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Research Article

Forensic Analysis of Adult Acute Poisoning in Makkah Region: A retrospective study

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Abstract
This paper aims to identify and assess acute poisoning cases in Makkah from 2017 to 2019, which proved its effect on the heath of population with regards to factors such as socio-economic elements. Consequently, the research employed a cross-sectional secondary analytical design to analyse data relating to regional hospitals and forensic laboratories and the concerned patients aged 18 and above. The study showed that adults of the age 20–39 years were the most affected, and accidental poisoning was their major problem. The switch from the use of solid substances to liquid substances as agents for exposure pointed to fresh trends in the use of substances, which proposed call for appropriate prevention programmes. Furthermore, comparing different age groups we identify healthcare-seeking behaviour differences, indicating lower perceived threat and the need for targeted interventions. This study establishes that, though improvements can be seen in forensic management of acute poisonings, there is a need for additional advancement especially in toxicological analysis and acute poisoning incidents in all Makkah's demographics.

Keywords: Forensic Analysis, acute poisoning, intentional poisoning, accidental poisoning, poisonous substances.

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Introduction

Background Study

The acute poisoning is a major world's health problem, a disease that influenced people in various regions around the world, with different rates depending on their geographical location, the level of economical development and the health care system of a country (Al Shubbar et al., 2024). Intoxication can occur from drugs and chemicals whether it was ingested, inhaled or contacted other toxic substances including medications, chemicals used at homes, industrial products or illicit drugs (Boriwala and Hankare, 2024; Gao et al., 2020). This has assumed a proportion that causes substantial morbidity and mortality, and a load that is borne by all health care systems globally.

Worldwide acute poisoning cases have escalated because of factors such as increased sell of over-the-counter (OTC) drugs and chemicals, growing substance use and dependence. World Health Organisation estimates that acute poisoning alone is responsible for causing thousands of deaths (Beigh et al., 2023). In high-income nations; poisoning mainly from drugs and more specifically opioid poisoning has been on the rise. For instance, the United States signified increased rates of poisoning deaths linked to opioids in the previous years; in 2020, the deaths due to opioid toxicity was more than 80,000 (Crowley-Matoka, 2020). Also, benzodiazepine and antidepressant deaths are also other major components of poisoning in many developed nations in the world. Acute poisoning from pesticides and industrial chemicals, suffocation from improper use of home appliances particularly those using carbon monoxide are more common (Wahba et al., 2021). In some countries psychological and sociocultural factors together are significant responsible for deliberate self poisoning particularly among younger

generation. The rate of accidental poisoning has increased in the MENA region as a result of accelerated rates of urbanization, industrialization, and liberal use of lethal chemical in agriculture and homes (Tobaiqy et al., 2020).

In Saudi Arabia, poisoning cases operate under certain socio-economic and culture influence. A cross-sectional study conducted in Jeddah showed that pharmaceutical poisoning and poisoning involving pain relievers, sleep inducing agents, and cardiovascular drugs constituted many cases of poisoning (Al-Khattabi et al., 2023; Althobaiti et al., 2023). Further, a high level of pesticide and chemical use in the rural areas assist in adding to the poisoning index. Another factor worthy of mention is the nature of Makkah region with people from far and near millions on a daily basis for pilgrimage hence exacerbating the poisoning cases occasioned by poor sanitation and disposal system for wastes, uncontrolled use of house hold and industrial chemicals (Al-Khattabi et al., 2023).

Statement of the Problem

Intentional acute poisoning is an essential and comparatively researched populace health issue in the Makkah region (Alnasser et al., 2022). Although several studies have aimed at determining prevalence and pattern of poisoning in different regions of Saudi Arabia, little information is available on adult acute poisoning in the Makkah (Alnasser, 2022). This deficiency in knowledge contributes to the inability to innovate prevention measures, and just about funding to control poisoning. These gaps suggest there is the need to carry out research on poisoning trends, the type of poisons used, and the individuals, groups or communities that are most affected.

Research Questions

- What are the main causes of adult acute poisoning in the region of Makkah?
- How does intentional poisoning and accidental poisoning compare among adults in Makkah?
- To what extent does the current management protocols for acute poisoning in the Makkah region is effective in decreasing morbidity and mortality?

Significance of the Study

The findings of this research will play a vital role in establishing types of toxins that cause poisoning, patients affected population, and results of existing therapies. The finding from this study will help the public health officials in planning, policy makers in their policy formulation and even assist clinicians on the best management of such patients. Moreover, this study findings will enable the knowledge gap on acute poisoning prevalence in the region to be filled in addition to enriching the data base to help in the formulation of relevant preventive measures. Finally, the findings from the current study might be useful for other regions with comparable poisoning issues, especially in the context of the MENA region, witnessing changes in poisoning trends due to industrialization and growing urbanization.

Review of Literature

Forensic analysis plays an important part in the management of acute poisoning cases since the identification of the toxin, the identification of the cause of poisoning and legal requirements are found helpful in the case (Kapoor et al., 2023). Adult acute poisoning in relation to forensic analysis has been discussed in this paper under the various fields including the toxicological testing methods, types of poisons present, the procedures that should be followed when handling the cases, and the difficulties that are likely to be met when analyzing the toxins present in the body samples (Kumar et al., 2022; Nithaniyal et al., 2021). This section critically discusses these features while drawing attention to the existing progress and deficiencies within present forensic processes.

The nature of poisons that lead to acute poisoning in adults differ from one region to another, with differences in wealth, and availability of certain products (Woyessa and Palanichamy, 2020). The common agents are medicines, alcohol, recreational drugs, pesticides, and chemicals used at home (Resiere et al., 2020). Data obtained by Albano et al. (2022) and Cowans et al. (2023) revealed that poisoning by overdosing, including opioids, benzodiazepines, and antidepressants are the commonest causes of poisoning in many developed nations including the United States and the United Kingdom. The literature presents overwhelming evidence for availability of these poisoning agents; however, there is a paucity of data on new toxins such as synthetic drugs (Cowans et al., 2023). These substances present difficulties for analysis in forensic toxicological examinations because of their continuous development and the absence of unambiguous screening methods (Albano et al., 2022). Furthermore, other narcotics such as Fentanyl which is being found mixed with others, we are seeing styles in fatal poisoning (Strenja et al., 2024). These trends require improved forensic methods to correctly identify and manage.

Toxicological examination of poisoning entails the determination of poisonous substances present in specimens as well as determination of concentration (Heinrich et al., 2022). Gas chromatography mass spectrometry (GC-MS) and liquid chromatography tandem mass spectrometry are described as the 'gold standard' in screening for a broad array of toxic substances (Peters and Wissenbach, 2023; Ranjan et al., 2023). They relative advantages includes high sensitivity and specificity that makes them suitable in cases where multiple toxins are ingested (Sapozhnikova, 2022). Nevertheless, according to the reviewed literature, interventions enlisted here have been found to have low efficacy rates (Peters and Wissenbach, 2023; Ranjan et al., 2023). This is because sample preparation and analysis take a lot of time and once toxicological results are needed in cases of acute poisoning for example, then the results are going to be delayed. However, various of these ideal approaches are expensive so they can be thrashed back in low resource-endowed areas. This underlines the requirement for the creation of enhanced, faster, cheaper, and transportable toxicological assays like immunoassay for that point-of-care equipment (Stoia et al., 2024). The trade off for the precision and overall potential of giving wrong positive or negative results are ideal for further enhancement for generalized forensic application.

Forensic Investigation Challenges

The main difficulties of the forensic examination of cases of acute poisoning can be understood from the perspective of distribution of toxins after death, and concentration of toxins

may change after death and this is one of the biggest challenges when interpreting toxicological result, as mentioned by Boedeker et al. (2020), Xu et al. (2023), and Wang et al. (2020). This can give rise to postmortem concentration variations that may result in erroneous definitive cause of death findings particularly in drug with high lipid solubility including antidepressants and benzodiazepines (Cowans et al., 2023). In addition, long-term substance consumers such as alcohol or opioids are likely to become tolerant and hence the probability variety of the lethal dose regularity is hidden adding to forensic confusion. Another difficulty is associated with the collection and storage of biological materials. The body fluids commonly used in toxicological analysis include blood, urine, and tissue samples but results may often be influenced by contaminants, degradation of compounds, and poor storage among other factors (Djilali et al., 2022; de Campos et al., 2022). As such, there is now a marked call for the scientific standardisation of such matters for enhancement of the quality of forensic evidence (Heavey et al., 2022).

Forensic toxicology is helpful in the prosecution of cases concerning cases of poisoning (Watson, 2020). Toxicological analysis may include identification of toxins, as well as their concentration in all forms of biological samples and this plays a critical role in determining cause of death, finding the culprit or absolving the suspect in criminal matters (Boriwala and Hankare, 2024). For example, the amount of a drug directly related to fatal levels can be evidence to homicide or manslaughter, whereas if there is a presence of minimum quantity, it would indicate suicide or accidental overdose. Hamnett and Dror (2020) observed that toxicological information is highly useful in intent mostly where it relates to suicide or drug-facilitated crimes.

Although not categorical the assessments based on toxicological results are still somewhat subjective mainly due to the fact that normally contexts of poisoning, the overall state of the poisoned organism, his reactions to possible interactions with other medications etc are taken into consideration (McCarty et al., 2020). This can lead to differences especially in legal matters where most of the decisions shall be swung by virtues of experts.

Another common shortcoming, noted in the literature review section, is the absence of stringent benchmarks for analyzing the toxicological information that can result in contradictory decisions for various jurisdictions (Felter et al., 2021). It is now necessary to implement systematic proposals aimed at increasing the reliability of forensic toxicological analysis at the international level.

Methodology

This research study employed a retrospective cross-sectional design, whereby existing analytic data on adult acute poisoning cases within the Makkah region between 2017 and 2019 were reviewed. The data collected in the study will include the records of patients and toxicological data from medical records, toxicology report and reports obtained from forensic cases that were collected from regional hospitals in Makkah and Poison Control and Forensic Medical Center (PCFMC) between 2017 and 2019.

The major data sources were patients' records, medical and forensic documentation of poisoning cases (patients of 15 years and above), toxicological examinations, and forensic postmortem examinations. They included cases of acute poisoning that can be diagnosed from clinical or forensic toxicology and upon being confirmed through toxicology that would involve gas chromatography-mass spectrometry (GC-MS) or liquid chromatography-mass spectrometry (LC-MS/MS). Patients with chronic poisoning, children, and those cases that had incomplete records will not be included in the study.

The data comprised of age and gender, type of poisoning, route of exposure and clinical impact; survival or recovery or death and toxicological results on type and concentration of poison and its metabolites. The kind of poisoning, whether it was accidental, intentional or of the cause is still unknown, were also discussed. Descriptive analysis was used in the quantitative data analysis to establish poisoning prevalence and trends. Categorical comparisons looked at gender, type of substance, and result. The data were analysed using Excel, and the study compared the rates of the types of poisonings.

Results

Gender

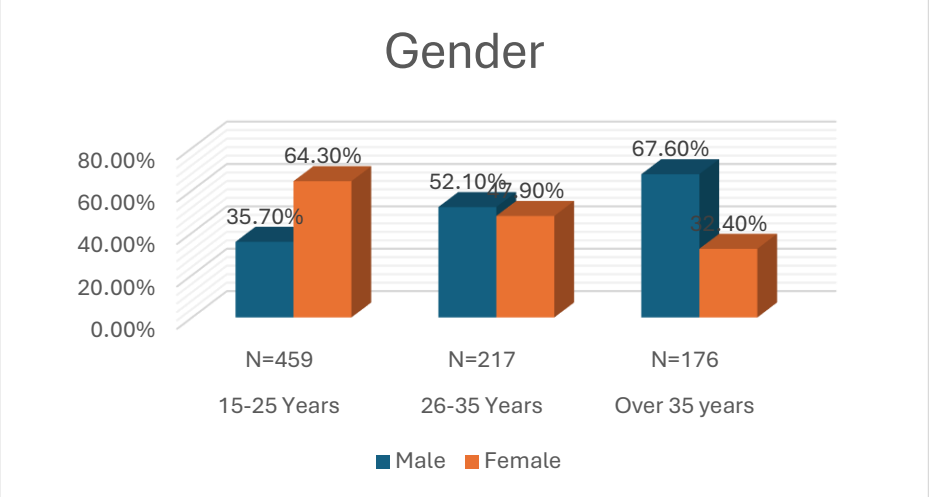

Figure 1: Gender

From the figure above, adults suffering from acute poisoning in Makkah are mostly male as the aged 35 years and above (67.6%). On the contrary, female aged between 15 and 25 years were the majority of persons who suffered acute poisoning between 2017 and 2019 (64.3%).

Form of Poisoning

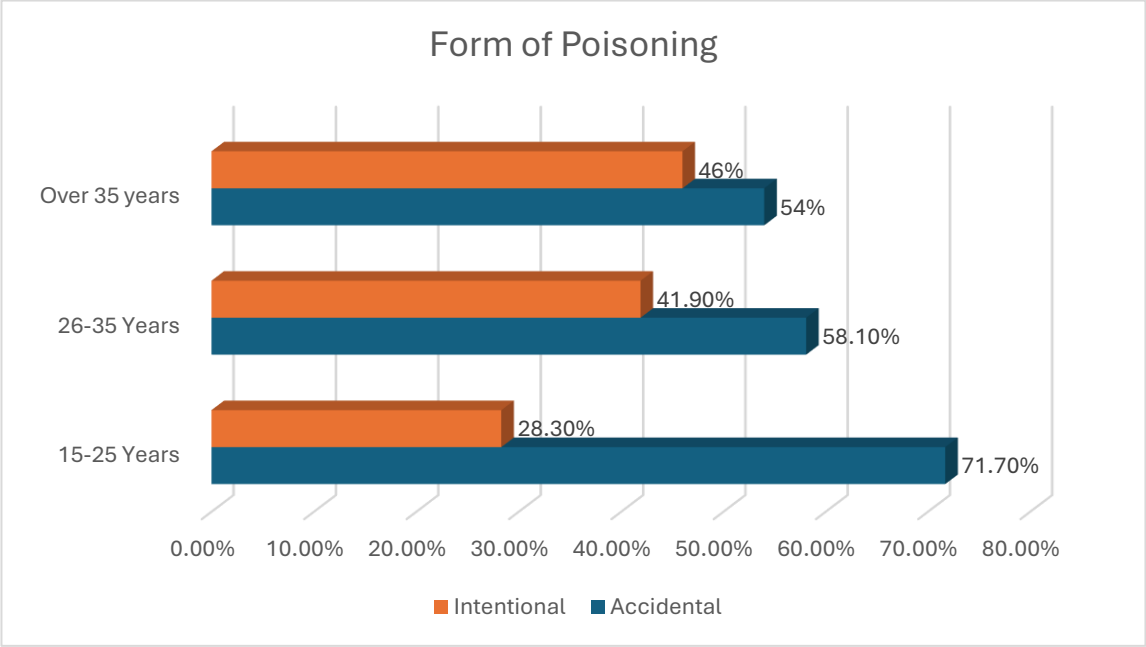

Figure 2: Type of poisoning

In Makkah region, accidental poisoning has been reported more commonly in the young adults aged between 15 and 25 years (71.7%) as opposed to intentional (28.3%) during for the period between 2017 and 2019. This may point to the fact that young people seem more vulnerable to those accidental encounters. On the other hand, intentional and accidental poisoning did decrease with increase in age. For instance, the adults aged 35 years and above as opposed to those between 15 and 25 years registered the lowest accidental poisoning (54%) and intentional poisoning (46%).

Physical State of Poison

Table 1: Physical State of Poison

	15-25 Years	**26-35 Years**	**Over 35 years**
Solid	74.90%	66.80%	42%
Liquid	18.10%	30.40%	55.70%
Gaseous	7%	2.80%	2.30%

Between 2017 and 2019, the rate of adult poisoning in Makkah has changed in terms of the physical state of the substances used in poisoning (See Table 1 above). The solid type poisons were most prevalent (74.9%), with victims being individuals aged between 15 and 25 years. However, as people increase in age, their usage reduced to 42% for those aged 35 years and above. The proportion of liquid poisoning rose with age, from 18.1% in the first age-group to 55.7% in those above 35 years. This implies that there is apparent trend toward the use of liquids. Suffocation by gas also hardly affected the young to senior adults.

Medical Service

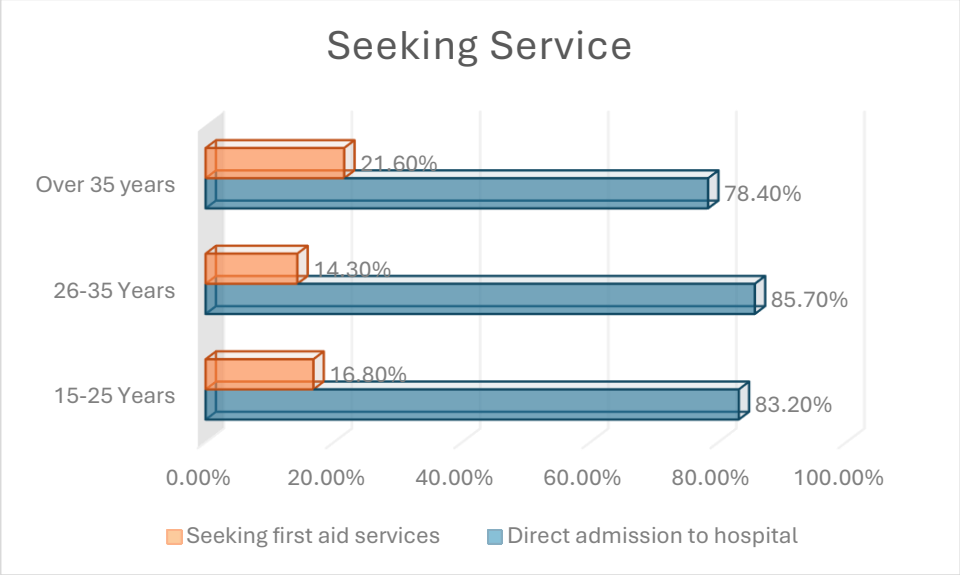

Figure 3: Medical service sought

As shown in Figure 3 above, the hospital direct admission was the most frequent amongst the Makkah residents who were victims of acute poisoning from 2017 and 2019, with those aged between 26 and 35 years being most affected (85.7%). This was closely followed by those between 15 and 25 years at 83.2% and finally those with more than 35 years (78.4%). However, it was observed that those who sought first aid services were highest among persons aged 35 years and above (21.6%), followed by those between 15 and 25 years at 16.8%) and finally by persons aged between 26 and 35 years at 14.3%. This indicates that the proportion of the elderly wants first aid, not hospitalization, in cases of poisoning, while the young seeks direct hospital admission.

Poisoning Route

Table 2: Route of poisoning

	15-25 Years	**26-35 Years**	**Over 35 years**
Oral	87.80%	90.30%	92.60%
Dermal	4.60%	5.10%	2.30%
Ocular	0.65%	0.90%	2.80%
Inhalation	6.95%	3.70%	2.30%

In 2017–2019, poisoning through oral use of the product for the inhabitants of Makkah was dominant, with an emphasis at all age levels, including 87.8% in individuals aged 15–25, 90.3% of 26–35 years, and 92.6% in persons older than 35 years (See Table 2). The consistent pattern indicates that the oral poisoning is a serious problem among people. Other routes included dermal 4.6%, ocular 0.65%, and inhalation 6.95%, which were considerably less common and suggested that the order of seeking medical services may base on the mode of poisoning where oral dominated more often an urgent hospital admission**.**

Management

Table 3: Management of Acute Poisoning

	15-25 Years	**26-35 Years**	**Over 35 years**
Specific medication	164	123	105
Gut decontamination	385	154	131
Activated charcoal	118	102	47
O2 therapy	39	54	33
No medication	85	38	15

The management of acute poisoning was analysed for the period between 2017 and 2019 and the outcomes presented the differences in management according to age. Gut decontamination was the most frequently used intervention among the persons aged 15 to 25 yeas (385). Specific medication was also frequently administered with 164 of the same age brackets. However, this number gradually decreased with increase in age among the residents of Makkah. Activate charcoal and oxygen therapy were also used to manage those who suffered acute drug poisoning. In particular, the proportion of patients who had no prescribed medication reduced with age, with the condition of older patients being managed better.

Final Outcome

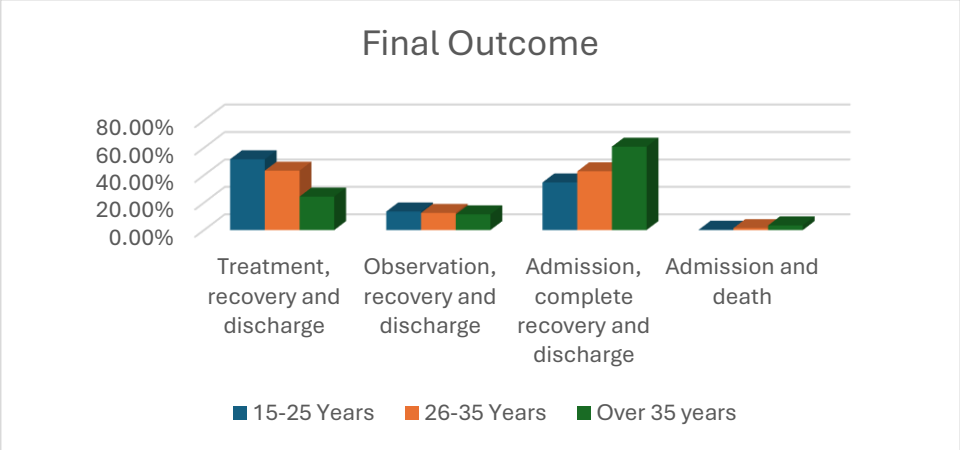

Figure 4: Final outcome of poisoning

The mortality rates of analyzed acute poisoning cases in the Makkah region in 2017-2019 depend on age and showed essential variability. 51.6% young adults between 15–25 years received treatment, recovery, and discharge showed that this group was well managed. Significantly lower proportion of patients with complete recovery post admission was observed among the younger age group patients 15-34 years at 47.8%, while the patients who are 35 years and above had a higher admission rate but a better prognosis with 60.8% recovering fully post admission. The admission rate also raised progressively with age and reached 3.4% in individuals above 35 years of age group. This should signify the need to ensure selected interventions that will reduce mortality especially in the elderly.

Discussion

The results obtained from acute poisoning cases from Makkah from 2017–2019 helped in confirming earlier studies on the global trends of these cases and how they can be managed, especially based on the age distribution of the patients. This cross-sectional study also supported by Tanzanian finding, where the poisoning among male patients greater than or equal to the age of 35 years proves stressing demographic and societal factors which opens access to toxins, while on the other hand intentional poisoning amongst female patients within the age of 15 to 25 years either by accidental or suicidal hazard remained very high. In point of fact, accidental poisoning, as the prevalence depicts at 71.7 % among the group of young adults shows a great threat in this demography, consistent with Eddleston et al, (2008) who assert that most accidents occurred in developing nations using household substances. In a cross-sectional study of acute poisoning, the change in agents for poisoning from solids to liquids involved with aging possibly indicates enhancing patterns because of exposed material or habits (McCarty et al., 2020; Boriwala and Hankare, 2024; Cowans et al., 2023). Concerning age, Makkah data revealed a trend in which young adults aged between 18 and 34years were admitted to the hospital (83.2%) while the 35 and above group relied on first aid (21.6%) suggesting that there is a gap in awareness or perceived severity when going for hospital care in the target group. This finding is consistent with literature's premise that it is important to design different intervention strategies based on ages in order to gain the best results (Strenja et al., 2024; Peters and Wissenbach, 2023; Ranjan et al., 2023; Sapozhnikova, 2022; Djilali et al., 2022).

Furthermore, specific differences between management of poison such as gut decontamination and certain drugs point to the lack of standard control measures in forensic toxicology (Kumar et al., 2022; Nithaniyal et al., 2021). This will assist in offering solutions to some of the problems observed in the undertaking of toxicological investigations in emergency situations and therefore enhance on patient care and legal justice in a poisoning incident. From the literature review it is seen that forensic management of acute poisoning has undergone a transformation, but there are some major issues which still need attention for future development in identifying new toxins and also in improving the management outcome in different age and gender groups.

Conclusion

To conclude, the presented forensic data on acute poisoning in Makkah from 2017 to 2019 showed age-related tendencies and risk factors—greatest among patients between 20 and 39 years old. Moreover, get a hold of the findings of worldwide research which proves the presence of a higher percentage of accidental poisoning in this selected group and argues the importance of developing specific preventive measures. The change in exposure from solid to liquid poisoning as people age s

strengthens the need to explore other changes in access and use of substances. At the same time, disparities in the patterns of health care consumption between age groups indicate that the need for action and the degree of perceived threat for oneself are lower among the identified target population, focusing on the issue of targeted interventions. The study also emphasizes on the need to formalize forensic procedures in a way that would improve effectiveness of poisoning investigations by providing timely toxicologic reports. In general, some improvement has been made; however, it is still pertinent to overcome existing challenges in forensic toxicology and enhance interventions to decrease the prevalence of acute poisoning in any group of the population in Makkah and others.

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