AMERICAN UNIVERSITY OF BEIRUT

QUANTITATIVE STUDY ON THE TRAINING GIVEN TO REGISTERED NURSES ON THE NEW PYXIS SYSTEM AT AUBMC

by
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AN ABSTRACT OF THE PROJECT OF

Jad Kamal BouDiab for Master of Human Resources Management
Major: Human Resources Management

Title: Quantitative Study on the Training Given to Registered Nurses on the New Pyxis System at AUBMC.

Automated dispensing machine is a medication distribution system that provides computer controlled storage, dispensing, and tracking of medications. This new technology has been recommended to improve efficiency and patient safety. They are now widely used in most of hospitals. The aim of this study is to investigate and discover the effectiveness of the training given to registered nurses for the PYXIS system at the American university of Beirut medical center AUBMC. After introducing the new automated dispensing system (PYXIS) in March 2018, at the American University of Beirut Medical Center (AUBMC), several problems emerged. Mainly, the goal of the hospital was to enhance the nursing practice, by facilitating faster access to first doses, new medication orders, and emergency medications. Moreover, some important goals include reduced cost, better clinical outcomes and higher compliance with the medication usage. However, RNs were facing a progressive problem in regard to the accessibility and the handling of this new machinery (PYXIS). This was due to a poor and ineffective training program. Therefore, this quantitative research investigated the effectiveness of the training implemented at AUBMC. A survey conducted with a modest sample of nurses working on different floors. The data collected from the survey aid in clarifying the difficulties that the nurses faced while implementing PYXIS training. Moreover, it can also be used as a reflective method to evaluate the effectiveness of the training itself. Therefore, this will help in later identifying the deficiencies in the training program. That would result in a series of future improvements after implementing the holistic electronic system (EPIC).

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To

My Beloved Family

CHAPTER I

INTRODUCTION

The American University of Beirut Medical Center (AUBMC) recognizes the need for long-term pharmacies; enabling it to provide its facilities with a secure and affordable solution for medication management systems. In turn, this improves the quality of care in these long term facilities by enhancing operational efficiency. According to Helmons, Dalton & Daniels (2012) these facilities are increasingly seeking the benefits of automated medicinal management systems for their sites. Such systems aid in regulatory compliance, security and help to increase the quality of care for nurses by enabling faster access to first doses, new medication orders, and emergency medications.

Moreover, the implementation of such systems at AUBMC may also provide operational benefits. Fanning, Jones & Manias (2015) found that reducing costs, and improving the charge capture by replacing the manual billing with an accurate automated process were the benefits mostly significant within the medical facilities. Therefore, the systems have the ability to charge automatically as an item is removed. Also, it promotes better clinical quality so the patients will have faster access to medications. In addition to that, these machines have higher compliance rate; the designated systems make it easier to manage and monitor the medication usage.

The introduction of new systems at any organization needs an effective training procedures, adequate qualifications and accurate assessment of the employees. According to Pasila (2017), several training methods can improve nurses' competences.

Medication administration at hospitals is prone to many errors. (Van Doormaal

et al., 2009) found that the handling of the medication, after removing it from the robot packaging, may contribute to high frequency of errors. This, in turn, may be reduced by training the nurse attendants, automated clinical decision support, and by measures to reduce workload. Thus, training nurses in point-of-care testing is cardinal, although the current in-depth descriptions of interventions in different settings are valuable.

Therefore, Registered Nurses (RNs), at any hospital, are the first liners in administering medications and treatment. As a result, a proper effective training on the new automated dispensing machines must be introduced by the nursing administration and the human resources department. This training must include class sessions and mock simulations of realistic scenarios to understand the (1) knowledge and (2) practice. A post-exam to critically assess their abilities, capabilities, and their comprehension of these machines is mandatory to evaluate the qualifications of these newly-trained nurses.

CHAPTER II

LITERATURE REVIEW

New Technology and Automated Dispensing System

Since the report, “To Err is Human”, was published by the Institute of Medicine (IOM), strategies for making health care safer have been modelled and implemented in different departments of health care facilities (Van Doormaal *et al*., 2009). The administration of medication is one of the most vital responsibilities of RNs (Sung, Kwon & Ryu, 2008) and even if it is the most common field being intervened, it is the most procedure susceptible to errors (McLeod, Barber & Franklin, 2013). Medication administration errors can have terminal effects on the patient’s health and life; hence, it is of utmost importance to prevent them especially when they rate 20% of total medical error (Keers, Williams, Cooke & Ashcroft, 2013). Some of the strategies implemented to reduce the MAEs include bar-code technology and automatic dispensing cabinets.

Automated dispensing systems are being introduced globally to improve efficiencies and safety in medicines management (Fanning *et al*., 2016). In 2008, A survey found that 82.9% of hospitals used automated dispensing cabinets, while Mandrack, Cohen, Featherling, Gellner, Judd, Kienle &Vanderveen (2012) showed that more than 94% of hospitals utilize ADC systems. ADCs such as the Pyxis and Omnicef offer a variety of benefits to the organization and the users (primarily nurses), such as secure and timely access to the most commonly used medications in a specific patient care area, more accurate tracking and capture of charge data for the medications used (Helmons *et al*., 2012), storage of medications within a secure computerized cabinet,

access restriction with individual fingerprint login, reduction of stock holding, and improvement of financial reporting (Roman, Poole, Walker & Dooley, 2016). The ADCs also improve the control and monitoring of narcotic and controlled substance and saves nurse time by instituting a 'blind count' (Wakefield, Ward, Loes & O'brien, 2010). For nurses in specific, Pyxis help improve medication safety, ensure pharmacist review the medication orders prior to administering them, and reduce delays related to medication availability, missing doses, and time-consuming controlled substance counts (Mandrack *et al*., 2012). A report even highlighted the efficiency of ward-based ADC in reducing costs and error rates simultaneously. Studies have even investigated the impact of ADCs within a short-stay geriatric unit. The deployment of ADCs in short-stay geriatric unit demonstrated a significant 53% reduction in MAEs yet there was an insignificant impact on total opportunities for errors in the MICU (Fanning *et al*., 2016). The latter is confirmed by two quality reports, one in 2007 (Wolcott *et al*., 2007) and another in 2010 (Institute of Medicine *et al.*, 2011) that concluded that healthcare has not necessarily grown safer. Medications errors often originate from system or process failures within the aspects of medication management (Fanning *et al*., 2016). Thus, more research has been focused on identifying personal and organizational predictors of errors to prevent them from occurring in the first place.

Planning & Implementation

In today's rapidly ever changing healthcare environment which is infested with computer assisted devices, nurses face a daily challenge to keep up with the advancements in the healthcare system. Implementing change can inflict upon the nursing facility anxiety and a fear of failure. Thus, whenever change is implemented in

a hospital, an adequate change management procedure should be applied for a smooth transition. Sutherland (2013) applied Lewin's Change Management Model on the implementation of bar-coded medication administration; however, this theory can be replicated on the implementation process of ADCs. The model encompasses three distinct phases known as unfreezing, moving and refreezing (Bozak, 2003). In the unfreezing phase, the key step is to communicate with all stakeholders including frontline nurses, information technology, pharmacy, clinical information services, nursing, program managers, clinical nurse educators and administrators. They are often gathered to discuss ideas that might affect the project's implantation. While the moving phase is where the project implementation actually takes place and it is important to keep open conversation with the nurses during this time. Round table discussions with the purpose of pointing out the driving and restraining forces occur. Some restraining forces Sutherland mentions are: staff resistance to using computerized devices, the possibility of workarounds, lack of computer experience, lack of trust in the organization, and aversion to using a new system. While the driving forces are: adequate financial investment, support from upper level management, potential for ease of use and better time management (Sutherland, 2013). Finally, the refreezing stage is used to evaluate the stability of the change and the overall effectiveness of it. Moreover, some areas to consider at the facility are implementation timelines, reliability of the equipment, educational training needs, effect on workflow, organizational culture and leadership (Spetz, Burgess & Phibbs, 2012). According to Sutherland (2013) it is imperative to have a project leader and that the ongoing support of the nurses on the frontline should continue until the transition is considered complete when all users are comfortable with the new device.

Moreover, another article's method included that 7 ADCs were introduced during a time frame of two months during the implementation period, in 3 critical care units, neonatology, intensive care unit, and emergency department (Rochais, Atkinson, Guilbeault & Bussières, 2014). However, Cottney (2014) takes another approach. He states that the ADC was acquired on a trial basis as long as the staff was still in the training phase.

Furthermore, Shu, Towne & So (2011) detailed the roll out and implementation process of AcuDose units. After the new machines where ready to be installed, the hospital's Information System replaced five old machines per day with new ones. "The first two ADC exchanges took one hour to complete, but subsequent exchanges took an average of 30 minutes." The rollout plan entailed the collaboration of pharmacy staff and nurses to always ensure that medication administration isn't disturbed and that a fully functioning ADC is always in close proximity.

Shu *et al*. (2011) also reported that the procedure of testing the new equipment required a team constituted from different departments. The testing team consisted of pharmacy staff and representatives of information system (IS) site services, the IS integration team, and the health system's medication build team. They also mention that the machine was tested via supplied "simulators" by the company and test computer servers, so the Multidisciplinary team was imperative to the success of the test.

Multidisciplinary planning and collaboration among nurses, pharmacists, and hospital leaders is of utmost importance in implementing the new change to ADCs. (Mandrack *et al*., 2012)

A chief nursing officer can serve as a liaison between pharmacists and nurses to ensure common understanding of best patient care processes with regards to ADC use

and collaborate on care policy development. Along with safety leader, s/he can also ensure nurses have the necessary education to use all functions of the ADC competently. The HR confirms nurses utilize the available orientation programs and tutorials and receive annual competency tests (Mandrack *et al*., 2012).

The IT Dept. conducts follow-up assessments to ensure staff members are maximizing the benefits of the technology by using all features and streamlining processes (Mandrack *et al*., 2012).

Furthermore, risk management units should aim to extend the learning process to the unit level, involving bedside nurses. This can reduce resistance, improve both top-down and bottom-up information flow, and promote a more-prompt response to errors (Drach-Zahavy, Somech, Admi, Peterfreund, Peker & Priente, 2014).

After implementation, the method of communicating system updates to staff is vital to initiating and maintaining a successful operation (Horning, 2011).

Component of the Training

Several authors had different approaches to the training procedure. Ferguson, Delaney & Hardy (2014) mention that the companies that sell the systems offer onetime onsite training for using the system since the purchased ADC already includes an instructional video for setting up and utilizing the system (Ferguson *et al*., 2014). While Vottero (2014) states that Pyxis ADC training was based on materials from the manufacturer and a video taken of a nurse withdrawing medications from the ADC in the hospital setting. Roman *et al*. (2016) wrote that one month prior to the installation of the ADCs, a compulsory education and training program was introduced for all nursing staff. The program included group tutorials and practical sessions demonstrating the

operation of the ADMs. New staff took the same training program on the first day of orientation. Moreover, others disclose that before implementing the ADS, nurses attended a 2-week training program (Chapuis *et al*., 2010). One author writes that the nurses were given 2 months to familiarize themselves with the Automated Drug-Dispensing Cabinets. During this period, a trained member of pharmacy staff was made available for the ward to contact should they have any problems pertaining to the new ADC (Cottney, 2014). Holden, Rivera-Rodriguez, Faye, Scanlon & Karsh (2013) state that as the new ADC system was being implemented over a period of 6 months first in the medical unit and then in the PICU, nurses were trained on the system. Also, some nurses were trained to be super users in order to ensure expert assistance on the units. Shu *et al*. (2011) mention that the training of over 2000 ADC users at the two hospitals, mainly nurses but also pharmacy, respiratory therapy, and radiology staff was led by a group of AcuDose "superusers" who had been trained onsite by McKesson in an eight-hour class. These 140 superusers were then responsible for teaching and training frontline personnel in their respective service areas. To help with the training process, they also convey that two weeks before the rollout date, few new ADCs were placed in designated areas with drawers loaded with candy to encourage users to familiarize themselves with the basic cabinet functions. Along with the superuser training, McKesson's automation division chose 15 staff members that were trained on advanced back-end technical topics such as building a formulary, setting options and rules, generating reports, and troubleshooting (Shu *et al*., 2011). Moreover, Martin, Burgess & Doeck (2000) note that the data collection that was later needed to be analyzed was completed using existing recording systems such as dispensing interventions, workload statistics, computer- generated reports etc.

Moreover, Cooley, May, Alwan & Sue (2012) report that training should be available in several different forms such as computer-based training, one on-one instruction, and printed instruction sheets to be able to cater for different learning styles and adjust to busy schedules. They continue to state that even though training can be a high cost element of new system implementation, the return on investment will be the accurate and efficient use of the device (Cooley *et al*., 2012) Current research show that every time an MAE is intercepted, $7000 is saved (Bravo, Cochran & Barrett, 2016) and these interceptions come as a result of vigorous training. These authors also mention some training tips for new system employment. They suggest that the training occurs just before the new system takes over to help ensure information retention; that last-minute training support is available; that clinician "super users" train other clinicians as they would have the same shared experiences and finally that training should be mandated as a prerequisite to obtaining new system access.

Importance of the Training

Lack of training is one of the most frequently cited barriers to technology use (Escobar-Rodriguez & Romero-Alonso, 2013). They continue to state that the effectiveness of the implementation process of nee innovative devices is defined by significant investments of time and money in start-up, training, and user support. "Training provided to healthcare personnel can have a significant influence on the perceived ease of use and perceived usefulness of unit-based medication storage and distribution systems" (Escobar-Rodriguez & Romero-Alonso, 2013).

To improve medication safety, health professionals' knowledge, skills and attitudes of toward safe medication practices should be positively influenced (Schneider

et al., 2006).

Additionally, many studies indicate that a lack or deficit in medication knowledge, education, or experience greatly contribute to MAEs (Kopp, Erstad, Allen, Theodorou & Priestley, 2006). Moreover, Keers *et al*. (2014) have found that investing in nurse education and training initiatives substantially improve MAE rates.

According to Wilson *et al*. (1998), studies have been too focused on which profession makes the most drug administration errors rather than focusing on other error contributing factors especially when recent studies have shown that medication errors are more related to systems failures such as team, task, environment, individual and system factors rather than individual professions. Training also provides health professionals with the necessary knowledge, skills and attitudes that enable them to work in a patient-centered team (Hewitt, Tower & Latimer, 2015). Lastly, training, both before and after implementation, has been shown to enhance nurses' attitudes toward Health Information Technology and has been identified as a critical factor in complex information technology adoption (Ward, Vartak, Schwichtenberg & Wakefield, 2011).

Post-Training Assessment/Evaluation

"Once completed and fully operational, an evaluation and summary of problems encountered, successes realized, and challenges encountered throughout the project should be done, for future Reference" (Sutherland, 2013). First, Straight (2008) stated that self-reported method of staff training on use of the Pyxis MedStation 2000 was the completion of the tutorial program available on the device itself. While Chapuis *et al*., (2010) reported that self-administered questionnaires were utilized to evaluate perceptions of the nurses of the new system. To highlight any "resistance-to change",

they were organized 2 weeks before, 6 weeks after, and 8 months after ADS implementation. Also, the assessors used a four-point Likert scale to avoid inconclusive neutral answers. Rochais *et al*., (2014) described in detail the quantitative and qualitative analyses following the ADC installation. For the Quantitative Analysis, questionnaires were administered to the nursing staff in the health care units where the ADCs were fixated. The unit's head nurses and nursing advisors helped distribute the questionnaire over a period of 2 weeks. The nurses, nursing assistants, and assistant head nurses received a copy of the questionnaire at the beginning of their shift and had to hand it back before the end of their shift. The questionnaire included 33 statements in a 4-level Likert-type scale. While for the Qualitative Analysis, during the same 2 weeks' period, a focus group that included pharmacists, a pharmacist assistant and a nursing advisor was established that aims to pinpoint the problems that were raised following the ADC's implementation and to propose solutions for each unit during meetings that last 90 minutes.

Last but not least, Novek (2002) communicated an assessment procedure that took place after the implementation of the Meditrol automated medication dispensing system (AMDS) in a hospital. The questionnaire was given to the nurses one year after the installation of the AMDS unlike Martin *et al*., (2000) who assessed nurses over the seven weeks immediately following implementation. The questionnaire focused on the transition from paper to electronic documentation; the amount of time devoted to medication administration; perceptions of medication safety; and issues of job control, training, and autonomy.

CHAPTER III

METHODOLOGY & SAMPLING

This study utilized a quantitative design using a self-administered survey methodology. Thus, it was important to meet with the hospital administration and the nurse managers to take the permission to conduct our research in their facility, and with their staff through IRB approval. The strategy of collecting data started by distributing the questionnaire to our nurses. Using the survey design helps in collecting data from nurses and finds the main causes of this major problem. Also, it is cost effective and less time consuming. Both large sample size and easy accessibility to the participants will facilitate the collection of sufficient information. One standardized structured questionnaire that focuses on closed-ended questions was distributed to all the participants. The questionnaire was divided into three main categories (pre, during, and post training) to assess the process effectively. The questions were building spatially for this project to assess the training given on Pyxis. All the questions were in English and distributed to the nurses randomly 5-8 nurses from each floor. Sent via AUB lime survey with 3 online reminders.

This research was conducted at AUBMC. Privacy and confidentiality are of the essence while conducting the interviews and research in general. The questionnaire was administered to at least 200 nurses working at AUBMC. Nurses were randomly selected from different floors within the hospital, specializing in different disciplines in the medical profession (medical, surgical, intensive, oncology and clinics). The random selection process ensures that the sample is representative and that the problem is in the overall nursing field rather than a specific specialty.

After conducting the surveys and gathering the data needed, a descriptive discussion was used to analyze the data retrieved from the nurses.

CHAPTER IV

RESULTS & ANALYSIS

Demographics

Out of 200 online surveys sent to the nurses randomly at AUBMC only 74 fully participated. The first section in the survey contains some demographics information of the participants such as gender, age, years of experience, and specialty.

From these nurses 39 were females and 29 were males. 17 others refuse to answer this question. Concerning the age of the participants as we can see from the below table the majority of the nurses were young (41% between 21-25 years old).

Table 1

Gender

Gender	Count
Female	33
Male	25
N/A	16
Total	**74**

Table 2

Age

Age	Answers
21-25	27
26-30	22
31-36	19
>36	6
Total	**74**

In the third question we were asking about the years of experience. This is a very important indicator. In nursing, experience is highly recommended and important. An experience registered nurse is more capable of relating nursing practice and new technologies than a fresh graduate RN. Finally the last question in this part focuses on specifying the area where participants are working. This is to asses that the problem in training is with all nurses and not with specific area or specialty.

Table 3

Years of Experience

Years of Experience	**Answers**
<1	9
1-5	34
5-10	21
>10	10
Total	**74**

Table 4

Specialty

Specialty	**Answers**
Intensive Care	40
Medical/Surgical	21
Outpatient services	1
Other	12
Total	**74**

Training Assessment Analysis

The second part of the survey analysis was divided into three main categories: pre, during, and post training assessment.

Pre-Training Assessment

In this part the questions were targeting the preparation and implementation of the new automated dispensing system at the hospital and how was the readiness of the nurses to accept and get comfortable with this transformation. To make it clear, the nursing administration and the CPDC department at AUBMC generated five online videos that explain the parts, uses, and functions of these machines in details.

The pre-assessment training included four main questions to assess the necessity, efficacy of the videos distributed to the nurses 20 days prior to the single training session. In first three questions below, and according to what nurses answered, the majority disagrees and consideration that the videos were not necessary and helpful (average 2.73). These results were expected. It is a new transformation in medication administration and dispensing system. Nevertheless, nurses in our community are not well prepared to new changes. Moreover, they don’t have enough time to waste it in watching videos, but rather they prefer demonstrative and simulation classes. And this is the role of the training sessions later on. In the last question, 35% of the nurses disagree on having a clear idea about why Pyxis was needed in the hospital with an average of 2.89. This is an important role of the administration in explaining such details.

Table 5

Pre –Training Assessment

Answers	The pre Pyxis training videos were necessary and useful	The videos prepared me well for the training	I felt confident about Pyxis after watching the videos	Before the training, it was clear to me why Pyxis was needed
Strongly disagree	6	5	6	5
Disagree	29	34	31	25
Neutral	17	12	23	15
Agree	17	20	11	21
Strongly disagree	6	3	3	8
Average	**2.81**	**2.75**	**2.64**	**2.89**

During-Training Assessment

In the second part we were trying to get a clear idea about the component of the training, the duration and the number of sessions given, and the materials used.

The table below gives a clear idea that the training session and the materials given were not suitable for the nurses. From the first table we can analyze that during the session 37% of the nurses agreed that not all the parts of the machines were covered (average answer 2.93). The second table showed that a gap in knowledge of using the machine was highly noted after the session. Also, 38% of the participants agreed that the sessions were not engaging and interesting (average 2.82). Thus, this is considered as disadvantage in teaching and delivering new ideas and experiences. The fourth question proof that 29% of the nurses didn’t get a proper idea of dispensing the medication by the end of the session (average 3.09).

Table 6

Training Assessment Table 1

Answers	The training session covered all the parts of the Pyxis machine	The training session gave me the needed knowledge to use the Pyxis machine	The training session was engaging & interesting	The training gave me a full idea about the machine and proper dispensing of medications
Strongly disagree	2	4	2	0
Disagree	30	25	31	25
Neutral	17	16	20	18
Agree	21	25	20	30
Strongly agree	4	4	1	1
Average	**2.93**	**3**	**2.82**	**3.09**

From the table below we can realize that one training session as scheduled for each nurse by the CPDC and approved by the administration was not enough at all (average 2.79) . This is clear because 41% of the participants were not capable of using the machine freely and with minimal supervision after the single session and before launching the system (average 2.75).

Table 7

Training Assessment Table 2

Answers	I found that one training session is enough for me to learn about the Pyxis	Registered nurses on the floors were capable of dealing with new machines before their implementation
Strongly disagree	6	4
Disagree	28	31
Neutral	15	19
Agree	25	19
Strongly agree	0	1
Average	**2.79**	**2.75**

After- Training Assessment

In the third part of the assessment analysis we were trying to find to which extent nurses are ready to use the machine at the big day of launching the machine on the floors. Moreover, we were assessing the collaboration of the team in this process. Collaboration and team work is one of the important six values at AUBMC. The question below show that 35% of the nurses were not capable of dealing with the new system immediately and with minimal supervision after the training was done and PYXIS was implemented (Average of 3.04).

Table 8

Post-Training Assessment Table 1

Answers	After the training session, I was able to use the Pyxis machine immediately with minimal supervision.
Strongly disagree	3
Disagree	27
Neutral	13
Agree	26
Strongly agree	5
Average	**3.04**

As we can see from the tables that the super users, pharmacist, and the IT department were helpful (average 3.44) but mainly the problem was in the materials and the length of the training as we can see in the fifth question. From the participants, 28% agree and 9% strongly agree that the length of training on PYXIS was insufficient or inadequate with an average answer of 2.85.

Table 9

Post-Training Assessment Table 2

Answers	Super-users were helpful during the launching of the Pyxis	Pharmacists were helpful during the launching of the Pyxis	IT department was helpful during the launching of the Pyxis	The length of Pyxis training was adequate
Strongly disagree	1	2	0	7
Disagree	18	19	14	24
Neutral	12	8	13	20
Agree	35	39	41	19
Strongly agree	8	6	6	4
Average	**3.41**	**3.37**	**3.52**	**2.85**

In the last two questions we were asking about the opinions of the participants generally in the training given. 33 % were not satisfied at all with the process (average 2.93). On the other hand the last table show that more than 15% agree and 10% strongly agree that they learned directly on the machine and the sessions given were useless without simulation and real life scenarios (average answers 2.79).

Table 10

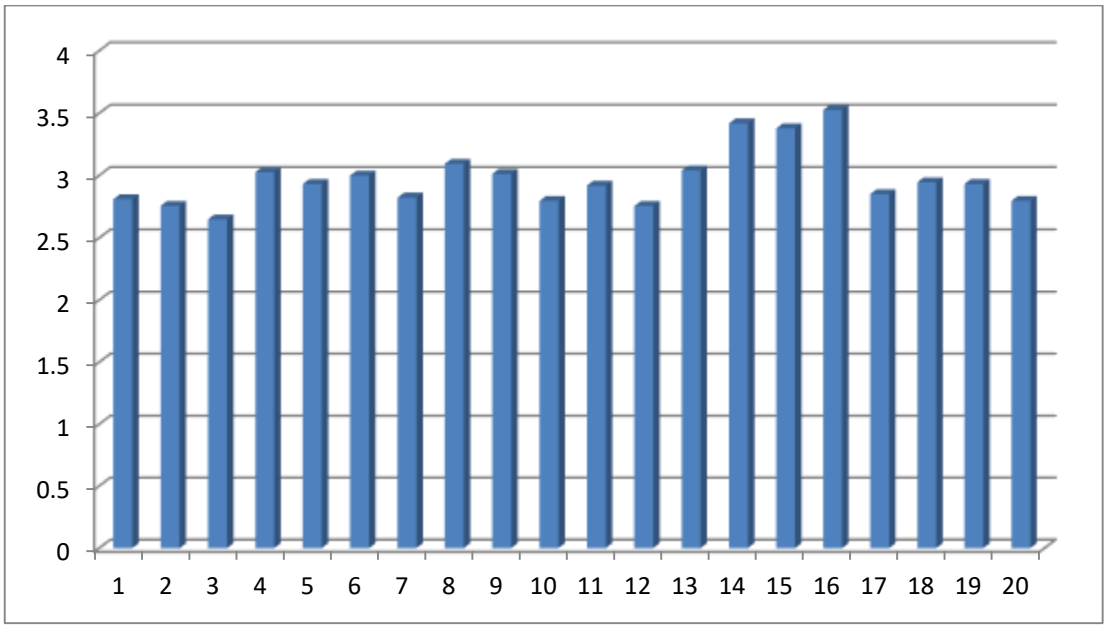
Post-Training Assessment Table 3

Answers	I am satisfied with the training process of the Pyxis machine	In my opinion, Pyxis training sessions were not needed as I learned on the machine directly
Strongly disagree	3	8
Disagree	25	28
Neutral	22	17
Agree	22	13
Strongly agree	2	8
Average	**2.93**	**2.79**

BAR Chart of All Questions

Figure 1

Pre/ During/ Post Training Bar Chart



CHAPTER V

DISCUSSION & CONCLUSION

From this study, we identified three major deficiencies in the Pyxis training at AUBMC. These include the resources used, session length and content, and training evaluation. This study has shown that during pre-training, the multimedia materials were not helpful to the nurses in preparing them on how to handle Pyxis. This is due to the fact the no formal explanatory session was done for the AUBMC nurses. This is contrary to literature which states that adding an explanatory session while using multimedia materials aids in preparing the nurses for the main training session. Moreover, this study demonstrated that AUBMC nurses were not satisfied with the length of the sessions. They only took one session of formal training while literature indicated that more frequent sessions are necessary for the nurses to familiarize themselves with the training content. Hence, for the content the results show that the content of the Pyxis training was not sufficient. As a result, proper identification of training modules and learning content is essential to be identified and implemented in order to ensure the transfer and understanding of the necessary Pyxis knowledge. As for post implementation, the nurses at AUBMC were not able to use the Pyxis machines freely and with minimal supervision. Hence, immediate evaluation of the training is needed to assess the readiness of the nurses for using the new system.

Although, from the literature we saw that a compulsory education and training program was introduced for all the nursing staff. The program included group tutorials and practical sessions demonstrating the operation of the automated dispensing machines. New staff took the same training program on the first day of orientation.

Moreover, others disclose that before implementing the ADS, nurses attended a 2-week training program. In other hospitals the new ADC system was being implemented over a period of 6 months first on the units. But, On the other hand, the training given to AUB staff on the ADMs lasted for 1 hour and was given to educators from the CPDC. The latter passed on the learnt information onto to the nursing team even though the "super users" from the CPDC were not perfectly acquainted with the training material. To cut on costs, AUB administration decided not to invest in a proper training given by company representatives; a decision that had adverse consequences on all ADM users. Moreover, in the literature they mention the importance of an assessment procedure that took place after the implementation of the automated medication dispensing system (AMDS) in a hospital to evaluate the efficacy of the training. No such Assessments were done or even taken into consideration at AUBMC.

Other Recommendations:

- *Communication*: whenever a major change occurs in an organization, communication is one of the most key ingredients. Top management must communicate their goals and targets to all levels of hierarchy to increase understanding, motivation and engagement.

- *Collaboration*: such a big project at a large scale needs significant collaboration between many departments at AUBMC. Nursing, pharmacy, CPDC and plant engineering must all work together to create the best training process for the nurses. Each department can add value and knowledge regarding the complicated Pyxis processes.

- *Engagement:* nurses are the key users for Pyxis. Thus, it is important for them to be involved in the planning and implementation. Selecting super users to assist

in training and allowing nurses to voice their ideas and knowledge in the medication administration process allows for a better implementation of Pyxis.

- *Evaluation*: once the training is done the most important aspect the trainers must do is to evaluate its effectiveness. As this study has shown, not all trainings are perfect. As a result, it is important to evaluate the training methods and resources used in order to identify gaps and improve them for future changes.

As a conclusion, nurses in the medical field are the first liners in handling and administering medications. Such systems aid in compliance, and help to increase the quality of care for the patients by enabling faster access to first doses, new medication orders, and emergency medications. As a result, an effective teaching and guidance program on the new automated dispensing machines must be introduced properly by the nursing administration, the human resources department, and the CPDC. This training must include class sessions and mock simulations of realistic scenarios to understand the knowledge and the practice. The trainers must carefully plan and select the training content they will provide for the nurses. In addition, the trainers must intelligently use multimedia as an aid to clarifying and transferring the training material. A post-exam is vitally important to assess their abilities, capabilities, and their comprehension of these machines. Moreover, it will help in evaluating the qualifications of these newly-trained nurses and identifying the deficiencies that can be improved in future trainings.

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