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Survey of Knowledge of Fifty Registered Professional Nurses Regarding Selected Factors of Indirect Blood Pressure Measurement

Audrey Gayle Krueger

LOMA LINDA UNIVERSITY

Graduate School

SURVEY OF KNOWLEDGE OF FIFTY REGISTERED PROFESSIONAL NURSES REGARDING SELECTED FACTORS OF INDIRECT BLOOD PRESSURE MEASUREMENT

by

Audrey Gayle Krueger

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Each person whose signature appears below certifies that he has read this thesis and that in his opinion it is adequate, in scope and quality, as a thesis for the degree of Master of Science.

Winifred M. Edwards, Chairman
Winifred M. Edwards, M.A., Associate Professor of Nursing

Frances L. Fickess
Frances L. Fickess, M.S., Assistant Professor of Nursing

Raymond B. Crawford MD
Raymond B. Crawford, M.D., Associate Professor of Medicine

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Audrey Krueger

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CHAPTER I

INTRODUCTION TO THE STUDY

The measurement of the blood pressure has become one of the three most universal procedures in medical and physiological practices, the other two being the recording of the body temperature and the heart rate or pulse.[1] Physiological research has often denoted blood pressure recordings as the most important contribution to the variability of the findings in the research. Blood pressure readings have also become an important criterion for both medical and nursing decisions regarding diagnosis and therapy. Despite the realization that wide variations of recordings on the same individual are due not only to actual changes in the pressure but also to differences in the methods and interpretations used, sphygmomanometry has continued to be one of the most valuable and practical procedures in medicine and has led to precision in that field.[2]

I. THE PROBLEM

Statement of the problem. This study was concerned with the problem of determining what knowledge registered professional nurses have regarding selected factors in the measurement of blood pressure as determined by the indirect method.

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[1]William Hall Lewis, "Procedures in Measurement of the Blood Pressure," The Practitioner, 184:243, February, 1960.

[2]"Standardization of Blood Pressure Readings," American Heart Journal, 18:95, July, 1939.

Importance of the study. A review of the literature has shown that the taking of blood pressures, which was formerly considered to be the doctor's province, has gradually become an accepted nursing function. However, there are those who sharply disagree with this idea. Gainsborough has stated that it is no part of a nurse's duty to measure the blood pressure of a patient except on specific medical request.[3] He further indicated that routine blood pressure measurements by a nurse were "unnecessary, officious, an unwarranted interference and often an ill-service to the patient and doctor."[4] This has been a harsh statement to nurses who have been taking blood pressure recordings for over thirty years.[5] He reasoned that an understanding of blood pressure involved a knowledge of physics and physiology on higher levels than that on which the nurse has been prepared. In addition, the patient's reaction to the procedure was unpredictable and the sources of error in estimation were considerable.[6] On the other hand, Middleton has stated that sphygmomanometry involves no mysterious or difficult technic; however, in accepting the responsibility of measuring blood pressures, the nursing profession has presupposed for its members a working knowledge of hemodynamics, particularly insofar as blood pressure might be

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[3]Hugh Gainsborough, "Taking the Blood Pressure," Nursing Times, 58:736, June 8, 1962.

[4]Ibid.

[5]Jane Wilcox, "Observer Factors in the Measurement of Blood Pressure," Nursing Research, 10:5, Winter, 1961.

[6]Gainsborough, loc. cit.

affected.[7]

The existence of discrepancies in submitted blood pressure readings on any one patient during a specified time allotment has strongly influenced decision making regarding diagnosis and treatment. If the indirect method of recording a blood pressure were not considered in proper perspective of the numerous variables that influence a reading, a patient could exhibit a variety of fluctuations. Therefore, a study such as this was needed to ascertain the degree of knowledge registered professional nurses have relative to the theories for obtaining an indirect blood pressure reading since they, among others, are frequent recorders of the human blood pressure.

Purpose of the study. It was the purpose of this study to (1) determine the concepts registered professional nurses held relative to selected factors that produced variations in the indirect measurement of blood pressure; (2) contribute to more effective methods of nursing education and hospital inservice; (3) provide better nursing service by application of knowledge gained from this study.

Hypothesis. There is a lack of knowledge among registered professional nurses concerning selected factors that influence an indirect method of recording a blood pressure.

Assumptions.

1. It was assumed that registered professional nurses had been

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[7]William S. Middleton, "Blood Pressure Determination: A Nursing Procedure," American Journal of Nursing, 30:1219, October, 1930.

taught to record an acceptable blood pressure, using an indirect method, during the course of their formal school instruction. It was realized and assumed that the method taught would vary from school to school.

2. It was assumed that what the registered professional nurses said he or she did when recording a blood pressure was reasonably comparably to what was actually done.

Limiting factors and scope.

1. The survey was confined to a selected group of fifty registered professional nurses.
2. Knowledge of the subject's understanding was assessed by statement only.
3. Only those nurses that were regularly employed in a hospital were studied.
4. Registered professional nurses 20 to 60 years of age were chosen for the study.
5. Instructors of clinical nursing were excluded because of an assumed increased amount of theoretical knowledge.

II. DEFINITIONS OF TERMS USED

For the purpose of this study the following definitions were used:

Blood pressure readings. The submitted figures representing systolic and diastolic pressures as expressed in millimeters of mercury recorded by the examiner after that examiner had determined the figure by observation of the patient's blood pressure using an indirect method.

The terms reading, recording, and measurement were used interchangeably throughout the text.

Indirect method. That method which utilized the external application of the sphygmomanometer and its cuff with or without the use of the stethoscope.

Direct method. That method of obtaining a blood pressure reading by placing a needle in the artery and connecting it to a manometer.

Registered professional nurse. Any individual who was a graduate of a planned program in nursing two to five academic years in length and had obtained licensure as a registered nurse in the state wherein he or she was practicing nursing.

Regularly employed. That nurse who gave nursing service for a minimum of forty hours per week, excluding holidays, vacations, and ill days.

Selected factors. Those components that have direct influence on the variability of blood pressure recordings; namely, cuff size, emotions and activities, obesity and thinness, position of the subject, inflation and deflation of cuff pressure, and site of measurement.

III. METHOD OF STUDY

The descriptive type of survey was used for this study. A selected random sampling of fifty registered professional nurses employed by White Memorial Hospital was used. An interview schedule was prepared

and utilized to assure uniformity in the collection of the data. A pilot study was conducted to aid in improvement of the interview schedule. A review of literature produced a background of information as well as served as a guide in selecting items to be included in the interview schedule.

IV. ORGANIZATION OF REMAINDER OF THE THESIS

The following chapters include (1) a review of the literature which deals with the history of the recording of a blood pressure, errors encountered in indirect measurement, and selected factors that contribute to variations in readings; (2) a discussion of materials used, group studied, and techniques employed; and (3) presentation of data with analysis and interpretation. Summary, conclusions and recommendations have formed the latter portion of the text, followed by a bibliography and appendix.

CHAPTER II

REVIEW OF THE LITERATURE

Much has been written in regard to the methods and instruments used in measuring blood pressure. Extensive material can be found applying to the errors of many of these methods. A brief summary of these two facets as well as the history of measurement devices and a discussion on selected factors that influence measurement will here be given.

I. HISTORY OF BLOOD PRESSURE MEASUREMENT

An original interest in blood began at the turn of the seventeenth century when William Harvey proved blood motion "was, as it were, in a circle."[1] This inauguration of interest was quelled for over one hundred years following the discovery of blood circulation.

The development of arterial blood pressure measurement was effected by the evolution of certain physiological concepts and the ingenuity of the construction of instruments. During 1733 in England, Stephan Hale directed an arterial puncture on animals and measured pressure by recording the height of the column of blood in a manometer tube.[2]

Nearly one hundred years later, Jean Poiseuille of France con-

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[1]"The Development of the Sphygmomanometer," The Medical Journal of Australia, 1:752, May 20, 1961.

[2]William Hall Lewis, "Procedures in Measurement of the Blood Pressure," The Practitioner, 184:243, February, 1960.

tributed to the technique of measurement when he reproduced Hale's method, but substituted a mercury tube for the hollow tubing of the previous trial.[3] This method suddenly incorporated convenience and made ready use of a small instrument.

From these early measurements of the blood pressure by direct cannulation of an arterial vessel, the practical application of an indirect method began to evolve. In 1855, Vierordt, a German subject, connected a manometer and Kymography over the artery and recorded the pressure required to obliterate artery pulsations. Von Basch introduced the use of pressure over the artery in 1881.[4] Up to this time the blood pressure measurement technic was too unreliable, complicated and clumsy for ordinary clinical use. The Italians, Riva and Rocci, in 1896, devised the first circular compression of an extremity by creating an inflatable pneumatic rubber cuff attached to a mercury manometer. A reading was obtained by observing pressure in the cuff when the radial pulse first became palpable on slow decompression.[5] Not until 1897 was a sphygmomanometer available for clinical use. Two Britishers, Hill and Barnard, developed a needle pressure gauge primarily for measuring diastolic pressure to supplement the Riva-Rocci apparatus.[6] From 1901 to 1904 the armband and accuracy of the methods

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[3] Ibid.

[4] Ibid., p. 244.

[5] Gerald R. Graham, "Measurement of Blood Pressure," British Journal of Anesthesia, 34:650, September, 1962.

[6] Lewis, loc. cit.

were sources of experimentation and improvement resulted in these two areas. Janeway and Erlanger were prominent in studies of human blood pressure.[7] The year 1905 proved to be remarkable in pressure measurement, for at that time the Russian physiologist, Korotkov (literature also spells it Korotkoff), exposed a series of sounds heard by auscultation.[8] The traditional division of these sounds are now generally referred to as the phases of Korotkov and are submitted in order as:

1. A sudden clear sound occurs when the blood passes through the narrow slit between the almost completely collapsed vessel. The sound may be due to a nozzle-swish action.
2. With further cuff pressure reduction, a murmuring quality is imparted to the first sounds and occurs when the vessel opens and closes quickly. This may be due to the stretching of the walls, abrupt closure of the vessel, or an alteration in the flow of blood through the vessel, and sudden separation and joining of the column of blood.
3. The sound becomes marked by a second clear quality, the physiology being the same as phase one.
4. A blurring of the second clear sound occurs when the vessel is not completely closed, but is partially collapsed and partially distended. The muffled sound may be associated with disturbing effects of this partial obliteration of the

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[7] Ibid., p. 245.

[8] Jane Wilcox, "Observer Factors in the Measurement of Blood Pressure," Nursing Research, 10:5, Winter, 1961.

blood flow through the vessel.

5. A complete disappearance of all sound finally results.[9]

Forssmann of Germany revealed an era of medical intelligence when in 1929 he made direct catheterization into the human heart via the brachial vein.[10] The premier of the United States' contribution came in 1941 when Richards and Cournand placed an indwelling catheter through an arm vein into the right side of the human heart. This introduced direct recording devices that could be maintained for periods of time under varied conditions.[11]

Clinical sphygmomanometry became a simplified, practical procedure by the association of three procedures: (1) external compression by von Basch; (2) mensuration by manometer cleverly designed by Riva and Rocci; and (3) auscultation of sounds to indicate systolic and diastolic changes of blood flow in an artery by Korotkov.[12]

II. DISCUSSION OF METHODS OF MEASUREMENT IN CURRENT USE

The indirect methods of obtaining a blood pressure recording are diverse and varied. Arterial pressures cannot be measured with precision

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[9]Clyde Brooks and Arno B. Luckhardt, "The Chief Physical Mechanisms Concerned in Clinical Methods of Measuring Blood Pressure," The American Journal of Physiology, 40:73-74, March 1, 1916; Charles D. Enselberg and Hunter Heath, "Pitfalls and Aids in the Clinical Measurement of Blood Pressure," Medical Times, 90:280, March, 1962.

[10]Lewis, loc. cit.

[11]Ibid.

[12]Ibid., p. 243.

by means of sphygmomanometers when compared to the pressure reading received from direct cannulation of the vessel.[13] Hamilton, Woodbury and Harper's comparative study of intra-arterial pressure and indirect pressure methods revealed that the indirect method is 3-4 mm of mercury too low in evaluating the brachial systolic pressure and 9 mm of mercury too high for the diastolic pressure.[14] Yet the clinical indirect measurement continues to be one of the most valuable procedures in medicine and has led to a greater degree of accuracy and improvement.[15]

Auscultatory method. The indirect method derived from the work of Riva and Rocci in 1896 has been essentially unaltered to the present day, but has been complemented, if not replaced, by the auscultatory method. This method involves listening for sounds through a stethoscope placed over a compressed artery while the sphygmomanometer cuff is slowly deflated.

From a 1938 survey presented by Wright, Schneider, and Ungerleider, the need for a universal standardization of the methods used in blood pressure measurement was emphasized.[16] Requests from perplexed medical personnel for a standardization also became known so that in

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[13]James Bordley, et al., "Recommendations for Human Blood Pressure Determinations by Sphygmomanometers," Circulation, 4:503, October, 1951.

[14]W. F. Hamilton, R. A. Woodbury, and H. T. Harper, "Physiologic Relationships Between Intrathoracic, Intraspinal and Arterial Pressures," Journal of the American Medical Association, 107:853, September 12, 1936.

[15]Lewis, op. cit., p. 245.

[16]Irvin S. Wright, et al., "Factors of Error in Blood Pressure Readings: A Survey of Methods of Teaching and Interpretation," The American Heart Journal, 16:469, October, 1938.

1939, the American Heart Association and the Cardiac Society of Great Britain and Ireland jointly recommended blood pressure recording technic as:

1. The blood pressure equipment, whether mercurial or aneroid, is to be in good condition and calibrated yearly.
2. The patient should be comfortably seated or lying with arms slightly flexed and the entire forearm supported at the heart level on a smooth surface. If any other position is used a notation should be made. Allow enough recovery time from exercise or excitement. There should be no arm constriction by clothing, etc.
3. In the position and method of the application of the cuff, a standard sized cuff containing a rubber bag 12-13 cm in width should be used. The completely deflated cuff is applied snugly and evenly with the lower edge one inch above the antecubital space and the rubber bag over the inner aspect of the arm.
4. Palpation should be used as a check on the auscultatory readings. The pressure in the cuff is quickly increased in steps of 10 mm of mercury until the radial pulse disappears and then allowed to fall rapidly. If the radial pulse returns at higher levels than at which the first sound is heard, accept the palpatory reading; otherwise the auscultatory.
5. The sphygmomanometer should rest on a level surface and on a level of the observer's eyes, for tilting may result in

incorrect reading. The level of mercury in the manometer should be exactly at the zero mark. The small air vent at the top of the glass tubing should not be clogged to prevent an incorrect reading.

6. The position and method of application of the stethoscope is to be placed over the previously palpated brachial artery in the antecubital space, not in contact with the cuff. There should be no opening between the lip of the stethoscope and the skin; use minimal pressure only. The hand of the subject is pronated or supinated, depending which position yields the clearest brachial pulse sounds.
7. To determine the systolic pressure, the cuff should be rapidly inflated about 30 mm above the level at which the radial pulse is palpated. The cuff then is to be deflated 2-3 mm of mercury per second. The level at which the first sound regularly appears (first Korotkov stage) should be considered the systolic unless palpatory levels indicate higher. If so, note this.
8. The determination of the diastolic pressure and the pulse pressure is accomplished with continued deflation of the cuff. The point at which the sounds suddenly become dull and muffled (fourth Korotkov phase) are noted as the diastolic. If there is a difference between that point and the level at which the sounds completely disappear, the latter reading is to be regarded also; e.g., 140/80-70. If the levels are identical, the blood pressure is to be recorded as 140/70-70.

The cuff should be completely deflated before any further determinations are made.[17]

In 1951 the above mentioned committee changed their recommendation regarding the diastolic reading to state that it should be read at the point of complete disappearance of sound rather than a muffling because at this point detection was easier and conformed more closely to the true diastolic pressure as determined by a direct measurement.[18]

The auscultatory method of indirect blood pressure measurement as originally devised by Korotkov in 1905 is meant to record the cuff pressures at which the artery just closes at the lowest point of the pulse wave. The sound is produced because the flow in the artery peripheral to the cuff is intermittent and turbulent.[19]

Palpatory method. The palpatory method of blood pressure measurement involves palpation of an occluded artery while a sphygmomanometer cuff is being deflated. A peculiar tactile sensation becomes evident as the pressure is gradually lowered in the manometer. The systolic reading is determined at the first pulse sensations. Authorities disagree on the artery to be palpated. Middleton advocates the radial

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[17]"Standard Method for Taking and Recording Blood Pressure Readings," Journal of the American Medical Association, 113:295-297, July 22, 1939.

[18]American Heart Association, Committee to Revise Standardization of Blood Pressure Readings, "Recommendations for Human Blood Pressure Determinations by Sphygmomanometers," Journal of the American Medical Association, 147:632-636, October 13, 1951.

[19]Martti J. Karvonen, "Effect of Sphygmomanometer Cuff Size on Blood Pressure Measurement," Bulletin of the World Health Organization, 27:805, 1962.

artery[20] while Enselberg recommends the brachial.[21] Enselberg and Heath have felt that if an artery is palpated at a distance from the compressing cuff, as the radial artery, the examiner is "unable to perceive the snap or whip" of the pulse beat.[22] The majority of authorities indicate that the systolic reading can only be recorded by this method; the diastolic level being too difficult to perceive.[23] During the 1951 revision the American Heart Association Committee appointed to standardize readings recommended that

> A patient's radial pulse should be palpated and its rate and regularity estimated and recorded. . . . The return of palpable beats (after the cuff has been compressed to eliminate the beat and then slowly released so the pressure in the manometer falls 2-3 mm of mercury per heart beat) at the normal rate of the heart should be noted as a preliminary estimate of systolic pressure. The cuff should be rapidly and completely deflated before further determinations are made.[24]

Comparison of auscultatory to palpatory method. Many investigators recommend a combination of the auscultatory and palpatory method. The familiar recommendation is that the artery be palpated first to locate its proper position then maintained during the auscultatory pro-

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[20]William S. Middleton, "Blood Pressure Determination: A Nursing Procedure," American Journal of Nursing, 30:1222, October, 1931.

[21]Charles D. Enselberg, "Measurement of Diastolic Blood Pressure by Palpation," The New England Journal of Medicine, 265:272, August 10, 1961.

[22]Enselberg and Heath, op. cit., p. 283.

[23]Mary A. MacRostie, "Pointers on Taking Blood Pressure," RN, 20: 113, January, 1957; Middleton, loc. cit.; G. C. Steel, "Blood Pressure. Is Repeated Post-operative Observation Necessary?" Nursing Times, 53: 1471, December 27, 1957.

[24]Bordley, op. cit., p. 504.

cedure to serve as a check. It is reasoned that if the artery has not been previously palpated, (1) the cuff may not exert enough pressure to occlude the blood flow through the artery and the first true systolic sounds may be missed; or (2) the cuff may exert so much pressure that the observer may have an unexpectedly long wait with his attention being diverted or may mistake an extraneous sound for the systolic sound.[25]

Both Phipps and Bordley have stated that a difference exists between the palpatory and auscultatory methods. Bordley has claimed the auscultatory method to be higher than the pressure at which the radial pulse beats are first palpable.[26] Phipps has said that this difference may be as high as five or ten mm of mercury.[27]

> When auscultatory methods alone are used, the actual blood pressure level may be definitely higher than the level at which the first sounds are detected. Under these circumstances, the palpatory reading will be the more nearly correct of the two. If both palpatory and auscultatory methods are used, as recommended, this error will be detected.[28]

Additional methods. Follett designed a new apparatus to produce results comparable with those measured by a clinical sphygmomanometer. This machine utilizes the filtering action of the ear during auscultation, which is not equally sensitive to all sound frequencies.[29]

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[25]"Pointers On Measuring Blood Pressure," RN, 25:78-80, May, 1962.

[26]Bordley, loc. cit.

[27]Cadis Phipps, "Blood Pressure," Boston Medical and Surgical Journal, 173:478, September 23, 1915.

[28]"Standard Method for Taking and Recording Blood Pressure Readings," op. cit., p. 99.

[29]D. H. Follett, et al., "An Apparatus for the Automatic Recording of Systolic and Diastolic Blood Pressure," The Lancet, 1:808, April 13, 1963.

Gainsborough preferred the aneroid type of instrument, incorporating air to fluctuate the needle on the gauge instead of reading mercury climbing a tube; thus he claimed this allowed the observer more freedom to view the patient.[30]

King conducted research into the use of a "Servo unit" to eliminate a rate of change in pressure when inflating or deflating a pressure cuff. His conclusions were (1) deflation of the cuff should be as slow as possible as the end points of the sound were heard; (2) the rate of deflation and inflation at any other time other than at the end points (being the systolic and diastolic levels) had no significant effect on the observed blood pressure; and (3) the cuff pressure was not to be held between the systolic and diastolic pressure levels for longer than was necessary since this may induce venous congestion distal to the cuff causing attenuation of the Korotkov sounds.[31]

III. COMMON ERRORS ENCOUNTERED IN INDIRECT MEASUREMENT OF BLOOD PRESSURE

The recording of a blood pressure with a mercury manometer can be subjected to variation from two main sources, (1) the individual observer error, and (2) changes due to the time sequence when repeated observations are recorded in a particular subject.[32] Human blood pres-

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[30]Hugh Gainsborough, "Taking the Blood Pressure," Nursing Times, 58:737, June 8, 1962.

[31]Geoffrey E. King, "Influence of Rate of Cuff Inflation and Deflation on Observed Blood Pressure by Sphygmomanometry," American Heart Journal, 65:306, March, 1963.

[32]W. F. Anderson and N. R. Cowan, "Observer Error In Recording Arterial Blood Pressure," British Heart Journal, 23:169, March, 1961.

sure responds readily to both internal physiological conditions and to external stimuli.[33]

Shock and Ogden concluded that significant differences in the variability of determination existed among different observers.[34] These differences were 1.2-1.8 mm of mercury for systolic and 1.8-2.0 mm of mercury for diastolic.[35] Other investigators have stated that this clinical difference in readings in normal persons can be as high as ± 8 mm of mercury.[36]

In an investigation of observer factors in blood pressure measurement by graduate nurses, Wilcox found that:

1. When using a stethoscope, the inter-observer (two or more persons measuring the pressure simultaneously) variability was random rather than systematic.
2. When reading blood pressure from a sound motion picture, the graduate nurses showed little difference between phase four and five of Korotkov's sounds.
3. No relationship between inter-observer variability and certain characteristics of the nurses that had been thought to be of possible significance was found. These characteristics were not identified.

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[33]Wilcox, op. cit., p. 4.

[34]Nathan W. Shock and Eric Ogden, "The Probable Error of Blood Pressure Measurements," Quarterly Journal of Experimental Physiology, 29:61-62, March, 1939.

[35]Ibid.

[36]Bordley, op. cit., p. 503.

4. No relationship of factors, e.g., age, presence or absence of visual or hearing defects, recency of experience in measuring blood pressure, kind of nursing position, and field of nursing, to the amount of variability among nurses in measuring blood pressure was found.[37]

She implied that graduate nurses measured blood pressure that yielded a considerable degree of inter-observer variability, particularly when concerned with the diastolic level. Her observations also led to the impression that the measurement of the blood pressure was performed in a mechanical way by the nurses. They concentrated on securing two numbers with little or no concern to the character of the sounds to which they were listening. For comparison, a selected sample of physicians were examined. A tentative conclusion was that less inter-observer variability was discovered among the physicians. They generally commented on the quality of the sounds, the characteristics of the various phases, and the rate and rhythm of the heart beat; they related what they were hearing to a possible diagnosis and clinical status of the subject.[38]

According to Enselberg and Heath, common errors encountered when recording the systolic level are (1) a low intensity of the first sounds below the threshold of audibility caused misinterpretation; (2) cardiac arrhythmias have caused atrial fibrillation and premature systoles; and

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[37]Wilcox, op. cit., p. 16.

[38]Ibid., pp. 16-17.

(3) the observer may become confused with the mingling of the Korotkov sounds with respirations. The sounds appear during expiration and disappear during inspiration.[39] They have stated the errors commonly associated with diastolic measurement as (1) the fourth Korotkov phase cannot always be heard; (2) or if the sounds are adequate, the transition of the phases is so gradual that the observer is unable to decide the diastolic reading; (3) the brisk sounds may persist to zero pressure with no muffling or termination; and (4) the sound diminishes so gradually that the point of disappearance cannot be determined.[40]

IV. SELECTED FACTORS THAT INFLUENCE BLOOD PRESSURE READINGS

Cuff width. Graham has stated concerning cuff width that

> The accuracy of the values obtained with the sphygmomanometer depends on the correct width of the cuff in relation to the size of the arm (or leg) which it surrounds. The pressure in the cuff is transmitted to the greatest depth at its centre. . . . If the cuff is too narrow, the pressure within the artery will be significantly less than that recorded from the cuff (i.e., pressure required to occlude the artery must be higher than that existing in the artery); the diastolic and systolic pressures will thus be read too high.[41]

Karvonen, Telivuo, and Jarvinen have agreed that too narrow a cuff gives erroneously high values due to an incomplete compression of

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[39]Charles D. Enselberg and Hunter Heath, "Pitfalls and Aids in the Clinical Measurement of Blood Pressure," Medical Times, 90:280-281, March, 1962.

[40]Ibid., pp. 281-282.

[41]Gerald R. Graham, "Measurement of Blood Pressure," British Journal of Anesthesia, 34:650, September, 1962.

the soft tissues against the underlying bone.[42] Karvonen has added that an increase in cuff width does not generally lead to too low readings in adults.[43] Ragan's graphic study comparing an intra-arterial and auscultatory method demonstrated that a pneumatic cuff 20 cm wide would frequently yield lower readings for both systolic and diastolic pressures than those obtained with a 13 cm cuff.[44]

Robinow has said that "proper width of the cuff increases with the circumference and with the length of the arm and probably decreases with its compressibility."[45] The American Heart Association Committee has recommended that the cuff should be approximately twenty percent wider than the diameter of the extremity on which it is to be used.[46] They have suggested for adult thighs a cuff of 18 cm; adult arms - 12 cm; child under eight - 8-9 cm; child under four - 5-6 cm; child under one--2.5 cm or less.[47] Middleton has suggested that the cuff be at

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[42]Martti J. Karvonen, Leo J. Telivuo, and Erkki J. K. Jarvinen, "Sphygmomanometer Cuff Size and the Accuracy of Indirect Measurement of Blood Pressure," The American Journal of Cardiology, 13:688, May, 1964.

[43]Martti J. Karvonen, "Effect of Sphygmomanometer Cuff Size on Blood Pressure Measurement," Bulletin of the World Health Organization, 27:805, 1962.

[44]Charles Ragan and James Bordley, III, "The Accuracy of Clinical Measurements of Arterial Blood Pressure, With a Note on the Auscultatory Gap," Bulletin of the Johns Hopkins Hospital, 69:504, October, 1941.

[45]M. Robinow, et al., "Accuracy of Clinical Determinations of Blood Pressure in Children," American Journal of Diseases of Children, 58:117, July, 1939.

[46]James Bordley, et al., "Recommendations for Human Blood Pressure Determinations by Sphygmomanometers," Circulation, 4:503, October, 1951.

[47]Ibid.

least 10 cm in width.[48] To most authorities 10 cm is an extremely minimal recommendation. Erlanger (1904), Muller and Blauel (1907), Day (1939), Orma and Karvonen (1961) have studied the effect of various cuff widths on readings. They have shown that increasing the cuff width beyond 12-13 cm has practically no influence on either systolic or diastolic readings in adults.[49] The World Health Organization has recommended a 14 cm wide cuff as preferable.[50]

Kotte has shown that the femoral systolic blood pressure cannot be measured accurately with a 13 cm cuff. He suggests a cuff width of 15.5 cm will produce greater accuracy.[51]

Considering the cuff length, Karvonen has felt that it should be long enough to encircle the arm or leg otherwise a portion of the cuff may balloon out when inflated and lead to grossly erroneous readings.[52] The American Heart Association states that "a length of bag sufficient to half-encircle a limb is adequate provided care is taken by the operator to place it on the side of the compressible artery.[53]

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[48]Middleton, op. cit., p. 1220.

[49]Karvonen, loc. cit.

[50]Ibid.

[51]J. Harold Kotte, Arnold Iglauer, and Johnson McGuire, "Measurements of Arterial Blood Pressure in the Arm and Leg: Comparison of Sphygmomanometric and Direct Intra-Arterial Pressures, With Special Attention to Their Relationship in Aortic Regurgitation," American Heart Journal, 28:489, October, 1944.

[52]Karvonen, op. cit., pp. 806-807.

[53]Bordley, op. cit., pp. 503-504.

Emotions and activities. Blood pressure takes wide swings numerous times a day to meet the body's demands at the moment. Physiologically speaking, the blood pressure is influenced by several factors: (1) blood volume and viscosity; (2) peripheral resistance; and (3) the force of heart contraction, the volume output per stroke, and its rate as a source of energy.[54] Emotions, expressed or repressed, directly affect the heart rate and in turn, the blood pressure.[55] In times of great emotional stress as fear, excitement or anger, the pressure may rise fifty percent, then return to its normal level with emotional reduction.[56] Robinow has found that blood pressure is slightly increased by moderate excitement.[57] The American Heart Association has stated that the first reading taken by a physician is often much higher than later ones, due to apprehension and nervousness on the part of the patient.[58]

Physical exertion generally induces an increase in systolic pressure.[59] Arterial systolic pressure characteristically remains elevated during the period of exercise, and "if a drop in arterial pressure

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[54]William S. Middleton, "Blood Pressure Determination: A Nursing Procedure," American Journal of Nursing, 30:1219-1220, October, 1930.

[55]Robert F. Rushmer, Cardiovascular Dynamics (Philadelphia: W. B. Saunders Company, 1961), pp. 57, 155.

[56]J. D. Ratcliff, "The Blood Pressure and What It Tells Your Doctor," Today's Health, 34:26-27, June, 1956.

[57]Robinow, op. cit., p. 118.

[58]"Standard Method for Taking and Recording Blood Pressure Readings," Journal of the American Medical Association, 113:98, July 22, 1939.

[59]Rushmer, op. cit., p. 155.

occurs at all, it is so transient at the beginning of exertion that it cannot be consistently demonstrated in man or experimental animals."[60]

Ratcliff has said that blood pressure rises at mealtime, falls when sleepy; it is lower in the morning before activity is begun, drops when taking warm baths; climbs with strenuous exercise, and falls when reading a diverting book.[61]

Gainsborough feels that "generally speaking, the diastolic pressure reading is the more valuable as it is less easily disturbed by the emotional condition of the patient, the systolic pressure is more subject to . . . apprehensions of the patient . . . ."[62]

Obesity versus thinness. A correlation between arm circumference and indirect blood pressure readings may depend on (1) the frequent real occurrence of elevated intra-arterial pressures in the obese; and (2) a technical error introduced by the cuff.[63] Trout, Bertrand, and Williams',[64] also Ragan and Bordley's[65] studies indicated that falsely high readings could be obtained in individuals with obese arms. The error could exceed normal for that individual as much as 30 mm of mercury.[66]

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[60] Ibid., p. 194.

[61] Ratcliff, loc. cit.

[62] Gainsborough, op. cit., p. 736.

[63] Karvonen, op. cit., p. 808.

[64] Kenneth W. Trout, Charles A. Bertrand, and M. Henry Williams, "Measurement of Blood Pressure In Obese Persons," Journal of the American Medical Association, 162:971, November 3, 1956.

[65] Ragan, op. cit., p. 526.

[66] Ibid.

When investigating measurements of the obese patient, Berliner found that eight out of ten systolic and nine out of ten diastolic levels were overestimated.[67] It is to be noted, however, that these falsely high readings in the extremely obese as caused by the large size of the arm do not regularly cause hypertension but may be an indication of incorrect measurement.[68] It is now widely accepted by many authorities that readings interpreted as indicating arterial hypertension are more common among the obese than among the lean and may be due to the exerted cuff pressure being dissipated in compressing the excess tissue rather than in compressing the artery.[69]

Misinformation can be obtained also in subjects with unusually small arms.[70] The error may exceed as much as 30 mm of mercury below the clinical normal.[71]

Position of the subject. Authorities advise many varied positions of the subject when measuring the blood pressure. The American Heart Association has proposed the following position:

1. The subject is either recumbent or comfortably seated.
2. He is placed at ease with time allowed for recovery from unusual recent exercise, meals, or apprehension.

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[67]Kurt Berliner, et al., "Blood Pressure Measurements in Obese Persons. Comparison of Intra-arterial and Auscultatory Measurements," The American Journal of Cardiology, 8:16, July, 1961.

[68]Ibid.

[69]"Pointers On Measuring Blood Pressure," RN, 25:76, May, 1962.

[70]Ragan, loc. cit.

[71]Ibid.

3. The arm is bared, slightly flexed, abducted and perfectly relaxed.
4. If sitting, the arm is supported at the heart level on a smooth surface.
5. The hand is pronated or supinated, depending which position is found to yield the clearest sounds.
6. The deflated bag and cuff is applied evenly and snugly around the upper arm with its lower edge about one inch above the antecubital space.[72]

Gainsborough essentially agrees with this recommendation.[73]

A standing position may be utilized with the auscultatory method, but frequently the Korotkov sounds become very indistinct.[74] "Such impairment of sounds seems to be referable to venous congestion distal to the cuff of the sphygmomanometer."[75] This congestion will lower the level at which the sounds appear and cause them to drop out when the cuff pressure is between the systolic and diastolic.[76] This elimination of sound is referred to as the auscultatory gap.[77]

The auscultatory gap can be reduced or eliminated by avoiding

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[72]Bordley, op. cit., p. 504.

[73]Hugh Gainsborough, "Taking the Blood Pressure," Nursing Times, 58:737, June 8, 1962.

[74]M. R. Berry, "The Mechanism and Prevention of Impairment of Auscultatory Sounds During Determination of Blood Pressure of Standing Patients," Proc. Staff Meeting, Mayo Clinic, 15:699, 1940.

[75]Ibid.

[76]Bordley, op. cit., p. 504.

[77]Ibid.

venous stasis, e.g., keeping the arm at the heart level or raising it to promote drainage, avoiding pendant arms and constricting clothing, decompressing cuff pressure 2-3 mm per second or faster, and inflating the cuff rapidly upon gaining initial pressure.[78] Other aids in prevention of this venous congestion is to inflate the pressure cuff no longer than necessary and after reading, reducing the pressure to zero to allow the veins to empty before another determination is started.[79]

Inflation and deflation of cuff pressure. The technique of inflating and deflating the blood pressure cuff is subjected to wide variations among the authorities. Wilkens and Bradley's study showed that when the cuff was inflated to pressures between the systolic and diastolic levels and maintained, the cuff isolated the distal circulatory system intermittently and caused an elevation of diastolic pressure peripheral to the cuff.[80] Observations from this study seemed to stress the importance of not maintaining a rising and falling cuff pressure in this zone for too long a period in routine determinations of blood pressure.[81] Bazett and Laplace showed that inflation could produce other changes in blood pressure because of mechanical obstruction of a large

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[78]Berry, loc. cit.; Enselberg and Heath, op. cit., p. 283; Ragan, op. cit., pp. 526-527.

[79]"Standard Method for Taking and Recording Blood Pressure Readings," op. cit., p. 100.

[80]Robert W. Wilkens and Stanley E. Bradley, "Changes in Arterial and Venous Blood Pressure and Flow Distal to a Cuff Inflated on the Human Arm," American Journal of Physiology, 147:268, October, 1946.

[81]Ibid.

area and reflex adjustments to this obstruction.[82] This change would rarely exceed 5-10 mm of mercury.[83]

If pressure deflation is rapid, profound local changes may occur in the pressures in the vessels previously compressed.[84] Bazett and Laplace have indicated that the lateral systolic and diastolic pressures become reduced, probably because the pressure energy is absorbed into the empty vessels below the cuff. Therefore all indirect measurements are too low, unless deflation is conducted slowly. A rate of 2-3 mm of mercury per second is recommended.[85]

Consecutive inflation and deflation of the cuff pressure can slightly transform a reading. If a second observation of the blood pressure follows successively, a difference of 0-3 mm of mercury for systolic and up to 5 mm of mercury for diastolic may result.[86]

Site of measurement. Phipps has revealed that blood pressure in the vessels of the leg and arm is not "practically the same in normal individuals."[87] His study showed that the pressure was not uniform in

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[82] H. C. Bazett and L. B. Laplace, "Studies on the Indirect Measurement of Blood Pressure. I. Sources of Error in the Riva Rocci Method," American Journal of Physiology, 103:66, January, 1933.

[83] Ibid.

[84] Ibid.

[85] Ibid.

[86] W. F. Anderson and N. R. Cowan, "Observer Error in Recording Arterial Blood Pressure," British Heart Journal, 23:172, March, 1961.

[87] Cadis Phipps, "Blood Pressure," Boston Medical and Surgical Journal, 173:478, September 23, 1915.

a subject's arm, thigh and calf on the same side.[88] A study of intra-arterial measurements concluded that in normal persons, the systolic pressure in the thigh could be 10-40 mm of mercury higher than in the arm, but the diastolic pressure was essentially the same.[89]

V. SUMMARY

Since the beginning of arterial blood pressure measurement in 1733, three important contributions have resulted from extensive research that have made blood pressure measurement a practical procedure for clinical use. von Basch perfected external compression which eliminated direct assault on a vessel; Riva and Rocci developed the manometer to measure pressure; and Korotkov described five distinct phases to indicate systolic and diastolic changes.

Many methods of indirectly measuring the arterial pressure are in current use. Two of the most common are the auscultatory method which involves listening for sounds through a stethoscope placed over a compressed artery while a sphygmomanometer cuff is slowly deflated, and the palpatory method where the reading is obtained by palpation of an occluded artery while the sphygmomanometer cuff is again slowly deflated. Since a diastolic level cannot be obtained from palpation, it is recommended that both the auscultatory and palpatory method be used simultaneously to serve as checks on one another.

The observer is not without error when measuring the blood

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[88] Ibid.

[89] Bordley, op. cit., p. 506.

pressure. The errors in reading usually result because the observer does not hear the sounds or he becomes distracted by environmental noises. In addition, difficulty is encountered in distinguishing Korotkov's phases and therefore results in inaccuracy.

Indirect blood pressure measurement is influenced by many factors. Six have been chosen for investigation.

A cuff width above or below 12-15 cm for an average adult arm will yield an inaccurate reading. A cuff less than 12 cm will give an erroneously high reading. A cuff more than 15 cm may or may not lower the actual reading. An 18 cm cuff should be used for the thigh.

Blood pressure readings will become elevated when the human body is confronted with sudden emotions as fear, anger or excitement. It usually decreases during nonstimulating activities as sleep and reading.

Contrary to popular thought, all obese individuals exhibiting high pressure readings do not necessarily have hypertension; the elevated readings could be obtained by incorrect measurement. Excessive tissue at the site of measurement can dissipate the cuff pressure abnormally and influence the reading. This is also true in those subjects with unusually small arms; too little tissue may increase the reading.

It is recommended that the subject be lying down or comfortably seated when the measurement is undertaken. If sitting, his arm should be supported at the heart level on a smooth surface. A standing position may produce an auscultatory gap because venous congestion is promoted. This will make the sounds indistinct.

If cuff pressure is maintained against an occluded artery, the diastolic reading is elevated. When deflation is more rapid than 2-3 mm

of mercury per second, local changes may occur in the vessels and influence the reading. Consecutive inflation and deflation can also transform the measurement.

Blood pressure of the legs and arms in the same individual are usually not the same when measured indirectly. The systolic pressure of the thigh may be as much as 10-40 mm of mercury higher. Pressures within the two arms of the subject may also show variance.

Investigation of registered professional nurses' knowledge concerning these factors was the subject of this study.

CHAPTER III

METHOD OF STUDY

This study was concerned with ascertaining the knowledge registered professional nurses have regarding selected areas of indirect blood pressure measurement. The purpose of this chapter is to give a description of the methodology utilized, development of the evaluating instrument, sampling method instituted and procedure for collection of the data.

I. METHOD SELECTED

The method chosen for this study was the descriptive-survey type. Description, as defined by Good and Scates, "includes induction, analysis, classification, enumeration, measurement and evaluation. The word survey indicates the gathering of data regarding current conditions."[1] This method is useful "wherever the objects of any class vary among themselves and one is interested in knowing the extent to which different conditions obtain among these objects."[2]

A degree of variance is existent between two individuals. It had been hypothesized that there was a lack of knowledge about the indirect measurement of blood pressure among registered professional nurses. This research was directed toward determining the variance of concepts

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[1]Carter V. Good and Douglas E. Scates, Methods of Research (New York: Appleton-Century-Crofts, Inc., 1954), p. 549.

[2]Ibid.

the nurses had regarding selected factors in pressure measurement.

II. DEVELOPMENT OF THE TOOL

Tool selected. An interviewing technique was used because the investigator felt more accurate information could be obtained from the nurse in contrast to the written or checked answers received from a questionnaire. The interviewer can seek clarification of inconsistencies, expand inadequate data by amplification of information gained, and ask the interviewee about his meaning to clear ambiguities.[3]

Through interviewing the nurse was allowed free expression of her concepts and methods without the influence of suggesting responses on a check list. The element of guessing was minimized.

Tool development. To standardize the interview, an interview schedule[4] was formulated using the background knowledge gained from a review of the nursing and medical literature, contact with specialists in the field and the investigator's experience. A variety of thirty-two open-ended and yes-no response questions were designed.

The questions were grouped into general and selected areas although such references were not used on the schedule proper. It was felt that utilizing additional space and words on the schedule would be a source of threat to the respondent. The questions were grouped in relation to:

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[3]Stephan A. Richardson, Barbara Snell Dohrenwend, and David Klein, Interviewing: Its Forms and Functions (New York: Basic Books Inc., 1965), p. 20.

[4]See Appendix A.

1. Interviewee qualifications and characteristics
2. General considerations
3. Cuff width
4. Emotions and activities
5. Obesity and thinness
6. Position of the subject
7. Inflation and deflation of cuff pressure
8. Site of measurement

All of the questions comprising any one selected factor were placed in a united section. The general consideration questions were scattered between the selected factor categories. The interviewee qualifications and characteristics were placed at the beginning and ending of the interview schedule to minimize personal interviewee threat.

Tool refinement. After designment, the interview schedule was tested on four regularly employed registered professional nurses to acquaint the researcher with its administration, to determine the length of time involved in an interviewing session, and for refinement of the questions as to clarity, meaning conveyed, and sequence.

Following this pilot study, necessary changes were made on the schedule. It was further evaluated when a fifth registered professional nurse was interviewed using the revised tool.

The data collected in the pilot studies were not used in the final study.

III. SAMPLING METHOD

Selection of facilities. A total of fifty regularly employed registered professional nurses from a general hospital participated in the study. A general hospital was selected for its variety of areas and nursing opportunities at securing indirect blood pressure readings. It was also chosen for its cosmopolitan employment of nurses from various geographical communities and types of nursing schools.

Permission for conduction of the interviews was obtained from the director of nursing service by written and personal contact. The researcher verbally notified the supervisors of each of the hospital areas she visited.

Selection of the respondents. Any regularly employed registered professional nurse working for the hospital was eligible for interviewing. However, nursing supervisors and administrators were eliminated due to their assumed advanced preparation and indirect patient contact.

All interviewees were randomly selected by the investigator. In part, suggestions from supervisors and the respondents were acted upon if the situation permitted. A variety of nurses employed on day, evening and night shifts was attempted; the majority being selected from the day or evening tours of duty due to their greater numbers and convenient accessibility.

Before the interview began, identification as to registration and regular employment of the respondent was established from the supervisor, head nurse or interviewee. Each nurse was questioned at a time convenient with her work schedule and while she was on duty. Little

attempt was made at meeting those nurses missed or off duty.

IV. COLLECTION OF THE DATA

Identification of researcher and environment. Each prospective respondent was approached by the researcher stating her name, position, activity and purpose of the study. Consent to be interviewed was gained from each interviewee. An attempt to conduct the interview in a small isolated room was initiated. This was not always available due to the nurse's work responsibilities. In such cases, the interview transpired in an area of minimal activity and conversation. Each interview lasted approximately twenty minutes and was conducted singly.

Conducting the interview. The interview guide was termed a schedule because its wording and the sequence of questions were determined in advance and these questions were asked of all respondents in the same way.[5] At the interview onset, the interviewee was encouraged to ask for clarification of any question when its meaning seemed obscure. Sufficient answering time was assured. In several instances the nurse being interviewed had limited use of the English language. When this communication problem was encountered, the question content was rephrased for simplicity and clarity.

The responses were recorded in the special precoded listings. At no time during the interview were the respondents allowed to view the schedule.

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[5] Ibid., p. 33.

For the most part, all the interviewees were cooperative and many expressed interest in the question and their correct answers. Several appeared reluctant when initially approached, indicating that they felt they were being quizzed on the right or wrongness of the indirect method. Reassurance as to their individual contribution was stressed. Consent to proceed was then readily given. One nurse refused to reply to the year of graduation. All other questions were answered. The schedule was so devised that a yes response to the first question in any series warranted further investigation by the researcher asking the additional questions pertaining to that topic. When a "no" or "uncertain" response was given, the following questions in that series were not asked.

Organization of the data. The information obtained from the interviews was scored, classified, analyzed and interpreted. Tables were prepared, findings summarized, and recommendations made.

V. SUMMARY

The descriptive-survey method using the interviewing technique was selected to survey the registered professional nurse's knowledge concerning selected factors in indirect blood pressure measurement. An open-ended and closed type of interview schedule was used to assure as much uniformity as possible. A pilot study aided in changes and improvement of the interview schedule. Fifty randomly selected registered professional nurses regularly employed in a general hospital were interviewed in single private conferences during and at their place of em-

ployment. Data tabulation, classification, analysis, and interpretation followed.

CHAPTER IV

PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

Fifty regularly employed registered professional nurses were interviewed to determine their knowledge concerning selected factors influencing the indirect measurement of blood pressure. Organization and statistical preparation of interviewee responses, characteristics of interviewees, discussion of responses to general consideration questions, and discussion of responses to selected factor questions are presented in this chapter. Statistical analysis, whenever appropriate, is included within the various subdivisions.

I. PREPARATION OF INTERVIEWEE RESPONSES

The interview schedule was so constructed that an interviewee's reply to most questions was checked on a special precoded listing of most common responses.[1] Each response in the listing was coded as correct, partially correct or incorrect. Aided by a statistical advisor, the researcher gave numerical value to each response; the best or correct answers received the highest value, partially correct valuated lower, and incorrect responses receiving a zero. This numerical tabulation of the data was used to aid in statistical evaluation of the interviewees' responses. It was assumed that those receiving a higher score due to more accurate responses were better informed. The first three questions of the schedule regarding the interviewee's methods of indirect

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[1]See Appendix A.

measurement were not included in the numerical evaluation. The main purpose of these questions was to discover if each nurse could determine an indirect blood pressure reading other than using the auscultatory method.

Interviewee qualifications and characteristics, i.e., area of present employment, type of nursing program completed, year of graduation and additional preparation, were also given numbers. These numbers carried no value but served as identifying agents. The interviewee qualifications and characteristics had been divided and placed at the beginning and ending of the interview schedule to minimize threat to the respondents during collection of the data. The discussion of this information in this chapter has been combined and presented first to identify the sample population. The data is needed later for statistical correlation with the nurses' knowledge regarding the selected factors.

After scoring each interview schedule, the numbers were transferred to a tally sheet. Questions pertaining to any one topic were totaled and recorded. Totals were also recorded by combining the selected factors, combining independent groups of general consideration question, and totaling each respondent's entire interview schedule.

II. INTERVIEWEE QUALIFICATIONS AND CHARACTERISTICS

Area of present employment. To facilitate ease in handling, the interviewee's place of hospital employment was grouped according to opportunities for indirect blood pressure measurement her nursing area usually provided. The groupings, as determined by the researcher through her nursing experience, were categorized as:

1. frequent - delivery room, emergency room, intensive care unit, recovery room.
2. moderate - ward.
3. infrequent or never - nursery, certain out patient clinics, operating room.

The distribution of the fifty professional nurses interviewed as to their job opportunities for indirect blood pressure measurement was fairly evenly divided in the three categories.

	Number of respondents	Percent
Frequent	16	32
Moderate	20	40
Infrequent/never	14	28
Total	50	100

Those nurses who had moderate opportunities constituted the largest group.

It would seem that the more opportunities a nurse had to indirectly measure a blood pressure, the more stimulated that nurse would be to seek perfection of her method and/or cultivate self-examination and investigation of various aspects of the measurement. This concept will be explored in later statistical analysis.

Type of nursing program completed. Distribution of the type of formal preparation each nurse received resulted in the majority of interviewees receiving their education in either diploma or baccalaureate programs.

Because the sample of associate degree graduates was extremely

limited, i.e., one nurse, this group was not included in any statistical evaluation of the data.

	Number of respondents	Percent
Associate of Science	1	2
Diploma	22	44
Baccalaureate	27	54
Total	50	100

Year of graduation. The year of graduation was divided into intervals to decrease the volume of numbers and eliminate confusing detail. The intervals were not equal because it was hoped different aspects of this characteristic could be evaluated. The 1964-65 interval constituted only two graduating classes. The researcher was eager to learn if those very recent graduates knew as much, less, or more than the nurses who had been out of school longer. The interval of 1960-63, containing four graduating classes, was designed to evaluate those nurses' knowledge who were not as recent graduates as the previous group, yet had not been absent from formal instruction as many of the remaining respondents. This group also constituted the remainder of the 1960 decade. The remainder of the intervals were arranged in decades.

Of the fifty professional nurses interviewed, nine graduated from their basic school of nursing in 1964 or 1965; sixteen graduated from 1960-63; nineteen graduated from 1950-59; four graduated from 1940-49; and only one graduated before 1940. One interviewee refused to reply. Table I shows the number and percent of this characteristic. Of the sample selected, the majority of any one group had been away from formal

continuous instruction for six to sixteen years. As high as thirty or more and no less than sixteen years characterized the absence of classroom instruction of the two minority groups.

TABLE I

YEAR OF GRADUATION OF FIFTY REGISTERED PROFESSIONAL NURSES

Year Graduated	Number of Respondents	Percent
1964 - 1965	9	18
1960 - 1963	16	32
1950 - 1959	19	38
1940 - 1949	4	8
Prior to 1940	1	2
No reply	1	2
Total	50	100

In communicating with the interviewees, the researcher gained the impression that the majority of those nurses completing their instruction in 1964-65 were baccalaureate graduates of one university. The majority of those graduating before 1959 attended diploma schools. Because of these two known factors, it could not be determined if the year of graduation or any one particular school was being analyzed. Therefore, any statement made on this characteristic would be invalid.

Additional preparation following graduation. Table II is a summary of the responses the interviewees gave when asked about additional

TABLE II

ADDITIONAL PREPARATION FOLLOWING BASIC NURSING EDUCATION FOR INDIRECT BLOOD PRESSURE MEASUREMENT OF FIFTY REGISTERED PROFESSIONAL NURSES

Additional Preparation	Number of Nurses			Total	Percent			Total
	Yes	No	No Reply		Yes	No	No Reply	
Hospital inservice	3	47	0	50	6	94	0	100
Physicians (individuals)	24	26	0	50	48	52	0	100
Medical meetings	2	45	3	50	4	90	6	100
Personal reading	17	33	0	50	34	66	0	100
Physiology courses	8	42	0	50	16	84	0	100
Refresher nursing courses	5	45	0	50	10	90	0	100
Other nurses	10	40	0	50	20	80	0	100
Other	17	33	0	50	34	66	0	100
Total	86	311	3	400	172	622	6	800
					(21 1/2)*	(77 3/4)*	(3/4)*	

*These figures were computed by dividing each total percent by the grand total of all percents and indicate the percentage of all nurses responding yes, no, or no reply.

preparation following graduation. Of the fifty respondents, only three had remembered receiving further information about indirect blood pressure measurement through hospital inservice education; forty-seven had none through this medium. Physicians had given individual instruction to twenty-four of the nurses while to twenty-six this had not been a source of help. Two of the interviewees attended medical meetings where they learned additional information about blood pressure readings; however, by far the majority were unexposed by this means. Three refused replies. Personal reading gave information to seventeen of the nurses; according to their statement, it had no influence on thirty-three respondents. Eight interviewees had postgraduate courses in physiology, forty-two did not. Five had taken refresher nursing courses. Ten nurses received suggestions about blood pressure measurement from other nurses; these other nurses usually being their immediate head nurse or supervisor. By contrast, forty of the respondents gained no information in their associations with their co-workers. In response to the researcher's encouragement to indicate other preparation not previously mentioned, seventeen interviewees stated the following areas: two became registered physical therapists following the nursing program; ten gained information through their own experience, this response indicating to the investigator as a trial and error method and not necessarily conveying accurate knowledge to the participant; two through observation of others recording blood pressures; one by questioning; one participated in a one day emergency care extension course; and one nurse was also a midwife.

For every respondent who had additional preparation, there were

3.6 interviewees who had no further information about indirect blood pressure measurement since their graduation from a basic nursing program.

Out of the eight different categories asked of each nurse, two diploma graduates listed five of these as being of help for providing additional information and/or preparation for blood pressure measurement. One baccalaureate, two diploma, and one associate degree nurse listed four areas as being beneficial; and three baccalaureate, four diploma graduates indicated three categories.

The information in Table III illustrates the number and percent of the nurses who had additional preparation of any kind as compared to the type of school they graduated from. The sample population showed that more of the diploma graduates had additional preparation than the

TABLE III

COMPARISON OF FIFTY REGISTERED PROFESSIONAL NURSES' ADDITIONAL BLOOD PRESSURE PREPARATION TO TYPE OF BASIC NURSING SCHOOL COMPLETED

Type of School	Number of Respondents	Additional Preparation		Percent
		Yes	No	
Baccalaureate	27	18	9	66.7
Diploma	22	19	3	86.7
Associate	1	1	0	100.0
Total	50	38	12	

baccalaureate graduates. Factors to consider in this observation are that several of the diploma graduates stated they were completing requirements for a baccalaureate degree and nine of the collegiate nurses had graduated less than three to fifteen months previous to their interviews. The sample of associate degree graduates was too small for comparison.

The chi square value for statistical correlation did not show any significance of relationship between the type of school from which the nurse graduated and the additional preparation she obtained.

Observation of the comparison of additional blood pressure measurement preparation to employment opportunities for measurement in Table IV indicates that those nurses who had only infrequent opportunities for recording indirect blood pressures, i.e., nursery, out patient clinic, or operating room, had a higher percentage of respondents who had had additional preparation than those who had moderate or frequent opportunities. This would indicate that even though they had less chances to take blood pressure, they could have been better prepared to measure the reading.

Of those respondents who had infrequent employment opportunities, three nurses listed three or more areas of additional preparation. Six nurses also gave three or more areas of preparation who worked in frequent measurement areas.

Information regarding employment opportunities for measurement was correlated with its relationship to additional preparation. The value of the chi square correlation indicated there was no significance to this relationship. This was interpreted as meaning those nurses who

had more frequent opportunities did not necessarily have more preparation following their basic nursing education and were not stimulated to seek knowledge or perfection of the methods they employed any more than the other two groups in this comparison.

TABLE IV

COMPARISON OF FIFTY REGISTERED PROFESSIONAL NURSES' ADDITIONAL BLOOD PRESSURE PREPARATION FOLLOWING GRADUATION TO AREA OF CURRENT EMPLOYMENT

Employment Opportunities for Measurement	Number of Respondents	Additional Preparation		Percent
		Yes	No	
Frequent	16	12	4	75
Moderate	20	14	6	70
Infrequent	14	12	2	86
Total	50	38	12	

III. DISCUSSION OF RESPONSES TO QUESTIONS OF GENERAL CONSIDERATION

Interviewee's methods of measurement. The first question each respondent was asked was, "Do you always use a sphygmomanometer plus a stethoscope when recording an individual's blood pressure?" It was hoped that this question and the succeeding two on the schedule, "If no, please explain," and "Which do you prefer and why?", would determine any variances of measurement the nurses knew and would use other than the auscultatory method. Thirty-two of the interviewees, or sixty-four percent, answered yes, indicating that they utilized no other methods.

Eighteen, or thirty-six percent, answered no; and none were uncertain. Of the eighteen using other methods, seventeen used palpation as an alternative. All were agreed that the sphygmomanometer cuff was placed on the upper arm and a pulse point distal to the cuff was palpated upon decompression of the inflated cuff. All said no diastolic level could be determined by this method. When describing the palpatory method of measurement, six named no specific artery to palpate; two said they used the brachial artery (antecubital space); four the radial artery; and five mentioned either the radial or the brachial artery could be used. The interviewees' description of the palpatory method, including variations of radial palpation, is in accordance with literature recommendations.[2]

One diploma graduate working in the intensive care unit suggested two methods other than the auscultatory measurement. In addition to the palpatory method described previously, she also obtained readings from a "flush method." After the sphygmomanometer cuff is inflated, the palm of the occluded arm is pressed firmly by the recorder to drain it of blood. The cuff is slowly deflated and the point on the measurement gage at which the color returns to the blanched palm is submitted as the systolic level. A diastolic level cannot be determined by this method.

Only one interviewee obtained readings other than by auscultation. She observed the fluctuating needle on the pressure gage of the sphygmo-

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[2]William S. Middleton, "Blood Pressure Determination: A Nursing Procedure," American Journal of Nursing, 30:1222, October, 1930; Charles D. Enselberg, "Measurement of Diastolic Blood Pressure by Palpation," The New England Journal of Medicine, 265:272, August 10, 1961; Charles D. Enselberg and Hunter Heath, "Pitfalls and Aids in the Clinical Measurement of Blood Pressure," Medical Times, 90:280, March, 1962.

manometer as the compressed cuff was being deflated. The point at which the needle began "jumping" was recorded as the systolic level. She read the diastolic level when the needle ceased to jump.

Readings obtained by observation of needle fluctuations are not described in the literature.

Of the eighteen using various methods, only two did not prefer the auscultatory over the palpatory method. The majority felt the auscultatory was more accurate, "for both a systolic and diastolic level could be determined." Other reasons were "hearing is more precise than feeling," "in palpation it may be the pulse one feels, not the pressure," "auscultation gives a better picture of the patient's condition," and "it is easier to hear than to feel." One nurse thought it was more convenient to use the auscultatory method while another preferred it because that was the method she initially learned.

Only one respondent preferred the palpatory method because she felt it was more accurate. "The recorder can observe feeling before hearing," she stated. The other respondent had no dominant preference of either method but felt both were comparable. She made no attempt to validate her statement.

Identifying and recording readings. Questions four through six of the interview schedule aimed at determining the respondents' usual practice of identifying and recording systolic and diastolic levels of blood pressure readings. The questions read in order were: "How do you identify the systolic level when recording a blood pressure?" "How do you identify the diastolic level?" and "How would you record the follow-

ing blood pressure?" (A hypothetical situation was then read.) It was assumed that all fifty respondents were familiar with the auscultatory method of measurement, so the questions were based on this method. Tables V and VI show the interviewees' responses.

The recommendations of the American Heart Association and the Cardiac Society of Great Britain and Ireland state that when using the auscultatory technic, the systolic level is determined by the first audible sound or palpatory sensation, whichever is highest.[3] Only three of the fifty interviewees, or six percent, gave this answer when asked what their identification of the systolic level was when recording a blood pressure. This would indicate that forty-seven nurses did not use a combination of auscultatory and palpatory technic as recommended.[4] Thirty-two, or sixty-four percent, said the systolic level they recorded was the first audible sound heard through the stethoscope upon cuff deflation, regardless of that sound's character or rhythm. Fourteen, or twenty-eight percent, used the first clear, steady rhythm of sound for systolic identification and were not necessarily concerned with the starting point. It is interesting to note that no one gave just a palpatory measurement as their preference for obtaining systolic readings. Only one had a different interpretation.

Only 1.5 of every 25 nurses knew how to correctly identify a systolic reading. Three-fifths had a partial knowledge by designating

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[3]"Standard Method for Taking and Recording Blood Pressure Readings," Journal of the American Medical Association, 113:96, July 22, 1939.

[4]Ibid.

TABLE V

SYSTOLIC BLOOD PRESSURE IDENTIFICATION BY FIFTY REGISTERED PROFESSIONAL NURSES

Systolic Interpretation	Number of Respondents	Percent
First audible sound or palpatory sensation, whichever is highest	3	6
First audible sound	32	64
First clear, steady rhythm of sound	14	28
First palpatory sensation	0	0
Other	1	2
Uncertain	0	0
Total	50	100

TABLE VI

DIASTOLIC BLOOD PRESSURE IDENTIFICATION BY FIFTY REGISTERED PROFESSIONAL NURSES

Diastolic Interpretation	Number of Respondents	Percent
Last audible sound	21	42
Beginning muffling of clear sound	21	42
Last audible sound ending before zero, otherwise beginning muffled sound	7	12
Cessation of rhythm, but not sound	0	0
Other	1	2
Uncertain	0	0
Total	50	100

the first audible sound while one-third were totally incorrect. These findings indicate that ninety-four percent of those interviewed had partial or incorrect information concerning systolic readings. Therefore, the readings they obtained would most likely be inaccurate.

In 1951 the American Heart Association stated that the most accurate indirect diastolic level corresponding to true intra-arterial diastolic pressure was the point of complete disappearance of sound through the stethoscope.[5] Of the group, twenty-one, forty-two percent, said they identified diastolic level at the last audible sound; and twenty-one said they took the reading when the clear sound began to muffle. This had been the original recommendation by the heart committee in 1939.[6] Seven respondents, fourteen percent, chose the last audible sound if it ended before zero, otherwise the diastolic level was determined at the beginning muffled sound. The one nurse observing the fluctuating pressure needle recorded diastolic readings when the needle ceased "jumping."

Unlike the findings on systolic identification, nearly half of the nurses submitted accurate diastolic readings, barring human observer errors as hearing, etc. The data would seem to indicate that over half of the professional nurses had not kept pace with recent literature recommendations regarding the taking of blood pressure.

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[5]American Heart Association, Committee to Revise Standardization of Blood Pressure Readings, "Recommendations for Human Blood Pressure Determinations by Sphygmomanometers," Journal of the American Medical Association, 147:632-636, October 13, 1951.

[6]"Standard Method for Taking and Recording Blood Pressure Readings," loc. cit.

To evaluate the recording of the blood pressure reading, each nurse was given a hypothetical measurement situation and then asked to write how she would record it.[7] According to the American Heart Association, the correct recording should have been written 120/80-60.[8] Only eight, sixteen percent, wrote it as such. The other eighty-four percent recorded it either as 120/80 or 120/60. This would seem to indicate that most of the nurses included in this study are unaware of the correct method of recording a blood pressure reading.

Statistical analysis of the respondents' scores on identifying and recording readings revealed no correlations of the means as related to job opportunities for measurement or their type of basic program. The scores of the interviewees who had opportunities to measure blood pressure infrequently or never tended to be consistent and grouped around the mean, making the individual members in that group nearly equal in knowledge. This was not true of the scores for those who had moderate or frequent opportunities. Scores as related to the type of school each respondent attended revealed no consistency or pattern but were widely scattered for both diploma and baccalaureate graduates. Therefore in each group with scattered scores, some nurses had much knowledge concerning identification and recording readings while others had moderate or very little knowledge. With only one graduate from the associate degree program, no valid comparison could be made.

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[7]See Appendix A, Question 6.

[8]"Standard Method for Taking and Recording Blood Pressure Readings," op. cit., p. 297.

The professional nurse's knowledge concerning identification and recording readings was not related to the type of nursing school she graduated from or her employment opportunities for measurement. In general, most nurses could not correctly identify a systolic reading nor correctly record a reading containing variables. Only one half of them could identify the diastolic reading adequately, the diastolic level being the most difficult to determine.

Type of blood vessel. Each nurse was asked to name the type of blood vessel in which indirect blood pressure was commonly measured. The researcher endeavored to gain a limited amount of information about each respondent's knowledge of anatomy as related to indirect measurement. Table VII gives the results of their responses. Thirty-eight nurses, seventy-six percent, correctly answered the artery. Of the six respondents stating vein, three of the individuals had opportunities for taking pressures moderately to frequently during their course of nursing duty. Six respondents were uncertain.

TABLE VII

RESPONSES OF FIFTY REGISTERED PROFESSIONAL NURSES AS TO TYPE OF BLOOD VESSEL MEASURED

Type of Blood Vessel	Number of Respondents	Percent
Artery	38	76
Vein	6	12
Uncertain	6	12
Total	50	100

Statistical analysis was not pertinent for this information. The greater majority of the nurses were familiar with the correct response. Of the twelve who answered incorrectly or were uncertain, further investigation is needed to determine if this had been correctly evaluated.

Korotkov sounds. When the nurses were asked if they had ever heard of the Korotkov sounds in blood pressure measurement, the majority of the fifty respondents did not know as shown in these results:

	Number of respondents	Percent
Had heard	2	4
Had never heard	43	86
Uncertain	5	10
Total	50	100

Of those responding "yes" or "not sure," the next question asked was to define the sounds. Only one individual made any attempt to answer. She stated that one could detect different sounds and determine different heart actions when listening to the blood pressure. In essence this is correct. The response was not pursued further by the interviewer. Again statistical analysis was not applicable.

Only one nurse knew what the Korotkov sounds were. Disregarding this nurse, it would seem that most nurses do not listen for sound patterns during a blood pressure measurement. Their main concern is to establish a systolic and diastolic reading rather than note the physiological aspects of the pressure sounds. Therefore, their measurement technics become mechanical rather than evaluating the body's response.

IV. DISCUSSION OF RESPONSES TO QUESTIONS ON SELECTED FACTORS

Cuff width. Each registered professional nurse was asked if she thought varying the sphygmomanometer cuff width would influence the reading. The results of the responses indicated the following:

	Number of respondents	Percent
Yes	22	44
No	16	32
Uncertain	12	24
Total	50	100

Literature reveals that a cuff that is too narrow for the limb it is measuring will give an erroneously high reading.[9] Most authorities agree that a proper cuff width for an average adult arm is 12-15 cm. However, there are discrepancies of thought that increasing the cuff beyond this width may or may not lower the actual reading when using the auscultatory method. Ragan demonstrated that a 20 cm cuff would lower both systolic and diastolic readings.[10] A variety of other researchers, including Erlanger, Day, and Karvonen, have shown this is not a significant variable.[11]

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[9]Martti J. Karvonen, Leo J. Telivuo, and Erkki J. K. Jarvinen, "Sphygmomanometer Cuff Size and the Accuracy of Indirect Measurement of Blood Pressure," The American Journal of Cardiology, 13:688, May, 1964.

[10]Charles Ragan and James Bordley, III, "The Accuracy of Clinical Measurements of Arterial Blood Pressure, With a Note on the Auscultatory Gap," Bulletin of the Johns Hopkins Hospital, 69:504, October, 1941.

[11]Karvonen, loc. cit.

The next question asked of the twenty-two responding that changing the cuff width could influence the reading was, "How will varying the cuff width affect the reading?" Table VIII shows that five, nearly twenty-three percent of those asked, accurately answered that narrowing the width would increase the reading. Three, fourteen percent, indicated that widening the cuff could decrease the reading. Of those giving incorrect responses, two said a narrow cuff decreases the reading, three said a wide cuff increases the reading, two stated there was no difference in the reading, five were uncertain, and two offered no replies.

All respondents were asked to state a reasonably correct cuff width for an average adult. Table IX gives the following information: twenty-three, forty-six percent, said 12-14.5 cm; thirteen, twenty-six percent, said 10-11.5 cm. Only five, or ten percent, gave below 10 cm as a reasonable width and seven, fourteen percent, said 15 cm or more. Two were uncertain.

Interpretation of the findings on the nurses' knowledge regarding cuff width indicated that less than half of the sample knew that width would influence the reading. Of this group, only one third knew in what way it differed. These statistics indicate that the registered professional nurse is inadequately informed about this selected factor. Even with the aid of a ruler, the nurses demonstrated difficulty in selecting a proper width. Half of them were able to say the recommended size. This again would seem to indicate mechanization of the nurse's practice in obtaining a blood pressure reading. They could most likely choose between an adult and a pediatric pressure cuff, but would be expected to have difficulty selecting the standard if several adult cuff choices were

TABLE VIII

KNOWLEDGE OF FIFTY REGISTERED PROFESSIONAL NURSES REGARDING CUFF WIDTH AND ITS INFLUENCE ON BLOOD PRESSURE READINGS

Differs in What Way	Number of Respondents	Percent (Asked)	Percent (All)
Narrow cuff increases reading	5	22.5	10
Wide cuff decreases reading	3	14	6
Narrow cuff decreases reading	2	9	4
Wide cuff increases reading	3	14	6
No difference in reading	2	9	4
Uncertain	5	22.5	10
No reply	2	9	4
Not asked	28	--	56
Total	50	100	100

TABLE IX

SUGGESTIONS OF FIFTY REGISTERED PROFESSIONAL NURSES REGARDING AVERAGE ADULT CUFF WIDTH

Width	Number of Respondents	Percent
Below 10 cm	5	10
10 - 11.5 cm	13	26
12 - 14.5 cm	23	46
15 cm or above	7	14
Uncertain	2	4
Total	50	100

available. Nurses seem to become victims of habit and current practices, for those in the sample repeatedly said, "Oh, you know the size that's always used" to the researcher's inquiry for an estimate of the proper cuff width.

Statistical analysis revealed a positive correlation, shown in Figure 1, between the job opportunities for blood pressure measurement and knowledge regarding cuff width. As the nurses had greater opportunities for measuring blood pressure, they also knew more about the cuff width and its influence on the reading.

A correlation, as shown in Figure 2, existed between the type of school the nurses graduated from and their knowledge about cuff width. The graduates of diploma schools received a higher mean score than those who had graduated from the baccalaureate nursing programs. Of the sample taken, the diploma graduate tended to know more about cuff width than the baccalaureate graduate. The individual scores of both groups were widely scattered and illustrated both informed and uninformed members were in each group.

The sample showed that the more employment opportunities for measurement a nurse had, the more she knew about cuff width. The diploma graduate also knew more than the baccalaureate graduate. From this sample information, the diploma graduate working in delivery room, emergency room, intensive care unit, or recovery room should know the most about cuff width. The baccalaureate graduate in nursery, certain out patient clinics, or operating room would be expected to know the least. A study larger in scope than this would be needed to validate these statements.

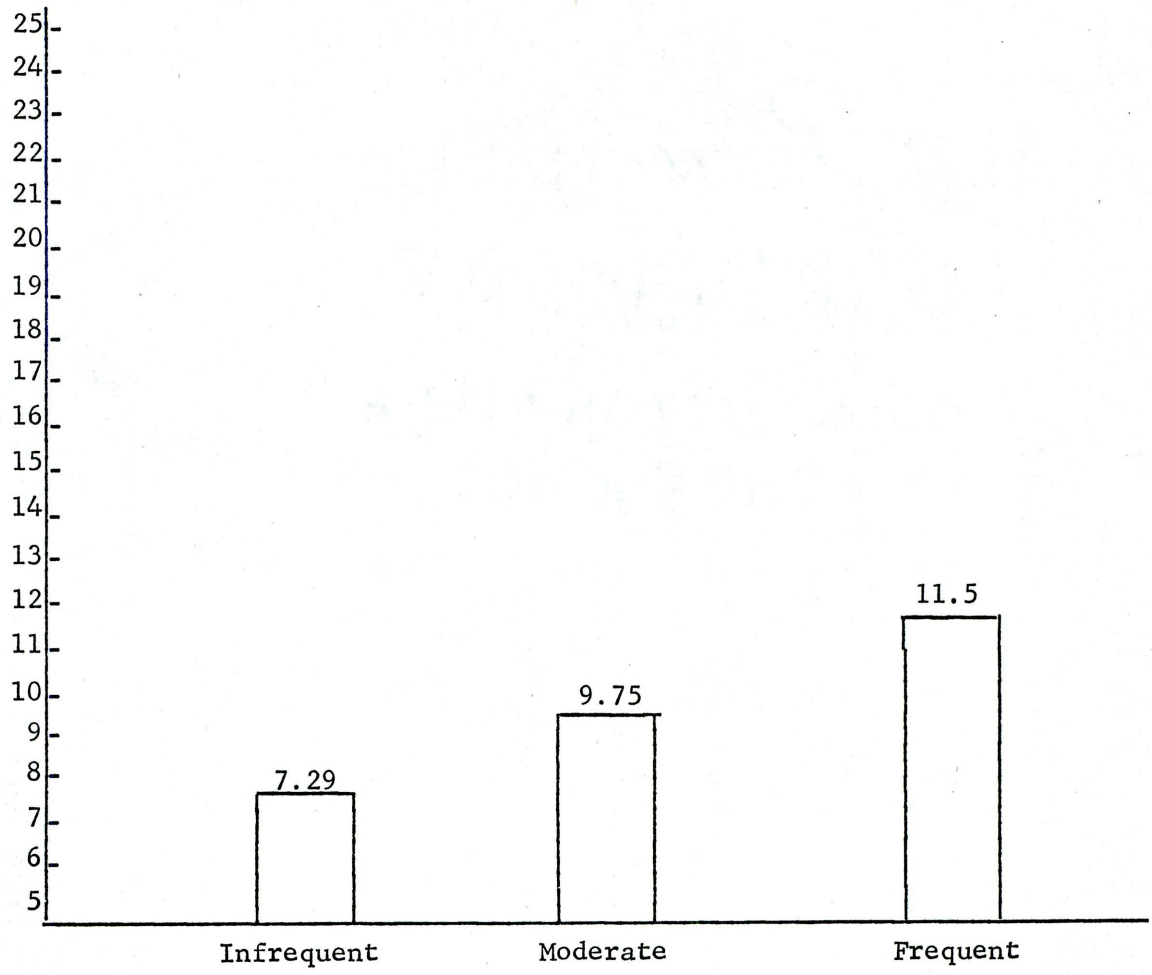

FIGURE 1

MEAN SCORES OF FIFTY REGISTERED PROFESSIONAL NURSES ABOUT CUFF WIDTH AS A FACTOR IN INFLUENCING BLOOD PRESSURE READINGS AS RELATED TO JOB OPPORTUNITIES FOR MEASUREMENT

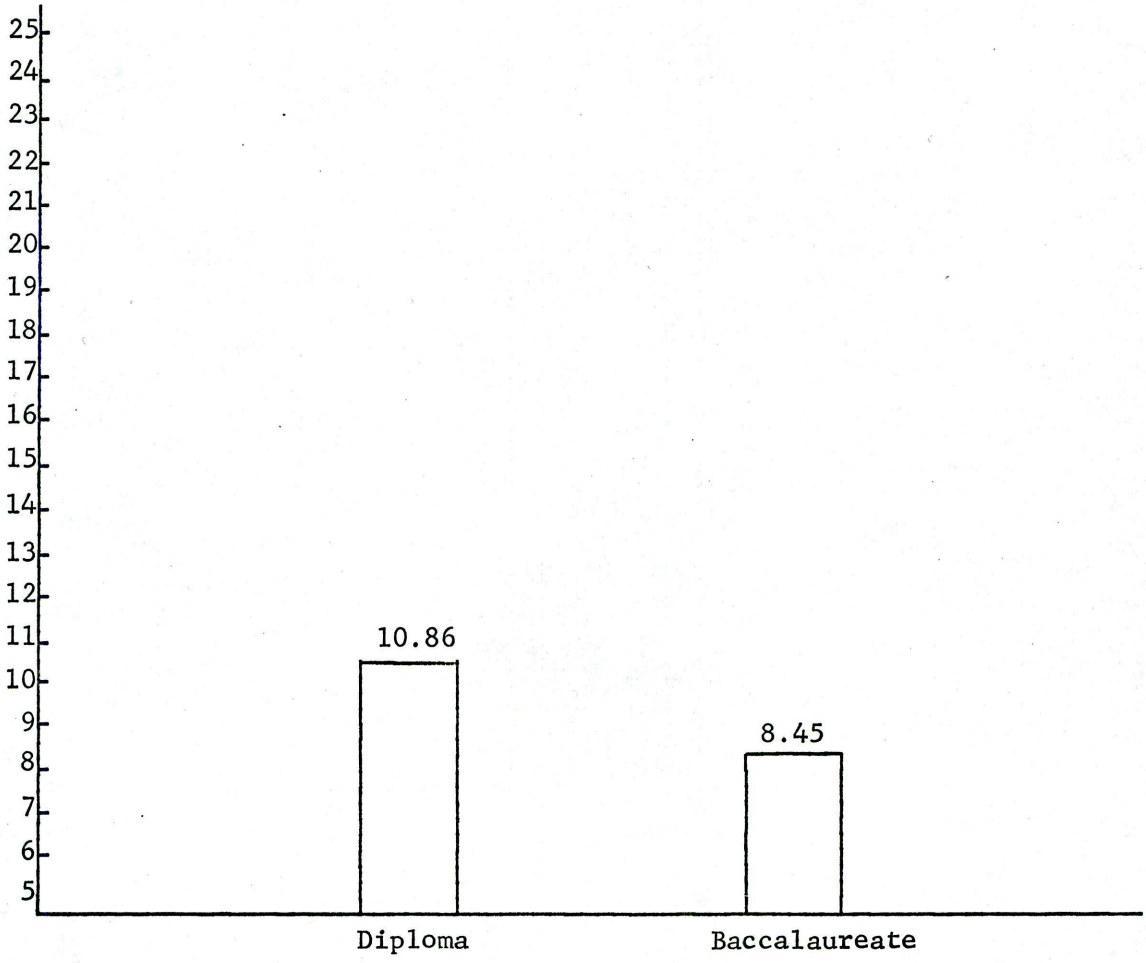

FIGURE 2

MEAN SCORES OF FIFTY REGISTERED PROFESSIONAL NURSES ABOUT CUFF WIDTH AS A FACTOR IN INFLUENCING BLOOD PRESSURE READINGS AS RELATED TO TYPE OF NURSING PROGRAM

Emotions and activities. Literature indicates that blood pressure is significantly raised during sudden emotions[12] and lowered when asleep.[13] Table X shows that when each nurse was asked, "How will such sudden emotions as fear, anger or excitement affect the blood pressure measurement?" the vast majority knew that the reading would be changed. Forty-nine, ninety-eight percent, said it would be increased; only one was uncertain.

TABLE X

RESPONSES OF FIFTY REGISTERED PROFESSIONAL NURSES REGARDING SUDDEN EMOTIONAL INFLUENCE ON BLOOD PRESSURE READING

How Emotions Influence Reading	Number of Respondents	Percent
Increase it	49	98
Decrease it	0	0
Remain unchanged	0	0
Uncertain	1	2
Total	50	100

Each nurse was also asked how sleep would affect the reading. The number and percent of their answers are shown in Table XI. Again the

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[12]J. D. Ratcliff, "The Blood Pressure and What It Tells Your Doctor," Today's Health, 34:26-27, June, 1956; M. Robinow, et al., "Accuracy of Clinical Determinations of Blood Pressure In Children," American Journal of Diseases of Children, 58:117, July, 1939.

[13]Ratcliff, loc. cit.

majority of respondents, forty-seven, correctly answered that the reading would be decreased during sleep. Two said it remained unchanged and one was uncertain.

TABLE XI

RESPONSES OF FIFTY REGISTERED PROFESSIONAL NURSES REGARDING SLEEP'S INFLUENCE ON BLOOD PRESSURE READINGS

How Sleep Affects Reading	Number of Respondents	Percent
Increase it	0	0
Decrease it	47	94
Remain unchanged	2	4
Uncertain	1	2
Total	50	100

Correct information on emotions and activities and their effect on blood pressure readings seemed widespread among the nurses in this sample. This would seem to indicate that they had some knowledge of the body's physiological response to stress. This subject is also of current discussion in medical and nonmedical circles. With the limited questioning in this section, difficulty is encountered in assessing the depth of the nurses' knowledge, and realizing that it may only be equal to but no greater than that of the general public. Statistical evaluation was not pertinent.

Obesity and thinness. The first question asked of each inter-

viewee concerning obesity was, "Considering other factors equal, would you expect blood pressure to be different in the obese individual as compared to one of average weight?" The majority of the respondents agreed they could expect a difference. Other responses included:

	Number of respondents	Percent
Yes	42	84
No	5	10
Uncertain	3	6
Total	50	100

Studies have revealed that falsely high readings, as much as 30 mm difference from intra-arterial pressure, could be measured in individuals with obese arms.[14] Table XII shows that of the ninety-three percent knowing a difference existed, seventy-four percent of these, or thirty-one nurses, could say it was at least 10 mm higher. Eight respondents knew it was slightly higher but said not more than 10 mm. Disregarding the three who were uncertain, all the other thirty-nine respondents knowing there was a difference also knew that the reading would be higher if that difference existed. No one said it would be lower.

Most of the nurses were aware that the obese individual could be expected to have an elevated blood pressure reading. They had difficulty determining the degree of this elevation. The scope of this study could not determine if the nurses knew this elevation is not synonymous with

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[14]Ragan, op. cit., p. 526; Kenneth W. Trout, Charles A. Bertrand, and M. Henry Williams, "Measurement of Blood Pressure in Obese Persons," Journal of the American Medical Association, 162:971, November 3, 1956.

TABLE XII

KNOWLEDGE OF FIFTY REGISTERED PROFESSIONAL NURSES REGARDING OBESITY AND ITS INFLUENCE ON BLOOD PRESSURE READINGS

Differ in What Way	Number of Respondents	Percent (Asked)	Percent (All)
Significantly higher (more than 10 mm)	31	74	62
Slightly higher (1 - 10 mm)	8	19	16
Slightly lower (1 - 10 mm)	0	0	0
Significantly lower (more than 10 mm)	0	0	0
Remain unchanged	0	0	0
Uncertain	3	7	6
Not asked	8	--	16
Total	50	100	100

hypertension. Obesity is a leading topic in current health discussions of modern society. Comparable with emotions and activities, the nurses' knowledge regarding obesity gained from this survey may be no broader in depth than that of the general public.

Each respondent was also asked if the amount of tissue mass at the site of measurement had any influence on blood pressure readings. The nurses were reversed in their answers when compared to their responses on obesity, as these findings show:

	Number of Respondents	Percent
Yes	11	22
No	32	64
Uncertain	7	14
Total	50	100

According to Crawford,[15] the more tissue mass that is present at the site of measurement, the higher the reading will be for the pressure from the cuff is dissipated into the tissue rather than properly occluding the artery. Ragan states that subjects with unusually small arms may be erroneously recorded as much as 30 mm below their normal.[16] No nurse said that thinness decreased the reading and only two said developed musculature increased it. These responses are shown in Table XIII. Four respondents incorrectly said the reading was lowered by developed muscles at the measurement site.

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[15]Statement by Raymond B. Crawford, M.D., personal interview, June, 1965.

[16]Ragan, loc. cit.

TABLE XIII

KNOWLEDGE OF FIFTY REGISTERED PROFESSIONAL NURSES REGARDING TISSUE MASS AND ITS INFLUENCE ON BLOOD PRESSURE READINGS

Affects in What Way	Number of Respondents	Percent (Asked)	Percent (All)
Thinness increases it	0	0	0
Thinness decreases it	0	0	0
Developed musculature increases it	2	18	4
Developed musculature decreases it	4	36.5	8
Remain unchanged	1	9	2
Uncertain	4	36.5	8
Not asked	39	--	78
Total	50	100	100

A significant number of nurses knew that obesity could increase the reading, yet were unable to associate the same principle to excessive tissue mass. It would seem that the nurses did not understand the role of this selected factor to any physiological depth. It is highly possible that the nurses only knew obesity's influence because of the special emphasis placed on that subject in current health concerns.

A correlation existed between the obesity-thinness factor and job opportunities for frequency of measurement. This is found in Figure 3. The data shows that as the job opportunities for measurement increased, so did the nurses' knowledge. The scores for the nurses within each group were not consistent with their mean, indicating both knowledgeable and unknowledgeable nurses could be found in each area of measurement frequency. One nurse who had frequent measurement opportunities in her area of employment received a perfect score for answering all questions pertaining to this factor correctly. No other nurse was able to achieve this.

As with job opportunities, Figure 4 indicates that the more education the nurse had, the more she knew about the influence of obesity and thinness. The scores of the collegiate graduates tended to be more consistent with the mean than those of the diploma school. The diploma graduates tended to be either very high or very low. Six of the twenty-two respondents in this category knew nothing about this selected factor, while two knew all or nearly all the responses to the questions asked. The baccalaureate nurses remained in a middle range and their mean indicates a truer assessment of their knowledge.

Interpretation of these correlations shows that the collegiate

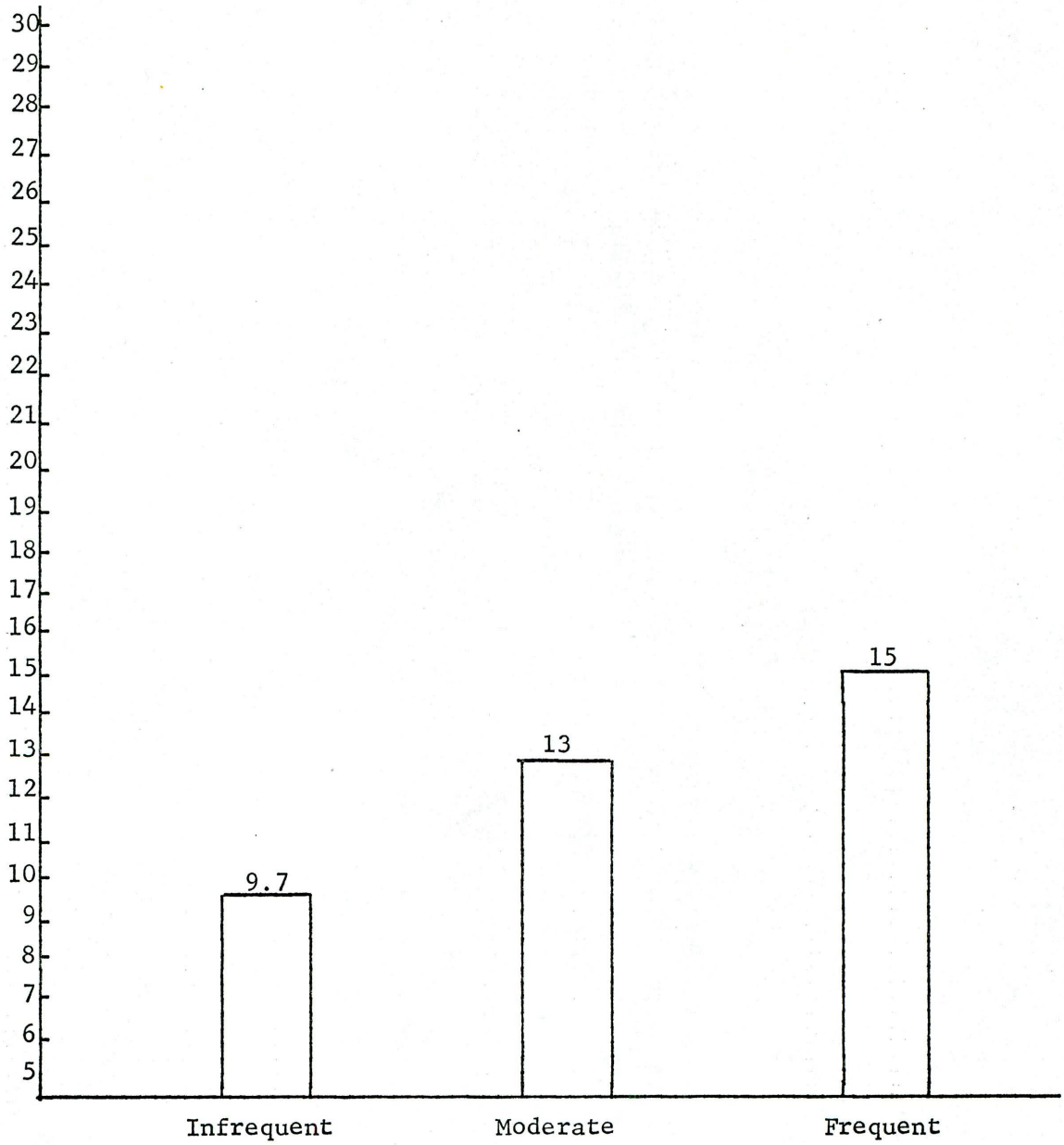

FIGURE 3

MEAN SCORES OF FIFTY REGISTERED PROFESSIONAL NURSES ABOUT OBESITY-THINNESS AS A FACTOR IN INFLUENCING BLOOD PRESSURE READINGS AS RELATED TO JOB OPPORTUNITIES FOR MEASUREMENT

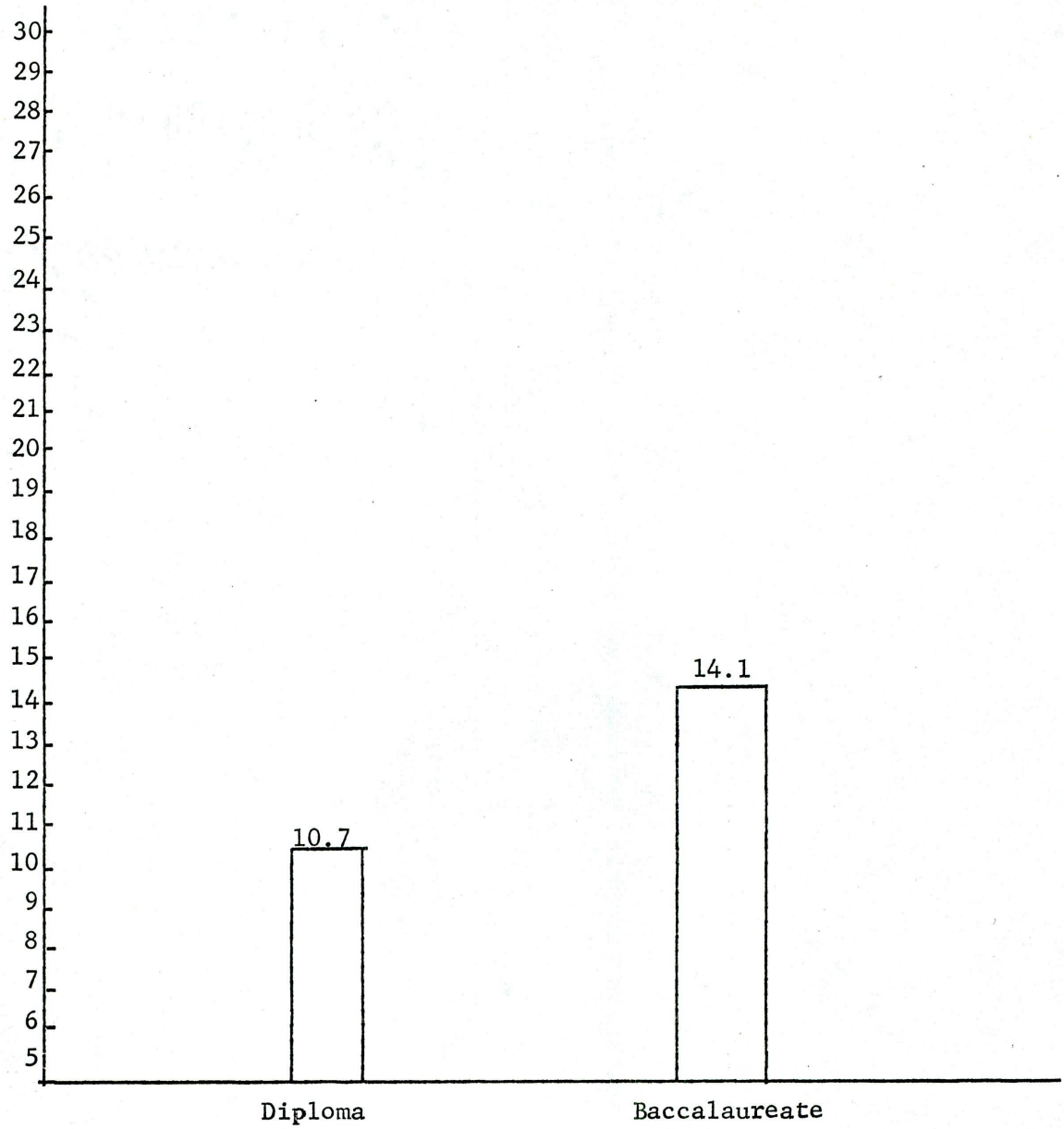

FIGURE 4

MEAN SCORES OF FIFTY REGISTERED PROFESSIONAL NURSES ABOUT OBESITY-THINNESS AS A FACTOR IN INFLUENCING BLOOD PRESSURE READINGS AS RELATED TO TYPE OF NURSING PROGRAM

graduate working in frequent measurement areas, i.e., delivery room, emergency room, intensive care unit, or recovery room, was the most familiar with the influence obesity or developed musculature exerted on blood pressure readings. They could transfer physiological principles into their recording of blood pressures concerning this factor. The diploma graduate employed in nursery, certain out patient clinics or operating room knew the least. A larger study is needed to validate these findings.

Position of the subject. The interviewees gave a variety of answers when asked what body position they had an ambulatory patient assume prior to his blood pressure measurement. These responses are shown in Table XIV. The American Heart Association recommends that the subject be lying down or comfortably seated.[17] This position is also advised by Gainsborough.[18] Twenty-six respondents, fifty-two percent, chose to have the subject sit in a chair; while sixteen, thirty-two percent, preferred a patient recumbent. No nurse answered that they had the patient in a high Fowler's position in bed which would have also been compatible with the authorities' recommendations. Only two stated a semi-Fowler's position in bed was most desirable, and none said standing or no specific position. Six of the respondents, however, said they would use either a supine position or sitting in a chair for their sub-

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[17]James Bordley, et al., "Recommendations for Human Blood Pressure Determinations by Sphygmomanometers," Circulation, 4:503, October, 1951.

[18]Hugh Gainsborough, "Taking the Blood Pressure," Nursing Times, 58:737, June 8, 1962.

TABLE XIV

RESPONSES OF FIFTY REGISTERED PROFESSIONAL NURSES REGARDING POSITION OF THE SUBJECT FOR BLOOD PRESSURE MEASUREMENT

Position	Number of Respondents	Percent
Sitting in chair	26	52
Supine	16	32
Semi-Fowler's (bed)	2	4
Fowler's (bed)	0	0
Standing	0	0
No special position	0	0
Supine or sitting in chair	6	12
Total	50	100

ject, whichever was convenient at the time of measurement.

It has been recommended by the American Heart Association that the subject's arm be supported on a smooth surface at the level of the heart when recording the pressure[19] to reduce venous stasis which could cause an auscultatory gap in the Korotkov sounds.[20] Each nurse was asked, "With the patient in a semi-Fowler's position in bed, how do you position the arm in relation to the heart level when recording the pressure?" It was hoped she would answer at the level of the heart and supported on a pillow. Table XV shows only two of the nurses, both collegiate graduates and taking blood pressures infrequently, replied in this manner. The majority of respondents, eighty-two percent, indicated that the subject's arm should be at the level of his heart when measuring his pressure. Only four percent went further to say it should be supported. Two nurses said hanging down, one said no special level, and four were uncertain.

Analysis of the data on the subject's arm position in relation to the heart level would indicate that the great majority of the respondents knew the arm should be level with the heart when recording the pressure in that site, but could not take a second step in saying the arm should be supported. Data did not reveal if these nurses employed these techniques in actual practice.

There was no statistical correlation of either job opportunities

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[19]Bordley, loc. cit.

[20]M. R. Berry, "The Mechanism and Prevention of Impairment of Auscultatory Sounds During Determination of Blood Pressure of Standing Patients," Proc. Staff Meeting, Mayo Clinic, 15:699, 1940.

TABLE XV

RESPONSES OF FIFTY REGISTERED PROFESSIONAL NURSES ABOUT SUBJECT'S ARM POSITION IN RELATION TO HEART LEVEL

Position	Number of Respondents	Percent
Level with heart and supported	2	4
Level with heart	41	82
Hanging down	2	4
Above heart level	0	0
No special position	1	2
Uncertain	4	8
Total	50	100

for measurement or type of school to position of the subjects. The scores of both groups tended to cling close to a mean score of 9.5 to 11. A perfect score was 20. The majority of the nurses knew approximately half of the knowledge sought.

Inflation and deflation of cuff pressure. Table XVI illustrates how the fifty nurses responded when asked how high they routinely inflated the cuff when initially recording pressure on a reasonably healthy adult. Thirty-four, sixty-eight percent, indicated they initially exerted enough pressure in the cuff compressing a limb to raise the mercury 140 - 180 mm before beginning the determination of a reading. Literature recommends this. Twenty-four percent, twelve respondents, said they routinely raised the pressure above 180 mm of mercury, and eight percent, four nurses, said between 120 - 140 mm. No one gave lower than 120 mm of pressure.

Wilkens and Bradley have shown that maintaining cuff pressure against a compressed artery would cause an abnormal elevation of the diastolic reading.[21] No time period was attached to this observation, therefore, the researcher, aided by Crawford, established a time period of thirty seconds or more as significantly longer than most determiners would be prone to use.[22] A variety of responses were collected from the interviewees when they were asked, "Do you feel that maintaining

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[21]Robert W. Wilkens and Stanley E. Bradley, "Changes in Arterial and Venous Blood Pressure and Flow Distal to a Cuff Inflated on the Human Arm," American Journal of Physiology, 147:268, October, 1946.

[22]Personal interview with Raymond B. Crawford, M.D., June, 1965.

TABLE XVI

RESPONSES OF FIFTY REGISTERED PROFESSIONAL NURSES REGARDING CUFF PRESSURE ON INITIAL INFLATION

Pressure	Number of Respondents	Percent
Above 180 mm	12	24
140 - 180 mm	34	68
120 - 140 mm	4	8
Below 120 mm	0	0
Uncertain	0	0
Total	50	100

cuff pressure against the arm for any period of time above 30 seconds is likely to influence the reading?" Nearly as many said "no" as "yes."

	Number of respondents	Percent
Yes	24	48
No	19	38
Uncertain	7	14
Total	50	100

Including those who were uncertain, fifty-two percent did not know the reading could be changed if pressure were maintained against an occluded artery.

Each of the respondents who answered affirmatively to the above question was then asked for what reason this change in reading when cuff pressure was maintained was likely to occur. Nine nurses gave the reason that the circulation would become blocked. Since the blood flow did not decrease or slow down, blood collected and thus increased the pressure and reading. One nurse described it this way, "The vessels need time to expand or the reading will be off. If the vessels are tied down, the pressure tends to build up." Seven nurses could give no reason other than that experience had shown with consecutive inflation the reading became distorted. Seven made no attempt at giving any reason. From the twenty-four individuals saying a change occurred, only fifty percent attempted a physiological explanation for this change.

"Do you feel that rapid deflation of the cuff pressure will give an inaccurate reading?" was asked of each nurse. The results of their responses show:

	Number of respondents	Percent
Yes	41	82
No	7	14
Uncertain	2	4
Total	50	100

Bazett and Laplace's study has shown that if deflation of the cuff pressure is too rapid, the systolic and diastolic pressures will be lower than those readings obtained with less rapid deflation.[23] They further recommended a deflation rate of 2 - 3 mm of mercury per second be used for a more accurate assessment of the reading.[24]

The nurses who felt the reading would be changed if cuff deflation was too rapid were then asked in what way the diastolic reading changed. The researcher was only concerned with the diastolic level because this reading is considered by many authorities to be of most value. It indicates what constant stresses are on the heart between beats when it should be receiving its vital rest.[25] Table XVII shows that less than half of those asked, thirty-nine percent, gave an acceptable reply. They said that the diastolic reading would be lowered 1 - 10 mm of mercury. This constituted only thirty-two percent of the

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[23]H. C. Bazett and L. B. Laplace, "Studies on the Indirect Measurement of Blood Pressure. I. Source of Error in the Riva Rocci Method," American Journal of Physiology, 103:66, January, 1933.

[24]Ibid.

[25]William S. Middleton, "Blood Pressure Determination: A Nursing Procedure," American Journal of Nursing, 30:1223, October, 1930; J. D. Ratcliff, "The Blood Pressure and What It Tells Your Doctor," Today's Health, 34:27, June, 1956.

TABLE XVII

KNOWLEDGE OF FIFTY REGISTERED PROFESSIONAL NURSES REGARDING RATE OF CUFF DEFLATION AND ITS INFLUENCE ON THE READING

Affect in What Way	Number of Respondents	Percent (Asked)	Percent (All)
Diastolic slightly lower (1 - 10 mm)	16	39	32
Diastolic significantly lower (above 10 mm)	9	22	18
Diastolic slightly higher (1 - 10 mm)	10	24.5	20
Diastolic significantly higher (above 10 mm)	2	5	4
Remain unchanged	0	0	0
Uncertain	4	9.5	8
Other	0	0	0
Not asked	9	--	18
Total	50	100	100

total group. However, nine additional respondents said it was lowered, even though they gave greater variance (more than 10 mm). Combining the two groups resulted in twenty-five, or fifty percent of all respondents, who knew that the diastolic level was abnormally lowered with rapid deflation of the cuff pressure, although their knowledge of the amount of decrease varied. Twelve respondents, thirty percent of those asked, were incorrect when they said the diastolic level was raised. Eight percent of the interviewees were uncertain; eighteen percent were not asked.

Table XVIII shows the distribution of the respondents as to how they replied when asked, "How fast do you recommend deflation of cuff pressure?" Only six said 2 - 4 mm/sec as recommended. Six said 5 - 7 mm/sec; five said more than 7 mm/sec; one recommended 2 mm/sec; and one said it varied. The largest group of respondents, or sixty-two percent, were uncertain. Of those who could not state a deflation rate, they did express their feelings about this rate with phrases as it should be "fairly slow," "slowly," and "real, real slow." These comments were not further interpreted by the investigator.

No correlations were evident on this factor. The scores of those nurses who had infrequent opportunities for measurement generally appeared higher than those of the moderate or frequent group, giving them the highest mean in this category.

Over half of the interviewees knew that initial cuff pressure should not exceed 180 mm of mercury. The majority of the respondents indicated little or no hesitation in answering the researcher's question pertaining to this topic, so in all probability they should have been

TABLE XVIII

RESPONSES OF FIFTY REGISTERED PROFESSIONAL NURSES REGARDING DESIRABLE DEFLATION RATE OF CUFF PRESSURE

Deflation Rate	Number of Respondents	Percent
2 - 4 mm/sec	6	12
5 - 7 mm/sec	6	12
More than 7 mm/sec	5	10
Less than 2 mm/sec	1	2
Varies	1	2
Uncertain	31	62
Total	50	100

aware of this during the actual measurements they conducted. Only nine nurses had any correct knowledge of the body's physiological response to extended external compression of a limb. Other individuals gave reasons, but the reasons were based upon personal "experience." As in previous interpretation of certain factors investigated in this survey, blood pressure measurement, when related to inflation and deflation of cuff pressure, was a matter of mechanics for most of the interviewees and contained no depth of scientific knowledge. Physiological response of the body and its effect on the blood pressure reading did not seem to be of prime consideration to the interviewees during their measurement performances.

Site of measurement. "In addition to the arm, can the blood pressure be taken elsewhere?" was the first question asked of all the professional nurses regarding site of measurement. The results of their responses were:

	Number of Respondents	Percent
Yes	41	82
No	1	2
Uncertain	8	16
Total	50	100

The forty-one nurses responding "yes" were asked where else might they take an indirect blood pressure measurement. Table XIX indicates their answers. Because five nurses suggested two acceptable sites for measurement, more sites were mentioned than total respondents. Thirty-two nurses knew the reading could be obtained by compressing the thigh.

However, thirteen of these respondents were unable to transfer knowledge about the arm site and were uncertain as to stethoscope placement or how to obtain the reading. Ten suggested using the lower leg. Again two did not know the reading was obtained by palpating or listening for the pressure sounds from the dorsalis pedis pulse point. Three said to compress the forearm and measure from the radial artery. Of the five interviewees mentioning two sites, four indicated the thigh and/or the lower leg or forearm. Only one individual was able to transfer sufficient knowledge to realize that obtaining a reading from either the forearm or lower leg involved similar principles and thus suggested both sites. Her method of measurement for either site was by palpation after compression of the artery. She did not suggest the thigh.

TABLE XIX

KNOWLEDGE OF FIFTY REGISTERED PROFESSIONAL NURSES REGARDING VARIOUS SITES OF INDIRECT BLOOD PRESSURE MEASUREMENT

Other Site	Number of Respondents	Percent (Asked)	Percent (All)
Thigh	32	78	64
Lower leg	10	24	20
Forearm	3	7	6
Not asked	10	24	20
Total	55*	132*	110*

*More than 50 respondents, or one hundred percent, because five nurses suggested two acceptable sites of measurement.

When questioned about varying the site of measurement, most of the respondents knew the blood pressure could be taken in a place other than the arm. The alternating site most frequently mentioned was the thigh. Several nurses also suggested the lower leg and forearm. Few of those nurses suggesting any site knew how the measurement was done. Many had never seen or done a measurement of a site other than the arm but they apparently made no attempt at reasoning out a similar technic. The nurses of this sample seemed unwilling or were unable to transfer the common principles involved in any indirect blood pressure measurement regardless of the limb used. Scientific reasoning was not evident.

Another question asked each nurse was, "All other factors being equal, would you expect a difference in readings between the arm and the thigh?" Bordley states that the systolic pressure in the arm may be 10 - 40 mm of mercury lower than in the thigh.[26] Fifty percent knew a difference could be expected, while another fifty percent were either uncertain or did not know.

	Number of respondents	Percent
Yes	25	50
No	10	20
Uncertain	15	30
Total	50	100

Of the twenty-five expecting a difference, only four, eight percent of all respondents, knew the arm measurement was 10 mm or more lower

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[26]Bordley, op. cit., p. 506.

than the thigh. This is shown in Table XX. The majority of those asked, six nurses, were uncertain, while the remaining fifteen interviewees varied their answers. Three of the latter group were able to say the reading could be lower, but did not think it would exceed 10 mm.

Seven of the fifty respondents knew blood pressure readings were usually lower in the subject's arm than in his thigh. This knowledge is directly comparable to that information gained on tissue mass at the site of measurement. In either case few of the nurses had accurate knowledge on the subjects. Personal investigation for depth of understanding seems lacking among the interviewees.

The final question put to each interviewee was, "When considering one arm pressure to the other arm pressure on the same individual, could you expect a difference in readings?" Forty-six, ninety-two percent, answered "yes"; only four said "no." None were uncertain. Table XXI gives this information.

It can be said that the greater percentage of all respondents had correct knowledge regarding this question. Investigation was not inclusive enough to seek the accurateness of the nurses' responses, nor the depth of their knowledge in this area. Since most nurses were aware of possible pressure differences in the arms of a subject, this knowledge would be valuable when that nurse was responsible for an initial reading which may later be used for comparison.

No correlation existed between site of measurement and the type of school each nurse graduated from, for both diploma and collegiate groups had the same mean score. A correlation was evident, however, between the site of measurement and job opportunities for measurement.

TABLE XX

KNOWLEDGE OF FIFTY REGISTERED PROFESSIONAL NURSES REGARDING DIFFERENCES IN READING ACCORDING TO SITE

Difference	Number of Respondents	Percent (Asked)	Percent (All)
Arm 10 mm or more higher than thigh	1	4	2
Arm 6 - 10 mm higher than thigh	3	12	6
Arm 1 - 5 mm higher than thigh	5	20	10
Arm 1 - 5 mm lower than thigh	0	0	0
Arm 6 - 10 mm lower than thigh	3	12	6
Arm more than 10 mm lower than thigh	4	16	8
No difference between arm and thigh	2	8	4
Uncertain	6	24	12
Other	1	4	2
Not asked	25	--	50
Total	50	100	100

By evidence of progressive means, the more job opportunities a nurse had for measurement, the more she knew about the site of measurement. Figure 5 shows this correlation and the mean scores for each group.

TABLE XXI

KNOWLEDGE OF FIFTY REGISTERED PROFESSIONAL NURSES REGARDING DIFFERENCE IN ARM PRESSURES ON THE SAME INDIVIDUAL

Arm Pressures Could Be Different	Number of Respondents	Percent
Yes	46	92
No	4	8
Uncertain	0	0
Total	50	100

In interpreting the findings shown in Figure 5, it could be concluded that the nurse working in delivery room, emergency room, intensive care unit or recovery room had the most accurate information about site of measurement. These hospital patient areas would also be most likely to make use of other site of measurement. More intensive study would be necessary to establish a possible relationship.

V. SUMMARY

Data on selected factors of indirect blood pressure measurement have been presented which were gathered from interviews with fifty registered professional nurses. The information aimed at determining the

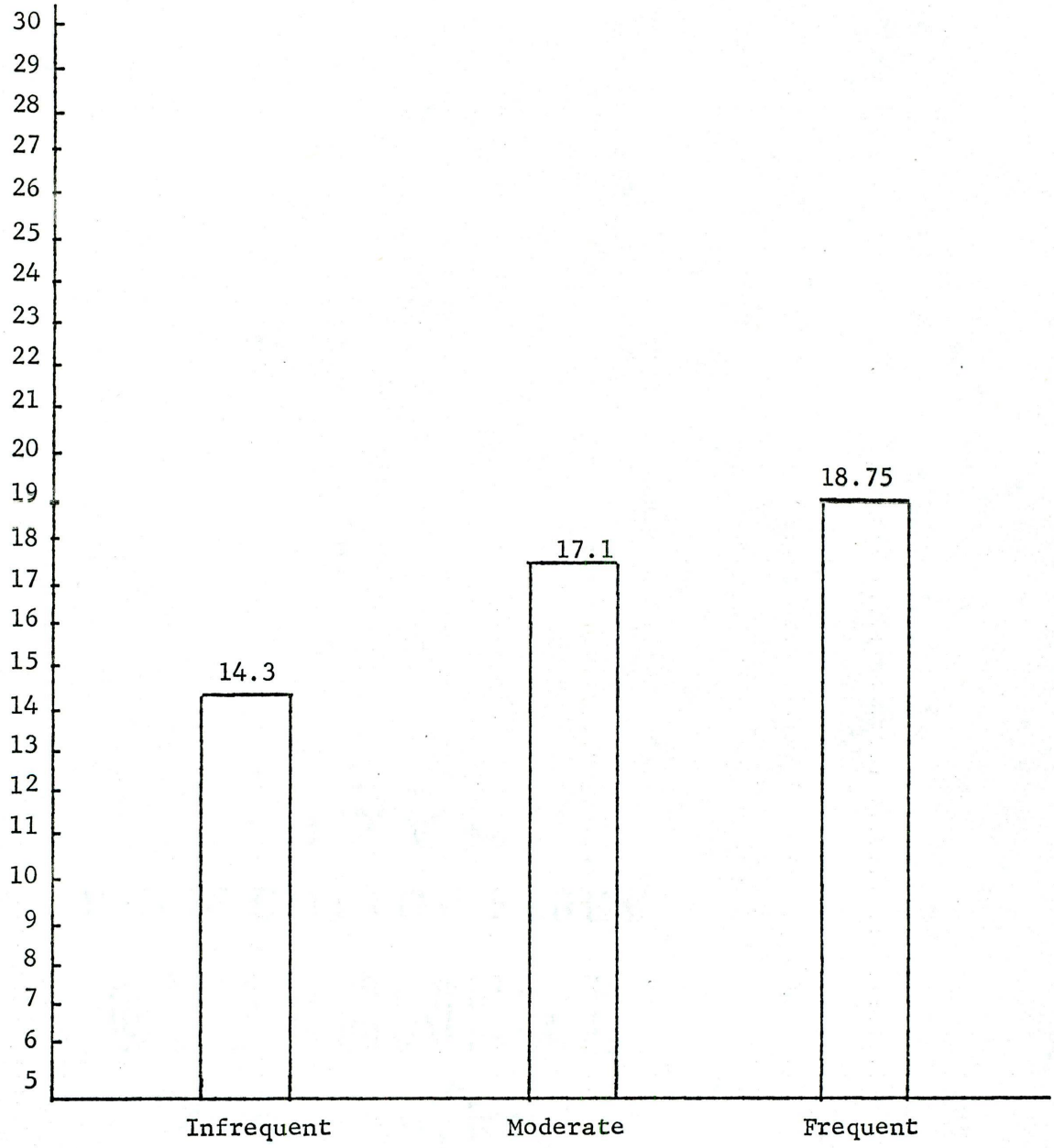

FIGURE 5

MEAN SCORES OF FIFTY REGISTERED PROFESSIONAL NURSES ABOUT SITE OF MEASUREMENT AS RELATED TO JOB OPPORTUNITIES FOR MEASUREMENT

amount of knowledge nurses had about certain facets in the technic of measurement. The areas considered were cuff width, emotions and activities, obesity and thinness, position of the subject, inflation and deflation of cuff pressure, and site of measurement. Information on several general areas as interviewee's method of measurement, identifying and recording readings, type of blood vessel and Korotkov sounds was also shown.

Correlations were made in a number of areas (see Figures 1 to 5) and five existed. Those nurses who had more employment opportunities for measuring blood pressure knew more about the relationship of cuff width, obesity and thinness, and site of measurement on blood pressure readings. The baccalaureate graduate knew more about obesity and thinness than the diploma graduate; and in contrast, the diploma nurse had more knowledge about cuff width. With only one respondent in the associate degree group, no statistical analysis could be made.

The sample population was small; therefore, statistical verification must be made on a larger group. Conclusions and recommendations follow in Chapter V.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to evaluate the concepts registered professional nurses had regarding selected factors influencing indirect measurement of blood pressure. It was hoped that contributions could be offered to nursing education and hospital inservice which would aid in providing more competent nursing service by direct application of the knowledge gained from this survey.

A review of the literature concerned the history of indirect measurement, errors encountered in measurement, and certain selected factors which could contribute to reading variations. From nearly two hundred years of research, blood pressure measurement has become a practical tool of evaluation for the preservation of human life. The two most significant contributions to its development were the construction of the manometer by Riva and Rocci in 1896, and in 1905, Korotkov distinguished five distinct phases of the sounds heard by auscultation. Literature primarily discusses two methods of indirect measurement. The auscultatory method involves listening for sounds through a stethoscope placed over an occluded artery while the sphygmomanometer cuff is slowly deflated. The palpatory method of measurement involves palpation of a compressed artery while the cuff is deflated. Other methods are in use but either tend to be inaccurate, cumbersome or impractical. Individual observers are one of the greatest sources of error in indirect measurement and contribute to variances on any one individual's reading usually through defects in hearing and/or measurement technic. Six selected

factors are investigated for use in this research. Studies show that cuff width influences the reading. A cuff of 12 - 15 cm wide is recommended for an average adult arm and that increasing or decreasing the width beyond these limits may produce a falsely high reading. Sudden emotions, as fear, anger or excitement will cause the reading to rise, while subdued activities as sleep will reduce it. As much difference as 30 mm of mercury may exist between a direct and indirect blood pressure reading on an obese individual, the indirect being erroneously elevated due to abnormal compression of the artery being measured. The most desirable position recommended for a subject prior to measurement is lying down or comfortably seated with the arm of measurement supported at the heart level on a smooth surface. This avoids venous stasis which could cause elimination of sounds during cuff decompression. Maintaining a rising and falling cuff pressure against an artery could cause the reading to become elevated; deflation of pressure can produce local changes in the artery and also change the reading. A steady deflation rate of 2 - 4 mm of mercury per second is recommended. The site used for measurement will reveal different readings. The systolic measurement of the subject's thigh can be expected to be 10 - 40 mm higher than his arm. Variances may also occur between the two arm pressures on one individual.

This study was explored through a descriptive survey method. Fifty registered professional nurses were interviewed by use of a structured interview schedule. Analysis of the data contributed to construction of tables and correlations as discussed in the preceeding chapter.

I. SUMMARY

Eighteen of the respondents utilized methods other than auscultation for blood pressure determination in their nursing practice. The most frequent alternative was the palpatory method. In most cases auscultation was preferred, since the nurses felt it to be more accurate. Only one and one half of every twenty-five nurses knew how to correctly identify a systolic reading. On the other hand, nearly twenty-five out of fifty respondents submitted accurate diastolic readings. Sixteen percent were able to correctly record a variable reading.

Seventy-six percent of the interviewees knew the pressure they measured was in the artery. However, ninety-six percent were not familiar with the Korotkov sounds and did not distinguish changes in the sounds they heard during auscultation.

Half of the group knew that varying the cuff width would influence the reading, yet only sixteen percent knew in what way it would be influenced. Twenty-three respondents could correctly estimate the proper cuff width to use on an average adult arm.

Nearly all the nurses knew the effects of sudden emotions and sleep on the blood pressure reading as well as knowing an elevated reading could occur in an obese individual when compared to one of average weight. They had difficulty determining how much higher it could be expected to vary and were very conservative in their responses by usually not suggesting more than 10 mm. Even though they knew obesity could cause elevation of pressure, they did not know excessive tissue mass at the site of measurement had the same results. Because of discrepancies

in the responses to the questions asked on obesity and tissue mass, evaluation of the nurses' replies could not determine if they were responding to the effect of obesity on the blood pressure rather than its effect on the accuracy of measurement.

Most nurses either preferred having the subject lying down or sitting when measuring his pressure. Only six used both positions as recommended. Forty-three respondents placed the arm to be measured level with the heart, but only two supported it on a smooth surface.

Three fourths of the sample routinely pumped the pressure cuff no higher than 180 mm of mercury on initial trial of pressure determination. For as many respondents that knew maintaining pressure against an occluded vessel for longer than thirty seconds influenced the reading, there were an equal number who did not. Forty-one interviewees were familiar with rapid deflation causing an inaccurate reading, yet only sixteen correctly knew in what way.

The majority realized blood pressure could be taken in a place other than the arm. Half of the group expected a difference in reading between the arm and the thigh, but only seven knew the thigh measurement was usually higher. Forty-six respondents knew a difference in arm pressures on the same individual could occur.

Correlations were made in a number of areas. There was no relationship found between the type of school the nurse graduated from and the additional preparation she had gained since graduation. The value of chi square correlation also did not indicate a significance between employment opportunities for measurement and additional preparation following graduation. Positive correlations did exist in five areas. Those

nurses who had more employment opportunities for measuring blood pressure knew more about cuff width, obesity and thinness, and site of measurement. The collegiate graduate knew more about obesity and thinness than the diploma graduate. The diploma nurse had more knowledge about cuff width. With only one respondent in the associate degree group, no statistical analysis could be made. The year of the nurses' graduation was also eliminated due to errors encountered in gathering the data.

II. CONCLUSIONS

With the small population studied, it was not possible to generalize on the knowledge of professional nurses concerning the effect of certain selected factors on indirect blood pressure measurement. The following conclusions, however, were drawn from the analysis of the data obtained from the professional nurses studied.

1. Because they did not show evidence of transfer of scientific principles of indirect blood pressure measurement from one situation to another as was especially evidenced in studying the site of measurement, and because indirect blood pressure measurement tended to be conducted mechanically by the nurses, and because they did not appear as concerned with noting the physiological variances of the sounds as they were in obtaining just the systolic and diastolic levels, it was concluded that blood pressure measurement was taught as a skill rather than a procedure based on scientific principles.
2. Little evidence was seen that the nurses kept pace with

current developments in measurement as described in literature. They had difficulty adding scientific depth and frequently gave only partial answers. Physiological responses of the body and its effect on blood pressure readings did not seem to be of prime consideration to the interviewees during their measurement performances when questioned about cuff inflation and deflation. This was somewhat improved regarding emotions and activities. The nurses were inadequately informed about the Korotkov sounds, cuff width, obesity and thinness, and site of measurement. It was concluded that more emphasis needed to be placed on teaching in these areas.

3. It was concluded from the evidence obtained that the hypothesis is accepted.

III. RECOMMENDATIONS

Based on the preceding conclusions, the following recommendations are made to improve the nursing practice of indirect blood pressure measurement.

1. That hospital inservice education take responsibility for instruction in various aspects of indirect blood pressure measurement. Inservice education should assess the needs of its members concerning this topic and give consideration to those areas of weakness. Instruction should not only include the mechanics of correct measurement, but suggest the scientific basis and principles for the methods so that

the graduate nurse may become aware of the physiological response of the body to the technique.

2. That schools of nursing re-evaluate its content of instruction on the indirect measurement of blood pressure. Revision may be necessary to unify common concepts regarding blood pressure. It should also be realized that certain aspects of measurement are controversial in explanations regarding the physiological process involved.

IV. IMPLICATIONS FOR FURTHER STUDY

Further study is suggested in the following areas:

1. That a study similar to this one but of greater depth be conducted into the responses of the nurses on the selected factors presented in this study.
2. That further studies be conducted on a variety of other factors, not here included, that also affect indirect measurement of blood pressure.
3. That studies be conducted to assess the relationship of the nurses' knowledge of theory regarding any nursing subject to his nursing practice of that topic.
4. That a study be conducted regarding how well the graduate nurse keeps abreast of other new developments in the area of nursing.

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APPENDIX

INTERVIEW SCHEDULE

Identifying number -

Area of present employment:

Delivery Room	Surgery
Emergency Room	Recovery Room
Intensive Care	Ward
Nursery	Other
Out Patient Clinic	

1. Do you always use a sphygmomanometer plus a stethoscope when recording an individual's blood pressure?

   a. Yes

   b. No

   c. Uncertain

2. If no, please explain.

3. Which do you prefer and why?

4. How do you identify the systolic level when recording a blood pressure?

   a. First audible sound

   b. First clear, steady rhythm of sound

   c. First palpatory sensation upon release of pressure

   d. First audible sound or palpatory sensation - whichever is highest

   e. Uncertain

   f. Other

5. How do you identify the diastolic level?

   a. Last audible sound

   b. Beginning muffling of clear sound

   c. Last audible sound of ending before zero, otherwise beginning muffling of sound

   d. Cessation of rhythm but not sound

   e. Uncertain

   f. Other

6. On this piece of paper, would you please write down how you would record the following: After initial pumping up of the sphygmomanometer cuff and gradual release of that pressure, the first sound you heard through the stethoscope was noted at 120 mm of mercury. With continued deflation the clear, steady sound became muffled at 80 mm of mercury and final cessation of all sound at 60 mm of mercury.

7. Physiologically speaking, do you think varying the sphygmomanometer cuff width would influence blood pressure readings?

   a. Yes

   b. No

   c. Uncertain

8. In regard to the last question, how will varying the width affect the reading?

   a. Narrow cuff increases reading

   b. Narrow cuff decreases reading

   c. Wide cuff increases reading

   d. Wide cuff decreases reading

   e. No difference in reading

   f. Uncertain

9. What would you say was a reasonably correct cuff width to use on an average adult? (Allow estimation with a ruler)

   a. Below 10 cm (4 inches)

   b. 10 - 11.5 cm (4 - 4.6 inches)

   c. 12 - 14.5 cm (4.8 - 5.8 inches)

   d. 15 cm or above (6 inches)

   e. Uncertain

10. What type of blood vessel is blood pressure commonly recorded in?

   a. Artery

   b. Vein

   c. Uncertain

11. How will such sudden emotions as fear, anger or excitement affect the blood pressure measurement?

   a. Increase it

   b. Decrease it

   c. Remain unchanged

   d. Uncertain

12. What about sleep?

   a. Increase it

   b. Decrease it

   c. Remain unchanged

   d. Uncertain

13. Considering other factors equal, would you expect blood pressure to be different in an obese individual as compared to one of average weight?

    a. Yes

    b. No

    c. Uncertain

14. If so, in what way would it be different?

    a. Significantly higher (above 10 mm of mercury)

    b. Slightly higher (1 - 10 mm)

    c. Slightly lower (1 - 10 mm)

    d. Significantly lower (above 10 mm)

    e. Remain unchanged

    f. Uncertain

15. Do you think the amount of tissue mass at the site of measurement, this interpreted as the thickness of muscle present, would influence blood pressure measurement in any way?

    a. Yes

    b. No

    c. Uncertain

16. How would the amount of muscle affect the reading?

    a. Thinness increases it

    b. Thinness decreases it

    c. Developed musculature increases it

    d. Developed musculature decreases it

    e. Remain unchanged

    f. Uncertain

17. What body position do you frequently select when obtaining a routine blood pressure reading on an ambulatory patient?

    a. Semi-Fowler's - in bed

    b. Fowler's - in bed

    c. Supine

    d. Sitting in chair

    e. Standing

    f. No special position

18. With the patient in a semi-Fowler's position in bed, how do you position the arm in relation to the heart level when recording the pressure?

    a. Level with heart

    b. Supported on a pillow

    c. Hanging down

    d. Above heart level

    e. No special position

    f. Other

    g. Uncertain

19. Have you ever heard of the Korotkov sounds in blood pressure measurement?

    a. Yes

    b. No

    c. Uncertain

20. Do you know what the Korotkov sounds are?

    a. Yes

    b. No

    c. Uncertain

21. If so, would you describe them to me?

22. When initially pumping up the cuff on an average reasonably healthy adult, how high do you routinely go?

    a. Above 180 mm of mercury

    b. 140 - 180 mm

    c. 120 - 140 mm

    d. Below 120 mm

    e. Uncertain

23. Do you feel that maintaining cuff pressure against the arm for any period of time above 30 seconds is likely to influence the reading?

    a. Yes

    b. No

    c. Uncertain

24. If so, for what reason?

25. Do you feel that rapid deflation of the cuff pressure will give you an inaccurate reading?

    a. Yes

    b. No

    c. Uncertain

26. In what way?

    a. Significantly raise diastolic (above 10 mm of mercury)

    b. Slightly raise diastolic (1 - 10 mm)

    c. Slightly lower diastolic (1 - 10 mm)

    d. Significantly lower diastolic (above 10 mm)

e. Remain unchanged

f. Uncertain

g. Other

27. How fast do you recommend deflation of cuff pressure as expressed in mm/sec?

a. Above 7 mm/sec.

b. 5 - 7 mm/sec.

c. 2 - 4 mm/sec.

d. Below 2 mm/sec.

e. Varied

f. Uncertain

28. In addition to the arm, can the blood pressure be taken elsewhere?

a. Yes

b. No

c. Uncertain

29. Where and how?

a. Thigh

b. Forearm

c. Lower leg

d. Other

30. All other factors being equal, would you expect a difference in reading between the arm and thigh?

a. Yes

b. No

c. Uncertain

31. If so, what difference?

    a. Arm 1 - 5 mm of mercury higher than thigh

    b. Arm 6 - 10 mm higher than thigh

    c. Arm more than 10 mm higher than thigh

    d. Arm 1 - 5 mm lower than thigh

    e. Arm 6 - 10 mm lower than thigh

    f. Arm more than 10 mm lower than thigh

    g. No difference between arm and thigh

    h. Uncertain

    i. Other

32. When considering one arm pressure to the other arm pressure on the same individual, could you expect a difference in readings?

    a. Yes

    b. No

    c. Uncertain

Type of nursing program completed:

    a. Associate of science (or) art

    b. Diploma

    c. Collegiate

Year of graduation:

    a. 1964-1965

    b. 1960-1963

    c. 1950-1959

    d. 1940-1949

    e. Prior to 1940

Of the following list of items that I will read, would you please tell me if you have had any additional preparation concerning the measurement of blood pressure?

a. Inservice

b. Physicians

   (1) Individual

   (2) Meetings

c. Personal reading

d. Courses

   (1) Physiology

   (2) Refresher nursing course

e. Other nurses

f. Other

LOMA LINDA UNIVERSITY

Graduate School

SURVEY OF KNOWLEDGE OF FIFTY REGISTERED PROFESSIONAL NURSES REGARDING SELECTED FACTORS OF INDIRECT BLOOD PRESSURE MEASUREMENT

by

Audrey Gayle Krueger

An Abstract of a Thesis

in Partial Fulfillment of the Requirements

for the Degree Master of Science

in the Field of Nursing

August 1966

This study was concerned with determining the knowledge registered professional nurses had regarding selected factors that contributed to variations in the indirect measurement of blood pressure. It was thought that assessment of the nurses' knowledge could contribute to more effective nursing service by disclosing areas of weakness which could be strengthened by hospital inservice and nursing education. Literature was reviewed on the methods of measurement in current use, common errors encountered in indirect measurement, and selected factors that influence blood pressure readings, i.e., cuff width, emotions and activities, obesity versus thinness, position of the subject, inflation and deflation of cuff pressure, and site of measurement. The information provided a foundation for this investigation. The method of study used was the descriptive survey type; the tool for collecting information a structured interview. Fifty regularly employed registered professional nurses were interviewed. The information obtained was scored, compiled, and analyzed. It was found that the most frequent alternate method of measurement the nurses used, other than auscultation, was the palpatory method. In general, most nurses could not correctly identify a systolic reading nor correctly record a reading containing variables. Only one half of the fifty respondents identified the diastolic reading adequately. Ninety-six percent did not distinguish changes in the sounds they heard during auscultation. The nurses were well informed about the effect of emotions and sleep on the blood pressure reading, but had little knowledge about the effect of cuff width, inflation and deflation of cuff pressure and site of measurement on blood pressure readings. Most

respondents positioned the subject as recommended by the American Heart Association and knew the arm to be measured should be level with the heart. They knew an elevated reading could be expected in the obese individual. They did not know that excessive tissue mass or thinness at the site of measurement affected the reading. Chi square correlations revealed that there were no relationships found between the type of school from which the nurse graduated or employment opportunities for measurement to the additional preparation she gained since graduation. Positive correlations did indicate that those nurses who had more employment opportunities for measurement knew more about cuff width, obesity and thinness, and site of measurement. The baccalaureate graduate knew more about obesity and thinness than the diploma graduate and in contrast, the diploma graduate had more knowledge about cuff width. It was concluded that the professional nurses were unable to transfer scientific principles of indirect measurement. They tended to mechanically measure the blood pressure and were not necessarily concerned with noting the physiological responses of the body as evidenced in the sounds. The nurses' answers did not indicate that they kept abreast of new developments in blood pressure measurement. Little scientific depth was incorporated in their responses.