ADVANCES

Adequacy of antidote stocking in British Columbia hospitals: The 2005 Antidote Stocking Study

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ABSTRACT

Background: Inadequate hospital stocking and the unavailability of essential antidotes is a world-wide problem with potentially disastrous repercussions for poisoned patients. Research indicates minimal progress has been made in the resolution of this issue in both urban and rural hospitals. In response to this issue the British Columbia Drug and Poison Information Centre developed provincial antidote stocking guidelines in 2003. We sought to determine the compliance with antidote stocking in BC hospitals and any factors associated with inadequate supply.

Methods: A 2-part survey, consisting of hospital demographics and antidote stocking information, was distributed in 2005 to all acute care hospital pharmacy directors in BC. The 32 antidotes examined (21 deemed essential) and the definitions of adequacy were based on the 2003 BC guidelines. Availability was reported as number of antidotes stocked per hospital and proportion of hospitals stocking each antidote. For secondary purposes, we assessed factors potentially associated with inadequate stocking.

Results: Surveys were completed for all 79 (100%) hospitals. A mean of 15.6 ± 4.9 antidotes were

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adequately stocked per hospital. Over 90% of hospitals had adequate stocks of *N*-acetylcysteine, activated charcoal, naloxone, calcium salts, flumazenil and vitamin K; 71%–90% had adequate dextrose 50% in water ($D_{50}W$), ethyl alcohol or fomepizole, polyethylene glycol electrolyte solution, protamine sulfate, and cyanide antidotes; 51%–70% had adequate folic acid, glucagon, methylene blue, atropine, pralidoxime, leucovorin, pyridoxine, and deferoxamine; and <50% had adequate isoproterenol and digoxin immune F_{ab}. Only 7 (8.9%) hospitals sufficiently stocked all 21 essential antidotes. Factors predicting poor stocking included small hospital size ($p < 0.0001$), isolation ($p = 0.01$) and rural location ($p < 0.0001$).
Conclusion: Although antidote stocking has improved since the implementation of the 2003 guidelines, essential antidotes are absent in many BC hospitals. Future research should focus on determining the reasons for this situation and the effects of corrective interventions.

Key words: antidote; overdose; toxicology; poisoning

RÉSUMÉ
Contexte : L'insuffisance des réserves à l'hôpital et la non-disponibilité d'antidotes essentiels constituent un problème mondial qui peut avoir des répercussions désastreuses pour les patients victimes d'un empoisonnement. La recherche révèle qu'on a réalisé très peu de progrès vers la résolution du problème dans les hôpitaux tant urbains que ruraux. C'est pourquoi le Centre d'information sur les drogues et les poisons de la Colombie-Britannique a établi en 2003 des lignes directrices provinciales sur les réserves d'antidotes. Nous avons cherché à déterminer la conformité des réserves d'antidotes dans les hôpitaux de la C.-B. et tout facteur associé à un approvisionnement inadéquat.
Méthodes : En 2005, on a distribué un questionnaire à deux volets, portant sur la démographie hospitalière et les réserves d'antidotes, à tous les directeurs de pharmacie des hôpitaux de soins actifs de la province. Les 32 antidotes examinés (21 jugés essentiels) et les définitions de la suffisance reposaient sur les lignes directrices de 2003 de la C.-B. On a indiqué la disponibilité par le nombre d'antidotes gardés par hôpital et par le pourcentage des hôpitaux qui avaient des réserves de chaque antidote. Pour des raisons secondaires, nous avons évalué des facteurs qu'il serait possible d'associer aux réserves insuffisantes.
Résultats : On a reçu un questionnaire rempli pour les 79 (100 %) hôpitaux. Chaque hôpital stockait adéquatement en moyenne 15,6 ± 4,9 antidotes. Plus de 90 % des hôpitaux avaient des réserves suffisantes de *N*-acétylcystéine, de charbon de bois activé, de naloxone, de sels de calcium, de flumazénil et de vitamine K; de 71 % à 90 % avaient suffisamment de solution aqueuse de dextrose à 50 % ($D_{50}W$) d'alcool éthylique ou de fomépizole, de solution physiologique de polyéthylène glycol, de sulfate de protamine et d'antidote du cyanure; de 51 % à 70 % avaient des réserves suffisantes d'acide folique, de glucagon, de bleu de méthylène, d'atropine, de pralidoxime, de leucovorine, de pyridoxine et de déféroxamine, et moins de 50 % avaient suffisamment d'isoprotérénol et d'anticorps spécifiques de la digoxine F_{ab}. Seulement 7 (8,9 %) des hôpitaux gardaient des quantités suffisantes des 21 antidotes essentiels. Les facteurs prédicteurs de réserves insuffisantes comprenaient la petite taille de l'hôpital ($p < 0,0001$), l'isolement ($p = 0,01$) et la ruralité ($p < 0,0001$).
Conclusion : Même si les réserves se sont améliorées depuis la mise en œuvre des lignes directrices de 2003, beaucoup d'hôpitaux de la C.-B. ne gardent pas certains antidotes essentiels. La recherche future devrait viser avant tout à déterminer les causes de cette situation et les effets de mesures correctives.

Background

Inadequate hospital stocking and the unavailability of essential antidotes is a worldwide problem with potentially disastrous repercussions for poisoned patients.[1–7] In most cases of drug overdose, gastric decontamination and supportive care are adequate; however, in some patients the timely administration of an appropriate antidote can be a life-saving intervention. Since this problem was identified in the mid-1980s,[1] subsequent research indicates minimal progress has been made in both urban and rural hospitals.[2–18]

In 2000, the first US consensus guidelines were published, providing direction for hospitals regarding which antidotes were necessary to stock and the quantity recommended.[19] Shortly thereafter, investigators in British Columbia, Quebec and Ontario evaluated the adequacy of antidote stocking in Canadian hospitals.[7,16,18] Although they

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applied different criteria, all 3 studies reported gross inadequacies in antidote stocking. In BC, no hospital adequately stocked all 14 evaluated antidotes and 59% adequately stocked fewer than 5 antidotes.[7] Ontario hospitals stocked an average of 4.8 antidotes and only 1 hospital (0.6%) stocked all 10 evaluated antidotes,[16] while Quebec hospitals stocked an average of 5.9 of 13 antidotes deemed essential.[18,20]

In 2003 the British Columbia Drug and Poison Information Centre (BC DPIC) developed antidote stocking guidelines for acute care hospitals in BC.[21] These guidelines sought to improve availability by providing minimum stocking recommendations and also through implementation of strategic stocking of expensive and infrequently used antidotes. The BC DPIC guidelines provide recommendations for minimum antidote stocking levels of 32 agents based on characteristics such as frequency of use, cost, and transport time from regionally designated "depot" hospitals. This depot model relies on strategic antidote stocking and assumes cooperative development of inventory sharing agreements between health care facilities. Depot hospitals are designated at the discretion of each regional health authority; however, each hospital is ultimately responsible for ensuring that an adequate supply of antidotes is available.

Guidelines were developed based on the following assumptions; (i) regardless of size and location, all acute care hospitals with an emergency department (ED) should stock a core supply of 19 common antidotes required on an urgent basis ("basic stock" items); (ii) strategic stocking of high cost, infrequently used antidotes ("target" items) can reduce inventory costs and minimize wastage of expired stock while still ensuring good patient care; and (iii) hospital pharmacies will work cooperatively to ensure that minimum antidote stocks are maintained. Hospitals in proximity to a depot require sufficient antidote supply to provide treatment until a back-up supply is accessed or patient transfer can be arranged. Back-up supplies may be obtained from the main depot or another nearby health care facility. Stocking recommendations assume use of routine transport (e.g., regular hospital courier, commercial bus service or commercial overnight courier service) for most stock replacement needs. The use of emergency transport (e.g., ground or air ambulance, police) is limited to high-cost antidotes and life-threatening poisoning. Minimum stocking levels in the BC guidelines are based upon the supply required for the initial treatment of one 70-kg patient. Hospitals are expected to adjust stocking level according to hospital size, population served and local special requirements. Hospitals are advised not to decrease their inventory to match the minimum-stocking list if past experience indicates that a larger inventory is required. The quantities are based on the combined inventory of all hospital departments (e.g., pharmacy, ED, night cupboard).

Antidote stocking levels in BC hospitals have not been evaluated since the development of the 2003 provincial guidelines, and thus the impact of these guidelines is unknown. The objectives of this study were to evaluate hospital compliance with antidote stocking guidelines and to determine factors associated with inadequate supply.

Methods

Design and study population

We conducted a prospective observational study in all BC acute care hospitals. The BC Ministry of Health provided a listing of all potentially eligible hospitals.[22] Eligible hospitals were defined as any hospital that had inpatient beds and could be required to treat an acutely poisoned patient. Extended care hospitals, diagnostic and treatment centres, cancer agencies, military hospitals, and Red Cross outposts were excluded.

Data collection and analysis

Data were collected using a 2-part survey instrument. Part 1 captured demographics including hospital size, presence of an ED (and ED hours of operation), pharmacy hours and the availability of on-call pharmacy services. Part 2 captured dosage form, strength and quantity of all 32 antidotes outlined in the BC DPIC guidelines.

All surveys were sent by mail on Sept. 2, 2005. A second mailing was sent to nonresponders on Oct. 3, 2005. A third and final contact attempt with nonresponders was conducted by telephone between Nov. 1, 2005, and Dec. 9, 2005. Any responses obtained after Dec. 9, 2005, were excluded from the analysis. Responses were accepted by fax (preferred method), mail, email or telephone.

Outcomes

The primary outcome was the number and proportion of the 21 essential antidotes appropriately stocked by the surveyed hospitals. All hospitals regardless of size or location are expected to carry on-site an adequate supply of all 19 basic items in addition to 5 targeted items, which are outlined in Table 1. For toxic ingestions where 2 different antidotes could be used (e.g., ethyl alcohol or fomepizole; calcium gluconate or calcium chloride; and the cyanide antidote kit or sodium thiosulfate) an adequate supply of either antidote was deemed sufficient. Other targeted and specialty antidotes included in the survey were excluded

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from the analysis, as they are either optional by current guidelines or only required in certain geographic or industrial settings.[21]

In a secondary analysis, we assessed factors potentially associated with inadequate stocking. These factors, defined a priori, included hospital size, geographic location (degree of isolation) and referral population. Hospital size was categorized as small (<50 beds), medium (50–250 beds) and large (>250).[16] Isolation was defined by distance to the nearest eligible hospital; a distance of >100 km, or the necessity to utilize ferry transport to reach the nearest hospital was categorized as isolated.[7] Urban hospitals were defined as those serving populations of >20 000.[7,23]

Statistical analysis

Data were entered into an Excel 2000 (Microsoft, Redmond, Wash.) database and imported to SPSS (ver. 11.0 Macintosh) and STATA (ver. 5.0 Macintosh) for analysis. Standard descriptive statistics were reported including means and standard deviations. The adequacy of antidote supply for each hospital was reported as a raw number and proportion of essential antidotes stocked. The overall proportion of hospitals stocking an adequate supply of each individual antidote was also determined. Overall comparison of the mean number of antidotes stocked between various hospital sizes was performed using a one-way analysis of variance (ANOVA) with a *p* value for statistical significance of 0.05. Two-group comparisons of the mean number of antidotes available between 2 a priori–defined hospital categories were made using a 2-tailed student's *t* test. No adjustments were made for multiple comparisons.

Results

Ninety-three potentially eligible hospitals were identified and invited to participate. Following the initial mailing, 14

Table 1. British Columbia Drug and Poison Information Centre (BC DPIC) minimum antidote stocking requirements, by antidote[21]

Antidote	Minimum quantity	Cost per unit, $*	Minimum stocking cost, $*
Activated charcoal	150 g	50 g = 5.96	17.88
N-Acetylcysteine	20 g	2 g/10 mL = 3.54	35.40
Atropine	100 mg	0.4 mg/mL × 10 = 6.10	152.00
Calcium gluconate	10 g	1 g/10 mL × 25 = 56.25	22.50
Calcium chloride	10 g	1 g/10 mL × 10 = 35.00	35.00
Sodium thiosulfate	12.5 g	2.5 g/10 mL × 5 = 39.00	195.00
Deferoxamine	7.5 g	500 mg/vial × 10 = 68.00	102.00
$D_{50}W$	500 g	25 g/50 mL vial × 25 = 39.75	31.80
Ethyl alcohol	120 g	100% 10 mL × 5 = 44.95	107.88
Flumazenil	2.5 mg	0.5 mg/5 mL × 10 = 167.50	83.75
Folic acid	100 mg	50 mg/10 mL = 5.00	10.00
Isoproterenol	10 mg	1 mg/5 mL × 10 = 50.29	50.29
Leucovorin	150 mg	50 mg/vial = 19.00	57.00
Methylene blue	250 mg	10 mg/1 mL × 10 = 21.60	54.00
Naloxone	8 mg	0.4 mg/1 mL × 10 = 20.70	41.40
PEG solution	8 L	6 × 4 L jugs pwd = 66.00	22.00
Protamine sulfate	500 mg	10 mg/mL × 10 = 23.00	115.00
Pyridoxine	5 g	100 mg/mL × 10 = 19.50	97.50
Vitamin K	100 mg	10 mg/mL × 10 = 7.60	7.60
Cyanide kit*	1 kit	1 kit = 250.00	250.00
Digoxin immune F_{ab}*	152 mg (4 vials)	1 vial = 431.00	1724.00
Fomepizole*	1.5 g	1.5 g/1.5 mL = 1000.00	1000.00
Glucagon*	15 mg	1 mg = 56.50	847.50
Pralidoxime*	3 g	1 g/vial × 6 = 148.97	74.49
Total			**3848.98†**

$D_{50}W$ = dextrose 50% in water. PEG = polyethylene glycol electrolyte
Note: Shaded cells denote target antidote as defined by BC DPIC Guidelines.[21]
*2006 acquisition cost in Canadian dollars, as obtained from Vancouver General Hospital, Vancouver, BC.
†Assumes stocking calcium gluconate, cyanide kit and ethyl alcohol rather than calcium chloride, sodium thiosulfate and fomepizole.

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hospitals were excluded because they did not have inpatient beds. All 79 eligible hospitals (100%) responded before the enrollment deadline and were included in the final analysis. Hospital characteristics are outlined in Table 2.

Primary outcomes

Table 3 summarizes stocking adequacy for each essential antidote. BC hospitals adequately stocked a mean of 15.6 ± 4.9 antidotes. Only 7 (8.9%) hospitals adequately stocked all 21 essential antidotes. Over 90% of hospitals had adequate stocks of *N*-acetylcysteine, activated charcoal, naloxone, calcium salts, flumazenil, and vitamin K; >70%–90% had adequate ethyl alcohol/fomepizole, polyethylene glycol electrolyte solution, protamine sulfate, cyanide antidotes, and dextrose 50% in water ($D_{50}W$); >50%–70% had adequate folic acid, glucagon, methylene blue, atropine, pralidoxime, leucovorin, pyridoxine, and deferoxamine; and <50% had adequate isoproterenol and digoxin immune F_{ab}.

Secondary outcomes

Table 4 shows that urban hospitals adequately stocked an average of 17.6 ± 3.5 (83.8%) antidotes versus 13.3 ± 5.3 (63.3%) for rural centres ($p < 0.0001$). Table 5 shows that isolated hospitals adequately stocked an average of 13.7 ± 5.4 (65.2%) antidotes versus 16.6 ± 4.3 (79.0%) in non-isolated hospitals ($p = 0.0111$). Small, medium, and large hospitals adequately stocked 13.4 ± 5.2 (63.8%), 18.5 ± 1.8 (88.1%), and 19.2 ± 1.9 (91.4%) antidotes, respectively ($p < 0.0001$) (Table 6).

Table 2. Characteristics of the 79 acute care hospitals in British Columbia that were evaluated during the study

Characteristic	No. (and %) of hospitals
Size	
Small (<50 beds)	46 (58.2)
Medium (50–250 beds)	24 (30.4)
Large (>250 beds)	9 (11.4)
Health region	
Vancouver Coastal Health	11 (13.9)
Fraser Health	12 (15.2)
Vancouver Island Health	14 (17.7)
Interior Health	22 (27.8)
Northern Health	19 (24.1)
Provincial Health Services	1 (1.3)
Isolated*	27 (34.2)
Non isolated	52 (65.8)
Rural	37 (46.8)
Urban†	42 (53.2)

*Defined by distance to the nearest eligible hospital; a distance of >100 km, or the necessity to utilize ferry transport to reach the nearest hospital.
†Those serving populations of >20 000.

Discussion

This study indicates that, despite improvements since the development of the BC antidote stocking guidelines, BC acute care hospitals still have substantial deficiencies in the stocking of several essential antidotes. Several factors are associated with adequacy of antidote stocking. Specifically, inadequate stocking was more common in smaller (<50 beds) hospitals and in rural hospitals. These findings are consistent with previous studies. Our study captured information on all 79 eligible hospitals in BC, which allows confidence that the results provide an accurate assessment of stocking adequacy.

Barriers to antidote stocking

High costs of antidote stocking and supply maintenance have been cited as barriers to adequate stocking.[4,5,13,20] The initial cost of purchasing an adequate supply of antidotes in Canada has been estimated at $9250 for suburban hospitals and $10 190 for remote hospitals, with stock mainte-

Table 3. Adequacy of antidote stocking in the 79 acute care BC hospitals evaluated during the study, by antidote

Antidote	No. (and %) of hospitals
N-Acetylcysteine	78 (98.7)
Activated charcoal	77 (97.5)
Naloxone	76 (96.2)
Calcium gluconate or chloride	75 (94.9)
Flumazenil	75 (94.9)
Vitamin K	74 (93.7)
Ethyl alcohol or fomepizole	65 (82.3)
PEG solution	62 (78.5)
Protamine sulfate	61 (77.2)
Cyanide kit or sodium thiosulfate	58 (73.4)
$D_{50}W$	56 (70.9)
Folic acid	55 (69.9)
Glucagon	54 (68.4)
Methylene blue	53 (67.1)
Atropine sulfate	52 (65.8)
Pralidoxime	52 (65.8)
Leucovorin	49 (62.0)
Pyridoxine	47 (59.5)
Deferoxamine	40 (50.6)
Isoproterenol	39 (49.4)
Digoxin immune F_{ab}	34 (43.0)

PEG = polyethylene glycol electrolyte; $D_{50}W$ = dextrose 50% in water

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nance costing an additional $2130 to $5410 annually.[24] Expenditures of this magnitude may not be feasible or efficient for many rural hospitals that serve small populations and only occasionally treat acute poisoning.

Although cost has been cited as a barrier to adequate antidote supply, we found that several inexpensive antidotes were poorly stocked. Folic acid, leucovorin and isoproterenol, which cost a combined total of less than $125 to purchase, were only adequately stocked in 70%, 62% and 49%, respectively. More expensive antidotes such as glucagon, atropine and cyanide kit/sodium thiosulfate were also poorly stocked. Even with the replacement cost of digoxin immune F_{ab} completely covered by a BC DPIC antidote stock replacement program, digoxin immune F_{ab}, was the most poorly stocked antidote. Table 1 shows that it would cost $3849 to purchase all 21 antidotes outlined in this study.

Antidote availability is a commonly cited barrier to stocking; however, during the course of the study all but 3 antidotes were readily available for purchase and thus stocking of most antidotes was not affected by availability. There were persistent shortages of pyridoxine and pralidoxime before and during the study period. Inadequate stocking of these 2 antidotes may reflect this shortage. The 3-drug cyanide antidote kit (sodium thiosulfate, sodium nitrite, amyl nitrite) is not available on the Canadian market and must be obtained through the Health Canada Special Access Program; however, sodium thiosulfate can be readily purchased as a single agent.

Limitations

Although it appears that the adequacy of antidote stocks has improved since the 2000 BC antidote survey, several limitations preclude a comprehensive comparative evaluation of this issue. First, the current study was not designed to compare stocking levels between 2000 and 2005. In ad-

Table 4. Adequacy of antidote stocking in the 79 study hospitals, stratefied by catchment population

Antidote	No. (and %) of hospitals with adequate stocks: Rural (n = 37)	Urban* (n = 42)
Activated charcoal	36 (97.3)	41 (97.6)
N-Acetylcysteine	36 (97.3)	42 (100)
Atropine	18 (48.6)	34 (81.0)
Calcium gluconate or chloride	34 (91.9)	41 (97.6)
Cyanide kit or sodium thiosulfate	20 (54.1)	38 (90.5)
Deferoxamine	17 (45.9)	23 (54.8)
$D_{50}W$	21 (56.8)	35 (83.3)
Digoxin immune F_{ab}	5 (13.5)	29 (69.0)
Ethyl alcohol or fomepizole	26 (70.3)	39 (92.9)
Flumazenil	33 (89.2)	42 (100)
Folic acid	20 (54.1)	35 (83.3)
Glucagon	21 (56.8)	33 (78.6)
Isoproterenol	14 (37.8)	25 (59.5)
Leucovorin	18 (48.6)	31 (73.8)
Methylene blue	19 (51.4)	34 (81.0)
Naloxone	35 (94.6)	41 (97.6)
PEG solution	23 (62.2)	39 (92.9)
Pralidoxime	20 (54.1)	32 (76.2)
Protamine sulfate	22 (59.5)	39 (92.9)
Pyridoxine	20 (54.1)	27 (64.3)
Vitamin K	34 (91.9)	40 (95.2)
Mean (and SD)	**13.3 (5.3)**	**17.6 (3.5)†**

$D_{50}W$ = dextrose 50% in water; PEG = polyethylene glycol electrolyte; SD = standard deviation.
*Hospitals serving populations of >20 000.
†$p < 0.0001$

Table 5. Adequacy of antidote stocking in the 79 study hospitals, stratified by isolation status

Antidote	No. (and %) of hospitals with adequate stocks: Isolated* (n = 27)	Non isolated (n = 52)
Activated charcoal	25 (92.6)	52 (100)
N-Acetylcysteine	26 (96.3)	52 (100)
Atropine	12 (44.4)	40 (76.9)
Calcium gluconate or chloride	25 (92.6)	50 (96.2)
Cyanide kit or sodium thiosulfate	18 (66.7)	40 (76.9)
Deferoxamine	11 (40.7)	29 (55.8)
$D_{50}W$	16 (59.3)	40 (76.9)
Digoxin immune F_{ab}	6 (22.2)	28 (53.8)
Ethyl alcohol or fomepizole	21 (77.8)	44 (84.6)
Flumazenil	25 (92.6)	50 (96.2)
Folic acid	13 (48.1)	42 (80.8)
Glucagon	15 (55.6)	39 (75.0)
Isoproterenol	9 (33.3)	30 (57.7)
Leucovorin	13 (48.1)	36 (69.2)
Methylene blue	14 (51.9)	39 (75.0)
Naloxone	27 (100)	49 (94.2)
PEG solution	18 (66.7)	44 (84.6)
Pralidoxime	15 (55.6)	37 (71.2)
Protamine sulfate	19 (70.4)	42 (80.8)
Pyridoxine	17 (63.0)	30 (57.7)
Vitamin K	24 (88.9)	50 (96.2)
Mean (and SD)	**13.7 (5.4)**	**16.6 (4.3)†**

$D_{50}W$ = dextrose 50% in water; PEG = polyethylene glycol electrolyte; SD = standard deviation.
*Defined by distance to the nearest eligible hospital; a distance of >100 km, or the necessity to utilize ferry transport to reach the nearest hospital.
†$p = 0.0111$

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dition, the minimum requirements used during the previous study were based on US consensus guidelines rather than BC guidelines. The BC guidelines differ from the US guidelines in several ways, including a minimum supply definition based on the ability to treat one rather than two 70-kg patients for some antidotes, and incorporation of the depot model for expensive and infrequently used antidotes. Finally, some agents that were deemed essential within the US guidelines were not included in the BC guidelines.

Another potential limitation is that our results are based upon on a reporting of antidote supply, rather than direct observation. It is conceivable that those completing the survey may have been more likely to overestimate rather than underestimate supplies at their location, thus improving the likelihood of their hospital meeting the minimum standards. Second, although there are several factors that may contribute to inadequate antidote supply, our study was not designed to thoroughly investigate the reasons for inadequate antidote supply. Finally, our study was not designed to evaluate any potential relationship between antidote stocking and patient outcome.

Table 6. Adequacy of antidote stocking in the 79 study hospitals, stratified by hospital size*

	No. (and %) of hospitals with adequate stocks		
Antidote	Small (*n* = 46)	Medium (*n* = 24)	Large (*n* = 9)
Activated charcoal	44 (95.7)	24 (100)	9 (100)
N-Acetylcysteine	45 (97.8)	24 (100)	9 (100)
Atropine	21 (45.7)	23 (95.8)	8 (88.9)
Calcium gluconate or chloride	42 (91.3)	24 (100)	9 (100)
Cyanide kit or sodium thiosulfate	27 (58.7)	23 (95.8)	8 (88.9)
Deferoxamine	18 (39.1)	14 (58.3)	8 (88.9)
$D_{50}W$	25 (54.3)	22 (91.7)	9 (100)
Digoxin immune F_{ab}	8 (17.4)	17 (70.8)	9 (100)
Ethyl alcohol or fomepizole	33 (71.7)	24 (100)	8 (88.9)
Flumazenil	42 (91.3)	24 (100)	9 (100)
Folic acid	26 (56.5)	20 (83.3)	9 (100)
Glucagon	26 (56.5)	20 (83.3)	8 (88.9)
Isoproterenol	15 (32.6)	17 (70.8)	7 (77.8)
Leucovorin	23 (50.0)	18 (75.0)	8 (88.9)
Methylene blue	24 (52.2)	22 (91.7)	7 (77.8)
Naloxone	43 (93.5)	24 (100)	9 (100)
PEG solution	31 (67.4)	22 (91.7)	9 (100)
Pralidoxime	27 (58.7)	17 (70.8)	8 (88.9)
Protamine sulfate	29 (63.0)	24 (100)	8 (88.9)
Pyridoxine	26 (56.5)	16 (66.7)	5 (55.6)
Vitamin K	41 (89.1)	24 (100)	9 (100)
Mean (and SD)	**13.4 (5.2)**	**18.5 (1.8)**	**19.2 (1.9)†**

$D_{50}W$ = dextrose 50% in water; PEG = polyethylene glycol electrolyte; SD = standard deviation.
*Small, <50 beds; medium, 50–250 beds; large, >250 beds.
†$p < 0.0001$.

Conclusion

Although antidote stocking has improved since the implementation of the 2003 guidelines, essential antidotes are absent in many BC hospitals. Future research should focus on determining the reasons for this situation and the effects of corrective interventions. Future research focusing on the implication of inadequate antidote stocking on actual patient outcomes would facilitate the future development and implementation of evidence-based guidelines.

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