

RESEARCH ARTICLE

# The establishment of a medical toxicology consulting service for advancing care of poisoning and overdose in Qatar

Amr Elmoheen<sup>1,\*</sup>, Galal AlEssai<sup>1</sup>, Waleed Awad Salem<sup>1</sup>, Stephen H Thomas<sup>1,2,3</sup>

Address for Correspondence:

Amr Elmoheen<sup>1,\*</sup>

<sup>1</sup>Department of Emergency Medicine, Hamad Medical Corporation, Qatar

<sup>2</sup>Weill Cornell Medical College in Qatar, Qatar

<sup>3</sup>University of London, London, UK

Email: Aelmoheen@hamad.qa

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## ABSTRACT

**Objectives:** The State of Qatar, in recent decades, underwent rapid, and substantial population growth. The country's emergency medicine (EM) needs are met by government-operated facilities of the Hamad Medical Corporation (HMC), which see virtually all acute-care cases in adults and children. In 2017, emergency departments (ED) established the Medical Toxicology Consulting Service (MTCS). This report aims to outline the MTCS's initial 100 cases' experience and report salient findings that can help ongoing national strategies in meeting Qatar's medical toxicology needs.

**Methods:** The study setting is Qatar, and the clinical base for the MTCS was the country's sole level I center, Hamad General Hospital. The MTCS group is composed of six physicians, all with advanced training in medical toxicology. The study group is composed of the first 100 consecutive cases of the MTCS registry. Registry entry was triggered by in-person consultation, telephone consultation, or identification of cases by daily MTCS rounder surveillance of the ED's electronic tracking board.

**Results:** The MTCS institution identified a significant number of medical toxicology cases within the national hospital system. The trends of poisoning in this study showed a median age of 30 years (range 1–81 years, IQR 22–36 years). Fourteen patients were < 18 years old. The median interval between exposure and ED presentation was 2 hours, with a range of 15 minutes to 24 hours (IQR 1–3 hours). Most patients (71%, 95% CI, 51%–80%) were symptomatic because they were exposed. The MTCS recommended therapeutic intervention in over a third of cases (36%, 95% CI, 27%–46%). Decontamination procedures were ordered in 8% of cases (95% CI,

4%–15%) and specific therapies recommended in 13 cases (13%, 95% CI, 7%–21%).

Conclusions: The study highlighted that the availability of experts in medical toxicology, such as with a poison center or toxicology consultation service, results in significant resource conservation in the management of poisoned patients.

## INTRODUCTION

Patients with acute poison exposure and acute poisoning typically present to medical care in an emergency department (ED). Medical toxicology services can be a useful complement to care provided to such patients,<sup>1,2</sup> which in Qatar would typically be managed in an ED or a Pediatric Emergency Center (PEC).

The State of Qatar has, in the past decades, undergone rapid growth, with a current population exceeding 2.6 million. Virtually all of the country's emergency care is provided by government-operated facilities of the Hamad Medical Corporation (HMC). The country's only tertiary care center, Hamad General Hospital (HGH), houses Qatar's main general-population ED.

As the providers of essentially all urgent and emergency care for the country, HMC's EDs, and PECs encounter most of the nation's caseload of acute poisonings, overdoses, envenomation, and other medical toxicology cases. In recognition of this caseload, the clinical services providing emergency and pediatric emergency care collaborated to form a Medical Toxicology Consulting Service (MTCS). Telephone consultations were provided beginning in 2015, and bedside consults with daily rounding were instituted in mid-2017.

This study primarily aimed to describe the formulation of Qatar's only MTCS and to summarize the types of cases encountered during its initial period of operation. It also aimed to report the circadian distribution of cases<sup>3</sup> (i.e., throughout the 24 hours of the day) to describe clinical presentations and treatments in the study population. It will provide baseline information as a frame of reference for further activities aimed at poison prevention and management and the expansion of medical toxicology services in Qatar.

## METHODS

### Design

This was a retrospective, descriptive analysis of data that was progressively entered into the MTCS

database at the time of MTCS evaluation. This study has been approved by the ethics study board of the Medical Research Center at Hamad Medical Corporation under the number MRC-02-20-319.

### Setting

The study setting was Qatar's government-operated healthcare system, HMC. HMC operates seven PECs (administered by the Department of Pediatrics) and four general EDs (administered by the Department of EM). The total annual volume of these 11 centers combined is 1,570,691 with PECs and EDs, each accounting for about half of the overall census.<sup>4–6</sup>

In Qatar, during the time frame included in this report, care at EDs is provided by trainees and board-certified specialist-grade physicians with supervision by consultants. The trainee presence and categories (e.g., residents, fellows) vary by site, but trainees are concentrated at HGH. Residency programs accredited by the Accreditation Council of Graduate Medical Education (ACGME-I) in emergency medicine (EM) and fellows training in unaccredited programs in general EM provides trainees to these respective sites. All trainees working in HMC are supervised in accordance with the ACGME-I guidelines.

The MTCS is under the clinical direction of a physician with a medical toxicology board certification and physicians with EM residency training and fellowship training, including advanced medical toxicology training, the components of which were in Qatar and externally in the UK and USA, such as a Postgraduate Diploma in Medical Toxicology at the University of Cardiff.

The MTCS was instituted at the commencement of the 2017–18 academic year (i.e., July 2017) with continuous 24-hour availability of medical toxicology consultations through a dedicated telephone consultation number, which was disseminated to all HMC EDs and PECs. These consultations by the MTCS service used a tiered system of consultation advice, with some first-call duties occasionally taken by EM fellows, most initial management provided by physicians based at HGH's ED, and complex or severe cases discussed with the MTCS clinical director.

In addition to responding to telephone consultations, each day, the rounding MTCS physician studied the HGH ED medical record tracking board information from the previous 24 hours to capture patients with poison exposure and poisoning. The MTCS physician assessed the chief complaints to ascertain whether the previous day had seen medical toxicology cases

managed without MTCS input. When surveillance identified such cases, the rounding MTCS physician reviewed the available clinical information. If the study prompted questions or concerns, they discussed things with the clinical care team if the patient was still in the ED or the patient if he or she has been discharged.

For all MTCS-assessed medical toxicology cases, patient information was entered into an MTCS clinical database during the consult, which included demographics, presentation, and clinical information, such as referral type, suspected exposure, times of exposure and consultation, laboratory and other results, treatments including antidotal therapy, and outcome. All cases were followed by MTCS during their ED stay or hospitalization to ascertain the outcome. For discharged cases judged to be at risk for delayed complications, the MTCS attempted telephone follow-up within a few days of discharge.

## Analysis

The study primarily focuses on a descriptive assessment of the initial 100 cases in the MTCS database. After normality assessment with Shapiro–Wilk testing, the continuous variables' central tendency was reported using median and interquartile range (IQR). For categorical data, percentages were reported with binomial exact confidence intervals (CIs) calculated at the 95% level. Descriptive and other statistics were calculated using Stata 15MP (StataCorp, College Station, Texas USA).  $p < 0.05$  was considered statistically significant.

## RESULTS

The 100 cases were accrued over a period spanning 76 days, during which the HGH ED volume was 113,271. The median age was 30 years (range 1–81 years, IQR 22–36 years). Fourteen patients were < 18 years old, and one patient was pregnant. Table 1

shows summary statistics for the study cases.

Illustration (Figure 1) shows the circadian time of MTCS patients' presentation to the ED. For the 84 cases with known exposure times, the time elapsed between exposure and ED arrival was calculated, with times rounded to 15-minute ( $\frac{1}{4}$ -hour) increments. For these 84 cases, the median interval between exposure and ED presentation was 2 hours, with a range of 15 minutes to 24 hours (IQR 1–3 hours). Information on exposure mechanisms was categorized based on what the patient reports. Table 2 reports these mechanisms and routes of exposure. With regard to specific agents, 19% of cases (95% CI 12–28%) involved multiagent exposure. Therefore, the total number of different agents for the 100 cases exceeded 100. Table 3 lists the various agents to which registry patients had been exposed; the numbers add to more than 100, and no 95% CIs were calculated for this reason.

Certain specific exposure types were tracked due to their high frequency or substantial potential for adverse outcome. Table 3 also reports these specific exposures. Since none of these particular specific exposures occurred simultaneously with other Table 3 agents, the percentage of these exposures of 100 cases is reported with 95% CI in the table.

No patient in the MTCS registry died during the index hospitalization or at the time of later electronic medical records follow-up, which occurred 1–3 months post-ED visit. Most patients (71%, 95% CI 51–80%) were symptomatic because they were exposed. Their symptoms were classified into cardiovascular, 11% (95% CI 6%–18%); central nervous system (CNS), 26% (95% CI 18%–36%); respiratory, 3% (95% CI 1%–9%); and cutaneous, 6% (95% CI 2%–13%).

The MTCS recommended therapeutic intervention in over a third of cases (36%, 95% CI 27%–46%).

Table 1. Descriptive statistics for 100 ED medical toxicology cases

Parameter	% (same as N)	95% confidence interval
Male	57%	47%–67%
Time of exposure known	84%	75%–91%
Presentation by ambulance	65%	55%–74%
ED shift during which the patient presented		
Early (0600–1400)	32%	23%–42%
Late (1400–2200)	34%	25%–44%
Overnight (2200–0600)	34%	25%–44%

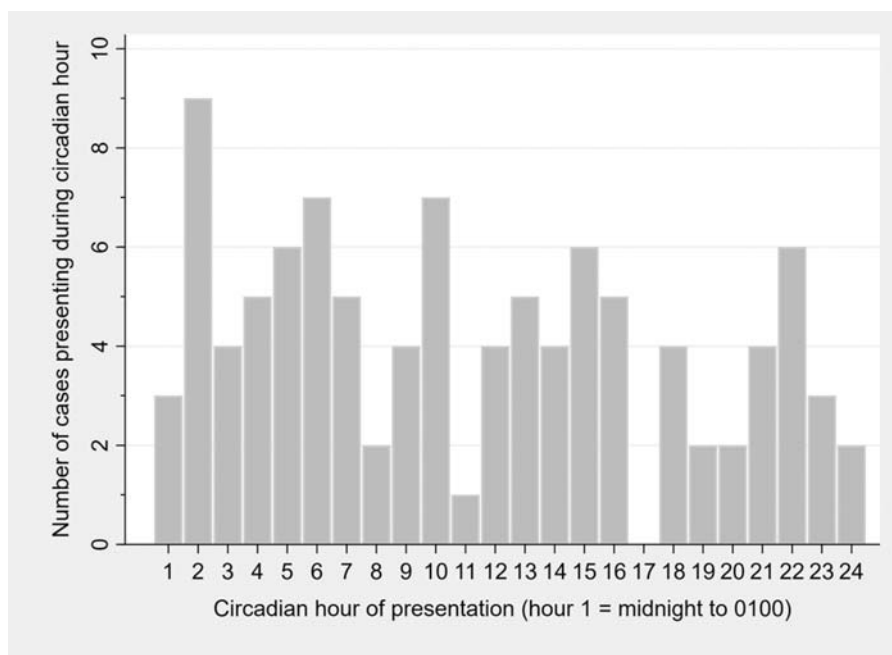


Figure 1.

Decontamination procedures were ordered in 8% of cases (95% CI, 4% – 15%). Specific therapies were recommended in 13 cases (13%, 95% CI 7% – 21%). Table 4 shows these recommendations. The MTCS recommendations decreased the unindicated use of antidotes and also reduced the use of N-acetylcysteine by 30% and reduced the use of naloxone in 16% of cases.

**DISCUSSION**

**Medical toxicology in Qatar**

As a country with heavy reliance on the system of Emergency Departments and Pediatric Emergency Centers to provide medical care, Qatar needs experts

in the field of medical toxicology such as those in other developed countries.<sup>7,8</sup> Whether poisoning comes from intentional overdoses, envenomation, therapeutic misadventures, adverse drug reactions, or other mechanisms, the massive patient base in the country warrants the presence of a dedicated group of medical toxicology physicians.

The State of Qatar has well-developed intermediate- and long-range plans for medical toxicology, such as the opening of a poison center, which will include the call center staffed with trained and licensed pharmacists as specialists in poison information, as well as an administrative base, and also a plan to use

Table 2. Exposure mechanisms and routes for 100 cases

Parameter	% (same as N)	95% confidence interval
Exposure mechanism		
Intentional misuse/abuse with no self-harm intent	36%	27% – 46%
Accidental or inadvertent	34%	25% – 44%
Intentional exposure with self-harm aim	27%	19% – 37%
Toxicity from the prescribed drug	3%	1% – 9%
Route of exposure		
Oral	69%	59% – 78%
Cutaneous (topical and bite/sting)	14%	8% – 22%
Inhalation	9%	4% – 16%
Intravenous	3%	1% – 9%
Ocular	3%	1% – 9%
Unknown	2%	0% – 7%

**Table 3. Selected specific exposures' percentage of presence in 100 cases**

Poison	Percentage with 95% confidence interval
CNS depressant	31%
Ethanol	23% (15%–32%)
Opioid	3% (1%–9%)
Chemical (acid, hypochlorite, pesticide)	23%
Pesticides	6% (2%–13%)
Analgesic (nonopioid)	20%
Paracetamol	15% (9%–24%)
Envenomation	11% (6%–18%)
Cardiovascular	7%
Beta-blocker	3% (1%–9%)
CNS stimulant	7%
Carbon monoxide	6%
Antiepileptic	5%
Antihistamine	4%
Antidepressant	4%
Cyclic antidepressant	3% (1%–9%)
Endocrine	4%

HGH as the primary toxicology treatment center in Qatar. These will be the inpatient facilities where patients will be admitted to manage poisoning. The MTCS described in this report aimed at providing improvement in medical toxicology care for all patients in Qatar. The utility of organized medical toxicology resources is well recognized globally, and the establishment of the MTCS was intended to bring some of these service advantages to Qatar's patients.

### Importance of tracking medical toxicology cases

Data describing the types of poison exposures and medical toxicology patients in the country should

optimally be used for judgments about the nature and amount of resources needed for Qatar's medical toxicology. Because the government-operated health-care system currently sees virtually all emergency cases, the study sites included in this analysis should provide a reasonable snapshot of the spectrum of medical toxicology case characteristics. With the understanding that any database populated by telephone consultation and daily surveillance inevitably underestimates need, it still seems likely that the goal of this study – to identify a "minimum" level of medical toxicology need for Qatar – is met with the current methodology.

The establishment and maintenance of a registry of poisoned patients provide valuable health and public

**Table 4. Specific therapies recommended by MTCS**

Parameter	% (same as <i>N</i> ) of 100 cases	95% confidence interval
Decontamination		
Activated charcoal (AC)	4%	1%–10%
AC+gastric lavage	1%	0%–5%
Whole bowel irrigation	3%	1%–9%
Benzodiazepine	4%	1%–10%
Naloxone	2%	0%–7%
Albuterol	1%	0%–5%
Antivenom + vasopressors	1%	0%–5%
Dextrose	1%	0%–5%
Glucagon	1%	0%–5%
<i>N</i> -acetylcysteine	1%	0%–5%
Pralidoxime + atropine	1%	0%–5%
Vitamin K	1%	0%–5%

health purpose.<sup>9,10</sup> The MTCS database used for this report's analysis was self-developed and intended as a pilot project to provide coarse guidance about medical toxicology in the country. The job of carefully tracking all medical toxicology cases is sufficiently important to warrant the use of dedicated electronic medical records developed specifically for this purpose.<sup>11</sup>

### Results from Qatar that appear different from the rest of the literature

With the caveat that selection bias and missed cases constitute an important limitation to the database, some useful preliminary lessons from the MTCS experience have been noted.

In our study, a male predominance was noted, which likely reflects the overall ED census and national population. Though only one pregnant patient (1% overall, 2% of females) was recorded, this is higher than the national average of 0.6% of poisonings occurring in pregnant women in the USA and Canada.<sup>12</sup> A larger sample is necessary to describe and assess the characteristics of poisoning in pregnant women within Qatar.

The general trend of poisonings in comprehensive US literature is that in children, males have a higher incidence of poisoning,<sup>13</sup> which is likely due to behavioral and developmental issues. During adolescence, this transitions to females having a higher incidence, which remains consistent throughout adulthood.<sup>13</sup> However, in our studied population, this was not the case.

Data from Western countries consistently demonstrates that a very high percentage of patients with poisoning have ingested alcohol. Although the range varies, it is likely that at least 50% to 65% of poisoned adults have alcohol as a coingestant.<sup>14,15</sup> Despite Qatar having significant restrictions on possession and use of alcohol, 23% of the patients in our study had alcohol as a primary or coingestant. Importantly, alcohol was the single most common substance ingested.

The number of patients with envenomation, 11%, in this study is significantly higher than the 1% of poisoned patients presenting for envenomation in the USA,<sup>13</sup> which is a tremendous difference, demonstrating that expertise in managing envenomation is particularly important in Qatar.

The percentage of patients admitting poison exposure with the intent of self-harm or for suicidal purposes

was much lower than encountered in other countries. In our sample, 27% of acute poisoning cases were reported with the intent of self-harm. By comparison, 50% of similar hospital-managed poisonings in the USA are suicidal in nature.<sup>16</sup>

In Qatar, attempts at self-harm or suicide are criminal. Therefore, we strongly suspect underreporting of suicide attempts. Although Qatar has a lower incidence of factors contributing to the suicide attempt, such as drug and alcohol abuse and psychiatric disease, we believe that there is significant underreporting of self-harm and suicide attempts.

### Lessons from Qatar database with respect to MTCS improvement

There are lessons to be gleaned from the initial experience of the MTCS, which will be useful both for the MTCS as it currently exists and also for the future state of medical toxicology in Qatar. First, as is often the case, communications about the resource and its availability are both a priority and a challenge. Introducing a new clinical service must be accompanied by appropriate dissemination of its existence and mechanisms for access; the results, as described earlier, indicate much room for improvement in this arena.

There are indications that disseminating information about the availability of the MTCS is worth expending energy on. In particular, there seem to be potential areas of improved clinical outcome or efficiency of care that may be accrued with a more widespread activation of the MTCS resource.

It is critically noteworthy that the MTCS recommended interventions were often *not* specifically directed at antidotal or specific therapy, which may be largely due to avoidance of unnecessary use of such interventions. This is unique in that, generally, the introduction of a new clinical service typically leads to an increase in resource utilization. In this instance, the MTCS has thus far demonstrated a resource-sparing tendency. Patient length of stay is a particular area worthy of further investigation to objectively quantify MCTS effect on patient management and resource utilization, which was obvious with the decrease of unnecessary use of antidotes and subsequent admissions to the hospital.

Our study demonstrates that poisoned patients present for cases consistently throughout the 24-hour day. Therefore, MTCS availability continuously

throughout the day and week is important in providing adequate coverage for emergency consultations.

The overwhelming majority of poisoned patients managed by the MTCS are at HGH, which is understandable since it has the largest ED census and is the physical base of the MTCS service. Further coordination with the rest of the HMC system is needed to ensure poisoned patients throughout the country have rapid and easy access to medical toxicology consults. This will be integrated with the poison center's operational plans.

### Future directions for MTCS and the poison center

The MTCS results suggested by this preliminary analysis will be validated as the experience of the service grows. Subsequent resource allocations, such as the addition of personnel and focused acquisition of antidotal therapy to match the country's needs, will be guided by the preliminary results of this work.

MTCS can improve the efficiency of care, reduce unnecessary antidote and resource use, and improve certain aspects of patient management, such as snake envenomation.

### Limitations

The study is inherently limited by a number of factors. Some are common to all database research, dealing with data accuracy and availability. This particular database is subject to other flaws, such as lack of certainty as to which remedies or interventions would have been executed in the absence of MTCS input.

Due to the limited time frame of this study, certain poisonings, which may be seasonal, such as carbon monoxide exposure that occurs more commonly during cool winter months or marine envenomation, which occurs more often during warmer times of the year, may not be proportionally represented.

Due to the general setting of pediatric EDs being physically separated from HGH, and children admitted for poisoning being transferred to a pediatric ICU, they will not be represented well in this study.

### CONCLUSION

The initial study of Qatar MTCS reveals that poisonings in Qatar occur by a variety of means and circumstances, such as unintentional and intentional or suicidal; from medications, envenomation, and nonmedicinal chemicals and substances; and primarily in adult males but also in women and children. Patients, some of whom are critically ill, present to EDs throughout a given 24-hour day with no specific or significant increase at a given time of day or day of the week.

Further areas of study could include an objective assessment of the impact of MTCS on resource utilization for poisoned patients.

With the expansion of the Qatar MTCS and the opening of a poison center, further ongoing assessments will be useful in defining the areas of greatest need and allowing identification of medical toxicology services in the most impactful manner.

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