Antidote Availability in Saudi Arabia Hospitals in the Riyadh Province

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Abstract: Inadequate antidote stocking is a global problem in hospitals. Insufficient supplies and delays in the administration of antidotes could lead to death and additional potentially negative clinical consequences. Our objective was to determine the availability of antidotes in hospitals listed on the Saudi Ministry of Health website in the Riyadh Province and to evaluate the leading poison in Saudi Arabia. A cross-sectional study was conducted using questionnaires. The questionnaires were distributed to pharmacist directors and emergency room-treating physicians in 17 public hospitals throughout the Riyadh Province. None (0/17) of the pharmacies contained the 24 recommended essential antidotes by the expert consensus guidelines for stocking of antidotes in hospitals. Polyvalent scorpion antivenom, atropine sulphate, calcium gluconate, flumazenil and naloxone hydrochloride were stocked in 94.12% (16/17) of hospitals. 66.67% of patients presented with osmolality, and 55.56% of referral patients with opiates, barbiturates, acetaminophen and salicylate. Our findings have important implications for healthcare institutions and pharmaceutical practices. National practice guidelines are needed to assist pharmacists in selecting appropriate antidotes based on the local pattern of poisoning incidents. Therefore, further study in the Kingdom of Saudi Arabia needs to be completed to fully evaluate the availability of antidotes throughout the country.
An estimated hundreds of thousands of people die each year in the Asia–Pacific region due to organophosphorus toxicity, which has been identified to be deliberate self-poisoning [7]. An estimated 1.2 million individuals and up to 100,000 deaths a year are from venomous snakes. Despite the use of pesticides and insects being reported as a common poison, there are no available antidotes for pesticide poison [1,2,6,8,9].

The awareness of suitable antidotes based on a country’s climate is not emphasized in most countries. The decision of which antidotes are suitable to be sufficiently stocked remains unresolved in most healthcare facilities. A previous study in British Columbia hospitals showed that among 14 selected potential antidotes, hospitals were deficient in stocking [8]. Small, medium and large hospitals adequately stocked 2.3 ± 1.7, 5.7 ± 2.2 and 7.7 ± 3.0 antidotes, respectively [8]. Furthermore, the most sufficiently stocked four antidotes in hospitals are sodium bicarbonate (77%), N-acetylcysteine (64%), ethanol (49%) and naloxone (47%), whereas digoxin immune Fab fragments, glucagon, pyridoxine and rattlesnake antivenin antidotes were stocked in 5%, 7%, 7% and 13% of hospitals, respectively, although these antidotes are still reported to be inadequately stocked due to their demand [8].

Twenty-four antidotes are recommended in the hospital by the expert consensus guidelines; among these 24 antidotes, stocking is divided into two categories [2]. Firstly, 12 antidotes should be available in the hospital emergency department for immediate use upon poisoned patient arrival. Secondly, nine antidotes should be available in the pharmacy to be administered within an hour of when the antidote is deemed necessary. Three antidotes are recommended to be stocked by the hospital, although these antidotes are not usually needed within the first hour of treatment [2]. Therefore, the hospital needs a quick medication delivery system to avoid delay of medication in case of an emergency.

A previous report has shown that over 90% of hospitals in New Zealand stocked acetylcysteine, activated charcoal, dantroline, desferrioxamine, naloxone, flumazenil and vitamin K, which are available within the recommended period. The majority of hospitals stocked at least one antidote for cyanide poisoning, usually dicobalt edetate [1]. Most hospitals keep ethanol, but not fomepizole, to treat toxic alcohol and glycol poisoning, and 15% of hospitals did not stock any toxic alcohol poisoning antidotes that are frequently used [1]. The majority of hospital pharmacies in the United Kingdom stocked relatively cheap antidotes in large quantities [10]. The reasons for stocking less commonly used antidotes vary. However, in an emergency, a delay in administering an antidote to the poisoned patient can result in the patient condition worsening, prolong the healing process or lead to death [10].

Pharmacists and physicians tend to believe that keeping all recommended antidotes is unreasonable, a waste can increase the hospital’s cost, or that an occasionally used antidote is not worth stocking and assume that they can acquire it from other healthcare facilities if needed [8]. It is a challenge to anticipate what antidotes will frequently be needed. For this reason, the number of annual visits to the emergency department and the number of antidotes commonly used can be utilized as key indicators for the stocking of adequate antidotes in the hospital or pharmacy [11]. Other studies have revealed that sufficient stocking of antidotes can be significantly correlated with the amount of N-acetyl-cysteine and naloxone consumed due to acetaminophen and opiate poisonings [11]. A previous study showed that there was a major problem with inadequate supply and distribution of antidotes in many tropical developing countries because antivenoms/antivenins were the leading cause of death, which occurred due to the lack of properly matching antidotes with envenoming [9]. In addition, rarely used antidotes, expensive antidotes and antidotes with a short expiration date have been reported to increase hospital costs; however, the choice not to stock these antidotes is unethical [6].

The objective of our study was to determine the availability of antidotes listed on the Saudi Ministry of Health website in Riyadh Province hospitals. In addition, we sought to evaluate the availability of the antidotes stocked in the hospitals and to evaluate the leading poison in the Riyadh Province of Saudi Arabia.

Materials and Methods

Study population. Our study population consisted of patients in all hospitals listed on the Ministry of Health website in the Riyadh Province of the Kingdom of Saudi Arabia. A total of 17 registered Ministry of Health hospitals were included in our study. Private and military hospitals were excluded.

Study design. A cross-sectional survey with a descriptive study design was provided to 17 hospitals in Riyadh, Saudi Arabia. The study was approved by the ethics committee on 9 June 2014. In December 2014, the online survey was created, and the link was distributed to all registered Ministry of Health hospitals in the Kingdom of Saudi Arabia for participants to respond online. The participants were given 2 months to respond to the questions. Unfortunately, there was no response from the participants. A telephone follow-up was completed weekly for 3 months, yet there was still no response. Due to the poor response rate, in April 2015, the sites for data collection were amended from all hospitals in the Kingdom of Saudi Arabia to the Riyadh province alone. The participants from each site were reminded weekly to complete the online survey, yet no response was obtained. In January 2016, the study team visited each hospital and met with Pharmacy directors and Emergency Department doctors to collect the data. The survey consisted of hospital demographics and antidote stocking information, and the questionnaires were distributed to the hospital’s pharmacy directors and treating physicians in the emergency department in the 17 Riyadh hospitals. Pharmacy directors and treating physicians were selected for this study because they were most aware of the types and quantities of medications stocked and the commonly reported toxins in the hospitals. Of the 32 recommended antidotes, 24 are considered essential. The definitions of adequacy were based on the 2003 British Columbia guidelines [2]. The availability was reported as number of antidotes stocked per hospital, and availability was defined as a minimum initial dose for a 100-kg patient. In addition, we assessed the possibility of a resulting toxin that was isolated in the blood or urine. Pharmacists were asked to report the availability of each antidote currently stocked in their hospital, and physicians were asked to report the most frequently treated poison and the identified toxin. Nine physicians and seventeen pharmacists directors responded.

Data analysis. Descriptive Statistic was used to analyse the data. The availability of the antidote and toxicology is presented as a percentage.
Ethical consideration. Approval for this study was sought from the Institute of Research Board at King Fhad Medical City. The purpose of the study was explained to each participant, and a written informed consent was obtained. The participants were informed that the participation in this study was voluntary and that they were allowed to withdraw at any time.

Results

Pharmacist directors from all 17 (100%) hospitals completed the requested survey, and 52.94% physicians from the selected hospitals responded to the survey.

Table 1 shows the antidote availability in the 17 hospitals surveyed. The adequacy of stocked antidotes was inconsistent. Our survey of the 17 hospitals in Riyadh revealed that many antidotes were not stocked in adequate quantities. Of the 24 antidotes we evaluated, the six that were most often adequately stocked were as follows: 94.12% of hospitals stocked polyvalent scorpion antivenom, polyvalent snake antivenom, atropine sulphate, calcium gluconate and naloxone hydrochloride; 88.24% stocked sodium bicarbonate and calcium chloride; 82.35% stocked flumazenil; 76.47% stocked glucagon hydrochloride; 70.59% stocked acetylcysteine; 64.71% stocked deferoxamine mesylate and pyridoxine hydrochloride; and 52.94% stocked pralidoxime chloride. We observed a lower availability of antidotes in five hospitals, including physostigmine salicylate (47.06%), digoxin immune fab (41.18%), octreotide acetate (35.29%), hydroxocobalamin hydrochloride (29.41%), cyanide antidote kit, methylene blue, dimercaprol and bivalent snake antivenom (17.65%), antidote kit, calcium disodium EDTA (11.76%) and fomepizole and ethanol (5.88%).

Table 2 shows the different toxins that were identified from patients who were directly visited to referral hospitals or primary healthcare hospitals. At primary healthcare hospitals, a total of 66.67% of patients presented with osmolality, 44.44% phenobarbital and 33.33% acetaminophen and salicylate. At referral hospitals, 55.56% of patients presented with opiates.

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## Table 2.

### Quantitative Blood or Urine Toxicology Test.

| Test Description                                      | Availability status | Number of hospitals | Percentage |
|--------------------------------------------------------|---------------------|---------------------|-------------|
| Pseudocholinesterase                                  | Available Primary Hospital | 1                   | 11.11       |
|                                                        | Referral Hospitals  | 0                   | 0.0         |
|                                                        | Not available      | 8                   | 88.89       |
| Methyl Alcohol                                         | Available Primary Hospital | 0                   | 0.0         |
|                                                        | Referral Hospitals  | 1                   | 11.11       |
|                                                        | Not available      | 8                   | 88.89       |
| Isopropyl Alcohol                                      | Available Primary Hospital | 0                   | 0.0         |
|                                                        | Referral Hospitals  | 0                   | 0.0         |
|                                                        | Not available      | 9                   | 99.99       |
| Lead                                                   | Available Primary Hospital | 1                   | 11.11       |
|                                                        | Referral Hospitals  | 1                   | 11.11       |
|                                                        | Not available      | 7                   | 77.78       |
| Mercury E(24 H Urine)                                  | Available Primary Hospital | 0                   | 0.0         |
|                                                        | Referral Hospitals  | 2                   | 22.22       |
|                                                        | Not available      | 7                   | 77.78       |
| Arsenic E(24 H Urine)                                  | Available Primary Hospital | 0                   | 0.0         |
|                                                        | Referral Hospitals  | 0                   | 0.0         |
|                                                        | Not available      | 9                   | 99.99       |
| Cocaine                                                | Available Primary Hospital | 0                   | 0.0         |
|                                                        | Referral Hospitals  | 3                   | 33.33       |
|                                                        | Not available      | 6                   | 66.67       |
| Opiates                                                | Available Primary Hospital | 0                   | 0.0         |
|                                                        | Referral Hospitals  | 5                   | 55.56       |
|                                                        | Not available      | 4                   | 33.33       |
| Barbiturates                                           | Available Primary Hospital | 1                   | 11.11       |
|                                                        | Referral Hospitals  | 5                   | 55.56       |
|                                                        | Not available      | 3                   | 33.33       |
| Amphetamines                                           | Available Primary Hospital | 1                   | 11.11       |
|                                                        | Referral Hospitals  | 2                   | 22.22       |
|                                                        | Not available      | 6                   | 66.67       |
| Cannabinoids                                           | Available Primary Hospital | 0                   | 0.0         |
|                                                        | Referral Hospitals  | 4                   | 44.44       |
|                                                        | Not available      | 5                   | 55.55       |
| Benzodiazepines                                        | Available Primary Hospital | 1                   | 11.11       |
|                                                        | Referral Hospitals  | 3                   | 33.33       |
|                                                        | Not available      | 5                   | 55.56       |
| Tricyclic Antidepressants (TCA)                        | Available Primary Hospital | 1                   | 11.11       |
|                                                        | Referral Hospitals  | 1                   | 11.11       |
|                                                        | Not available      | 7                   | 77.78       |
| Acetaminophen (Paracetamol) Serum Test                 | Available Primary Hospital | 3                   | 33.33       |
|                                                        | Referral Hospitals  | 5                   | 55.55       |
|                                                        | Not available      | 1                   | 11.11       |
| Salicylate                                             | Available Primary Hospital | 3                   | 33.33       |
|                                                        | Referral Hospitals  | 5                   | 55.55       |
|                                                        | Not available      | 1                   | 11.11       |
| Co-oximetry for Oxygen Saturation, Carboxyhemoglobin and Methemoglobin | Available Primary Hospital | 2                   | 22.22       |
|                                                        | Referral Hospitals  | 0                   | 0.0         |
|                                                        | Not available      | 7                   | 77.78       |
| Phenobarbital (If urine barbiturates are positive)     | Available Primary Hospital | 4                   | 44.44       |
|                                                        | Referral Hospitals  | 0                   | 0.0         |
|                                                        | Not available      | 5                   | 55.56       |
| Methanol                                               | Available Primary Hospital | 0                   | 0.0         |
|                                                        | Referral Hospitals  | 2                   | 22.22       |
|                                                        | Not available      | 7                   | 77.78       |
| Ethanol                                                | Available Primary Hospital | 0                   | 0.0         |
|                                                        | Referral Hospitals  | 3                   | 33.33       |
|                                                        | Not available      | 6                   | 66.67       |
| Ethylene Glycol                                        | Available Primary Hospital | 0                   | 0.0         |
|                                                        | Referral Hospitals  | 2                   | 22.22       |
|                                                        | Not available      | 7                   | 77.78       |

(continued)
barbiturates, acetaminophen and salicylate and 44.44% presented with cannabinoids. In addition, cocaine, ethanol and benzodiazepine toxicity was observed in 33.33% of patients and 22.22% of patients with mercury E, amphetamines, methanol and ethylene glycol.

**Discussion**

Our study revealed that an insufficient number of the essential required antidotes were stocked in the 17 hospitals surveyed. The antidotes stocked in hospital pharmacies do not meet the required guideline recommended by the expert consensus guidelines for stocking of antidotes in hospitals [2]. Our results are consistent with additional studies from various authors [1, 4, 6, 11]. Antidotes, such as polyvalent scorpion anti-venom, atropine sulphate, calcium gluconate, flumazenil and naloxone hydrochloride, were found adequately stocked in 94.12% (16/17) of hospitals, suggesting that these antidotes are in high demand within the Riyadh Province of Saudi Arabia. Some antidotes are linked with patient visits to the emergency department presenting with opiate, barbiturate, acetaminophen and salicylate toxicity, where 555.56% of the cases were referred from another institution for further management. Our results correspond with previous reports that show the amount of N-acetyl-cysteine and naloxone consumed due to acetaminophen and opiate poisonings [1, 11]. Toxic alcohol and glycol poisoning antidotes, such as ethanol and fomepizole, were inadequately stocked (15.88%) at hospitals. This result could be linked with cultural, social, religious and legal constraints on Muslim Arab inhabitants living in the Arabian Peninsula. The consumption of alcohol or drugs is discouraged. In agreement with a previous study, the number of visits to the emergency department and the number of antidotes frequently consumed can be used as key indicators for stocking adequate antidotes in the hospital or pharmacy [11]. Hospitals must reassess their current antidote inventories and stock the required antidotes that correspond with frequently observed poisonings. Therefore, policy, including specific guidelines, must be developed and consistently adopted as the standard of practice in the country.

**Conclusions**

Our findings have some important implications for healthcare institutions and pharmacy practice. National practice guidelines are needed to assist pharmacist managers in selecting appropriate antidotes based on the local patterns of poisoning incidents. Therefore, we suggest further study in the Kingdom of Saudi Arabia to evaluate the availability of antidotes in the country.

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