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RESEARCH

# Parental Knowledge, Attitudes, and Practices on Safe Medication Storage and Disposal: A Cross-Sectional Study in Benghazi, Libya

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## ABSTRACT

**Background:** Poisoning in children is a worldwide public health issue and a primary cause of accidental injuries among the pediatric population. It underscores the critical necessity of maintaining ongoing situational awareness regarding potential risks and hazards in order to mitigate the occurrence of emergencies, as part of the first domain of the Chain of Survival Behaviors.

**Methods:** A cross-sectional study was conducted exclusively within the outpatient department of Benghazi Children's Hospital in Libya. Data were collected using a structured, interviewer-administered questionnaire that was adapted from validated KAP (knowledge, attitude, and practices) surveys concerning medication safety and poisoning prevention in children.

**Results:** This study of 59 parents of children aged 0–6 years indicated no significant association between a parent's place of residence or educational level with their practices or attitudes. However, a statistically significant relationship

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was observed between the parents' gender and their practices concerning medications in the home that could lead to a first aid emergency, with mothers demonstrating notably better practices than fathers.

**Conclusion**: This study provides an initial exploration of parental knowledge, attitudes, and practices regarding safe medication storage and disposal among parents in the outpatient department at Benghazi Children's Hospital. While attitudes were generally positive, a notable gap existed between attitudes and actual practices, with mothers demonstrating safer practices than fathers. These findings are consistent with international evidence. Further research is needed to confirm and expand the findings in more diverse settings.

**Keywords:** Accidental, disposal, medication, poisoning, storage

## خلاصة

**الخلفية:** يُعدّ التسمم لدى الأطفال مُشكلة صحية عامة عالمية، وسببًا رئيسيًا للإصابات العرضية بين الأطفال. ويؤكّد هذا على الضرورة القُصوى للحفاظ على وعي مُستمر بالمخاطر والتهديدات المُحتملة للحدّ من حدوث حالات الطوارىء، كجُزء من المجال الأول من سلسلة سلوكيات البقاء.

**المنهجية:** أُجريت دراسة مقطعية حصريًا في قسم العيادات الخارجية بمستشفى بنغازي للأطفال في ليبيا. جُمعت البيانات باستخدام استبيان مُنظّم، أُجرِيَ بواسطة المُقابلات، مُقتبس من مُسوحات مُعتمَدة حول المعرفة والمواقف والممارسات ، حول سلامة الأدوية والوقاية من التسمم لدى الأطفال.

**النتائج:** أشارت هذه الدراسة، التي شملت 59 والدًا لأطفال تتراوح أعمارهم من 0 إلى 6 سنوات، إلى عدم وجود ارتباط يُذكر بين مكان إقامة الوالدين أو مستواهم التعليمي وممارساتهم أو مواقفهم. ومع ذلك، لوحظت علاقة ذات دلالة إحصائية بين جنس الوالدين وممارساتهم المتعلقة بالأدوية في المنزل والتي قد تؤدي إلى حالات إسعافات أولية طارئة، حيث أظهرت الأمهات ممارسات أفضل بشكل ملحوظ من الآباء.

**الخلاصة:** تُقدّم هذه الدراسة استكشافًا أوليًا لمعارف الوالدين ومواقفهم وممارساتهم المُتعلقة بالتخزين الآمن للأدوية والتخلص منها بين الآباء في قسم العيادات الخارجية بمستشفى بنغازي للأطفال. وبينما كانت المواقف إيجابية بشكل عام، وُجدت فجوة ملحوظة بين المواقف والممارسات الفعلية، حيث أظهرت الأمهات ممارسات أكثر أمانًا من الآباء. تتوافق هذه النتائج مع الأدلة الدولية. هناك حاجة إلى مزيد من الأبحاث لتأكيد النتائج وتوسيع نطاقها في بيئات أكثر تنوعًا.

**الكلمات المفتاحية:** عرضي، التخلص، الأدوية، التسمم، التخزين.

## MUHTASARI

**Usuli:** Sumu kwa watoto ni tatizo la afya ya umma duniani kote na ni miongoni mwa sababu kuu za majeraha yasiyokusudiwa kwa watoto. Tatizo hili linaonesha umuhimu mkubwa wa kudumisha uelewa wa mara kwa mara kuhusu hatari na vihatarishi vinavyoweza kusababisha dharura, kama sehemu ya eneo la kwanza la *Mnyororo wa Tabia za Uhai (Chain of Survival Behaviors)*.

**Mbinu:** Utafiti wa mtambuka (cross-sectional) ulifanyika katika idara ya wagonjwa wa nje pekee ya Hospitali ya Watoto ya Benghazi nchini Libya. Takwimu zilikusanywa kwa kutumia dodoso lililopangwa, lililosimamiwa na mhojiwa, na lililorekebishwa kutoka tafiti zilizothibitishwa za KAP (maarifa, mitazamo, na vitendo) kuhusu usalama wa dawa na kinga dhidi ya sumu kwa watoto.

**Matokeo:** Utafiti huu ulihusisha wazazi 59 wa watoto wenye umri wa miaka 0–6 na haukuonesha uhusiano wa maana kati ya makazi ya mzazi au kiwango cha elimu na vitendo au mitazamo yao. Hata hivyo, uhusiano wa kitakwimu ulionekana kati ya jinsia ya mzazi na vitendo vyao kuhusu matumizi na uhifadhi wa dawa nyumbani ambavyo vinaweza kusababisha dharura ya huduma ya kwanza, ambapo akina mama walionesha vitendo bora zaidi kuliko akina baba.

**Hitimisho:** Utafiti huu unatoa tathmini ya awali ya maarifa, mitazamo, na vitendo vya wazazi kuhusu uhifadhi na utupaji salama wa dawa miongoni mwa wazazi wanaohudhuria idara ya wagonjwa wa nje katika Hospitali ya Watoto ya Benghazi. Ingawa mitazamo kwa ujumla ilikuwa chanya, kulikuwa na pengo kubwa kati ya mitazamo na vitendo halisi, huku akina mama wakionesha vitendo salama zaidi kuliko akina baba. Matokeo haya yanaendana na ushahidi wa kimataifa. Tafiti zaidi zinahitajika ili kuthibitisha na kupanua matokeo haya katika mazingira tofauti zaidi.

**Maneno Muhimu:** Ajali, utupaji, dawa, sumu, uhifadhi

Poisoning is a significant global health concern and a leading cause of unintentional injury among pediatric populations (Ahmed et al., 2022). A study conducted in Benghazi children's hospital included 232 cases, found that accidental poisonings are most prevalent in children under six years old, and the vast majority of poisoning cases, 93%, are unintentional. In contrast, intentional poisoning accounts for 7% of cases, with nine documented suicide attempts, four of which involved the ingestion of multiple drugs (Alaqeli et al., 2023). Similarly, another study conducted in the same hospital included 127 cases of drug ingestion poisoning, found that the majority of poisoning incidents were accidental, with the highest prevalence observed among children aged 1 to 3 years (Bohagar et al., 2022). Drug ingestion was identified as the leading cause of poisoning; these findings suggest that improper storage of medications constitutes a primary risk factor for pediatric poisoning.

Numerous studies worldwide have indicated that, ultimately, unused medications are predominantly disposed of through household garbage, serving as the primary disposal method. Additionally, secondary pathways include disposal via sewage systems, pharmacies, and other designated locations (Alnahas et al., 2020). A cross-sectional study conducted in Qatar found that approximately 60% of parents retain unused medications in their homes, while about 10% were uncertain about the disposal or subsequent handling of their leftover pharmaceuticals (Hendaus, Darwish, et al., 2021).

Countries with stringent environmental regulations tend to possess more comprehensive and effective systems for managing pharmaceutical waste. Conversely, less developed nations often depend on less efficient methods for waste disposal, reflecting disparities in regulatory frameworks and infrastructural capacity (Hoque et al., 2023).

We hypothesize that parents with higher levels of knowledge and positive attitudes toward safe medication storage and disposal will demonstrate better medication safety practices. Moreover, based on previous studies conducted at Benghazi Children's Hospital, it has been observed that pediatric poisoning cases are more prevalent in urban areas compared to rural areas (Alaqeli et al., 2023; Bohagar et al., 2022). Therefore, we thought that living in urban areas is associated with a higher number of poisoning cases. We suggest that this may be due to increased access to medications in urban settings, whereas rural residents tend to use fewer medications, often relying more on natural resources and herbal remedies.

This study aims to assess parental knowledge, attitudes, and practices regarding the safe storage and disposal of medications in Libya, with a focus on risks related to child poisoning. This subject addresses the first domain of the chain of survival behaviors, emphasizing proactive prevention and preparation. It highlights the critical need for continuous situational awareness concerning potential risks and hazards to reduce the incidence of emergencies. To design effective interventions tailored to the Libyan context, it is essential to first assess the current parental knowledge, attitudes, and practices (KAP) concerning medication safety.

## METHODS

### Study design

For this study, we used a cross-sectional survey design to assess the knowledge, attitudes, and practices of parents

regarding the prevention of accidental drug ingestion in children aged 0–6 years in Libya. We collected data using a structured, interviewer-administered questionnaire that was adapted from validated KAP surveys concerning medication safety and poisoning prevention in children (Makki et al., 2021). The QUM-Qatar (Questionnaire on Unused Medications in Qatar) instrument exhibited acceptable psychometric properties, suggesting its suitability for future application in research and clinical settings to evaluate knowledge, attitudes, and practices related to unused medications in Qatar and globally. We translated the questionnaire into Arabic and pilot tested it to ensure clarity and cultural relevance.

We conducted this study exclusively in the outpatient department of Benghazi Children's Hospital, Libya, on 12 and 13 January 2025. We included parents aged 18 years and above with at least one child aged 0–6 years who were present in the outpatient department at Benghazi Children's Hospital and who provided informed consent to participate in the study. Participants were recruited consecutively during clinic visits. We excluded parents whose children were all older than six years, as well as any individuals who declined to provide consent for participation.

## Recruitment of study participants

Most of the parents included in this study came to the outpatient department seeking help and treatment for their children's medical conditions. This department includes clinics for various pediatric specialties. To minimize selection bias, consecutive sampling of all eligible parents in the outpatient department was used. We emphasized confidentiality and encouraged honest reporting to reduce social desirability bias, almost all parents were interviewed separately. Each interview lasted approximately 10 minutes.

The questionnaire comprised 27 items divided into five sections: six questions addressing sociodemographic data, four questions related to parenting responsibilities, four questions assessing knowledge, seven questions evaluating attitudes, and six questions concerning practices, as set out in Table 1.

We analyzed data by using the statistical software program IBM SPSS version 24, using descriptive statistics to summarize participant demographics and KAP scores. Associations between sociodemographic factors and KAP outcomes were analyzed using the Pearson chi-square test. The Fisher-Freeman-Halton exact test was used when more than 20% of cells had expected frequencies less than 5.

| Category | Questions | Response | |
|---|---|---|---|
| | | Answers | Score |
| Socio-Demographic Data | Age | | |
| | Nationality | | |
| | Place of residency | | |
| | Marital Status | Single | |
| | | Married | |
| | | Divorced | |
| | | Widow | |
| | Educational Level | No education | |
| | | Basic education | |
| | | Secondary education | |
| | | Higher education (diploma, bachelor's degree, master's degree, doctorate) | |
| | Profession | Unemployed | |
| | | Employee (mention the job) | |
| | | Retired | |
| | | Student | |

(Contd.)

| Category | Questions | Response | |
|---|---|---|---|
| | | **Answers** | **Score** |
| Parental responsibilities | Relationship with the Child | Father | |
| | | Mother | |
| | How many hours do you directly supervise your child | 1–4 hours daily | |
| | | 5–10 hours daily | |
| | | 11–15 hours daily | |
| | | 16 or more hours daily | |
| | Do you share parenting responsibilities | No | |
| | | Yes | |
| | Number of children under 6 years old in the family | One | |
| | | Two | |
| | | Three | |
| | | Four | |
| | | Five or more | |
| Knowledge | Do you know the correct way to dispose of unused or expired medications? | Yes | 3 |
| | | Maybe | 2 |
| | | No | 1 |
| | Have you ever received information about safely disposing of unused or expired medications? | Yes | 3 |
| | | To some extent | 2 |
| | | No | 1 |
| | What are the reasons for keeping medicines at home? (More than one option can be chosen) | Used for chronic diseases | |
| | | Multiple prescriptions | |
| | | As needed basis | |
| | | Discontinued use after improvement | |
| | | Discontinued use due to side effects | |
| | | May be used in the future | |
| | | The doctor changed the treatment | |
| | | Others | |
| | What are your sources of information regarding safe medication storage and disposal? (More than one option can be chosen) | There is no information | |
| | | Media | |
| | | Educational seminars | |
| | | Family and Friends | |
| | | Medical Staff | |
| Attitude and self-efficacy | Do you think it is important to read medicine labels to know how to store them? | Strongly disagree | 1 |
| | | Disagree | 2 |
| | | Not sure | 3 |
| | | Agree | 4 |
| | | Strongly agree | 5 |

(Contd.)

| Category | Questions | Response | |
|---|---|---|---|
| | | **Answers** | **Score** |
| | Do you think it is important to know the expiry date of the medicine? | Strongly disagree | 1 |
| | | Disagree | 2 |
| | | Not sure | 3 |
| | | Agree | 4 |
| | | Strongly agree | 5 |
| | Do you think children are more susceptible to medication poisoning at home than outside? | Strongly disagree | 1 |
| | | Disagree | 2 |
| | | Not sure | 3 |
| | | Agree | 4 |
| | | Strongly agree | 5 |
| | In our community, do you think there is a lack of adequate information about the safe disposal of unused or expired medicines? | Strongly disagree | 1 |
| | | Disagree | 2 |
| | | Not sure | 3 |
| | | Agree | 4 |
| | | Strongly agree | 5 |
| | Would you like to participate in a health education program on ways to safely dispose of unused or expired medications? | Strongly disagree | 1 |
| | | Disagree | 2 |
| | | Not sure | 3 |
| | | Agree | 4 |
| | | Strongly agree | 5 |
| | How concerned are you about the risk of poisoning in your child's daily life? | I don't feel worried at all | 1 |
| | | I feel a little anxious | 2 |
| | | I feel moderate anxiety | 3 |
| | | I feel very anxious | 4 |
| | | I feel very worried | 5 |
| | In your opinion, how can we control or reduce the negative impact of unused or expired medications? (More than one option can be chosen) | I don't know | |
| | | Provide adequate safe disposal instructions to users | |
| | | Prescribing medications in specific doses and duration | |
| | | Reducing the number of medications prescribed at the same time as much as possible | |
| | | Donating unused medications | |
| Practice | Do you check disposal instructions for unused or expired medications before disposing of them? | Never | 1 |
| | | Rarely | 2 |
| | | Sometimes | 3 |
| | | mostly | 4 |
| | | always | 5 |
| | How do you dispose of unused or expired medications? | Throw it in the trash | |
| | | Flush it in the toilet or sink | |
| | | Take it to a pharmacist for disposal or a take-back program | |
| | | I don't know what to do with it | |

(Contd.)

| Category | Questions | Response | |
|---|---|---|---|
| | | **Answers** | **Score** |
| | How often do you check your home for hidden or missing medications to make sure they are stored safely? | Never | 1 |
| | | Monthly | 2 |
| | | Weekly | 3 |
| | | Daily | 4 |
| | Are all medications stored in cabinets with child-safe locks or in high, inaccessible locations? | No | 1 |
| | | Yes | 2 |
| | Do you avoid taking medications in front of your children? | No | 1 |
| | | Yes | 2 |
| | Do you have contact information for poison control? | No | 1 |
| | | Yes | 2 |

**Table 1:** The questionnaire utilized in this study.

Ethical approval for the study was granted by the Libyan National Committee for Bio-safety and Bioethics (LNCBB) on September 30, 2024, reference number NBC:008. H.24.9. All participants were thoroughly informed that their interview data would be utilized for medical research purposes, and they provided their informed consent to participate in the study.

## RESULTS

The study included a total of 59 parents of children aged 0–6 years, comprising 30 (50.9%) mothers and 29 (49.2%) fathers, with a mean age of 38.2 years (SD = 9.6). Of these participants, 57 (96.6%) were Libyan and two (3.4%) were non-Libyan. The majority resided in Benghazi, 44 (74.6%) participants, with 14 (23.7%) living in rural areas and only one (1.7%) participant from Sabha city. Regarding marital status, most participants were married 58 (98.3%), with only one (1.7%) individual being divorced. Educational attainment varied, with 33 (55.9%) participants holding higher education degrees, 12 (20%) having completed secondary education, 13 (22%) possessing basic education, and one (1.7%) participant lacking formal education. Employment status revealed that 34 (57.6%) parents were engaged in various occupations or businesses, while the remaining 25 (42.4%) were unemployed. In terms of parenting roles, data indicated that 45 (76.3%) parents shared parenting responsibilities, whereas 14 (23.7%) did not. In the sample, 20 parents had one child younger than six years, another 20 had two children within this age range, 13 parents had three children under six, 5 parents had four children under six, and only one parent indicated having five or more children under the age of six. the socio-demographic data is set out in Table 2.

Attitude scores were categorized based on Bloom's cutoff categories as positive (≥ 80%), neutral (60%–79%), or negative (<60%). A total of 39 (61%) parents demonstrated a positive attitude, 19 (32.2%) demonstrated a neutral attitude, and one (1.7%) demonstrated a negative attitude, (only one mother demonstrated a negative attitude, none of the fathers demonstrated a negative attitude).

Additionally, responses about practice were categorized as good (≥80%), moderate (60%–79%), or poor (<60%). Among the participants, 12 (20.3%) parents demonstrated good practice, 26 (44.1%) demonstrated moderate practice, and 21 (35.6%) displayed poor practice, (only one father demonstrated good practice, 11 mothers demonstrated good practice).

Among the participants residing in Benghazi, 30 (68.2%) parents showed a positive attitude, 13 (29.5%) showed a neutral attitude, and only one showed a negative attitude. Regarding the parents residing in the countryside, 8 (57.1%) showed a positive attitude, 6 (42.9%) showed a neutral attitude, and none showed a negative attitude. Additionally, the sole parent residing in Sabha demonstrated a positive attitude.

| Socio-demographic data | | N | % |
|---|---|---|---|
| Nationality | Libyan | 57 | 96.6% |
| | Non-Libyan | 2 | 3.4 % |
| Place of Residence | Benghazi city | 44 | 74.6 % |
| | Sabha city | 1 | 1.7 % |
| | Rural areas | 14 | 23.7% |
| Marital status | Married | 58 | 98.3% |
| | Divorced | 1 | 1.7 % |
| Educational level | Higher education degree | 33 | 55.9% |
| | Secondary education | 12 | 20% |
| | Basic education | 13 | 22% |
| | Lacking formal education | 1 | 1.7 % |
| profession | Engaged in an occupation or business | 34 | 57.6% |
| | Unemployed | 25 | 42.4 % |
| Relationship with the Child | Father | 29 | 49.2 % |
| | Mother | 30 | 50.9 % |
| Number of Children under 6 years old in the family | One | 20 | 33.9% |
| | Two | 20 | 33.9% |
| | Three | 13 | 22% |
| | Four | 5 | 8.5% |
| | Five or more | 1 | 1.7% |

**Table 2:** Sociodemographic characteristics of 59 parents participating in the survey.

In addition, among the 44 participants residing in Benghazi, 8 (18.2%) demonstrated good practice, 21 (47.7%) demonstrated moderate practice, and 15 (34.1%) demonstrated poor practice. In contrast, of the 14 participants residing in the countryside, 4 (28.6%) demonstrated good practice, 5 (35.7%) demonstrated moderate practice, and 5 (35.7%) demonstrated poor practice. The only parent residing in Sabha demonstrated poor practice.

Among the 33 parents with higher education degrees, 23 (69.7%) showed a positive attitude and 10 (30.3%) showed a neutral attitude, while none showed a negative attitude. Additionally, of the 12 parents with secondary education, 9 (75%) displayed a positive attitude and 3 (25%) a neutral attitude, with no negative responses. Among the 13 parents with basic education, 6 (46.2%) expressed a positive attitude, another 6 (46.2%) a neutral attitude, and only 1 (7.7%) had a negative attitude. The one parent with no formal education also demonstrated a positive attitude.

Among the 33 parents with higher education degrees, 7 exhibited good practice, 14 demonstrated moderate practice, and 12 demonstrated poor practice. Of the 12 parents with secondary education, 2 exhibited good practice, 6 demonstrated moderate practice, and 4 demonstrated poor practice. Among the 13 parents with basic education, 3 demonstrated good practice, 6 demonstrated moderate practice, and 4 demonstrated poor practice. The single parent with no formal education exhibited poor practice.

The analysis showed no significant association between place of residence and parenting practices or attitudes related to safe medication storage and disposal (exact p-value > 0.05). Similarly, no significant relationship was found between educational level and either parenting practice or attitude related to safe medications storage and

disposal (exact p-value > 0.05). Conversely, a statistically significant association was observed between the parent-child relationship and parenting practice related to safe medication storage and disposal (exact and asymptotic p-value = 0.002), with mothers exhibiting significantly better practices than fathers. Both mothers and fathers exhibited positive attitudes toward parenting; however, no significant difference was identified between their attitudes (exact and asymptotic p-value > 0.05).

Results from questions where multiple-choice items, illustrated in the following graphs, were not incorporated into the scoring process. The data indicate that medical staff were the most frequently cited source of information, whereas schools were the least common source, as shown in Figure 1.

Regarding the reasons for storing medications at home, the most frequently selected response was "As needed basis", as shown in Figure 2.

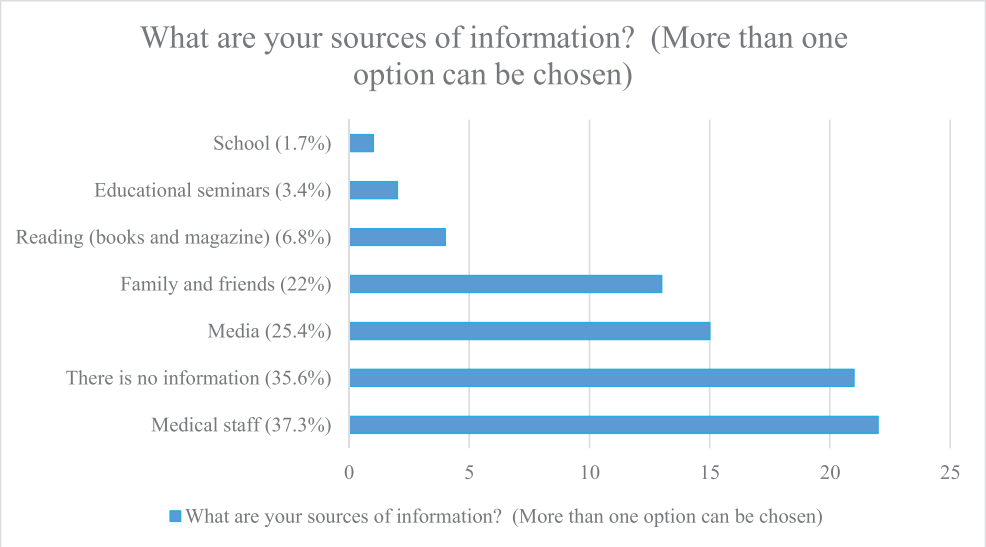


**Figure 1:** Sources of information for parents.

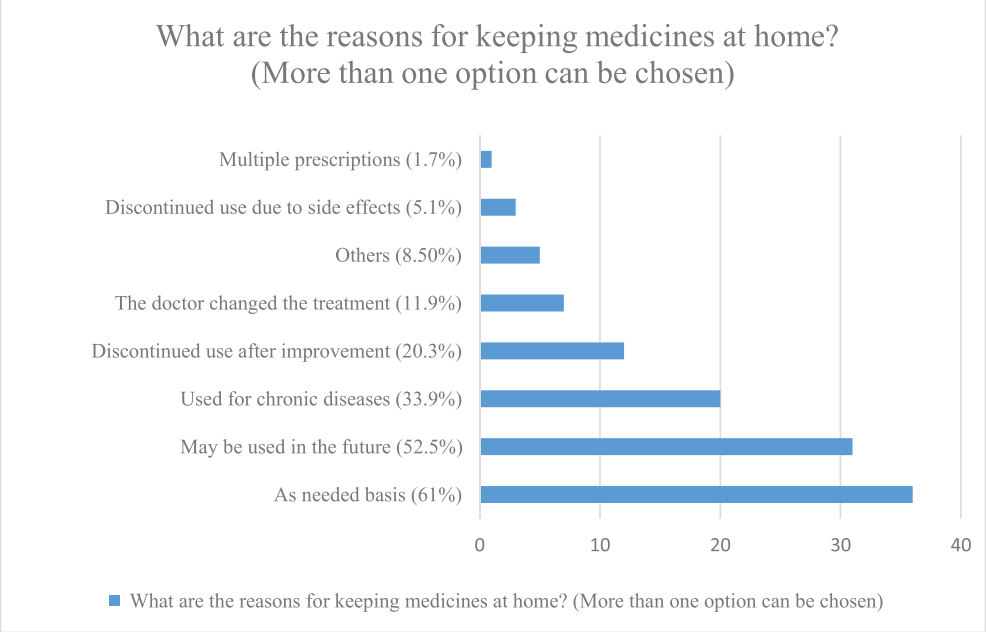


**Figure 2:** Reasons stated for keeping medicines at home.

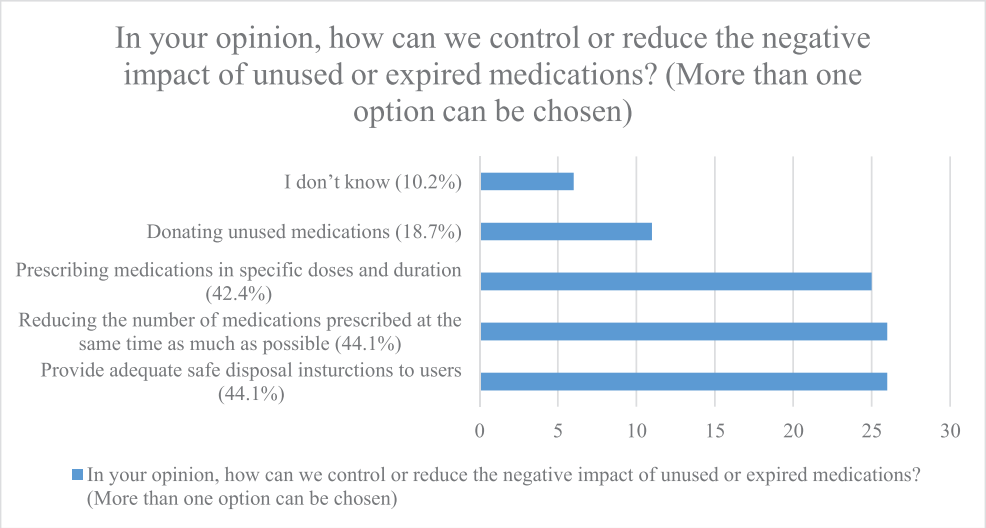


**Figure 3:** Strategies to reduce the negative impact of unused or expired medications.

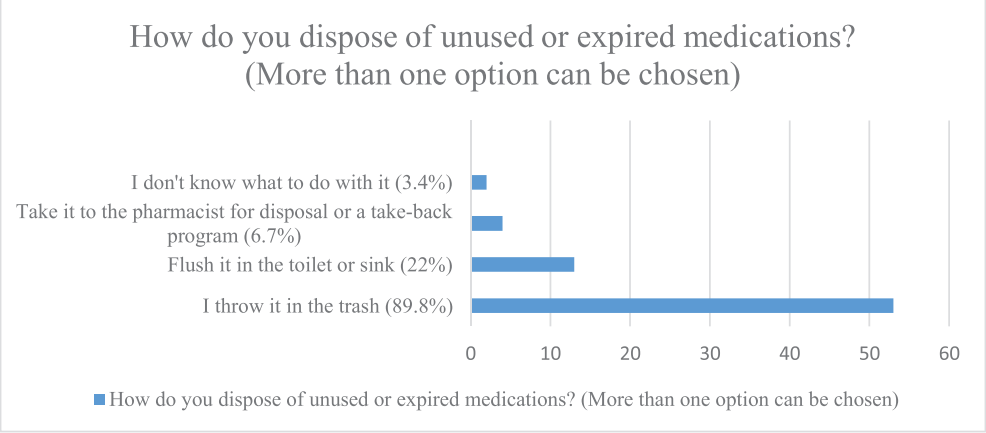


**Figure 4:** Methods of disposing unused or expired medications.

Concerning strategies to mitigate the negative impacts of unused or expired medications, two responses emerged as particularly popular: "reducing the number of medications prescribed simultaneously as much as possible" and "providing adequate and safe disposal instructions to users", as shown in Figure 3.

When asked about methods for disposing of unused or expired medications, the most commonly chosen answer was "I throw it in the trash", as shown in Figure 4.

## DISCUSSION

Our study aimed to assess parents' knowledge, attitudes, and practices related to the safe storage and disposal of medications. Results demonstrated predominantly positive attitudes across both parental groups, with mothers exhibiting significantly better practices than fathers. A recent systematic review reported that advanced age, female sex, and higher education level were associated with improved medication storage practices (Jafarzadeh et al., 2021). Similarly, female gender, an age greater than 30 years, and a secondary or high school education were identified as significant predictors of safer medication storage practices (Samha et al., 2024).

Our study revealed no statistically significant association between parental educational level and their practices or attitudes. Similarly, in another study the level of education was not significantly associated with medication management behaviors, such as storing medications in a locked location or combining multiple medications into a single bottle (Hendaus et al, 2021b).

For context, Makkia et al. (2024) indicated that participants possessed a satisfactory level of knowledge and a positive attitude regarding unused medications. In contrast, their practical behaviors, specifically those related to the acquisition and disposal of medication, were poor. Another study conducted by Shehata et al., 2023 found that the majority of mothers included in their study demonstrated a positive attitude toward managing childhood toxicity. However, they also found a significant lack of comprehensive information regarding appropriate medication disposal practices.

Increased knowledge is thought to contribute to safer practices. However, a study conducted in the State of Qatar found that possessing knowledge alone does not reliably lead to the adoption of safer attitudes or behaviors, implying that the knowledge base does not necessarily align with the practical skills and behavioral modifications necessary for effective poisoning prevention (Weerasinghe et al., 2025).

Furthermore, a study conducted in Saudi Arabia indicated that the majority of the population supports the implementation of a mechanism for medication waste disposal, including a smartphone application (Althagafi et al., 2022). However, this positive intention was not widely reflected in practice, as only a small minority of participants (fewer than 9%) actually returned discarded medicines to pharmacies or healthcare facilities.

A systematic review indicated that despite a recognized high level of awareness regarding environmental safety's influence on safe medication waste disposal, the corresponding behavior within the population does not align with the knowledge and information received (Kusturica et al., 2016).

Bridging the gap between knowledge and action, through targeted educational and awareness initiatives, is crucial for motivating behavior change and, consequently, preventing pediatric harm. Our study indicated that the most prevalent reason for keeping medications at home is to have them available for use when needed and to allow management of ongoing health conditions without delay. This is corroborated by a similar study, which indicated that the most frequently reported reasons for storing medications were their potential future use and daily use (Al Ghadeer et al., 2024).

In this regard, Diep et al., 2024 also found that household medication storage is highly prevalent, and some of the storage behaviors observed were inappropriate. Parental education represents a vital and impactful approach to preventing childhood poisoning by substantially minimizing the dangers posed by unsafe storage of pharmaceuticals and toxic household agents. In addition to that, there is a critical necessity of maintaining ongoing situational awareness regarding potential risks and hazards in order to mitigate the occurrence of emergencies.

The perceived efficacy of an individual's actions on mitigating risks to environmental safety and public health constitutes a key factor in shaping compliance behavior, specifically as it relates to medical waste management protocols (Gifford et al., 2014).

To effectively mitigate the risks associated with improper medication handling, a coordinated effort is required to educate both the public and healthcare professionals regarding the significance of safe medication storage and disposal. By focusing on education as prevention these initiatives support the first domain of the chain of survival behaviors, that emphasizing the importance of proactive prevention and preparedness.

## Limitations and strengths of the study

Several limitations should be acknowledged. Firstly, the cross-sectional design of the study restricts causal inferences between variables. Secondly, the sample size was relatively small and was collected using convenience sampling methods. Furthermore, reliance on self-reported data introduces potential biases, such as overestimation of knowledge or recall inaccuracies due to memory lapses. Finally, our study was conducted in a single hospital, which may limit the external validity of the findings.

However, this study is among the initial efforts to assess parental awareness in Libya regarding the appropriate storage and disposal of used and unwanted medications. The investigation explored parents' knowledge on these topics, with a nearly equal representation of mothers and fathers, thereby minimizing gender bias. Additionally, the sample included parents from diverse sociodemographic backgrounds, which enhances the generalizability of the findings.

### Recommendations

First, larger and more representative studies are needed to validate the trends observed in this study, particularly the discrepancy between knowledge, attitudes, and practical behaviors highlighted both in our findings and in the wider literature. Surveys conducted across diverse community settings such as primary healthcare clinics, nurseries, kindergartens, schools, and community centers and expanded through digital or social media platforms may help capture a more comprehensive picture of parental practices in Libya.

Second, qualitative research could help clarify why positive attitudes toward safe medication handling do not consistently translate into safe practices. Understanding parental motivations, perceived barriers, and daily routines would provide important context for designing effective interventions.

Finally, once more robust and representative data are available, small pilot educational initiatives could be developed and evaluated. These should focus on bridging the knowledge practice gap, improving household safety behaviors, and reinforcing the prevention-oriented domain of the chain of survival behaviors. At this stage, however, broad implementation of such programs would be premature.

## CONCLUSION

This study provides an initial exploration of parental knowledge, attitudes, and practices regarding safe medication storage and disposal among parents in the outpatient department at Benghazi Children's Hospital. While attitudes were generally positive, a notable gap existed between attitudes and actual practices, with mothers demonstrating safer practices than fathers. These findings are consistent with international evidence but must be interpreted cautiously due to the study's limited sample size, single location, and less representative sampling method. Further research involving larger and more diverse parental populations across multiple settings in Libya is required to better understand the factors influencing medication safety practices and to confirm whether the trends observed in this study reflect broader national patterns. Such work is essential before developing large-scale interventions and will help ensure that any future prevention strategies are evidence-based, context-appropriate, and aligned with the proactive preparedness emphasized in the first domain of the chain of survival behaviors.

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## COMPETING INTERESTS

The authors have no competing interests to declare.

## AUTHOR CONTRIBUTIONS

AMA proposed the research idea. SAI, MFF, AYA, AMA and FBE contributed to the initial conceptualization of the study. SAI developed the study design and methodology and drafted the initial manuscript. MFF, AYA, SAI, AMA and FBE organized the questionnaire. AYA, MFF, FBE and AMA conducted the interviews, AYA played a key role in the interview process. FBE contributed to the manuscript by drafting the recommendations and conclusion sections. RF performed the data analysis. MFF interpreted the results, conducted the literature review, and led the main drafting of the manuscript. AYA, MFF designed the figures and tables. MFF, FBE, AYA participated in manuscript editing, MFF made a significant contribution to the editing process. NPC provided mentorship throughout the project. All authors read and approved the final version of the manuscript and share collective responsibility for its content and integrity.

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