give Saridon tablet to their friend are wrong. It is not a good practice to give medicines meant for you to someone else just because they have similar symptoms as of yours.

According to Penteado et al., a study conducted with 215 adults showed that 86% of people inappropriately dispose of medications, with 55% throw them in the garbage, 20% disposed them in the sink or toilet, 6% stock drugs, and 5% saying they burn them in the backyard. It was also observed that 45% of people believed discarding the medicines in the trash, sink or toilet and burn the drugs in the backyard is the appropriate way of disposal and that 77% of respondents never pursued to know about the right method of disposal [26].

Now, according to USFDA guidelines, unused or expired drugs should be returned back to the pharmacy or to the drug-take back program site run by the local or central government. However, if drug take-back program is not there or pharmacy do not agree to take-back unused or expired medications, then patients or people should segregate the unused and expired medications under two categories.

- 1) Disposable through flush
- 2) Non-disposable through flush

Those drugs that cannot be disposed through flush should be properly packed in a sealed plastic bag as directed by FDA and then thrown into the trash can [27].

List of medicines recommended by FDA for flushing (Any drug that contains the following words written anywhere in the drug label)	
Buprenorphine	Diazepam rectal gel
Fentanyl	Methylphenidate transdermal system
Hydrocodone Or Benzhydrocodone	Oxycodone
Hydromorphone	Oxymorphone
Meperidine	Tapentadol
Methadone	Sodium Oxybate
Morphine	

Also in an article by John Holden, disposing medications improperly in the dustbin have more severe effects on the environment. Empty inhalers should not be thrown into the dustbin and they should be returned to the pharmacy [25].

Thus, assessing the attitude of people with respect to their knowledge, our study findings showed that 11.04% of the participants burn the unused and expired medications in open ground. Only 6% of the study participants responded that they flush the unused and expired medicines down the sink or toilet. Also few of the participants (around 8%) having asthma responded that after their inhaler goes empty, they either throw the inhaler in the dustbin or store it in the cupboard. Thus, the actions presented by the respondents in the present study do not align with good disposal practices of unused and expired medications. The knowledge does not align with the attitude of dealing with the disposal of unused and expired medications. This shows that there is a need to create awareness and drug take-back campaigns by the local or central government to

educate people on proper disposal of unused and expired drugs so as to bring a change in the attitude.

Study by Supriya Sonowal *et al*, found that the major reasons for people storing unused and expired medications at their home include [17]:

- Frequent change of medications by physicians
- Having more number of prescribed drugs than required
- Consumers purchasing extra medicines as OTC for future use
- Not completing the prescribe dose and stopping the treatment in between upon symptomatic relief
- Non-compliance with the advice given by physician

In an article published on internet by Apollo 24/7, these are the ten essential medicines that must be available in every household [28]:

1. Aspirin for body ache, inflammation, cold, and fever
2. Paracetamol for people who cannot tolerate aspirin
3. Antacid for heartburn or acidity or bloating
4. Antihistamines to treat allergic reactions such as severe itching, swelling, runny nose, and watery eyes
5. Nasal Decongestants to relieve stuffy or congested nose due to cold
6. Antitussive lozenges to get relief from itching throat
7. Antiseptic Ointments
8. Antifungal medications to treat fungal infections
9. Anti-sickness medications to treat nausea and vomiting
10. Topical ointments for burns

A basic comparison of results from our study with the list of already published similar studies showed the following list of medicines found most commonly in household of people:

Thus, Analgesics, Antibiotics, and Antimicrobials are the most common medications stored by people in their house which later on becomes expired or remains unused. Knowledge of healthcare professionals plays a major role in creating awareness among people on proper utilization of medicines and disposal of unused and expired medications. Physicians, nurses, and pharmacists should advise patient's visiting hospital or clinic on the correct way of disposing unused and expired medications. People should be advised not to purchase medication without proper prescription from a doctor or without doctor's advice. HCPs should aware people not to take expired medications and not to hoard or stock medications.

In one of the results of a study carried out by Yohanes Ayele and Mulu Mamu, it was found that 17.6% of the study participants (n=694) strongly disagreed to have received any advice from doctors and other HCPs on safe disposal of unused and expired household medicines. 24.1 % of the study population disagreed to have received any advice from doctors and other HCPs on safe disposal of unused and expired household medicines. However, 34.4% of study population agreed and 15.4% strongly agreed to have received advice from doctors and other HCPs on safe disposal of unused and expired household medicines [8].

Kriti Bhayana *et al*, carried out a study to determine the knowledge, attitude, and practices among HCPs on good practices of disposing unused and expired medications. 300 HCPs participated in the study. The study results showed that [30]:

- Nurses had better knowledge than physicians on proper disposal of unused and expired medications. Nurses also had better practice than pharmacists and had knowledge on proper disposal of expired and unused medicines.
- Both nurses and physicians had better knowledge than pharmacist on type of formulations that should undergo incineration for safe disposal.
- However, majority of the HCPs in the study were unaware of validity of dispensing medicines before 15 days of mentioned expiry date.
- A significant proportion of physician and nurses commented that

safe disposal of unused and expired medications are not only the responsibility of HCPs but of each and every citizen.

In contrast to the above two studies, our study showed different results. Majority of the participants i.e. 72.3% responded to have never received any advice from a physician, or pharmacist, or a nurse on how to properly dispose unused, and expired medications. This could be a major reason of having 66.2% of the study participants disposing their medication improperly in the dustbin rather than returning it back to the pharmacy. This also shows that healthcare professionals (HCP) in Odisha must be aware of the good disposal practices of unused and expired medications. They should give advice to patients on proper use of prescribed medications, and proper disposal of unused and expired medications. The state healthcare authority should carry out more studies among HCPs to assess their Knowledge, Attitude, and Practices (KAPs) on proper disposal of expired medications. Apart from this, awareness among patients needs to be created to ask questions to their healthcare provider on proper disposal practices of their prescribed medications.

Discussion on the opinion of study participants on the use of E-Pharmacy, Drones, and Robots as future dispensing models for medicines has been clearly explained in the results section. Also from that discussion we can know that people participating in this survey have a mixed feeling when it comes to the use of smart technologies in dispensing medicines.

Talking about the limitations of the present study, one limitation of our study was that since the study was conducted as an Internet based survey, thus populations who do not use internet or do not know how to operate internet could not participate in the study. Thus no knowledge can be acquired about the disposal practices of such population. The other limitations of our study include:

- The study does not answer the question, who is responsible for improper utilization of medications and improper disposal of unused and expired medications?
- Information on Socioeconomic status (SES) of survey participants is absent from the present study.
- Although the study asks opinion from the participants about the use of E-pharmacy, E-Prescriptions, and drones as future dispensing models for medicines, it does not address the issue of automation technology that may affect the environment. This study does not ask the participant on what type of impact cans automation cause to the environment. The study does not ask the participant, if technology can be used for dealing the issues of environment and how?

## CONCLUSION

The main aim of this study was to understand the knowledge, attitude, and practice among people of Odisha on proper drug utilization and its disposal along with their opinion on future dispensing models for medicines. The findings of the present study could interest a range of constituencies, from consumers to health care professionals, health and environmental policymakers, and leaders of pharmaceutical companies.

The major findings from the study include:

- Although the participants knew the correct procedure for purchasing any medicine and had knowledge about the definition of expired medications, they lacked knowledge on the proper utilization of medications.
- The participants lacked a correct attitude or awareness towards the proper disposal method for unused and expired medications despite having an understanding that improper disposal of unwanted and expired medications can cause damage to the environment and human health.
- An overwhelming majority of participants never got any guidance on proper methods of medication disposal from Health Care Professionals (HCPs)
- Younger population (18-29 years) showed a higher interest to participate in the study than the older population (50 years and above).
- Education level of people does not determine their action to properly dispose of unused and expired drugs
- Age of the participants is not linked to the number of medications they have at their home



- Majority of the participants showed interest to have E-Pharmacy and drones as medicine delivery technology system

The analysis conducted in this study points out that the problem of improper drug utilization and disposal can be mitigated through adequate social and organizational interventions. They are required to support widespread social change in good utilization practices of prescribed medicines, carry out drug take-back campaigns, and create awareness on proper disposal practices of household pharmaceutical wastes (mainly unused and expired medications). In practice, pharmaceutical corporations and the central and state governments will need to demonstrate their commitment to social responsibility by ensuring that the development and marketing lifecycle of pharmaceutical goods is monitored and necessary steps are exercised for minimal environmental and human health risks. Overall, we can conclude that larger online surveys with a diverse group of participants across socioeconomic strata, conducted over a longer period of time in both web-based and paper-based formats, are required to better understand how people can be made aware of the impact of improper pharmaceutical disposal on the environment and human health on a large scale.

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**Authors' contributions:** The authors confirm contribution to the research article as follows:

**Research article conception and design:** Priyabrata Panda, Sarojini Nayak, and Md Sahil & **Data collection:** Priyabrata Panda, Sarojini Nayak, and Md Sahil. All authors reviewed and approved the final version of the research article.

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## REFERENCES

- Globe Newswire. (2021, September 28). India \$11 Billion Active Pharmaceutical Ingredients (API) Markets, 2017-2020 & 2021-2023 & 2027. Retrieved from <https://www.globenewswire.com/news-release/2021/09/28/2304140/28124/en/India-11-Billion-Active-Pharmaceutical-Ingredients-API-Markets-2017-2020-2021-2023-2027.html>
- Heba Shaaban, H. A. (2018). Environmental Contamination by Pharmaceutical Waste: Assessing Patterns of Disposing Unwanted Medications and Investigating the Factors Influencing Personal Disposal Choices. *Journal of Pharmacology and Pharmaceutical Research*, 1(1):003.
- Shakeel, M. A. (2020). Unused and Expired Medications Disposal Practices. *Pharmacy*, 8 (4):196.
- Mohmad Amin Dar, M. M. (2019). Pharmaceutical Wastes and their disposal practice in routine. *International Journal of Information and Computer Science*, Vol.6, Issue 4, 78-92.
- Shailendra Mudgal, A. D. (2013, December 13). *Study on the environmental risks of medicinal*. Retrieved May 7, 2021, from Bio Intelligence Service: [https://ec.europa.eu/health/sites/default/files/files/environment/study\\_environment.pdf](https://ec.europa.eu/health/sites/default/files/files/environment/study_environment.pdf)
- Amien Ewunetei, H. Y. (2021). Household Level Drug Utilization and Associated Factors in South Gondar Zone, North Western Ethiopia. *Drug, Healthcare and Patient Safety*, 13, 47-58.
- Express News Servcie. (2018, January 1). Odisha: Girl taking expired tuberculosis drugs succumbs. Odisha, India. Retrieved February 08, 2022, from <https://www.newindianexpress.com/states/odisha/2018/jan/01/odisha-girl-taking-expired-tuberculosis-drugs-succumbs-1741449.html>
- Ayele, Y. &. (2018). Assessment of knowledge, attitude and practice towards disposal of unused and expired pharmaceuticals among community in Harar city, Eastern Ethiopia. *Journal of pharmaceutical policy and practice*, 11, 27.
- Abahussain, E. B. (2007). Disposal of unwanted medicines from households in Kuwait. *Pharm World Sci* 29, 368-373 (cross reference).
- Bound, J. P. (2005). Household disposal of pharmaceuticals as a pathway for aquatic contamination in the United Kingdom. *Environmental health perspectives*, 113(12), 1705-1711.
- Law, A. V. (2015). Taking stock of medication wastage: Unused medications in US households. *Research in social & administrative pharmacy : RSAP*, 11(4), 571-578.
- Assefa, T. G. (2020). Assessment of Pharmaceuticals Waste Practices Among Private Drug Retail Outlets in Ethiopia. *Journal of Primary Care & Community Health*, 11, 1-8.
- Muhammad Anwar, Q. I. (2020, April 12). Improper disposal of unused antibiotics: an often overlooked driver of antimicrobial resistance. *Expert Review of Anti-infective Therapy*, 18(8), 697-699.
- Kümmerer, K. (2010). Pharmaceuticals in the Environment. *Annual Review of Environment and Resources*, 35, 57-75.
- Nash JP, K. D. (2004). Long-term exposure to environmental concentrations of the pharmaceutical ethynylestradiol causes reproductive failure in fish. *Environmental Health Perspectives*. Dec;112(17), 1725-1733.
- JANA ZEILINGER, T. S.-H. (2009). EFFECTS OF SYNTHETIC GESTAGENS ON FISH REPRODUCTION. *Environmental Toxicology and Chemistry*, 28(12), 2663-2670.
- Supriya Sonowal, C. D. (2016-2017, December-February). A Survey of Knowledge, Attitude, and Practice of Consumers at a Tertiary Care Hospital Regarding the Disposal of Unused Medicines. *Journal of Basic and Clinical Pharmacy*, 8(1), 4-7.
- Mohammad Bashaar, V. T. (2017). Disposal practices of unused and expired pharmaceuticals among general public in Kabul. *BMC Public Health*, 17(45).
- Yohanes Ayele, M. M. (2018, November 15). Assessment of knowledge, attitude and practice towards disposal of unused and expired pharmaceuticals among community in Harar city, Eastern Ethiopia. *Journal of Pharmaceutical Policy and Practice*, 11(1), 1-7.
- Qualtrics. (n.d.). Determining sample size: how to make sure you get the correct sample size. Retrieved April 4, 2022, from Qualtrics. com: <https://www.qualtrics.com/au/experience-management/research/determine-sample-size/>
- Keshminder, JS. Using Microsoft Excel for Chi-Square Test ( Nonparametric Test). YouTube, 5 May 2020, <https://youtu.be/9HadJBDmoAM>. Accessed 13 Oct. 2022.
- Wright, K. B. (2017, July 17). Researching Internet-Based Populations: Advantages and Disadvantages of Online Survey Research, Online Questionnaire Authoring Software Packages, and Web Survey Services. *Journal of Computer-Mediated Communication*, 10(3).
- Susanne Kelfve, M. K. (2020, October 8). Going web or staying paper? The use of web-surveys among older people. *BMC Medical Research Methodology*, 1-12.
- Jeffrey A. Gray, N. E. (2012, June 25). Prescription Drug Abuse and DEA-Sanctioned Drug Take-Back Events: Characteristics and Outcomes in Rural Appalachia. *Archives of Internal Medicine*, 172(15), 1186-1187.



25. Holden, J. (2013, March 5). Why throwing your unused meds in the bin is a bad idea. *The Irish Times*.
26. Pozza, C. S. (2012). Managing Household Pharmaceutical Wastes: The Practices and Perception of Users. *Conference: ISWA - World Solid Waste Congress*.
27. U.S. Food and Drug Administration. (n.d.). *Drug Disposal: Dispose "Non-Flush List" Medicine in Trash*. Retrieved May 05, 2022, from U.S. Food and Drug Administration: <https://www.fda.gov/drugs/disposal-unused-medicines-what-you-should-know/drug-disposal-dispose-non-flush-list-medicine-trash>
28. Halefom Kahsay, M. A. (2020, April 14). Assessment of Knowledge, Attitude, and Disposal Practice of Unused and Expired Pharmaceuticals in Community of Adigrat City, Northern Ethiopia. *Journal of Environmental and Public Health*, 1-11.
29. Sachin Manocha, U. D. (2020). Current Disposal Practices of Unused and Expired Medicines Among General Public in Delhi and National Capital Region, India. *Current Drug Safety*, 15(1), 13-19.
30. Kriti Bhayana, H. S. (2016). Comparison of the knowledge, attitude, and practices of doctors, nurses, and pharmacists regarding the use of expired and disposal of unused medicines in Delhi. *Indian Journal of Pharmacology*, 48(6), 725-728.
31. B.K.Nayak, A. (2011). How to choose the right statistical test? *Indian Journal of Ophthalmology*, 59(2), 85-86.



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