Research Article

EXPLORING GENERAL AWARENESS AND ATTITUDES TOWARDS DISPOSAL PRACTICE & STORAGE CONDITION OF MEDICATION AMONG THE GENERAL PUBLIC AT ACHROL, JAIPUR, RAJASTHAN (INDIA): A CROSS-SECTIONAL



Mazhar Jamil¹, Ashutosh Upadhayay², Md Sabir Alam³, Vikram Kumar⁴, Aafrin Waziri⁵, Shambaditya Goswami⁶, Navneet Kumar Upadhyay⁴, Tejpal Yadav⁴*

¹NIMS Institute of Pharmacy, NIMS University Rajasthan, Jaipur, India.
 ²School of Pharmaceutical Sciences, MVN University, Aurangabad, Haryana, India.
 ³SGT College of Pharmacy, SGT University, Gurgaon-Badli Road Chandu, Budhera, Gurugram, Haryana, India.
 ⁴Amity Institute of Pharmacy, Amity University Rajasthan, Jaipur, India.
 ⁵University School of Biotechnology, Guru Gobind Singh Indraprastha University, Golf Course Rd, Sector 16 C, Dwarka, Delhi, India.
 ⁶Department of Pharmaceutical Chemistry, Divine College of Pharmacy, Ziradei, Siwan, Bihar, India.

Corresponding Author*: Tejpal Yadav, Ex-Scientist 'E', Amity Institute of Pharmacy, Amity University Rajasthan, Jaipur, India.

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Abstract

Aim: This study aims to assess the awareness, attitudes, and practices of the general public in Achrol, Jaipur, Rajasthan, India, regarding the disposal and storage of medications.

Methods: A cross-sectional survey was conducted with 250 participants using a semi-structured questionnaire to evaluate their knowledge, perception, and practices related to medication disposal and storage. Data were analyzed using SPSS version 20.

Results: The findings revealed that 71.6% of participants had unused medications at home, with most individuals (50.8%) storing them until expiration. The most common disposal method was discarding in household trash (19.6%), followed by flushing (2%), burying (5.3%), and burning (1.6%). Only 11.2% returned medications to a pharmacy. Additionally, 80.8% of participants reported checking expiration dates before purchasing medications, but 16% never did. Lack of awareness about proper disposal methods was evident, with 54.8% never having received related guidance.

Conclusions: The study highlights a significant gap in public awareness and practices regarding the proper disposal and storage of medications. Most respondents acknowledged the importance of proper disposal but lacked the necessary knowledge. Public awareness campaigns and structured programs are essential to mitigate improper disposal practices and potential environmental and health risks.

Keywords: Cross-sectional study, Medication disposal, Unused medications, Public awareness.

1. Introduction

In developing countries, access to medications and their distribution systems have gradually improved, particularly with the implementation of essential drug programs. However, a significant gap remains in educating the population on the proper handling and usage of these medications[1]. While the availability of advanced treatments for numerous health

conditions has increased, and public awareness of health-related issues has grown, the responsible use of medications continues to be challenging. The rising burden of diseases, the demand for faster recovery, and the cultural acceptance of selfmedication contribute to the practice of domestic drug storage. Many households in low-income regions choose to stockpile medications due to inadequate healthcare access, limited medical personnel, and frequent drug shortages. Consequently, unused medications accumulate due to changes in health status, adverse reactions, or expiration. Storing medications at home presents various challenges, such as exposure to environmental factors like humidity and temperature fluctuations, which can lead to drug degradation and reduced efficacy. Often, individuals are unaware of expired medications, leading to their unintended consumption and an increased risk of adverse effects. Additionally, unsecured storage poses a threat, as children and unauthorized users may accidentally ingest these medications, leading to poisoning incidents. The easy availability of medications at home can also encourage inappropriate use and contribute to the growing issue of antibiotic resistance through drug sharing practices[2].

The global consumption of pharmaceuticals has surged in recent years[3], leading to significant amounts of unused or expired medications[4-6]. Improper storage and disposal of these drugs can have serious consequences, including potential misuse and environmental contamination[7].

Studies indicate that a substantial portion of pharmaceutical waste ends up in the environment, where it poses risks to public health and ecosystems. For example, the accumulation of antibiotics in aquatic systems can promote antibiotic resistance and alter bacterial pathogenicity[8]. Addressing these environmental concerns requires targeted efforts to identify, assess, and mitigate the adverse effects of pharmaceutical waste[9]. A large rise in drug use among the populace creates issues with poor storage, illogical use, and the gathering of superfluous medications in homes. The population discards up to 10% of the entire quantity of medications sold as domestic garbage, leaving them unutilized[10].

Globally, drug use impacts all families. The annual growth in global drug consumption is associated with rising populations, longer lifespans, and the unwise or uncontrolled use of medications. The prevalence of drug residues in natural environments, especially in water supplies, increases in tandem with the rate of drug use among the general population. Academic literature, company instructions, suggestions for improvement, and potential risks to people's well-being from pharmaceutical contamination of ecosystems are receiving increased attention[11]. The USFDA approves the removal of certain drugs through sewage systems or washrooms. Flushing such medications eliminates the risk of keeping expired medicines in households[12]. One accidental dose of these drugs can be fatal. The USFDA advises returning unused and expired medications to hospitals, clinic pharmacies, retail pharmacies, and authorized collection locations. Certified Drug Enforcement Administration (USDEA) agents may grant access to facilities in the United States for the collection and proper disposal of outdated drugs[13].

Drugs and medications in the environment pose a critical risk to human well-being. The vast majority of drug users worldwide may have no idea how to properly dispose of unwanted or outdated prescription drugs. More than half of all prescription and retail pharmaceutical sales are incorrect, resulting in dangerous drug overstocking and posing a serious environmental risk. Statistics from the World Health Organization (WHO) confirm this[14]. There are several reasons why people don't take all their medicine as prescribed, including adverse effects, dosage modifications, healing quickly, out-of-date sales, and physicians offering guidance and recommendations via relatives and friends[15]. Inappropriate disposal of drugs may have serious consequences for human health, wildlife, and ecosystems[16,17]. Two real-life examples illustrate this. The non-steroidal antiinflammatory medicine (NSAID) diclofenac has almost wiped off the vulture population in Southeast Asia by causing renal failure and death[18].

Exposure to trace amounts of the OTC pill ingredient Ethinylestradiol (EE) causes the feminization of fish in European waters[19]. Drug expiration can lead to efficacy loss, safety compromises, potency loss, and the creation of potentially harmful compounds. Drugs that have gone hazardous can leave behind byproducts that can lead to carcinogenicity, antibiotic resistance, and other problems. Strict adherence to disposal protocols is necessary for medications that are no longer in use or have reached their expiration date[20]. Drugs that have expired might still result in drug misuse and unintentional poisoning; therefore, it's important to get rid of them safely[21]. Longterm storage of unused, outdated drugs can lead to physicochemical changes, moisture absorption, and microorganism contamination [22]. Global guidelines exist for disposing of healthcare waste, but their applicability to the general population is unclear, or the public is simply unaware of their existence[23].

Patients and their families must know how to safely store and dispose of expired or unnecessary drugs[13]. When many people in a country don't have access to even the most basic primary healthcare, the problem of prescription waste becomes all the more pressing[24]. Our participant community lacks understanding about how to get rid of unused, unwanted, and expired pharmaceuticals. Numerous studies on a global and national scale have shown that many patients improperly store their prescriptions at home, which may lead to unintended consequences including incorrect medication, unintentional overdoses, and misuse of medications. Instead of wasting them, people keep expired medications because they don't know how to check their expiration date or dispose of them[25-29].

Pharmaceutical firms must have a suitable framework in place to handle situations like these, as pharmaceutical supply chains have high levels of spillover and waste, as well as frequent problems with returns and drug recalls.³⁰ Highlighted hospitals' reverse logistical processes. Reuse, recycling, and disposal are the three forms of reverse logistics activities mentioned, and their employment should not compromise the potency of medications. Reverse logistics is crucial to the pharmaceutical sector from an economic, environmental, and legal perspective. Important considerations include the safety of the returned items, the reduction of expenses through automation, and the ability to track objects from the buyer to the landfill[30].

Lack of knowledge and education are the major factors contributing to improper medication waste disposal. We aim to raise awareness of acceptable disposal procedures and minimize detrimental consequences on the ecosystem and community by collecting information on how to properly dispose of a wide variety of household pharmaceuticals.

2. Methodology

2.1 Study Design

A comprehensive cross-sectional study was conducted among the residents of Achrol, Jaipur, Rajasthan (India) using both an online Google form and faceto-face interviews based on a structured and prevalidated questionnaire. The study was carried out over a period from September 2022 to January 2023. The investigator visited each household individually to conduct self-structured interviews. On average, each interview session lasted approximately fifteen minutes per household. Through these interactions, the researcher gathered essential information to accurately complete the individual questionnaire and data collection form, ultimately achieving a minimum of 250 responses[31].

2.2 Data Collection

Data collection was facilitated using a standardized questionnaire, which had been previously developed for related research. The questionnaire was divided into two sections: the first section gathered demographic details such as age, gender, education level, and occupation, while the second section focused on medication storage and disposal practices. Questions in the latter section included topics such as the retention of unused medications at home, their sources, types, reasons for non-usage, and the practice of checking expiration dates. Participants who were 18 years or older were considered eligible for inclusion in the study[32].

2.3 Study Tools

Three data collection methods were employed: a self-designed questionnaire, an online Google form, and face-to-face interviews. The questionnaire was validated by subject matter experts. The investigator conducted structured interviews by visiting each household individually, dedicating an average of 15 minutes per household. These interactions provided the necessary information to complete the questionnaire and data collection form effectively. The questionnaire covered aspects such as medication usage, storage, disposal habits of family members, and the prevalence of chronic diseases. Specific forms were used to document details regarding unused or expired medications. Additionally, an informative brochure summarizing proper medication use, storage, and disposal practices was distributed to the participants to raise awareness[33].

2.4 Data Analysis

The collected data were presented using numerical values and percentages. Descriptive statistical methods were applied to classify the variables effectively. Data analysis was conducted with the aid of Microsoft Excel and SPSS software (version 20)[34].

3. Results

3.1 Demographic Data

Among the 250 people who filled out the survey, the majority were men (n = 189, 75.6%) and women (n = 61, 24.4%), and the majority were also between the ages of 18 and 25 (n = 208, 83.2%). They

have a literacy rate of above 98% (n = 247). The respondents' demographic features include a high percentage of students and university students (Table 1).

3.2 General Knowledge on Unwanted Medication

Among those who participated in the survey, 71.6% (n = 179) were found to have at least one drug that was not being utilised. Most respondents (n = 101, or 40%) cited an improvement in the patient's health as the reason for not taking their medications, while a smaller but still significant number (n = 54, or 21.6%) cited the medications' expiration date. The most common reasons for prescription waste were non-adherence (n = 10, 4%), adverse effects (n = 4, 1.6%), and medication confusion (n = 9, 3.6%). A total of 31 respondents, or 12.4%, did not provide a reason for not using medication. NSAIDs (n=53, 21.1%) were the most often discarded drug, followed by vitamins and other supplements (n=49, 19.6%)and antibiotics (n=74, 29.6%). Antibiotics are often not utilised because of this aversion to therapy (p =0.001). Table 2 shows that before making a purchase, 80.8% of respondents (n = 202) looked at the expiry date of the medication.

3.3 Medication Disposal Practice

The majority of responders (n = 127, 50.8%) reported keeping unneeded medications until they had passed their expiration dates. Expiring medications were most often thrown away in the trash (n = 49, 19.6%), followed by being flushed down the toilet or sink (n = 5, 2%). Furthermore, 41 people (16.4%) said they'd given medication to friends or family. Most responders (n = 137, or 54.8%) said they were never given instructions on safe drug disposal. Only little more than two-thirds (n = 179, 71.6%) agreed that irresponsible behaviour might compromise environmental quality and public health (Table 2). Nearly three-quarters (73.2%) of respondents (n = 183) agreed that education on safe drug disposal should be provided (Table 3).

3.4 Storage Condition

Almost two thirds (n = 160, 64%) of the homes had suitable storage for their medications, consisting of either containers or shelves. The remainder of them lacked any kind of logical system for storing things. Table 4 shows that almost as many people (n = 120, 48%) keep their medicine at the correct temperature. Moreover, over 40% of homes (n=95) reported monthly checking of expired medications (Table 2). Every month, (n = 64, 25.6%) discarded their unneeded medication. Many different options existed for drug disposal. (38.5%) of the population openly discarded their medication, most often in their own yards or public spaces; (22.8%) openly burned their medications. Of those who were given medication, just 41 (16.4%) brought it back to the pharmacy. In this sample, 47.2% (n = 118) of respondents obtained prescription medication, whereas 21.2% (n = 53) obtained over-the-counter medication (Table 3).

| S. No. | Demographic Parameters | (n) % | |
|--------|-------------------------------|------------|-------------|
| | | 18-25 | 208 (83.2%) |
| 1. | Age | 26-35 | 34 (13.6%) |
| | | 35+ | 8 (3.2%) |
| 2. | Gender | Male | 189 (75.6%) |
| | | Female | 61 (24.4%) |
| | | Other | - |
| 3. | Qualification | literate | 247 (98.8%) |
| | | Illiterate | 3 (1.2%) |

 Table 1: Demographic characteristics of the respondents (n=250)

| Table 2: | General | Knowledge | of the | consumer | regarding | medicine |
|----------|---------|-----------|--------|----------|-----------|----------|
| | | | | | | |

| S. No. | Question | Response | N % |
|--------|--|-----------------|-------------|
| 1. | Do you own any unutilized | Yes | 179 (71.6%) |
| | household? | No | 71 (28.4%) |
| | | Every month | 95 (38%) |
| | How frequently do you check | Every 3 month | 60 (24%) |
| 2. | the date when an unused | Every 6 month | 47 (18.8%) |
| | medication expires? | Yearly | 26 (10.4%) |
| | | Never | 22 (8.8%) |
| 3. | Do you possess any over- the-counter (OTC) or non- prescription medications? | Yes | 117 (46.8%) |
| | | No | 99 (39.6%) |
| | | Don't know | 34 (13.6%) |
| 4. | Do you have any prescription medicine at home? | Yes | 208 (83.2%) |
| | | No | 30 (12%) |
| | | Don't know | 12 (4.8%) |
| | Have you ever shared unused | Yes | 111 (44.4%) |
| 5. | medications with someone who's suffering from similar symptoms? | No | 115 (46%) |
| | | No answer given | 24 (9.6%) |
| | | Yes | 77 (30.8%) |
| 6. | Do you know anything about the DUMP comparing? | No | 149 (59.6%) |
| | | No answer given | 24 (9.6%) |

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| | | 0 | 71 (28.4%) |
|-----|--|---|-------------|
| | How many unused medications do you have at home? | 1-5 | 147 (58.8%) |
| /. | | 6-10 | 27 (10.8%) |
| | | >10 | 5 (2%) |
| | | Improved medical condition | 101 (40.4%) |
| | | The drug was expired | 54 (21.6%) |
| | | Changes in therapy | 33 (13.2%) |
| | | Non-adherence to medication | 10 (4%) |
| | | Adverse drug reactions | 4 (1.6%) |
| 8. | What is the cause of the non-use of medications? | Did not know/sure about the purpose of medication | 9 (3.6%) |
| | of medications. | Instruction for use was unclear | 2 (0.8%) |
| | | Kept for reoccurring condition | 6 (2.4%) |
| | | The patient was pregnant | |
| | | The patient was passed away | |
| | | Did not know | 31 (12.4%) |
| | Class of drugs | NSAIDs | 53 (21.2%) |
| | | Vitamins and nutritional supplements | 49 (19.6%) |
| | | Antibiotics | 74 (29.6%) |
| 9. | | Herbal drugs | 6 (2.4%) |
| | | Antihypertensive drugs | 5 (2%) |
| | | Cough medication | 16 (6.4%) |
| | | Antiallergic drugs | 7 (2.8%) |
| | | Antidiabetic drugs | 4 (1.6%) |
| | | Antiulcer drugs | 2 (0.8%) |
| | | Others | 34 (13.6%) |
| | | Held at home till their expiry | 127 (50.8%) |
| | How did you handle any leftover medication? | Threw away in household garbage | 49 (19.6%) |
| 10. | | Gave to friends/relatives | 41 (16.4%) |
| | | Dumped into a drain or the toilet | 5 (2%) |
| | | Donated to the hospital | 28 (11.2%) |
| | Reasons for the excess medication in the home? | Discontinuation of medication by the doctor | 91 (36.4%) |
| | | Self-discontinuation | 79 (31.6%) |
| 11. | | Buying medication because of advertisements | 15 (6%) |
| | | Overprescription/over dispending of medication | 65 (26%) |
| | Did you check the expiration | Yes | 202 (80.8%) |
| 12. | date of medicine before | No | 40 (16%) |
| | procuring? | Did Not Know | 8 (3.2%) |

| S. No. | Question | Response | Answer (Total 250) |
|---|--|--|--------------------|
| | | Every month | 64 (25.6%) |
| | | Every 3 month | 53 (21.2%) |
| 1. | How often do you dispose unused medicines? | Every 6 month | 57 (22.8%) |
| | incureines : | Yearly | 44 (17.6%) |
| | | Never | 32 (12.8%) |
| | | Dumping | 96 (38.4%) |
| | | Burning | 57 (22.8%) |
| 2. | How do you dispose the unused medicines? | Flushing | 17 (6.8%) |
| | | Return to pharmacy | 41 (16.4%) |
| | | Donate | 39 (15.6%) |
| 2 | Did you ever receive information about proper medication disposal practice? | Yes | 113 (45.2%) |
| 3. | | No | 137 (54.8%) |
| 4. Did you know that improper medication disposal could harm the environment and population health? | Did you know that improper medication | Yes | 179 (71.6%) |
| | No | 71 (28.4%) | |
| | Did you think education on proper medication disposal methods was necessary? | yes | 183 (73.2%) |
| 5. | | No | 41 (16.4%) |
| | | Did not know | 26 (10.4%) |
| | Way to procuring medicines? | Purchased on prescription | 118 (47.2%) |
| 6. | | Purchased over the counter | 53 (21.2%) |
| | | Purchased over the advised of known person | 32 (12.8%) |
| | | Received from the friend/others | 8 (3.2%) |
| | | No | 15 (6%) |
| | | Did Not Know | 24 (9.6%) |

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|----------|----------|----------|-----------|----------|---------------------------------------|
| Table 5: | Consumer | attitude | regarding | aisposai | of medicine |

Table 4: Consumer attitude regarding the storage of medicine

| S. No. | Question | Response | Answer (Total 250) |
|--------|--|--------------|--------------------|
| 1. | How and where do you store unused medicines? | Container | 119 (47.6%) |
| | | Shelf | 41 (16.4%) |
| | | Window side | 13 (5.2%) |
| | | Plastic bag | 43 (17.2%) |
| | | Fridge top | 13 (5.2%) |
| | | Did Not Know | 21 (8.4%) |
| 2. | Did you maintain temperature as per requirement of medication? | Yes | 120 (48%) |
| | | No | 102 (40.8%) |
| | | Did Not Know | 28 (11.2%) |

| S. No. | Particular | Agree | Neither agree/ nor disagree | Disagree |
|--------|---|-------------|--------------------------------|-----------|
| 1. | Is the safe disposal of medicines necessary? | 209 (83.6%) | 27(10.8%) | 14 (5.6%) |
| 2. | Is there any need for a program to collect unused or expired medicines from home? | 198 (79.2%) | 30 (12%) | 22 (8.8%) |
| 3. | Is awareness regarding the hazards of unsafe disposal and method of safe disposal of medicines among the general public required? | 213 (85.2%) | 22 (8.8%) | 15 (6%) |

Table 5: Consumer attitude regarding disposal of unused and expired medicines

3.5 Evaluation of Customer Attitude

The vast majority of those polled (n = 209, or 83.6%) agreed that proper medication disposal is important. Most people (n = 198, or 79.2%) agreed that there should be a system in place to pick up old or unused drugs from people's homes. The majority of people surveyed in this research (n = 213, 85.2%) agreed that more education is needed to raise awareness about the risks associated with inappropriate medication disposal and the best optimal way to do so as shown in Table 5.

4. Discussion

The findings of this study provide valuable insights into the awareness, attitudes, and practices related to medication storage and disposal among the general public in Achrol, Jaipur, Rajasthan. Our results highlight a significant gap in knowledge and proper disposal practices, which can pose serious environmental and health risks[31].

4.1 Awareness and Attitudes toward Medication Disposal

The study revealed that while a majority of respondents (71.6%) reported having unused medications at home, a large proportion (50.8%) stored them until expiration rather than disposing of them promptly. This indicates a lack of awareness regarding appropriate disposal methods. Moreover, nearly half of the respondents (46.8%) purchased medications over the counter, which suggests a high prevalence of self-medication practices. The low percentage (16%) of participants who checked

expiration dates before purchasing medications further emphasizes the need for educational interventions to promote responsible medication management[35].

4.2 Current Disposal Practices and Associated Risks

A concerning finding from the study is that a significant proportion of respondents (19.6%) disposed of medications in household garbage, and 2.2% reported flushing medications down the toilet. These practices can lead to environmental contamination, including water pollution and the development of antibiotic-resistant bacteria. Only 11.2% of respondents returned unused medications to pharmacies, highlighting the limited utilization of proper disposal channels[28].

4.3 Factors Influencing Storage and Disposal Practices

Several factors contribute to the improper disposal of medications, including a lack of knowledge about disposal methods (54.8% of respondents), convenience, and misconceptions about the environmental and health impacts of incorrect disposal. Additionally, a high percentage of respondents (83.2%) reported possessing prescription medications at home, further underscoring the need for awareness campaigns on safe storage and disposal practices[35].

4.4 Need for Educational Interventions and Policy Implementation

The findings suggest that public awareness campaigns and educational programs are crucial to improving medication disposal practices. Most respondents (73.2%) agreed that educational initiatives are necessary to address the issue. Pharmacists and healthcare providers can play a pivotal role in disseminating information about safe disposal methods. Furthermore, the implementation of takeback programs and the availability of designated collection points could enhance compliance with proper disposal practices[36].

4.5 Comparison with Previous Studies

Similar studies conducted in other regions have reported comparable findings, indicating a global challenge in medication disposal practices. Studies from Ethiopia and Nigeria have shown that improper disposal methods, such as open dumping and flushing, are prevalent due to a lack of awareness and available disposal facilities. The present study reinforces the need for a standardized framework for medication disposal, aligning with global best practices.

4.6 Limitations and Future Directions

This study has certain limitations, including a relatively small sample size and potential response biases. Additionally, socioeconomic factors that may influence medication disposal practices were not extensively analyzed. Future research should focus on larger, more diverse populations and explore the impact of socioeconomic and educational factors on medication management[37,38].

5. Conclusion

This study provides valuable insights into the general public's awareness, attitudes, and practices regarding the storage and disposal of medications in Achrol, Jaipur, Rajasthan. The findings indicate a significant gap in knowledge and proper disposal practices, with many individuals storing expired or unused medications at home and resorting to inappropriate disposal methods such as throwing them in household garbage or flushing them down the drain. Despite high literacy levels, a substantial portion of the population remains unaware of the environmental and health hazards associated with improper medication disposal. The study highlights the urgent need for targeted educational interventions to promote safe disposal practices and encourage the responsible management of pharmaceutical waste. Increased awareness campaigns, pharmacist counseling, and the establishment of take-back programs can contribute to reducing the environmental impact and potential health risks posed by unused or expired medications. Furthermore, collaboration between healthcare providers, policymakers, and the community is crucial to developing sustainable solutions for proper medication disposal and storage practices.

Future research should focus on exploring the long-term effectiveness of educational programs and policy interventions to address this issue comprehensively. Implementing stringent guidelines and increasing public engagement can lead to more responsible medication management and contribute to better public health and environmental outcomes.

6. Abbreviations

- **EE:** Ethinylestradiol
- **FBS:** Fetal bovine serum
- HGF: Hepatocyte growth factor
- NSAIDs: Non-steroidal anti-inflammatory drugs
- **OTC:** Over the counter
- USFDA: United States Food and Drug Administration
- USDEA: United States Drug Enforcement Administration

7. CRediT Authorship Contribution Statement

Mazhar Jamil: Data curation, Writing- Original draft preparation, Software, Formal analysis, Investigation.

Ashutosh Upadhayay: Conceptualization, Methodology, Supervision, Writing- Reviewing and Editing, Project administration.

Md Sabir Alam: Writing-Reviewing and Editing.

Vikram Kumar: Validation, Writing-Reviewing and Editing.

Aafrin Waziri: Writing-Reviewing and Editing.

Navneet Kumar Upadhyay: Validation, Writing-Reviewing and Editing.

Tejpal Yadav: Supervision, Visualization, Conceptualization, Writing- Reviewing and Editing, Writing- Original draft preparation, Project administration, Data Curation, Formal analysis, Validation.

8. Ethics Approval and Consent to Participate: Not applicable

9. Funding: Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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11. Conflict of Interest: None

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