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FEATURED ARTICLE

Evaluating a Training Program for Pharmacist Code Blue Response

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Abstract

Objective: The purpose of this study was to determine if pharmacy-specific didactic and experiential education could increase pharmacists' knowledge about code situations and their comfort level in responding to these events. Secondarily, we examined the impact of the program on pharmacists with various prior experience with cardiac arrest resuscitation (code blue events).

Design: Given the extensive use of medications during advanced cardiac life support, pharmacists working on resuscitation teams have a unique opportunity to improve patient care. If properly trained, pharmacists could potentially reduce medication errors, aid in medication preparation, and provide drug and compatibility information. However, a pharmacy-specific education program of this type is not currently available.

Before beginning this project, a knowledge assessment and comfort level survey were administered to pharmacists to obtain baseline information about their knowledge of commonly used medications, hospital policies, and perceived comfort levels in performing resuscitation practices. The pharmacists attended an education session about these topics and were given an opportunity to practice medication preparation. Upon completion, each pharmacist repeated the knowledge assessment, a comfort survey, and a competency check list.

Results: Pharmacists' performance on a written knowledge assessment improved by a mean of 3.5 ± 0.6 questions ($P = 0.0001$). Perceived comfort level also increased for several aspects of code involvement.

Conclusion: The data suggests that targeted education could increase pharmacists' knowledge and comfort levels related to resuscitation efforts. Further investigation is required to determine the impact of the program on pharmacist performance during a resuscitation effort.

Keywords — pharmacy; resuscitation; code; pharmacy education; pharmaceutical care

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The practice of advanced cardiac life support (ACLS) in hospital settings is complex. According to published reports, the success of this intervention can vary greatly from institution to institution. Four time intervals are considered critical to patient survival. These are the time from collapse to the initiation of cardiopulmonary resuscitation (CPR), collapse to first defibrillation, collapse to advanced airway management, and collapse to administration of the first resuscitation medication.[1,2,3]

Pharmacy organizations continue to seek ways to expand pharmacy services.[4] The recognition of the importance of efficient medication administration during a resuscitation effort provides pharmacists with a unique opportunity to enlarge their clinical practice as well as improve patient care. Another positive aspect of pharmacists becoming members of resuscitation teams is the increase in departmental visibility within an institution.[5,6]

Reports of pharmacist involvement in resuscitation efforts span 30 years.[5] According to a recent survey, 33% of 1,109 responding hospitals had a pharmacist as an active member of their resuscitation teams.[7] Another analysis found that pharmacist participation in the code response team was one of four clinical services that reduced hospital mortality rates.[8]

Inclusion of a pharmacist on the resuscitation response team could potentially reduce medication errors, verify doses, and

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Table 1. Knowledge Assessment Results

	Number of Pharmacists Answering the Question Correctly	
	Pre-education	Posteducation
1. Which of the following medications is considered the primary resuscitation medication and is usually administered first in a code situation?	18	26
2. Which controlled medications for codes are located in *Pyxis*?	16	24
3. How should vecuronium be reconstituted?	17	21
4. What is the reversal agent for opiate toxicity?	18	21
5. What is the first task a pharmacist should perform on arrival to a code?	14	20
6. If a pharmacist is already involved in a code, what tasks should a second pharmacist complete?	17	22
7. Where are the patient's individualized code dosing requirements found?	15	19
8. What is the standard sequence of medications for asystole?	16	19
9. What is the concentration of high-dose epinephrine?	14	20
10. What is the concentration of low-dose epinephrine?	19	23
11. What is the first medication administered for ventricular tachycardia or ventricular fibrillation?	17	19
12. Which agent on the code tray is used to treat acidosis during a code?	14	23
13. Which resuscitation medications have to be labeled during a code?	19	23
14. What is the proper procedure for obtaining a controlled medication from *Pyxis* during a code?	12	22
15. What is the most common dose of normal saline per kilogram for volume?	14	21
16. Epinephrine should be administered every _____ minutes during a code?	17	22
17. When a physician asks for a "d-stick," what is he or she testing for and what medication should the pharmacist anticipate?	18	20
18. What is the most common time interval between atropine doses?	9	13
19. In which situation should a medication be prepared with a needle in place?	18	20
20. Which item on the code tray should be drawn up and labeled as "flush"?	20	22
21. Which provides a higher concentration of calcium, calcium chloride or calcium gluconate?	13	17
22. Which agent on the tray is used to treat malignant hypertension?	12	16
23. How should dextrose be prepared prior to administration?	14	15
24. Which two resuscitation medications are incompatible both in syringe and in IV lines?	20	22
25. What is the maximum number of pharmacists that should attend a code?	19	20
Group Average	14.4 (± 4.7)	17.9 (± 3.2); $P = 0.0001$

Table 2. Knowledge Assessment Results Based on Prior Code Experience

Code Experience	*Pre-education* Mean Score (SD)	*Post-education* Mean Score (SD)
High[a] (2 pharmacists)	21 (± 1.4)	24.5 (± 0.7)
Intermediate[b] (6 pharmacists)	17.2 (± 4)	20.5 (± 1.6)
Low[c] (20 pharmacists)	12.95 (± 4.5)	16.6[d] (± 4.1)

[a]High-level code experience = greater than 10 codes attended in the previous year
[b]Intermediate level of code experience = 5 to 10 codes attended in the previous year
[c]Low level of code experience = less than 5 codes attended in the previous year
[d]$P = 0.0007$

provide drug and compatibility information. When properly trained, pharmacists can prepare intravenous admixtures quickly and facilitate the acquisition of additional medications.[5,6]

Pharmacists at our institution did not historically participate in resuscitation efforts. Pharmacists began to assist during resuscitations when the nursing staff phoned for assistance. As a result, the hospital's code committee revised its policy to describe a role for pharmacists that included "being responsible for aiding in the preparation of vasoactive drips and other medications as necessary for the patient during a resuscitation effort."

Several authors have questioned the appropriateness of available education programs such as ACLS and pediatric advanced life support (PALS) for pharmacists.[9,10] In particular, these programs do not emphasize pharmacotherapy, admixture, or medication compatibility.[1,2,3]

The purpose of this study was to determine if pharmacy-specific didactic and experiential education could improve pharmacists' knowledge about code situations and their comfort level in responding to these events. Secondarily, we examined the impact of the program on pharmacists with prior experience with cardiac arrest resuscitation (code blue events).

METHODS

This trial was conducted at Egleston Children's Hospital, part of Children's Healthcare of Atlanta. The Egleston campus is a 235-bed, tertiary-care referral center. The pharmacy provides inpatient and outpatient services; decentralized satellites serve the intensive care units, operating rooms, and hematology/oncology unit.

The pharmacists' knowledge at baseline was evaluated through a 25-question, multiple-choice test approved by the hospital's code committee (see Table 1). Questions were derived from pediatric resuscitation review literature, medication package inserts, resuscitation training programs, and hospital policies.

The pharmacists were also asked to complete a 20-question survey evaluating their comfort level with resuscitation tasks and quantifying their past attendance at resuscitation efforts within the hospital (see Table 2). The pharmacists used a 5-point scale to describe their level of comfort with performing each of the tasks, with 1 = Very Uncomfortable, 2 = Uncomfortable, 3 = Neutral, 4 = Comfortable, and 5 = Very Comfortable. Each pharmacist was asked to quantify their previous code experience as follows: High = greater than 10 codes attended in the last year, Intermediate = 5 to 10 codes attended in the last year, and Low = less than 5 codes attended in the last year. Results were also analyzed for the entire group and stratified based on experience (see Table 3).

Upon completion of the preprogram assessment, pharmacists attended a 2-hour lecture. The verbal and written materials presented in this lecture addressed the pharmacology and indications for resuscitation medications, proper technique for the preparation of each medication, and hospital policies related to codes. Pharmacists were given time at the end of the lecture to examine the code trays and practice admixtures. The comfort survey and knowledge assessment were repeated 1 week after the in-service, with each pharmacist serving as his or her own control. The results from the knowledge and comfort surveys were provided to the pharmacists after the study. Each pharmacist completed a resuscitation-related competency skills checklist prior to completing this program (see Figure 1).

A t-test was used to compare before and after assessments. A

Table 3. Results of Before and After Program Comfort Level Survey

Question	*Group Mean* Pretest (± SD)	*Group Mean* Posttest (± SD)	*P-Value*
1. Upon arrival at the code, ask nursing/staff what needs to be done	4.04 ± 0.37	4.43 ± 0.39	0.031
2. Calculate doses of resuscitation medications to be drawn up	3.54 ± 0.43	3.96 ± 0.2	0.015
3. Draw up resuscitation medications based on a preprinted dosing sheet	3.82 ± 0.46	4.25 ± 0.38	0.050
4. Calculate vasoactive drip rates based on a patient's weight	3.18 ± 0.5	3.68 ± 0.41	0.017
5. Ensure that the area surrounding the code tray and patient is clear of sharps and syringes	4.14 ± 0.36	4.5 ± 0.31	0.048
6. Anticipate medications that may be ordered by the physician	3.04 ± 0.32	3.36 ± 0.37	0.026
7. Performing necessary medication dilutions	3.18 ± 0.5	3.68 ± 0.44	0.003
8. Obtain needed controlled medications from automated dispensing system	3.04 ± 0.5	3.54 ± 0.29	0.017
9. Locate the code tray and remove from tamper evident covering	5	5	–
10. After the code, ensure that pharmacy inventory sheet is stamped for billing purposes	5	5	–
11. Be a runner for additional needed medications	5	5	–
12. Make sure a patient specific code dosing sheet is available	4.8	5	–
13. Label medications	5	5	–
14. Communicate with the charting nurse about doses administered	4.8	5	–
15. Obtain extra medications needed for a code	4.7	5	–
16. Stay at the code until completion	5	5	–
17. Communicate with the ICU satellite to obtain medications and vasoactive drips	4.2	4.5	–
18. Help keep medications in adequate supply	4.5	4.6	–
19. Exchange trays at the end of the code and perform necessary billing	5	5	–
20. Draw up flushes	5	5	–

P-value of less than 0.05 was considered significant. Each pharmacist's preprogram and postprogram knowledge assessment scores were totaled for comparison purposes. Individual items were compared for the comfort survey.

RESULTS

All 28 full- and part-time pharmacists completed the training. Scores on the knowledge assessment increased for all participants (see Table 1). A significant improvement of 3.5 ± 0.6 questions (13.8%) was observed (P = 0.0001). The impact of previous code participation experience was also examined (see Table 3).

Of the 20 items on the comfort survey, eight showed statistically significant improvement after the education session (see Table 3).

DISCUSSION

The results of our assessments indicate an improvement in knowledge base and certain aspects of comfort level with regard to resuscitation activities after completion of the training program. All participants demonstrated an increase in knowledge test scores.

Task	Acceptable	Needs to Repeat	Completion Date
Identify first two medications to be drawn up			
Prepare an *Abboject* product			
Demonstrate proper procedure for obtaining emergency meds from *Pyxis*			
Identify low-dose epinephrine			
Demonstrate preparation of a 10 g dextrose dose			
Prepare calcium dose on individualized dosing sheet			
Identify and prepare a dose of the opiate reversal agent			
Identify high-dose epinephrine			
Correctly draw up flush			
Identify two drug interactions			
Correctly prepare diazeoxide			
Describe where succinyl choline can be found (in refrigerator)			
Demonstrate preparation of a fluid bag with IV tubing			
Demonstrates proper way to present a medication to the administering nurse			
Correctly prepare vecuronium			

Date Completed _____ Evaluator _____

Figure 1. Pharmacist code competency checklist

The results of the comfort survey results were also encouraging. The ability to anticipate the next medication that may be ordered and the ability to prepare medications were thought to be very important. Many medications used during resuscitation efforts are not routinely used by the medical staff outside of the intensive care environment. Several medications are only available in multiple-dose vials or nonpediatric doses. It is hoped that after instruction about resuscitation pharmacotherapy, pharmacists can provide information and potentially prevent medication errors and improve critical response times during codes. Currently available education programs offer little instruction in medication preparation and the pharmacists' role in code situations.

This study had several limitations. It is unreasonable to believe that a lecture can prepare every pharmacist to function effectively during a resuscitation effort. Resuscitations involve emotional and psychological stress, which may not be handled appropriately by some individuals. Ongoing education and evaluation are also important. A second limitation is the lack of further follow-up. Our intervention did not provide practical experience for pharmacy staff. Current literature supports the need for consistent use of knowledge and skills related to resuscitations to maintain competency.[11,12,13]

CONCLUSION

The data suggest that pharmacy-specific departmental education could increase knowledge and comfort levels related to pharmacist participation in advanced cardiac life support. Initial education should be reinforced with regular practical experience and formal assessment of knowledge and skills.

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program, the booth was positioned in the corner of the arena opposite the main entrance. Setting up next to an entrance or in a high traffic area, while not blocking traffic, was not possible at the Salt Lake City Sports Complex. Another limitation to this program was the inability to track the patients who needed follow-up care. Documenting and calling every patient who needed intervention would require a significant time commitment and may be worth implementing in a future study.

The health care screening/education events proved beneficial for all of the stakeholders involved in this program. The University of Utah Hospitals and Clinics created a new program to support its mission of community service, gained exposure in terms of its health care programs, and generated new patient referrals. The university's hockey program, which is a relatively new entity, increased attendance through the promotion of the games and by reducing admission fees to $1. For the program sponsors, it provided marketing exposure for their company and their products and positive community public relations for the support of a community oriented service. The health care patrons were provided a valuable health care service that may result in disease prevention and detection opportunities.

CONCLUSION

Based on the patrons' surveys and the number of patrons participating, it was determined the health care education/screening session provided at the University of Utah hockey games were successful. Patrons provided positive verbal feedback on a regular basis, and the majority perceived education/screening sessions as valuable. The University of Utah Hospitals and Clinics, University of Utah hockey program, program sponsors, and especially patrons of the hockey games all benefited from these events. This program also demonstrated pharmacists can play a very effective role in designing and delivering health education to large numbers of patients.

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