

Running head: WILL TRAINING INCREASE ED NURSES' KNOWLEDGE LEVELS

Will Training Increase Emergency Department Nurses'

Knowledge Levels?

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April 28th, 2005

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Introduction

Much attention has been placed on medication errors lately. The Institute of Medicine estimates that 7000 deaths occur in the United States every year because of preventable medication errors (Kohn, Corrigan, & Donaldson, 2000). Since this report was released, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) has made improving the safety of using medications a top priority for hospitals by including this in its hospital National Patient Safety Goals for 2004 and 2005 (JCAHO, 2005a).

The Emergency Department has a higher risk of errors than other hospital departments. Crosskerry et al. (2004) state, "the unique milieu of the Emergency Department (ED) provides a number of factors that may exacerbate medication error rate and severity" (p. 289). These factors include: multiple patients being treated concurrently, wide range of drugs in use, wide variety of dangerous drugs, time pressures, distractions and interruptions, and dispensing drugs without a pharmacist's supervision (Croskerry et al., 2004).

Most drug errors occur either in preparation or administration. Taxis and Barber (2003) show that 14.5% of intravenous (IV) drug errors occur at preparation, while 44% of IV drug errors occur at the time of administration. If these errors can be reduced or eliminated, patient safety will be dramatically improved.

One way to reduce and/or eliminate IV drug errors is to use technological advances in IV pumps to warn staff members of potential errors. Pumps with these features have been called *smart pumps*. These IV infusion pumps can be programmed to alert the nurses when drug specific rates are exceeded, dosages are too high, or concentrations are inappropriate.

Previous studies on the efficacy of smart pumps have shown that they are not reducing errors as much as hypothesized (Husch et al., 2005; Rothschild, et al. 2005). The common

problem is that nurses are not using the smart pumps correctly. Nurses are either overriding the safety features or not activating the safety features.

This problem with smart pumps has not been addressed, as it has only recently been identified. Several solutions were offered for this problem. Husch et al. (2005) argues that integrating smart pumps with other technologies, such as electronic medical records or computerized physician order entry, is the best way to solve this problem. While Taxis and Barber (2003) recommend ready prepared IV drugs purchased from pharmaceutical companies combined with staff training to reduce errors. Rothschild et al. (2005) find that “nurses need to be able to use these devices seamlessly and quickly to make sudden changes in infusion therapy for unstable patients” (p. 538) and conclude that a refinement of the technology and further training of nurses is necessary. For the purposes of this study, an educational module will be utilized to teach nurses about the proper use of smart pump technology.

The purpose of this study is to determine whether additional education on smart pumps will increase the knowledge level of ED nurses. This study will attempt to answer the following questions: (a) does additional training on smart pumps increase nurses' knowledge and (b) do nurses believe that such training will help prevent medication errors?

Review of the Literature

Patient safety is always a top priority for healthcare providers. While the origin of “primum non nocere” or “above all, do no harm” is currently in dispute, it is a widely held belief of the American public and healthcare workers alike (Smith, 2005). According to JCAHO (2005b), “almost 50 percent of Joint Commission standards are directly related to safety” (§ 3). To show how important medication safety is, JCAHO (2005a) has made it a national patient safety goal for 2004 and 2005. Of all medication errors, IV drug errors are potentially the most

dangerous. IV drug errors have the most potential to be deadly due to the 100% bioavailability of any drug introduced into the blood stream and the fact that there is no “recall mechanism” exists once the drug enters the bloodstream (Rosenthal, 2004).

Numerous possibilities for error exist in infusion device programming. For example, one can easily inadvertently program a pump to administer a drug in micrograms per kilogram per minute rather than of micrograms per minute. Similarly, a 24-hour dose may be delivered over 1 hour, or an erroneous decimal point or additional zero may result in a 10-fold overdose (Wilson & Sullivan, 2004). Because of the potential danger, the first priority in increasing the safety of medications should be to reduce or eliminate IV drug errors. The best way to do this is to use smart pumps.

One study showed that a potential life-threatening error was avoided every 2.6 days at a 350-bed facility while using a smart pump system (Alaris, 2004). However, another study demonstrated that smart pumps will not improve patient safety until integrated with other technological safeguards like computerized physician order entry systems and electronic medical records (Husch et al., 2005). Yet another study, performed in a cardiac surgery intensive care unit (ICU) found that 72% of preventable errors could have been avoided by using a smart pump but were not because nurses either bypassed or overrode the safety systems (Rothschild et al., 2005).

No published study has examined the use of smart pumps in the ED, nor has any study evaluated nurses' knowledge on smart pumps. Longitudinal studies have been performed (Wilson & Sullivan, 2004; Husch et al., 2005; Rothschild, et al., 2005; Fortier, Mazur, Ankney, & Bush, 2004), but no study has been done using a before-and-after quasiexperimental design

measuring nurses' knowledge about the use of smart pumps. Based on Rothschild et al.'s (2005) findings, this may be an important link in preventing medication errors.

Typically when new equipment is purchased by a hospital, the manufacturer will hold an inservice training session to introduce the piece of equipment and its features. While these sessions usually give a overview of the product, they do not always succeed in explaining how the product will benefit both nurses and patients. Nurses often miss these inservice sessions for many reasons, including staff shortages, high patient acuity, and lack of desire to attend training sessions on their days off. As a result, not all staff are appropriately trained, and those who are trained may not fully understand the product. This can be especially true of more advanced technology such as smart pumps.

The theoretical framework for this study will be Knowles' andragogy, based on Knowles, Holton and Swanson's (1998) adult learning theory. In this work, the authors discuss six assumptions of andragogy: *learner's need to know*, *learner's self concept*, *role of the learner's experience*, *student's readiness to learn*, *student's orientation to learning*, and *student's motivation to learn*. Learner's need to know encompasses the assumption that adult learners need to know why they need to learn something before undertaking to learn it, while learner's self concept assumes that adults need to be responsible for their own decisions and to be treated as capable of self-direction (Knowles et al., 1998). Role of learner's experience suggests adult learners have a variety of experiences of life which represent the richest resource for learning; these experiences are however imbued with bias and presupposition (Knowles et al., 1998). Student's readiness to learn supposes adults are ready to learn those things they need to know in order to cope effectively with life situations. Student's orientation to learning presumes that adults are motivated to learn to the extent that they perceive that it will help them perform tasks

they confront in their life situations (Knowles et al., 1998). New to Knowles' theory in 1998 is the introduction of the student's motivation to learn. Fidishun (2000) explains that "while adult learners may respond to external motivators, internal priorities are more important. Incentives such as increased job satisfaction, self-esteem and quality of life are important in giving adults a reason to learn." All of these factors must be addressed in a training session for it to be effective.

Methods

Design

The study design is quasiexperimental using before-and-after testing. There will be four separate sessions held in order to accommodate the staff. One will be held at 0700 and another at 1900 on the same day. This will allow both the oncoming and off going shifts to attend, as well as provide times from which non-working staff can choose. Two make-up sessions will be held the payday and day after following the initial session at 1300. The facility where the study will occur still issues checks on payday, so staff who are not working tend to come to the hospital to receive their paychecks. Availability should be high on this day.

The smart pump chosen for this study is the Baxter Colleague CX pump with Guardian feature. Guardian is a program that allows the pharmacist to enter into the pump medication information, such as medication name, strength in milligrams, volume of dilutant, milligrams per milliliter, and how the medication is delivered. For instance, a medication may be delivered in milligrams per hour, micrograms per minute, micrograms per kilogram per minute, etc.. This pump also allows the pharmacist to enter an acceptable range of dosages for each medication. In theory, this prevents a patient from under and over dosage. This pump does allow a manual override in case of a true emergency, but this feature should be used extremely rarely. Entering

all high alert, vasoactive, vasoconstrictive, thrombolytic, anticoagulant, and commonly prescribed IV medications into the pump should reduce or eliminate IV drug errors in this ED.

The purpose of this study is to determine whether additional education on smart pumps will increase the knowledge level of ED nurses. This study will attempt to answer the following questions: (a) does additional training on smart pumps increase nurses' knowledge and (b) do nurses believe that such training will help prevent medication errors?

Sample

This study will have a convenience sample that consists of the staff of a rural 8-bed ED located in the southeastern United States which records an average of 15,000 visits a year. This ED is staffed with ten full-time nurses, four part-time nurses, and eleven PRN nurses who work 12-hour shifts. The staffing schedule calls for two nurses working from 0700 to 1900, with the third nurse from 1100 to 2300; the original two nurses then change shifts with two others who work from 1900 to 0700. The inclusion criterion is all registered nurses employed in the ED. Exclusion criterion is anyone not a registered nurse in the ED.

Setting

The study will take place in a 30-foot by 50-foot classroom with ceiling-to-floor windows along one side of the room. There are two doors along the opposite wall, one in the front, and the other in the back of the room. This room is climate controlled for comfort at 72 degrees Fahrenheit. Six plastic-topped tables that normally accommodate six people each will be set up in three rows of two tables. Three metal folding chairs with cushions on the seats and backs will be placed on one side of each table facing the front of the room. This setting can accommodate 18 staff members at a time. Each table will have a single channel Baxter Colleague CX pump with Guardian feature.

Intervention

An inservice consisting of lecture, demonstration, and hands-on time will be performed. The participants will be informed why they need to learn about smart pump technology, and a lecture will be given about the specific smart pump. A demonstration will follow the lecture so that the participants can see the specific details. A hands-on time will then occur in which the participants will have to demonstrate their understanding of how to use their smart pumps by performing specific tasks. During this time they have the ability to ask questions and receive answers from the preceptor. Lastly, there will be time for any unanswered questions or comments by the participants to be addressed.

Research Procedure

Upon entering the room and waiting for the group to settle, an explanation of what is to happen will be given to the group verbally. Informed consent will be provided to the nurses with a pre-test. The preceptor will then leave the room and allow the nurses 10 minutes to read the informed consent and choose to sign it or to not participate. If the nurses choose to participate, they will then need to answer a ten question pre-test and drop it into a locked box with a slit in the top. After ten minutes is elapsed the preceptor will knock on the front door and ask if everyone is finished with the pre-test. If not, additional time will be granted as needed to finish the pre-test. Otherwise, the educational portion will begin.

The educational intervention has three goals. The first is to show the nurses the real and potential problems with IV drug infusions. The second is to give each nurse experience with a smart pump and adequate time to ask questions. The final goal is that this will increase the nurses' knowledge on how to use smart pumps appropriately.

The educational portion of this study will be based on Knowles' theory of adult learning (Knowles et al., 1998). Working within this framework, the preceptor will explain the benefits of smart pump technology including: decreased chance of infusion errors, pre-programmed drug-specific dosages that have been approved through the appropriate hospital committees and follow all current procedure, the ability of the nurse to check that the appropriate drug amount is in the approved volume of dilutant for staff-mixed drugs by comparing the pump to what the nurse mixed, and time savings in that the nurse only has to select the drug from a list and the pump will change to the appropriate mode. This should satisfy the learner's need to know. The learner's self concept will be addressed when they are able to have hands on with the IV pump and are able to make their own decisions with how to use it. The learner's experience will be taken into account with a review of common errors with standard IV pumps, including miscalculated IV rates, drug amount mixed in the wrong volume of dilutant, and the complication of drug calculations that use milligrams per kilogram per minute. Participants will be allowed time to share stories about when these errors have occurred and the related patient outcomes. This also satisfies the first goal of the intervention. By this time the participants should be ready and oriented to learn about how this pump will make their jobs easier and the environment safer for their patients. Finally, motivation will be given as the participants are told that the pump is easy to use, reduces errors and therefore liability, and improves the quality of their patient care.

The discussion session will last 30 minutes and include a demonstration of the pump's basic features and then will move on to the Guardian feature. The nurses will be shown how to activate the Guardian feature and how to select the medication they are infusing from a preprogrammed list. This demonstration will include selecting a variety of drugs that encompass every possible mode of delivery (milligrams per hour, micrograms per kilogram per minute,

etc.). The participants will be shown how the pump is already programmed with the appropriate amount of the drug in its appropriate volume of dilutant. For example, the pump will show 400 milligrams in 500 milliliters when dopamine is selected. Staff will be told that this programming cannot be changed and if there is a conflict that the pump is not wrong, the nurse is, and that the drug must be remixed.

After the discussion session there will be a 15-minute hands-on session in which the nurses will be required to complete various assigned tasks on the pump. The nurses will work in groups of no more than three, with each nurse spending a minimum of five minutes with the pump. The preceptor will roam during this time to answer any questions that the nurses may have. Throughout this process each individual will be asked once if he or she has any questions. This will control for personal bias.

Once the 15-minute session is complete there will be a final 5 minutes for final thoughts, questions, and answers. A post-test will then be distributed with instructions to place it in the same locked box in which the pre-test and informed consent were placed. The nurses will be told they are free to leave. At this time the preceptor will leave the room. The preceptor will only reenter the room once all nurses have left. The preceptor will then secure the items from the lock box, separate them into three stacks by form type, and relock the box to prepare for the next session.

Variables and their Measures

The independent variable in this study is the educational inservice. This variable is consistent across all four sessions. Its effects will be measured by the before-and-after test design.

The dependent variables in this study are the nurses' knowledge and belief that training will prevent medication errors. These are shown in the research questions: (a) does additional training on smart pumps increase nurses' knowledge and (b) do nurses believe that this training will help prevent medication errors? Nurses' knowledge will be measured using a before-and-after test design with the number of questions answered correctly on the pre-test compared to those answered correctly on the post-test. Nurses' belief that training will or will not help prevent medication errors will be measured after the intervention by questions on the post-test.

Informed Consent

This proposal will be approved through the hospital's institutional review board (IRB) before this study is performed. All measures will be taken to protect the rights of the human participants. Once approved by the IRB, informed consent will be obtained by those participating in the study. Finally, all applicable Healthcare Insurance Portability and Accountability Act protections will be honored.

Strengths and Weaknesses

According to LoBiondo-Wood and Haber (2002), quasiexperimental designs are "practical, feasible, and generalizable" (p. 214). They continue, "these designs are more adaptable to the real-world practice setting than the controlled experimental designs" (LoBiondo-Wood & Haber, 2002, p. 214). These strengths fit the desired outcomes of this study.

Some weaknesses include "the possibility that something else besides the intervention accounts for all or part of the observed difference over time" (United Kingdom Evaluation Society, 2003, ¶5). This is controlled for by the short amount of time between the tests. Another weakness is testing. This is a very low threat in this study because the pre-test and post-test are different. These weaknesses are potential threats to internal validity. Using a convenience

sample, there is risk of introducing bias. This risk is minimized due to the sample's inclusion of all nurses in the ED. This is a potential threat to external validity. Overall, this study is internally and externally valid.

Timeline

The timeline for this study is as follows:

Submit research proposal to IRB	January 2006
Hire and train research assistant	March 2006
Prepare pre-test and post-test	
Negotiate time for the classroom	April 2006
Arrange for all Baxter pumps to be available at time of study. Assist with securing replacement pumps, if necessary	
Obtain final approval from IRB	June 2006
Perform study and analyze results	July 2007
Continuing analyzing results	August 2007
Submit manuscript for publication	October 2007

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Appendix A

The "ED Smart Pump Pre-Test" would be inserted into this section. This test will be 10 multiple choice questions. This test will measure the baseline knowledge about smart pumps of the nurses participating in this study. These 10 questions will ask about the proper use of a smart pump, when to override the preprogrammed drug ranges, and why smart pump technology is being implemented. Since this instrument is not standard and has not been measured in the field, its validity will be face validity. Also, the reliability is not known.

Appendix B

This appendix will contain the list of tasks that nurses will perform during the hands-on portion of the intervention. Tasks will include how to activate the Guardian feature, how to select and change medications, and how to do a temporary program based on how the drug is administered (micrograms per minute, etc.). These tasks would include selecting one drug from each category of administration (micrograms per minute, etc.), so that the nurses can experience the nuances of each category.

Appendix C

This appendix will contain the “ED Smart Pump Post-Test.” The post-test will consist of a total of 14 questions. Ten of those questions will be multiple choice and will measure the knowledge of the participants. Four basic questions will be the same as the pre-test, while the other six will be more advanced. This will prevent the testing effect and help measure what the nurses learned while giving some common ground for comparison. By comparing the pre-test answers to the post-test answers, the first research question, “does additional training on smart pumps increase nurses’ knowledge,” can be answered. The remaining four questions will be answered using a seven point Likert scale. These questions will ask the nurses to rate the education module on effectiveness and the potential of the educational module to preventing medication errors in practice. This satisfies the second research question, “do nurses believe that such training will help prevent medication errors?” This document will have face validity; since it is new, the reliability is not known.