Improving Clinician Competency in Assessing Blood Pressure Measurement: A Quality Improvement Project

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PART I: DNP PROJECT PROPOSAL

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Abstract

Purpose: The purpose of this quality improvement project was to assess the baseline knowledge for taking an accurate blood pressure measurement for nurse practitioners (NPs) working at a retail health clinic (RHC) before and after the completion of an education intervention. **Methods:** An 18-question pre-intervention survey was distributed to nurse practitioners working at RHCs located in South Carolina. The implementation of this quality improvement project consisted of a pre-intervention survey to assess knowledge for taking an accurate blood pressure measurement. The NPs were then asked to review an educational intervention that focused on the proper equipment, techniques to obtain an accurate blood pressure measurement, and common errors identified when measuring blood pressure. The same 18-question post-intervention survey was distributed four weeks after the initial recruitment. **Results:** A paired t-test was used to compare the results of the pre-intervention and post-intervention survey responses to determine if there is a statistical significance regarding knowledge gains. Based on the data analysis, there was an improvement in the post-survey responses after the participants reviewed the educational intervention. The p-value for the paired t-test was 0.01202 and was smaller than the alpha of 0.05 therefore providing evidence that there was a statistical difference between the mean pre-survey and the post-survey. **Discussion:** Based on the information gathered from the pre-and post-intervention survey there were areas of opportunity regarding the baseline knowledge of nurse practitioners working at RHCs and routine education about proper blood pressure measurement techniques could prove to be beneficial to the overall knowledge.

Keywords: Retail health clinics, nurse practitioners, blood pressure monitoring blood pressure training.

Clinician Competency in Assessing Blood Pressure Measurement

Background

According to the CDC (2020), blood pressure (BP) measurement is the pressure the blood against the walls of the blood vessels as it circulates throughout the body and is usually measured in millimeters of mercury. The result of this measurement has a direct impact on the patient care plan. However, the quality of BP measurements in clinical practice remains poor (Muntner et al. 2019), is unreliable, and despite numerous educational programs, the poor quality of these BP measurements results in the systemic over-diagnosis of hypertension (Myers, Asmar & Staessen 2018). This simple measurement is taken for all acute patients seeking care at one of the area's largest retail health clinics. The RHC location for this project uses two pieces of equipment to take a manual blood pressure measurement, a stethoscope, and an aneroid sphygmomanometer, also known as a blood pressure cuff. Patients presenting to the clinic have their blood pressure measured but there may be an opportunity for improving the accuracy of the BP measurements. The RHC has a standard chair for patients to sit on during the visit. Additionally, there is an examination table that patients may choose to sit on during their visit. Of these sitting positions only one, a patient sitting in a chair with their feet flat and back supported, is approved, and recommended by the American Heart Association (AHA). Not adhering to the approved blood pressure measurement guidelines can lead to inaccurate measurements and have a potentially negative impact on the health of the patients receiving care.

Problem Statement

There are several factors that can cause inaccurate blood pressure readings. This study will focus on three main factors, patient positioning, the size of the BP cuff, and the documentation of Korotkoff sounds. In a study by Morcos et al. (2018), it was discovered that improper positioning while measuring the blood pressure resulted in misclassification of prehypertension and hypertension in 7.4% of patients. Kallioinen et al. (2017), also noted that using a BP cuff that was too small could result in an artificially elevated BP

reading, and using a cuff that was too large could result in a reading that is artificially low. The length of the BP cuff should be 75%-100% of the patient's arm circumference and the width should be 37%-50% of the patient's arm circumference (Muntner et al. 2019). Muntner el al. (2019) as noted that the most frequent error in measuring office BP is miscuffing, with undercuffing large arms accounting for 84% of the miscuffings.

Organizational "Gap" Analysis of Project Site

This specific retail health care company has over 1,100 clinical facilities nationwide. Each clinic has the same equipment to provide uniformity and is set up in a similar floor plan for consistency among the clinics. This set up allows clinicians to work in various clinics without having to adjust to their work environment. The clinic room has one exam table and one standard chair for the patient to sit on during the clinical encounter. It is also this environment that presents an opportunity for errors in the recommended blood pressure techniques while obtaining a blood pressure measurement. The patients will typically sit in the chair while the clinician registers the patient and obtains the pertinent history. The patients will then move to the exam table during the physical exam. After the exam, patients will often return to the chair while the clinician completes the documentation and wraps up the visit.

Following the proper technique is recommended when assessing a blood pressure to obtain the most accurate reading.

Review of the Literature

A literature review was conducted using multiple scientific databases, CINAHL, PubMed, and Ebscohost. The keywords and phrases used for the search were retail health clinic, blood pressure measurement, nurse practitioners, and blood pressure training. The keyword search yielded only one result, but the search result did not provide information related to the quality improvement project intention. The article discussed the key role that community pharmacist and nurse practitioners played in the development of a new service in Perth, Western Australia, that focused on the management of mental health patients with metabolic risks (Maulavizada et al., 2016). There is a gap in the literature and shows that this quality

improvement project is one that could add value to the knowledge base of nurse practitioners working in a retail healthcare setting.

Cardiovascular disease is the leading contributor to overall mortality in America according to the Seventh Joint National Committee (JNC 7) and hypertension is the most important preventable risk factor for heart disease. The JNC 7 re-classified blood pressure measurements as normal (<120/80 mmHg), elevated (120/80 – 129/80 mmHg), stage 1 (130/80 – 139/89 mmHg) and stage 2 (≥140/90 mmHg). This most recent re-classification of blood pressure by the JNC 7 changed the prevalence of hypertension in the United States to 46% compared to 32% when using previous classification criteria. These figures account for almost half of the adult population in the U.S with only about 24% of those with a diagnosis of hypertension having it under control. According to the Center for Disease Control and Prevention, nearly half a million deaths in the United States included hypertension as a primary or contributing cause. Not only did hypertension claim almost half of million lives in 2018, according to the CDC, it costs the United States healthcare system about $131 billion each year (Kirkland et al., 2018). Kirkland (2018) concluded that individuals with hypertension are estimated to face nearly $2,000 higher annual healthcare expenditures when compared to individuals without hypertension.

A study by Matheson et al. (2020) examined changes in nursing knowledge following an education session that focused on proper blood pressure measurement techniques. They found that nurses who attended the educational session had a 60.9% increase of knowledge and saw greater adherence to the established and recommended AHA guidelines for the measurement of blood pressure. Prior to the educational session, Matheson et al. (2020), observed the BP measurement technique of nurses in the cardiovascular intensive care unit (CICU) and identified that patient position was not correct 67% of the time. Similarly, a study by Morcos et al. (2018) observed that 60% of primary care practices operated by the same health care organization did not adhere to the AHA's recommendation for patient positioning. Sewell et al. (2016) identified that BP measurements in a clinical care setting seldom follow the protocols recommended by national guidelines,

potentially leading to overestimates or underestimates of blood pressure control. Sewel et al. (2016) also suggested that common measurement approaches in real-world clinical settings tend to increase the diagnosis of uncontrolled hypertension and can result in the misdiagnosis of a chronic condition or the unnecessary initiation or titration of anti-hypertensive medications.

A study by Block et al. (2018), noted that although nurses and other healthcare providers learned the proper techniques for measuring a blood pressure, the knowledge and skills needed to take it accurately decayed over time. It was determined that providers needed continual education and information about new protocols and techniques to ensure that clinicians provided standardized care (Block et al., 2018). In a study by Block et al. (2018), clinicians completed an online educational training plan. Clinicians that completed this training did improve their knowledge of correct blood pressure measurement techniques and demonstrated greater adherence to the AHA's recommended guidelines for blood pressure measurement. Likewise, Arena and Peterson (2020) identified a significant improvement in attitudes, practice behaviors, and knowledge after participants in their study completed an educational initiative that provided BP assessment tools.

Evidence-based Practice: Verification of Chosen Option

The importance of accurately assessing a patient's blood pressure while having them positioned correctly cannot be overstated. A study by Morcos et al. (2018) compared the blood pressure readings 209 participants that had their blood pressure assessed while sitting on an exam table and again while properly positioned. The study found a significant lowering of overall blood pressure for those participants that had their blood pressure assessed while being properly positioned. The results showed that 7% of participants that were not positioned correctly during their blood pressure assessment had been misclassified with prehypertension and another 5.9% of participants were misclassified as having hypertension. This misclassification could lead to the unnecessary use of antihypertensive medications. As the nation's largest retail health clinic, the opportunity to improve and adhere to the recommended guidance for taking a blood pressure measurement can help prevent the misdiagnosis of hypertension and avoid the prescription of

unneeded medications used to treat hypertension.

Theoretical Framework or Evidence-based Practice Model

Adult learning theory (ALT) was developed by Malcom Knowles in 1984 and operates on four key principles. The four key principles focus on: 1. adult involvement in the planning and evaluation of their instruction, 2. experiences that provide a basis for learning, 3. subjects that have an immediate impact on their jobs or personal lives, and 4. focus on being problem-centered learning instead of content orientated. These four principles can be applied to this project concerning knowledge acquisition of nurse practitioners working in retail health clinics.

Goals, Objectives, and Expected Outcomes

The goal of this project was to assess the knowledge gains of nurse practitioners working at retail health clinics in South Carolina after completing an educational intervention. Nurse practitioners were provided with a brief survey prior to completing the educational intervention to establish a baseline of their knowledge regarding proper blood pressure measurement techniques. The nurse practitioners had one week to complete the first survey, another week to complete the educational intervention, one week to absorb the education information and on the fourth week, a second post-education survey was sent for the nurse practitioners to complete. At the conclusion of this timeframe, the pre-and post-survey data was analyzed and compared. Prior to implementation, it was determined that a sample size of 54 would be needed to have a high-power study (0.95). However, this sample size was not achieved. This will be further discussed in the results and discussions sections.

Methods

This quality improvement (QI) project originated with the distribution of a recruitment email containing instructions, access information, and a secure link to an online Qualtrics pre-interventions survey. The email was distributed via the facility's internal and secure Outlook email server. The survey was distributed using Qualtrics and the data was secured in a password protected account. The online pre- and

post-intervention survey used was an 18-question survey adapted from an original 21-question survey developed by A.M Crosley and J.R. LaRose, for their 2013 original research study. Permission was granted by both authors to use the pre- and post-intervention survey. Permission was also granted to modify to modify the length and questions as needed for the target population.

A week after the initial email, the participants received a follow up email with a PowerPoint attachment of the educational intervention. The educational PowerPoint presentation contained current information from the American Heart Association (AHA) toolkit and the Wisconsin Heart Disease and Stroke Prevention Program toolkit for clinicians to review.

A third email, a week later, was sent to the participants reminding them to complete the educational intervention. The fourth and final email was sent the following week with the secure link to the online post-intervention survey. The post-intervention survey was also completed using Qualtrics to ensure the security of the information and had the same instructions on how to access and complete the survey.

The aim of the project was to assess the baseline knowledge of nurse practitioners working at a RHC regarding proper blood pressure measurement techniques before and after the completion of an educational intervention focused on accurate blood pressure measurement techniques.

Project Site and Population

The quality improvement project was implemented at one of the largest retail health clinic chains in the country. This organization has RHCs in 36 states with over 1,100 clinics nationwide. The RHCs located in South Carolina were the locations selected for this project. The clinicians selected to participate in this project were all be family nurse practitioners (FNPs) working in various cities across South Carolina. All the nurse practitioners work independently within the RHC. The setting and participants for this project was made up of a convenient sample size of 250 nurse practitioners working at a chain of RHCs in South Carolina. A sample size based on a repeated measures analysis found that 54 participants were needed to achieve 0.95 power. Out of the 250 surveys sent out, only 8 participants completed all the steps of the project. The demographics for

the participants that completed both surveys (N=8) were all women with 75% being >40 years old, 25% were

between the ages of 26-30 and the other 25% were between the ages of 31-35 years old (Table 1). Five

participants were Caucasian (62%), one African American, one Hispanic, and one NP identified as other. Two

nurse practitioners (25%) had their doctoral degrees, and the remaining six NPs (75%) had a master's degree.

Table 1

Participant Demographics

Post-Survey N=8	N	%
Female	8	100%
Male	0	0%
Non-Binary/third gender	0	0%
Prefer not to answer	0	0%
20-25 yo		0%
26-30 yo	2	25%
31-35 yo		0%
36-40 yo	2	25%
40+	6	75%
Caucasian	5	62%
African American	1	12%
Hispanic	1	12%
Asian	0	0%
Other	1	12%
Masters	6	75%
Doctorate	2	25%

Measurement Instruments

The measurement instrument used for this quality improvement project was the pre-and post-

intervention survey. Participants completed an 18-question survey to assess their knowledge of the AHA

guidelines on how to accurately measure a blood pressure. The final four questions were demographic

questions identifying the participant's gender, age, ethnic group, and highest academic degree earned. The

pre-and post-intervention surveys had the same questions. This survey was created using Qualtrics and the

link to the surveys and the participant's results were secured.

Data Collection Procedures

The data from the completed surveys was kept in the Qualtrics system that was secured via the Box. The data was transferred to a password protected Microsoft Excel spreadsheet. It was organized in a table distinguishing the results for each of the participants that completed both the pre-intervention survey and the post-intervention survey. The overall score for questions 1 through 13 were calculated for the pre-and post-intervention surveys. Microsoft Excel software was also used to analyze the data (Table 2).

Table 2

Participant Scores

Participant Scores			
Participant	Pre-Intervention survey	Post-Intervention Survey	Difference
AF3259	69%	69%	0%
AT4792	31%	84%	53%
HC9467	46%	76%	30%
HO0216	53%	69%	16%
MC1455	61%	69%	8%
NL3083	61%	92%	31%
SC3907	53%	69%	16%
YS2618	53%	61%	8%
Mean	**53%**	**74%**	21%

Data Analysis

The data was collected and organized onto an Excel spreadsheet. A paired *t*-test was used to analyze the data to determine if there was a significant and statistical difference in the knowledge of nurse practitioners before and after the educational intervention.

Cost-Benefit Analysis/Budget

This was a budget neutral project. Access to Qualtrics and the data-management system was provided by the academic institution. There was no cost incurred during the creation of the educational intervention and it was distributed electronically free of charge. The participants were all volunteers and were not compensated monetarily at any time during the study. Participants did not have to miss any time from work for this study and were able to complete the surveys and the educational intervention in between patient visits.

Timeline

The total timeline for this project was 6 weeks from the initiation of the project to the dissemination of the findings (Table 3). Participants were actively engaged during the first four weeks with the completion of the pre-intervention survey on week one. The second week allowed participants to complete the education intervention. A reminder email was sent to the participants on the third week reminding them to complete the educational intervention. An email sent on the fourth and final week asked the participants to complete the post-intervention survey. The following 2 weeks were dedicated to the collection and analysis of the data, the interpretation of outcomes, and dissemination of findings.

Table 3

Project Timeline

Week	Activity
Week 1	Recruitment email sent. Participants will complete the pre-intervention survey
Week 2	Email with education intervention sent to participants for their review.
Week 3	Email sent to participants reminding them to review the educational intervention.
Week 4	Email with the post-intervention survey is sent to the participants
Week 5	Data will be collected and analyzed.
Week 6	Interpretation of outcomes and dissemination of findings.

Ethical Considerations/Protection of Human Subjects

The quality improvement project was reviewed and approved by the University's Institutional Review Board (IRB). The retail health facility that was selected for this study has regulations and restrictions that

prohibited access to patient specific information and therefore patient outcomes could not be measured. Only nurse practitioners employed at the RHCs were selected to be part of this study. All participants remained anonymous, and all data was stored in BOX, a secure password protected site. These measures were implemented to protect participants under the Health Insurance Portability and Accountability Act of 1996 (HIPPA) which guarantees, protects the privacy of participants' information. Additionally, the DNP student, who was the primary investigator that conducted the project followed the *Standards of Care* for practice the healthcare organization.

The risk to clinicians participating in the project was no different from the risks of clinicians who elected not to participate. Recruitment emails, providers' email addresses were all kept confidential. All electronic files containing data and other potentially identifiable information were stored on a secure password protected BOX.

Discussion

The recruitment email was sent to a total of 250 nurse practitioners within the RHCs of this facility within South Carolina. Sixteen participants completed the pre-intervention study, and eleven participants completed the post-intervention study. After the survey results were collected, only eight participants completed both the surveys. Only Participants that completed both surveys were included in the data analysis. Although the number of participants did not meet the determined number of 54 participants to have a high-power study of 0.95, a significant improvement in the knowledge base of participants after the educational intervention was observed. The mean score for the pre-survey was 53%. The mean score for the post-survey was 74%, showing a difference of 21% after the completion of the educational intervention. The data analysis did provide evidence that the p-value of 0.01202 was less than the alpha of 0.05 and therefore the difference between the two scores was statistically significant and rejected the null hypothesis (Table 2). More time was needed to allow for greater participation and to track the knowledge retention over the course of longer period of three to six months.

Table 2
Participant Scores

Participant	Pre-Intervention survey	Post-Intervention Survey	Difference
AF3259	69%	69%	0%
AT4792	31%	84%	53%
HC9467	46%	76%	30%
HO0216	53%	69%	16%
MC1455	61%	69%	8%
NL3083	61%	92%	31%
SC3907	53%	69%	16%
YS2618	53%	61%	8%
Mean	**53%**	**74%**	21%

Both surveys had the same questions. Results from some of the questions were significant to this quality improvement project as well and the potential for future studies.

Question #4: *A nurse practitioner using an aneroid sphygmomanometer observes a systolic blood pressure reading of 133. Which of the following is the correct recording to enter in the patient's chart?*

a) *130*

b) *132*

c) *133*

d) ***134***

A systolic pressure of 134 was the correct answer. Of the eight participants, only one participant answered it correctly on both the pre-and post-intervention survey. The standard gauge on a BP cuff only measures BP in degrees of 2 mmHg. The AHA recommends rounding to the nearest 2mmHg when using an aneroid BP cuff.

For example, a systolic measurement thought to be 133 would be rounded up to 134 based on the recommendations. Incorrect documentation of a blood pressure reading could lead to an incorrect diagnosis and the development of an erroneous treatment plan. Review of this AHA recommendation should be shared in upcoming continual training at RHCs.

> Question #6: *Which of the following is the recommended frequency for retraining health care*
>
> *professionals on blood pressure measurement technique?*
>
> e) *Every two years*
>
> f) *Once per year*
>
> g) ***Every six months***
>
> h) *At your own discretion*

When reviewing the responses for the surveys, it was evident that the participants were not familiar with the recommendations for the retraining intervals. None of the participants selected the correct response for the training interval on the first survey. Only three clinicians selected the correct response after the educational intervention. The findings from this project could prompt a change in the re-training program for this facility. All participants selected the correct response to questions 5, 9, 11, and 13 after the intervention. Question #12 showed the greatest improvement in selecting the correct response when compared to the same question on the pre-survey.

> Question #12: *Which part of the stethoscope is preferred when measuring a blood pressure?*
>
> a. ***Bell***   b. *Diaphragm*

There was a 75% improvement for that question after the intervention. According to the AHA the bell is recommended over the diaphragm because it provides a greater ability to listen to lower pitched sounds like the blood rushing through the brachial artery.

Limitations

A potential limitation of this study was the small size (n=8). However, there was a significant improvement seen with those who chose to participate. Another limitation for this project was the inability to observe clinicians taking a blood pressure measurement before and after the educational intervention. The inability to collect information about patient outcomes after the completion of the educational intervention was also a limitation. The educational intervention was in a read only Power Point format because the ability to listen to audio files in the clinic was limited. This read only feature could have been a limitation for participants that learn best by listening to information. Finally, the short time frame of four total weeks between the pre-intervention survey, education intervention and the post-intervention survey could also have an influence in the number of clinicians that participated in this project.

Conclusion

There is value in the information gained from this project and the proper technique for blood pressure measurement is fundamental skill that should be performed accurately and one that would need continual education throughout the career of a practicing nurse practitioner. Based on the results from the completed survey, nurse practitioners at this RHC would benefit from re-training every six months

Participants that completed both surveys did show an improvement in their understanding of how to effectively use the tools needed to measure BP. There positive difference of 37.5% in knowing how to select the proper BP cuff after the reviewing the educational intervention. The proper usage of the stethoscope was the greatest improvement among all the questions. 75% of clinicians properly identified that using bell of the stethoscope was the preferred method of taking a BP measurement because the bell allows clinicians to listen to low-pitched sounds much easier. This project reinforced the idea that knowing the guidelines for the fundamentals of patient care are extremely important and that biannual re-training is recommended to ensure all clinicians can accurately assess a patient's BP.

The final manuscript will be uploaded onto the RHC's secured internal intranet so that all clinicians

working at the RHC can have access to the results of this project.

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Appendix A

Questionnaire used for the research in: Knowledge of accurate blood pressure measurement procedures in

nurse practitioners working in a retail health clinic.

Please enter your initials and last four digits of your employee ID number

_____

1. How many blood pressure readings are recommended each time you measure blood pressure?

   a) One
   b) At least twice
   c) As many as there is time for
   d) The same number as taken at the last patient visit.

2. Which is true?
   a) The arm should always be at the level of the thigh.
   b) At subsequent visits, it is sufficient to take one blood pressure reading.
   c) If you take two readings and the systolic pressures are 134 and 141, the average should be recorded as the systolic blood pressure.
   d) At the first visit, blood pressure measurements should be taken in both arms.

3. Which of the following patient procedures can cause an error of a higher blood pressure reading?
   a) The patient is seated on the exam table.
   b) The arm is at the level of the heart.
   c) The forearm is supported with the palm up.
   d) The patient's back is against the chair with the feet flat on the floor.

4. A nurse practitioner using an aneroid sphygmomanometer observes a systolic blood pressure reading of 133. Which of the following is the correct recording to enter in the patient's chart?
   a) 130
   b) 132
   c) 133
   d) 134

5. According to evidence-based guidelines, which of the following is the recommended cuff deflation rate for assessing a blood pressure?
   a) 2-3 mm Hg per second
   b) 4 mm Hg per second
   c) 1 mm Hg per second
   d) The deflation rate does not matter.

6. Which of the following is the recommended frequency for retraining health care professionals on blood pressure measurement techniques?
   a) Every two years
   b) Once per year
   c) Every six months
   d) At your own discretion

7. When selecting the correct cuff size, the bladder circumference of the BP cuff should be at which of the following percentages of the upper arm?
   a) 30%
   b) 40%
   c) 50%
   d) 80%

8. Which of the following is the correct time to wait in between blood pressure readings on the same individual?
   a) Not more than 30 seconds
   b) At least one minute
   c) More than five minutes
   d) No specific time is required

9. Which is false?
   a) The patient should not talk during the measurement.
   b) The patient should relax for five minutes before the first measurement
   c) In the absence of a hard surface to rest the arm, the patient can hold up the arm during the blood pressure measurement.
   d) Urinary bladder distension can cause a significant error in blood pressure measurement.
      .

10. Which of the following is not part of the blood pressure measurement guidelines?
   a) Use the bell is the preferred method for auscultating a blood pressure.
   b) The upper arm should be bare and without any constricting clothing.
   c) Inflate the blood pressure cuff to at least 30 mm Hg above the point where the radial pulse disappears.
   d) It is permissible to omit the systolic blood pressure measurement by palpation.

11. It is important to determine the auscultatory gap?
   a)   Yes   b. No

12. Which part of the stethoscope do you use to measure the blood pressure?
   a)   Bell   b. Diaphragm

13. Which of the following Korotkoff phases do you use to measure the diastolic pressure?
   a)   When the sounds disappear   b. When the sounds become muffled

14. In which position is your patient in when you measure the blood pressure?
   a)   Sitting in a chair   b. Sitting on the table

Demographics

15. What gender do you identify with?   A. Male   B. Female   C. Non-binary/third gender D.

Prefer not to answer.

16. What is your age? A. 20-25 years old   B. 26-30 years   C. 31-35 years   D. 36-40 years   E.

40+ years

17. What is your Ethnic group   A. Caucasian   B. African American C. Hispanic   D. Asian

E. Other

18. What is your highest degree: A. Masters B. Doctorate