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Blood Pressure Measurement Training Program and Adherence of Public Health Nurses to BP Measurement Guidelines

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Abstract

Objective.—To compare the level of adherence of public health nurses to BP measurement guidelines based on their knowledge if the guidelines and skills in BP measurement before and after Blood Pressure Measurement Training Program (BPMTP).

Methods.—An experimental pre- and post-test design using two-staged cluster randomization was conducted. 118 PHNs (mean age ± 38.45 years, mean years of experience ± 13.45 years; 84.1% women) from six districts in Manila were equally assigned to either the BPMTP group or control group. Structured instruments were used.

Results.—Demographic characteristics, current BP measurement practices, and level of adherence to BP measurement guidelines based on knowledge of the guidelines and skills in BP measurement were equivalent in both groups at baseline. Nurses in the BPMTP group showed improved adherence (p=<0.05) compared to nurses in the control group. Both groups did not show significant change in their skill on recording, interpretation, and referral (p=1.000).

Conclusion.—This study showed that Blood Pressure Measurement Training Package is feasible in improving adherence of nurses based on their increased knowledge of the BP measurement guidelines and skills in BP measurement. A larger-scale study is warranted to show that BPMTP can potentially improve clinical management of hypertension in public health clinics globally.

Keywords

BP measurement guidelines; adherence; training program; public health nurses

Introduction

Public health nurses (PHNs) are explicitly required to perform accurate assessment, screening, and monitoring which include blood pressure (BP) measurement.[1] BP

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measurement is the only assessment tool that confirms the diagnosis of and classifies individuals with hypertension, ascertains BP-related risks, guides interventions for BP control, and appraises intervention outcomes.[2–5] Decades of studies reveal practice variations in BP measurement and the lack of adherence to BP measurement guidelines;[6–10] these compromise accuracy of BP readings and results to reduced prevention, diagnosis, and control of hypertension, poor disease outcomes, high cost of care, and premature mortality.[11–16]

Studies conducted among health professionals who perform BP measurements revealed common pitfalls and lack of adherence to guidelines. There is a general consensus among the studies on BP measurement that strongly recommend regular training and retraining of health care professionals on BP measurement.[3,4,17–22] Educational intervention based on guidelines improved BP measurement skills and knowledge.[6,7,14,17,19,20,23,24]

There are no known major studies in the Philippines related to practice variations, and adherence to BP measurement guidelines. There is also a dearth of literature on evaluation studies of intervention outcomes on adherence to BP measurement guidelines by health professionals.

This study determined the level of adherence of PHNs to BP measurement guidelines before and after the BP Measurement Training Program (BPMTP). This study refers to adherence as the knowledge and BP measurement skills of PHNs following the guidelines specified in the BP Measurement Guidelines Manual (BPMGM), an essential component of the Blood Pressure Measurement Training Program.

Guided by Roy's Adaptation Model,[21–22] the response elicited by the stimulus BPMTP should find congruence to one or all of their adaptation modes: 1) capability to adapt to the expected behaviour, 2) value of the behaviour to self/team, 3) value of the behaviour to the community, and 4) value of professional collaboration, and alliance. Figure 1 illustrates how the educational intervention could increase the level of adherence of PHNs to BP measurement guidelines.

Significance of the Study

Standardized care (i.e., BP measurement based on guidelines), is integral to nursing education, quality care, and safe nursing practice.

Adherence to guidelines reduces inaccuracies that may expose the patient to misdiagnosis and inappropriate care.[11–16] Therefore, BP measurement based on guidelines becomes truly a valuable tool in screening for high risk patients, early detection and control of hypertension and prevention of complications. Recognition of practice variations, and common pitfalls would help motivate nurses to pay attention to current guidelines and narrow the gap between theory and practice.

Methods

Design

An experimental, pre – and post – test design was used to determine the level of adherence to BP measurement guidelines among public health nurses (PHNs). Two-stage cluster sampling method was applied using unmarked ballots, and two non-transparent boxes, one marked “Intervention” and the other marked “Control.”

Sample Selection

The study participants are PHNs who working for the government specifically in the health centers, clinics, city high schools, and special services units who are mandated to address pressing health problems in the City of Manila. The 1st stage assigned all the health districts in Manila to either the intervention or the control group by simple random sampling. The intervention group (BPMTP) was drawn from Districts I, II, and VI; control group (no structured training) was drawn from Districts III, IV, and V.

The 2nd stage placed the names of all PHNs from the master list into appropriate ballot boxes. Using systematic random sampling, ballots were alternately drawn until computed sample size was completed. Randomizing by cluster allows investigators to measure the effectiveness of an intervention in routine clinical practice using clusters (rather than individuals) to create comparative groups. Sample size was determined using software G-power and the application of Cohen’s power of 0.80, α=0.05, effect size of 0.30, and an oversampling of 20% (n=128). PHNs were excluded from the study if they did not have a functional BP measurement device in their unit or were not willing to participate in the study. Figure 2 illustrates the sample selection - a total of 128 PHNs were recruited from 194 PHNs from 6 districts in Manila; five nurses were excluded from each group resulting to 118 PHNs equally randomized to the BPMTP group (n=59) or the control group (n=59). Figure 2 illustrates the sample selection.

Setting

The study was conducted in all six districts of Manila where prevalence of non-communicable diseases is high and hypertension remains to be one of the major risk factor for cardiovascular diseases, stroke, and kidney disease.

In a country classified as one of the lower middle-income countries in the world, and like in any other cities in the Philippines, Manila has to contend with limited resources in the delivery of its health care services.[23]

Instrumentation

The following structured instruments were used. Respondent Profile Questionnaire; Blood Pressure Measurement Device Quality Checklist;[19] Blood Pressure Measurement Skills Checklist;[19, 24] and Blood Pressure Measurement Knowledge Test.[919, 25] Table 1 provides a more in-depth description of each instrument.

Pilot Testing

Pilot testing was done in a similar urban setting, located in the National Capital Region. PHNs in this testing site provide health services to their constituents and are closely linked with the program of the Department of Health. The characteristics of their population and resources are similar. Tools were found to be simple and appropriate for the study. It also affirmed that the instruments were valid and reliable. The inter-rater reliability test using Cohen's Kappa showed 0.86.

Blood Pressure Measurement Training Program (BPMTP)

BPMTP integrates three essential components to promote BP measurement that adheres to guidelines – 1) BP Measurement Training Manual (BPMTM) which is the source of scientific evidence for the program, 2) modeling of the BP measurement techniques based on guidelines, and 3) experiential learning with peers. This is designed as a prescheduled study time for the duration of 2.5 hours, held in an appropriate venue selected by nurse supervisors of the BPMTP group. A 90-minute lecture – demonstration was done by the primary author, followed by a 10-minute snack time. A 20-minute practice session and return demonstration was observed with the assistance of six trained research assistants who are all professional nurses with research background. Practical and written examination was performed after the practice sessions using the prescribed tool in this study. BPMTP group received a BPMGM handout after the program. BPMGM handout was also given to the control group upon completion of the evaluation phase.

BPMTP was evaluated by a panel comprised of the 1) Section of Hypertension Chairperson, Department of Medicine; 2) Adult Health Nurse Practitioner (Board Certified); 3) Nursing Quality Management System Coordinator (Nurse VI); and 4) Senior Trainor (Nurse IV). BP Measurement Guidelines Manual was evaluated as a reliable and important reference for PHNs. All other aspects of the training program, i.e. instructional design, and BPMGM handout were found to be appropriate, adequate, and easily understood. Its significance was connected to hypertension as the 3rd cause of morbidity in the Philippines, and PHNs as the primary health care givers of the Filipinos.

This educational intervention aims to improve the level of adherence to BP measurement guidelines by improving the level of knowledge of the guidelines and skills in BP measurement. Although confounding variables may affect the outcome of the study, attempt to control this was done using statistical treatment during data analysis.

Data Collection Process

The preparation for data collection included: 1) pretesting of instruments; 2) orientation and training of research team; 3) expert opinion; and 4) seeking ethical approval, official permit, and signing of informed consent by the study participants.

The data collection proper was done in three phases. Figure 3 illustrates the data collection process.

The research assistants were blinded to the groupings during Phase 1. Although all the RAs were involved in Phase 2 (Intervention Phase), in Phase 3 (Evaluation Phase) they were

assigned to a different grouping from their previous assignment in Phase I. The individual scores of the nurses were also kept confidential from co-participants, and their heads.

Data Analyses

Descriptive statistics including means, ranges, standard deviations and χ^2 statistics were used to characterize the study population. Perceived confidence, knowledge and adherence were compared between PHNs assigned to the BPMTP vs. the control group using the analysis of covariance statistic. First, we determined whether there were significant group differences in mean outcome scores over time. Then, to account for the possibility that similar group means might be found only because outcomes improved over time for 1 group while worsening for the other, we conducted analyses of group χ time interactions. To control for the baseline group differences, we controlled for time 1 values by entering them as covariates in the analysis of covariance equation. The adjusted means presented herein account for the influence of time 1 value. All statistical analyses were carried out using SPSS for Windows (version 20; SPSS, Inc, Chicago, Illinois); statistical significance was set at $P < .05$ for all analyses.

Results and Discussion

There is homogeneity in the demographic characteristics of the study participants (p=>.05) as shown in Table 2. Their mean age, length of experience both as RNs and PHNs suggest substantial maturity among them which could imply that study participants are cut-out for their job since the role of PHNs is complex and broad, requiring varied competencies.[1,26] Although predominantly female, there is a significant difference between groups in sex. This alerted the examiner to exercise caution when analyzing the data. The presence of physical-sensory limitations signals the risk for error in BP taking. The auscultatory method of BP measurement requires good coordination of hand/arm mobility with the eyes, and ears. A good sense of hearing is needed to hear the appearance of phase I, phase IV, and the disappearance of phase V of the Korotkoff sounds.[4] In this study, participants with physical-sensory limitations declared interventions were done allowing them to still perform BP measurements.

Both groups are similar (p=>.05) in terms of BP measurement-related confidence and practices, i.e., a mean confidence rate in taking BP measurement is 3 (in a 0–4 scale), generally without training or certification in BP measurement procedures, have not read any BP measurement guidelines within the last 2 years, mostly do not have their BP measurement device calibrated, use aneroid sphygmomanometer as the common measurement device, sees a wide range of patients daily, and performs a wide range of BP measurements per nurse daily. These data are summarized in Table 3.

Confidence level by the study participants is high which may relate to the fact that BP measurement is a simple, basic procedure which they have been doing routinely for the longest time. In one study, only a few nurses report some uncertainty about their confidence in BP taking (Armstrong 2002)[6]. Lack of awareness of BP measurement guidelines, and conformity to the standards of BP measurement result to practice variations that compromise

accuracy[2,4,6,9,17,19,27] leading to costly and deleterious consequences to the individual, their families, and to the nation.[23, 27–30]

Tracking of BP measurement device validation/ calibration/maintenance is low among the study participants. The respondents assumed that machines purchased for them underwent validation testing and did not need testing. An observation of newer equipments showed no serial numbers, not zeroed “0” mm Hg, with pressure gauge unable to reach maximum inflation pressure smoothly. Further, there are no manuals, warranty card, and certification of machine validation available. In practice, there is no tracking logbook found in any of the study setting. This data implies that PHNs should be reminded on the need to examine BP measurement devices using a BP measurement device quality checklist based on guidelines.[19,30]

The range of patients seen for BP taking and the number of BP measurements done daily may easily shift depending on the activities and health programs of the Department of Health, and the Local Government Units. The volume of patients was reported to cause stress which may increase the tendency to disregard recommended guidelines and compromise BP measurement accuracy. Practice variations among clinic nurses, PHNs, and community health nurses are generally attributed to their hectic and stressful work situation.[4, 12]

There is homogeneity in the level of adherence to the guidelines between groups at baseline (p=>.05). Baseline score of study participants were ≤ 62% in knowledge of the BP measurement guidelines, and skills in: 1) preparation for procedure, 2) BP measurement device quality check, 3) BP measurement techniques, 4) 1st BP examination, 5) elevated initial BP examination, 6) subsequent BP examination, 7) recording, interpretation, and referral based on JNC 7 BP classification. These data are summarized in Table 4.

Knowledge scores at baseline were compared to the findings of Armstrong et al[6] where no item got a 100% response. This study was also similar to that of Dickson and Hajjar[21] where only two of the five community health nurses passed the knowledge test at baseline.

Scores of BP measurement skills at baseline confirmed the findings of Drevenhorn et al.[29] where 21 PHNs who performed 3 BP measurements were evaluated based on standardized measurement. Study showed lower scores in 10 areas: 1) *documentation of the time of day, 2) palpating the pulse while inflating the bladder, 3) unbroken rest for 5 minutes or more, 4) documentation of each arm used, 5) registration at even 2 numbers, 6) right cuff size, 7) not inflating the bladder while deflating, 8) equipment calibrated, 9) palm turned upwards, and 10) patient’s legs not crossed.* The participants of this study performed 100% only in *positioning the arm at heart level, and correct application of cuff*. This implies the need to standardize training and retraining of health care providers who directly perform BP measurements.

Post-test scores of both groups are summarized in Table 5. The intervention group showed a significant increase in the level of adherence based on knowledge of BP measurement guidelines (p=<.001), and skills in: 1) preparation for the procedure (p=<.001); 2) technique (p=<.001); and 3) subsequent BP examination (p=<.002). The increase was not significant

in: 1) BP device quality check, and 2) elevated initial BP examination. No change was shown in recording, interpretation, and referral based on JNC7 BP classification, and 1st BP examination. The post-test scores of the control group showed no significant difference from their baseline level of adherence in all the outcome variables. When compared, the post-test scores of the intervention group were significantly higher in most of the outcome variables (p=<.05), i.e., in knowledge of BP measurement guidelines, and skills in 1) preparation, 2) technique, 3) device quality check, and 4) subsequent BP examination. Both groups showed no significant difference in the skill in recording, interpretation, and referral based on JNC7 guidelines.

This study supports findings of other studies that training and awareness of the guidelines will not guarantee BP measurement practices to follow established guidelines.[2,4,6,12,19]Other studies also show that the practices of community health nurses improve towards adherence based on the observer's knowledge or training on the guidelines, the equipment used, and the work setting.[19]

Limitation of the Study

The characteristic of the study participants which is inherent to their complex role in the community and the very nature of their specific setting limit the external validity of findings. Generalization to other population must be done with caution.

Implications of the study

Performing BP measurements that adhere to the guidelines strengthens a standardized practice, limits inaccuracies, and becomes a more meaningful assessment tool for the prevention, control, and management of hypertension. Existing programs on health promotion and NCD prevention and control, safety, standards, efficiency, and quality care may benefit from BPMTP. BPMTP may have added value when integrated into nursing foundation courses where practice standards and accuracy are given serious attention. It is possible to objectively measure adherence to BP measurement guidelines based on knowledge of the guidelines, and skills in BP measurement with existing reliable and valid tools.

Conclusion

Practice variations exist and pitfalls in BP measurement could easily be overlooked or neglected. Our data show that the implementation of a BPMTP is feasible and improves adherence to BP measurement guidelines with higher level of knowledge of the guidelines and skills in BP measurement. While BPMTP improved adherence of BP measurement to the guidelines, special attention must be given to skills in BP recording, interpretation, and referral by both groups, BP measurement device quality checklist, 1st clinic visit, and elevated 1st BP reading on clinic visit. Low adherence may be multi-factorial which may require a collaborative effort to examine and fully address them, considering its impact to health and care services. A larger-scale randomized clinical trial is warranted to show that BPMTP can potentially improve clinical management of hypertension in public health clinics globally.

Recommendations

1. Adopt a regularly administered “step-by-step”/ “competency-based” BP measurement protocol based on current guidelines for the nursing foundations and in all related courses.
2. Include BPMTP as part of quality assurance processes, to include accurate and efficient system of recording, and dissemination of acceptable guidelines, and algorithms to simplify and coordinate nursing actions.
3. Replicate the study to a bigger population of nurses, with longer intervention time, and repeated evaluation period to determine sustainability of positive adaptation of BP measurement practices that adhere to the guidelines.

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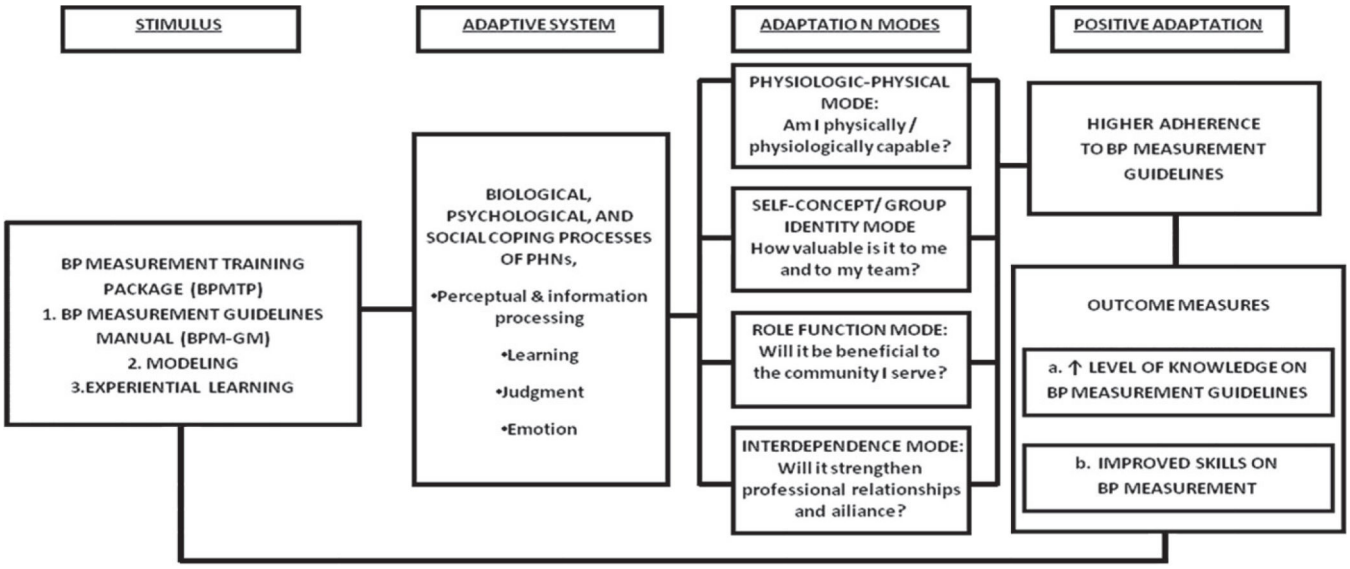

Figure 1.

Theoretical Paradigm (Roy, 1970/1984). Blood Pressure Management Training Package (BPMTP) integrates three components: 1. BP Measurement Guidelines (BPM-GM) – the scientific evidence, 2. Modeling the procedure based on the guidelines, and 3. Experiential learning with peers. The stimulus, BPMTP, initiates a response from the PHN (adaptive system) who utilizes inherent biological, psychological and social coping processes to analyze information, make judgement, become aware of associated feelings/emotions, and learn to respond towards positive adaptation/BP measurement that adheres to the guidelines when response is congruent to one or all of the adaptation modes – Physiologic-physical capability, value of the action individually/the team, value to the community they serve, and value to professional relationships and alliance. The outcome measures of positive adaptation/BP measurement that adheres to the guidelines are a) knowledge of BP measurement guidelines and b) skills in BP measurement.

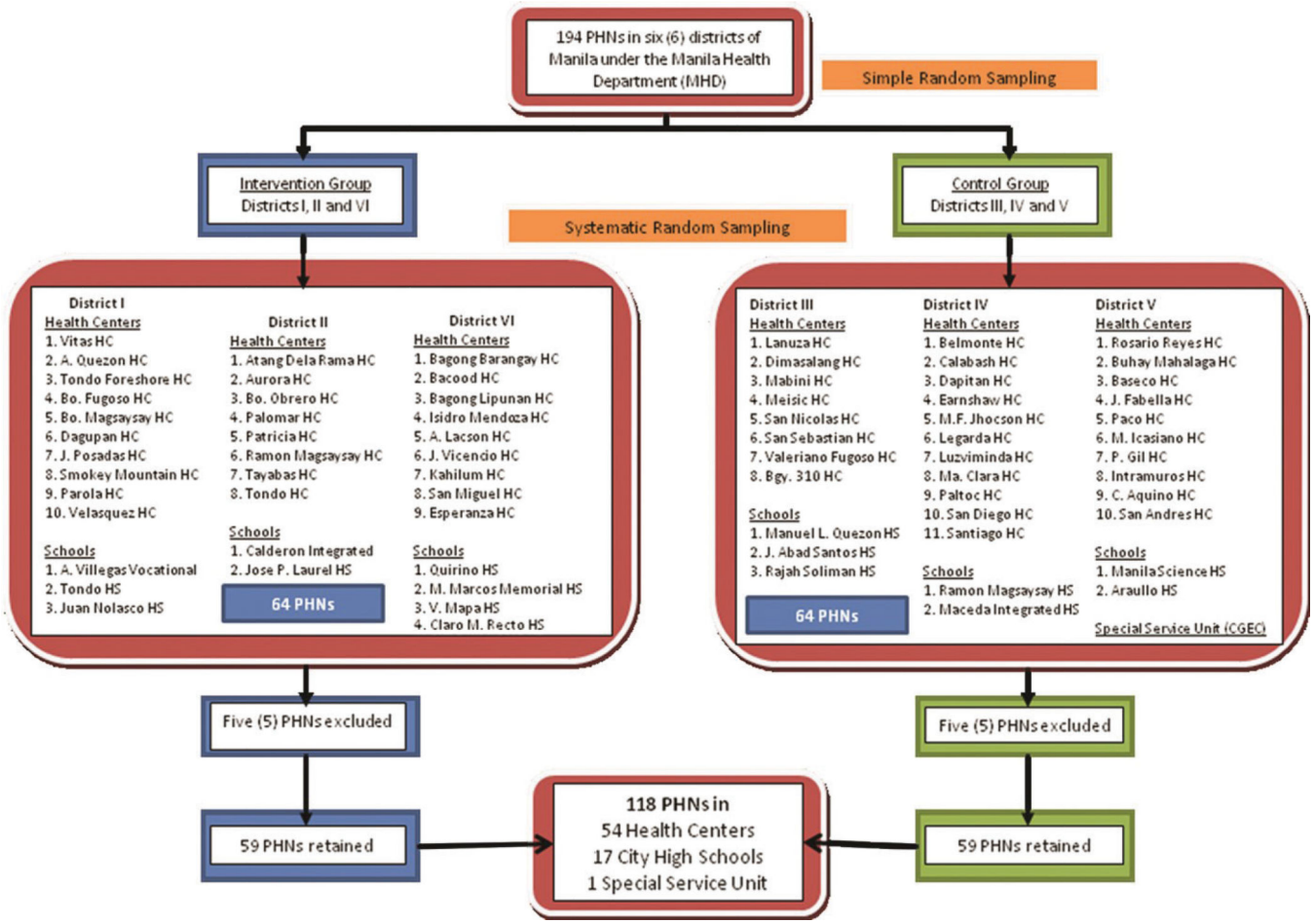

Figure 2. Sample Selection.

Two-stage sampling design was used to select PHNs from a sampling frame (N=194) within the 6 Districts of Manila. The districts were assigned to the intervention (Districts I, II, VI) and the control (Districts III, IV, V) groups using simple random sampling. From the health centers, city high schools, and special services unit in both groups, study participants were selected using systematic random sampling (n=128). 10 PHNs were excluded based on the exclusion criteria. Final sample (n=118) was drawn from 57 health centers, 17 city high schools, and 1 Special Services Unit. Each group has the same number of sample (I=59, C=59).

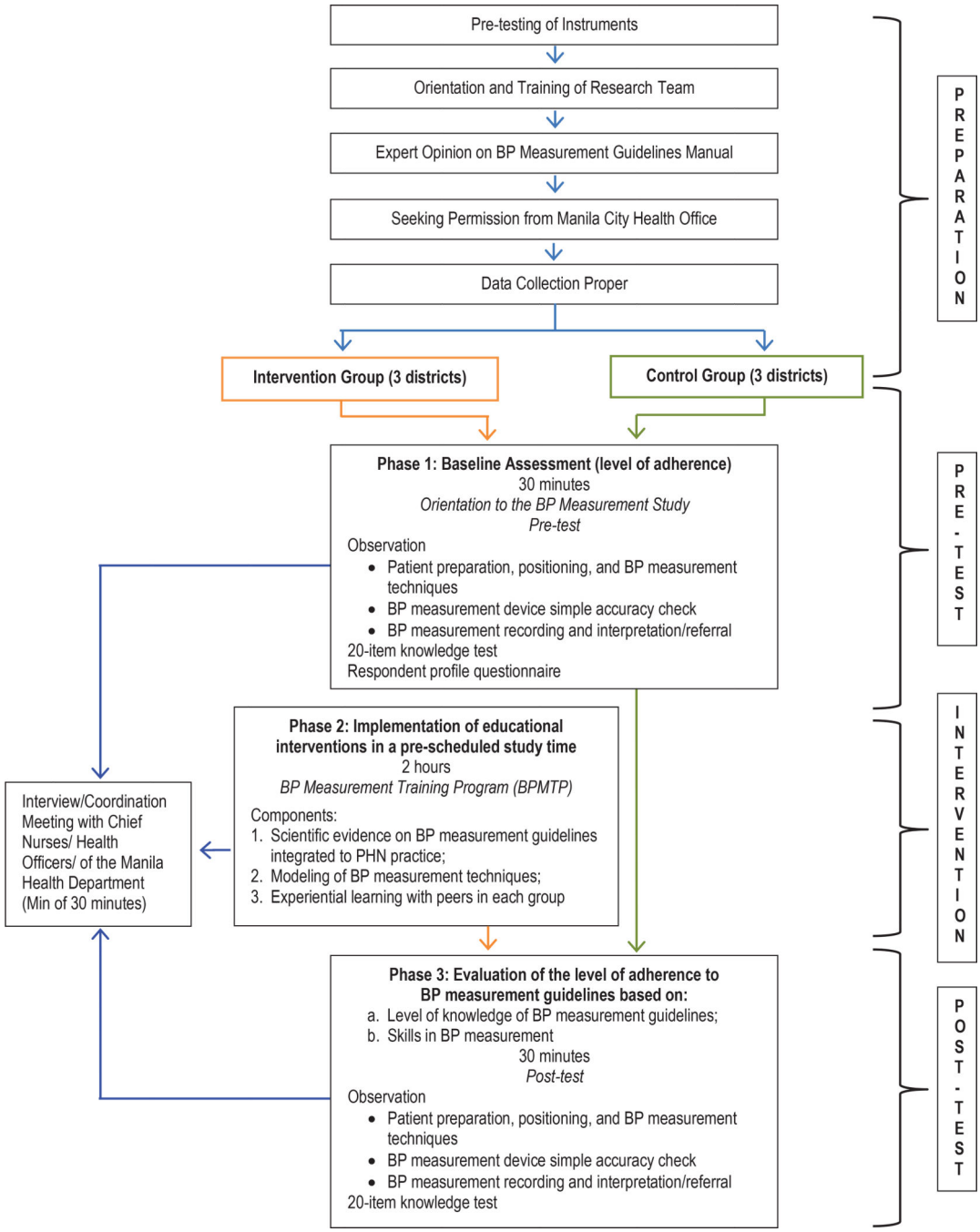

Figure 3.

Flow Chart of Data Collection. This describes the four stages of the data collection process – preparation, pre-test, intervention, and post-test. Data was obtained using structured tools for observation and knowledge test.

Table 1.

Instruments used to measure the study variables

Instruments	Description
1. Respondent Profile Questionnaire	Provides data on characteristics of the study participants. Part I – Socio-demographic data: age, sex, rank, length of nursing experience Part 2 – BP measurement-related information: confidence level in the accuracy of BP measurement, awareness of BP measurement guidelines, training and certification on BP measurement, knowledge on the type of BP devices used, tracking of regular calibration, maintenance, and validation of BP measurement devices, number of patients seen daily, number of BP measurements done daily, presence of physical-sensory limitations (hearing, vision, hand/arm mobility)
2. BP Measurement Device Checklist[23]	Measures the capability of the study participant to check the accuracy of the BP measurement device. • Type of device used (indicate serial number) • Position/placement of the device • Documentation of last Quality Assurance check • Integrity of the BP cuff • Tubing condition • Device accuracy
3. BP Measurement Skills Checklist[23]	Evaluates the 47 essential steps in BP measurement based on guidelines. Each item is scored 0 for non-performance, 2 for a well-performed step. A summative score was tallied at the end of the procedure. Each respondent is observed in taking BP measurements in four (4) patients. They are observed in the following: 1. Preparation for the procedure – patient preparation, patient positioning, and selection of cuff size 2. Techniques – application of correct size BP cuff and use of stethoscope, palpation of estimated systolic BP, and BP reading by auscultation 3. Other guidelines for specific situations – 1st clinic visit, subsequent clinic visit, elevated 1st BP reading 4. Recording, interpretation, and referral based on JNC 7 BP classification – significant details that require documentation as reference for future consultation
4. BP Measurement Knowledge Test[19, 24, 25, 26]	A 20-item test designed to evaluate the knowledge of the study participants on BP measurement guidelines • Patient factors (6) • Observer factors (5) • Techniques (6) • Equipment factors (3)

Table 2.

Demographic characteristics of the intervention and control groups

Characteristics	Intervention (n=59)	Control (n=59)	*p* value
	f (%)	f (%)	
Age (mean years) ≠	38	37	0.49
Sex ◊			
Female Nurses	45 (78)	53 (90)	0.05 *
Male Nurses	14 (22)	6 (10)	
Male-female ratio	1:3.5	1:9	
Work Experience as RN (mean years) ≠	12	13	0.89
Work Experience in current area (mean years) ≠	7	7	0.89
Position ◊			
Junior Nurses	37 (63)	34 (58)	0.53
Senior Nurses	22 (37)	25 (42)	
Physical-Sensory Limitations ◊			
Hearing	0 (0)	1 (2)	0.16
Vision	19 (32)	19 (32)	0.08
Hand/arm mobility	2 (3)	2 (3)	0.32

Note:

≠Independent t-test

◊Chi-square test X^2 test

*Statistically significant at α - 0.05

Table 3.

BP measurement-related confidence and practices of the intervention and control groups

Characteristics	Intervention f (%)	Control f (%)	*p* value
Level of confidence in performing accurate BP measurement			
Strongly disagree (0)	0 (0)	0 (0)	0.36
Disagree (1)	1 (2)	1 (2)	
Unsure (2)	2 (4)	2 (4)	
Agree (3)	38 (68)	36 (64)	
Strongly agree (4)	15 (27)	19 (34)	
Mean confidence rate	3.18	3.07	
Training/Certification in BP Measurement	1 (2)	5 (9)	1.00
Yes	58 (98)	53 (91)	
No			
Reading BP measurement guidelines (past 2 years)			
Yes	10 (17)	11 (19)	1.00
No	49 (83)	48 (81)	
BP measurement device validation/calibration/ maintenance tracking	10 (18)	18 (31)	0.68
Yes	48 (8)	40 (69)	
No			
Common BP measurement device			
Aneroid (portable)	51 (81)	50 (93)	0.71
Aneroid (wall type)	4 (7)	1 (2)	
Mercurial (portable)	2 (3)	3 (6)	
Patient seen daily			
≤15 patients	20 (34)	12 (20)	0.99
16 –30 patients	12 (20)	12 ((20)	
31 – 50 patients	11 (19)	12 (20)	
> 50 patients	12 (20)	17 (29)	
BP measurements performed daily			
≤15 BP measurements	15(25)	28 (47)	0.99
16 – 30 BP measurements	9 (15)	16 (27)	
31 – 50 BP measurements	18 (30)	6 (10)	
> 50 BP measurements	11 (19)	4 (7)	

*Statistically significant at α=0.05

Table 4.

Baseline adherence to BP measurement guidelines between intervention and control groups

Outcome Variable	Intervention Mean Rank %	Standard Deviation	Control Mean Rank %	Standard Deviation	Mean Difference	*p*-value
I – Knowledge of BP measurement guidelines	56.83	2.31	62.17	2.64	5.34	.240
II – Skills in BP measurement						
A. Preparation for the procedure	58.61	2.90	60.39	3.33	1.78	.694
B. Techniques	60.48	5.39	58.52	5.06	−1.96	.673
C. Recording, interpretation, and referral based on JNC 7 BP classification	59.00	0,43	60.00	0.46	1.00	.317
D. Device quality check	61.81	3.15	57.19	3.17	−4.62	.434
E. For 1st BP examination	31.02	0.30	27.50	0.00	−3.52	.074
F. For elevated initial BP taken	28.10	0.77	30.08	0.78	1.98	.570
G. For subsequent BP examination	51.64	0.45	57.96	0.74	6.32	.099

*Statistically significant at α 0.05

Table 5.

Public health nurses' adherence to BP measurement guidelines before and after intervention

Outcome Variable	Intervention (n=59)				Control (n=59)				2 Groups	
	Mean Rank (%) Pre-test	Mean Rank (%) Post-test	Standard Deviation	*p* value	Mean Rank (%) Pre-test	Mean Rank (%) Post-test	Standard Deviation	*p* value	p – value Pre-test	p – value Post-test
I – Knowledge of BP measurement Guidelines	56.83	70.52	3.21	<0.001 *	62.17	48.48	2.69	.225	.240	< 0.001 *
II – Skills in BP measurement										
A. Preparation for BP measurement procedure	58.61	70.69	4.64	<0.001 *	60.39	48.31	2.98	.213	.694	< 0.001 *
B. Techniques	60.48	76.61	7.80	<0.001 *	58.52	42.79	4.74	.835	.673	< 0.001 *
C. Recording, interpretation, and referral based on JNC 7 BP classification	59.00	59.50	0.58	1.000	60.00	59.50	0.81	.317	.317	1.000
D. Device quality check	61.81	71.42	3.23	0 179	57.19	47.58	3.27	.146	.434	< 0.001 *
E. For 1st BP examination	31.02	15.88	1.04	0.317	27.50	11.65	0.55	.317	.074	0 .036 *
F. For elevated initial BP taken	28.10	30.92	0.89	0.584	30.08	30.08	0.86	.584	.570	0.036 *
G. For subsequent BP examination	51.64	67.30	0.96	0 002 *	57.96	48.54	0.00	.186	.099	<0 001 *

* Statistically significant at α - 0.05