Nurses' knowledge and skill of blood pressure measurement technique in a private hospital setting

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Dissertation submitted in fulfillment of the requirements for the degree Magister Curationis in the School of Nursing Science at the Potchefstroom Campus of the North-West University

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ABSTRACT

Background: Nurses are responsible for the monitoring and assessment of blood pressure in the clinical setting. Increasing evidence has demonstrated that inaccurate measurement technique often leads to the misclassification of large numbers of individuals as hypertensive. The impact of untreated or poorly treated hypertension, due to misclassification of patients, is a major contributor to the overall burden of adult diseases in any population. Accurate measurement of blood pressure relies on knowledge and skill and is considered paramount in the management of cardiovascular risks. There seems to be limited information on the knowledge and skill of nurses in South Africa regarding the correct measurement of BP when using a sphygmomanometer and the auscultatory method. Given South Africa's primary healthcare philosophy, and the significant role that nurses play in the prevention and treatment of hypertension, it is of importance to investigate nurses' knowledge and skill of blood pressure measurement.

Objectives: (i) to determine nurses' skill and knowledge in measuring blood pressure using a sphygmomanometer and auscultation, and (ii) to determine if there is a correlation between nurses' skill and knowledge of blood pressure measurement technique.

Design and method: This study followed a quantitative, descriptive design with an observational checklist and survey method. In phase one, nurses' skills of blood pressure measurement using a sphygmomanometer was determined by means of an observation checklist. In phase two, the researcher determined nurses' knowledge of blood pressure measurement technique by using a standardised set of questions. Finally, the researcher investigated whether there was a correlation between nurses' knowledge and their skill of blood pressure measurement technique in the mentioned setting.

Results: Overall, the mean score for correctly completing the skills on the observational checklist was 87.7%. Nurses' scored an average of 63.1% for knowledge of blood pressure measurement technique. The relationship between the assessment of skills and performance on the written questionnaire on knowledge was not significant (*r=0,062, p=0,5)*.

Conclusions: Although the average scores were 87.7% for skills and 63.1% for knowledge, this study identified deficits in both the knowledge and to a lesser degree, in the skill of nurses to understand and perform blood pressure measurement. Regular updates and carrying readily available documents on the standardized procedure for BP measurement techniques could support the training and correction of nurses' knowledge and skill in the acute setting. Educational preparation that is more detailed may also greatly contribute to more understanding

and knowledge of blood pressure for nurses involved in the diagnosis and treatment of cardiovascular risk.

Keywords: blood pressure, education, knowledge, measurement technique, skill.

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RESEARCH OUTLINE

This research study is presented in an article format and includes the following chapters:

(1) Chapter 1: An overview of the research

(2) Chapter 2: Review of the literature

(3) Chapter 3: Article as follows:

Article title:

Nurses' knowledge and skill of blood pressure measurement technique in a private hospital setting.

Submitted to:

International Journal of NursingPractice

(4) Chapter 4: Conclusions, recommendations and limitations

Note that the dissertation is submitted in article format and that the following apply to the list of references in this dissertation.

For Chapter 1, 2 and 4: Reference list compiled according to Harvard style as prescribed by the North-West University Postgraduate guidelines.

For Chapter 3: Reference list compiled according to International Journal of Nursing Practice author guidelines and presented in Vancouver style.

AUTHORS' CONTRIBUTIONS

The research study was planned and executed by the following researchers:

INDIVIDUAL	RESPONSIBLE FOR:
Mrs. H. du Toit	Conceptualisation of the research question, review of literature, analysis of the data, and interpretation and reporting of the data.
Dr. R. Pretorius	Conceptualisation of the research question, analysis and interpretation of the data, and supervision of the student.
Prof. H.W. Huisman	Conceptualisation of the research problem, co-supervisor, and reviewer of the study.

Declaration:

I hereby declare that I have approved the inclusion of the article mentioned above in this dissertation and that my contribution to this study is indeed as stated above. I hereby grant permission that this article may be published as part of the M.Cur dissertation of Mrs. H du Toit.

Dr R Pretorius Date

Prof HW Huisman Date

LIST OF ABBREVIATIONS

AHA	American Heart Association
AIDS	Acquired immunodeficiency syndrome
ANA	American Nursing Association
BP	Blood Pressure
BHS	British Hypertension Society
CVD	Cardiovascular disease
DoH	Department of Health
EN	Enrolled Nurse
ESC	European Society of Cardiology
ESH	European Society of Hypertension
HFA	Heart Foundation of Australia
HIV	Human Immunodeficiency Virus
MI	Myocardial infarction
mmHg	Millimetre Mercury
NW	North West
RN	Registered Nurse
SA	South Africa
SANC	South African Nursing Council
SADHS	South Africa Demographic and Health Survey
TB	Tuberculosis
USA	United States of America
WHO	World Health Organization

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CHAPTER 1: OVERVIEW OF THE RESEARCH STUDY

1.1 INTRODUCTION

Nurses are responsible for the monitoring and assessment of blood pressure (BP) in the clinical setting, and accurate measurement of BP is considered paramount in the management of cardiovascular risks. Despite advances in the monitoring of BP, knowledge of BP measurement is still poorly understood in both the medical and nursing professions (Torrance & Sergison, 1996; Pickering *et al.,* 2005). Evidence has increasingly demonstrated that inaccurate measurement techniques often lead to the misclassification of large numbers of individuals as hypertensive (Pickering *et al.,* 2005*)*.

Hypertension is a cardiovascular disorder and according to Freel and Connell (2004), the epidemiology differs immensely amongst different populations of the world, accounting for 95% to 99 % of all cardiovascular disorders reported. Limited information is available concerning the knowledge and skill of nurses in South Africa (SA) regarding the correct measurement of BP when using a sphygmomanometer and the auscultatory method. In light of the significant role that the nurse plays in determining patients' BP in the clinical setting and the importance of knowledge and skill in the correct measurements of BP, the aim of this study is two-fold. Firstly, to determine nurses' knowledge and skill of correct BP measurement techniques, and secondly, to investigate if a correlation exists between nurses' knowledge of BP measurement technique and their actual skill of BP measurement.

1.2 BACKGROUND

Despite advances in treatment, cardiovascular disease (CVD) is expected to be the leading cause of morbidity and mortality worldwide by 2020 (Gaziano *et al.*, 2005). The World Health Organization (WHO, 2005) estimates that hypertension causes one in every eight deaths, making it the third leading cause of death in the world. According to The National Heart Foundation of Australia (2010), hypertension is responsible for more deaths and disease than any other biomedical risk factor worldwide. As assessment of BP is an important tool in diagnosing hypertension, this study subscribed to the European Society of Hypertension's (ESH, 2013) parameters for the classification of BP levels (Table 1.1 refers).

Table 1.1: Definitions and classification of BP levels (mmHg) according to the European Society of Hypertension (ESH) guidelines (ESH, 2013)

Category	Systolic		Diastolic
Optimal	<120	And	<80
Normal	120-129	and/or	80-84
High normal	130-139	and/or	85-89
Grade 1 hypertension	140-159	and/or	90-99
Grade 2 hypertension	160-179	and/or	100-109
Grade 3 hypertension	> or equal to180	and/or	> or equal to 110
Isolated systolic hypertension	> or equal to 140	And	<90

Smeltzer *et al*. (2010) report that about 31% of adults in the United States of America (USA) have hypertension, with the prevalence increasing significantly as people become older or develop other cardiovascular risk factors. Recent reports from the USA have shown that while 70% of adults with hypertension are aware of their condition and 59% receive treatment, only 34% reach BP control (values less than 140/90mm Hg) and even fewer have levels lower than 135/85mm Hg (Brunner & Suddarth, 2010). According to Bradshaw *et al.* (2003) non-communicable diseases such as ischemic heart disease, stroke, hypertension, and diabetes mellitus rank among the top 10 diseases and conditions contributing to mortality globally. Given the fact that non-communicable diseases account for 65 000 deaths per year in SA, the prevention of these ought to be a priority on South Africa's health agenda (Bradshaw *et al*., 2003).

Similarly, Schutte *et al,* (2008) report that hypertension is markedly prevalent in SA, resulting in high stroke mortality rates. According to the South African Demographic and Health Survey (SADHS) conducted in 2003, the percentage of men and women considered hypertensive was 12, 5 % and 17, 9 % respectively (SADHS, 2003). These percentages were reported as highest in white men (35, 8 %) and Indian women (29, 1 %). In addition, the survey also showed that for both men and women, the systolic BP seemed to increase with age. Sekokotla *et al.* (2003) argue that hypertension is a major public health problem in SA, because of the role it plays in the development of disease and disability.

1.3 PROBLEM STATEMENT

Pickering *et al,* (2007) assert that BP determination continues to be one of the most important measurements in clinical medicine, but is one of the most inaccurately performed. The gold standard for clinical BP measurement has always been readings taken by a trained health care provider, using the auscultatory method. The impact of

untreated or poorly treated hypertension on the health of patients is a major contributor to the overall burden of adult diseases in any population (SADHS, 2003). The impact of poorly controlled hypertension may however, be avoided if early detection and cost-effective management of the condition occurs (SADHS, 2003). For BP measurements to be meaningful, standardised and reproducible, protocols or guidelines of measurement are essential. Various studies abroad however indicated a deficit in the knowledge of guidelines and skills related to the measurement of BP (McKay *et al.*, 1992; Torrance & Serginson, 1996; Chlinton, 1997; Dickson & Hajjar, 2007).

In a study conducted by Chlinton (1997), to determine whether a knowledge deficit existed among health care professionals regarding BP and its measurement, the author reported on a significant shortfall in knowledge of BP and the indirect arterial method of BP measurement. Similarly, Dickson and Hajjar (2007) piloted a study to determine if a BP measurement-training programme would improve knowledge and technique of BP measurement. The authors concluded that nurses' knowledge of the AHA (American Heart Association) guidelines on BP measurement technique was poor. The common lack of knowledge was associated with error in measurement and included incorrect cuff size, incorrect patient position, rapid cuff deflation, terminal digit preference or bias, monitor not at eye level, rest period of the participants before BP measurement, and the documentation of any abnormal BP patterns (Dickson and Hajjar, 2007). McKay *et al.* (1992) stated that the recommended techniques to measure BP for assessment of hypertension are seldom followed in the ambulatory care setting. Their study has found that interns (family practitioners who have just completed a 7-year degree) and first-year family practice residents (doctors in their first year of practice) have significant deficits in their knowledge and use of the recommended techniques to measure BP. The results suggest that inadequacies exist in the teaching of BP measuring techniques in the medical schools of Canada, the consequences of which are misdiagnosis and improper treatment of high BP. McKay *et al.* (1992) concluded that on average the AHA recommendations for BP measurement techniques were followed only 42% of the time.

Several of the studies cited above were conducted abroad and followed the guidelines described by the AHA. None of the studies explored the SA context or the guidelines recommended by the ESH, that are generally followed in most South African healthcare facilities. There are minor differences between the guidelines of the AHA and ESH. The AHA recommends that at least two blood pressure readings be taken, with a one-minute interval between them, and the average of the measurements recorded (AHA, 2005). According to the ESH (2013), suspected hypertensive patients should have additional readings taken at 1 and 3 minutes (adjusted from 5 minutes) after standing. Given SA's primary healthcare philosophy, and the significant role that nurses play in the prevention

and treatment of hypertension, it has been deemed that it is now time to investigate nurses' knowledge and skill of BP measurement techniques in a private hospital setting in SA (Pretorius, 2011).

1.4 RESEARCH QUESTIONS

In the light of the limited information available on the knowledge and skill of South African nurses with regard to their BP measurement technique, the following questions were asked:

(1) What are nurses' knowledge and skill of blood pressure measurement technique?

(2) Is there a correlation between nurses' knowledge and their skill of blood pressure measurement technique?

1.5 OBJECTIVES

To answer the research questions, the following objectives were stated:

(1) To determine nurses' skill in measuring blood pressure using a sphygmomanometer and auscultation by means of an observational checklist (Appendix B) in accordance with the ESH guidelines.

(2) To determine nurses' knowledge of blood pressure measurement technique using a questionnaire based on the ESH guidelines (Appendix C).

(3) To determine if there is a correlation between the nurses' skill and knowledge of blood pressure measurement technique.

1.6 RESEARCHER'S ASSUMPTIONS

Assumptions are principles that we accept as being true based on logic or custom, without proof (Polit & Beck, 2012). Alligood (2010) refers to assumptions as experiences that provide a frame of reference for expected outcomes. According to Brink *et al.* (2012), assumptions are often embedded in thinking and behaviour, requiring introspection and a strong knowledge base in the research area that is to be uncovered. They determine the nature of concepts, definitions, purposes and relationships and are the basic underlying truths from which theoretical reasoning proceeds (Brink *et al*., 2012). Accordingly, the researcher now discusses the theoretical and methodological assumptions of this study.

1.6.1 Theoretical assumptions

According to Babbie (2007), a researcher's theoretical assumptions are interrelated statements that explain aspects of life according to laws, facts, and principles. The nursing profession often uses theories to guide its members' critical thinking and perspectives linked to aspects of nursing (Alligood, 2010). Nursing is a practice-based discipline and assessment of skills such as measurement of BP is considered essential in delivering high quality patient care. According to Miller *et al.* (1988) a nurse exhibits competence when he/she has the ability to perform nursing tasks (skills), and when they have the ability to integrate the cognitive (knowledge), affective and psychomotor skills needed to deliver high quality nursing care. The levels of skills acquisition, developed by Nicol *et al.* (1996) provide the theoretical framework for this study. This framework presents an operationalisation of Benner's model of skills acquisition and distinguishes five levels (A to E) (Benner, 1984). Each of the levels represents not only the psychomotor component of a skill but also includes the cognitive and affective component. According to the authors, the early stages of learning a new skill (such as measuring BP, which is taught in the first year of nursing school) focus mainly on the psychomotor domain, but as the nurse becomes more practised, this domain becomes increasingly autonomous. As a result, he/she becomes increasingly able to develop and integrate both the cognitive and affective domain of the skill (Nicol *et al*., 1996). Level A or the foundation level refers to the initial exposure to the skill where the nurse knows what he/she is required to do but needs practice. In level B, or the safe and accurate performance level in the skills centre, the nurse gains self-directed practice in an environment in which the so-called threat to self is minimised in that the nurse practices the skill on manikins and not actual patients. Level C refers to safe and accurate performance under direct supervision in the acute setting and refers to the stage where the nurse is able to perform the skill, but is not yet able to cope with the complex and unpredictable nature of the acute setting, implying that the supervisor may take control, should the need arise. In Level D, or the safe and accurate performance level with indirect supervision in the acute setting, the nurse is considered competent, implying that he/she is able to perform the skill safely and accurately, integrating the cognitive, affective and psychomotor domains to deliver high quality patient care. Finally, level E or the skills mastery level demonstrates the nurse's ability to integrate his/her increasing knowledge and experience to a level of mastery.

Of importance to note here is that Nicol *et al.* (1996), argued that some nurses may never achieve level E, because experience alone will not result in mastery. According to these authors, only nurses in which knowledge and development increases, through reflection

on their experience, will ultimately master a skill. The following concepts are considered important in this study and a conceptual definition of each follows:

1.6.1.1 Blood pressure

Van Putte *et al.* (2011) define BP as a measure of the force the blood exerts against blood vessel walls.

1.6.1.2 Blood pressure measurement

An instrument called a mercury (Hg) manometer, measures BP in millimetres of mercury (mm Hg). Healthcare professionals most often use the auscultatory method to measure BP. The technique involves wrapping a cuff connected to a sphygmomanometer around the patient's arm just above the elbow and placing a stethoscope over the brachial artery. The cuff is inflated until the brachial artery is completely occluded. The pressure in the cuff is then gradually lowered to allow blood flow to return. As the blood flows, it produces vibrations that may be heard through the stethoscope. These sounds are called Korotkoff sounds (Seely & Ecker, 2011).

1.6.1.3 Enrolled Nurse

An enrolled nurse (EN) is typically trained at a nursing college over a period of two years and receives a certificate upon successful completion of the course. The scope of practice of an enrolled nurse encompasses certain acts and procedures that are planned and initiated by a registered nurse or registered midwife and which are carried out under the direct or indirect supervision of the registered nurse (RN) or midwife (Searle, 2000; South African Nursing Council (SANC): Regulation (R) 879 of 2 May 1975, as amended, R. 881 of 2 May 1975, as amended or in regulations published in terms of the Nursing Act, 1984 (Act No. 13 of 1984) under Government Notice No. 36 of 1987, as amended).

1.6.1.4 Registered Nurse

Registered nurses (RNs) are trained at approved facilities that include either a nursing college or a university. The training of a registered nurse spans four years, and upon successful completion the individual exits with a diploma (nursing college) or a degree (university). The scope of practice of registered nurses provides parameters for the regulation of all actions taken by them (SANC: Regulations(R) 425 of February 1985, as amended R 1312 of 19 June 1987 as amended R 2078 of 25 September 1987, as amended R753 of 22 April 1988 or in regulations published in terms of the Nursing Act, 1984 (Act No. 13 of 1984)).

1.6.1.5 Private hospital

Lippincott (2000) define a private hospital as a hospital similar to a group hospital, except that it is controlled by a single practitioner and the associated in his or her office. It is a hospital operated for profit.

1.6.1.6 Knowledge

Knowledge, in the context of this research study, is defined as the understanding and skill needed in applying information to promote, maintain, and restore health (Smeltzer *et al.,* 2010).

1.6.1.7 Skill

Searle (2000) defines skills as methods of dealing with definite problems by means of motor-psycho-social-medical- or nursing abilities. In the context of this study, skills imply the provision, at various levels of preparation, of services essential to or helpful in the promotion, maintenance and restoration of health and well-being of sick or injured individuals.

1.6.2 Methodological assumptions

Methodological assumptions refer to good science (Botes, 1995). Similarly Botma *et al.,* (2010) stated that methodological assumptions explain what the researcher believes good science practice is.

Quantitative research flows directly from the particular research question and form the specific purpose of the study (Brink, 2012). The quantitative research design is the set of logical steps taken by the researher to address the research question. It forms the 'blue print" of the study and determines the methodology used to obtain sources of information by the researcher (Brink, 2012).

Descriptive designs entails gathering information from a repressentative sample of the population like nurses. The focus in the collection of data is on structured observation, questionnaires and survey studies (Brink, 2012). According to Polit & Beck (2012) constrains are imposed so that there is consistency in what is asked and how answers are reported, in an effort to enhance objectivity, reduce biases and facilitate analysis. In analysing quantitative data, statistics are the most powerful tool (Brink, 2012).

Quantitative research is a scientific investigation conducted to generate knowledge that will directly influence or improve clinical practice. According to Burns and Grove (2009)

the purpose of applied research is to solve problems, to make decisions, or control outcomes in real-life practice situations.

1.7 RESEARCH DESIGN

The study followed a quantitative, descriptive design with an observational checklist and survey method. The study is descriptive in nature in that it identified a phenomenon of interest and variables within the phenomenon and developed and described these variables in the study situation. The subject of interest in this study was nurses' knowledge and skill of BP measurement technique in a private hospital setting in the North-West (NW) Province of South Africa (SA).

In order to achieve the objectives, nurses' knowledge and skills were determined in two phases. In phase one, their skills of BP measurement using a sphygmomanometer were determined by means of an observation checklist based on the guidelines from the ESH (Appendix B). According to Polit and Beck (2012), "….observational research does not involve an experimental intervention, but is merely the observation of phenomena occurring in a natural setting". Similarly, Brink *et al.* (2012), pointed out that non-experimental research is carried out in a natural setting and phenomena are observed as they occur.

In phase two, the researcher determined nurses' knowledge of BP measurement technique by using a standardised set of questions based on the ESH guidelines (Appendix C). According to Burns and Grove (2009), a questionnaire is a printed self-report form designed to elicit information that may be obtained from a subject's written response (Burns & Grove, 2009). To obtain this information the researcher investigated the participants' knowledge of BP measurement technique using a questionnaire. In addition, the researcher performed a literature review after the collection and analysis of the data, the focus of which was to compare the findings of this study with existing literature in order to be able to draw conclusions. The results are subsequently presented in Chapter 3 of this study. Finally, the researcher investigated whether there was a correlation between nurses' knowledge and skill of BP measurement technique in the setting described.

1.7.1 Setting, population and sampling for phases 1 and 2

1.7.1.1 Setting

Polit and Beck (2012) define the setting as the physical location and conditions in which data collection takes place in a study. The setting for this study included a private hospital located in the NW Province. The hospital has a relatively large adult patient population

and the nurses perform high numbers of BP measurements daily, as part of the routine care of patients. The hospital routinely admits patients with medical insurance and has an average bed occupancy rate of 82%.

1.7.1.2 Population

According to Polit and Beck (2012), a population refers to the entire set of individuals or objects having some common characteristics. The population for the study included all full-time registered nurses (N=56) and full-time enrolled nurses (N=46) working in the acute care setting of the given hospital. Both categories of nurses were included because they are primarily responsible for the measurement of BP.

1.7.1.3 Sampling

Burns and Grove (2009) define sampling as the process of selecting a group of people, events, behaviours, or other elements that are representative of the population being studied. Given the small population size (N=102), the researcher decided on an all-inclusive sample. Nurses working in the medical, surgical, orthopaedic, oncology, urology, maternity, casualty and psychiatric units were invited to participate. To ensure a certain degree of homogeneity in the sample the researcher incorporated the following inclusion criteria:

- Only RNs and ENs who are permanent staff were invited to participate.
- Only nurses working in any of the above-mentioned units were invited to participate. Nurses working in intensive care units (adult, paediatric and neonatal) were excluded because BP measurements are typically monitored invasively in these units.

1.8 DATA COLLECTION METHOD

As stated previously, data were collected in two phases. Prior to collecting the data, the researcher discussed the purpose of the study with the hospital management. Nurses were informed of the study approximately one week in advance and invited to communicate their willingness to participate to the researcher. A schedule for the collection of the data was subsequently developed and nurses were invited according to the pre-set set date and time.

In phase one, the researcher made use of an observational checklist (Appendix B) developed according to the guidelines of the ESH to assess nurses' skill in obtaining BP readings using a sphygmomanometer and auscultation. The checklist consisted of two sections: preparing for BP measurement (7 items) and technique (18 items), and was completed by the researcher. For the observation schedule, nurses were informed of the

purpose shortly before the start to prevent preparation and minimise the risk of bias. A room equipped with a table holding: a Tycos Jewel Movement Sphygmomanometer, Lifetime Certified, 109574918, Welch Allyn Blood Pressure Cuffs (medium and large) as well as a dual headed stethoscope, was prepared. Student nurses acted as mock patients and included normotensive females with a medium upper arm circumference (not exceeding 33 cm). The participants' ability, to correctly identify the Korotkoff sounds and pulse palpation, was assessed using a dual headed stethoscope (Code: P27105). According to Dickson and Hajjar (2007), a dual headed stethoscope is the standard for assessing measurement accuracy and determining the difference between the researcher's and the participants' BP reading.

In phase 2, the participant's knowledge of BP measurement technique was determined by means of a self-administered questionnaire based on the literature and guidelines laid down by the ESH for BP measurement by sphygmomanometer (Appendix C). Participants were asked to complete the questionnaire in a room adjacent to the locale where their skill of BP measurement technique was assessed. Participants were provided with access to the questionnaire on a laptop which had internet connectivity and a unique identifier number. The original name list and identifier numbers were known only to the researcher and the study supervisors. Instructions on the completion of the questionnaire were provided on its first page, and the researcher was available to clarify any questions. The questionnaire consisted of five sections. Section one focused on demographic information that included age, gender, highest qualification, hospital, unit, how long the nurse had been measuring BP, hearing or visual problems and aids, when last information on BP guidelines had been read and the last time they received training on BP measurement. Sections two to five focused on questions related to background knowledge of BP (11 items), measurement technique (5 items), cuff size and arm position (5 items), and palpation to identify systolic pressure (2 items). The questionnaire took approximately 20 minutes to complete, and the results were saved to a secure online server.

1.9 DATA ANALYSIS

The data for phase 1 of the study were captured and stored as an MS Excel spreadsheet. The data was cleaned and verified to be accurate before exporting it to the statistical software programme SPSS 17.0 for analysis. Analysis included descriptive statistics. The data for phase 2 were captured on an online secure server and stored as an MS Excel spreadsheet that was exported to SPSS 17.0 for analysis. The analysis included both descriptive and inferential statistics. The mean score of the entire sample population was calculated, as well as the percentage of respondents who correctly executed the skills on the observational checklist and correctly answered the items in the knowledge

questionnaire. To determine the correct identification of the pulse and Korotkoff sounds, an independent t-test was conducted on the values obtained by the researcher and the participants. Finally, any correlation between skill and knowledge was investigated by means of a Spearman correlation coefficient (Polit & Beck, 2012).

1.10 ETHICAL CONSIDERATIONS

This research proposal was submitted to the postgraduate committee of the School of Nursing Science at the North-West University (Potchefstroom Campus) to review the methodology and ethics prior to submitting the proposal for ethical clearance. Following approval for this, the proposal was submitted for an ethics review to the Research ethics Committee of North-West University. Approval was granted under ethics number: NWU-00028-12-S1. The fundamental ethical principles of respect, beneficence and justice as mentioned by Brink *et al,* (2012) informed the study (Table 1.2 refers).

Table 1.2: Fundamental ethical principles

Respect for persons	• Autonomy of individuals and their right to decide to participate in this study was recognised in the decision of the participant, no risk of penalty or prejudice, right to withdraw at any stage of the study. • Informed consent was obtained from every participant in recognition of voluntary participation and the right to protection. • A letter of information on the study was provided to each participant prior to obtaining his or her informed consent to partake in the study. • Confidentiality was protected by assigning a unique identifier number to each participant. The master list with names and codes was known to the researcher and study supervisors only.
Beneficence	• The right to be protected from any discomfort or harm was controlled in providing each participant with a unique identifying number to protect his or her identity. • Participation in the study carried no physical risk.
Justice	• All data was processed anonymously and the participant's right to privacy was respected. • Data gathered in the study will be locked in a safe place and is not available to other persons.

1.11 RIGOUR

Burns and Grove (2009) define rigour as the striving for excellence in research using discipline and scrupulous adherence to detail and accuracy. According to Botma *et al.* (2010), rigour is required to ensure the truth-value of the research outcome. The use of literature, content experts, and the representativeness of the population should contribute to the rigour of a study. Validity of this study was ensured in that all measures were taken to ensure the use of current literature, scrutiny of the questionnaire by content experts and representativeness of the population. Both the observational checklist on skills and the self-administered questionnaire on knowledge of BP measurement were reviewed for content validity by three experts: a registered critical care nurse, a cardiovascular physiologist and a statistician. Internal consistency for the observational checklist measured 0.68 and 0.67 for the questionnaire (Polit & Beck, 2012).

1.12 SUMMARY

BP measurement may be influenced by a range of extraneous variables. This section outlined a quantitative research study, designed to determine the skills and knowledge of nurses about their BP measurement technique. A discussion of the problem, subsequent research questions and objectives were presented. The researcher further provided discussions on the assumptions and considered the research design that included both data collection and analysis, as well as the ethical considerations upon which the study was founded. In the next chapter, a comprehensive discussion of the literature considered important to the subject under investigation is presented.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

According to Burns and Grove (2009) the review of relevant literature involves the analysis and synthesis of research sources to generate a picture of what is known and what is not known about a particular situation or research problem. In quantitative research, the literature review directs the progress and implementation of the study (Burns & Grove, 2009) and is typically conducted at the beginning of the research process (Burns & Grove, 2007). Chapter 2 presents a comprehensive overview of the literature considered important in understanding knowledge and skill of BP measurement technique.

2.2 SEARCH STRATEGY

In order to achieve the objectives of the study, the researcher conducted a search of peer-reviewed studies and publications related to nurses' knowledge and skill of this technique. Studies that investigated the knowledge and skill of any other type of healthcare professionals were also reviewed. Databases such as Medline, Science Direct, Ebsco Host, Pro Quest, SA publications, and Google Scholar were searched, using a combination of the following keywords:

- blood pressure
- measurement
- technique
- knowledge
- skill
- nurs*
- healthcare professional.

The North-West University library's electronic database was used to access articles. Hard copies were obtained with the assistance of the librarian on duty and included both national and international studies. The researcher also consulted a number of relevant textbooks. A total of 51 articles were included for consideration in this literature review.

2.3 PRESENTING THE LITERATURE

The following section presents an overview of literature considered relevant in understanding the phenomenon under investigation.

Hypertension is considered the most prevalent cardiovascular disease (CVD) risk factor and is responsible for approximately 9% of the total deaths in S.A (Norman *et al*., 2007). Arterial stiffness is increasingly recognized as an important prognostic index and potential therapeutic target in patients with hypertension (Payne *et al*., 2010). It is known as a silent killer for it rarely has obvious symptoms, but in light of the many serious effects (such as stroke, end-stage renal failure and heart attacks) it is crucial to accurately obtain BP measurements. Several studies indicate that measurement technique might not always be based on best practices (Armstrong, 2002). This position is supported by Dickson and Hajjar (2007), and González-López *et al.* (2009) who reported that poor BP measurement technique often leads to over- or underestimation of a patient's true BP measurement. These errors in measurements may have detrimental effects on the patient's immediate health and quality of life. BP is measured regularly in the acute/hospital or clinical setting and it is generally assumed that nurses perform the procedure accurately and with full understanding (Gillespie & Curzio, 1998). A number of studies have however cast doubt on this assumption and report that poor knowledge of BP measurement is not uncommon (Torrance & Serginson, 1996; Kay, 1998; Dickson & Hajjar, 2007).

2.3.1 The history of blood pressure measurement

Although there can be little doubt that simple palpation of the pulse was carried out by the early Egyptians, actual measurement of the pressure in parts of the circulation really started in the middle of the eighteenth century with the experiments of Stephen Hales (Booth, 1977).

The investigation of this phenomenon made a major contribution to the discovery of BP. Johannes Muller, who lived in the nineteenth century, was of the opinion that "….the discovery of BP was more important than the discovery of blood" (Booth, 1977). A schematic illustration of the history of the development of BP measurement technique is provided in Table 2.1.

Table 2.1: History of the development of BP measurement (Welch Allyn, s.a)

Year	Invention
1733	Reverend Stephen Hales inserts a long glass tube into horse's artery, and the pumping action of heart generates pressure, raising blood level in tube.
1847	Carl Ludwig records human blood pressure with kymograph ("wave writer" in Greek), by inserting a catheter directly into artery using a U-shaped manometer tube with an ivory float rod and quill attached.
1855	Karl Vierordt uses an inflatable cuff around the arm to pressurise arterial pulse.
1860	Ettienne Jules Mary invents the sphygmograph. The device is accurate for pulse, not blood pressure, and becomes the first clinical device yielding successful pulse measurement.
1881	Samuel Siegfried Karl Ritter von Bach invents the sphygmomanometer, a water-filled bag connected to manometer that feels the pulse on skin above the artery.
1896	Scipione Riva-Rocci develops the mercury sphygmomanometer (inflatable cuff over upper arm).
1901	Harvey Cushing brings Riva-Rocci's design of the mercury sphygmomanometer to the US. Today mercury devices are still perceived as the most accurate in the manual market.
1905	Nikolai Korotkoff distinguishes systolic blood pressure with sounds at different phases of cuff inflation and deflation. Use of stethoscope for Korotkoff sounds makes auscultatory method standard practice.

Although physiologists who studied animals were aware of BP in the 1700's, it was many years before physicians were able to find a method of measuring it in humans. Since the innovation of the sphygmomanometer in the early 1880's, doctors have had an accurate device and uncomplicated procedure for measuring BP, making BP measurement an essential part of a medical examination (Howard Hughes Medical Institute, 1998). Consequently, the recording of BP ultimately led to the discovery of the condition of hypertension. Today, BP measurement is able to be performed using non-invasive-, as well as invasive measurement. Non-invasive measurement involves occlusion of the brachial artery and measures BP using either the auscultatory method or the oscillometric method. The non-invasive method forms part of the routine assessment of a patient and is considered an indirect method because the measurement is taken externally. The indirect measurement of BP by arterial occlusion and palpation was first described by Scipione Riva-Rocci in 1896 (Torrance & Serginson, 1996). The method typically requires less experience on the part of the healthcare provider and is a simple and quick procedure to perform, but is considered less accurate than the invasive method. According to the American Heart Association (AHA, 2005), the 'gold standard' device for BP measurement has been the auscultatory sphygmomanometer. Mercury sphygmomanometers are critical for evaluating the accuracy of any type of non-mercury device (AHA, 2005).

Environmental concerns about mercury contamination and mercury sphygmomanometers did however lead to the banishment of these from several healthcare facilities in the United States of America (USA). Because there is currently no generally accepted replacement for mercury, it is nonetheless recommended that a properly maintained aneroid sphygmomanometer be used for routine office measurements. In aneroid sphygmomanometers, the pressure is registered by a mechanical system of metal bellows that expands as the cuff pressure increases, activating a series of levers that register the pressure on a circular scale (AHA, 2005). This type of system does not necessarily maintain its stability over time, particularly if handled roughly. It is therefore inherently less accurate than the mercury sphygmomanometer and requires calibrating at regular intervals (AHA, 2005).

Although blood pressure measurement at the brachial artery plays a central role in our understanding and managing of cardiovascular risk, in recent years great emphasis has been placed on the importance of central blood pressure (Tomlinson, 2012).

The invasive method requires the placement of a cannula needle into the radial artery of a patient and is therefore restricted to use in specialised units in hospitals. It is considered a direct method and the cannula is typically inserted by a physician or nurse trained in critical care. The method is considered more accurate than the non-invasive method but requires close supervision because of the risks involved with insertion and monitoring of the BP (Welch Allyn, s.a).

Given the importance of correct techniques in obtaining BP using non-invasive methods, several organisations have developed criteria or guidelines to ensure accurate measurement. The following section reviews the guidelines and highlights common errors associated with incorrect BP measurements.

2.3.2 Guidelines for non-invasive blood pressure measurement

Extensive literature has been used in the preparation of guidelines laid down by organisations such as the British Hypertension Society (BHS), American Heart Association (AHA) and the European Society for Hypertension (ESH), to ensure that BP is recorded in a reproducible and standardised manner (Torrance & Serginson, 1997). Most practices related to the diagnosis and management of hypertension in South Africa are based on the guidelines of the ESH.

Following the publication of many observational studies and clinical trials in the field of hypertension in the early 2000's, newer and clearer guidelines on the diagnosis and management of the disease were developed and released by several organisations such as the Joint National Committee in the USA, the ESH and the European Society of

Cardiology (ESC) (Golino & Trimarco, 2003). All of the guidelines apparently share common, central concepts related to BP measurement. The ESH guidelines for the classification of hypertension are presented in Table 2.2. All organisations stress the importance of accurate measurements of BP under appropriate conditions (Golino & Trimarco, 2003).

Table 2.2: Definitions and classification of BP levels (mmHg) according to the ESH guidelines (ESH, 2013)

Category	Systolic		Diastolic
Optimal	<120	and	<80
Normal	120-129	and/or	80-84
High normal	130-139	and/or	85-89
Grade 1 hypertension	140-159	and/or	90-99
Grade 2 hypertension	160-179	and/or	100-109
Grade 3 hypertension	> or equal to180	and/or	> or equal to 110
Isolated systolic hypertension	> or equal to 140	and	<90

According to guidelines from the ESH on the methodological aspects of non-invasive measurements of BP, the patient should be relaxed in the sitting position, with the back supported, without crossing legs, in a quiet room at a comfortable temperature and at least 5 minutes of rest should precede the measurement (Parati *et al*., 2008). In addition, the patient should ideally not have eaten or smoked for at least 30-60 minutes before the measurement. A number of extraneous variables are known to influence BP and should always be considered when performing BP measurement. These include the individual's activity, emotions, environmental stressors, pharmacological factors and other physiological variables (such as bladder distension and pain). These variables must always be considered and every effort must be made to minimise these variables, because if they go unrecognised, erroneous diagnosis and inappropriate management may result (Parati *et al.*, 2008). It is recommended that measurements be taken in conditions that are carefully standardised to limit the influence of such variables.

In addition, the arm from which the measurement is taken must always be supported on a table (if the patient is in sitting position) to limit the effect of isometric exercise that can increase BP measurements by up to 10% (Parati *et al.*, 2008). It is also important to make sure that the cuff is positioned at the level of the heart. When the cuff is below or above the heart level, the BP will be overestimated or underestimated respectively. Further to this, the ESH recommends that BP measurements must be done on both arms at the time of the first measurement to exclude any occlusive arterial disease (Parati *et al.*, 2008). If the patient's BP measurement shows a consistent and significant between-arm

difference on repeated measurement, the arm with the higher measurement must always be selected.

When selecting the cuff and bladder, it is important to consider and use an appropriate size (AHA, 2005). When using a bladder that is too small or too large the BP measurement may be overestimated or underestimated respectively. In addition, the length of the inflatable bladder should cover 80-100% of the arm circumference and the width should be about half of that length (Parati *et al.*, 2008; AHA, 2005). For each measurement, the cuff must be wrapped around the upper arm with the centre of the bladder placed over the brachial artery. Ideally, the arm should be bare or free from restrictive clothing and measurements should always be recorded to the nearest 2 mmHg.

The Heart Foundation of Australia (HFA, 2008) advises health care practitioners to use the recommended technique at every BP reading to ensure accurate measurements and avoid common errors. According to the HFA (2008), particular attention should be given to the patient's first BP assessment, when the BP must be measured on both arms. Thereafter one should use the arm with the higher reading. Variation of up to 5 mmHg in BP between arms is acceptable, but if the BP varies by more than 5 mmHg (e.g. in the presence of chronic aortic dissection or sub-clavian artery stenosis), use the arm with the higher reading for all future BP measurements. In patients who may have orthostatic hypotension (e.g. the elderly or those with diabetes), it is recommended that the BP be measured in the sitting position, and repeated after the patient has been standing for at least 2 minutes (HFA, 2008).

Authors report on several common sources of error in BP monitoring, and studies of doctors and nurses have all indicated problems in the accuracy of BP measurements (Torrance & Serginson, 1997). According to the British Hypertension Society (2006), the most common causes for error in BP measurement may be attributed to:

- Defective equipment such as leaking tubing or a damaged valve
- Failure to ensure the mercury column reads 0 mmHg at rest
- Too speedy deflation of the cuff
- Use of an incorrectly sized cuff: if the cuff is too small the BP will be overestimated and if it is too large, the BP will be underestimated
- If the cuff is not at the same level as the heart
- Failure to observe the mercury level accurately – the top of the mercury column should be at eye level

- Poor technique – for example, failing to note when the sound disappears
- Digit preference, rounding the reading up to the nearest 5 or 10 mmHg
- Observer bias – for example, expecting a young patient's BP to be between normal limits.

Similarly, a summary of the type of errors and possible contributing factors as reported by GE Healthcare (s.a.), is provided in Table 2.3.

Table 2.3: Common errors in BP measurement (GE Healthcare, s.a)

Error Type	Cuff	Human
False high	- Inflatable portion of cuff too narrow. - Inflatable portion of cuff too short. - Cuff too loose or uneven. - Cuff deflates too slowly (Diastolic). - Cuff over inflated. - Cuff inflated too slowly (Diastolic)	- Recording BP immediately after patient's meals, while patient is smoking or with distended bladder. - Patient's arm below level of heart.
False low	- Cuff too wide.	- Patient's arm above heart level. - Failure to notice auscultatory gap. - Inability to hear feeble Korotkoff sounds. - Failure to have meniscus of mercury at eye level. Stethoscope bell applied too firmly.
False high or low		- Caregiver's error. - Cuff deflated too fast.

Using the wrong sized cuff may affect accuracy by up to 30 mmHg. Although blood pressure is usually measured in the upper arm, issues such as vascular access surgeries and difficulty in finding the right-sized cuff for some patients motivate nurses to use other sites (Schrauf, 2012). The AHA (2005) recommends that the cuff bladder width be 40% of the arm circumference and that the cuff bladder length be 80% of the arm circumference. Pickering *et al.* (2005) stated that BP tends to increase when the patient is cold. Therefore, BP readings in an environment with a low room temperature, such as a doctor's office, may be higher than expected. Although blood pressure is usually measured in the upper arm, issues such as vascular access surgeries and difficulty in finding the right-sized cuff for some patients prompt nurses to use other sites (Schrauf,

2012). Beevers (2001) noted that many operators have a preference for ending numbers in 0 or 5 for BP readings, leading to lowering or rising by 2 to 3 mmHg in both, respectively. In addition, operators tend to round down the numbers if the person being measured appears healthy and to round up if the person appears overweight or unhealthy. The authors also stated that rapid inflation and deflation of the cuff by the operator may lead to artificially lower systolic and higher diastolic numbers.

The ESH (2013) describes correct BP measurement as follows:

- Let the patient sit for several minutes in a quiet room before attempting the BP measurements.
- Take at least two measurements, spaced by 1-2 minutes, and additional measurements if the two are noticeably different. Use a standard bladder (12 – 13 cm long and 35 cm wide) but have a larger and a smaller bladder available for obese and thin patients, respectively.
- The cuff should be at heart level, whatever the position of the patient. Use phase I and V of the Korotkoff sounds (Table 2.4) to identify systolic and diastolic BPs, respectively. Measure the BP at 1 and 5 minutes after assumption of standing position in elderly patients, diabetic patients and in conditions in which orthostatic hypotension may be frequent or suspected.
- Measure the heart rate by pulse palpation (at least 30 seconds) after the second measurement in the sitting position

Table 2.4: Phases of Korotkoff sounds (Mosby, 2011)

Phase I	Two consecutive beats indicate the systolic pressure as well as the beginning of phase I.
Phase II	The Korotkoff sounds being heard will disappear and will reappear 10 to 15 mmHg lower. The period of silence is the auscultatory gap.
Phase III & Phase IV	The sounds that are first crisp (Phase III) become muffled (Phase IV).
Phase V	The point at which the sounds disappear. This is the second diastolic sound.

Some nurses record the diastolic number sooner than recommended. Recording the lower BP number at phase IV, versus phase V, leads to a higher diastolic pressure. Harper (2010) mentioned that failing to detect the auscultatory gap leads to a lower systolic pressure being recorded. This problem is easily avoided by inflating the cuff until there is an absence of the radial pulse. Nurses who have difficulty with hearing might consider using a stethoscope with a built-in amplifier. Stibich (2006) reported that mistakes are

common in BP measurement and recommended that equipment be regularly checked to make sure that the cuff is in good working order and the stethoscope clean and effective. It is also suggested that the health care provider immediately record the BP reading after measurement instead of trying to remember it and recording it later. In the light of the significant role that training and retraining of health care providers plays in decreasing error in BP measurement (Dickson & Hajjar, 2007; Gillespie & Curzio, 1998), the following section will focus on the training of healthcare providers in BP measurement in SA and a synthesis of studies from abroad that have investigated health care providers' knowledge of BP measurement.

2.3.3 Blood pressure measurement technique

BP measurement, using the standard technique of sphygmomanometry and auscultation with a stethoscope (auscultatory method), is a routine activity for many nurses in the clinical setting. Despite being a common task, BP measurement remains a poorly understood procedure (Bauer & Huynh, 1998).

2.3.3.1 Training of nurses in SA

BP measurement is taught to South African nursing students in the first year of training at either university or college level. The South African Nursing Council (SANC) distinguishes between different groupings of nurses that include the supporting category (inclusive of the enrolled categories) and the professional category (which include all persons on the registers). A RN may obtain either a diploma or a degree after four years of study at a nursing college or university (Department of Health (DoH), 2002; SANC, 1978). The EN course spans a period of two years and is provided by a nursing college (DoH, 2002; SANC, 1978).

The scope of practice of an EN encompasses certain acts and procedures which have been planned and initiated by a RN or registered midwife and which are carried out under her direct or indirect supervision as part of the nursing regimen (Searle, 2006). The scope of practice of both RN's and EN's entails the monitoring of patients' vital signs (SANC, 1978). Aspects of the procedure which are considered crucial for an accurate measurement of BP such as correct preparation of the patient, accurate placement of the cuff, correct location of the arterial pulse, assessment of the systolic pressure by palpation, correct placement of the stethoscope over the artery and recognition of the Korotkoff sounds against the manometer scale, and the interpretation and management of the results are usually specifically included in the training of the RN category.

2.3.3.2 The international context

As stated earlier, several international studies investigating BP measurement techniques report on inaccuracies in the readings performed by both doctors and nurses. In a study conducted by Feher *et al.* (1992) on hospital doctors' knowledge related to BP measurement, 43% of the participants did not know how to select the correct cuff size. Approximately 59% of the participants in the study also rounded off their readings to the nearest 5 or 10 mm Hg. Similarly McKay *et al*. (1990) investigated the manometry technique of primary care physicians in Canada. Of the 114 participants, none adhered completely to the recommendations prescribed by their institutions for accurately measuring BP. In a later study by the same authors, it was found that less than 50% of newly qualified doctors followed recommendations for accurate measurement (McKay *et al*., 1992).

In a study conducted by Wilcox in the early 1960's, the author concluded that observer factors are a major source of variation in BP measurement by graduate nurses and suggested a need to improve practice in this area. Nolan and Nolan (1993) investigated nurses' knowledge of BP measurement and found that only 40% measured BP to the nearest 2 mmHg, while 74% were unable to identify the recommended deflation rate. Only 52% of the participants reported the cessation of Korotkoff sounds to be the diastolic pressure. Chlinton (1997) investigated 129 health care professionals' knowledge of BP and the indirect arterial method of BP measurement in the USA. Results of this study indicated that a significant knowledge deficit existed among health care professionals in this sample regarding BP and the indirect arterial method of BP measurement. In addition, Dickson and Hajjar (2007) conducted a pilot study on a BP Measurement Education and Evaluation Program to improve measurement accuracy among community based nurses. The result of the study indicated that the technique for measuring BP used by these community nurses was not in accordance with the AHA guidelines and did not ensure accuracy. Their baseline knowledge of guidelines and their technique were considered poor before the implementation of the educational programme. Balgir and Ahmed (1997) conducted a study in Saudi Arabia concerning the knowledge of BP measurement among teaching hospital staff in a developing nation. They concluded that poor knowledge of BP measurement leads to poor skills and inaccurate measurement, which may seriously affect the diagnosis and the clinical management of hypertension.

As stated in Chapter 1, it has long been accepted that nursing procedures and practices are based on rituals and tradition rather than on evidence produced from research (Torrance & Serginson, 1996). In support of that finding, international research, spanning 60 years, confirmed the deficiencies in teaching and performing BP measurement (Armstrong, 2002). From the literature, it was evident that errors in measurement may

have a detrimental effect on the patient's health as underestimation often leads to cardiac, cerebral and vascular complications, whilst overestimation is associated with unnecessary medical treatment (Armstrong, 2002). Given that acquiring the accurate technique of measurement of BP is an assumption made on completion of study in this area of training of nurses, and the fact that several studies prove otherwise, an investigation of the SA context is considered vital.

2.4 SUMMARY

Literature on BP and the correct measurement technique dates back to the 1800's. The limitations of correct measurement of BP have emphasised the need for improvement of nurses' knowledge and skill. In this chapter, from the literature presented, it is clear that health care professionals appear to exhibit deficiencies in both knowledge and skill as related to the correct measurement of BP.

CHAPTER 3: ARTICLE: NURSES' KNOWLEDGE AND SKILL OF BLOOD PRESSURE MEASUREMENT TECHNIQUE IN A PRIVATE HOSPITAL SETTING

AUTHOR GUIDELINES FOR THE INTERNATIONAL JOURNAL OF NURSING PRACTICE

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Books

(3) Dunning T. *Care of People with Diabetes: A Manual of Nursing Practice.* Oxford: Blackwell Science, 1994.

Chapters in Books

(4) Reid F. Mobility and safer handling. In: McMahon CA, Harding J (eds). *Knowledge to Care:A Handbook for Care Assistants.* Oxford: Blackwell Science, 1994; 53–69.

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Declaration:

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Author contributions:

All persons listed as authors contributed in the following manner: Hanette du Toit contributed to the conceptualisation of the study, data collection and analysis, the interpretation of the findings and the drafting of the manuscript. Ronel Pretorius and Hugo Huisman contributed to the conceptualisation of the study, data interpretation, drafting of the manuscript (results and discussion sections), supervision, and the critical revision of the intellectual content. There are no conflicts of interest to disclose.

Ethical approval:

A formal, written proposal of the project was submitted to the Ethics Committees of both the North-West University and the private hospitals that participated in the study. Ethical approval was obtained from the North-West University Ethics Committee: NWU-00028-12-S1; the Ethics Committees of the private hospital groups that participated in the study. Informed consent was obtained from every participant in recognition of voluntary participation and the right to protection.

TITLE PAGE

Nurses' knowledge and skill of blood pressure measurement technique in a private hospital setting

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ABSTRACT

Nurses are responsible for monitoring blood pressure and accurate measurement is considered paramount in the management of cardiovascular risks. This descriptive study with an observational checklist and survey method assessed nurses' (n=102) knowledge and skill of blood pressure measurement technique in a private hospital setting. Overall, the mean score for correct skills in measuring blood pressure was 87.7% with areas of concern being: resting time before measurements, considering variables that can influence the reading and not recording which arm was used for measurement. Nurses scored 63.1% for knowledge of blood pressure measurement technique with deficits in their knowledge associated with defining the auscultatory gap and Korotkoff sounds, rapid cuff deflation, marking of the mercury column, resting time between measurements, position of the arm and palpating the systolic blood pressure. The relationship between nurses' skills and their knowledge of blood pressure measurement was not significant (*r=0,062, p=0,5)*. In addition, there was no practical significance between the BP readings obtained by the researcher and the nurses. On the whole, the deficits in knowledge did not seem to influence nurses' skill in BP measurement technique. Regular updates and carrying readily available documents on the standardized procedure for BP measurement techniques is able to support the training and correction of nurses' knowledge in the acute setting.

KEY WORDS: Blood pressure, education, knowledge, measurement technique, skill.

3.1 INTRODUCTION

Despite advances in the monitoring of blood pressure (BP), BP measurement technique is still poorly understood in both the medical and nursing professions.[1] BP determination continues to be an important measurement in clinical medicine, but is one of the most inaccurately performed measurements.[2,3] BP is regularly measured in the acute setting and it is usually assumed that nurses perform the procedure accurately and with full understanding.[4] A number of studies however cast doubt on this assumption and report that poor knowledge of blood pressure measurement is not uncommon among healthcare professionals.[1, 5-6]

In a study conducted by Feher *et al.* in 1992[7] on hospital doctors' knowledge related to BP measurement, 43% of the participants did not know how to select the correct cuff size. Approximately 59% of the participants in the study also rounded off their readings to the nearest 5 or 10 mm Hg. Similarly McKay *et al*. in 1990[8] investigated the manometry technique of primary care physicians in Canada. Of the 114 participants, none completely adhered to the recommendations prescribed by their institutions for accurately measuring BP. In a later study by the same authors, it was found that less than 50% of newly qualified doctors followed recommendations for accurate measurement.[8] Wilcox in the early 1960's concluded that observer factors are a major source of variation in BP measurement by graduate nurses and suggested a need to improve practice in this area.[9] Nolan and Nolan in 1993 [10] investigated nurses' knowledge of BP measurement and found 74% were unable to identify the recommended deflation rate, with only 52% of the participants reporting the cessation of Korotkoff sounds to be the diastolic pressure.

Chlinton in 1997[11] investigated 129 health care professionals' knowledge of BP and the indirect arterial method of BP measurement in the United States of America. Results of this study indicated that a significant knowledge deficit existed regarding the professionals' knowledge of BP and the indirect arterial method of BP measurement. Similarly, El Balgir and Ahmed in 1997[12] conducted a study on the knowledge of BP measurement among teaching hospital staff in a developing nation in Saudi Arabia. They concluded that poor knowledge of BP measurement leads to poor skills and inaccurate measurement which may seriously affect the diagnosis and the clinical management of hypertension.

It has long been accepted that nursing procedures and practices are based on rituals and tradition rather than knowledge and research evidence.[1] With regard to that notion, international research, spanning 60 years, confirmed the deficiencies in teaching and performing BP measurement. [13] From the literature it was evident that errors in measurement might have a detrimental effect on the patient's health as underestimation

often leads to cardiac, cerebral and vascular complications, whilst overestimation is associated with unnecessary medical treatment.[13] The main objectives of this study were to determine nurses' knowledge and skill in measuring blood pressure and to determine if there is a correlation between nurses' knowledge and skill of blood pressure measurement technique.

3.2 METHOD

3.2.1 Participants

Given the small population size, the researchers decided on an all-inclusive sample, that comprised of full-time registered nurses (n=56) and full-time enrolled nurses (n=46) working in the acute care setting of a private hospital in the North West Province of South Africa. Both registered and enrolled nurses were included because all nurses are trained in the basic skills of measuring BP and these nurses are primarily responsible for the measurement of BP in this setting. Nurses working in intensive care units (adult, paediatric and neonatal) were excluded because BP measurements are typically monitored invasively in these units. At the time of the study, there were 115 full-time nurses eligible to participate in the study. Thirteen nurses however did not participate due to annual or maternity leave, resulting in an 88.6% sample.

3.2.2 Ethical considerations

A formal, written proposal for the project was submitted to the Ethics Committees of both the North-West University and the private hospital that participated in the study. Ethical approval was obtained from the North-West University Ethics Committee: NWU-00028-12-S1; and the Ethics Committee of the said private hospital. Informed consent was obtained from every participant in recognition of voluntary participation.

3.3 DATA COLLECTION

A week before the onset of the study the researchers circulated an invitation to the acute care units, inviting nurses to participate in the study. An appointment was scheduled with each of the nurses and a standard introduction to the protocol was provided.

The participants' skill on blood pressure measurement technique was assessed first in a room equipped with a table, sphygmomanometer (Tycos: Jewel Movement Sphygmomanometer, Lifetime Certified – 109574918), medium and large cuffs (Welch Allyn Blood pressure cuff) and a dual headed stethoscope. All measurements were taken on normotensive females with a medium upper arm circumference (not exceeding 33 cm), in an upright position. The participants' ability, to correctly identify the Korotkoff sounds and pulse palpation, was assessed using a dual headed stethoscope (Code: P27105).

The participant's knowledge of blood pressure measurement technique was determined by means of a questionnaire based on the literature and guidelines by the ESH[14]. Participants were asked to complete the questionnaire in a room adjacent to where their skill of BP measurement technique had been assessed. Instructions on the completion of the questionnaire were provided on the first page of the questionnaire, and the researcher was available to clarify any questions.

3.4 INSTRUMENT

The observational checklist to assess nurses' skill in obtaining blood pressure using a sphygmomanometer and auscultation was developed according to the guidelines of the ESH[14.] The checklist consisted of two sections: preparing for BP measurement (7 items) and technique (18 items), and was completed by the researcher.

The self-administered questionnaire on knowledge of BP measurement was based on the literature and guidelines by the ESH[14] for blood pressure measurement by sphygmomanometer. The questionnaire consisted of five sections and started with demographic information that included age, gender, highest qualification, hospital, unit, how long the nurse has been measuring BP, hearing or visual problems and aids, when last information on BP guidelines had been read and the last time they received training on BP measurement. The subsequent sections focused on questions related to background knowledge of BP (11 items), measurement technique (5 items), cuff size and arm position (5 items), and palpation to identify systolic pressure (2 items).

Both the observational checklist and the self-administered questionnaire on knowledge of BP measurement were reviewed for content validity by three experts: a registered critical care nurse, cardiovascular physiologist and a statistician. It was agreed that the aims of clarifying the language of the questions as well as the ability of the questions to elicit responses that indicated understanding had been achieved.

3.5 DATA ANALYSIS

The data was captured on an online secure server and stored as an MS Excel spread sheet that was exported to the statistical software programme SPSS 17.0 for analysis. The analysis included both descriptive and inferential statistics. The mean score of the entire sample population was calculated, as well as the percentage of respondents who had correctly executed the skills on the observational checklist and correctly answered the items in the knowledge questionnaire. To determine the correct identification of the pulse and Korotkoff sounds, an independent t-test on the values obtained by the researcher and the participants was conducted. Finally, correlation between skill and knowledge was investigated by means of a Spearman correlation coefficient.

3.6 RESULTS

Participant demographics

The characteristics of the study population are provided in Table 1. Sixty-two participants were registered nurses and most were aged between 30-49 years (70%). Almost half of the participants (46%) had been trained at a nursing college and held a diploma in nursing science. Slightly more than half of the participants have been measuring BP for more than 15 years (53%). Sixty-five participants (63.7%) had not recently read the guidelines on the measurement of BP, while 63 participants (61.8%) had received training in BP measurement in the last 5 years.

3.7 SKILL

The results of the participants' performances in terms of skill in measuring BP are given as frequencies and percentages in Table 2. The table shows that the range for the correct answers for the 7 questions on preparing for BP measurement ranged from a low of 56% of the participants, for the question allowing the patient to rest for 5 minutes before measuring the BP, to a high of 100% (having adequate lighting in the room). Participants obtained low scores for resting the patient (56%), and asking about factors such as nicotine or caffeine intake that might have influenced the reading (57%). The next 18 questions focussed on the technique used when taking the BP; scores ranged from a low 59% (record which arm was used for measurement) to a high of 100% (using the bell of the stethoscope). The majority of the participants (96%) used the correct cuff size, had the sphygmomanometer at eyesight level (90%), the mercury column at zero (93%), palpated the brachial artery before using the stethoscope (97%), and placed the midline of the bladder over the brachial artery (92%). A high number (78%) ensured that the patient's feet rested uncrossed on the ground. Eighty-seven participants (86.1%) did have the arm of the patient at the level of the heart, and in 88.1% the lower edge of the cuff was 2 cm above the antecubital fossa. Of concern was the fact that only 60 participants (59%) recorded the arm used for the measurement.

Although determining the rate of deflation was difficult to judge, 90% of the participants deflated the cuff at 2mm/sec. A comparison of the researcher and participants' identification of the pulse and Korotkoff sounds using the dual headed stethoscope showed a statistically significant difference between their readings for the systolic pressure measured on the right arm, but the value is of no practical significance. For the diastolic pressure measured on the right arm and the systolic and diastolic pressure measured on the left arm, there was no statistically significant difference between the readings of the researcher and the participants (Table 3).

Overall, the mean score for correctly completing the activities on the checklist was 21.91 out of 25 (87.7%). On average, the ESH[14] guidelines for BP measurement were followed by 87.7% of the participants during completion of the checklist (n=102). Internal consistency for the observational checklist measured 0.68.

3.8 KNOWLEDGE

A summary of the scores obtained for the knowledge questionnaire is provided in Table 4. Internal consistency for the questionnaire on knowledge measured 0.67. Eleven items (Table 4) measured the participants' knowledge of general definitions of BP measurement technique. The scores for the 11 questions ranged from 11.8% (not recording the arm the BP was measured on) to 98% (knowing that it is sometimes required to measure the BP in both arms). In all, 89 participants (87.3%) identified systolic pressure as the pressure during contraction, while 86 participants (86.3%) defined diastolic pressure as pressure during relaxation. Seventy-one participants (69.9%) were able to identify a full bladder, coffee and a small cuff size as having an influence on BP values. Sixty-one participants (59.8%) indicated that they measure the BP in both arms, while only 12 participants (11.8%) recorded the arm used for the measurement. Ninety-eight percent of the participants agreed that it might be appropriate to measure the BP in both arms in special circumstances, and 96 participants (94.1%) expected the reading to be the same in both arms. As a whole, only 40 participants (39.2%) have heard the term "auscultatory gap", while 85 participants (83.3%) were able to recognise the correct definition of an auscultatory gap. For the Korotkoff sounds, 34 participants (33%) indicated that they had heard about Korotkoff sounds previously and 44 participants (43.1%) were able to identify the Korotkoff sounds that represent systolic- and diastolic pressure.

For the five questions related to measurement technique, 90 participants (88.2%) correctly indicated a rest period of five minutes before measuring the BP. Less than half of the participants (48%) identified the 2 mm increment marking and only 49 participants (48%) answered concerning the required deflation rate of 2-3 mm per second. When asked about the recording of the diastolic pressure, 84 participants (82.4%) correctly identified it as "when the sound disappears". In response to the waiting time between two consecutive measurements on the same individual, only half of the participants (49%) correctly identified five minutes.

In reply to questions about cuff size and arm position, 79 participants (77.5%) indicated the arm should be supported by a surface. Only 36 participants (34.6%) said that the patient's elbow should be slightly flexed. Eighty-four participants (82.4%) indicated that a patient's arm should always be assessed for cuff size before applying the cuff, while 69 participants (67.5%) agreed that a narrow cuff would cause the greatest error in

measurement. In terms of the final two questions on identifying the systolic pressure, only 65 participants (63.7%) palpated the systolic pressure before using the stethoscope, and only 30 participants (29.4%) knew the reason for identifying the systolic pressure by palpation. Overall, participants scored an average of 63.1% for knowledge on BP measurement technique (n=102).

Finally, the relationship between the observation of the performance of the skill and the written questionnaire measuring knowledge of BP measurement technique was not significant (*r=0.062, p=0.5*). Also, there seemed to be no statistically significant relationship between the participants' skill and knowledge of BP measurement technique and their highest level of education (*r=-0.013, p=0.89; r=-0.117, p=0.24)*, years of experience (*r=0.044, p=0.66; r=-0.155, p=0.12)*, the last time they had received training in blood pressure measurement (*r=0.014, p=0.89; r=-0.121, p=0.22)* and their age (*r=0.061, p=0.54; r=-0.33, p=0.73)*(Table 5).

3.9 DISCUSSION

Contrary to findings in other studies, the result of this study revealed that there is no relationship between nurses' skill in measuring BP and their knowledge of BP measurement technique.[1,6,8] In our study, to our knowledge, the first of its kind in South Africa, we focused on general BP measurement skill as well as on knowledge.

In clinical practice, the preparation of the patient for measuring BP is considered important and advocated for by societies such as the ESH. In this study, 30 of the participants (29%) neglected to inform the patient of the procedure. Similarly a study conducted on student nurses' measurement of arterial blood pressure, showed that only two out of 51 participants explained the procedure to the patient.[1] More than half (57%) did not ask about extraneous factors such as recent eating, smoking or a full bladder, all or any of which may influence the measurement. There were also a large number of nurses (56%) who did not allow for a minimum of five minutes' rest before taking the BP reading. Likewise, McKay et al. in 1992, [8] conducted a study on recently graduated doctors' assessment of BP measurement in Canada and reported that less than 40% of the participants allowed for five minutes' rest.

When looking at the results for skills in BP measurement technique, 22% of the nurses did not ensure that the patients' feet rested uncrossed on the ground. Only 48% of the participants knew that the mercury sphygmomanometer was marked in 2 mm increments while 49% indicated the correct cuff deflation rate of 2mm per second.[14] This preference for the terminal digit 0 was evidenced in other studies also. Torrance and Serginson[1] reported that 60% of students in their study did not know the increments on the mercury

sphygmomanometer and that only 58% selected the correct cuff deflation rate. Approximately 70% of the students in their study recorded pressures ending in zero while zero would only be expected to occur 20% of the time.[1] A deflation rate that is too fast will underestimate the systolic BP and overestimate the diastolic BP.[2] The literature findings indicated that error is also introduced by rounding off the actual measurement to an observer-preferred digit.[13] Of concern in this study was the fact that 61% of the nurses reported rounding readings off, up to the nearest 5 mm Hg. McKay *et al*. [8] report that systematic errors, even those as small as 5mm Hg, may increase or decrease the number of patients meeting the criteria for pharmacological therapy by 50% or more.

The responses to items in the self-administered questionnaire indicated that 39.2% of the participants had heard of the term “auscultatory gap” previously and 33% of “Korotkoff sounds”. Only 43.1% of the participants were able to correctly identify which Korotkoff sound represented systolic or diastolic BP. Torrance and Serginson[1] reported that 90% of the participants in their study claimed not to have heard of the abovementioned terms. Furthermore, in a study conducted by Kemp *et al.* in 1993[15], it was reported that half of their sample of 118 participants was unaware of the existence of Korotkoff sounds. The lack of knowledge of the auscultatory gap is of particular concern, given that the identification of this gap is part of the palpation procedure to identify the systolic pressure.[13] Similarly, Armstrong[13] reports that the preliminary estimation of the systolic BP by palpation is essential to avoid inflating the cuff to a point within the auscultatory gap. This can prevent significant underestimation of the systolic BP or overestimation of the diastolic BP. While 63.7% of the participants in this study reported that they identify the systolic pressure by palpation, only 30.8% reported that the palpation was done to obtain a more accurate reading.

Fifty-nine percent of the participants suggested that BP should be routinely measured in both arms. Of concern was the finding that only 11.8% of the participants record the arm on which they took the measurement, and that almost all participants (94.1%) reported that the BP would measure the same in both arms. Several studies report on the difference between both systolic and diastolic pressures between arms,[16-17] and current guidelines suggest that BP be measured in both arms during the initial assessment. If there is a significant difference between the measurements, the arm with the higher reading should be used for subsequent measurements.[14,18] The majority of the participants were aware that the arm should be supported by a surface during measurement (77.5%), and 86.1% indicated that the arm should be at heart level. According to Armstrong,[13] this factor is of particular importance given the fact that for every 5 cm that the midpoint of the cuff is below the level of the right atrium, a variance of up to 3-4 mmHg may occur. During the observation of the participants, 88% of the

participants provided support for the arm during the measurement. The majority of the participants (64.5%) indicated that the arm should be straight during measurement, in contrast to the recommendation of the ESH [14] that the arm should be slightly flexed. Of interest was the fact that 88.2% of the participants knew that they should rest the patient for at least 5 minutes before measuring the BP, but only 56% of the participants actually did so during the observation phase of the study. Armstrong[13] reported that in 1996[19] Wingfield *et al,* explored this phenomenon of having the correct knowledge but performing differently, which probably explains this discrepancy.

This study has attempted to determine nurses' knowledge and skill of BP measurement in a private hospital setting in South Africa. The results identified some areas of concern in the participants' knowledge and skill and gives direction regarding where additional teaching is needed, including: resting time before measurements; considering variables that might influence the reading; not recording which arm was used for measurement; defining the auscultatory gap and Korotkoff sounds; rapid cuff deflation;, marking of the mercury column; resting time between measurements; position of the arm and palpating the systolic blood pressure. The findings additionally highlighted that there seems to be no correlation between nurses' knowledge and the skill of their BP measurement technique.

Limitations of the study included the small sample size (n=102) which limited the ability to generalise. However, although the results cannot be generalised beyond this group, international literature does seem to suggest similar problems.[1,8,13] It is assumed that all of the nurses who participated in the study received their training in South Africa, suggesting that the results may be reproducible in other settings in South Africa. It is of importance to note Armstrong[13] who recounts that several authors indicated that short educational programmes did not seem to improve the technique of BP measurement,[20-22] but that continued effort and bi-annual updates through in-service training led to higher average scores in knowledge of BP measurement.[23] In addition, Armstrong[13] suggests that healthcare facilities carry an authoritative, comprehensive, referenced document that is readily available to staff on standardized blood pressure measurement techniques. McKay *et al*.[8] support the training of students to measure BP according to current guidelines and the provision of additional evaluation and corrections of BP measurement where appropriate. However, Nicol *et al*[24] went further, suggesting that only when nurses allow experience to be accompanied by increasing knowledge and development of the skill through the practice of reflection is care able to occur at a level that contributes to high quality nursing care.

3.10 CONCLUSION

Nurses must be trained to measure BP according to current guidelines. Additional training and evaluation through bi-annual updates and regular in-service training programmes are necessary to ensure the correct use of the BP measurement technique. The practice of reflecting on knowledge and skill development should also be promoted to ensure that nurses move beyond performing a skill safely and accurately to being able to integrate the cognitive, affective and psychomotor domains in an effective way to provide high quality nursing care.

3.11 ACKNOWLEDGMENTS

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3.12 CONFLICT OF INTEREST

This work is from a self-founded Master's study. No existing or potential conflict of interest has been identified.

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TABLES

Table 3.1: Characteristics of the study population (n=102):

		f (%)
CATEGORY	Registered Nurse	62 (60.7)
	Enrolled Nurse	40 (39.3)
AGE	20-29 years	14 (13.7)
	30-39 years	38 (37.2)
	40-49 years	33 (32.3)
	50-59 years	12 (11.7)
	60-69 years	5 (4.9)
HIGHEST QUALIFICATION	Certificate in Nursing	40 (39.2)
	Diploma in Nursing	47 (46)
	Degree in Nursing	5 (4.9)
	Postgraduate qualification	10 (9.8)
		f (%)
BP MEASUREMENT TECHNIQUE	How long have you been measuring BP?	
	< 3 years	3 (2.9)
	3-6 years	23 (22.5)
	7-10 years	11 (10.8)
	11-14 years	11 (10.8)
	> 15 years	54 (53)
	Read guidelines on BP measurement technique recently?	
	No	65 (63.7)
	Yes	37 (36.3
	When last did you receive BP measurement training?	
	< one year ago	3 (2.9)
	1-5 years ago	63 (61.8)
	6-10 years ago	10 (9.8)
	> 10 years ago	26 (25.5)
	Hearing problems	
	No	97 (95.1)
	Yes	5 (4.9)
	Hearing checked in last three years	
	No	86 (84.3)
	Yes	16 (15.7)
	Visual problems	
	No	52 (51)
	Yes	50 (49)
	Eyes checked in last three years	
	No	39 (38.2)
	Yes	63 (61.8)

f=frequency

Table 3.2: Skills correctly completed (n=102)

		f (%)
PREPARATION FOR BP MEASUREMENT	Patient in comfortable position	97 (96)
	Measurer in comfortable position	87 (86)
	Adequate lighting for the room	102 (100)
	Level of noise in the room	98 (97)
	Inform patient that BP is going to be measured	72 (71)
	Ask about factors affecting BP	58 (57)
	Rest at least 5 minutes	56 (56)
TECHNIQUE	Use of appropriate cuff size	97 (96)
	Feet resting on floor	78 (78)
	Device at eyesight level	91 (90)
	Mercury column starting at zero	94 (93)
	Palpate midline of bladder over brachial artery	98 (97)
	Place midline of bladder over brachial artery	93 (92)
	Wrap cuff well	89 (88)
	Tourniquet effect	93 (92.1)
	Arm at heart level	87 (86.1)
	Lower edge at least 2 cm above fossa	89 (88.1)
	Palpate SBP	94 (93.1)
	Total deflation after palpating BP	97 (97)
	Use bell of stethoscope	101 (100)
	Ear peace towards patient	100 (99)
	Put stethoscope on the brachial pulse	98 (97)
	Inflate 20-30 or more palpable SBP	95 (94.1)
	Deflate at 2mm/sec	90 (90)
	Record arm used for measurement	60 (59)

f=frequency; Cronbach Alpha=0.68

Table 3.3: Comparison of the researcher and participant's identification of pulse and Korotkoff sounds (n=102)

	RESEARCHER		PARTICIPANT			
	M	**S.D**	**M**	**S.D**	**M Diff**	**p-value***
Right systolic	128.08	16.65	127.51	16.91	-0.56	0.001
Right diastolic	78.98	10.26	78.73	10.08	-0.24	0.243
Left systolic	127.65	16.01	127.34	16.02	-0.31	0.057
Left diastolic	79.09	9.7	78.67	9.97	-0.42	0.099

M= Mean; SD=Standard deviation; Diff=difference; * p value calculated on the mean difference.

Table 3.4: Participants that correctly answered questions related to knowledge of blood pressure measurement (n=102)

		N	f (%)
BACKGROUND KNOWLEDGE	Systolic pressure is...	102	89 (87.3)
	Diastolic pressure is...	102	86 (86.3)
	Which of the following factors will have an influence on blood pressure?	102	71 (69.6)
	Which arm should be used to measure blood pressure?	102	61 (59.8)
	Do you record the arm that BP was measured on?	102	12 (11.8)
	Circumstances appropriate to take measurement in both arms?	102	100 (98)
	Do you expect the blood pressure to be the same in both arms?	102	96 (94.1)
	Have you heard about the term auscultatory gap?	102	40 (39.2)
	Have you heard about the term Korotkoff sounds?	102	34 (33)
	What is an auscultatory gap?	102	85 (83.3)
	Which Korotkoff sound usually represents systolic and diastolic blood pressure?	102	44 (43.1)
MEASUREMENT TECHNIQUE	For how long should a patient rest before you measure the blood pressure?	102	90 (88.2)
	The sphygmomanometer's mercury column is marked in...	102	49 (48)
	The diastolic blood pressure is recorded when the sound becomes...	102	84 (82.4)
	What is the correct cuff deflation rate?	102	49 (48)
	How long should you wait between two consecutive blood pressure readings on the same individual?	102	50 (49)
CUFF SIZE AND ARM POSITION	What should the position of the patient's arm be during blood pressure measurement?	102	78 (76.5)
	Should the arm be supported during measurement?	102	79 (77.5)
	Should the elbow be slightly flexed or straight?	102	36 (35.5)
	Do you assess the patient's arm for cuff size before applying the cuff?	102	84 (82.4)
	What cuff size would cause the greatest error?	102	69 (67.5)
IDENTIFYING SYTOLIC PRESSURE	Do you palpate to identify the systolic pressure before using the stethoscope?	102	65 (63.7)
	What is the reason for identifying the systolic pressure by palpation?	102	30 (29.4)

f: frequency; Cronbach Alpha = 0.67.

Table 3.5: Correlation of knowledge and skill with selected biographic data (n=102)

	HIGHEST LEVEL OF EDUCATION		YEARS OF EXPERIENCE		BP MEASUREMENT TRAINING		AGE	
	r	**p**	**r**	**p**	**r**	**p**	**r**	**p**
SKILL	-0.013	0.89	0.044	0.66	0.014	0.89	0.061	0.54
KNOWLEDGE	-0.117	0.24	-0.155	0.12	-0.121	0.22	-0.33	0.73

BP=blood pressure

CHAPTER 4: CONCLUSIONS, RECOMMENDATIONS AND LIMITATIONS

4.1 INTRODUCTION

In this chapter, the main findings of the study are evaluated, followed by a discussion of the recommendations for nursing practice, research, and education. The chapter concludes with a discussion of the limitations of the study.

4.2 EVALUATION OF THE STUDY AND CONCLUSIONS

The objectives of this study were to:

(1) Nurses' skill in measuring blood pressure using a sphygmomanometer and auscultation by means of an observational checklist (Appendix B) in accordance with the ESH guidelines.

(2) Determine nurses' knowledge of blood pressure measurement technique using a questionnaire based on the ESH guidelines (Appendix C).

(3) Determine if there is a correlation between nurses' skill and their knowledge of blood pressure measurement technique.

Considering the fact that hypertension is a common condition in SA often resulting in extensive target-organ damage and premature death, determining nurses' skill and knowledge of BP measurement was considered vital (Steyn, 2006).

In terms of objective 1, nurses showed skill in BP measurement technique with an average mean score of 87.7%. In general there was good compliance with the guidelines for the measurement of BP as prescribed by the ESH; however with a common lack of knowledge of: the resting time before taking the measurement; considering variables that might influence the readings and not recording the arm on which the measurement was taken. Results for objective 2 showed knowledge in terms of BP measurement technique with participants scoring a mean average of 63.1%. Common lack of knowledge of BP measurement technique included: not being able to define the auscultatory gap and Korotkoff sounds; rapid cuff deflation rate; not knowing the marking of the mercury column; uncertainty about the time between readings; the position of the elbow during measurement and palpating the systolic pressure.

For objective 3 the results indicated that there was no statistical significance between the nurses' skill in measuring BP and their knowledge of BP measurement technique (*r=0,062, p=0,5)*. Most of the problems identified from the study are common and have been reported in studies undertaken elsewhere (Torrance & Serginson, 1996; Kay, 1998; Dickson & Hajjar, 2007). Although the findings of the study did not indicate major deficits in the knowledge and skill of nurses on BP measurement technique, it did highlight areas for additional training and correction regarding the daily care of patients.

4.3 RECOMMENDATIONS

The following recommendations in terms of nursing practice, research, and education emanated from the findings of the study.

4.4 Recommendations for practice

The quality of nursing practice and the safety of nursing practice in South Africa were accorded a high priority status in the National Nursing Strategy for Nurses (Nursing Strategy for South Africa, 2008). In terms of the findings of this study as well as those of international authors, the following is recommended for nursing practice:

- Standardisation and implementation of guidelines in daily practice. Since BP measurement is primarily used in the diagnosis of hypertension, the technique needs standardisation and implementation of the guidelines in daily practice. According to Vloet *et al. (*2002) following standard guidelines can greatly improve the accuracy of BP measurement. Many RNs and ENs are however, unaware of recent evidence and the reasons behind guidelines for the measurement of BP.

- Ensuring competency in nursing tasks; in this case, the skill of the given technique.

- As described in Chapter 1, the levels of skills acquisition, developed by Nicol *et al.* (1996) provided the theoretical framework for this study. According to Miller *et al.* (1988) a nurse exhibits competence when he/she has the ability to perform nursing tasks (skills) along with the ability to integrate the cognitive (knowledge), affective and psychomotor skills needed to deliver high quality nursing care. Recognising the different categories of nurses responsible for the monitoring of BP in the acute care setting, it might be acceptable to have enrolled nurses', function on level C of the model. That is safe and accurate performance of the skill under supervision but not able to cope with the complex and unpredictable nature of the acute setting, implying that the supervisor (RN) may take control should the need arise. On the

other hand, it is important to train registered nurses to move beyond the early stages of learning a new skill (such as measuring BP) to become more autonomous practitioners. This implies that RNs are trained to function on level E where their skills mastery level illustrates their ability to integrate his/her increasing knowledge and experience to a level of mastery. To facilitate functioning on this level, management must promote reflective practices to ensure that knowledge and experience contribute to mastery of the skill.

4.4.1 Recommendations for research

- Research exploring a comparison between nurses' knowledge and their skill of BP measurement technique in a private and public hospital setting.
- A pilot study to determine the effect of a BP measurement training programme to improve guideline knowledge and technique among nurses working in acute care settings.

4.4.2 Recommendations for nursing education

- Regular in-service training (at least bi-annually) on BP measurement technique as well as the physiology associated with BP.
- Informing nurse educators in the acute care setting that poor knowledge of BP measurement leads to inaccurate measurement and resultant inaccurate diagnosis and management of conditions such as hypertension.
- Informing management of the cost implications associated with an increased length of stay as results of misdiagnosis.

4.5 LIMITATIONS

Limitations of the study included the small sample size (n=102) which prevented being able to generalise the findings widely. Although the results cannot be generalised beyond the group that participated in this study, international literature seems to suggest that similar problems exist elsewhere (Torrance & Serginsonin 1996; McKay *et al.,*1992; Armstrong, 2002). It was assumed that all of the nurses that participated in the study received their training in South Africa, suggesting that the results may be reproducible in other settings in South Africa. Given

the deficiencies in both knowledge and skills highlighted in this study it seems appropriate for nurse educators to ensure that core knowledge and skills are taught and regularly updated.

4.6 SUMMARY

In this chapter, the researcher reflected on the objectives of the study by means of an evaluation of the latter. Recommendations and limitations were also provided. In drawing to a close it is vital to recognise the importance of the improvement of nurses' knowledge and skill of BP measurement technique. Ensuring the updating of the knowledge and skill of nurses will contribute to the correct diagnosis and treatment of hypertension in South Africa.

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APPENDIX A: LETTER TO PARTICIPANT

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10 November 2012

Dear participant,

PARTICIPATION IN A RESEARCH PROJECT: BLOOD PRESSURE MEASUREMENT TECHNIQUE

My name is Hanette du Toit, and I am currently busy with my dissertation for a Masters' Degree in Nursing Science at North West University (Potchefstroom Campus). The title of my dissertation is: Nurses' knowledge and skill of blood pressure measurement technique in a private hospital setting. The objectives of the study include:

- To determine nurses' knowledge and skill of correct blood pressure measurement techniques when using a sphygmomanometer, and
- To determine if there is a relationship between nurses' knowledge and skill of blood pressure measurement technique when using a sphygmomanometer.

What will be expected of you in the study
If you decide to participate in the study, you will be asked to perform a blood pressure measurement using a sphygmomanometer on a health adult, and to complete a questionnaire asking questions related to the correct technique when measuring a blood pressure. The questionnaire will be available in a room adjacent to where you measure the blood pressure and will be completed on a computer. Once you have completed your questionnaire, please enter on the "submit" button to send the completed document to an online secure server.

Time required
The measurement will take approximately 5 minutes to complete and the questionnaire will take approximately 20 minutes to complete.

Risks
No risks or discomforts are anticipated from taking part in this study. If you feel uncomfortable with a question, you can skip that question or withdraw from the study altogether. If you decide to quit at any time before you have finished the measurement or the questionnaire, your answers will NOT be recorded.

Benefits
You will be contributing to an understanding of nurses' knowledge and skill of blood pressure measurement technique using a sphygmomanometer. After we have finished data collection, we will also be able to provide you with more detailed information about the purposes of the study and the research findings.

Compensation
Please note that there is no incentive offered for participation in this study.

Confidentiality, Participation and withdrawal
Your responses will be kept anonymous in the study. We will not be able to identify any of your data related to the actual measurement of the blood pressure because your name will not be listed on the checklist. Also, there will be no personal identification requested on the questionnaire, and we will not be able to return your questionnaire to you once submitted to the online server. The data will be kept for 5 years afterwhich it will be destroyed. When research results are reported, responses will be aggregated and described in summary.

Your participation is completely voluntary, and you may refuse to participate without penalty or loss of benefit to which you may otherwise be entitled. You may quit at any time without penalty or loss of benefit to which you may otherwise be entitled. You may also skip any question, but continue to complete the rest of the questionnaire.

How the findings will be used
The results of the study will be used for scholarly purposes only. The results from the study will be presented in educational settings and at professional conferences, and the results might be published in a professional journal in the field of psychology.

Ethical approval
Please note that the study was granted ethical clearance from the North-West University Ethics Committee, ethics number [NWU 00028-12-A1]. The management of the hospital were you work has also provided ethical clearance and permission for the study to be conducted.

Contact details
If you have questions or concerns about this research, please contact:
Mrs Hanette du Toit
Tel: 079 846 3239.

You may also contact the academic supervising this work:
Dr. Ronel Pretorius
Tel: 018 299 1853
E-mail: ronel.pretorius@nwu.ac.za

Sincerely,

Hanette du Toit

APPENDIX B: BLOOD PRESSURE TECHNIQUES OBSERVATIONAL CHECKLIST

Participant's No	
Date	
Location	

Blood pressure reading obtained:	PARTICIPANT Right arm	RESEARCHER Right arm	PARTICIPANT Left arm	RESEARCHER Left arm
Systolic				
Diastolic				

OBSERVATION				
		YES	NO	Comments
	Patient in comfortable position			
	Measurer in comfortable position			
	Adequate lighting for the room (Can read numbers on device when at a distance)			
	Level of noise in the room (can hear whispers)			
	Inform patient that BP is going to be measured			
	Ask about factors affecting BP (exercise, anxiety, coffee)			
	Rest at least 5 minutes prior to reading BP			

TECHNIQUE				
		YES	NO	Comments
	Use of appropriate cuff size			
	Feet resting on floor, no crossed legs			
	Device at eyesight level			
	Mercury column starting at zero			
	Palpate brachial artery at base			
	Place midline of bladder over brachial artery			
	Wrap cuff well			
	Tourniquet effect			
	Arm at heart level during recording BP			

TECHNIQUE				
		YES	NO	Comments
	Lower edge is at least 2 cm above fossa			
	Palpate SBP			
	Total deflation after palpable BP			
	Use bell of stethoscope			
	Ear peace towards patient			
	Put stethoscope on the brachial pulse			
	Inflate to 20-30 > palpable SBP			
	Deflate at 2 mm/sec			
	Record arm used for measurement			

APPENDIX C: BLOOD PRESSURE QUESTIONNAIRE

BLOOD PRESSURE QUESTIONNAIRE

Introduction

We are very grateful to you for your participation in this study. All information given by you will be held in strict confidence, and will be used for the purpose of this study only after removing any personal identifying information.

INSTRUCTIONS:

- The researcher will supply you with a participant number to enter.
- Please select the correct/most appropriate answer.
- Indicate your answer by marking the correct response.
- The questionnaire consists of five sections and 36 questions. Please complete all the sections and questions.
- It will take approximately 20 minutes of your time.
- Move through the questionnaire by clicking on the 'Next Page' button or the 'Previous Page' button.
- Please click on the 'Submit' button when you've completed the questionnaire.

Thank you for participating in this study.

BLOOD PRESSURE QUESTIONNAIRE

SECTION 1: DEMOGRAPHIC DETAIL

***1. Participant number:**

***2. Age:**

- ◯ 20-29
- ◯ 30-39
- ◯ 40-49
- ◯ 50-59
- ◯ 60-69
- ◯ Above 70

***3. Gender:**

- ◯ Female
- ◯ Male

***4. Highest Qualification:**

- ◯ Certificate
- ◯ Diploma
- ◯ Degree
- ◯ Post-Basic Qualification

***5. Hospital:**

- ◯ Parkmed Neuro clinic
- ◯ Sunningdale Hospital
- ◯ Wilmed Park Private Hospital

***6. Unit:**

- ◯ Day clinic
- ◯ Maternity
- ◯ Medical
- ◯ Oncology
- ◯ Orthopaedic
- ◯ Pediatric
- ◯ Psychiatric
- ◯ Surgical
- ◯ Urology

***7. How long have you been measuring blood pressure?**

- ◯ Less than 3 years
- ◯ 3 -6 years
- ◯ 7-10 years
- ◯ 11-14years
- ◯ More than 15 years

***8. Do you have any hearing problems?**

- ◯ Yes
- ◯ No

BLOOD PRESSURE QUESTIONNAIRE

***9. Have you had your hearing checked in the last 3 years?**

- ◯ Yes
- ◯ No

***10. Do you have any visual problems?**

- ◯ Yes
- ◯ No

***11. Have you had your eyes checked in the last 3 years?**

- ◯ Yes
- ◯ No

***12. Have you read the guide lines for blood pressure measurement recently?**

- ◯ Yes
- ◯ No

***13. When did you last receive training on blood pressure measurement technique?**

- ◯ Less than a year
- ◯ 1 year
- ◯ 2 years
- ◯ 3 years
- ◯ 4 years
- ◯ 5 years
- ◯ 6-10 years
- ◯ More than 10 years

BLOOD PRESSURE QUESTIONNAIRE

SECTION 2: BACKGROUND KNOWLEDGE

***14. Systolic pressure is:**

- ◯ Pressure during heart contraction
- ◯ Pressure during heart relaxation
- ◯ Average pressure during cardiac cycle
- ◯ Average arterial pressure

***15. Diastolic pressure is:**

- ◯ Pressure during heart contraction
- ◯ Pressure during heart relaxation
- ◯ Average pressure during cardiac cycle
- ◯ Average arterial pressure

***16. Which of the following factors will have an influence on blood pressure?**

- ◯ Full urinary bladder
- ◯ Coffee 30 minutes prior to BP reading
- ◯ Small cuff on a large arm
- ◯ All off the above

***17. Which arm should be used to measure BP?**

- ◯ Left arm
- ◯ Right arm
- ◯ Bilateral arms

***18. Do you record the specific arm when BP is charted?**

- ◯ Always
- ◯ Sometimes
- ◯ Never

***19. Are there any circumstances when it might be appropriate to measure the BP in both arms?**

- ◯ Yes
- ◯ No

***20. Do you expect the BP to be the same in both arms?**

- ◯ Yes
- ◯ No
- ◯ Don't know

***21. Have you heard about the term auscultatory gap before?**

- ◯ Yes
- ◯ No

BLOOD PRESSURE QUESTIONNAIRE

***22. Have you heard about the term Korotkoff sounds before?**

- ◯ Yes
- ◯ No

***23. What is an auscultatory gap?**

- ◯ A disrythmia
- ◯ Inability to hear the systolic pressure
- ◯ A disappearance of sound between systolic and diastolic pressure
- ◯ An arrhythmia

***24. Which Korotkoff sounds usually represent systolic and diastolic blood pressure?**

- ◯ III and IV
- ◯ III and V
- ◯ I and V
- ◯ I and II

BLOOD PRESSURE QUESTIONNAIRE

SECTION 3: MEASUREMENT TECHNIQUE

***25. For how long should a patient rest before BP measurement?**

- ◯ 5 minutes
- ◯ 2-1 minutes
- ◯ 3-4 minutes
- ◯ Unnecessary to rest

***26. Is the sphygmomanometer's mercury column mark in...**

- ◯ 1 mm
- ◯ 2 mm
- ◯ 5 mm increments?

***27. Do you record the diastolic BP when the sound becomes ...**

- ◯ muffled
- ◯ it disappears?

***28. What is the cuff deflation rate?**

- ◯ 2-3 mm per second
- ◯ 4-5 mm per second
- ◯ 1 mm per second

***29. How long should you wait in between two consecutive BP readings on the same individual?**

- ◯ 2 minutes
- ◯ 10 minutes
- ◯ 5 minutes
- ◯ No specific time between measurements required

BLOOD PRESSURE QUESTIONNAIRE

SECTION 4: CUFF SIZE AND ARM POSITION

***30. What should the position of the subject's arm be during BP measurement?**

- ◯ Under heart level
- ◯ Above heart level
- ◯ At heart level

***31. Should the arm be supported during measurement?**

- ◯ Yes, by the nurse
- ◯ Yes, by a surface
- ◯ Unsupported

***32. Should the elbow be slightly flexed or straight?**

- ◯ Slightly flexed
- ◯ Straight
- ◯ Don't know

***33. Do you access the subject's arm for cuff size before applying a cuff?**

- ◯ Always
- ◯ Sometimes
- ◯ Never

***34. What cuff size would cause the greatest error?**

- ◯ Narrow cuff
- ◯ Wide cuff
- ◯ Don't know

BLOOD PRESSURE QUESTIONNAIRE

SECTION 5: PALPATION TO IDENTIFY SYSTOLIC PRESSURE

***35. Do you palpate to identify the systolic pressure before using the stethoscope?**

- ◯ Never palpitated
- ◯ Sometimes
- ◯ Always

***36. What is the reason for identifying systolic pressure by palpation?**

- ◯ To get a more accurate reading
- ◯ To avoid over inflation
- ◯ To identify where to place the stethoscope
- ◯ Don't know

Thank you for participating in this study.

APPENDIX D: PERMISSION TO CONDUCT RESEARCH IN SELECTED HOSPITALS

NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT
POTCHEFSTROOM CAMPUS

Private Bag X6001, Potchefstroom
South Africa 2520

Tel: (018) 299-1111/2222
Web:http://www.nwu.ac.za

TO:

Tel: 018 299 1853
E-mail: Ronel.Pretorius@nwu.ac.za

6 September 2012

Dear Sir,

PERMISSION TO CONDUCT RESEARCH IN SELECTED HOSPITALS

Title of the study: Nurses' knowledge and skill of blood pressure measurement technique in a private hospital setting.

The focus of this research programme is on "Nurses' knowledge and skill of blood pressure measurement technique".

The objectives are as follows:

1. To determine nurses' skill in measuring blood pressure using a sphygmomanometer and auscultation by means of observation checklist in accordance with the European Society of Hypertension (ESH) guidelines.
2. To determine nurses' knowledge of blood pressure measurement technique using a questionnaire based on the ESH guidelines.
3. To determine if there is a relationship between the knowledge and skill and the values obtained by the ten best scored and ten lowest scored participants when compared with an invasive reading.

There is currently NO baseline data in South Africa with regard to the knowledge and skill of nurses' on blood pressure measurement technique. Findings of this study will contribute to clinical practice and the way in which current knowledge and skill of nurses is managed to ensure safe and high quality patient care. In order to reach the objectives set in the study we request permission to include both registered- and enrolled nurses in determining their level of knowledge and skill on blood pressure measurement technique.

For the last objective, we plan to include blood pressure values obtained from intra-arterial pressure recordings in critical care units. Intra-arterial blood pressure readings are considered most accurate and will prove valuable in determining the existence of a relationship between the mentioned study variables. Please note that we will not record any patient information and that our execution of the data collection for the final objective will be arranged with the unit manager of the critical care unit prior to the collection of the data. A comprehensive discussion of the procedures related to the collection of the data for objective 1-3 is included in the research proposal. We intend to publish the findings of the study in a professional journal and/or present the findings at conferences, symposia or other meetings of such a nature. We will at all times protect the identity of the hospitals and the research participants by assigning each a random code that will only be known to Dr. Ronel Pretorius (supervisor), Professor Hugo Huisman (co-supervisor) and Mrs H. du Toit (MCur student).

Kindly contact Dr. Ronel Pretorius or Mrs. Hanette du Toit should you wish any additional information.

Yours sincerely,

Dr. Ronel Pretorius
Study leader

Mrs. Hanette du Toit
MCur Student

Permission to conduct a research study at this Hospital group and access to information as requested is hereby approved

Name of Chief Executive Officer:

Name of Hospital group:

Signature:

APPENDIX E: ETHICAL CLEARANCE: NWU

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Ethics Committee
Tel +27 18 299 4850
Fax +27 18 293 5329
Email Ethics@nwu.ac.za

2012/06/01

ETHICS APPROVAL OF PROJECT

The North-West University Ethics Committee (NWU-EC) hereby approves your project as indicated below. This implies that the NWU-EC grants its permission that, provided the special conditions specified below are met and pending any other authorisation that may be necessary, the project may be initiated, using the ethics number below.

Project title : Research evidence to improve nursing practice in cardiovascular disease.

Project Leader: Dr. Ronel Pretorius

Ethics number: N W U - 0 0 0 2 8 - 1 2 - A 1
(Institution – Project Number – Year – Status)

Status: S = Submission; R = Re-Submission; P = Provisional Authorisation; A = Authorisation

Approval date: 2012/05/15 **Expiry date: 2017/05/14**

Special conditions of the approval (if any): None

General conditions:

While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, please note the following:

- *The project leader (principle investigator) must report in the prescribed format to the NWU-EC:*
  - *annually (or as otherwise requested) on the progress of the project,*
  - *without any delay in case of any adverse event (or any matter that interrupts sound ethical principles) during the course of the project.*
- *The approval applies strictly to the protocol as stipulated in the application form. Would any changes to the protocol be deemed necessary during the course of the project, the project leader must apply for approval of these changes at the NWU-EC. Would there be deviated from the project protocol without the necessary approval of such changes, the ethics approval is immediately and automatically forfeited.*
- *The date of approval indicates the first date that the project may be started. Would the project have to continue after the expiry date, a new application must be made to the NWU-EC and new approval received before or on the expiry date.*
- *In the interest of ethical responsibility the NWU-EC retains the right to:*
  - *request access to any information or data at any time during the course or after completion of the project;*
  - *withdraw or postpone approval if:*
    - *any unethical principles or practices of the project are revealed or suspected,*
    - *it becomes apparent that any relevant information was withheld from the NWU-EC or that information has been false or misrepresented,*
    - *the required annual report and reporting of adverse events was not done timely and accurately,*
    - *new institutional rules, national legislation or international conventions deem it necessary.*

The Ethics Committee would like to remain at your service as scientist and researcher, and wishes you well with your project. Please do not hesitate to contact the Ethics Committee for any further enquiries or requests for assistance.

Yours sincerely

Prof Amanda Lourens
(chair NWU Ethics Committee)