

PERSONAL DIGITAL ASSISTANTS: THEIR INFLUENCE ON
CLINICAL DECISION-MAKING AND THE UTILIZATION OF EVIDENCE-BASED
PRACTICE IN BACCALAUREATE NURSING STUDENTS

A Dissertation

Submitted to the School of Nursing

Duquesne University

In partial fulfillment of the requirements for
the degree of Doctor of Philosophy

By

Carol S. Gorelick

May 2010

Copyright by
Carol S. Gorelick

2010

PERSONAL DIGITAL ASSISTANTS: THEIR INFLUENCE ON
CLINICAL DECISION-MAKING AND THE UTILIZATION OF EVIDENCE-BASED
PRACTICE IN BACCALAUREATE NURSING STUDENTS

By

Carol S. Gorelick

Approved February 24, 2010

Carolyn J. Nickerson, EdD, MSN, MA,
RN, CNE
Associate Professor of Nursing
(Committee Chair)

Gladys Husted, PhD, RN, CNE
Professor Emeritus, School of Nursing
(Committee Member)

Lenore Resick, PhD, CRNP, FNP-BC,
NP-C, FAANP
Associate Professor of Nursing
(Committee Member)

Gibbs Kanyonga, PhD
Assistant Professor of Educational
Statistics
(Committee Member)

Eileen Zungolo, EdD, RN, CNE, FAAN,
ANEF
Dean, School of Nursing
Professor of Nursing

Joan Lockhart, PhD, RN, CORLN
AOCN®, CNE, FAAN
Associate Dean, School of Nursing
Professor of Nursing

ABSTRACT

PERSONAL DIGITAL ASSISTANTS: THEIR INFLUENCE ON CLINICAL DECISION-MAKING AND THE UTILIZATION OF EVIDENCE-BASED PRACTICE IN BACCALAUREATE NURSING STUDENTS

By

Carol S. Gorelick

May 2010

Dissertation supervised by Carolyn Nickerson, EdD, RN, CNE

During the last decade, the advent of the personal digital assistant (PDA) and the development of clinical software specific to nursing practice have changed the way that many nurses manage information and workload. More recently, PDAs have become a standard tool in undergraduate nursing education. Though there is substantial discussion in the literature on PDA technology, the emphasis there has been descriptive and anecdotal. Since 2002, nurse authors have reported that PDA use has reduced medication errors and streamlined data gathering. This has lead to speculation that use of the PDA is a clinical tool that supports evidence-based practice and the complex thinking necessary for sound clinical decision-making. Such speculation has been one factor in the rapid adoption of the PDA by many baccalaureate programs. However, there is a paucity of research supporting this conjecture. In fact, the PDA has been accepted as a tool that

supports evidence-based practice and clinical decision-making in the absence of validation. The anecdotal data reported are insufficient to support the extension of this device in both nursing practice and education. Hence, the objective of this study was to provide some quantitative validation for the future application of this promising clinical and educational tool.

A descriptive, correlational design was used to compare the performance of upper-class nursing students who have used PDAs and upper-class nursing students who have not used PDAs on measures of clinical decision-making (Clinical Decision-Making in Nursing Scale [CDMNS]) and evidence-based practice (Evidence-Based Practice Questionnaire [EBPQ]). Data were analyzed using the independent t-test, Spearman's rho correlation, and multiple regressions. There were no significant differences between PDA users and non-users on measures of clinical decision-making. However, there was a significant difference in use of evidence-based practice ($p < 0.05$) for those who occasionally used the PDA as opposed to those who never used the device. Furthermore, several demographic variables influenced the scores of both the CDMNS and the EBPQ.

DEDICATION

This study is dedicated to the memory of my dear sister Mary Whelan, one of my staunchest supporters. While she was alive, Mary was always enthusiastic for my numerous endeavors and offered an unwavering belief in my ability to fulfill this dream. Though she is no longer here to see the fruits of my labor, her spirit was present and guided me throughout the dissertation process. Mary, I know that you will be smiling when I receive my hood.

ACKNOWLEDGEMENT

This doctoral experience would not have come to fruition without the support of numerous individuals, and it is with gratitude that I acknowledge the following people.

To my husband, Paul, who offered me unwavering support during my schooling.

To our children, who have offered support, encouragement, and especially patience during this process.

To Dr. Carolyn Nickerson, the chair of my dissertation committee. You jumped aboard the bandwagon in the middle of production, and as any great conductor, never missed a beat. Your knowledge has been an inspiration to me and you've kept me on the road to success with your patience, guidance, and unfaltering faith in my ability.

To Dr. Gladys Husted, committee member, who has shared with me her expertise in nursing education and ethics. You are the essence of what every nurse educator strives to be.

To Dr. Lenore Resick, committee member, whose passion for qualitative research has proved to be contagious. Many thanks for sharing with me your research and knowledge of the subject.

To Dr. Gibbs Kanyongo, committee member, who kept me on the statistical path to success.

To the entire SON doctoral faculty who have gotten me to this final step.

Last, but not least, to my sisters, and especially Joan Straka, who has supported me throughout the entire doctoral journey, physically, emotionally, and spiritually. I couldn't have done it without you, Joanie.

TABLE OF CONTENTS

	Page
Abstract.....	iv
Dedication.....	vii
Acknowledgement.....	viii
List of Tables.....	ix
1. Introduction and Overview	1
1.1 Introduction.....	1
1.2 Impact of IT on Health Care.....	2
1.3 Contributions of Personal Digital Assistants (PDAs) to Nursing Education and Practice.....	4
1.4 Lack of Evidence-Based Guidelines for PDA Use in Healthcare	5
1.5 Purpose.....	6
1.6 Long Term Goals of this Program of Study.....	6
1.7 Research Questions.....	7
1.8 Significance to Nursing Education.....	8
1.9 Significance to Clinical Practice.....	9
1.10 Significance to Evidence-Based Practice.....	10
1.11 Expansion of Nursing Knowledge Base.....	11
1.12 Definition of Terms.....	12
1.13 Assumptions of the Study.....	13
1.14 Limitations of the Study.....	13
1.15 Summary.....	14

2. Review of the Literature	16
2.1 Introduction.....	16
2.2 Theoretical Perspective for the Study.....	16
2.3 Decision Making Theories.....	20
2.3.1 Information Processing Theory.....	20
2.3.2 Intuitive-Humanist Model.....	20
2.3.3 Strengths and Limitations of Decision Making Theories.....	21
2.4 Decision Making Continuum.....	22
2.5 Clinical Learning.....	23
2.5.1 Definition of Clinical Learning.....	23
2.5.2 Learning Outcomes in the Clinical Setting for Safe Nursing Practice.....	23
2.5.3 Relationship to Clinical Decision-Making and Evidence Based Practice.....	25
2.6 Critical Thinking.....	26
2.6.1 Relationship to Clinical Learning.....	27
2.6.2 Relationship to Clinical Decision Making.....	27
2.6.3 Relationship to Evidence-Based Practice.....	27
2.7 Clinical Decision-Making.....	28
2.7.1 Thinking Processes of Nurses in Clinical Decision-Making.....	28
2.8 Instruments for Measuring Clinical Decision-Making.....	30
2.9 Clinical Decision-Making in Nursing Scale.....	33
2.10 Evidence-Based Practice.....	36
2.10.1 Evidence-Based Practice Movement.....	36

2.10.2 Importance of Evidence-Based Practice.....	37
2.10.3 Lack of Utilization of Evidence-Based Practice in the US.....	39
2.10.4 PDAs for Enhancing the Utilization of Evidence-Based Practice.....	40
2.10.5 Instruments for Measuring the Utilization of Evidence- Based Practice.....	41
2.11 Evidence-Based Practice Questionnaire.....	41
2.12 PDA Adoption in Healthcare.....	43
2.13 PDAs in Education.....	44
2.14 PDAs in the Health Professions.....	45
2.15 Use of PDAs in Nursing Practice and Education.....	47
2.16 Rationale for Present Study.....	53
2.17 Summary.....	54
3. Methodology	56
3.1 Overall Approach.....	56
3.2 Research Design.....	56
3.3 Sample Site and Selection.....	56
3.4 Human Subject Consideration.....	57
3.5 Subject Recruitment.....	58
3.6 Instrumentation.....	59
3.6.1 Clinical Decision-Making in Nursing Scale.....	59
3.6.2 Evidence-Based Practice Questionnaire.....	62
3.6.3 Demographic Survey.....	62
3.7 Data Collection Procedures.....	62

3.8 Procedures for Data Analysis.....	63
3.8.1 Stage 1: Descriptive Analysis.....	64
3.8.2 Stage 2: Reliability Analysis.....	64
3.8.3 Stages 3 – 5: Exploratory Analysis of the Research Questions.....	65
3.9 Sample Size.....	66
3.10 Summary.....	67
4. Results.....	68
4.1 Introduction.....	68
4.2 Description of the Sample.....	68
4.3 Demographic Characteristics of the Sample.....	69
4.4 Confirmatory Analysis of Study Instruments.....	72
4.4.1 Clinical Decision-Making in Nursing Scale.....	72
4.4.2 Evidence-Based Practice Questionnaire.....	73
4.5 PDAs.....	73
4.5.1 Criteria Used to Define PDA and Non-PDA Users.....	73
4.5.2 PDA Use.....	74
4.5.3 Patterns of PDA Use.....	75
4.6 Significant Differences on Other Demographic Parameters.....	76
4.7 Reference Software Use.....	76
4.8 Exploratory Analysis of the Data.....	77
4.9 Summary.....	85
5. Discussion and Summary.....	88
5.1 Overview of the Study.....	88

5.2 Descriptive Findings Regarding PDA Use.....	89
5.3 Effects of PDA Use on Clinical Decision-Making.....	90
5.4 Effects of PDA Use on Utilization of Evidence-Based Practice.....	92
5.5 Relationship between PDA Use and Clinical Decision-Making.....	93
5.6 Relationship between PDA Use and Evidence-Based Practice.....	93
5.7 Demographic Variables Influencing Clinical Decision-Making and EBP.....	93
5.7.1 Clinical Decision-Making.....	93
5.7.2. Evidence-Based Practice.....	96
5.8 Limitations of the Study.....	97
5.9 Implications for Nursing Education and Practice.....	97
5.9.1 Nursing Education.....	97
5.9.2 Nursing Practice.....	98
5.10 Recommendations for Future Research.....	99
5.11 Summary.....	101
List of References.....	102
Appendix 1 E-mails to Students.....	115
Appendix 2 Flyers for School Placement.....	118
Appendix 3 Clinical Decision Making in Nursing Scale.....	121
Appendix 4 Evidence-Based Practice Questionnaire.....	129
Appendix 5 Demographic Survey.....	132
Appendix 6 Cover Letter.....	134
Appendix 7 Deans' Letters.....	136
Appendix 8 Internal Review Board Approvals.....	139

LIST OF TABLES

	Page
Table 4.1 Demographic Characteristics of the Sample including PDA Use.....	71
Table 4.2 Frequency of PDA Use.....	74
Table 4.3 Specific Demographic Characteristics and Patterns of PDA Use.....	75
Table 4.4 Frequency of Computer Use in Clinical Agency and Hours Worked Weekly in Healthcare.....	76
Table 4.5 Frequency of Reference Software Use.....	77
Table 4.6 Means and Mean Differences of the CDMNS and Subscale (A – D) Scores...	78
Table 4.7 Means and Mean Differences of the EBPQ and Subscales (1 – 3) Scores.....	80
Table 4.8 Mean Differences of Frequency of PDA Use and EBPQ Subscale 1.....	81
Table 4.9 Correlation Matrix of EBPQ Scores and PDA Use.....	82
Table 4.10 Regression Analysis of Demographic Traits and Total CDMNS.....	83
Table 4.11 Regression Analysis of Significant Demographic Traits and CDMNS Subscales A, C, D.....	84
Table 4.12 Regression Analysis of Demographic Traits and EBPQ Subscale 2.....	85

Chapter 1

Introduction and Overview

1.1 Introduction

The remarkable advances in information technology (IT) in the past decade have had a tremendous influence on all aspects of our society. With the expanding capabilities of IT, information and its organization are rapidly at hand. The effects of IT proliferation are readily seen in business, industry, education, and, most recently, healthcare. As this gradual integration of IT occurs within the healthcare arena, an entirely new healthcare model is being created, one in which quality is about how much nurses know as opposed to how many they number. In this information age, readily available knowledge is the key success factor (Simpson, 2007). Consequently, nursing education and practice are being challenged as never before. Nursing faculty must now groom students to remain competitive in the health care work force with proficiency not only in clinical skills and decision-making, but also in information technology (Huffstutler, Wyatt, & Wright, 2002).

The purpose of this chapter is to describe the context for, and provide background information on, the relevance of personal digital assistant (PDA) use by nursing students and their clinical decision-making and engagement in evidence-based practice (EBP). The research questions, conceptual and operational definitions of the main variables, and the study's significance to nursing education and practice are also addressed.

1.2 Impact of IT on Healthcare

Two landmark reports by the Institute of Medicine (IOM) have further supported the emerging dynamics behind the changing face of healthcare. The first, *To Err is Human: Building a Safer Health System* (IOM, 1999), identified an alarming rate of preventable medical errors and stated that IT application is integral to improving the quality of the nation's healthcare system (Oritz, 2003). One of the main conclusions of the report was that the majority of medical errors do not result from individual negligence or misconduct, but rather from flawed systems, processes, and conditions that lead individuals to err, or fail to prevent them from doing so (1999). Information technology can reduce the rate of errors in the following three ways: by preventing errors and/or unfavorable events, by facilitating a more rapid response after an adverse event, and by tracking and providing feedback about adverse events (Bates & Gawanda, 2003).

The second report, *Crossing the Quality Chasm: A New Health System for the 21st Century* (2001) explicitly addressed the failure of the healthcare industry and the educational systems that produce future practitioners stating that the nation's healthcare industry delivery system has fallen significantly short "... in its ability to translate knowledge into practice and to apply new technology safely and appropriately" (2001, p.3). The report identified the significant role of information technology in designing a health system that produces care that is safe, effective, patient-centered, timely, efficient, and equitable. It also urged healthcare providers to embrace technology and adopt evidence-based practice as a means to increase patient safety and improve the quality and cost effectiveness of care delivery (Pierce, 2005).

More importantly, this report recommended a restructuring of clinical education, and so in 2003 a meeting of an interdisciplinary team of health profession leaders addressed the reconstruction of clinical education. Known as the Committee on the Health Professions Education Summit, the group identified five core competencies that all clinicians across healthcare disciplines should possess to meet the needs of the 21st century healthcare system. These competencies include providing patient-centered care, working in multidisciplinary teams, applying quality improvement, using EBP, and utilizing informatics (Burns & Foley, 2005).

Encouraged by the advances in IT and persuaded by the above recommendations, a strategy for a National Health Information Infrastructure (NHII) was developed by the government and released in 2004. This framework pursues four major objectives to realize the nation's vision for improved health care. The goals include introduction of information tools into clinical practice, electronic interconnection of clinicians to each other, using information tools to personalize care delivery, and advancing surveillance and reporting for population health improvement (Brailer, 2004).

The nursing education community has also responded to these proposals. The American Association of Colleges of Nursing (AACN) initiated two new programs, the Clinical Nurse Leader and the Doctor of Nursing Practice, that include informatics competencies in a foundational way (Warren & Connors, 2007). More recently, the National League for Nursing (NLN, 2008) issued a call for all nursing programs to graduate students with current knowledge and skills in computer literacy, information literacy, and informatics.

1.3 Contribution of Personal Digital Assistant (PDA) Use to Nursing Education and Practice

The personal digital assistant has emerged as one educational technology resource to aid in developing information processing skills. The uses for the PDA are numerous as it stores, organizes, processes, and allows for instant retrieval of important data (Cornelius, 2005). This device offers nursing students the potential to retrieve and organize data, access up to date clinical information, and enhance the immediacy of patient teaching (Altmann & Brady, 2005). Furthermore, by enhancing the students' ability to gather data and build information and knowledge, new knowledge results (Thompson, 2005). Moreover, knowledge that is obtained at the point of care is more likely to be remembered by the learner (Nissen, Abdulla, Khandheria, Kienzle, & Zaher, 2004). Thus, emerging data support the claim that handheld technology encourages active learning by engaging students in information seeking activities at the point of care (Cornelius, 2005; Goldsworthy, Lawrence & Goodman, 2006).

Evidence-based practice (EBP) has been heralded as an important course for 21st century healthcare and healthcare education. EBP may promote more individualized care and provide a framework for clinical decision-making, thus allowing clinicians the ability to remain informed of best practice in their specialty (Pape, 2003; Upton & Upton, 2006). The literature clearly signifies EBP as the key to sustaining quality and access in cost-constrained environments (Jennings, 2000; Shirey, 2006). However, for the universal utilization of evidence-based practice, clinicians need easy-to-use handheld tools (Fontelo & Ackerman, 2004). Sackett and Straus (1998) demonstrated that physicians who had easy access to evidence-based resources during rounds actually increased the extent to which they sought and utilized evidence for patient care decisions.

The mobility of the PDA offers the clinician the ability to access information and transfer it into useful knowledge for decision support at the point of care (Fontelo & Ackerman, 2004). Though the PDA does not offer the full functionality of the personal computer, the emergence of *Smart* technology does. With the introduction of wireless connectivity there has been an increasing capacity for remote access to clinical data repositories and web-based sources of evidence using handheld devices (Bakken, Cimino, & Hripcsack, 2004). Such technological innovations can indeed facilitate EBP.

1.4 Lack of Evidence-based Guidance for PDA Use in Health Care

Though there is substantial discussion in the literature on PDA technology, it has been primarily descriptive and anecdotal. Since 2001, nurse authors have reported that PDA use has reduced medication errors and streamlined data gathering (Eastes, 2001; Goss & Carrico, 2002; Ruland, 2002). This has led to speculation that use of the PDA is a clinical tool that supports evidence-based practice and the complex thinking necessary for sound clinical decision-making (Cornelius, 2005; Goldsworthy, Lawrence & Goodman, 2006). Such speculation has been one factor in the rapid adoption of the PDA by many baccalaureate programs. However, there is a paucity of research supporting this conjecture. In fact, the PDA has been accepted as a tool that supports evidence-based practice and clinical decision-making in the absence of validation. The anecdotal data reported are insufficient to support the extension of this device in both nursing practice and education, and there are few quantitative research studies found to date in the literature (Cornelius, 2005; Goldsworthy, Lawrence & Goodman, 2006).

For strategic use of the PDA, both in nursing education and practice, many questions must be answered by nurse educators. These questions include how best to

implement and use such tools; which teaching-learning practices are enhanced; how student and faculty development is facilitated; and which outcomes are best achieved with PDA use (Jeffries, 2005). Only when the answers to these questions are described and publicized will the profession have the evidence-based guidance for PDA utilization.

1.5 Purpose

The specific objective of this study was to explore the relationship between BSN students' use of personal digital assistants (PDAs), their perceptions of their clinical decision-making ability, and their utilization of evidence-based practice. Very little research exists investigating the use of PDAs in healthcare, and specifically, whether or not the tool contributes to supporting clinical decision-making and, thus, the quality of nursing care (Cornelius, 2005). Furthermore, there is a very limited body of knowledge regarding handheld technology in nursing education (Koeniger-Donohue, 2008). Finally, this research will begin to shed some light on whether PDAs encourage the utilization of evidence-based practice. With directives from the government, numerous professional organizations, and policy groups calling for evidence as the basis for healthcare decisions (Shirey, 2006), any approaches, including technology, which support EBP should be investigated, documented, and encouraged.

1.6 Long Term Goals of this Program of Study

The long term goals of the program of study being inaugurated with this proposal include the following:

1. Replication of this project with a larger sample and randomization.
2. Further study of PDA use in a variety of contexts and clinical environments.

3. Exploration and testing of additional applications for emerging handheld technology which can further enhance its value as a teaching tool
4. Investigation of the utilization of PDAs by faculty and the influence this use has on students.
5. Exploration and development of applications for the PDA and other emerging technology for faculty (i.e.. record keeping, evaluation, *Twitter*).

Programs of study such as these are needed as information technology is transforming the design, delivery, and evaluation of nursing education (Jeffries, 2005).

1.7 Research Questions

The study will consist of the following research questions:

- Question 1. Do upper-level (junior and senior) nursing students who have used PDAs as part of their undergraduate curriculum differ from upper-class nursing students who have not used PDAs as part of their undergraduate curriculum on perceived clinical decision-making as measured by the Clinical Decision-Making in Nursing Scale (CDMNS)?
- Question 2. Do upper-level nursing students who have used PDAs as part of their undergraduate curriculum differ from upper-class nursing students who have not used PDAs as part of their undergraduate curriculum on utilization of evidence-based practice (EBP) as measured by the Evidence-Based Practice Questionnaire (EBPQ)?
- Question 3. What is the relationship between PDA use and perceived clinical decision-making?

- Question 4. What is the relationship between PDA use and the utilization of evidence-based practice?
- Question 5. What is the relationship between perceived clinical decision-making, evidence-based practice, and the demographic variables of gender, age, ethnicity, marital status, academic level, GPA, use of on-line information resources at the student's clinical agency, and employment status (within healthcare)?

1.8 Significance to Nursing Education

PDA technology offers nursing education an innovative method for teaching and learning. Presently, the most transforming power of the PDA comes from its ability to carry deskbound resources for more efficient use (Thompson, 2005). This allows students to obtain accurate information at the point of care, thus maximizing their learning time (Altmann & Brady, 2005). Additionally, this mobile method can allow for the collection and organization of patient assessment data along with the selection of appropriate diagnoses and interventions, thereby enhancing student mastery of the nursing process (Cornelius, Glasgow, Gordon, & Draper, 2006). Other identified advantages include improved motivation, improved student perception for the need to use current resources, and an increased number of questions arising from the clinical experience (Goldsworthy, Lawrence & Goodman, 2006). Moreover, PDAs have been shown to reinforce core knowledge for practice as well as strengthen students' professional confidence by allowing for immediate patient feedback (White, et al., 2005).

Though research is quite limited on PDA use in undergraduate nursing education, what has been offered lends to the belief that the personal digital assistant is an

innovative teaching strategy that can provide students the structured learning activities essential for the information technology skills necessary to practice in the 21st century. This study will add to the growing knowledge base concerning the use of innovative technology by nurse educators and students.

1.9 Significance to Clinical Practice

Tooley and Mayo (2003) maintained that the goal of the PDA in the clinical setting is to allow for clinicians to create efficient workflow, thereby allowing nurses to spend more time at the bedside. Ultimately, this will lead to improvement in healthcare delivery. The reported benefits of the PDA are immediate access to drug databases and nursing references, bedside data entry, the ability to manage patient and procedure information, data collection for teaching and research, and improved communication between healthcare workers (Davenport, 2004). Courtney and colleagues (2005) reported that the top three clinical applications of nurse PDA users were drug software, clinical calculators, and clinical algorithm software. This adds credence to the fact that PDA use has been shown to reduce medication error and cost, thus improving overall patient care (Rosenbloom & Ramsdell, 2004).

Simpson (2005) maintained that integrating IT (including PDAs) can aid staff recruitment and retention by improving job satisfaction. Furthermore, he emphasized that technology and the data it provides can help nursing improve care in three ways: by counteracting human error; by improving human behavior; and by putting nurses where they can be most effective (Simpson, 2004).

The literature offers several specific examples of PDA use by nurses which include:

1. Use by infection control nurses in their daily routine for surveillance, time management, information management, and communication (Goss & Carrico, 2002).
2. Use by infusion therapy nurses to monitor outcomes of the services provided. The PDA also had these nurses accepting new ways to manage data and to value analysis over perception (Goss & Carrico, 2002).
3. Use by trauma nurses for point-of-care documentation (Eastes, 2001).
4. Use by advanced practice nurses for information on treatment options, drug therapy, support of differential diagnoses/diagnostic reasoning, checking lab results, and prescribing (Rempher, Lasome, & Lasome, 2003).

Clearly, the PDA is a technological innovation that deserves further investigation and this research may begin to answer questions as to PDA suitability for the clinical nurse.

1.10 Significance to Evidence-Based Practice

With the extraordinary increase in scientific information in recent decades, access to current research is a must in present day healthcare. Professional commitment to evidence-based practice casts the nurse in the role of active decision-maker. Evidence-based practice involves the integration of the best evidence available which is guided by nursing expertise and the values and preferences of individuals, families, and communities who are served (Alspach & Veijo, 2006). The momentum for the EBP movement has been influenced by the rise in consumerism, industry and other providers' demands for cost containment, and greater availability of up to date information. The movement has also been accelerated by public questioning of the legitimacy of the

healthcare professions because of the high frequency of medical errors and ineffective or unsafe protocols being reported regularly in the news (Pape, 2003).

Yet, evidence-based practice has only been slowly adopted by this nation's health care providers, with the nursing profession remaining the most hesitant. A major obstacle for the implementation of EBP by nurses is the lack of information seeking behaviors within the profession. Nursing education continues to place emphasis on teaching students how to conduct research rather than to efficiently access, critically appraise, and use research data in practice (Fineout-Overholt, Melnyk, & Schultz, 2005). Bates and Gawande (2003) maintain that "providing reliable, efficient, and individualized care requires a degree of mastery of data and coordination that will be achievable only with the increased use of information technology" (p. 2534).

Both evidence-based practice and use of informatics have been identified as core competencies required of all healthcare practitioners (Burns & Foley, 2005). The PDA has been identified as a tool that has the potential to increase information seeking behavior (Cornelius, 2005; Goldsworthy, Lawrence & Goodman, 2006), and by so doing, the use of EBP. With its capabilities, the handheld computer permits instant access to databases and will allow the nursing profession and the evidence-based practice movement to surge forward. This investigation may also make important contributions to the debate over whether the PDA is a necessity for fully utilizing EBP (Fontelo & Ackerman, 2004).

1.11 Expansion of Nursing Knowledge Base

The integration of new technology is changing the face of society as most of us have known it, and it is transforming the design, delivery, and evaluation of nursing

education (Jeffries, 2005). Yet, to date there have been few quantitative studies by nurse researchers regarding the use of technological innovations, such as the PDA. What information the literature offers has been primarily descriptive and anecdotal. For nurse educators to keep abreast of these technological innovations, new and creative teaching strategies that incorporate technological advances must be identified, investigated, and disseminated. This research project will foster such evidence-based guidance for nursing education.

1.12 Definition of Terms

The key terms used throughout this study are defined and operationalized as follows:

Personal Digital Assistant (PDA) Use

Conceptual definition: PDA use is defined as individual student employment of a handheld electronic device that combines computing, organizing, data collection and storage, Internet access, and networking features.

Operational definition: PDA use will be measured by frequency of use.

Clinical Decision-making

Conceptual definition: A dynamic and complex thinking process that results in independent and interdependent nursing interventions (White, 2003).

Operational definition: Perceived clinical decision-making will be measured by the Clinical Decision-Making in Nursing Scale [CDMNS] (Jenkins, 1985).

Evidence-based Practice

Conceptual definition: As defined by Sigma Theta Tau International, evidence-based practice is the integration of the best evidence available which is guided by

nursing expertise and the values and preferences of individuals, families, and communities who are served (Alspach & Veijo, 2006).

Operational definition: Evidence-based practice will be measured by the Evidence-based Practice Questionnaire [EBPQ] (Upton & Upton, 2006).

1.13 Assumptions of the Study

The following assumptions are identified for this study:

1. There is variation among individual students' knowledge and use of information technology and evidence-based practice.
2. There is variation in the utilization of the personal digital assistant among PDA users.
3. Student experiences will affect their responses to the questionnaires.
4. There may be an effect on the dependent variable resulting from students' awareness of being under study.
5. The handheld computer (PDA) is currently the *state of the art* device for this study.

1.14 Limitations of the Study

The limitations of the methodology and data analysis for this study include the following:

1. There is a lack of generalizability of study results, as the target population was restricted to the selected geographic areas in the study.
2. The data are limited to a small sample.
3. A convenience sample is being used which lends to a greater risk of sampling bias and less scientific rigor.

4. Insufficient student knowledge of information technology, evidence-based practice, and ineffective use of PDAs may skew the results.
5. Students who volunteer may very well be more technically skilled and interested in the use of information technology.

1.15 Summary

The bounty of technology in the new millennium has changed the worlds of healthcare and education for healthcare. Technology-infused education can create an active learner, one who knows how to access the right information at just the right time, efficiently, and in the service of the patient (Cornelius & Donnelly, 2006). The use of PDAs is an innovative teaching tactic that can provide nursing students structured learning activities including data entry and retrieval, time management, and effective use of information at the point-of-care. Since healthcare environments are increasingly demanding that nurses be flexible, innovative, and knowledgeable about information technology (Cornelius, 2005; Shorten, Wallace, & Crooks, 2000), the addition of the PDA or other emerging mobile technology to undergraduate programs, may be one strategy for educating the nurse of tomorrow. This chapter has reviewed the effect information technology has had on our healthcare delivery system and the challenges IT poses for the practice of nursing. Research questions were formulated that investigated one IT tool, the PDA, and the influence its use may have on nursing education and practice with regard to clinical decision-making and the utilization of evidence-based practice. Though the literature is replete with anecdotal and descriptive information of the PDA, it is lacking in actual research studies of the effects of PDA use on clinical decision-making and the utilization of evidence-based practice. The research will add to

the knowledge base regarding use of mobile devices as well as informatics education in nursing.

Chapter 2

Review of the Literature

2.1 Introduction

This literature review was performed to establish background knowledge for the development of this study comparing PDA use, perceived clinical decision-making, and utilization of evidence-based practice in two groups of upper-level baccalaureate nursing students. Decision-making theories, clinical decision-making and evidence-based practice were discussed along with the relationship that clinical learning and critical thinking have on the aforementioned. The final portion of this literature analysis reviewed a variety of descriptive studies, as well as, qualitative and quantitative research published regarding the use of PDAs in healthcare with an emphasis on undergraduate education. This review presented the most applicable research that has been found supporting this investigation.

2.2 Theoretical Perspective of the Study

In 2003, White identified a specific gap in the literature regarding clinical decision-making. The researcher recognized that little is known about how nursing students learn and implement the clinical decision-making process. White used Heideggerian phenomenology and hermeneutical analysis as the philosophical perspective for her research design. She opined that clinical decision-making is embedded in the everyday world of nursing students, thus, it is best revealed by examining their experiences.

The study involved 17 senior nursing students completing their last semester of coursework in a baccalaureate program. Each student completed a six week clinical rotation in a critical care unit prior to being interviewed by the investigator. Each interview was audio taped and transcribed verbatim. Data were then analyzed using the hermeneutic interpretive process, coded and collapsed, and initial themes were identified. Theme identification was accomplished through Lincoln and Guba's constant comparative method. The following five themes were identified as components associated with nursing students' clinical decision-making:

- Gaining confidence in their skills. Students identified two types of skills important to their clinical decision-making; technical and communication. They explained that if they felt confident in completing a technical skill or initiating a conversation with the patient, they could readily focus on the patient.
- Building relationships with staff. The importance of rapport with the nursing staff was deemed critical for decision-making by the students. If the students recognized they were valued in the clinical environment and that the staff had confidence in their abilities, learning and self-assurance were enhanced.
- Connecting with patients. For students, this component meant *coming to know* the patient. When the patient and student connected, individualized care was provided and the student was able to respond to the patient's distinctive characteristics and needs. Thus, the patient effectively taught the student the *how* of nursing.
- Gaining comfort in self as a nurse. As the students gained confidence in the clinical arena, their comfort level increased and their ability to function in the nursing role increased.

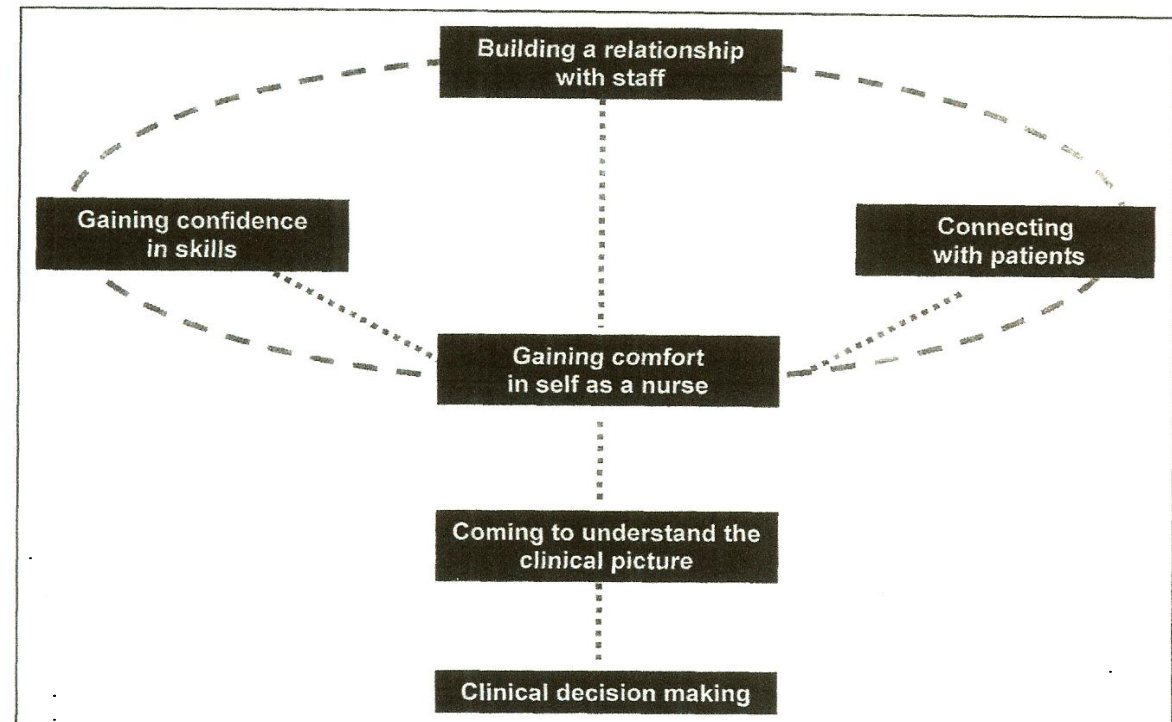
- Understanding the clinical picture. As knowledge, experience, and self-confidence expanded, the students were able to demonstrate a greater understanding of the clinical picture as a whole, integrating information to form the clinical picture. This allowed for a greater understanding of what the student needed to anticipate in providing patient care. In understanding the clinical picture, the students began to appreciate the suitability of decisions made in the clinical environment (White, 2003).

White began to envision a schematic of nursing students' clinical decision-making, pictured below in Figure 1, and it was chosen as a framework for this study for the following reasons:

1. Other theories and conceptual models found in the literature apply to practicing nurses.
2. The schematic recognizes that each individual will become comfortable with decision-making at his or her own pace.
3. The schematic encourages educators to dialogue about innovative teaching strategies that will foster confidence and comfort with skills among nursing students.
4. Several of the desired components identified in the schematic as essential for learning clinical decision-making, have been associated with students who have used PDAs in their curriculum.

The figure below demonstrates the circular, interconnectedness of the essential components of learning clinical decision-making among nursing students visualized by White (reprinted with permission from author).

Figure 1: Clinical decision-making among nursing student's schematic (White, 2003).



Though this researcher understands that hermeneutic phenomenology cannot be generalized beyond the study group, the schematic envisioned by White was used as a broad framework for this study for the above mentioned reasons. The elements of the model that have been associated with PDA users include increased rapport with staff (Altmann & Brady, 2005); increased self confidence (Goldsworthy, Lawrence, & Goodman, 2006); and the possibility of increased understanding of the clinical picture (Cornelius, 2005).

2.3 Decision-Making Theories

Since clinical decision-making is a central theme of this research, the various approaches to it will be discussed. Two models of clinical decision-making have historically been discussed in the nursing literature. They are the information-processing model and the intuitive-humanist model.

2.3.1 Information-processing model

The information-processing model uses a scientific or hypothetico-deductive approach and is rooted in medical decision-making (Joseph & Patel, 1990). The main assumption behind this model is that the human decision system is separated into two components, short and long-term memory. It is short term memory that quarters the stimuli information that is required to release factual (semantic) and experimental (episodic) knowledge from long-term memory (Thompson, 1999).

This hypothetico-deductive approach to clinical decision-making requires several stages: cue recognition, cue interpretation, generation of hypotheses, and hypothesis evaluation. Cue recognition occurs during the initial patient encounter. Following this is cue interpretation and then hypothesis generation. In hypothesis evaluation, the clinician weighs the pros and cons of each alternative and chooses the one that is most supported by a predominance of evidence (Thompson, 1999; Banning, 2006).

2.3.2 Intuitive-humanist model

The intuitive-humanist model focuses on the relationship between nursing experience, the knowledge gained from it, and the enrichment it offers the clinical decision-making process as a nurse progresses in the clinical role (Banning, 2007). Benner (1984) is the nurse author most attributed to development of the intuitive model.

Whereas the information-processing model uses a conscious, logical, step by step process, the intuitive model is typically understood to having the exact opposite meaning (Lauri & Salanterä, 2002). Rew (2000) describes intuition as “...the deliberate application of knowledge or understanding that is gained immediately as a whole and that is independently distinct from the usual, linear and analytical reasoning process” (p. 95). According to Rew (2000), when applied to clinical situations, intuition is a component of complex judgment, deciding what to do in perplexing, ambiguous, and uncertain circumstances. Intuitive judgment involves the synthesis of empirical, aesthetic, ethical, and personal knowledge. In other words, one acts on “...a sudden awareness of knowledge that is related to previous experience, perceived as a whole, and difficult to articulate” (p. 95). The typical characteristics of the intuitive-humanistic model include rapid information processing, simultaneous cue use, pattern recognition, the evaluation of cues at a perceptual level, and the principle of weighted-average organizing (Lauri & Salanterä, 2002).

2.3.3 Strengths and limitations of decision-making models

According to Thompson (1999) both of the above decision-making models have strengths and limitations and these can be separated into four themes: communicability, simplification, context specificity, and applicability (p. 1223). With the intuitive-humanist model, knowledge can only be shared if it is communicated. Thompson further stated that it is virtually impossible to communicate the unquantifiable, or something the clinician cannot express. He also implied that simplification becomes a problem in the information-processing model if the model fails to denote all the variables involved in decision-making. Context of specificity refers to the practice context and its importance

to decision-making. Both models have problems in this area. The information-processing approach can be criticized because it assumes that judgment is the result of one process used by all clinicians at all times. On the other hand, the intuitive-humanist approach is disapproved of for the opposite reason. The model views each clinical situation as unique with the manners and cues of a subjective nature. Consequently, it is almost entirely context specific and cannot be communicated to others. Thus, the nursing profession has a problem with the applicability of both models. Neither offers a complete picture of the clinical decision-making used by nurses and many scholars feel the need for an alternative approach to this dilemma; specifically one where "... the two approaches occupy the same theoretical plane" (Thompson, 1999, p. 1227).

2.4 Decision-Making Continuum

Thompson (1999) proposed the need for *middle ground* in clinical decision-making theory in nursing. He recommended a third theoretical stance, the idea of a cognitive continuum. The information processing stance would be at one pole of the continuum and the intuitive-humanistic approach would be at the other end of the pole. This is not a new idea as Hammond (2000) synthesized these two contrasting approaches to decision theory, the intuitive/experiential and analytical/rational modes in his Cognitive Continuum Theory (CCT), first applied with highway engineers. Since that time, CCT has been applied to the decision-making of numerous professionals in the fields of engineering, social policy making, medicine and nursing (Cader, Campbell, & Watson, 2005). Hamm (1988a) has shown that the theory, when applied to medicine, can assist with improvement in clinical judgment in environments of uncertainty. Thompson (1999) argued that Hamm's analysis of the CCT from the medical perspective can easily

be applied to any situations where decision-making is crucial including nursing practice. This endorsement was supported by Harbison (2001) who felt the continuum would be a significant organizing tool for shaping and directing nursing research as it has both a descriptive and prescriptive orientation. The promotion of such a stance would recognize the diversity of cognitive strategies, and help to identify the differences between value laden theory and clinical reality.

2.5 Clinical Learning

2.5.1 Definition of clinical learning

As described by Benner (1984), clinical learning is a dialogue between principles and practice that with experience and reflection matures into clinical knowledge. As the nursing student gains clinical experience, the clinical education becomes a combination of practical and theoretical knowledge, or a blend of “knowing how” and “knowing that” (Benner, 1984; Edwards, 2006).

Since the clinical arena allows the learner the opportunity to perform skills, apply knowledge, and test theories, the learning experience in that environment is thought to best prepare students for professional nursing practice. Consequently, the learning experience should reflect the realities students will face as professionals that cannot be conveyed by a textbook, laboratory, or simulation (Gaberson & Oermann, 1999).

2.5.2 Learning outcomes in the clinical setting for safe nursing practice

The expertise needed for professional nursing practice is influenced by numerous factors including the healthcare delivery system, demographics, technological advances, and developments in higher education. Hence, it is ever changing. Yet, the learning

outcomes for the clinical area necessary to facilitate safe, competent, nursing practice remain the same, and include knowledge, skills, and affective competencies (Reilly & Oermann, 1992).

Knowledge as a learning outcome involves enabling the student to transfer classroom learning to the clinical setting. This knowledge exceeds factual and procedural information and includes cognitive skills in information evaluation, critical thinking, problem solving, and clinical decision-making. With the tremendous advances in information processing in today's healthcare, the procedural proficiency of psychomotor capabilities that has traditionally dominated the clinical area (Rosenstein & O'Daniel, 2005) may well be challenged by the need for information literacy. Informatics skills are now considered a core competency in nursing education (Burns & Foley, 2005) and information literacy has become an essential for the graduate nurse.

An information literate individual is able to recognize when facts are needed and have the ability to locate, evaluate, and use effectively the needed information (American Library Association, 2006). Today's professional nurse requires not only the tools and skills for information technology (such as handheld computer devices) but also the knowledge of how and when to utilize them to provide quality, cost-effective care in a timely manner. Currently, educators must assist students in acquiring this technical competence and help them develop the dispositions that foster its use (Courey, Benson-Soros, Deemer, & Zeller, 2006). Proficiency in this area may well enhance psychomotor experiences as well as the communicative, organizational, and affective competencies needed for success.

Lastly, attitudes and values consistent with those of the profession are further formed during clinical learning experiences, rounding out the professional socialization of the nursing student. These affective outcomes embody the humanistic and ethical dimensions of the nursing profession. Internalization of the norms and values of nursing are enhanced where accountability is demanded (Gaberson & Oermann, 1999).

2.5.3 Relationship to clinical decision-making and evidence-based practice

Skill, professional knowledge, and professional socialization are attributes sought after in the real-time clinical arena, and activities that support the development of such experiential knowledge enhance the development of clinical decision-making. The activities of the clinical experience will vary with different settings. They must remain appropriate to students' level of knowledge and skill, yet challenging enough to encourage active learning. The activities must also center on the needs of a new healthcare model that emphasizes health promotion and illness prevention. Along with technical innovations, evidence-based practice is increasingly being utilized by clinicians and organizations. EBP compels the clinician to actively seek justification for practice, increases confidence, and encourages life long learning (Stevens & Ledbetter, 2000; Pape, 2003).

The PDA and emerging mobile technologies present the opportunity to augment the clinical experience and aid in the development of the required skills, knowledge and socialization. The new software programs for mobile point-of-care motivate active learning with numerous tools from e-mailing to updated clinical practice guidelines (Farrell, 2009). With the use of such resources, students and professionals alike can

establish who they are, what they do, and the effect they have on patient outcomes (Richardson, Miller, & Potter, 2002).

2.6 Critical Thinking

In the late 1980's, systematic inquiry sponsored by the American Philosophical Association (APA), was made into how critical thinking (CT) was defined and assessed across a variety of disciplinary fields. The end product of the project was the Delphi Report which defined critical thinking as "...purposeful, self-regulatory judgment which results in interpretation, analysis, evaluations, and inferences, as well as the explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based (Facione, 1990, p. 16)." Broadly speaking, critical thinking is the process of purposeful self-regulatory judgment; an interactive, reflective, human reasoning process. To make purposeful judgment, the APA identified the necessary CT cognitive skills as follows: interpretation; analysis, evaluation, inference, explanation, and self-regulation. Facione and Facione described the ideal critical thinker as having the following dispositions: truth seeking, open-mindedness, analyticity, systematicity, CT self confidence, inquisitiveness, and maturity. One can readily see that critical thinking is a fundamental phenomenon in practice disciplines, especially nursing (Facione & Facione, 1996).

Nursing practice consistently demands interpretation, analysis, evaluation, inference, justification, and self-regulation, and thus reflects the critical thinking skills and dispositions necessary for effective and safe care (Ignatavicius, 2001). Similarly, faculty assessment of critical thinking in nursing education often involves the use of rubrics for student writing assignments and performance evaluation that incorporate

analysis, synthesis integration, insight, reflection, evaluation, and inquisitiveness.

Students are often asked to provide rationales for their claims and choices in the form of credible research or practice guidelines (Neidringhaus, 2001).

2.6.1 Relationship to clinical learning

Ideally, critical thinking and clinical learning would have a reciprocal relationship. As one's clinical learning increases, so too would one's ability to think critically. Naturally, though, the development of CT would greatly depend on the learning context. Thus, nursing educators need to use strategies that have been shown to increase critical thinking, i.e., case studies, role playing, and journals (Simpson & Courtney, 2002).

2.6.2 Relationship to clinical decision-making

Critical thinking is considered one parameter of the clinical decision-making process. It aids an individual in organizing approaches to test his or her own theories in the context of specific assumptions and the cautious acceptance of new information (Facione & Facione, 1996). When a decision maker's dispositions to CT grow stronger, he or she is more likely to employ critical thinking skills to strengthen clinical decision-making.

2.6.3 Relationship to evidence-based practice

Critical thinking is paramount to support evidence-based practice. The CT skills of interpretation, analysis, evaluation, inference, explanation, and self-regulation and the CT dispositions of truth seeking, open-mindedness, analyticity, systematicity, CT self confidence, inquisitiveness, and maturity are requisite to the utilization of the best available evidence (Profetto-McGrath, 2005). Tanner (1999) stated that the evidence-

based practice movement requires the skills of critical thinking so that students have the ability to read and understand research. Nursing students at all levels “...must develop the habit of asking, “Why are we doing this? What is the evidence that supports this action?” (p. 99). Nurturing students to ask such questions will not only facilitate their CT skills, but also help to develop evidence-based practitioners of the future

2.7 Clinical Decision-Making

Hamers, Huijer, and Halfens, (1994) argue that the literature provides no precise definition of decision making in nursing, nor any consensus regarding the exact terminology to be used. Varying expressions used by authors to describe clinical decision-making include clinical judgment, clinical reasoning, clinical inference, diagnostic reasoning, and problem solving. Thompson (1999) maintains that the descriptions are interchangeable for a single process, which Luker and Kenrick (1992) explicitly identified as the “operationalization of nursing knowledge” (p. 458).

2.7.1 Thinking processes of nurses in clinical decision-making

Tanner (2006) maintained that nurses use a variety of reasoning patterns, either alone or in combination, in making clinical decisions. She based her conclusions after reviewing nearly 200 studies on clinical judgment. This review demonstrated at least three interrelated patterns of reasoning used by experienced nurses: analytic processes, intuition, and narrative thinking. The pattern elicited in any given context will depend upon the nurse’s initial grasp of the situation.

With the analytical process, the nurse breaks down a situation into its elements and begins generating hypotheses. It is often used by new nurses or when there is a mismatch between what is expected and what is actually happening. This process is also

used when multiple options are available to the decision maker. The intuitive process is a function of experience and is characterized by an immediate grasp of a situation. It is characterized by recognition of a pattern. Lastly, narrative thinking involves making sense of an experience through an interpretation of human concerns, intents, and motives. In other words, it is how humans understand and explain what they see (Tanner, 2006).

Other patterns of thinking used in clinical decision-making have been described in the literature. In a qualitative study, Higuchi and Donald (2002) investigated the cognitive processes used by nurses in actual clinical decision-making contexts. In a 200 bed community hospital, the investigators used a criterion sampling technique to select eight nurses for inclusion in the study. Randomly selected charts ($n = 50$) were then reviewed and data gathered from the patient care logs, with special attention given the nurses' narrative notes. Each phrase in these notes was coded by thinking process and operation. With the use of Donald's model of higher-order thinking processes (1992), a table categorizing exemplars of nurses' thinking processes was developed. Categorization of the nursing exemplars provided operational definitions of reasoning processes. The operations describing problem solving, critical thinking, hermeneutics, the scientific method, and expertise were grouped into six major thinking processes: description, selection, representation, inference, synthesis, and verification. It was found that description was discovered in all surgical notes and 79% of the medical notes, i.e. transfer of a patient from ICU to PCU. Selection was found in 88% of the surgical notes and 69% of the medical clinical notes. Patient cues, i.e. report of chest pain, comprised the majority of the thinking process of selection. Evidence of inference was found in 58% of surgical notes and 33% of medical notes, i.e. nursing notes recording conclusions

about a clinical situation. When nurses recorded statements relating to nursing interventions based on analysis of various clinical data, evidence of synthesis was established (20% of surgical notes and 48% of medical notes). Lastly, in 8% of the surgical notes and 36% of the medical charting, the nurses used verification (commenting on the effectiveness of previous nursing interventions). These results suggest that clinical decision-making is a complex cognitive process. The research provided a clear perception of the thinking required of nurses in their daily practice and was felt to serve as a paradigm for nursing educational purposes.

2.8 Instruments for Measuring Clinical Decision-Making

There are few instruments available that effectively measure clinical decision making ability in nursing and they have received only negligible attention in the literature. Most research on the concept has explored the process itself using instruments that measure abilities thought to be important to clinical decision-making.

Brooks and Shepherd (1990) explored the relationship between decision making skills and general critical thinking abilities. Their study sought to determine which of the four types of nursing educational programs had the higher mean scores on tests measuring these two concepts. The convenience sample ($n = 200$) included 50 students from each type of program (hospital-based, associate, RN upper division, and generic baccalaureate). The investigators used the 126-item Nursing Performance Simulation Instrument (NPSI) to measure problem solving skills and the Watson-Glaser Critical Thinking Appraisal (WGTCA) to measure critical thinking. The findings from ANOVA and Tukey HSD showed that upper division and baccalaureate students had significantly

higher mean scores ($p = 0.05$) in both critical thinking and decision making than the associate degree and diploma students.

In a very similar investigation, Shin (1998) studied the critical thinking and decision making of associate degree ($n = 119$) and baccalaureate degree ($n = 115$) nursing students in Korea. Again, both the WGTCA and the NPSI were the instruments of choice for the convenience sample. Shin remarked that the results of the study were virtually identical to that of Brooks and Shepherd with the baccalaureate students scoring significantly higher (independent t-test, $p < 0.001$) than the associate degree group on both critical thinking and clinical decision-making.

Two other instruments that have appeared in the literature are the Joseph Decision Making Tool (JDMT) and the Actual Decision Making (ADM) instrument which were developed by the same researcher. The JDMT was designed to measure beliefs and attitudes toward decision making. The instrument consists of 20 short scenarios that imitate specific situations requiring nursing decisions and actions. The ADM is a Likert-type scale consisting of 27 items measuring actual decision making that requires nursing judgment without benefit of collaboration. The pilot study for the JDMT, which was a descriptive, correlational design, measured the effects of sex-role stereotype, years of experience, and education upon attitudes toward decision making. The selected sample consisted of 85 nurses from medical-surgical units of two large metropolitan hospitals. Multiple regression analysis showed that masculine sex-type scores, along with diploma education, significantly influenced the nurses' taking responsibility for decision-making ($p < 0.05$). However, experience was found to have an inverse relationship ($p < 0.01$), with

the JDMT. The more experienced nurses were less willing to make decisions (Joseph, 1985).

The ADM was initially used in a comparison study “...to determine the effects of collaborative relationships, attitudes toward decision making and the clinical practice setting upon actual decision making processes (Joseph, Matrone, & Osborne, 1988, p. 21).” The convenience sample consisted of a heterogeneous group of 91 nurses. Pearson’s Correlation Coefficient demonstrated that nurses willingly participate in actual decision-making ($p = 0.001$), with the practice setting having significant influence.

Catolico and colleagues (1996) used these same instruments, along with computer-assisted simulations, to investigate the quality of RN decision making in a 1996 descriptive, correlational study. The convenience sample consisted of 26 RNs. Results were then compared with education, age, experience, practice area, and specialty certification. Pearson’s r revealed moderate positive correlations between age and awareness of priorities ($p < 0.01$), practice area and frequency of actual decision making ($p < 0.001$), and between experience and growth and development ($p < 0.05$). Negative correlations were found between experience and ethnicity ($p < 0.01$) and between certification and frequency of actual decision-making ($p < 0.05$).

Lauri and Salanterä (2002) developed the Nursing Decision-Making Instrument, a 56-item structured questionnaire, designed to reflect the four stages of the decision-making process; data collection, data processing, plans of action with implementation, monitoring and evaluation. The decision-making instrument allows for the assessment of the different decision-making processes employed by individual nurses. Half of the tool’s items were designed to measure analytical decision-making which includes analytical

step-by-step and information processing decision-making. The remaining items were designed to measure intuitive-processing decision-making. Nonetheless, every item measures both the analytical, analytical-intuitive, or intuitive decision-making, depending upon the given answers. Furthermore, the instrument was devised to denote nursing knowledge, practical experience, and nursing context (Lauri & Salanterä, 1995). The instrument was used with an international data sample of nurses ($n = 1,460$) in seven different countries and in different fields of nursing. Results demonstrated that nurses' approaches to decision-making varied not only among, but also within, different fields of nursing.

2.9 Clinical Decision-Making in Nursing Scale

The Clinical Decision-Making in Nursing Scale (CDMNS) was the instrument chosen for use in this study for several reasons. First, it was originally developed by Jenkins (1983) to examine nursing students' self-perception of their own decision-making abilities. Secondly, it has been used in over 90 studies, many of which can be found in the literature (Girod, 2000). Finally, it has been included in the highly acclaimed series of *Measurement of Nursing Outcomes* (Waltz & L. Jenkins, 2001) lending credence to its value as a reliable research instrument.

The instrument consists of a 40-item questionnaire with a 5-point Likert-type response scale. The CDMNS assesses four categories of decision-making which comprise the following subscales:

- Search for Alternatives or Options. The individual's actions in this phase of decision-making are characterized by the context of the situation and past

experiences, especially in the manner one searches for options. Items 1 and 30 reflect these aspects:

1. If the clinical decision is vital and there is time, I conduct a thorough search for alternatives.

30. I do not ask my peers to suggest options for my clinical decisions.

- Canvassing of Objectives and Values. This subscale addresses an individual's professional values and attitudes toward cultural diversity. The following are indicative of this position:

9. I assist clients in exercising their rights to make decisions about their own care.

40. The client's values have to be consistent with my own in order for me to make a good decision.

- Evaluation and Re-evaluation of Consequences. Appraising and reconsidering one's course of action and evaluating potential outcomes are considered with this subscale as indicated by the following statements:

13. I don't always take time to examine all the possible consequences of a decision I must make.

26. When examining consequences of options I might choose, I am aware of the positive outcomes for my client.

- Search for Information and Unbiased Assimilation of New Information. (Jenkins, 1985). This subscale is especially relevant for this study with its emphasis on evidence-based practice. Its focus is reflected in the following:

4. *Looking for new information in making a decision is more trouble than it is worth.*

11. *I listen to or consider expert advice or judgment, even though it may not be the choice I would make.*

A total of 10 items are assigned to each of the four subscales. The items ask respondents about their decision-making behavior while caring for patients. Responses range from *never* (rated 1) to *always* (rated 5) with potential total scores that range from 40-200. Each subscale has a maximum value ranging from 10-50 (Thiele, Holloway, Murphy, Pendarvis, & Stucky, 1991) and higher score values are interpreted as a more positive perception of decision-making (Jenkins, 2001).

Cronbach's alpha, a measure of internal consistency reliability, was calculated for the instrument and resulted in a value of 0.83 for the entire set and a standardized-item alpha of 0.85 (Jenkins, 1985). Subscale alphas ranged from 0.35 – 0.57 (Byrnes & West, 2000). An alpha coefficient of 0.80 - 0.90 is highly desirable and indicates an instrument that is capable of making discriminations among the levels of the construct (Lew-Snyder, 2003). Other studies that have publicized reliability coefficients for the CDMNS include the following: Thiele and colleagues' (1991) investigation of novice baccalaureate students ($n = 82$, $\alpha = 0.88$); Corder's (1992) research with generic, baccalaureate students ($n = 195$, $\alpha = 0.84$); Sorenson Bowles' (1997) inquiry in to senior baccalaureate students ($n = 65$, $\alpha = 0.84$); Stover's (2000) study of RNs ($n = 64$, $\alpha = 0.43$); Girot's (2000) study of UK nurses ($n = 50$, $\alpha = 0.78$); Lew-Snyder's (2003) examination of urban registered nurses ($n = 131$, $\alpha = 0.80$); and Baumberger-Henry's (2005) analysis of three groups of associate degree nursing students ($n = 123$, $\alpha = 0.81$).

Jenkins established content validity of the CDMNS in several ways. The researcher (1983) maintained that items were based on related concepts that were present in the literature. Pretest of the preliminary instrument was undertaken with examination of the results for clarity and congruity. Lastly, a panel of five nurse experts in baccalaureate education and decision-making rated each item with a specification matrix. The matrix yielded a total score for each item. Items that received a total agreement score of 77% (good) or greater were kept. Items that rated 70%-75% (fair) were thoroughly scrutinized for inclusion and items that scored less than 70% were not retained.

2.10 Evidence-Based Practice

2.10.1 Evidence-based practice movement

The current resurgence of evidence-based practice actually began in England in the early 1970s. A British epidemiologist, Dr. Archie Cochrane, cautioned that physicians were not incorporating the best evidence when making important decisions about health care (Hedges, 2006). However, it was not until 1993 that Cochrane's ideas came to fruition with the founding of the Cochrane Collaboration involving individuals from nine countries. The aim of this international alliance was to help individuals make good decisions about healthcare by preparing, maintaining, and disseminating systematic reviews of the effects of healthcare interventions. This initiative has progressed rapidly, infusing a new approach to teaching and practicing medicine. Today, it is a global enterprise with fifteen centers around the world (Cochrane Collaboration, 2006).

Another pioneer of evidence-based medicine (EBM), Dr. David Sackett, defined the practice as conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients. The practice of EBM means

integrating individual clinical expertise with the best external evidence gathered from systematic research (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996). This movement has now shifted over to the broader conception of using best evidence by all healthcare practitioners in a multidisciplinary team (French, 1999). Most recently, the application of the principles of evidence-based medicine have been extended to all professions associated with healthcare, including purchasing and management (Centre for Evidence-Based Medicine, 2004).

The use of different phrases in the literature for describing EBP can be confusing for healthcare professionals. Terminology includes evidence-based medicine, evidence-based practice, evidence-based nursing, and evidence-based nursing practice. Regardless of the lexis used, whether medicine, nursing, or practice, for all intents and purposes, the meaning remains the same. For this study the Sigma Theta Tau International definition of EBP will be used. Evidence-based-practice is the integration of the best evidence available which is guided by nursing expertise and the values and preferences of individuals, families, and communities who are served (Alspach & Veijo, 2006).

2.10.2 Importance of evidence-based practice

Evidence-based practice (EBP) has become increasingly important in the last 15 years and the movement gained momentum in 2001 after publication of the report, *Crossing the Quality Chasm: A New Health System for the 21st Century* (IOM). The report explicitly addressed the failings of the healthcare industry and the educational systems that produce future practitioners. It stated that the nation's healthcare industry delivery system has fallen significantly short "... in its ability to translate knowledge into practice and to apply new technology safely and appropriately" (2001, p. 3). It further

identified the significant role of information technology in designing a health system that produces care that is safe, effective, patient-centered, timely, efficient, and equitable. Healthcare providers were urged to embrace technology and adopt evidence-based practice as a means to increase patient safety and improve the quality and cost effectiveness of care delivery (Pierce, 2005). The rise in consumerism, industry, and other providers' demands for cost containment, along with the greater availability of information has added further impetus to the movement. Additionally, the legitimacy of the healthcare profession has been questioned frequently, with medical errors and ineffective or unsafe protocols being reported regularly in the news (Pape, 2003).

EBP has been decreed the wave of the future (Fineout-Overholt, Melnyk, & Schultz, 2005). Aside from providing a framework for clinical decision-making and allowing clinicians the ability to keep current with best practice in their specialty, it also allows for more individualized care (Pape, 2003; Upton & Upton, 2006). Furthermore, evidence-based practice allows for the acquisition of new knowledge which provides the nurse with the confidence needed to justify decisions to physicians, patients, and other colleagues (Stevens & Ledbetter, 2000). Evidence-based practice has been described as essential for nurse professionals to establish who they are, what they do, and what effect they have on patient outcomes (Richardson, Miller, & Potter, 2002).

There are several advantages for using evidence-based practice. EBP provides high quality, cost-effective care that has a knowledge or evidence base supporting it. Thus, EBP allows nurses to use the latest research findings in their clinical practice, keeping pace with advances in their profession. Additionally, EBP guidelines promote more focused client care. Other positive effects of EBP include the following:

1. Improves clinical communication skills as users collect patient data to determine the best interventions.
2. Facilitates and enhances the information skills necessary to find and evaluate research studies.
3. Encourages lifelong learning which frequently increases an interest in furthering one's education.
4. Creates a means for promoting the nation's agenda to improve health care.
5. Provides a common language for use by multidisciplinary teams in collaborating on practice issues (Pape, 2003).

2.10.3 Lack of utilization of EBP in the US

The nation's healthcare providers have been slow in adopting evidence-based practice and the nursing profession has been most hesitant. A main reason for this phenomenon is that nursing education continues to place emphasis on teaching students how to conduct research rather than to efficiently access, critically appraise, and use research data in practice (Fineout-Overholt, Melnyk, & Schultz, 2005; Shorten, Wallace & Crookes, 2000). Nursing education urgently needs to explore various alternatives and teach students to access and evaluate information resources, including research. Today's professional nurse requires not only the knowledge of information technology, but also the tools of IT to provide quality, cost-effective care in a timely manner (Courey, Benson-Soros, Deemer, & Zeller, 2006).

However, other impediments to using EBP cannot be ignored, as they play a major role in its lack of implementation in the nation. These include:

1. Little consensus as to what constitutes usable evidence for EBP.

2. Lack of dissemination and the complexity of research findings.
3. Continued reliance on the increasingly dated knowledge that was acquired in nursing school.
4. Misperceptions about evidence-based practice (too time consuming).
5. Lack of organizational support (both financial and moral).
6. Resistance to change, both by the profession and administration.
7. Inadequate knowledge, beliefs, and skills by advanced practice and staff nurses.
8. An insufficient number of EBP mentors in healthcare systems (Fineout-Overholt, Melnyk, & Schultz, 2005; DiCenso, 2003).

Nevertheless, the critical barrier to evidence-based practice remains the lack of information literacy within the nation's nursing population (Estabrooks, O'Leary, Ricker, & Humphrey, 2003). The Department of Health and Human Services recently supported development of the *LISTEN* project at the University of Tennessee, School of Nursing. This project, Learning Information Seeking and Technology for Evidenced-based Nursing, was designed to improve information literacy competencies of students and practitioners through a series of on-line learning modules (listenuphealth, 2010). Point-of-care (POC) technology can make a critical difference in the utilization of EBP. Projects like the LISTEN Project are facilitated by the availability of PDAS (including the emerging Smart technology), and can only enhance the transformation of nursing education and practice.

2.10.4 PDAs for enhancing the utilization of EBP

The decentralization of computers has transformed nursing practice from one that emphasizes reliance on memory, to one that emphasizes the continuous use of

information resources when needed (Thompson, 2005). Furthermore, the recent development of wireless connectivity to the Internet allows practitioners the ability to easily obtain rapid retrieval of data from evidence-based repositories (Bakken, Cimino, & Hripcsack, 2004). This same wireless technology then allows for communication between team members for improved coordination of care. Thus, with the mobility of the PDA, accessed information can be transferred into useful knowledge for decision support at the bedside (Fontelo & Ackerman, 2004). Thompson (2005) maintains that PDAs have the power to revolutionize nursing practice by transforming nurses from technical experts to knowledge workers. PDA use at the point of care requires active information seeking behaviors (Cornelius, 2005; Altmann & Brady, 2005), and thus, can and will improve the utilization of evidence-based practice.

2.10.5 Instruments for measuring the utilization of EBP

Several instruments have measured various aspects of EBP, but prior to 2006, no means existed to quantify enthusiasm for EBP or measure the extent that barriers may prevent the use of EBP (Upton & Upton, 2006). For example, the Fresno test was developed as a formal measure of competence in evidence-based medicine, but its use is primarily for medical education (Ramos, Schafer, & Tracz, 2003). However, the measure does not consider the extent to which the evidence is utilized. Other attempts have used postal surveys or qualitative interviews to assess attitudes, awareness, and use of EBP among health professionals in primary care (O'Donnell, 2004; Stevenson, Lewis, & Hay, 2004). However, the literature rarely mentions the psychometric properties of these measures. Thus, there remained a need to measure attitudes towards, knowledge of, and

implementation of EBP. This has been accomplished with development of the Evidence-Based Practice Questionnaire (Upton & Upton, 2006).

2.11 Evidence-Based Practice Questionnaire

The Evidence-Based Practice Questionnaire is the instrument chosen for this study to measure several aspects of EBP, including utilization. In the development of this tool, an extensive item pool was cultivated from a literature search of the key factors influencing EBP, as well as input from significant health and social care professionals. The underlying dimensions of the scale were revealed through principal component factor analysis. The initial item pool was piloted and discussed with 33 senior health care professionals, then reduced through item analysis and scaling methods. Calculation of item-total correlation coefficients produced the items for the measure. Items that had factor loading of at least 0.4 or above on their factor were retained for the draft questionnaire, which was revised on two further occasions. Revisions were made by the initial group of health care professionals and by a steering group of experts in health and social care policy.

The initial draft was sent to a stratified sample of 500 nurses. Results from this survey were then used to structure the questionnaire. The new measure was sent to 500 different nurses for further modification and validation which resulted in the Evidence-Based Practice Questionnaire [EBPQ] (Upton & Upton, 2006).

The EBPQ is a self-report measure of knowledge, practice, and attitudes towards evidence-based practice (EBP). The instrument was designed to explore nurses' day to day use of EBP. It consists of 24 items which are organized into three subscales (EBP, attitudes towards EBP, and knowledge of EBP). All items of the instrument are scored on

a Likert-type scale of 1-7, with a higher score indicating more frequent use, greater knowledge of the value of EBP, and more positive attitudes towards the clinical effectiveness of EBP. Cronbach's alpha measured 0.87 for the entire questionnaire, demonstrating internal consistency. Internal reliability was also confirmed for the three subscales with a Cronbach's alpha of 0.85 for practice of EBP, 0.79 for the attitudes toward EBP, and 0.91 for knowledge of EBP. Construct validity was established through the demonstration of convergent and discriminant validity (Upton & Upton, 2006).

Thus far this chapter has reviewed the literature related to clinical learning and critical thinking, and the effects of these constructs on clinical decision-making and utilization of evidence-based practice. White's Clinical Decision-Making among Nursing Students schematic (2003) was introduced and the rationale for its use as the study's organizing framework provided. Furthermore, a review of decision-making theories was presented; relevant information on clinical decision-making and evidence-based practice, and the dependent variables in this investigation was provided. Various instruments for measuring these concepts were appraised and rationales offered as to the choice of the Clinical Decision-Making in Nursing Scale and the Evidence-Based Practice Questionnaire for this study. The remainder of the literature review will now be directed toward the independent variable, the use of PDAs in education with an emphasis on the allied health professions and more specifically, nursing.

2.12 PDA Adoption in Health Care

Originally envisioned in the 1970s, the hand-held computer was not marketable until 1996 when Palm, Inc. released the Pilot 1000 and 5000 (Peterson, 2003). In the last decade, sales of these products have soared and were expected to top 17 million by 2008.

It was estimated that the adoption rate for professional use of the handheld computers among physicians was 45 to 85% (Garrity & El Emam, 2006). In 2009, 64% of physicians were using smartphones, and their use is predicted to increase to 81% by 2012 (Manhattan Research, 2010). In 2005, the adoption rate for the nursing population was estimated at 25% (Cheatham, Chang, Fischer, & LeClair, 2005). Naturally, one might assume that this is now higher, especially with smartphone technology, but exact figures could not be found even after an extensive Internet search.

The most transforming power of the PDA came from its ability to carry deskbound resources for more efficient use. Software applications for the devices now number in the hundreds, with many shareware and freeware applications available for healthcare users. Four basic types of resources or devices have shown their value in being transferred to handheld computers and include library resources (data bases, e-journals, i-resources), calculators, electronic health records, and communication devices (Thompson, 2005). Within healthcare, Medline indexes approximately 4800 biomedical and health journals with more than 12 million citations (Fontelo & Ackerman, 2004). Meanwhile, CINAHL offers over 600 nursing and allied health journals (Altmann & Brady, 2005). Information retrieval at the point-of-care is vital for accurate decision-making, especially with the emphasis on evidence-based practice.

2.13 PDAs in Education

To understand how handheld technology could be used effectively in the classroom, SRI International and Palm Inc. created the Palm Education Awards (PEP) in 2001. These awards placed handheld computers in the hands of every student in more than 175 classrooms, K-12 across the United States. Evaluations from completed

questionnaires, monthly project self-evaluation reports, student surveys, and random site visits demonstrated an overwhelmingly positive view of the handheld technology. The devices were universally seen as having positive effects on student learning, on teaching practices, and on the quality of learning activities (Crawford & Vahey, 2002).

In higher education PDAs are also becoming major technology tools and are presently being rapidly integrated into the educational setting on college campuses. Educators and administrators have begun to realize that such technology fosters active learning and numerous universities are experimenting with the handheld devices. Smart technology now offers instant communication and educators are now using Twitter in the classroom. Today, American university membership in Educause, a non-profit organization with the mission of advancing higher education by promoting the intelligent use of IT, numbers over 2000 (Educause, 2010).

Since this technology is mobile, students are becoming nomadic, carrying on conversations and thinking across campus spaces. Handheld technology fosters students to be creative, communicative participants rather than passive, reception-only consumers (Alexander, 2004). The ability to access the web and download files and attachments is a tremendous learning benefit. Wireless connectivity also makes project collaboration easy, convenient, and more appealing (McDonough & Berge, 2006).

2.14 PDAs in the Health Professions

There are numerous reports in the literature regarding PDA use by various health care professionals including physicians, medical students, residents, pharmacists, pharmacy students, physician assistants, nurse practitioner students, etc. In fact, over 25% of the nation's medical schools require third and fourth year students to use PDAs

(Fallon, 2002). Kuziemy and colleagues (2005) reviewed the diffusion of PDAs in healthcare and showed that adoption and usage rates of the device are growing in health care professionals. Though there were few studies providing evidence of the impacts of such adoption and use, the studies that were available have shown promise with regard to PDA use improving patient outcomes. However, as previously mentioned, most of the studies to date are merely descriptive, with authors describing various activities and accomplishments with PDA use.

For example, Cina and Choi (2001) reported that Harvard surgical residents found the PDA very useful as a drug reference, textbook or journal reference, for medical calculations, documenting operative logs and for patient tracking. Likewise, Eastes (2001) found that point-of-care trauma documentation allowed interns and NPs more time to track and closely evaluate patient laboratory values, eliminate unnecessary medications, and adjust therapy appropriately. McCord (2003) also reported that PDAs streamlined the workload for OR nurses. The devices helped solve problems associated with updating, maintaining, and retrieving surgical preference cards and accessing medication and treatment references. Similarly, Goss and Carrico (2002) reported how infection control practitioners (ICPs) used PDAs for surveillance, time management, and communication at the University of Louisville Hospital. Through collaboration with the ICPs, the hospital's infusion therapy nurses were able to develop software that allowed them to gather data and document in several areas. This provided the infusion therapy team the tools necessary to monitor the outcomes of the services provided. Kelly's (2000) review of *going wireless* described how physical therapists at a New Jersey children's hospital found that the ease of data entry and communication with the facility's billing

software, improved documentation and billing speed, and allowed more time with patients.

Dee, Teolis, and Todd (2005) used a questionnaire designed to explore PDA use in a clinical setting. Descriptive and non-parametric statistics were used to examine the frequency of PDA use by attending physicians (n = 59) and physicians in training (n = 49). The questionnaire further explored physicians' perceptions on the impact of PDA use on clinical decision-making. The results showed that 87% of the respondents reported PDA use for patient encounters. Fifty-five percent of those responding reported frequent use and 32%, occasional use. Of the frequent PDA users, 85% reported that the instrument had influenced their overall clinical decision-making and 73% mentioned treatment alterations specifically. Furthermore, approximately 60% of participants who reported occasional use specified that the PDA had affected their overall clinical decision-making. However, more correlational and experimental studies are needed for establishment of a distinct knowledge base regarding this technology.

2.15 Use of PDAs in Nursing Practice and Education

As previously mentioned, most of what is known about PDA use in nursing practice and education is based on descriptive studies and anecdotal reports. Nurses currently use PDAs as a reference source, to organize patient data, write and transmit prescriptions, and follow patient visits.

Martin (2007) identified numerous benefits for PDA use in the clinical setting by undergraduate nursing students including the following:

1. Increased knowledge and availability of resources at their fingertips.
2. Assistance in the delivery of more comprehensive care.

3. Increased timeliness of documentation and assessments.
4. Better continuity of care through tracking software.
5. Decreased stress on the student resulting in more quality patient time
6. Increased patient safety through safer medication administration.

One of the most popular PDA software for the nurse has to do with medications. Not only can a particular drug be promptly located, but also its side effects, drug interactions, and dosages can be found. Furthermore, with the PDA's ability, medication dose calculation, estimate measures for arterial blood gases, body mass indices, laboratory values, and IV drip/infusion rates are readily available (Peterson, 2003). Since the use of handheld computers is relatively new to nursing education, especially of undergraduates, the literature is just beginning to demonstrate the effect these devices have on increased patient safety through safer administration of medication by students (Farrell & Rose, 2008; Altmann & Brady, 2005; McGill, 2004; Rempher, Lasome, & Lasome, 2003; White, et al., 2005).

In a quasi-experimental study, Greenfield (2007) used a convenience sample of undergraduate nursing students ($n = 87$). The study examined whether using PDA technology reduced nursing medication errors and provided more efficient nursing care. Students were given a case study and were asked six different questions regarding medication administration. Two primary variables were tested, speed and accuracy. T-test results showed that the PDA significantly influenced speed ($p = 0.002$) and accuracy ($p = 0.037$) in the experimental group (those using PDAs). Furthermore, on the basis of these results, the researcher recommended to her dean that all incoming students have a PDA with drug reference and medication calculator. Another recommendation was that

clinical decisions be included in the medication calculation course. Since this study involved a self-selection of students from one school of nursing, generalizability is questionable.

Farrell and Rose (2008) used a quasi-experimental, non-equivalent experimental design to explore whether the use of PDAs by student nurses enhanced pharmacological knowledge and decision support during a medical-surgical clinical rotation. Focus group discussions were then conducted to ascertain if PDA use influenced the way the students contextualized medical-surgical nursing knowledge and to identify factors affecting student PDA use in the practice setting. All second year students ($n = 76$) in a baccalaureate program participated and were randomly placed in the experimental group (PDA users) or control group. PDA users were provided training sessions on PDA functions prior to clinical placement. One week prior to clinical placement, both groups completed the pretest, a questionnaire consisting of demographic information and multiple choice pharmacological questions. Although the PDA users increased their mean score from the pretest (double that of the control group), a repeated measures analysis of variance showed no significant differences from the PDA intervention. Results of the focus groups revealed that the general impression of the PDAs were positive and encouraging for future use in the clinical area. The students' general impression was that the PDA was easy to use, secure in their clip-on case, and that the pharmacological database in the MIMS format was easily understood. Though the students felt that PDA use enhanced their pharmacological knowledge, they did not find that it influenced their medical-surgical contextual knowledge.

Goldsworthy and colleagues (2006) examined the relationship between self-efficacy and the preparation of medications among second year BSN students. They used a controlled experimental pretest-posttest method and a convenience sample of 36 students, of which two groups had PDAs and two groups had paper resources equivalent to the PDA software. Paired sample t-tests demonstrated a significant increase in self-efficacy ($p < .001$) in the groups with the PDAs which was measured by the 10-item General Self Efficacy instrument. Similarly, other authors (Rosenbloom, 2003; White, et al., 2005) have reported that the use of PDAs in clinical practice appears to enhance productivity, core knowledge for practice, professional confidence, and reduce student stress and anxiety.

Ruland (2002) used a three-group-sequential design with one intervention and two control groups of patients ($n = 155$). The investigator examined the use of *CHOICE*, a PDA based support system for preference-based care planning that assists the nurse in obtaining patient preferences for functional performances at the bedside. *CHOICE* explicitly evaluates the effects of system use on nursing care priorities, preference achievement, and patient satisfaction. A total of 28 nurses on medical/surgical units used the data collection tool and ANCOVA findings demonstrated an improvement in nursing care priorities and patient preferences ($p = 0.001$).

Cornelius piloted the Gerontological Reasoning Informatics Program (GRIP) in 2004 with 26 students for the purpose of investigating the effectiveness of PDA technology in nursing education for the development of decision-making skills and clinical competency in undergraduate nursing students. The GRIP tool is used for a comprehensive assessment of an elderly patient. It is modeled after Gordon's Functional

Health Patterns and includes 11 essential patterns that are assessed. With a series of targeted interview questions, which are then integrated with an algorithm, a calculation of patient risk for complications is produced. When all 11 modules are completed, GRIP generates an organized report of patient data which allows the student to identify patient care priorities (Glasgow, Dreher, & Cornelius, 2006). Cornelius used simultaneous mixed methodology, grounded theory, and comparative statistics for data analysis and the researcher deduced the following:

1. GRIP was effective in aiding students to reason and construct meaning from the data gathered, thus supporting decision-making. This was deduced from faculty interviews
2. PDA technology was effective in the development of clinical decision-making skills and clinical competency as reported by both students and faculty.
3. When using GRIP, students were able to identify the top three nursing care priorities at a level of expertise comparable to faculty experts. Concurrence occurred 66% of the time.
4. A more comprehensive patient assessment was accomplished with the use of GRIP as reported by 48% of the students.
5. The PDA could be a barrier to nurse-patient interaction as 66% of the students reported a preoccupation with the GRIP tool.
6. Design and functionality of the GRIP tool did need to have some revision. This theme emerged in both field observation and in-depth interviews (Cornelius, 2005).

Carr-Wagner (2007) investigated handheld computers as to whether they support or constrain nursing students at the point-of-care. The researcher used a mixed method design to direct the study. Qualitative methodology (Biemiller & Meichenbaum's Think-Aloud approach) was used at the onset and conclusion of the study to garner information using the think-aloud protocol. A grounded theory approach was used to gather data in semi-structured interviews when the participants were observed accessing the PDA. An electronic tracking microchip on a nursing focused PDA software program was the last element of data collection. Results demonstrated that the PDA supported self-regulated/self directed learning in the students, though levels of significance were not offered. The think-aloud component confirmed that all participants increased in their ability to be self-directed learners at the end of the study. Furthermore, the tracking system established that students were accessing the PDA, not only at the clinical site, but in the classroom, in studying for tests, and in completing assignments.

Kuiper (2008) used a comparative, descriptive design with 21 senior nursing students to investigate the effect of PDA resources on thinking processes and clinical reasoning for problem solving and decision-making during a seven week critical care rotation. The sample consisted of PDA users ($n = 12$) and nonusers ($n = 9$). Participants completed a PDA user survey, clinical reasoning worksheets, a computer self-efficacy scale, and a clinical log. The results were then compared and findings revealed little difference between device users and nonusers in regard to the clinical reasoning worksheets. However, self-efficacy scores (represented by descriptive statistics of median, mode, and range) were high for the PDA users as were self-reports of better organization when using the device.

Newman and Howse (2007) used a pretest-posttest mixed design to collect both quantitative and qualitative data from a convenience sample of 56 senior undergraduate nursing students enrolled in a nursing management class. The researchers investigated the impact of a PDA assisted documentation tutorial on student nurses attitudes toward computerized documentation, their anticipation to exercise professional judgment while documenting, and their satisfaction with computer technology for documentation. Findings revealed that there were no significant increases in attitudinal scores toward computerized documentation after the tutorial. However, paired t tests showed significant increases ($p < 0.05$) in anticipation to use professional nursing judgment. Satisfaction with the attributes of the instrument for documenting generated high mean scores ($M = 3.86$) and satisfaction with the learning tutorial encouraged positive attitudes. The researchers concluded that the PDA may be an important documentation tool for teaching professional nursing judgment and documentation skills to undergraduate nursing students.

2.16 Rationale for Present Study

The above examples demonstrate that PDAs have the potential to change how healthcare is taught and provided in the future. Nurse educators have been challenged to prepare graduates with 21st century knowledge and skills for practice in the emerging, technologically sophisticated health care environment. In 2005, Jeffries stated there was a definite educational shift taking place in nursing curriculum. Efforts were focusing on incorporating technology, thereby providing students more learning opportunities, creating novel teaching practices, and advancing current, accurate information retrieval systems for point-of-care nurses (Jeffries, 2005). The literature has shown that patient

safety and satisfaction have been positively affected with PDA use. Furthermore, PDA use has been correlated with an increase in self-confidence and self-directed learning. However, only a few studies have explored whether or not PDA use enhances clinical reasoning, professional judgment, and clinical decision-making. Thus, further concrete research is necessary to establish if this technology can provide decision support systems for nursing education and practice. Additionally, the question of whether or not PDAs support the utilization of evidence-based practice remains unanswered. Only with well designed research studies asking these questions will the nursing profession realize if the PDA does, in fact, achieve its expected potential. This investigation purports to help answer these questions.

2.17 Summary

The literature review has concluded with a concentration on the use of handheld computers in education, the health professions, and nursing practice and education. Many descriptive and anecdotal reports have been found that indicate this technology can transform nursing care and education with time management, error reduction, improved efficiency, improved quality of care, and enhanced information seeking behaviors. However, a definite gap in the research literature exists with regard to empirical studies regarding the use of the PDA for nursing education and practice. The empirical studies that have been reviewed, demonstrate that PDA use increased speed and accuracy of medication administration (Greenfield, 2007); increased self-efficacy (Goldsworthy, Lawrence, & Goodman, 2006; Kuiper, 2008); exhibited improvement in nursing care priorities and patient preferences (Ruland, 2002); and demonstrated improvement in reasoning that supported decision-making skills and clinical competency (Cornelius,

2005). Though these studies are promising, there are far too few to make definitive conclusions regarding PDA use in practice and education. What is yet unknown is whether the use of this device enhances clinical decision-making and the utilization of evidence-based practice. This study will augment the emergent body of data regarding this subject and add to the growing knowledge base for implementation and best use of handheld and information technology in nursing programs.

Chapter 3

Methodology

3.1 Overall Approach

The researcher investigated the relationship between baccalaureate nursing students' use of personal digital assistants (PDAs), their self-perceived clinical decision-making, and their utilization of evidence-based nursing practice. This chapter describes the methodology for this investigation and includes the research design, questions, sampling process, instrument description, the plan for protection of human participants, and the procedure for data collection and analysis

3.2 Research Design

A descriptive, correlational design was used to compare the performance of upper-level nursing students who have used PDAs and upper-level nursing students who have not used PDAs on measures of clinical decision-making and evidence-based practice. This design is appropriate as the purpose of this investigation was to describe the relationship among variables rather than to infer cause-and-effect relationships (Polit & Beck, 2004). There are few substantive exploratory studies for the effect of PDA use on clinical decision-making and utilization of evidence-based practice in the current literature. This fact further fostered the chosen methodology.

3.3 Sample Site and Selection

The target population for this study was upper-level (junior and senior) undergraduate nursing students throughout the Mid-Atlantic and Midwestern region of

the United States. The convenience sample consisted of junior and senior baccalaureate students from two different nursing programs: one in which students were required to purchase, and encouraged to use PDAs in their clinical and course work, and one in which students were not. Two comparable schools of nursing were selected based on the following criteria: enrollment, curriculum, geographic area, size of faculty, and a commitment to serve diverse, urban communities. Additionally, the schools were selected for sampling as both were easily accessible to this investigator, allowing for large numbers of potential participants. Prior to receiving IRB approval for this project, letters of support were obtained from the Deans of both schools of nursing (Appendix 7) and any additional requirements or refinements required by the IRB were satisfied.

3.4 Human Subject Consideration

No data were collected until written approval was obtained from Duquesne University's Institutional Review Board (IRB) and the IRBs of the universities where data was collected (Appendix 8). Respondent data did not include identifiers or other information that could be used to recognize any individual participant. The collective results have been reported as aggregate data. Questionnaires and data are stored in a password protected computer, with paperwork stored in a locked desk drawer in the PI's home office. Data will be kept by the PI for five years and will then be destroyed by shredding. No identifying information was collected from the students or recorded on the data collection tools. At the time of campus data collection, the principal investigator explained the provisions of participation, including the purpose of the study, the procedures of data collection, and the participants' responsibilities and rights. The students were then asked to complete the surveys.

There was little risk to individuals for participating in this survey, which required approximately 30 minutes to complete. Student participants were informed that participating or declining participation at any time during the study would not affect grading, class standing, or further opportunities at the university. They were also told that they could terminate participation in the study at any time. Participants were not identifiable by their responses, as data has been reported in the aggregate.

3.5 Subject Recruitment

After approval had been obtained from the IRBs of both universities, the sampling procedure began. The student sample was recruited by the principal investigator (PI) at the nursing schools participating in the study. Students were enlisted through personal e-mails from the PI, sent out by an administrative assistant using listserv (see Appendix 1), flyers placed throughout the campus and school of nursing (see Appendix 2), and word of mouth. As an incentive for participation, a \$5.00 gratuity was offered. The researcher felt that this amount was clearly low enough not to place undue influence on prospective participants, thus balancing the principles of respect and justice (Sears, 2001).

Inclusion criteria for PDA users in the project were as follows: upper-level, generic, baccalaureate nursing students who have used PDAs as required educational adjuncts in theory and clinical courses for a minimum of two years (junior and senior) and who were native English speakers, ranging in age from 18-30 years of age. Students enrolled in accelerated second degree nursing programs were excluded from the study. There were no other exclusion criteria.

Inclusion criteria for non PDA users in the project were: upper-level, generic, baccalaureate nursing students who had not used PDAs as required educational adjuncts

in theory and clinical courses and who were native English speakers, ranging in age from 18-30 years of age. Exclusion criteria for this group were those students who had access and used individual PDAs containing nursing reference material, and students enrolled in an accelerated second degree nursing program.

3.6 Instrumentation

Both groups of students were asked to complete the following questionnaires: the Clinical Decision-Making in Nursing Scale (CDMNS, see Appendix 3) and the Evidence-Based Practice Questionnaire (EBPQ, see Appendix 4). Additionally, participants were asked to complete a survey containing demographic questions (Appendix 5) regarding age, gender, ethnicity, marital status, current GPA, PDA usage, reference software usage, use of on-line information resources at the student's clinical agency, and employment status (within health care).

3.6.1 Clinical Decision-Making in Nursing Scale (CDMNS)

The CDMNS was developed by Jenkins (1983) to measure nurses' perceptions of their clinical decision-making skills. The instrument consists of 40 items which are rated on a 5-point Likert-type scale and contains the following subscales: A, Search for Alternatives or Options; B, Canvassing of Objectives and Values; C, Evaluation and Re-evaluation of Consequences; and D, Search for Information and Unbiased Assimilation of New Information (Jenkins, 1985). There are 10 items in each of the four subscales. The items ask respondents about their decision-making behavior while caring for patients. Responses range from "never" (rated 1) to "always" (rated 5) with potential total scores that range from 40-200. Each subscale has a maximum value of 50 (Thiele, Holloway,

Murphy, Pendarvis, & Stucky, 1991). Higher score values are interpreted as a more positive perception of decision-making (Jenkins, 2001).

Jenkins used Janis and Mann's (1977) normative model of decision-making as the conceptual framework for construction of the CDMNS. Their criteria for effective decision-making came from an extensive review of the literature on decision-making in general, as well as in nursing, and are summarized below.

The decision maker, to the best of his or her ability, and within his or her information processing capabilities:

- (a) thoroughly canvasses a wide range of alternative courses of action;
- (b) surveys the full range of objectives to be fulfilled and the values implicated by the choice;
- (c) carefully weighs whatever he or she knows about the costs and risks of negative consequences, as well as the positive consequences, that could flow from each alternative;
- (d) intensively searches for new information relevant to further evaluation of the alternatives;
- (e) correctly assimilates and takes account of any new information or expert judgment to which he or she is exposed, even when the information or judgment does not support the course of action he or she initially prefers;
- (f) reexamines the positive and negative consequences of all known alternatives, including those regarded as unacceptable, before making a final choice;
- (g) makes detailed provisions for implementing or executing the chosen course of action, with special attention to contingency plans that might be required if various known risks were to materialize. (Janis & Mann, 1977, p. 11)

After critical examination of the activities characteristic of effective decision-making, Jenkins created four categories of decision-making. Again, the researcher reviewed the decision-making and nursing decision-making literature for items that applied to each of the four categories. Principal factor methods (two factor analyses) were performed to assess the grouping of items into factors or subtests. The first analysis generated 14 factors and the second analysis, four factors. These four factors ultimately became the four subscales of the CDMNS identified above (Jenkins, 1983). Finally, the items within

each of the four subscales were tested for congruence with a single construct. The subscales were not found to be representative of any single construct, thus “less credence can be given to the results of the subscales” (Jenkins, p. 64). After preliminary testing of the instrument with 32 senior nursing students, Jenkins made revisions to the tool. Twenty-three items were discarded and the remaining 44 items comprised the tool. Pilot testing of the instrument proceeded with 30 nursing student volunteers considered representative of the final sample. Four items that yielded low item-to-total coefficients were discarded and the remaining 40 items comprise the present scale. Formal testing of the tool then commenced with 111 students that were currently engaged in clinical practice (Jenkins, 2001).

Content validity of the CDMNS was established in several ways. Jenkins (1983) maintained that items were based on related concepts that were present in the literature. Then, there was preliminary testing and subsequent revision of an early form of the CDMNS. Lastly, a panel of five nurse experts in baccalaureate education and decision-making rated each item with a specification matrix. The matrix yielded a total score for each item. Those that received a total agreement score of 77% (good) or greater were kept. Items that rated 70%-75% (fair) were thoroughly scrutinized for inclusion or exclusion and items that scored less than 70% were not retained.

Cronbach's alpha was used to determine the internal consistency reliability of the CDMNS. This statistical test examined the degree to which the instrument measured perceived clinical decision-making. The coefficient obtained for the total CDMNS was 0.83; standardized-item alpha was 0.85 (Jenkins, 1985). The instrument has been used in over 90 research projects (Giro, 2000) and included in the highly acclaimed series of

Measurement of Nursing Outcomes. The editors claim that this collection is a compendium of some of the finest instruments and methods available to nurses (Waltz & L. Jenkins, 2001).

3.6.2 Evidence-Based Practice Questionnaire (EBPQ)

The Evidence-Based Practice Questionnaire is a recently developed self-report measure of knowledge, practice, and attitudes towards evidence-based practice (EBP). The instrument was designed to explore nurses' day to day use of EBP. It consists of 24 items which are organized into three subscales (EBP, attitudes towards EBP, and knowledge of EBP). All items of the instrument are scored on a Likert-type scale of 1-7, with a higher score indicating a more positive attitude towards clinical effectiveness of EBP, frequency of use, or knowledge of clinical effectiveness for EBP. Cronbach's alpha for the pilot study measured 0.87 for the entire questionnaire. Construct validity was obtained through convergent and discriminate validity (Upton & Upton, 2006).

3.6.3 Demographic survey

Additionally, participants completed a brief demographic survey (see Appendix 5), consisting of age, gender, ethnicity, marital status, academic level, grade point average (GPA), employment (within health care) status, frequency of PDA usage, frequency of use of reference software, and use of on-line information resources at the nursing programs' clinical agencies. The survey items (variables) were selected based on their possible influence on the dependent variables (CDMNS and EBPQ).

3.7 Data Collection Procedures

Because students at both institutions spent considerable time off campus in clinical experiences, a multi-pronged approach to recruitment and data collection was

used. An e-mail to all learners invited students to participate and informed them of how to gain access to the questionnaire. A designated time (following a scheduled class), and classrooms for data collection were identified for all students through flyers and e-mails. Students interested in participating either met the PI on their respective campuses at designated times to complete the questionnaire, or asked that the questionnaire be mailed to them. Students who elected to meet the PI on campus were provided with a packet that included a cover letter (Appendix 6) and the survey. The cover letter explained the study and included all of the elements of an informed consent form. Students who completed and returned the questionnaire received the \$5.00 stipend. The PI mailed questionnaires and the \$5.00 stipend to each student who selected that option. A postage paid envelope was included in the packet sent to these students. In the accompanying cover letter, it was requested that no return address be placed on the envelope in order to protect confidentiality. Completion and return of the surveys to the PI constituted informed consent for all. Any questions that the students had during the process were answered by the investigator. Completed questionnaires are kept by the researcher in a locked desk drawer in a home office. They will be disposed of (shredded) after all data has been garnered from them.

3.8 Procedures for Data Analysis

Data were entered by the PI into the Statistical Package for Social Sciences (SPSS), version 16.5, graduate pack. Four separate stages were used in the analysis, and were guided by the research questions and survey instruments used. Initially, descriptive statistics were tabulated and used to describe and summarize all variables, including any missing data. This was followed by reliability analysis to determine the internal

consistency of the Clinical Decision-Making in Nursing Scale and the Evidenced-Based Practice Questionnaire within the context of this study. The remaining stages of analysis were determined by the examination of each individual research question, and remained exploratory in nature.

3.8.1 Stage 1: Descriptive analysis

Descriptive analysis was used to reveal the general attributes of the dataset. Descriptive statistics were calculated for each variable and included the mean, mode, median, range, standard deviation, symmetry, etc. Additionally, bivariate descriptive statistics were used to express the relationship between different variables.

3.8.2 Stage 2: Reliability analysis

Cronbach's alpha, a measure of internal consistency reliability, was originally calculated in 1983 for the Clinical Decision-Making in Nursing Scale, resulting in a value of 0.83 for the entire set and a standardized-item alpha of 0.85 (Jenkins, 1985). Subscale values ranged from 0.35 – 0.57 (Byrnes & West, 2000). An alpha coefficient of 0.8 is highly desirable in an instrument and indicates the tool is capable of making discriminations among the levels of the construct (Lew-Snyder, 2003). Other published reliability coefficients have ranged from .43 (Stover, 2000) to .88 (Thiele et al., 1991)

The original Cronbach's alpha for the initial testing of the Evidence-Based Practice Questionnaire measured 0.87 for the entire questionnaire, demonstrating internal consistency. Internal reliability was also confirmed for the three subscales with a Cronbach's alpha of 0.85 for practice of EBP, 0.79 for the attitudes toward EBP, and 0.91 for knowledge of EBP (Upton & Upton, 2006). There were no other reliability coefficients published for the EBPQ.

Prior to the examination of the research questions, a coefficient alpha was computed for both of the above scales to ascertain if the dataset generated similar levels of reliability.

3.8.3 Stages 3 – 5: Exploratory analysis of the research questions

Several analytical models were used to examine the research questions and they differed according to the variables considered, yet several criteria throughout the analysis were consistent. All of the statistical tests were performed at the 5% ($\alpha = .05$) level of significance.

Research Question 1. Do upper-level (junior and senior) nursing students who have used PDAs as part of their undergraduate curriculum differ from upper-class nursing students who have not used PDAs as part of their undergraduate curriculum on perceived clinical decision-making as measured by the Clinical Decision-Making in Nursing Scale (CDMNS)?

Research Question 2. Do upper-level nursing students who have used PDAs as part of their undergraduate curriculum differ from upper-class nursing students who have not used PDAs as part of their undergraduate curriculum on utilization of evidence-based practice (EBP) as measured by the Evidence-Based Practice Questionnaire (EBPQ)?

The first two questions were examined using the independent t-test. The t-test assesses whether the means of two groups are statistically different from each other and is especially appropriate as the analysis for the post-test only two group design. This parametric test is characterized by the following assumptions: (1) normal distribution of data; (2) samples that are independent of each other; (3) the estimation of a parameter is

involved; and (4) the independent variable is nominal, and the dependent variables are considered interval level data (Polit & Beck, 2004).

Research Question 3. What is the relationship between PDA use and perceived clinical decision-making?

Research Question 4. What is the relationship between PDA use and the utilization of evidence-based practice?

Research Question 5. What is the relationship between perceived clinical decision-making, evidence-based practice, and the demographic variables of gender, age, ethnicity, marital status, academic level, GPA, use of on-line information resources at the student's clinical agency, and employment status (within health care).

Correlation and multiple regression analysis were used to examine the remaining research questions. Spearman's rho was used to determine if a relationship existed between two or more of the variables, while multiple regression allowed a description of the nature of the relationship between variables. These two statistical analyses helped to answer questions regarding a relationship between variables; the strength of the relationship; the type of relationship; and if any predictions can be made from the relationship (Bluman, 2001).

3.9 Sample Size

Power analysis with G*Power was used a priori to determine sample size for the two-tailed independent t-test and multiple regression. Power refers to the probability that the specific test will find a statistically significant difference when, in fact, such a difference exists. Power analysis helps determine adequate sample size. A power of 0.80 or

greater is commonly accepted for the use of inferential statistics. Similarly, an alpha (error rate) of .05, and an effect size (moderate confidence that a difference is meaningful) of 0.5 is also desirable (Bluman, 2001).

Thus, using a medium effect size = 0.5, an alpha = .05, and a power = .80 for a two tailed t-test, a sample size of 128 total (two groups of 64) was needed. Using an effect size of $f^2 = .15$, an alpha of .05, and a power of .80, a total sample of 68 was needed for multiple regression analysis (Erdfelder, 1992). Upon IRB approval from both universities, the convenience sample was sought, with participation in the study being strictly voluntary.

3.10 Summary

This study utilized a descriptive, correlational design consisting of two questionnaires and a demographic assessment. Participants were upper-level, generic, nursing baccalaureate students from two different universities, one located in the Mid-Atlantic States and the other in the Midwest. Participation in the study was strictly voluntary with no foreseeable risk involved. The survey consisted of the Clinical Decision-Making in Nursing Scale, the Evidence-Based Practice Questionnaire, and a demographic assessment. Data analysis consisted of four stages including descriptive analysis, reliability analysis, and exploratory analysis utilizing parametric and non-parametric statistical methods.

Chapter 4

Results

4.1 Introduction

The purpose of this chapter is to present the statistical analysis of the data obtained from this study. SPSS, 16.5 graduate version, was the analysis program used to examine the data. The sample of the study is described initially, followed by confirmatory analysis of the instruments. The five research questions are then presented individually, with exploratory analysis of the data.

4.2 Description of the Sample

The target population for this study was upper-level (junior and senior) undergraduate nursing students throughout the Mid Atlantic and Midwest regions of the United States. The convenience sample consisted of junior and senior baccalaureate nursing students from two different universities: University A, in which students were required to purchase, and encouraged to use PDAs in their clinical and course work, and University B, in which students were not. Two comparable schools of nursing were selected based on the following criteria: enrollment, curriculum, geographic area, size of faculty, and a commitment to serve diverse, urban communities.

An overview of the study was offered by the PI to both the junior and senior classes at University A. After an explanation of the study was provided, and the freedom of choice to participate was clarified, survey packets were distributed to willing participants. Packets were then returned to the PI and stipends were provided.

The above procedure was repeated for the junior nursing class at University B. However, senior nursing students at this university are in preceptored clinicals and their presence on campus during their last semester is not required. Their class work is in online format. Thus, senior participants were solicited via e-mail.

Altogether 185 survey packets were completed and returned to this investigator. However, only 25 were obtained from University B (which did not require PDA purchase and use). Repeated efforts were made to obtain an adequate sample from this school of nursing, but they were unsuccessful. In addition, many possible participants (approximately 30) from University B used personal PDAs or other hand-held electronic devices with nursing references on them for their clinical or course work. This practice excluded them from eligibility for participation as members of the comparison group. Because the number of qualified participants from University B (those who did not use PDAs) was too small to comprise a comparison group, the final comparison group was obtained from the SON of University A, which required PDA purchase and strongly encouraged use of the device. No data obtained from participants at University B were used in the final analysis.

4.3 Demographic Characteristics of the Sample

Of the 160 survey packets completed by students at University A, one was excluded from data analysis as it did not contain the demographic survey, and thus, PDA use or non-use could not be determined. Table 4.1 summarizes the demographic characteristics and PDA use of the upper-level nursing students. Seniors comprised 49.7% of the subjects, while juniors totaled 50.3%. Ages ranged between 20 and 29 years ($M = 21.57$) while reported GPA ($n = 156$) ranged from 2.6 – 4.0. The majority of

students were female at 88%, with males at 12%. Of the total participants, 93% were Caucasian. Two of the participants were married. The students were asked the number of hours they worked weekly in the healthcare field. The majority, 67%, worked 0-8 hours. Lastly, participants were asked if internet access was available at their clinical agency, and, if so, how often they utilized such access. Ninety-two percent of the students were offered internet access. Of those who were offered access, 86% took advantage of the opportunity to varying degrees.

Table 4.1

Demographic Characteristics of Sample Including PDA Use

Characteristic	<i>n</i>	% of <i>n</i>	PDA Users	Non-Users
			(n)	(n)
Students	159			
Juniors	80	50.3	56	24
Seniors	79	49.7	33	46
Gender				
Female	140	88	81	59
Male	19	12	8	11
Age	159			
20 – 22	135	84	77	58
23 – 29	24	16	12	12
GPA	156		<i>M</i> = 3.36	<i>M</i> = 3.32
Ethnicity				
Caucasians	148	93	81	67
African-American	3	2	3	0
Hispanic	1	1	1	0
Asian	5	3	3	2
Other	1	1	1	0
Weekly Work Hrs				
0 – 8	107	67	68	39
9 – 32	44	28	18	26
33 – 40	8	5	3	5
Marital Status				
Single	156	98	87	70
Married	2	2	2	0
Clinical Agency				
Internet Access				
Yes	146	92	82	64
No	13	13	7	6
Amt. of Internet Use				
Never	31	20	20	11
Seldom	25	16	15	10
Occasionally	43	28	21	22
Frequently	39	25	24	15
Always	18	11	6	12

4.4 Confirmatory Analysis of Study Instruments

4.4.1 Clinical Decision-Making in Nursing Scale (CDMNS)

Chapter 3 offered a complete description of the CDMNS, which consists of a 40 item questionnaire divided into four subscales and uses a 5-point Likert-type scale: Always = 5 (A); frequently = 4 (F); occasionally = 3 (O); seldom = 2 (S); and never = 1 (N). A total of 10 items are assigned to each of the four subscales. The items ask respondents about their decision-making behavior while caring for patients. Potential scores for the total questionnaire range from 40-200. Each subscale has a maximum value ranging from 10-50 (Thiele, Holloway, Murphy, Pendarvis, & Stucky, 1991) and higher score values are interpreted as a more positive perception of decision-making (Jenkins, 2001). In scoring of the items, 22 were rated as positive and used the above scoring format. Items 2, 4, 6, 12, 13, 15, 19, 21, 22, 23, 24, 25, 30, 31, 32, 34, 39, and 40 were rated as negative and used frequency anchors from Always (1) to Never (5).

The Cronbach's alpha for the instrument initially was 0.85 for the total score (Jenkins, 1985) and subscale values ranged from 0.35 – 0.57 (Byrnes & West, 2000). However, values obtained by other researchers for the total score have ranged from 0.43 – 0.88 (Stover, 2000). For this study, the Cronbach's alpha for the CDMNS (total score) was 0.68. The alphas for the subscale scores were as follows: Subscale A – 0.29; subscale B – 0.40; subscale C - 0.32; and subscale D – 0.17. The subscales have been consistently reported in the literature with low values. Jenkins (1983), in originally testing the subscales, found that they were not representative of a single construct, and felt that less credence should be given their results (Stover, 2000). All of the above values may have been adversely affected by a typographical error that transposed the order of two letters

throughout the entire answer sheet. The PI was not aware of this error until data entry, as attention was brought to it by comments from participants on their answer sheets.

4.4.2 Evidence-Based Practice Questionnaire (EBPQ)

The EBPQ is a self-report measure of practice, attitudes, and knowledge towards evidence-based practice (EBP). It consists of 24 items which are organized into three subscales (EBP, attitudes towards EBP, and knowledge of EBP). All items of the instrument are scored on a Likert-type scale of 1-7, with a higher score indicating a more positive attitude towards the clinical effectiveness of EBP, or use and knowledge of clinical effectiveness and EBP. The scores for the entire EBPQ can range from 24 – 168; subscale 1, from 6 – 42; subscale 2, from 4 – 28; and subscale 3, from 14 – 98.

Cronbach's alpha for the pilot testing measured 0.87 for the entire questionnaire, demonstrating internal consistency. Internal reliability was also confirmed for the three subscales with a Cronbach's alpha of 0.85 for EBP, 0.79 for the attitudes toward EBP, and 0.91 for knowledge of EBP. Since the EBPQ is a fairly new instrument, the literature offers no further reports on reliability from other research studies. For this investigation, the alpha coefficient for the total scale was 0.91. Subscale 1 (evidence-based practice) measured 0.84; subscale 2 (attitudes toward EBP) was 0.61; and subscale 3 (knowledge of EBP) was 0.91.

4.5 PDAs

4.5.1 Criteria used to define PDA and non-PDA users

PDA users were identified as those individual students who employed a handheld electronic device for reference use either in the clinical area, for class work, or both. Non-PDA users were those individual students who did not access any handheld

electronic device for reference material, either in the clinical area or for class work. Non-users were those who answered *Never* to the question regarding *frequency of PDA use* on the demographic survey (see Appendix 5). This criterion applied to participants from both universities.

4.5.2 PDA use

PDA use, both in the clinical area and for class work, was measured as follows: Never (N); seldom (S); occasionally (O); frequently (F); and always (A). Overall, 70% of the juniors (n = 56) used the PDA in the clinical area and 39% (n = 31) used the device for class work also (Table 4.3). Seniors, meanwhile, used the PDA less often. Forty-three percent (n = 33) used the device in the clinical area and 16% (n = 13) for class work (Table 4.2).

Table 4.2

Frequency of PDA Use – Total Sample (n = 159)

Frequency of PDA Use	Juniors (n)	Seniors (n)
<i>Clinical</i>		
Never	24	46
Seldom	20	16
Occasionally	16	15
Frequently	11	9
Always	9	2
<i>Class Work</i>		
Never	49	66
Seldom	22	11
Occasionally	4	2
Frequently	4	0
Always	1	0
<i>Clinical & Class</i>		
Never	51	69
Seldom	8	5
Occasionally	5	4
Frequently	10	0
Always	6	1

4.5.3 Patterns of PDA use

The mean age for PDA users ($M = 21.47$, $SD = 1.53$) was lower than non-PDA users ($M = 21.70$, $SD = 1.11$). Chi square was used to test whether or not a significant relationship existed between PDA use and age, gender, and academic level. Those students aged 20 - 21 used the PDA significantly more often than students aged 22 – 29, $t(157) = -2.51$, $p = .013$. Female students ($M = 1.58$, $SD = 0.50$) used the PDA more than their male counterparts ($M = 1.42$, $SD = 0.51$), though not significantly, $X^2(1, n = 159) = 1.684$, $p = .194$. However, junior level students ($M = 1.70$, $SD = 0.46$) used the PDA significantly more than seniors ($M = 1.42$, $SD = 0.50$), $X^2(1, n = 159) = 12.852$, $p = .000$. Moreover, Caucasians ($M = 1.55$, $SD = 0.50$) used the PDA less than members of other ethnic groups ($M = 1.80$, $SD = 0.42$), but not significantly (Table 4.3).

Table 4.3

Specific Demographic Characteristics and Patterns of PDA Use as a Percentage (n = 159)

Characteristic	PDA Users (n = 89)	Non-Users (n = 70)	Clinical (n = 89)	Class (n = 44)	Both (n = 39)
	%	%	%	%	%
Grade					
Juniors	70	30	70	39	36
Seniors	47	58	42	16	13
Gender					
Female	58	42	58	25	25
Male	42	58	42	26	21
Ethnicity					
Caucasian	55	45	55	28	24
African/American	100	0	100	67	33
Hispanic	100	0	100	0	0
Asian	60	40	60	60	60
Other	100	0	100	0	0

Percentages will exceed 100 due to distribution of PDA use

4.6 Significant Differences on other Demographic Parameters

Chi square tests of distribution were conducted on the demographic variables prior to analyzing various traits for relationships. The number of hours worked per week was significantly different between grade level (juniors and seniors, $X^2 (4, n = 159, p < .05)$). Seniors ($n = 34, 43\%$) were twice as likely to work (anywhere from 9 – 40 hours weekly) than were juniors ($n = 18, 22\%$). Additionally, there was a significant difference in grade level and use of the internet. Seniors ($n = 64, 83\%$) used the internet in the clinical setting significantly more so than juniors ($n = 61, 77\%$), $X^2 (4, n = 156 = 14.37, p < .05)$. There were no other significant differences noted.

Table 4.4

Frequency of Computer Internet Use in Clinical Agency and Hours Worked Weekly in Healthcare

Frequency	n	PDA Users	Non-Users	Total
		%	%	%
Internet Use	156			
Never	31	66	34	100
Seldom	25	60	40	100
Occasionally	43	49	51	100
Frequently	39	62	38	100
Always	18	33	67	100
Work Hours/Weekly	159			
0 – 8	107	64	36	100
9 – 16	26	50	50	100
17 – 24	14	14	86	100
25 – 32	4	75	25	100
33 – 40	8	38	62	100

4.7 Reference Software Use

The demographic survey also asked students to rate their use of the reference software on a 1 – 5 Likert-type scale as follows: 1 = Never; 2 = Seldom; 3 =

Occasionally; 4 = Frequently; 5 = Always. The reference software consisted of the following:

1. *Nursing 2008 Drug Handbook*, special mobile/desktop bundle
2. *Stedman's Medical Dictionary for the Health Professions and Nursing*, 28th ed.
3. *Manual of Laboratory and Diagnostic Tests*, 7th ed., special mobile/desktop bundle
4. *Nurse's Handbook of Health Assessment*, 5th ed., special mobile/desktop bundle
5. *Nurse's Pocket Guide: Diagnosis, Prioritized Interventions and Rationales*, 10th ed., special mobile/desktop bundle. (Skyscape, Inc. 2008).

The drug book was the most frequently used, closely followed by the *Nurse's Pocket Guide*. Least used was the manual for laboratory and diagnostic tests. Table 4.5 summarizes the frequency of use of the various reference materials.

Table 4.5

Frequency of Reference Software Use

Reference	Always	Frequently	Occasionally	Seldom	Never
Drug Book	53	15	8	7	73
Pocket Guide	13	23	22	13	85
Dictionary	3	15	13	25	100
Assessment	3	12	22	13	91
Diagnostic Book	6	8	14	25	103

4.8 Exploratory Analysis of Data

Research Question 1:

Do upper-level (junior and senior) nursing students who have used PDAs as part of their undergraduate curriculum differ from upper-class nursing students who

have not used PDAs as part of their undergraduate curriculum on perceived clinical decision-making ability as measured by the Clinical Decision-Making in Nursing Scale (CDMNS)?

For the entire sample the mean score for the CDMNS was 148.97 (SD = 10.88). Mean scores and ranges for the CDMNS (total score) and each subscale are presented in Table 4.6. Though not significantly different, the mean score of the total CDMNS was higher for juniors (149.59, SD = 1.26) than seniors ($M = 148.34$, SD = 1.18) and females ($M = 149.27$, SD = 10.65) as opposed to males ($M = 146.74$, SD 12.54).

Table 4.6

Means and Mean Differences of the CDMNS and Subscales (A – D) Scores (n = 159)

Scale	PDA Users n = 89	Non-Users n = 70	t (157)	Two-tailed Significance
	<i>Mean (SD)</i>	<i>Mean (SD)</i>		
Total CDMNS	148.04 (9.94)	150.14 (11.93)	$t = 1.18$	$p = .24$
Subscale A	36.51 (3.30)	37.11 (3.67)	$t = 1.09$	$p = .28$
Subscale B	38.29 (3.78)	38.47 (4.30)	$t = .28$	$p = .78$
Subscale C	37.01 (4.14)	37.43 (4.53)	$t = .60$	$p = .55$
Subscale D	36.24 (3.59)	37.13 (3.44)	$t = 1.59$	$p = .11$

The independent t-test was used to test the difference in the scores on the CDMNS for PDA users and non-PDA users. No significant differences were found in the means of the total CDMNS scores or any subscale scores (Table 4.6) between PDA users

($M = 148.04$, $SD = 9.94$) and non users ($M = 150.14$, $SD = 11.93$). Furthermore, no significant differences were found when testing was extended to include the frequency of PDA use, i.e., seldom, occasionally, frequently, and always. Lastly, the t-test was used to compare the above scores between non PDA users ($n = 65$) and those who used the PDA in both the clinical area and for class work ($n = 39$). No significant differences were found.

Research Question 2:

Do upper-level nursing students who have used PDAs as part of their undergraduate curriculum differ from upper-class nursing students who have not used PDAs as part of their undergraduate curriculum on utilization of evidence-based practice as measured by the Evidence-Based Practice Questionnaire (EBPQ)?

The minimum and maximum scores for the EBPQ and subscales are as follows: Total scores can range from 24 – 168; subscale 1, from 6 – 42; subscale 2, from 4 – 28; and subscale 3 from 14 – 98. Higher scores indicate a more positive attitude toward the use of EBP, or the clinical effectiveness and knowledge of clinical effectiveness of EBP. The mean scores for the EBPQ and its subscales are summarized in Table 4.7.

Table 4.7

Means and Mean Differences of the EBPQ and Subscales (1 - 3) Scores (n = 155)

Scale	PDA Users n = 87	Non-Users n = 68	t (153)	Two-tailed Significance
	<i>Mean (SD)</i>	<i>Mean (SD)</i>		
EBPQ Total	124.17 (20.18)	123.13 (21.52)	$t = -.31$	$p = .76$
Subscale 1	32.02 (6.27)	31.29 (6.04)	$t = -.73$	$p = .47$
Subscale 2	21.33 (4.25)	21.28 (4.40)	$t = -.08$	$p = .94$
Subscale 3	71.64 (11.21)	71.61 (11.57)	$t = -.02$	$p = .99$

The independent t-test demonstrated no significant differences between the means of PDA users ($M = 124.17$) and non-users ($M = 123.13$) in the total EBPQ score and subscales 1, 2, and 3 (Table 4.7). However, when testing was extended to include the frequency of PDA use (i.e. seldom, occasionally, frequently, and always), the t-test (Table 4.8) was significant for Subscale 1 (use of evidence-based practice), $t(98) = -2.16$, $p = .028$, between those who occasionally used the PDA in the clinical area ($n = 31$, $M = 130.42$) as opposed to those who never used it ($n = 68$, $M = 123.13$). Additionally, when the t-test was expanded to include students who used the PDA frequently and always, as opposed to those who never or seldom used the device, the results were close to significant at .06 ($t(157) = 1.89$, $p = .061$).

Table 4.8

Mean Differences in EBPQ Subscale 1 by Frequency of PDA Use

Scale	Frequency	<i>t</i>	Two-tailed Significance
Subscale 1			
	Seldom	<i>t</i> (102) = .82	<i>p</i> = .41
	Occasionally	<i>t</i> (99) = -1.84	<i>p</i> = .03*
	Frequently	<i>t</i> (79) = -1.11	<i>p</i> = .28
	Always	<i>t</i> (79) = .93	<i>p</i> = .37

**p* < .05

Research Question 3

What is the relationship between PDA use and perceived clinical decision-making?

Spearman's rho was used to determine if a relationship existed between total PDA usage and the CDMNS (both the total and subscale scores). No significant correlations were found.

Research Question 4

What is the relationship between PDA use and the utilization of evidence-based practice?

Spearman's rho was used to determine if a relationship existed between total PDA usage and the EBPQ (both total and subscale scores). No significant correlations were found. Though there was a significant difference found with the utilization of EBP (Subscale 1) between those who occasionally used PDAs in the clinical area and those that did not (*p* = .03), correlation analysis could not be performed. This is due to the fact that *frequency of PDA use* was a ranking within the variable of *total PDA use*.

Table 4.9

Correlation Matrix of EBPQ Scores and PDA Use

Scale	PDA Use N = 155	Correlation Coefficient	Two-tailed Significance
EBPQ Total	1.000	.015	.852
Subscale 1	1.000	.064	.426
Subscale 2	1.000	.000	.994
Subscale 3	1.000	-.026	.747

Research Question 5

What is the relationship between perceived clinical decision-making, evidence-based practice, and the demographic variables of gender, age, ethnicity, marital status, academic level, GPA, use of on-line information resources at the student's clinical agency, and employment status (within healthcare).

Multiple regression analysis was performed to evaluate the relationship of various demographic factors with perceived clinical decision-making. Because the variables of marital status, ethnicity, and gender were seriously skewed, they were excluded from the analysis as any results from them would be questionable. GPA was the only factor to predict a higher total CDMNS score, $p < .05$. Table 4.10 demonstrates the results of the analysis of the various demographic traits with the total CDMNS score.

Table 4.10

Regression Analysis of Demographic Traits and Total CDMNS

Trait	SEM	β	<i>t</i>	<i>p</i>-value
GPA	3.04	.20	2.42	.02*
Grade	1.94	-.10	-1.17	.28
Age	.71	-.008	-.09	.97
Hours Worked	.85	.16	1.80	.09
Computer Use	.72	.06	.66	.52
R^2 .075				
F 1.459				
ΔR^2 .024				
* $p < .05$				

Legend:

<i>SEM</i>	standard error of the mean
β	standardized regression coefficient
<i>t</i>	significance of the correlations
R^2	squared multiple correlation
ΔR^2	adjusted squared multiple correlation

Furthermore, GPA predicted a higher score for CDMNS Subscale A, *Search for Alternatives and Options*, $p < .05$, and Subscale C *Evaluation and Reevaluation of Consequences*, $p < .05$. The other demographic characteristics that influenced the scores of the various subscales were hours worked per week in healthcare, $p < .05$ for Subscale A, and academic level for Subscale D, *Search for Information and Unbiased Assimilation of New Information*, $p < .05$ (Table 4.11).

Table 4.11

Regression Analysis of Significant Demographic Traits and CDMN Subscales A, C, D

<i>Subscale</i>	<i>Trait</i>	<i>SEM</i>	<i>β</i>	<i>T</i>	<i>p-value</i>
Subscale A	GPA	.95	.18	2.24	.02*
	Work Hours	.27	.19	2.28	.02*
R^2 .085 F 2.729 ΔR^2 .054					
Subscale C	GPA	1.18	.24	2.96	.004*
R^2 .062 F 2.026 ΔR^2 .033					
Subscale D	Grade	.64	-.20	-2.28	.04*
R^2 .054 F 1.830 ΔR^2 .027					

* $p < .05$ **Legend:***SEM* standard error of the mean β standardized regression coefficient*t* significance of the correlations R^2 squared multiple correlation ΔR^2 adjusted squared multiple correlation

Multiple regression analysis of the demographic factors with the total EBPQ score yielded no significant results. Furthermore, no significant results were found with multiple regression analysis of the demographic variables and EBPQ subscales 1 and 3. However, two characteristics influenced the score of subscale 2, *Attitudes toward EBP*, at a significance level of $<.05$. These traits were grade level and internet computer use within the clinical agency (Table 4.12).

Table 4.12

Regression Analysis of Demographic Traits and EBPQ Subscale 2

Trait	SEM	β	<i>t</i>	<i>p</i>-value
GPA	1.19	-.008	-.10	.92
Grade	.75	.23	2.59	.01*
Hours Worked	.33	.08	.93	.34
Computer Use	.29	-.24	-2.81	.01*
R^2	.086			
F	2.706			
ΔR^2	.054			

* $p < .05$ **Legend:***SEM* standard error of the mean β standardized regression coefficient*t* significance of the correlations R^2 squared multiple correlation ΔR^2 adjusted squared multiple correlation**4.9 Summary**

The purpose of this study was to explore the relationship between BSN students' use of personal digital assistants (PDAs), their perceptions of their clinical decision-making ability, and the utilization of evidence-based practice. Two groups of students (PDA users and non-PDA users) from the same university formed the sample of 159 students who completed a demographic survey and two questionnaires, the Clinical Decision-Making in Nursing Scale (CDMNS) and the Evidence-Based Practice Questionnaire (EBPQ). Confirmatory analysis for the total CDMNS and the four subscales in this study was less than desirable for a frequently used instrument. However, it was well within range of alpha coefficients for the instrument reported by other

investigators (Stover, 2000). The reliability of the EBPQ and its subscales was consistent with the developers' findings (Upton & Upton, 2006), demonstrating internal consistency.

Exploratory analysis of the data included the independent t-test, correlation, and multiple regression. The independent t-test was used to analyze the difference between the means of the comparison groups on the scores of the total CDMNS and each of its four subscales (Research question 1). There were no significant differences noted between the scores of PDA users and non-PDA users. As a result no correlation was established between PDA use and the CDMNS (Research question 3).

The mean scores of the EBPQ and its subscales were also analyzed using the independent t-test to establish any differences between the comparison groups (Research question 2). No significant results were found between the means of PDA users and non-users in the total questionnaire score and subscales 2 and 3. However, the results for subscale 1 (evidence-based practice), was significant for those who occasionally used the PDA in the clinical area ($n = 31$) as opposed to those who never used it ($n = 68$).

Correlational studies could not be performed due to the fact that *frequency of PDA use* was a ranking within the variable *total PDA usage*. Spearman's rho was performed on *total PDA usage*, but did not demonstrate a significant relationship (Research question 4).

Multiple regression was used to inquire into the possible impact of any of the demographic factors on perceived clinical decision-making and/or the utilization of evidence-based practice (Research question 5). Age, academic level, GPA, use of on-line information resources at the student's clinical agency, and employment status (within healthcare) were the variables examined. GPA was found to influence clinical decision-

making, both in the overall CDMNS score, and in the score of Subscale A, *Search for Alternatives and Options* and Subscale C, *Evaluation and Reevaluation of Consequences*. The other demographic characteristics that influenced the scores of the various subscales were hours worked per week in healthcare for Subscale A, and academic level for Subscale D, *Search for Information and Unbiased Assimilation of New Information*.

Finally, multiple regression analysis for the EBPQ demonstrated no significant results for the total score and scores for Subscales 1 and 3. However, two demographic traits, academic level and internet computer use within the clinical agency demonstrated significant influence on Subscale 2 which reflects one's attitudes toward evidence-based practice.

Chapter 5

Discussion and Summary

5.1 Overview of the Study

The effects of the proliferation of information technology have been readily seen in most segments of society, and gradually within healthcare. As this ongoing integration of IT occurs in healthcare, an entirely new high tech healthcare model is being created. It is one in which quality is about how much nurses know as opposed to how many they number. Readily available knowledge is the key success factor in this information age (Simpson, 2007). Consequently, nursing education and practice are being challenged as never before. Nursing faculty must now incorporate the rapidly changing technology environment into the learning experience of all nursing students. Moreover, nursing education must prepare nurses to leverage technology for improved patient care.

The personal digital assistant (PDA) has emerged as one educational technology resource to aid in developing information processing skills. Yet, very little research exists investigating the use of PDAs in healthcare, and specifically, whether or not the tool contributes to improved clinical decision-making and, thus, the quality of nursing care (Cornelius, 2005). Furthermore, there is a very limited body of knowledge regarding handheld technology in nursing education (Koeniger-Donohue, 2008).

The purpose of this study was to explore the relationship between BSN students' use of personal digital assistants (PDAs), their perceptions of their clinical decision-making ability, and their utilization of evidence-based practice. This chapter will present

a discussion of the research findings, beginning with the results of the descriptive statistics, followed by the outcomes of the exploratory analysis organized according to the research questions. Additionally, limitations of the study, implications for nursing education and practice, and recommendations for future research will be addressed.

5.2 Descriptive Findings Regarding PDA Use

PDA use was significantly higher for juniors than seniors, both in the clinical area and for class work. This coincides with the fact that younger students (20 -21 yrs.) were more apt to use the device than their older peers. One possible explanation for this occurrence is that younger students may have more experience and confidence with technological innovations (i.e., text messaging, iPods), and thus, adapt to innovation more readily than older students (Scollin, et al., 2007). Also, according to nursing faculty, numerous students had experienced technical and/or software issues with their PDAs, and therefore, had declined the use of them. It is likely, but not known for certain, that this applied more to seniors than juniors.

Though the difference was not statistically significant in this sample, the mean use of the PDA was lower for males than for females and for Caucasians when compared to their non-Caucasian peers. These are unusual findings, as the *digital divide* dictates otherwise. The phrase *digital divide* has typically been applied to occupants of developed and developing nations, rich and poor, or urban and rural. The literature is somewhat silent regarding the gender and ethnic gap in information technology. Yet, the divide still seems to exist and males typically have been considered to have the advantage in knowledge, attitude, and aptitude for technological innovations (Himmelsbach, 2005). Similarly, Caucasians are reported to have greater computer ownership, usage, and

internet access than other ethnic groups. Finally, males and Caucasians are reported to possess higher computer self efficacy. Research has demonstrated that women possess a more positive attitude toward the value of computers for productivity and this could help explain the discrepancy between male and female PDA use (Smith, 2005). The fact that University A required ownership of PDAs may well explain the differences in use among various ethnic groups.

5.3 Effects of PDA Use on Clinical Decision-Making

The total Clinical Decision-Making in Nursing Scale (CDMNS) score can range from 40 – 200, with higher scores indicating better decision-making. However, Jenkins (1983) never defined any set standards or norms for satisfactory scores. In this investigation, the overall mean score for the total CDMNS ($M = 148.96$) corresponds to what would be described in the literature as moderately high, and resembles scores found in previous studies of baccalaureate nursing students using the same instrument. However, baccalaureate nursing student participants in the study by Thiele et al. (1991), demonstrated significantly lower mean scores ($M = 111.58$) than participants in this investigation. The study by Thiele and colleagues placed students in clinical simulations, prior to administration of the CDMNS. This leaves one to wonder if the moderately high scores obtained in this study would vary if the CDMNS was completed after an actual or simulated clinical encounter.

Results of the independent t-test exploring the differences in perceived clinical decision-making, as measured by the CDMNS, between PDA users and non-users were not statistically significant. Nonetheless, the mean total scores for the CDMNS and all four subscales were slightly higher for non-PDA users than users. The software available

to PDA users consisted strictly of reference material and did not contain any clinical decision-making support program or internet access capabilities. Either of these capabilities might easily improve students' sense of self efficacy and thereby, their perceived competency in clinical decision-making. Garg and colleagues (2005) reviewed 97 controlled trials of clinical decision support systems and reported improved practitioner performance (diagnosis, preventive care, disease management, drug dosing or drug prescribing) in 64% of the studies.

The total CDMNS score was somewhat higher, though not significantly, for juniors than seniors. As noted above, juniors used their PDAs much more frequently than did seniors. Immediate access to the reference software may have offered them some degree of comfort in the clinical arena, increased confidence in their decision-making skills, and the possibility of increased understanding of the clinical picture, thus enhancing their self-perception of their clinical decision-making skills. Moreover, students with PDAs are often requested to retrieve information for nursing staff, which allows for establishment of positive rapport within the clinical area. Descriptive and exploratory studies have demonstrated this fact (Altmann & Brady, 2005; Goldsworthy, Lawrence, & Goodman, 2006; Greenfield, 2007), and, if such is the case, then the broad framework for this study is supported. The schematic visualized by White illustrated relationships among a number of factors that positively affect students' learning clinical decision-making. The process began with students gaining comfort in their skills, building relationships with staff, and connecting with their patients. These components were important for a certain comfort in the nursing role which eventually led to a better understanding of the clinical picture (White, 2003).

However, other possibilities exist. The junior study participants from this BSN program were in the early stages of learning the nursing process. Jenkins, the developer of the tool, commented that learning the nursing process may actually be analogous to learning the decision-making model. Furthermore, she stated that as students progress from simple to more complex tasks (junior to senior level), they sometimes become less confident in perceptions of their clinical capabilities and decision-making (1985).

5.4 Effects of PDA Use on Utilization of Evidence-Based Practice

The independent t-test was used to compare the differences between PDA users and non-users on the means total and subscale scores of the Evidence-Based Practice Questionnaire (EBPQ), (Research question 2). The EBPQ measures knowledge, practice, and attitudes toward evidence-based practice (EBP). The analysis showed no significant differences between PDA users and non-users on mean EBPQ total and subscale scores, though the means for all scores were higher for PDA users. Moreover, when testing was extended to examine the influence of *frequency of PDA use* (i.e., seldom, occasionally, frequently, and always), a significant difference was found in the mean of EBPQ subscale 1 score (evidence-based practice) of those who reported occasional use of the PDA in the clinical area when compared to those who never used it. Additionally, when testing was extended to include students who used the PDA frequently and always, the results were close to significant when compared to those who seldom or never used the device. These are encouraging finds, and similar to observations among undergraduate nursing students at Ohio State University. Researchers found that PDA use made the students more cognizant of evidence-based practice recommendations (Bauldoff, et al., 2008). Since evidence-based practice depends on active information seeking at the point of care,

Stroud and colleagues (2009) assert that skill in the use of handheld electronic devices will soon become a fundamental practice competency and have potential to enhance patient outcomes. Furthermore, when research evidence is embedded within the clinical care process, as could be the case when point-of-care information access is made possible, practice variations are limited. This can contribute to improved equivalence and continuity of care (Doran, 2009).

5.5 Relationship between PDA Use and Clinical Decision-Making

Since no significant results were found between PDA use and perceived clinical decision-making, correlational analysis was not significant (Research Question 3).

5.6 Relationship between PDA Use and Evidence-Based Practice

Spearman's rho correlation coefficient was used to analyze the relationship between evidence-based practice and PDA use (Research question 4). Spearman's rho was the test of choice because *total PDA use* was considered an ordinal level variable. No significant results were found for either the EBPQ total score or any of its three subscales. As mentioned in Chapter 4, even though there was a significant finding for occasional PDA use and EBPQ subscale 1, no correlation could be calculated between occasional PDA use and evidence-based practice. This was due to the fact that *frequency of PDA use* was not a distinct variable, but simply one of all rankings of the ordinal variable, *total PDA use*.

5.7 Demographic Variables Influencing Clinical Decision-Making and EBP

5.7.1 Clinical decision-making

Research question 5 explored the influence of various demographic variables on clinical decision-making and the utilization of evidence-based practice. Multiple

regression demonstrated that several traits, including GPA, age, grade level, and computer use within the clinical agency were predictive of total CDMNS and selected subscale scores.

GPA was the only variable found to be a significant influence on the total score of the CDMNS. This conflicts with the findings of Morris (1999) and Sorenson-Bowles (1997). Both of these investigators found no significant relationship between GPA and the total score of the CDMNS. Yet, both of these studies did find correlations between critical thinking and GPA. Critical thinking is considered one parameter of the clinical decision-making process as it aids in organizing approaches in specific contexts, and allows the cautious acceptance of new information (Facione & Facione, 1996). Although findings vary, several studies have demonstrated correlations between critical thinking and GPA (Bentz, 1996; Martin, 1998; & Shin, 1998). Thus, this finding does not seem that unusual.

GPA also predicted higher scores for subscale A, *Search for Alternatives and Options*; and subscale C, *Evaluation and Reevaluation of Consequences*. Jenkins (1985) maintained that students' actions in searching for alternatives and options are defined by situation complexity and past experience with similar situations. Furthermore, decisions that pertain to client outcomes (benefits and consequences) are constantly being scrutinized as evidenced in subscale C. The student must display the ability to integrate the facts of the client's condition and determine the appropriateness of actions taken. Again, one can see the relevance of critical thinking (often significantly correlated with GPA) to the clinical decision-making process. Perception of clinical decision-making ability may very well be augmented in students with higher GPAs because they

continuously and consciously demonstrate complex thinking, an essential precursor to CDM (Cornelius, 2005).

Another demographic characteristic that influenced the score for Subscale A was *hours worked per week in healthcare*. Students who worked in healthcare more than eight hours weekly, scored higher in searching for options and alternatives in planning care for their clients. In her initial work, Jenkins (1983) asserted that individuals respond to situations in habitual patterns, drawing on own past experiences. Items 3 and 27 of the CDMNS instrument indicate the utility of such experiential knowledge (Saunders, 1997):

3. The situational factors at the time determine the number of options that I explore before making a decision.

27. I select options that I have used successfully in similar situations in the past.

The experiential base provided to students working in healthcare allows them the opportunity and time to cultivate their CDM skills, thereby enhancing perceptions of their abilities. Research into the perceptions of the CDM skills of nursing students employed in positions other than healthcare is of interest and perhaps worthy of future investigation

Lastly, academic level influenced the score of Subscale D, *Search for Information and Unbiased Assimilation of New Information*. Juniors scored higher than did the seniors for this subscale. This is an anomaly and again, one must wonder if the students' experience of progressing from the performance of simple to more complex tasks influences their perceptions of their clinical capabilities and decision-making as Jenkins (1985) suggested. Additionally, the knowledge base of the younger student is not nearly as expansive as the seniors, and they are beginning to clarify and apply the meanings of

their newly acquired knowledge (Gaberson & Oermann, 1999). This would enhance the search for information and unbiased assimilation of new information.

5.7.2 Evidence-based practice

Regression analysis of the same demographic variables as above yielded no significant results for the total EBPQ scores and those for subscales 1 and 3. However, two characteristics influenced the score of Subscale 2, *Attitudes toward EBP*. These traits were grade level and internet computer use within the clinical agency. Four questions comprise Subscale 2 in the EBPQ, each consisting of a pair of statements. Participants were asked to place themselves on a 1 – 7 scale (lower to higher) for each pair of statements. An example follows:

<i>I am too busy during clinicals to keep up to date with all the new evidence</i>	1 2 3 4 5 6 7	<i>New evidence is so important that I make the time in my clinical schedule</i>
--	---------------------------	--

Mediocre attitudes toward EBP were demonstrated by junior level students, and students who used the clinical agency computer more. One can understand these results for the younger students at the junior level, as they are just being exposed to the importance of evidence-based practice and developing a sense of what counts as evidence. Seeing the relevance of, and accepting and implementing evidence-based practice, are processes that occur in due course as the individual's cognitive development, experiential knowledge, and information literacy increase. Additionally, it is not uncommon for beginning students to feel overwhelmed with their demanding schedules and to be very protective of their time. One of the barriers to EBP is the assumption that it requires too much time (DiCenso, 2003). This may also be the perception of students new to clinical situations.

The findings that more frequent use of computers situated in the clinical area, were predictive of mediocre attitudes toward EBP is more puzzling. One would think that considerable computer use would have a positive effect upon attitudes toward EBP, as theoretically, these individuals should be more information and computer literate. However, one cannot overlook the numerous barriers to practicing evidence-based care, including the complexity of research findings, misperceptions about EBP, and the lack of mentors within the clinical area.

5.8 Limitations of the Study

There are several limitations associated with this study. As mentioned in Chapter 4, recruitment problems that occurred at University B limited the range of eligible participants for the study. The resulting sample was small, limited to one school of nursing, at one point in time, and is not representative of nursing students overall. Secondly, a convenience sample was used which lends to a greater risk of sampling bias and measurement error. Moreover, insufficient student knowledge of information technology, evidence-based practice, and ineffective use of PDAs may have influenced the results. Unfortunately, the typographical error on the CDMNS answer sheet more than likely affected both the results and the confirmatory analysis of the instrument. Lastly, a stipend was offered to participants.

5.9 Implications for Nursing Education and Practice

5.9.1 Nursing education implications

The use of the point-of-care electronic handheld devices like the PDA by undergraduate nursing students is likely to expand. In 2006, required use of the device in undergraduate nursing education was over 25% (Smith & Patillo, 2006). Furthermore,

health care venues where patient care is provided are increasingly adopting technology that enhances information access for staff, faculty, and students alike (Morrissey, 2004).

Though exploratory research on PDAs is limited, the results of the studies are encouraging. Medication errors have been decreased (Greenfield, 2007), clinical decision-making has been enhanced (Cornelius, 2005), self-efficacy has increased (Goldsworthy, Lawrence, & Goodman, 2006), and evidence-based practice recommendations have been heeded (Bauldoff, et al., 2008). The findings in this study demonstrate that EBP is enhanced even with occasional use of the PDA. Evidence-based practice is contingent, in part, on up to date information at the point-of-care and any measures that promote its use need to be advanced.

The challenge for nursing education is to channel the power of PDAs and Smart technology for learning and enacting good clinical decision-making. In such a learning environment, students will be empowered to locate, appraise, choose, and synthesize information, thereby supporting evidence-based practice in the clinical arena.

5.9.2 Nursing practice implications

The most recent literature reveals that the PDA is emerging as an effective and efficient tool for information use and clinical decision-making support (Doran, 2009). Estimates of nursing use of the device are approximately 50% (DeGroote & Doranski, 2004), with nurse practitioner use at 64%. Nurses and physicians have found them invaluable for increased productivity, clinical decision-making support, and promotion of patient safety (Stroud, Smith, & Erkel, 2009).

The new generation of PDAs, the Smartphones, offer all of the functionality of a desktop computer plus telephone, e-mail, web browsing, and voice functions. They are

also capable of updating software directly onto the device with no need to connect to a regular computer. These features will provide the practicing nurse better access to clinical repositories and can only enhance patient care and intra and interdisciplinary collaboration. As hardware improves and applications become more sophisticated and robust, the Smartphone will be the instrument of choice for healthcare personnel.

5.10 Recommendations for Future Research

An evidence base must be developed to guide use of handheld technology in undergraduate nursing education. Furthermore, the most effective teaching-learning methods for cultivating PDA (or other smart technology) skills need to be studied. Future research should include more exploratory studies and fewer descriptive studies and anecdotal reports. Mixed methodology will most likely yield the most insight into the many research questions this innovative technology poses. Rigorous quantitative methods will solicit answers to whether or not PDAs support clinical decision-making, improve patient safety, enhance time management, and improve productivity. Qualitative methods will inform educators as to student attitudes toward the device and the best methods of incorporating them into the curriculum.

In replicating this study, this researcher would make a significant change. The CDMNS and EBPQ would be administered directly after a specific clinical experience, laboratory simulation, or case study, allowing the participants to consider a particular experience in answering the questionnaires. It is felt that such a point of reference would allow for more accurate answers to questions posed in the surveys.

Additionally, cognitive maturity was a factor controlled for in this study. The age of participants was limited to those under 30 years. Life experiences influence decision-

making regardless of the situation involved. Research exploring the decision-making processes of various age groups would be of relevance for nursing educators, especially since nursing attracts numerous non-traditional students. With the knowledge of the cognitive processes used by the different age groups, educators can help students understand the complexity of decision-making and the strengths and limitations of various decision-making models (Lauri & Salanterä, 2001). Furthermore, teaching/learning strategies could be developed to enhance or modify these models.

Lastly, an entirely new healthcare model has been created, one concerned with health promotion and disease prevention. With this new model and the advances that information technology has brought to the healthcare arena, the industry is changing from one that is task-based to one that is knowledge-based. Nursing must change from a profession of task performers to a profession of knowledge workers (Simpson, 2007). As the nursing profession transitions from the Industrial Age to the Information Age, nurses can no longer be process-oriented and functionally focused. Rather they must look beyond to quality outcomes based on evidence-based practice (Porter-O'Grady, 2003).

Knowledge workers are best described as individuals who synthesize a compilation of information and knowledge from a variety of sources and apply that synthesis to nursing work (Porter-O'Grady, 2003). These individuals are not measured by performance of tasks but by the results they achieve (Sorrell-Jones & Weaver, 1999) and they are in need of knowledge-based tools. By adopting such tools, including best practice databases, clinical repositories, and point-of-care technology, the nursing profession can maximize its intellectual capital. Future research should focus on ways to

best utilize information technology to help transform nursing tasks into nursing knowledge (Simpson, 2007).

5.11 Summary

This chapter has presented a discussion of the research findings including the results of the descriptive statistics and the outcomes of the exploratory analysis.

Limitations of the study, implications for nursing education and practice, and recommendations for future research were also addressed.

It remains apparent that information technology has exponentially changed the volume of clinically related health information today's nurse needs to practice safely and effectively. Nursing educators face numerous challenges in dealing with this explosion of data and the complexity of today's healthcare. The 21st century nursing student will not only require, but demand, dynamic and innovative educational methods. By providing information through an expedient electronic resource such as the PDA, nursing education is using a credible and valuable approach to satisfying these needs and expectations.

REFERENCES

1. Alexander, B. (2004). Going nomadic: Learning in higher education. *Educause Review, September/October*, 29-35.
2. Alspach, G., & Veijio, A. (2006). Nurses' use and understanding of evidence-based practice: Some preliminary evidence. *Critical Care Nurse, 26*(6), 11-12.
3. Altmann, T. K., & Brady, D. (2005). PDAs bring information competence to the point-of-care. *International Journal of Nursing Education Scholarship, 2* (1), 2-12.
4. American Library Association (2006). *Information Literacy Competency Standards for Higher Education*. Retrieved June 3, 2008 from <http://www.ala.org/acrl/ilcomstan.html>.
5. Bakken, S., Cimino, J., & Hripesak, G. (2004). Promoting patient safety and enabling evidence-based practice through informatics. *Medical Care, 42*(2), 49-56.
6. Banning, M. (2006). A review of clinical decision making: Models and current research. *Journal of Clinical Nursing, 17*, 187-195.
7. Bates, D., & Gawande, A. (2003). Patient safety: Improving safety with information technology. *The New England Journal of Medicine, 348*(25), 2526-2534.
8. Bauldoff, G., Kirkpatrick, B., Sheets, D., Mays, B., & Curran, C. (2008). implementation of handheld devices. *Nurse Educator, 33*(6), 244-248.
9. Baumberger-Henry, M. (2005). Cooperative learning and case study: Does the combination improve students' perception of problem-solving and decision making skills? *Nurse Education Today, 25*, 238-246.
10. Benner, P. (1984). From novice to expert: Excellence and power in clinical nursing practice. Menlo Park CA: Addison-Wesley.
11. Bentz, P. (1996). *The relationship between clinical performance and critical thinking disposition of nursing students*. (Doctoral dissertation). Retrieved from PDQ&T. (AAT 9813889).
12. Bluman, A. (2001). *Elementary statistics: A step by step approach*. 4th ed. New York: McGraw-Hill.

13. Brailer, D. J. (2004). *The decade of health information technology: Delivering consumer-centric and information-rich health care; framework for strategic action*. Retrieved March 31, 2007 from U.S. Department of Health and Human Services, Office of the National Coordinator for Health Information Technology, <http://www.hhs.gov>.
14. Brookfield, S. D. (1987). *Developing critical thinkers*. San Francisco: Jossey Bass.
15. Brooks, K., & Shepherd, J. (1990). The relationship between clinical decision making skills in nursing and general critical thinking abilities of senior nursing students in four types of nursing programs. *Journal of Nursing Education*, 29, 391-399.
16. Burns, H.K., & Foley, S.M. (2005). Building a foundation for an evidence-based approach to practice: Teaching basic concepts to undergraduate freshmen students. *Journal of Professional Nursing*, 21(6), 351-357.
17. Byrnes, M., & West, S. (2000). Registered nurses clinical reasoning abilities: A study of self-perception. *Australian Journal of Advanced Nursing* 17(3), 18-22.
18. Cader, R., Campbell, S., & Watson, D. (2005). Cognitive Continuum Theory in nursing decision-making. *Journal of Advanced Nursing*, 49(4), 397-405.
19. Carr-Wagner, D. (2007). *Handheld computers: Do they support or constrain nursing students at the point-of-care*. (Doctoral dissertation). Retrieved from PDQ&T. (AAT 3297595).
20. Catolico, O., Navas, M., Sommer, C., & Collins, M. (1996). Quality of decision making by registered nurses. *Journal of Nursing Staff Development*, 12, 149-154.
21. Centre for Evidence-Based Medicine (2004). Glossary of EBM terms. Retrieved June 3, 2008 from <http://www.cebm.utoronto.ca/glossary/>.
22. Cheatham, N., Chang, E., Fischer, L., & LeClair, C. (2005). Oncall healthcare PDA. *SSRE, April*. Retrieved from WWW on November 20, 2006: <http://www.ssre.org>.
23. Cina, R. A., & Choi, E. (2001). Practical use of the palm pilot for surgical residents. *Current Surgery*, 58(3), 329-331.
24. Cochrane Collaboration, (2006). What is the Cochrane Collaboration? Retrieved January 15, 2007 from <http://www.Cochrane.org/docs/descrip.htm>.

25. Corder, J. B. (1992). *The association among critical thinking, clinical decision-making, and selected demographic characteristics of generic baccalaureate nursing students*. (Doctoral dissertation). Retrieved from PDQ&T. (AAT 9312967).
26. Cornelius, F. (2005). *Handheld technology and nursing education: Utilization of handheld technology in development of clinical decision making in undergraduate nursing students*. (Doctoral dissertation). Retrieved from PDQ&T. (AAT 3178690).
27. Cornelius, F., & Donnelly, G. (2006). Point of care technology to enhance student learning and patient outcomes: Drexel University's PDA Initiative. *Dean's Notes*, 27(3) 1-2.
28. Cornelius, F., Glasgow, M., Gordon, M., & Draper, J. (2006). Leveraging mobile resources to enhance student mastery of the nursing process. *International Journal of Nursing Terminologies and Classifications*, 17(1), 28-29.
29. Courey, T., Benson-Soros, J., Deemer, K., & Zeller, R. (2006). The missing link: Information literacy and evidence-based practice as a new challenge for nurse educators. *Nursing Education Perspectives*, 27(6), 320-323.
30. Courtney, K., Demeris, G., & Alexander, G. (2005). Information technology: Changing nursing processes at the point-of-care. *Nursing Administration Quarterly*, 29(4), 315-322.
31. Crawford, V., & Vahey, P. (2002). *Palm education pioneers program March 2002*. Evaluation report, retrieved November 6, 2006 from http://www.palmgrants.sri.com/PEP_R2_Report.pdf
32. Davenport, C. (2004). *Analysis of PDAs in nursing: Benefits and barriers*. Retrieved November 15, 2006 from www.pdacortex.com/Analysis_PDAs_Nursing.htm
33. Dee, C., Teolis, M., & Todd, A. (2005). Physician's use of the personal digital assistant (PDA) in clinical decision-making. *Journal of the Medical Library Association*, 93(4), 480-486.
34. DeGroote, S., & Doranski, M. (2004). The use of personal digital assistants in the health sciences: Results of a survey. *Journal of the Medical Library Association*, 92, 341-348.
35. DiCenso, A. (2003). Evidence-based nursing practice: How to get there from here. *Leadership Perspectives*, 16(4), 20-26.

36. Doenges, M., Moorhouse, M., & Murr, A. (2006). *Nurse's pocket guide: Diagnosis, prioritized interventions and rationales* (10th ed.). Philadelphia: F. A. Davis.
37. Doran, D. (2009). The emerging roles of PDAs in information use and clinical decision-making. *EBN*, 12(2), 35-38.
38. Eastes, L. (2001). Use of the personal digital assistant for point-of-care trauma documentation. *Emergency Nursing*, 27(5), 515-518.
39. Educause (2010). *About Educause*. Retrieved January 19, 2010 from www.educause.edu
40. Edwards, L. (2006). The art of nursing in clinical learning. *The Kansas Nurse*, 81(10), 1-2.
41. Erdfelder, F., & Erdfelder, E. (1992). *GPower: A priori, post hoc, and compromise power analysis for MS-DOS* [Computer program]. Bonn, FRG: Bonn University, Dept. of Psychology.
42. Estabrooks, C., O'Leary, K., Ricker, K., & Humphrey, C. (2003). The Internet and access to evidence: How are nurses positioned? *Journal of Advanced Nursing*, 42(1), 73-81.
43. Facione, P. A. (1990). *Executive summary – critical thinking. A statement of expert consensus for purposes of educational assessment and instruction*. Millbrae, CA: California Academic Press.
44. Facione, N., & Facione, P. (1996). Externalizing the critical thinking in knowledge development and clinical judgment. *Nursing Outlook*, 44(3), 129-136.
45. Fallon, M. (2002). *Handheld devices: Toward a more mobile campus*. Retrieved May 15, 2008 from www.syllabus.com/article.asp?id6896.
46. Farrell, J. (2009). *Mobile apps zero in on POC*. Retrieved January 19, 2010 from www.healthcaregoesmobile.com.
47. Farrell, M., & Rose, L. (2008). Use of mobile handheld technology in clinical nursing education. *Journal of Nursing Education*, 47(1), 13-20.
48. Fineout-Overholt, E., Melnyk, B., & Schultz, A. (2005). Transforming health care from the inside out: Advancing evidence- based practice in the 21st century. *Journal of Professional Nursing*, 21(6), 335-344.

49. Fischbach, F. (2004). *Manual of laboratory and diagnostic tests*, (7th ed.). Philadelphia: Lippincott Williams & Wilkins.
50. Fontelo, P., & Ackerman, M. (2004). Evidence-based medicine needs easy-to-use handheld tools for universal utilization. *Medscape General Medicine*, 6(3), 53. Retrieved on February 15, 2007.
from www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1435639
51. French, P. (1999). The development of evidence-based nursing. *Journal of Advanced Nursing*, 29(1), 72-78.
52. Gaberson, K., & Oermann, M. (1999). *Clinical teaching strategies in nursing*. New York: Springer Publishing.
53. Garg, A., Adhikari, N., McDonald, H., Roses-Arellano, M., Devereaux, P., Beyene, J., et al. (2009). Effects of computerized clinical decision support systems on practitioner performance and patient outcomes. *JAMA*, 293(10), 1223- 1236.
54. Garrity, C., & El Emam, K. (2006). Who's using PDAs? Estimates of PDA use by healthcare providers: A systematic review. *Journal of Medical Internet Resources*, 8 (2)1-19.
55. Girot, E. (2000). Graduate nurses: Critical thinkers or better decision makers? *Journal of Advanced Nursing*, 31, 288-297.
56. Glasgow, M. E., Dreher, H., & Cornelius, F. (2006). Technology-infused nursing education: The Drexel Model. *Nursing Spectrum*, 15(15), 22-23.
57. Goldsworthy, S., Lawrence, N., & Goodman, W. (2006). The use of personal digital assistants at the point of care in an undergraduate nursing program. *CIN: Computers, Informatics, Nursing*, 24(3), 138-144.
58. Goss, L., & Carrico, R. (2002). Get a grip on patient safety: Outcomes in the palm of your hand. *Journal of Infusion Nursing*, 25(4), 274-279.
59. Greenfield, S. (2007). Medication error reduction and the use of PDA technology. *Journal of Nursing Education*, 46(3), 127-131.
60. Hamm, R. M. (1988a). Clinical intuition and clinical analysis expertise and the cognitive continuum. In *Professional Judgment: A Reader in Clinical Decision-Making* (Dowie, J., & Elstein, A. Eds). Cambridge: Cambridge University Press, pp. 78-109.
61. Hammond, K. (2000). *Judgments under Stress*. New York: Oxford University Press.

62. Hamers, J., Huijter, A., & Halfens, R. (1994). Diagnostic process and decision making in nursing: A literature review. *Journal of Professional Nursing*, 10, 154-163.
63. Harbison, J. (2001). Clinical decision making in nursing: Theoretical perspectives and their relevance to practice. *Journal of Advanced Nursing*, 35, 126-133.
64. Hedges, C. (2006). Research, evidence-based practice, and quality improvement. *AACN Advanced Critical Care*, 17(4), 457-459.
65. Higuchi, K., & Donald, J. (2002). Thinking processes used by nurses in clinical decision-making. *Journal of Nursing Education*, 41(4), 145-154.
66. Himmelsbach, V. (2005). Women are still on the wrong side of the digital divide, but P3s can change that. *Technology in Government*, 12(7), 22.
67. Huffstutler, S., Wyatt, T., & Wright, C. (2002). The use of handheld technology in nursing education. *Nurse Educator*, 27(6), 271-275.
68. Ignatavicius, D. D. (2001). Six critical thinking skills for at-the-bedside success. *Dimensions of Critical Care Nursing*, 20(2), 30-34.
69. Institute of Medicine Committee on Quality of Health Care in America. (1999). *To Err Is Human: Building a Safer Health System*. Washington, DC: National Academy of Sciences.
70. Institute of Medicine Committee on Quality of Health Care in America. (2001). *Crossing the Quality Chasm: A new Health Care System for the 21st Century*. Washington, DC: National Academy of Sciences.
71. Janis, I. C., & Mann, L. (1977). *Decision-making: A psychological analysis of conflict, choice, and commitment*. New York: Free Press.
72. Jeffries, P. (2005). Technology trends in nursing education: Next steps. *Journal of Nursing Education*, 44(1), 3-4.
73. Jenkins, H. M. (1983). *Perceptions of decision-making among baccalaureate nursing students as measured by the Clinical Decision Making in Nursing Scale*. (Doctoral dissertation). Retrieved from PDQ&T. (ATT 8402583).
74. Jenkins, H. M. (1985). A research tool for measuring perceptions of clinical decision making. *Journal of Professional Nursing*, 1, 221-229.
75. Jenkins, H. M. (2001). Clinical Decision Making in Nursing Scale. In C. F. Waltz & L. S. Jenkins, (Eds). *Measurement of nursing outcomes (2nd ed.)*:

Volume 1: Measuring nursing performance in practice, education, and research (pp. 33-40). New York: Springer.

76. Jennings, B. M. (2000). Evidence-based practice: The road best traveled? *Research in Nursing and Health*, 23(5), 343-345.
77. Joseph, D. (1985). Sex-role stereotype, self concept, education, and experience: Do they influence decision making? *International Journal of Nursing Studies*, 22, 21-32.
78. Joseph, D. H., Matrone, J., & Osborne, E. (1988). Actual decision making: Factors that determine practices in clinical settings. *The Canadian Journal of Nursing Research*, 20, 19-31.
79. Joseph, G., & Patel, V. (1990). Domain knowledge and hypotheses generation in diagnostic reasoning. *Medical Decision Making*, 10, 31-46.
80. Karch, A. (2007). *Nursing 2008 drug handbook*. Philadelphia: Lippincott, Williams & Wilkins.
81. Kelly, J. (2000). Going wireless. *Hospital and Health Networks*, 74(11), 65-68.
82. Koeniger-Donohue, R. (2008). Handheld computers in nursing education: A PDA pilot project. *Journal of Nursing Education*, 47(2), 74-78.
83. Kuiper, R. (2008). Use of personal digital assistants to support clinical reasoning in undergraduate baccalaureate nursing students. *Computers, Informatics, Nursing*, 26(2), 90-98.
84. Kuziemy, C., Laul, F., & Leung, R. (2005). A review on diffusion of personal digital assistants in healthcare. *Journal of Medical Systems*, 29(4), 335-342.
85. Lauri, S., & Salanter, S. (1995). Decision-making models of Finnish nurses and variables related to these models. *Journal of Advanced Nursing*, 21, 520-527.
86. Lauri, S., & Salanter, S. (2002). Developing an instrument to measure and describe clinical decision making in different nursing fields. *Journal of Professional Nursing*, 18(2), 93-100.
87. Lew-Snyder, D. M. (2003). *Moral judgment, level of satisfaction with values conflict resolution, perceived intuitiveness, and clinical decision-making in nursing*. (Doctoral dissertation). Retrieved from Dissertation Abstracts International. (AAT 3122127).

88. LISTEN Project (2010). *LISTEN: Learning information seeking and technology for evidence-based nursing practice*. Retrieved January 18, 2010 from www.listenuphealth.org.
89. Luker, K., & Kenrick, M. (1992). An exploratory study of the sources of influence on the clinical decisions of community nurses. *Journal of Advanced Nursing*, 17, 457-466.
90. Manhattan Research (2010). *Physician smartphone adoption rate to reach 81% in 2012*. Retrieved January 18, 2010 from www.ehealthserver.com/research-and-development/321-physician-smartphone-adopt.
91. Martin, C. (1998). *Critical thinking of nursing students, graduate nurses, and expert nurses in simulated clinical situations*. Unpublished doctoral dissertation, Wayne State University, Detroit (AAT 9915698).
92. Martin, R. (2007). Making a case for Personal Digital Assistant (PDA) use in baccalaureate nursing education. *Online Journal of Nursing Informatics*, 11(2), 1-8.
93. McCord, L. (2003). Using personal digital assistants to streamline the OR workload. *AORN Journal*, 78(6), 996-1001.
94. McGill, K. (2004). Wireless technology has the potential to dramatically impact nursing care. *American Association of Critical Care Nurses*, 6(21), 35-39.
95. McDonough, K., & Berge, Z. (2006). PDAs: Revolutionizing the way we learn and teach. *Turkish Online Journal of Distance Education*, 7(2), 153-159.
96. Morris, B. (1999). *Relationships among academic achievement, clinical decision making, critical thinking, working, and NCLEX-RN status*. (Doctoral dissertation). Retrieved from PQD&T (AAT 9950255).
97. Morrissey, J. (2004). Mobile phones in the hospital: Improved mobile communication and mitigation of EMI concerns can lead to an overall benefit to healthcare. *Health Physics*, 87(1), 82-88.
98. National League for Nursing (2008). *Preparing the next generation of nurses to practice in a technology-rich environment: An informatics agenda*. Retrieved June 12, 2008 from http://www.nln.org/aboutnln/PositionStatements/informatics_052808.pdf.
99. Newman, K., & Howse, E. (2007). The impact of a PDA-assisted documentation tutorial on student nurses' attitudes. *Computers, Informatics, Nursing*, 25(2), 6-83.

100. Ndiwane, A. (2005). Teaching with the Nightingale Tracker technology in community-based nursing education: A pilot study. *Journal of Nursing Education*, 44(1), 40-42.
101. Niederhaus, L. K. (2001). Using student writing assignments to assess critical thinking skills: A holistic approach. *Holistic Nursing Practice*, 15(3), 9-17.
102. Nissen, S., Abdulla, A., Khandheria, B., Kienzle, M., & Zaher, C. (2004). The role of technology to enhance clinical education and educational efficiency. *Journal of the American College of Cardiology*, 44(2) 256-260.
103. O'Donnell, C. (2004). Attitudes and knowledge of primary care professionals towards evidence-based practice: A postal survey. *Journal of Evaluation in Clinical Practice*, 10(2), 197-205.
104. Ortiz, E. (2003). Federal initiatives in information technology to improve patient safety and quality of care. *Studies in Health Technology and Informatics*, 92, 59-71.
105. Pape, T. M. (2003). Evidence-based nursing practice: To infinity and beyond. *The Journal of Continuing Education in Nursing*, 34(4), 184-190.
106. Peterson, M. (2003). The personal digital assistant and its future in nursing. *Kansas Nurse*, 78(9), 78-79.
107. Pierce, S. T. (2005). Integrating evidence-based practice into nursing curricula. *Annual Review of Nursing Education*, 3, 233-250.
108. Polit, D. F., & Beck, C. T. (2004). *Nursing research: Principles and methods* (7th ed.). Philadelphia: Lippincott.
109. Porter-O'Grady, T. (2003). Nurses as Knowledge Workers. *Creative Nursing*, 2, 6-9.
110. Profetto-McGrath, J. (2005). Critical thinking and evidence-based practice. *Journal of Professional Nursing*, 21(6), 364-371.
111. Ramos, K., Schafer, S., & Tracz, S. (2003). Validation of the Fresno test of competence in evidence-based medicine. *British Medical Journal*, 326(7384), 319-321.
112. Reilly, D., & Oermann, M. (1992). *Clinical teaching in nursing education* (2nd ed.). New York: National League for Nursing.

113. Rempher, K., Lasome, C. E., & Lasome, T. J. (2003). Leveraging palm technology in the advanced practice nursing environment. *AACN Clinical Issues*, 14(3), 363-370.
114. Rew, L. (2000). Acknowledging intuition in clinical decision-making. *Journal of Holistic Nursing*, 18, 94-107.
115. Richardson, A., Miller, M., & Potter, H. (2002). Developing, delivering, and evaluating cancer nursing services: Searching for a United Kingdom evidence- base for practice. *Cancer Nursing*, 25(5), 404-415.
116. Rosenbloom, M. (2003). Medical error reduction and PDAs. *International Pediatrics*, 18(2), 69-77.
117. Rosenbloom, M., & Ramsdell, E. (2004). Personal digital assistants and the reduction of medical error. *Harvard Health Policy Review*, 5(1), 36-46.
118. Rosenstein, A. & O'Daniel, M. (2005). Disruptive behavior and clinical outcomes: Perceptions of nurses and physicians. *Nursing Management*, 36(1), 18-28.
119. Ruland, C. M. (2002). Handheld technology to improve patient care. Evaluating a support system for preference-based care planning at the bedside. *Journal of the American Medical Informatics Association*, 9(2), 192-201.
120. Sackett, D. L., Rosenberg, W. M., Gray, J., Haynes, R. B., & Richardson, W. S. (1996). Evidence-based medicine. What it is and what it isn't. *British Medical Journal*, 312, 71-72.
121. Sackett, D. L. & Straus, S. E. (1998). Finding and applying evidence during clinical rounds: The evidence cart. *JAMA*, 280, 1336-1338.
122. Saunders, D. (1997). *Clinical decision-making and clinical judgment outcomes by student nurses in traditional or non-traditional curricula*. (Doctoral dissertation). Retrieved from PDQ&T (AAT 9807607)
123. Seager, S. (1990). *A comparison of clinical decision-making skills of associate degree and baccalaureate degree nursing students*. (Doctoral dissertation). Retrieved from PDQ&T (AAT 9113584)
124. Scollin, P., Healy-Walsh, J., Kafel, K., Mehta, A., & Callahan, J. (2007). Evaluating students' attitudes to using PDAs in nursing clinicals at two schools. *Computers, Informatics, Nursing*, 25(4), 228-235.
125. Sears, J. M. (2001). The payment of research subjects: Ethical concerns. *Oncology Nursing Forum*, 28(4), 657-663.

126. Shin, K. (1998). Critical thinking ability and clinical decision making skills among senior nursing students in associate and baccalaureate programmes in Korea. *Journal of Advanced Nursing*, 27, 414-418.
127. Shirey, M. (2006). Evidence- based practice: How nurse leaders can facilitate innovation. *Nursing Administration Quarterly*, 30(3), 252-265.
128. Shorten, A., Wallace, M., & Crooks, P. (2000). Developing information literacy: A key to evidence-based nursing. *International Nursing Review*, 48, 86-92.
129. Simpson, E., & Courtney, M. (2002). Critical thinking in nursing education: Literature review. *International Journal of Nursing Practice*, 8, 89-98.
130. Simpson, R. L. (2004). The softer side of technology: How IT helps nursing care. *Nursing Administration Quarterly*, 28(4), 302-305.
131. Simpson, R. L. (2005). Patient and nurse safety: How information technology makes a difference. *Nursing Administration Quarterly*, 29(1), 97-101.
132. Simpson, R.L. (2007). Information technology: Building nursing intellectual capital for the information age. *Nursing Administration Quarterly*, 31(1), 84-88.
133. Skyscape, Inc. (2007). *Skyscape Products*. Retrieved January 15, 2008 from www.Skyscape.com/smartrain/smartraindb.aspx?data=jHftjM1f71CuoXJeO%2b0RXJaGhQbely%2fZmnzyFim2roY8Vs0y%2bXTGkvgV1jdPdrQS
134. Smith, C., & Patillo, R. (2006). PDAs in nursing curriculum: Providing data for internal funding. *Nurse Educator*, 31(3), 101-102.
135. Smith, S. (2005). The Digital Divide: Gender and racial differences in information technology education. *Information Technology. Learning and Performance Journal* 23(1), 13-23.
136. Sorensen Bowles, K. (1997). *Effects of critical thinking, grade point average, and the college experience on the clinical judgment skills of baccalaureate nursing students*. (Doctoral dissertation). Retrieved from PDQ&T (AAT 9734861).
137. Sorrells-Jones, J. & Weaver, D. (1999). Knowledge workers and knowledge-intensive organizations, Part 3: Implications for preparing healthcare professionals. *Journal of Nursing Administration*, 29(10), 14-21.
138. Stedman's Terminology (2006). *Stedman's medical dictionary for the health*

professions and nursing (28th ed.). Philadelphia: Lippincott, Williams & Wilkins.

139. Stevens, K. R., & Ledbetter, C. A. (2000). Basics of evidence-based practice: Part 1. The nature of the evidence. *Seminars in Perioperative Nursing*, 9, 91-97.
140. Stevenson, K., Lewis, M., & Hay, E. (2004). Do physiotherapists' attitudes towards evidence-based practice change as a result of an evidence-based programme? *Journal of Evaluation in Clinical Practice*, 10, 207-217.
141. Stover, L. M. (2000). *The relationship between perceived clinical decision-making ability and medication dosage calculation ability of registered nurses*. (Doctoral dissertation). Retrieved from PQD&T (AAT 9964643).
142. Stroud, S., Smith, C., & Erkel, E. (2009). Personal digital assistant use by nurse practitioners: A descriptive study. *Journal of the American Academy of Nurse Practitioners*, 21(1), 31-38.
143. Tanner, C. (1999). Evidence-based practice: Research and critical thinking, *Journal of Nursing Education*, 38(3), 99-100.
144. Tanner, C. A. (2006). Thinking like a nurse: A research-based model of clinical judgment in nursing. *Journal of Nursing Education*, 45(6), 204-212.
145. Thiele, J., Holloway, J., Murphy, D., Pendarvis, J., & Stucky, M. (1991). Perceived and actual decision making by novice baccalaureate students. *Western Journal of Nursing Research* 13, 616-626.
146. Thompson, C. (1999). A conceptual treadmill: The need for 'middle ground' in clinical decision making theory in nursing. *Journal of Advanced Nursing*, 30, 1222-1229.
147. Thompson, B. (2005). The transforming effect of handheld computers on nursing practice. *Nursing Administration Quarterly*, 29(4), 308-314.
148. Tooley, M., & Mayo, A. (2003). Handheld technologies in a clinical setting: State of technology and resources. *AACN Clinical Issues*, 14(3), 342-349.
149. Turner, P. (2005). Critical thinking in nursing education and practice as defined by the literature. *Nursing Education Perspectives*, 26(5), 272-277.
150. Upton, D., & Upton, P. (2006). Development of an evidence-based practice questionnaire for nurses. *Journal of Advanced Nursing* 53(4), 454-458.

151. Waltz, C. F., & Jenkins, L (Eds.), (2001). *Measurement of nursing outcomes (2nd ed.): Volume 1: Measuring nursing Performance in practice, education, and research*. New York: Springer.
152. Warren, J., & Connors, H. (2007). Health information technology can and will transform nursing education. *Nursing Outlook*, 55(1), 58-60.
153. Weber, J. (2007). *Nurse's handbook of health assessment (5th ed.)*. Philadelphia: Lippincott, Williams, & Wilkins.
154. White, A. H. (2003). Clinical decision making among fourth-year nursing students: An interpretive study. *Journal of Nursing Education*, 42(3), 113-120.
155. White, A., Allen, P., Goodwin, L., Breckenridge, D., Dowell, J., & Garvy, R. (2005). Infusing PDA technology into nursing education. *Nurse Educator*, 30(4), 150-154.

APPENDIX 1

E-mail to Students
(non PDA users)

To All Juniors and Seniors,

PhD candidate, Carol Gorelick, is looking for participants for her dissertation research. Participants will be asked to fill out a brief demographic survey and two, Likert-type questionnaires, one regarding clinical decision-making and the other regarding evidence-based practice. The time required to do this will be approximately 30 minutes. A \$5.00 stipend will be given to those willing to complete the questionnaires.

Requirements for participation are as follows:

Juniors and seniors, enrolled in the **traditional** BSN program that are native English speaking, and between the ages of 18 – 30 years of age. Exclusion criteria would be any students who have used PDAs (or any hand-held computer) with nursing references on them for their clinical or course work.

The questionnaires will be administered on campus, time and place yet to be determined; or by mail for those students who cannot participate on campus.

Please understand that participation is voluntary and will remain confidential. Whether you choose to participate or not, there will be no consequences for either decision.

However, if you are interested in being a part of cutting-edge research, please contact Carol at Cgorelick@aol.com.

Thanks,

E-mail to Students

To All Juniors and Seniors,

PhD candidate, Carol Gorelick, is looking for students willing to participate in her dissertation research. Participants will be asked to fill out a brief demographic survey and two, Likert-type questionnaires, one regarding clinical decision-making and the other regarding evidence-based practice. The time required to do this will be approximately 30 minutes. A \$5.00 stipend will be given to those willing to complete the questionnaires.

Requirements for participation are as follows:

 Juniors and seniors, enrolled in the **traditional** BSN program that are native English speaking, and between the ages of 18 – 30 years of age.

The questionnaires will be administered on campus, time and place yet to be determined; or by mail for those students who cannot participate on campus.

Please understand that participation is voluntary and will remain confidential. Whether you choose to participate or not, there will be no consequences for either decision.

However, if you are interested in being a part of cutting-edge research, please contact Carol at Cgorelick@aol.com.

Thanks,

APPENDIX 2

Flyer for School Placement
(non PDA users)

STUDENTS NEEDED



For Research Project

PhD candidate, Carol Gorelick, is looking for juniors and seniors willing to participate in her dissertation project.

Carol will have a brief demographic survey and 2 questionnaires to be filled out: one on clinical decision-making and one on evidence-based practice. Completing the questionnaires will take approximately 30 minutes total.

Needed are junior and senior, traditional, BSN students, native English speaking, and between the ages of 18 – 30 years of age.

Exclusion criteria for participants are nursing students who have used PDAs (or any hand-held computers) with nursing references on them for their clinical or course work.

Participation is strictly voluntary and will in no way affect academic standing or future opportunities within the university. Participants' identities will remain confidential. As an incentive for participation, a \$5.00 stipend will be given to participants upon completion of the questionnaires.

If interested, please e-mail Carol at _____ for further information.

Flyer for School Placement
(PDA users)

STUDENTS NEEDED



For Research Project

PhD candidate, Carol Gorelick, is looking for juniors and seniors willing to participate in her dissertation project.

Carol will have a brief demographic survey and 2 questionnaires to be filled out: one on clinical decision-making and one on evidence-based practice. Completing the questionnaires will take approximately 30 minutes total.

Needed are junior and senior, traditional, BSN students, native English speaking, and between the ages of 18 – 30 years of age.

Participation is strictly voluntary and will in no way affect academic standing or future opportunities within the university. Participants' identities will remain confidential. As an incentive for participation, a \$5.00 stipend will be given to participants upon completion of the questionnaires.

If interested, please e-mail Carol at

for further

information.

APPENDIX 3

Clinical Decision-Making in Nursing Scale
Developed by Helen M. Jenkins, PhD. (1983)

Directions for the Clinical Decision Making in Nursing Scale (CDMNS)

For each of the following statements, think of your behavior while caring for clients. Answer on the basis of what you are doing now in the clinical setting.

There are no “right” or “wrong” answers. What is important is your assessment of how you ordinarily operate as a decision maker in the clinical setting. None of the statements cover emergency situations.

Statements are listed beginning on the following page. Use the answer sheet provided. Do not dwell on a response. Circle the answer that comes closest to the way you ordinarily behave.

Answer all items. About twenty minutes should be required to complete this questionnaire.

Scale for the CDMNS

Circle whether you would likely behave in the described way:

A---Always: What you consistently do every time.

F---Frequently: What you usually do most of the time.

O---Occasionally: What you sometimes do on occasion.

S---Seldom: What you rarely do.

N---Never: What you never do at any time.

Sample statement: I mentally list options before making a decision.

Key: A F O S N

The line under response F means that you usually mentally list options before making a decision.

Clinical Decision Making in Nursing Scale

NOTE: **Be sure to respond in terms of what you are doing in the clinical setting at the present time.**

1. If the clinical decision is vital and there is enough time, I conduct a thorough search for alternatives.
2. When a person is ill, his or her cultural values and beliefs are secondary to the implementation of health services.
3. The situational factors at the time determine the number of options that I explore before making a decision.
4. Looking for new information in making a decision is more trouble than it is worth.
5. I use books or professional literature to look up things I don't understand.
6. A random approach for looking at options works best for me.
7. Brainstorming is a method I use when thinking of ideas for options.
8. I go out of my way to get as much information as possible to make decisions.
9. I assist clients in exercising their rights to make decisions about their own care.
10. When my values conflict with those of my client, I am objective enough to handle the decision making required for the situation.
11. I listen to or consider expert advice or judgment, even though it may not be the choice I would make.
12. I solve a problem or make a decision without consulting anyone, using information available to me at the time.
13. I don't always take time to examine all the possible consequences of a decision I must make.
14. I consider the future welfare of the family when I make a clinical decision which involves the individual.
15. I have little time or energy available to search for information.

NOTE: Be sure to respond in terms of what you are doing in the clinical setting at the present time.

16. I mentally list options before making a decision.
17. When examining consequences of options I might choose, I generally think through “if I did this, then...”.
18. I consider even the remotest consequences before making a decision.
19. Consensus among my peer group is important to me in making a decision.
20. I include clients as sources of information.
21. I consider what my peers will say when I think about possible choices I could make.
22. If an instructor recommends an option to a clinical decision making situation, I adopt it rather than searching for other options.
23. If a benefit is really great, I will favor it without looking at all the risks.
24. I search for new information randomly.
25. My past experiences have little to do with how actively I look at risks and benefits for decisions about clients.
26. When examining consequences of options I might choose, I am aware of the positive outcomes for my client.
27. I select options that I have used successfully in similar circumstances in the past.
28. If the risks are serious enough to cause problems, I reject the option.
29. I write out a list of positive and negative consequences when I am evaluating an important clinical decision.
30. I do not ask my peers to suggest options for my clinical decisions.
31. My professional values are inconsistent with my personal values.
32. My finding of alternatives seems to be largely a matter of luck.

NOTE: Be sure to respond in terms of what you are doing in the clinical setting at the present time.

- 33. In the clinical setting I keep in mind the course objectives for the day's experience.
- 34. The risks and benefits are the farthest thing from my mind when I have to make a decision.
- 35. When I have a clinical decision to make, I consider the institutional priorities and standards.
- 36. I involve others in my decision making only if the situation calls for it.
- 37. In my search for options, I include those that might be thought of as "far out" or non-feasible.
- 38. Finding out about the client's objectives is a regular part of my decision making.
- 39. I examine the risks and benefits only for consequences that have serious implications.
- 40. The client's values have to be consistent with my own, in order for me to make a good decision.

Thank you for being a part of this study. Do you have any ideas about decision making in nursing that were not covered in the scale that you would like to share?

You can speak to specific items or give any general comments you would like.

Feel free to use this last page or the back of the answer sheet.

ANSWER SHEET FOR CDMNS

Scale:

A---Always: **What you consistently do every time.**

F---Frequently: **What you usually do most of the time.**

O---Occasionally: **What you sometimes do on occasion.**

S---Seldom: **What you rarely do.**

N---Never: **What you never do at any time.**

Circle the selection that comes closest to the way that you ordinarily behave.

- | | | |
|---------------|---------------|---------------|
| 1. A F S O N | 15. A F S O N | 29. A F S O N |
| 2. A F S O N | 16. A F S O N | 30. A F S O N |
| 3. A F S O N | 17. A F S O N | 31. A F S O N |
| 4. A F S O N | 18. A F S O N | 32. A F S O N |
| 5. A F S O N | 19. A F S O N | 33. A F S O N |
| 6. A F S O N | 20. A F S O N | 34. A F S O N |
| 7. A F S O N | 21. A F S O N | 35. A F S O N |
| 8. A F S O N | 22. A F S O N | 36. A F S O N |
| 9. A F S O N | 23. A F S O N | 37. A F S O N |
| 10. A F S O N | 24. A F S O N | 38. A F S O N |
| 11. A F S O N | 25. A F S O N | 39. A F S O N |
| 12. A F S O N | 26. A F S O N | 40. A F S O N |
| 13. A F S O N | 27. A F S O N | |
| 14. A F S O N | 28. A F S O N | |

Clinical Decision Making in Nursing Scale (CDMNS)

Information Sheet

The following is important information to use when scoring the CDMNS and arranging for statistical analysis.

- I. These 22 items are rated as positive and use the frequency anchors Always (5) to Never (1).

1, 3, 5, 7, 8, 9, 10, 11, 14, 16, 17, 18, 20, 26, 27, 28, 29, 33, 35, 36, 37, 38.

All other items are rated as negative and use frequency anchors from Always (1) to Never (5).

- II. Subscales are composed of the following items:

Subscale A: Search for Alternatives and Options

1, 3, 6, 7, 16, 22, 27, 30, 32, 37

Subscale B: Canvassing of Objectives and Values

2, 9, 10, 14, 21, 31, 33, 35, 38, 40

Subscale C: Evaluation and Reevaluation of Consequences

13, 17, 18, 23, 25, 26, 28, 29, 34, 39

Subscale D: Search for Information and Unbiased Assimilation
of New Information

4, 5, 8, 11, 12, 15, 19, 20, 24, 36

APPENDIX 4

Clinical Effectiveness and Evidence Based Practice Questionnaire (EBPQ).

(Developed by D. R. Upton and P. M. Upton, 2005)

This questionnaire is designed to gather information and opinions on the use of evidence based practice. There are no right or wrong answers for we are interested in *your* opinions and *your* own use of evidence in *your* practice. As you respond to the questions, consider your clinical assignments and your care of your patients.

1. Considering your practice in relation to an individual patient's care over the past year, how often have you done the following in response to a gap in your knowledge (please mark an X in the appropriate box):

Formulated a clearly answerable question as the beginning of the process towards filling this gap:

Never ☐ ☐ ☐ ☐ ☐ ☐ ☐ **Frequently**

Tracked down the relevant evidence once you have formulated the question:

Never ☐ ☐ ☐ ☐ ☐ ☐ ☐ **Frequently**

Critically appraised, against set criteria, any literature you have discovered:

Never ☐ ☐ ☐ ☐ ☐ ☐ ☐ **Frequently**

Integrated the evidence you have found with your expertise:

Never ☐ ☐ ☐ ☐ ☐ ☐ ☐ **Frequently**

Evaluated the outcomes of your practice:

Never ☐ ☐ ☐ ☐ ☐ ☐ ☐ **Frequently**

Shared this information with colleagues:

Never ☐ ☐ ☐ ☐ ☐ ☐ ☐ **Frequently**

2. Please indicate (by an X) where on the scale you would place yourself for each of the following pairs of statements:

I am too busy during clinicals to keep up to date with all the new evidence	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	New evidence is so important that I make the time in my clinical schedule
---	--	---

I resent having my clinical practice questioned	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	I welcome questions on my clinical practice
---	--	---

Evidence based practice is a waste of time	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Evidence based practice is fundamental to professional practice
--	--	---

I stick to tried and trusted methods rather than changing to anything new	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	My clinical practice has changed because of evidence I have found
---	--	---

3. On a scale of 1 to 7 (with 7 being the best) how would you rate your:

Please circle one number for each statement							
	Poor						Best
Research skills	1	2	3	4	5	6	7
Internet Technology skills	1	2	3	4	5	6	7
Monitoring and reviewing of practice skills	1	2	3	4	5	6	7
Converting your information needs into a research question	1	2	3	4	5	6	7
Awareness of major information types and sources	1	2	3	4	5	6	7
Ability to identify gaps in your professional practice	1	2	3	4	5	6	7
Knowledge of how to retrieve evidence	1	2	3	4	5	6	7
Ability to analyze critically, evidence against set standards	1	2	3	4	5	6	7
Ability to determine how valid (close to the truth) the material is	1	2	3	4	5	6	7
Ability to determine how useful (clinically applicable) the material is	1	2	3	4	5	6	7
Ability to apply information to individual cases	1	2	3	4	5	6	7
Sharing of ideas and information with colleagues	1	2	3	4	5	6	7
Dissemination of new ideas about care to peers	1	2	3	4	5	6	7
Ability to review your own practice	1	2	3	4	5	6	7

APPENDIX 5

Demographic Survey

Please complete the following:

All students:

1. Marital status _____
2. Ethnicity _____
3. Current grade point average (GPA) _____
4. Gender _____
5. Grade level _____
6. Age _____
7. If you are currently employed, providing patient care, how many hours do you work weekly _____

For Students Using PDAs:

On a scale of 1 – 5 (with 1 being never and 5 being always) how would you rate:
(Circle one number)

Frequency of PDA use for clinicals: 1 2 3 4 5

Frequency of PDA use for class work: 1 2 3 4 5

Does the agency where you do your nursing program-related clinical experiences offer on-line information resources? Yes _____ No _____

If so, how often do you use the agency's on-line information resources?

1 2 3 4 5

You are currently using the following reference software: Please place a number, 1, 2, 3, 4, or 5 (1 being used the least and 5 being used the most) regarding the frequency you use each reference.

Nursing 2008 Drug Handbook _____ Stedman's Medical Dictionary _____

Manual of Lab and Diagnostic Tests _____ Nurse's Handbook of Health Assessment _____

Nurse's Pocket Guide: Diagnosis, Prioritized Interventions and Rationales _____

APPENDIX 6



DUQUESNE UNIVERSITY

600 FORBES AVENUE ♦ PITTSBURGH, PA 15282

Participant Cover Letter

Dear Research Participant:

Thank you for your willingness to participate in this study, Personal Digital Assistants: Their Influence on Clinical Decision-Making and the Utilization of Evidence-Based Practice in Undergraduate Baccalaureate Students.

I want to provide this information about the study. If you have questions about any point, feel free to ask for clarification or more information from Carol Gorelick, the Principal Investigator at gorelickc@aol.com, and/or Dr. Paul Richer, Chair of the Duquesne University Institutional Review Board at 412-396-6326.

The purpose of the study is to seek initial answers about the value of the personal digital assistant as a clinical and educational tool for clinical decision-making and the promotion of evidence-based practice. There are no risks greater than those encountered in everyday life. The benefit of the study is the altruistic contribution to knowledge and the opportunity to participate in a research study.

You are eligible to participate if you are a junior or senior (second semester) in the traditional baccalaureate nursing program, 18-30 years of age, with English as your first language. A \$5.00 gift card will be provided in gratitude for your participation in this study.

Doing a study involves systematically collecting and analyzing data. As a participant in this study, you will be asked to complete a socio-demographic questionnaire, the Evidence-Based Practice Questionnaire (10 minutes), and the Clinical Decision-Making in Nursing Scale. The entire process should take approximately 45 minutes. These are the only requests that will be made of you.

Please know that you are free to terminate participation in the study at any time. Your name will never appear on the research instruments. No identity will be made during the data analysis. All subjects' response(s) will only appear in statistical data summaries. Once the study is concluded, the results will be available for the participants to view with no reference to any particular participant's name or identity.

Once again, thank you for your willingness to participate!

Sincerely,

Carol Gorelick,

APPENDIX 7

Dear Carol,

I am sorry for my delay in responding to your request for a letter of support for your IRB application related to your dissertation. It is my understanding that you hope to recruit nursing students from the school to participate in your study, Personal Digital Assistants: Their Influence on Clinical Decision-Making and Utilization of Evidence-Based Practice in Baccalaureate Nursing Students.

We make every effort to support the work of doctoral students, however it is important that the faculty be appraised of the work, and do not see it as a problem for the course. I hope you have sought the approval of the faculty who teach in the undergraduate program. The undergraduate curriculum committee is chaired by Maureen Leonardo, who has made a considerable investment in PDAs and has been an early "adopter".

Assuming the support of the faculty, I fully support your work within the school. Best wishes on this work. I am hopeful that your findings will contribute to our understanding of both clinical decision making in students, and the role of the PDA in facilitating that.

Eileen H. Zungolo, Ed.D., RN, FAAN
Professor and Dean
School of Nursing
Duquesne University
Pittsburgh, PA 15282
zungolo@duq.edu



October 15, 2008

To Whom It May Concern:

As Dean of Oakland University's School of Nursing, I readily support the research endeavor of Carol Gorelick, Duquesne University doctoral candidate.

The advances in information technology (IT) have affected not only the health care system, but have challenged nursing education and practice. Ms. Gorelick's proposed study will provide support to the profession's growing knowledge base regarding the implementation of new technology in undergraduate nursing programs.

Ms. Gorelick will be recruiting baccalaureate student participants from Oakland University School of Nursing as well as the Duquesne School of Nursing population. Her research will provide a comparison of these two groups of students: Duquesne students who are currently utilizing PDAs in their clinical and course work; and Oakland University students who are not required to use PDA's in their clinical and course work. Student participants will be provided a \$5.00 stipend to complete a demographic survey and two Likert-type questionnaires; the Clinical Decision-Making in Nursing Scale (CDMNS) and the Evidence-Based Practice Questionnaire (EBPQ) which will take approximately 30 minutes to complete.

I believe that Ms. Gorelick's research will validate a need for information technology aides to be implemented at its earliest possible levels in the undergraduate nursing programs.

If I can be of further assistance, please do not hesitate to contact me (248) 370-4081.

Sincerely,

Linda Thompson Adams, DrPH, RN, FAAN
Dean and Professor

LTA/el

APPENDIX 8

Dr. Paul Richer
Chair, Institutional Review Board
Human Protections Administrator
Phone (412) 396-6326 Fax (412) 396-5176
e-mail: richer@duq.edu

November 17, 2008

Ms. Carol Gorelick

Re: Personal digital assistants: their influence on clinical decision-making and utilization of evidence-based practice in Baccalaureate nursing students (Protocol # 08-124)

Dear Ms. Gorelick:

Thank you for submitting your research proposal to the IRB.

Based upon the recommendation of IRB member, Dr. Kathleen Sekula, along with my own review, have determined that your research proposal is consistent with the requirements of the appropriate sections of the 45-Code of Federal Regulations-46, known as the federal Common Rule. The intended research poses no greater than minimal risk to human subjects. Consequently, the research is approved under 45CFR46.101 and 46.111 on an **expedited** basis under 45CFR46.110.

The consent form is attached with IRB approval and expiration date. You should use the stamped form as original for copies that you distribute.

The approval must be renewed in one year as part of the IRB's continuing review. You will need to submit a progress report to the IRB in response to a questionnaire that we will send. In addition, if you are still utilizing your consent form in one year, you will need to have it renewed. In correspondence please refer to the protocol number shown after the title above.

If, prior to the annual review, you propose any changes in your procedure or consent process, you must inform the IRB of those changes and wait for approval before implementing them. In addition, if any unanticipated problems or adverse effects on subjects are discovered before the annual review, they must be reported to the IRB Chair before proceeding with the study.

When the study is complete, please provide us with a summary, approximately one page. Often the completed study's Abstract suffices. You should retain a copy of your research records, other than those you have agreed to destroy for confidentiality, over a period of five years after the study's completion.

Thank you for contributing to Duquesne's research endeavors.

If you have any questions, feel free to contact me at any time.

Sincerely yours,

Paul Richer, Ph.D.

C: Dr. Kathleen Sekula
Dr. Carolyn Nickerson
IRB Records



**Institutional Review Board for the
Protection of Human Subjects**

Office of Grants, Contracts & Sponsored Research
544 O'Dowd Hall
Rochester, Michigan 48309-4401
(248) 370-4898 Fax: (248) 370-2973

December 5, 2008

Professor Darlene Schott-Baer
School of Nursing

Reference: IRB application #4006, "Personal Digital Assistants: Their Influence on Clinical Decision-Making and Utilization of Evidence-Based Practice in Baccalaureate Nursing Students" (Carol Gorelick)

Dear Professor Schott-Baer:

On behalf of the Institutional Review Board (IRB), responsible for the review of research involving human subjects, Dr. Christine Hansen, IRB Chair, has reviewed your submission referenced above and determined that as defined in 45CFR46.101(b)(2) the project, as currently described, is **exempt** from IRB review. **The exemption is granted for one year starting 12/5/08 and ending 12/5/09.**

This exemption is made with the understanding that no changes may be made in the procedures to be followed until after such modifications have been submitted to the IRB for review and approval. If a consent form is required for your project, please be sure your consent form includes the IRB contact name and telephone number (Dr. Christine Hansen, Chair, Oakland University Institutional Review Board for the Protection of Human Subjects, 248-370-2762). **Researchers must retain a copy of the informed consent form in their files for three years and must provide a copy of the consent form to the subject.**

Any unanticipated problems involving risks to human subjects or serious adverse effects must be promptly reported to the IRB.

Two-months prior to the expiration of this approval you will receive notification of the need for updated information to be used for the project's continuing review. **When project is completed, please download the IRB Completion Form from Human Subjects site at the Research webpage, complete and email it to me. Thank you.**

Sincerely,

Judette Haddad, Ph.D.
Regulatory Compliance Coordinator