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Nahm, E., Resnick, B., Magaziner, J., Zhu, S., Brown, C., & **(Gartrell) Kim, K.** (2012). Fear of falling in community-dwelling older adults and its relationship with level of exercise, *Gerontologist*, November, 52, 29-29, 1p. Supplement: 1

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ABSTRACT

Title of Dissertation: Factors Associated with Electronic Personal Health Record Use among Registered Nurses for Their Own Health Management

Kyungsook Gartrell, Doctor of Philosophy, 2014

Dissertation Directed by: Alison M. Trinkoff, PhD, RN, Professor, School of Nursing

Background: Electronic personal health records (ePHRs) are consumer-centric tools that enable consumers to securely access, manage and share their health information with health care providers. Although the potential for ePHRs to improve healthcare is significant, there is no available evidence on health care professionals' use of ePHRs for their own health management. Nurses have a tremendous opportunity to assist and educate patients in ePHRs. Research has shown that ePHR adoption among patients were influenced by perceived usefulness and ease of use using the technology acceptance model (TAM). This study expanded the TAM adding perceived data privacy security protections and health promoting role models for the ePHR acceptance model.

Purpose: This study examined (1) characteristics associated with ePHR use by nurses: health, technology experience, and attitudes about privacy of electronic health information, (2) psychometric properties of the measures in the research model, (3) association of ePHR acceptance constructs: perceived usefulness, ease of use, data privacy and security protections, and health promoting role model with ePHR use, and (4) moderating effects of nurses characteristics: age, chronic illness and/or medication use, providers use of electronic personal health record (EHR) on the relationships between ePHR acceptance constructs and ePHR use.

Methods: Registered nurses working in hospitals and members of the nursing informatics community (NIC) completed an anonymous online survey in the Fall of 2013 (n=847). Differences between groups were examined using t-tests and χ^2 tests. The associations between nurses' characteristics and ePHR use were examined via multiple logistic regression models that also held constant possible confounding covariates and interaction terms.

Results: Less than half (41%) of the hospital nurses were ePHR users. The odds of ePHR use was significantly greater among those with chronic medical conditions/medication use (OR=1.64, 95% CI=1.06-2.53) and those whose health care providers used EHRs (OR=3.62, 95% CI=2.45-5.36) controlling for age, marital status, current positions and specialty area. ePHR use was more common among NIC nurses (72%). The odds of ePHR use was also increased among NIC nurses with providers that used EHRs (OR=5.99, 95% CI=1.40-25.61), but users were 70% less concerned about privacy of health information online than nonusers (OR=0.32, 95% CI=0.14-0.70) controlling for ethnicity, race and practice regions. The majority of both ePHR users and nonusers would grant access to their primary care providers. However, fewer ePHR users in both nursing groups granted permission to designated family members or friends, other care providers who care for them, or pharmacists to view ePHRs than nonusers who answered hypothetically. Sufficient reliability for usefulness, ease of use, and privacy and security protections, and health promoting role model scales were found (all Cronbach alphas>0.70). Three constructs contributed significantly to ePHR use after adjusting nursing group, age, chronic illness and medication use, and health care providers use of EHR (usefulness, OR=0.87, 95% CI=0.85-0.89; data privacy and security protection,

OR=1.04, 95% CI=1.01-1.07; and health promoting role model, OR=1.07, 95% CI=1.04-1.11). Significant interactions existed between perceived data privacy and security protections and providers EHR use, and between perceived health promoting role model and age on ePHR use ($p < 0.05$).

Conclusion: The study findings suggest practical insights for nurses. With the experience of using ePHRs, nurses can leverage use of ePHRs for patient education on chronic illness and medication management. Nurses in NIC can also play an important role in practical ePHR design to enhance functionality and security in ePHR with their specialties in nursing informatics.

Factors Associated with Electronic Personal Health Record Use among Registered
Nurses for Their Own Health Management

by
Kyungsook Gartrell

Dissertation submitted to the Faculty of the Graduate School of the
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TABLE OF CONTENTS

CHAPTER	PAGE
I: BACKGROUND.....	1
1.1 Introduction.....	1
1.2 Statement of the Problem.....	3
1.3 Conceptual Framework.....	5
1.3.1 Technology Acceptance Model.....	5
1.3.2 Research Model and Hypotheses.....	7
1.3.3 Research Hypotheses.....	8
1.4 Purpose of the Study.....	14
1.5 Significance of the Study.....	15
1.6 Methodological Approach.....	16
1.6.1 Study Design.....	16
1.6.2 Population/Sample Setting/Sampling Frame.....	16
1.6.3 Data Collection Procedures.....	16
1.6.4 Measurement.....	18
1.6.5 Data Analyses.....	22
1.6.6 Sample Size Adequacy.....	25
1.6.7 Human Subjects.....	26
1.7 Introduction of the Three Manuscripts.....	27
II: (Manuscript 1): ELECTRONIC PERSONAL HEALTH RECORD USE AMONG REGISTERED NURSES¹.....	29
2.1 Introduction.....	29
2.2 Methods.....	31
2.2.1 Study Design and Sample.....	31
2.2.2 Survey Development.....	32
2.2.3 Survey Domains.....	32
2.2.4 Analysis.....	34
2.3 Results.....	34
2.3.1 Health and Healthcare Experience.....	37
2.3.2 Technology Experience and Awareness of New Technology.....	37
2.3.3 Attitudes about Privacy of Electronic Information.....	39
2.3.4 Factors Associated with ePHR Use.....	41
2.4 Discussion.....	44
2.5 Limitations.....	48
2.6 Conclusions.....	48
III: (Manuscript 2): ELECTRONIC PERSONAL HEALTH RECORD USE AMONG NURSES IN THE NURSING INFORMATICS COMMUNITY¹.....	50
3.1 Introduction.....	50

CHAPTER	PAGE
3.2 Methods	52
3.2.1 Study Design and Sample.....	52
3.2.2 Survey Domains and Measurement	53
3.2.3 Analysis	54
3.3 Results.....	55
3.3.1 Health and Healthcare Experience.....	59
3.3.2 Technology Experience and Awareness of New Technology.....	59
3.3.3 Attitudes about Privacy of Electronic Health Information.....	61
3.3.4 Factors Associated with ePHR Use among NIC Nurses.....	63
3.4 Discussion	65
3.5 Limitations	67
3.6 Conclusion	68
IV: (Manuscript 3): FACTORS AFFECTING NURSES ACCEPTANCE OF ELECTRONIC PERSONAL HEALTH RECORD FOR THEIR OWN HEATH MANAGEMENT¹	69
4.1 Introduction.....	69
4.1.1 ePHR Acceptance Research within Health Care Professionals.....	70
4.1.2 Patient Acceptance of ePHR Research	72
4.1.3 Research Model and Hypotheses	73
4.1.4 Variable Definitions.....	74
4.2 Methods	79
4.2.1 Research Design	79
4.2.2 Data Collection Procedure.....	79
4.2.3 Measurement	80
4.2.4 Analysis.....	82
4.3 Results.....	82
4.3.1 Sample Descriptive	82
4.3.2 Reliability and Validity	83
4.3.3 Model Testing.....	85
4.4 Discussion	92
4.5 Limitations	94
4.6 Conclusion	95
V: DISCUSSION.....	97
5.1 Summary of Findings	97
5.2 Discussion of Findings	101
5.2.1 ePHR Use among Registered Nurses.....	101
5.2.2 ePHR Use among Nurses in Nursing Informatics Community.....	103
5.2.3 Factors Affecting Nurses' Acceptance of ePHR for Their Own Health	105
Management.....	105
5.3 Limitations	107

CHAPTER	PAGE
5.3.1 Cross-Sectional and Convenience Sampling Design.....	107
5.3.2 Self-administered Online Survey.....	108
5.3.3 Self-Reported Data.....	109
5.4 Implications.....	110
5.4.1 Implications for Practice and Policies.....	110
5.4.2 Implications for Future Research.....	114
5.5 Summary.....	115
 APPENDIX A: Table A.1: Definition of Personal Health Record.....	 117
 APPENDIX B: Figure A.1: Illustrations of TRA, TPB, TAM2, TAM3, UTAUT, and DIT	 118
 APPENDIX C: Table A.2: Measurement Matrix for Concepts and Operational Variables.....	 121
 APPENDIX D: Survey for Nurses about Electronic Personal Health Records Acceptance	 131
 REFERENCES	 141

LIST OF TABLES

TABLE	PAGE
2.1: Characteristics of Hospital Nurses by Personal Use of ePHR.....	35
2.2: Technology Use and Attitudes of Hospital Nurses by Personal ePHR use.....	38
2.3: Adjusted ^a Odds Ratios of Factors Associated with ePHRs Use by Hospital Nurses (n=660).....	42
3.1: Characteristics of Nurses in Nursing Informatics Community by Personal use of ePHR.....	56
3.2: Technology Use and Attitudes of Nurses in Nursing Informatics Community by Personal Use of ePHR.....	60
3.3: Adjusted ^a Odds Ratios of Factors Associated with ePHRs Use by NIC Nurses (n=180).....	64
4.1: Characteristics (n, %) ^a of Nurses(n=847).....	83
4.2: Perceived Usefulness, Ease of Use, Data Privacy and Security and Role Model for ePHR Users and Nonusers: Mean (SD), Cronhbach's Alpha.....	84
4.3: Odds Ratios of ePHR Acceptance Constructs on ePHR Use by Nurses.....	86
4.4: Odds Ratio ^a Estimates of Perceived Data Privacy/Security Protections by ePHR use in Providers use of Electronic Health Records Subgroup.....	88
4.5: Odds Ratio ^a Estimates of Perceived Health Promoting Role Model by ePHR use in Age Subgroup.....	90

LIST OF FIGURES

FIGURES	PAGE
1.1: Technology Acceptance Model (Davis, Bagozzi, & Warshaw, 1989, p.985).....	6
1.2: ePHR Acceptance Model among Nurses.....	8
1.3: Sample Diagram.....	18
2.1: Proportion Granting Permission to Specific Entities to View ePHR among Users and Nonusers (n=527, 79%).....	40
3.1: Proportion Granting Permission to Specific Entities to View their ePHR among NIC ^a Users and Nonusers Willing to Share Data (n=119).....	62
4.1: ePHR Acceptance Model among Nurses.....	74
4.2: Predicted Probability of ePHR use and Perceived Data Privacy and Security Protections by Providers use of Electronic Health Records.....	89
4.3: Predicted Probability of ePHR use and Perceived Health Promoting Role Model by Age.....	91

CHAPTER I BACKGROUND

1.1 Introduction

Electronic personal health records (ePHRs) are consumer-centric tools that individuals can use to communicate with their health care providers to manage their own health and health care (Healthcare Information Management and Systems Society [HIMSS], 2007). ePHRs are perceived as an important element in reducing medical error and increasing quality of care by bringing efficiency and accessibility to the health care system (Markle Foundation, 2005).

Definitions of ePHRs are evolving with advances in health information technologies (see Table A.1, Appendix). The National Alliance for Health Information Technology (NAHIT, 2008) defined an ePHR as “an electronic record of health-related information on an individual that conforms to nationally recognized interoperability standards and that can be drawn from multiple sources while being managed, shared, and controlled by the individual” (p. 6).

Currently, two types of ePHRs are available. These include non-tethered and tethered ePHRs. Non-tethered ePHRs include stand-alone formats (e.g., PC, USB drive) and Web-based formats (e.g., Microsoft HealthVault, My Personal MD) (American Health Information Management Association [AHIMA], 2005, 2010). ePHRs tethered with electronic health record (EHRs) include Kaiser Permanente’s ePHR [My Health Manager] linked to its EHR system [Kaiser Permanente HealthConnect], and Veterans access ePHR portal [My HealtheVet, MHV] connecting to VA’s EHR system [Vist A]) (Turley, Garrido, Lowenthal, & Zhou, 2012; U.S. Department of Veterans Affairs, 2011).

By integrating the EHR, computerized decision support (Osheroff et al., 2007), and telehealth (Johnston et al., 2007), the ePHR can contribute to better quality and efficiency in health care management (Tang, Ash, Bates, Overhage, & Sands, 2006). ePHRs provide improvement in consumer adherence to medical intervention, satisfaction, and empowerment by making medical records accessible to them (Archer, Fevrier-Thomas, Lokker, McKibbon, & Straus, 2011). Furthermore, they can also support the special needs or aspects of care characteristic of specific populations of consumers, such as those with chronic conditions (Dorr et al., 2007) and the elderly and their caregivers (Archer et al., 2011). ePHRs can also be used for family health management (Tang et al., 2006).

The most recent national surveys show that ePHR use by the public was 10% in Markle's 2010 study (Markle Foundation, 2011) and 7% in the 2010 California HealthCare Foundation study (CHCF, 2010a). Doctors and hospitals are the most common ePHR suppliers for those who use ePHR (Markle Foundation, 2011). In the survey of CHCF (2010a), users of ePHRs were predominantly under age 45, educated, higher income, and male. The survey also found that low-income, chronically ill patients with less education knew more about their health care as a result of using ePHR.

The ideal ePHR can be augmented by data from health care provider EHRs, pharmacies, health monitoring devices, and laboratory and radiology clinics (Johnston et al., 2007). The integrated data can provide a more complete view of relevant health information for both consumers and their care providers (Tang et al., 2006). Literature review (Kim & Nahm, 2012) suggests that integrated ePHR with providers' EHR [Tethered ePHR] is preferred. ePHRs can empower patients in managing their health

through improved consumer-provider communication, ability to access their medical information as needed, chronic disease management, and behavioral change. Challenges to the use of ePHRs include data accuracy, data privacy and security, and digital divide and literacy issues. Although the emerging literature suggests that ePHRs may have the potential to contribute significantly to individuals' health management, the rates of ePHR use is still low (CHCF, 2010a).

It is critical for patients and health care professionals to become educated on ePHR use as our nation continues to grow in its use of ePHR. Since 2011, health care providers have been regulated to use EHRs for patients' health information. A patient portal (e.g., ePHR) would provide individuals access to their health information and electronic health information exchange between their health care providers (U.S. Department of Health and Human Services [DHHS], 2012). There are no studies that focus on health care professionals' use of ePHRs as patients for their own personal health management.

1.2 Statement of the Problem

Registered nurses (RNs) are a very important health care workforce in the US. According to the Health Resources and Services Administration [HRSA] (2013), there were 2.8 million RNs (including advanced practice RNs) in the nursing workforce including those working in nursing field and seeking nursing employment from 2008 to 2010. More than 63% of RNs are providing inpatient and outpatient care in hospital settings. Female RNs accounted for 91% and the average age of RNs was 44.6 years. Although the absolute number of RNs younger than 30 has increased, about one-third (35%) of the nursing workforce is older than 50.

Nurses were asked by the American Nurses Association (ANA) and the Office of the National Coordinator (ONC) to participate in ePHR use and patient education (ANA, 2014). Nurses have a tremendous opportunity to assist and educate patients in establishing and leveraging ePHRs and related applications for more efficient care and improved clinical outcomes (Kupchunas, 2007; Thede, 2008). Assisting patients in efforts to be more proactive in their own healthcare and personal health data record-keeping is a first step in establishing effective partnerships between patient and nurses (Northern Illinois Physicians for Connectivity and Northern Illinois University Regional Development Institute [NIPFC & NIU RDI], 2009). Nurses can act as role models in encouraging and motivating consumers or patients to learn about their health and what they can do to take more ownership of their decisions and behaviors that ultimately affect their health. Nurses should be a role model for using ePHRs for their own health management. As a result, they can facilitate better patient engagement and activation to use ePHRs to enhance health promotion and disease prevention. ePHR will yield numerous health benefits for patients or consumers, but only if privacy and security barriers are overcome.

Assessing nurses' adoption of ePHRs as patients themselves is very important since they may be an important factor in endorsing and engaging their patients to adopt and use ePHRs. Nurses also could leverage a PHR portal to accomplish tasks such as providing health education resources. Nurses can participate in design of ePHRs. Consumers should have access to, and be educated on the use of ePHRs systems and this education can be facilitated by nurses (Kim et al., 2007; Lee et al., 2007). Nurses can learn about ePHRs by using them and promote health behavioral change for patients as a

role model. However, there is no available research that examines nurses' use of ePHRs for their own personal health management.

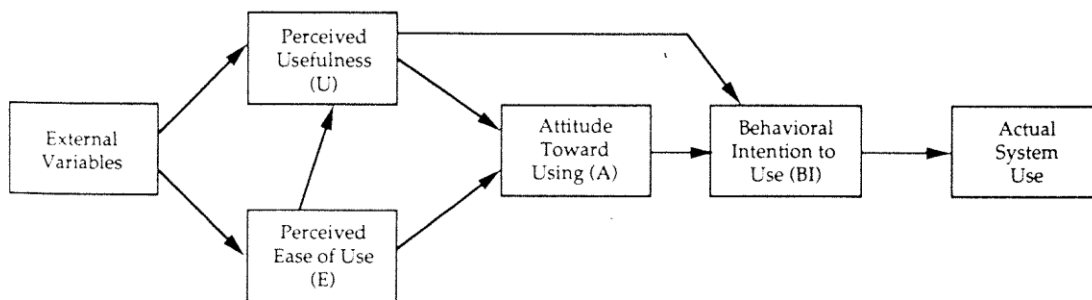
1.3 Conceptual Framework

1.3.1 Technology Acceptance Model

Health information technology (HIT) acceptance and use has been studied using several models, which originated from different theoretical disciplines: psychology, sociology, and information systems (Holden & Karsh, 2010). Empirical studies support behavioral theories or models including: technology acceptance model (TAM) (Davis, 1989), technology acceptance model 2 (TAM2) (Venkatesh & Davis, 2000), theory of reasoned action (Fishbein & Ajzen, 1975), theory of planned behavior (Ajzen, 1991), diffusion of innovation theory (Rogers, 1995), unified theory of acceptance and use of technology (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003) (see Figure A.1, Appendix). These models have reportedly explained a substantial portion of the variances in behavioral intention in health care. Also these models explained an impressive variance in actual use in health care. It is evident that TAM has widespread application in explaining health care professionals' (physicians, nurses, case managers, and some mix of clinicians) behavioral intention to adopt HITs, which is explained by perceived usefulness and perceived ease of use (Chismar & Wiley-Patton, 2002; Chismar & Wiley-Patton, 2003; Dixon & Stewart, 2000; Jayasuriya, 1998; Hu, Chau, Liu Sheng, & Kar, 1999; Liang, Xue, & Byrd, 2003; Liu & Ma, 2006; Lu, Hsiao, & Chen, 2012; Pare, Sicotte, & Jacques, 2006; Schnall & Bakken, 2011; Van Schaik, Bettany-Saltikov, & Warren, 2002; Zhang, Cocosila, & Archer, 2010).

Davis's TAM (1989) adapted the theory of reasoned action (TRA) as a basis in predicting and explaining information system usage behavior. It stated that an individual's system usage is determined by behavioral intention which is the most proximal antecedent to use IT. Behavioral intention has two determinants: perceived usefulness and perceived ease of use (Figure 1.1).

Figure 1.1: *Technology Acceptance Model (Davis, Bagozzi, & Warshaw, 1989, p.985)*



TAM has gone through many changes. Venkatesh and other colleagues developed TAM2 (Venkatesh & Davis, 2000) and TAM3 (Venkatesh & Bala, 2008). They removed the attitude toward use component from the initial TAM due to its weak role as a mediator between the beliefs and behavioral intention. The UTAUT (Venkatesh et al., 2003) is a theory with resemblance to TAM in that like TAM, it includes performance expectancy (usefulness) and effort expectancy (ease of use), and it adds social influence and facilitating conditions.

TAM2 and TAM3 incorporate two moderators (experience and voluntariness of use) and UTAUT incorporates four moderators (age, gender, experience, and voluntariness of use) that moderate the relationship between the independent variables and the dependent variable intention to use. Previous studies conducted in healthcare professionals investigated the moderator effect in TAM. Chismar and Wiley-Patton (2002) investigated moderators (age, size of practice, and computer experience) in

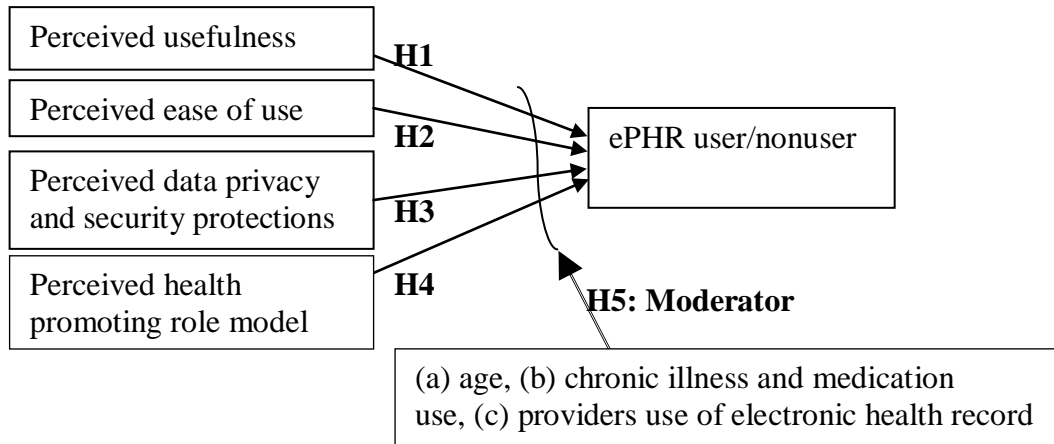
pediatric physicians' acceptance of Internet based Health applications (Chismar & Wiley-Patton, 2002). Schaper and Pervan (2007a) investigated moderators (age, computer experience, computer skill level, job position, work sector, work setting, and geographical area) in occupational therapists' acceptance of information and communication technology.

According to the theory-testing analysis of Walker and Avant (2005) who examined how to evaluate theories, the conceptual framework for this study is based on the TAM (Figure 1.1). The reasons are three-fold. First, TAM has been repeatedly validated in health care settings and has explained fairly large proportions of variance as behavioral intention. Second, TAM is the most parsimonious model to explain behavioral intention to use HIT. Third, the relationship between perceived usefulness and behavioral intention to use HIT is significant in most of the empirical studies and suggests that perceived usefulness predicts behavioral intention. Also perceived ease of use was a significant antecedent of perceived usefulness in most of the studies.

1.3.2 Research Model and Hypotheses

For the research model (Figure 1.2), TAM was expanded adding two new constructs: perceived data privacy and security protections, and perceived health promoting role model.

Figure 1.2: *ePHR Acceptance Model among Nurses*



The research model posits two new relationships that have not been empirically tested. Those two factors are very important to be included in the research model based on the literature review. First, with the Health Insurance Portability and Accountability Act (HIPAA) and increased awareness of personal health information breaches, data privacy and security has been a major concern among the general population of patients and health care professionals. Second, nurses are involved in direct patient care and their health promoting role model in using ePHRs could be very important. The moderating influence of age, chronic illness and medication use, and providers’ use of EHR between ePHR acceptance constructs and use of ePHR have been tested based on the literature review. Because females are predominant in the nursing workforce, gender does not vary sufficiently to test it as a moderator.

1.3.3 Research Hypotheses

The research model contains four constructs (perceived usefulness, ease of use, data privacy and security protections, and health promoting role model) on the left side and the outcome variable (ePHR use or non-use) on the right side. The directions are

illustrated with arrows for each hypothesis. The tested moderators between four constructs and the outcome variable are illustrated as one big arrow.

1.3.1.1 Outcome: ePHR users vs. nonusers

Based on Davis (1989), use behavior (use or non-use) is a specific individual's behavior of interest performed with regard to ePHR. The variance in actual use of HIT (55%-75%) was explained by perceived usefulness and perceived ease of use in studies for health care professionals (Jayasuriya, 1998; Liang et al., 2003; Lu et al., 2012; Pare et al., 2006). The assumption is that ePHR use behavior will be determined by perceived usefulness (PU), perceived ease of use (PEOU), perceived data privacy and security protections (PDPSP), and perceived health promoting role model (PHPRM).

1.3.1.2 Perceived Usefulness (PU)

Based on the original definition of Davis (1989), PU is the degree to which an individual believes that using an ePHR would improve his or her ability and effectiveness in managing his or her disease. PU was the strongest predictor of behavioral intention to use HITs among health care professionals in 13 studies though none focused on ePHR use among health care professionals (Barker et al., 2003; Chau & Hu, 2002a; Chau & Hu, 2002b; Chen et al, 2007; Chismar & Wiley-Patton, 2002; Chismar & Wiley-Patton, 2003; Dixon & Stewart, 2000; Duyck et al., 2008; Han et al., 2005; Hu et al., 1999; Liang et al., 2003; Liu & Ma, 2006; Lu et al., 2012; Pare et al., 2006; Rawstorne et al., 2000; Schaper & Pervan, 2007a; Schaper & Pervan, 2007b; Schnall & Bakken, 2011; Tung et al., 2008; Van Schaik et al., 2002; Wu et al., 2007; Yi et al., 2006; Zhang et al., 2010). However, PU was a strong factor that influenced use of an integrated PHR system among patients (Day & Gu, 2012). These studies suggest that nurses are more likely to use ePHR if they

believe it is useful for managing their health. **Hypothesis 1 (H1) is: perceived usefulness will be positively associated with ePHR use** (i.e., ePHR users will have higher score in the PU scale than nonusers).

1.3.1.3 Perceived Ease of Use (PEOU)

Based on the original definition of Davis (1989), PEOU is the degree to which an individual believes that using an ePHR would be free of effort. PEOU was found to be a good secondary predictor of behavioral intention to use HITs among health care professionals in 11 studies (Chen et al, 2007; Dixon & Stewart, 2000; Liang et al., 2003; Liu & Ma, 2006; Lu et al., 2012; Rawstorne et al., 2000; Schaper & Pervan, 2007a; Schaper & Pervan, 2007b; Tung et al., 2008; Wu et al., 2007; Zhang et al., 2010). PEOU without being a burden on time or money was a facilitator for adoption of ePHR system among family practitioners in Canada (Yau et al., 2011). Meanwhile, the majority of patients who used an ePHR indicated that the ePHR was easy to use (Hassol et al., 2004) and PEOU was one of the factors that influenced use of an integrated PHR among patients (Day & Gu, 2012). These studies suggest that nurses are more likely to use ePHRs if they feel that the ePHR is easy to use. **Hypothesis 2 (H2) is: perceived ease of use will be positively associated with ePHR use** (i.e., ePHR users will have higher score in the PEOU scale than nonusers).

1.3.1.4 Perceived Data Privacy and Security Protections (PDPSP)

Based on the original definition of privacy by the U.S. Department of Health and Human Services [DHHS] (2008), perceived data privacy protection is the degree to which an individual believes that their ePHR protects “individually identifiable health information and the corresponding obligation of those persons and entities that participate

in a network for the purposes of electronic exchange of such information” (ep.11).

Perceived data security protection is the degree to which an individual believes that their ePHR contains “physical, technological, and administrative security safeguards used to protect individually identifiable health information” (DHHS, 2008, ep. 11). Data privacy and security is perceived as a concern to adoption of ePHR among consumers (CHCF, 2010a), and were also found in physicians groups related to adoption of HITs (Gagnon et al., 2010; Wynia, Torres, & Lemieux, 2011). Security and privacy issues were important barriers for adoption of ePHRs among family practitioners (Yau et al., 2011). Most physicians perceived patient privacy as a potential risk for willingness to use ePHRs in clinical practice (Wynia et al., 2011). Angst and Agarwal (2009) found that privacy concerns were negatively related to the likelihood of adoption of ePHR among the general population. These studies suggest that nurses are more likely to use ePHR if they feel their data privacy and security are protected. **Hypothesis 3 (H3) is: perceived data privacy and security protections will be positively associated with ePHR use** (i.e., ePHR users will have higher score in the PDPSP scale than nonusers).

1.3.1.5 Perceived Health Promoting Role Model (PHPRM)

Based on the original definition of Rush, Kee, and Rice (2010), PHPRM reflect nurses responsibility to model personal health promoting practices and behaviors. PHPRM of nurses is an important factor in promoting a healthy lifestyle of patients based on nurses’ positive experiences (Connolly, Gulanick, Keough, & Holm, 1997) and negative experiences (Rush et al., 2010). There were no studies of the association of PHPRM on intention to use an ePHR either in health care professionals or patients. The assumption is that nurses are more likely to use ePHR if they believe that they are health

promoting role models. **Hypothesis 4 (H4) is: perceived health promoting role model will be positively associated with ePHR use** (i.e., ePHR users will have higher score in the PHPRM scale than nonusers).

1.3.1.6 Moderators

A moderator is a third variable that affects the correlation between the independent variable and dependent variable (Baron & Kenny, 1986). The weakness of cross-sectional design is that causality cannot be inferred (Rothman & Greenland, 2005). The relationship may be causal or due to something else such as confounding variables or moderators (Aday & Cornelius, 2006). Rogers (1995) states that individual characteristics are important factors for technology adoption in the innovation decision process. Tested moderators are discussed the next.

Age: Venkatesh et al. (2003) identified key moderating variables in the UTAUT model that showed significant influence on intention to use IT as gender, age, experience, and voluntariness of use. Chismar and Wiley-Patton (2002) found significant impact of age, on behavioral intention to use intent-based health applications (IHA) among physicians. In the younger age (20-40) group, PEOU had significant effect on behavioral intention to use IHA. This effect was not found in the group over age 50. Perceived ease of use and behavioral intention to use information and communication technology (ICT) decreased with age and the relationship was not significant with age over 50 (Schaper & Pervan, 2007a). Since nursing workforce is getting older (35% of RNs were older than 50), the assumption is that the association of PU, PEOU, PDPSP, and PHPRM on ePHR use will be moderated by age.

Chronic Illness and Medication Use: Studies report that ePHRs are valuable tools for chronic disease management such as diabetes, heart failure, or multiple sclerosis (Fonda, Kedziora, Vigersky, & Bursell, 2010; Miller et al., 2011; Ross, Moore, Earnest, Wittevrongel, & Lin, 2004). The national consumer survey indicated that those who are chronically ill consumers gain benefits from using ePHR (CHCF, 2010a). More than half (53%) of households with a chronic illness were willing to pay to use ePHR (Thornewill & Baluch, 2007); and 56% of respondents who had chronic conditions searched for specific information about their medical conditions or prescription medications among consumers (CHCF, 2008). The assumption is that the associations of PU, PEOU, PDPSP, and PHPRM on ePHR use will be moderated by both chronic illness and medications use.

Health Care Providers' EHR Use: The meaningful use of EHRs by health care providers should provide patients with timely electronic access to their health information (i.e., ePHR) (Centers for Medicare & Medicaid Services [CMS], 2013). Meaningful use is the federal government's HIT policy, which encourages providers to use EHRs (DHHS, 2012). Work sector and work setting were tested as moderators in studies of technology acceptance among occupational therapists in Australia (Schaper & Pervan, 2007a; Schaper & Pervan, 2007b). Physicians who used EHRs were more likely to be aware of ePHRs than physicians who either plan to adopt EHRs or have no intention to use EHRs (Fuji et al., 2008). More than half (54%) of physicians adopted EHR in 2011, and 74% of adopters believed patient care was enhanced by using an EHR (Jamoom et al., 2011). The assumption is that the associations of PU, PEOU, PDPSP, and PHPRM on ePHR use will be moderated by providers' use of EHR for care. Hypotheses 5 (**H5**) regarding moderators were tested.

1.3.1.7 Potential Covariates

The study sample contained hospital nurses and nursing informatics community (NIC) nurses. Because they do not work in the same organizations, it is likely that they have different characteristics. Nurses in NIC are more likely to be technologically savvy, so they are more likely to be aware of the federal government meaningful use initiative and of privacy and security regulations than hospital nurses and indicated demographic differences. Therefore, nursing group (hospital vs. NIC) was controlled. Other covariates included all moderators (age, chronic illness and medication use, and providers use of EHR), which also were included as covariates, prior to testing them as moderators.

1.4 Purpose of the Study

The primary research question for this study was where are nurses at baseline of ePHR use? The secondary research question was what are nurses characteristics that are related to ePHR acceptance? The third question was what factors are associated with acceptance of ePHR use among nurses for their own personal health management? By developing a research model that explains factors associated with nurses' acceptance of ePHR use for their own personal health management, the specific aims were proposed as follows:

- (1) To examine factors associated with ePHR use by nurses characteristics (health, technology experience, and attitudes about privacy of electronic health information);
- (2) To examine the psychometric properties of the measures in the research model;

- (3) To examine an association of ePHR acceptance constructs (perceived usefulness, ease of use, data privacy and security protections, and health promoting role model) with an ePHR use; and
- (4) To examine the moderator effect of nurses characteristics (age, chronic illness and medication use, providers use of EHR) on the relationships between ePHR acceptance constructs and ePHR use.

1.5 Significance of the Study

This proposed research could make several contributions to both ePHR research and nurses patient care practices, as well as ePHR design. This is the first study to examine baseline use of ePHR among nurses for their own health management. This baseline assessment identifies facilitators and barriers of using ePHR among nurses. The investigation of perceived data privacy and security protections on ePHR use is critical, given that health information must be protected, because concerns for data privacy and security were adoption barriers for patients and providers. The investigation of nurses' perceptions of themselves as health promoting role models offered a pioneering opportunity to examine whether their role model perception is related to ePHR use. The findings from this proposed study offered practical insights that can be used to drive public policy decisions such as including nurses in ePHR design and increase adoption of ePHRs by patients or consumers and health care professionals. Also, the finding could improve health care professional education about patient chronic disease self-management or medication compliance based on their experience with ePHR use.

1.6 Methodological Approach

The section summarizes the methodology which was used to address the research aims. The study design, sample frame, data collection, measurement, data analyses, and sample size adequacy are presented. Human subject issues are described in detail.

1.6.1 Study Design

A non-experimental, cross-sectional, self-administered online survey design was used to examine factors associated with ePHR acceptance among nurses for their own personal health management.

1.6.2 Population/Sample Setting/Sampling Frame

The target population was licensed registered nurses (RNs) working in hospitals and RNs in the nursing informatics community (NIC). The sample recruiting sites were 12 hospitals from the Maryland and Washington DC area and two nursing informatics organizations: Healthcare Information and Management Systems Society (HIMSS) and American Medical Informatics Association (AMIA). Accessible population included nurses aged 18 years or older of both genders, who were able to read English and were listed on the hospital, AMIA, and HIMSS LISTSERVS. All RNs must be currently employed at the time of taking the survey, so retired and unemployed (including students) and non-nurses were excluded. The study received Institutional Review Board (IRB) approval from the University of Maryland, Baltimore and the hospital IRB. The study also obtained permission from AMIA and HIMSS.

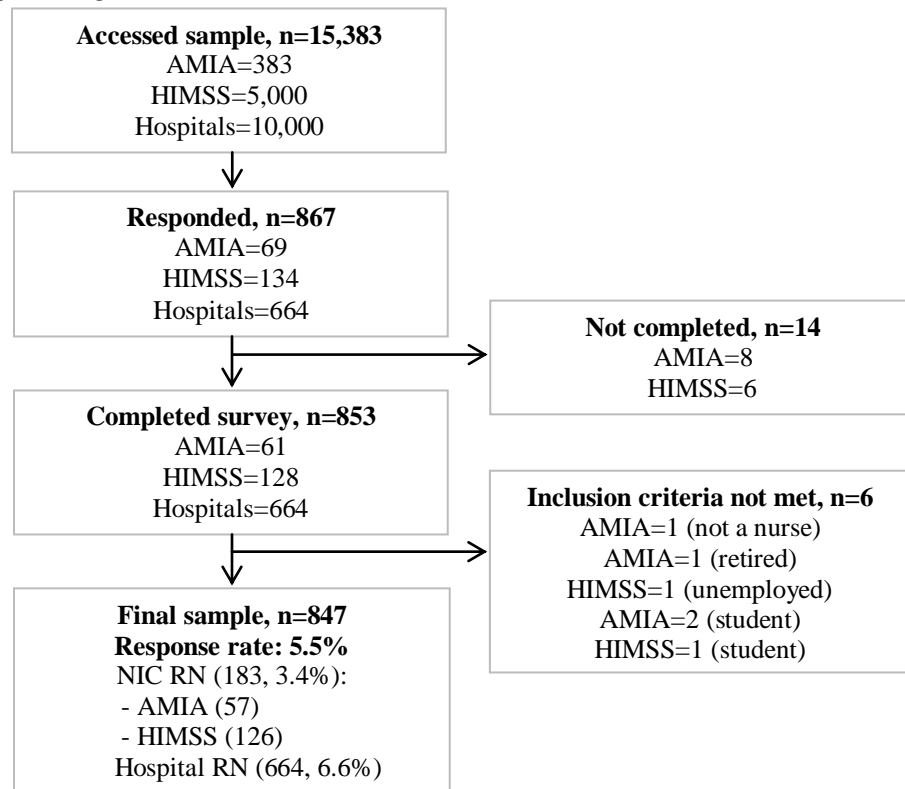
1.6.3 Data Collection Procedures

A convenience sampling approach was used to recruit RNs in hospitals, AMIA, and HIMSS to participate in an anonymous self-administered online survey. The online

survey using the Qualtrics platform was conducted from October 2013 to January 2014. Each facility had a different start and end date that was chosen for the facility's convenience, but all data were collected between November 2013 and January 2014. Multiple contacts were used, starting with pre-notice to reduce the chance of discarding the survey by respondents. This was followed by invitation emails containing online survey link, cover letter with voluntary consent information and anonymity protection for the survey. The invitation emails, follow-up reminders, and extended survey reminders were sent out by the research director in each hospital, the Director of Clinical Informatics for HIMSS, and directly to AMIA members by the researcher. The 37 item survey took approximately 15 minutes to complete (see Survey in Appendix).

As an incentive to participate, two participants received iPad Minis from an offered drawing. As seen in Figure 1.3, the estimated accessible sample was 15,383 nurses from AMIA and HIMSS and 12 hospitals.

Figure 1.3: *Sample Diagram*



Among 867 submitted surveys, 14 survey responses were not included as completed surveys because they quit before completing the survey (i.e., respondents did not “click” submit button and this step can be done at the end of the survey page). Among the remaining 853 completed surveys, 6 submissions were excluded because they did not meet the inclusion criteria (non-nurse, retired, unemployed, and students). The final sample was comprised of 847 individuals (approximately a 5.5% estimated response rate).

1.6.4 Measurement

Based on the research model, concepts and operational definitions were summarized in Table A.2 (see Appendix). The survey questions were tailored to appropriately reflect the nursing context as well as the context of an ePHR user or nonuser (e.g., ePHR users were asked whom they granted permission to view their ePHR

and ePHR nonusers were asked whom they would grant permission to view their ePHRs). After a review by informatics experts working in the area of ePHRs and those with survey experience, pilot testing was performed prior to distribution. Original instruments were modified and reworded as necessary to appropriately reflect nurse and ePHR context. The ePHR acceptance survey contained five domains: Part I. Awareness of new technology and attitudes about privacy of electronic health information, Part II. ePHR acceptance, Part III. Technology experience, Part IV. Health status and decision making preferences, and Part V. Job information and demographics.

An introduction to the survey defined ePHR as the tool that allows an individual to access with their user identification and password to enter and view his or her own data, update their health information and manage their health care (HIMSS, 2007; NAHIT, 2008). An example of an ePHR screen image was shown to the participants. A short instruction regarding how to navigate the online survey was followed. For Part I, participants' awareness of new technology (meaningful use policy and providers use of EHR) and attitudes about general concern for privacy and security of electronic health information were assessed with each single item from national consumer survey on HIT by California HealthCare Foundation (CHCF) (2010b).

For Part II, ePHR use and nonuse was defined based on the yes or no response to the question, "Have you ever used an ePHR to view, update, or manage your health information?" This item was adapted from national consumer survey on HIT by California HealthCare Foundation (CHCF) (2010b). For ePHR users, the frequency of use and amount of time spent each time were asked, which was adapted from health information technology evaluation collaborative (HITEC) consumer HIT survey of Patel

et al. (2011). For ePHR nonusers, their intention to use ePHR was assessed with 2 items from Venkatesh and Davis (2000). The original scale demonstrated good internal consistency reliability (ICR) (Cronbach's $\alpha=0.91-0.93$). Two new items were added into intention to use. 4-point Likert scale anchors ranged from "strongly agree" to "strongly disagree." ePHR acceptance model was assessed with participants PU, PEOU, PDPSP, and PHPRM. Those constructs were tailored to ePHR users and nonusers. For PU, 10 items were adopted from national consumer survey on HIT by California HealthCare Foundation (CHCF) (2010b). 4-point Likert scale anchors ranged from "very useful" to "not at all useful." PEOU was measured with 4 items that were adopted from Davis (1989) scale which demonstrated good ICR with 6 items (Cronbach's $\alpha =0.94$). 4-point Likert scale anchors ranged from "strongly agree" to "strongly disagree." For PDPSP, 8 items were adopted from national consumer survey on HIT by California HealthCare Foundation (CHCF) (2010b). 4-point Likert scale anchors ranged from "very protected" to "not at all protected." For PHPRM, 8 items were adapted from Self as Role Model for Health Promotion (SRMHP) scale of Rush et al. (2010), which demonstrated from moderate to good ICR with 19 items (Cronbach's $\alpha=0.43-0.71$). 4-point Likert scale anchors ranged from "strongly agree" to "strongly disagree." Permission to view ePHR was tailored to ePHR users and nonusers with separate yes or no questions. The questions inquired about sharing information with designated family or friends, primary care providers, other providers (e.g., specialists or emergency departments), pharmacists, health insurance companies or their employer.

For Part III, technology experience was assessed by the following items: work place ePHR and EHR experience, computer and internet usage, and frustration when

learning new applications. Internet usage was measured using items adopted from HITEC consumer HIT survey (Patel et al., 2011). eHealth literacy was measured with 4 items that were adopted from Norman and Skinner (2006) covering whether participants (1) know where to find health resources on the internet, (2) know how to use the information they found, (3) have the skills to evaluate the health resource they found and (4) feel confident using information to make health decisions. The original scale demonstrated good ICR with 8 items (Cronbach's $\alpha=0.88$). 4-point Likert scale anchors ranged from "strongly agree" to "strongly disagree."

For Part IV, health status and decision making preference regarding health care was assessed. Self-rated health status was adopted from World Health Survey (World Health Organization [WHO], 2002). Chronic conditions and taking prescribed medications were measured with items from (HITEC) consumer HIT survey (Patel et al., 2011). Decision making preference for health management of self as well as family members were measured with items from HITEC consumer HIT survey (Patel et al., 2011).

Finally, for Part V, job information and demographics were assessed. Employment status, number of years worked as RN, and current position were assessed items adopted from Nurses' Worklife and Health Study survey (Trinkoff et al., 2006). Nursing specialty was asked that was adopted from the website of the Hospital of the University of Pennsylvania (HUP) (2013). Current practice region was adopted from national consumer survey on HIT by California HealthCare Foundation (CHCF) (2010b). For demographic characteristics, questions from U.S. Census Bureau (2012b) were adopted. These included age, gender, marital status, ethnicity, and race. Education level

and caregiver status was assessed with items from Nurses' Worklife and Health Study survey (Trinkoff et al., 2006).

1.6.5 Data Analyses

Analyses were performed using SPSS 21. A significance level of 0.05 was chosen for all comparisons. Collected data from online survey program was downloaded in SPSS format. Data dictionary was used to look up how the variables were labeled. A logbook was made to document the process of cleaning data. Exploratory data analysis was conducted including range, consistency and outliers check, and missing data. For instance, continuous variables (e.g., age, years of working experience as RN) were checked for reasonable values and for outliers. Chronic medical conditions and taking prescribed medications were combined into one health variable due to overlap between them such that: 0= neither condition, 1= either one, and 2= both. Missing values were all screened and imputation was not needed. Data were investigated using univariate analysis for missing patterns, outliers, normality, homoscedasticity, and transformation. Normality was checked using skewness, box plot, or histogram to examine whether data and variable transformation was needed. Extreme points (outliers with asterisk*) in the boxplot was investigated. Scatter plot for linearity check was done for continuous variables.

A Likert summary scale was created to summarize a series of measures intended to test research hypotheses regarding ePHR acceptance constructs (PU, PEOU, PDPSP, PHPRM) and eHealth literacy. The individual items in those scales ranged from positive endpoints (e.g., strongly agree or very useful) to negative endpoints (e.g., strongly disagree or not at all useful). These were reverse coded in order to have negative

endpoints on the left, so that high scores then consistently reflect a greater level of PU, PEOU, PDPSP, PHPRM, and eHealth literacy. DeVellis (2003) suggests that the summary scales produced from the ordinal-level can be treated as interval-level data for the more powerful statistical procedures (e.g., multiple regression analysis).

To test whether the items in each construct were conceptually congruent, internal consistency reliability was used primarily in evaluating summary scales, but not single items. Reliability of a survey measure refers to the degree of stability of measures of the same concept when a measurement is repeated under identical conditions (Aday & Cornelius, 2006). It is important items that cover each construct in ePHR acceptance model should have high internal consistency (i.e., that scores on these items correlate highly with each other). Cronbach's alpha (α) coefficient measured internal consistency reliability among a group of items combined to form a single scale. This approach was appropriate for the summary scales for PU, PEOU, PDPSP, PHPRM, and eHealth literacy.

Data analysis focused on the specific aims of the study. Aim 1 examined factors associated with ePHR use by nurses' characteristics such as health, technology experience, and attitudes about privacy of electronic health information. Data analyses were separated to two nursing groups (hospital nurses and NIC nurses), because there were differences in many areas between hospital and NIC nurses. Descriptive statistics were used to examine the distribution and frequency of the variables in the various domains. Differences in group means for continuous respondent characteristics by ePHR use were tested using t-tests and relationships for categorical variables by ePHR use were tested using χ^2 tests (Yate's correction for continuity or Fisher's exact test where appropriate), with 2-sided tests. All variables with a bivariate association with ePHR use

(p -value ≤ 0.20) were included in multiple logistic regression models using the forced entry method. Odds ratios estimated the magnitude of the associations between RN characteristics and ePHR use. Multiple logistic regression models were generated to examine the magnitude of the association between RN characteristics and ePHR use controlling covariates. For the hospital nurse analysis, all models were adjusted with demographics (e.g., age, marital status) and job information (e.g., current position, specialty area). For the NIC nurse analysis, ethnicity, race, and practice region were adjusted. Outliers and multicollinearity across the covariates was examined. For model adequacy, omnibus tests and Hosmer-Lemeshow tests were examined.

For Aims 2, 3, and 4, reliability of the ePHR acceptance constructs was tested with Cronbach's α coefficient. Inferential statistics was performed to examine research hypotheses (2-tailed hypothesis testing) and to examine moderators' effect. Bivariate analysis of the data was conducted to examine differences between ePHR users and nonusers by four ePHR acceptance constructs (PU, PEOU, PDSP, PHPRM), age, chronic illness and medication use, providers use of EHR, and nursing group (NIC vs. hospital nurses). T-tests for continuous variables and χ^2 tests (Yate's correction for continuity or Fisher's exact test where appropriate) for categorical variables were used with 2-sided tests. Correlations among four constructs were checked using Pearson's correlation. Odds ratios were used to determine the significant constructs of ePHR acceptance and to examine the multiple relationships among the variables. Crude odds ratios were summarized for hypothesis testing (H1-H4) and moderator testing hypothesis (H5) using binary logistic regression. Multiple logistic regression models with forced entry were used to examine the associations of four ePHR acceptance constructs and

ePHR use, plus covariates (nursing group and all moderators). For the significant moderators, we plotted interaction graphs and calculated separate odds ratios for subgroups. In general, logistic regression has no assumption of the distribution in independent variables (normality and homoscedasticity) (Pallant, 2007). Binomial distribution of outcome variable (ePHR use or not use) should be statically independent. Outliers (standardized residual > 3) and multicollinearity across the covariates were checked. Omnibus tests and Hosmer-Lemeshow tests were examined.

1.6.6 Sample Size Adequacy

Considering cross-sectional design effect, Aday and Cornelius (2006) suggest to compute an estimated sample size. The estimated sample size was 384 cases for one group cross-sectional design based on 95% confidence interval, $\alpha=0.05$ statistical significance level, desired precision ($d=0.05$), and estimated proportion ($p=0.50$).

Formula was based on the following:

$$\text{Estimated sample size (n)} = [Z^2_{1-\alpha/2}P(1-P)]/d^2,$$

where P=estimated proportion and d=desired precision.

$$\text{Thus, } n = [1.96^2 \times (0.50)(0.50)]/(0.05)^2 = 384.$$

At least 384 cases were required to have a desired precision or power in addressing the study aims. The effect size (Pseudo R^2) reflects how much association there is between independent variables and outcome variables (Tabachnick & Fidell, 2007). The total sample size of 664 for hospital nurses was sufficient enough to detect a small to medium effect size ($R^2=0.04-0.16$) in the logistic regression models (Cohen, 1992). For the NIC nurses, the total sample size of 183 showed a medium to large effect size ($R^2=0.11-0.25$) in the logistic regression models. According to Green's rule (a minimum sample size

$\geq 50 + 8m$, m is the number of predictors) (Green, 1991), this NIC sample ($n=183$) allowed enough independent variables (used maximum 6 variables) in the logistic regression models. The total sample size of 847 was sufficient enough to detect a small to large effect size ($R^2=0.01-0.44$) in the logistic regression models for the research model testing.

1.6.7 Human Subjects

Participants were invited to voluntarily participate in the survey through communications outlined in the methods section. No participant personal health information or protected health information identifiers were obtained from the participants. The survey did not address any undesirable work behavior or disclosures that could be damaging to subjects' employability. The online survey website was programmed to execute an "anonymous" application so that the email addresses, names, and IP addresses of all respondents could not be identified. The drawing of iPad Mini was separate from the survey, because the email address provided by respondents at the end of the survey could not be tracked to the information respondents provided on the survey. Therefore the potential risk of any disclosure or linking of information with an individual participant was minimal. This dissertation study was determined to be exempt under Research Risks Code of Federal Regulations 45 CFR 46.101(b), from the IRB review of the University of Maryland, Baltimore, on September 27, 2013 (HP-00056823). This study obtained permission to use LISTSERVES from AMIA and HIMSS.

1.7 Introduction of the Three Manuscripts

This thesis includes three manuscripts, which were developed based on the study aims of the dissertation projects, as Chapters 2, 3, and 4.

The first manuscript included Aim 1, which focuses on a descriptive paper about factors associated with ePHR use by hospital nurses characteristics. Less than half of respondents (41%) were ePHR users. Nurses who had chronic illness and medication use, and those whose providers used EHR for care were significantly associated with ePHR use controlling for age, marital status, current positions and specialty area. Sharing of information with designated family members or friends, health care providers and pharmacists was more likely to be endorsed by RNs who were not actual users. However, more ePHR users granted permission to share their information with health insurance companies and their employer compared to nonusers.

Since NIC nurses had many different characteristics from hospital nurses, the second manuscript included Aim 1, which focuses on a descriptive paper about factors associated with ePHR use by NIC nurses characteristics. Almost three-quarters of NIC nurses (72%) used ePHR for their health care. NIC nurses whose providers used EHR for their care, and less concerned about health information online were associated with ePHR use controlling for ethnicity, race, and practice regions in US. Similar to hospital nurses (manuscript #1), fewer ePHR users among NIC nurses granted permission to designated family members or friends, other healthcare providers, or pharmacist than nonusers.

The third manuscript included Aim 2-4. For Aim 2, ePHR acceptance model demonstrated sufficient reliability for each construct with Cronbach's $\alpha > 0.70$. For Aim3, ePHR users were more likely to perceive ease of use and health promoting role

model than nonusers. ePHR users were less likely to perceive usefulness of ePHR than nonusers. The associations between four constructs (perceived usefulness, ease of use, data privacy and security protections, and health promoting role model) and ePHR use was statistically significant after adjusting for nursing group. For Aim 4, significant interaction effects existed between perceived data privacy security protections and providers EHR use, and between perceived health promoting role model and age of nurses using ePHR, respectively.

CHAPTER II (Manuscript 1) ELECTRONIC PERSONAL HEALTH RECORD USE AMONG REGISTERED NURSES¹

2.1 Introduction

Electronic personal health records (ePHRs) are consumer-centric tools that individuals can use to communicate with their health care providers to manage their own health and health care (Healthcare Information Management and Systems Society [HIMSS], 2007). ePHRs are perceived as an important element in reducing medical error and increasing quality of care by bringing efficiency and accessibility to the health care system (Markle Foundation, 2005).

Definitions of ePHRs have been evolving with advances in health information technology (HIT). An ePHR is defined as “an electronic application through which individuals can access, manage and share their health information and that of others for whom they are authorized, in a private, secure and confidential environment ”(Tang, Ash, Bates, Overhage, & Sands, 2006, p. 2). Although currently there are many different types of ePHRs , the ideal ePHR is one that can be augmented by data from health care provider electronic health records (EHRs), pharmacies, health monitoring devices, and laboratory and radiology clinics (Johnston et al., 2007). An integrated ePHR with providers’ EHRs (also known as a tethered ePHR) can provide a more complete view of relevant health information for both consumers and their health care providers.

ePHRs can empower patients in managing their health through improved consumer-provider communication. Patients have the ability to access their medical information as needed, manage chronic disease, and make behavioral changes (Dorr et

¹ Gartrell, K., Trinkoff, AM., Storr, CL., Wilson, ML., Charters, KG., & Gurses, A.
In preparation for submission to *Public Health Nursing*.

al., 2007; Patel et al., 2012; Tang et al., 2003; Tenforde, Jain, & Hickner, 2011; Tobacman et al., 2004). Furthermore, they can also support the special care needs for the elderly and caregivers and for family health management (Tang et al., 2006). Studies suggest that a tethered ePHR can increase patient-centered care, improve patient ability to manage their health and health care, enhance the use of appropriate preventive services, and promote ePHR use (Do, Barnhill, Heermann-Do, Salzman, & Gimbel, 2011; Wagner et al., 2012). The usefulness of tethered ePHR has also been reported for accessing lab results and patient education materials, requesting medication refills and appointments, and engaging in preventive screening and health promotion behaviors (e.g., vaccinations) (Krist et al., 2011; Nazi, 2010; Wright et al., 2012).

Although the potential for ePHRs to improve healthcare is significant, there are barriers to widespread adoption of ePHRs. The rates of ePHR use among consumers still low, averaging about 10% (CHCF, 2010a). Although almost 50% of Americans responded favorably toward the idea of ePHR, they are relatively unfamiliar and inexperienced with ePHRs (Markle Foundation, 2008). Data accuracy, data privacy and security concerns, and digital divide and literacy are found to be prevalent concerns affecting ePHR usability (Archer, Fevrier-Thomas, Lokker, McKibbon, & Straus, 2011; Kahn, Aulakh, & Bosworth, 2009; Tang et al., 2006).

As our nation continues to grow in its use of HIT, it is critical for patients and health care professionals to become educated on ePHR use (HealthIT.gov, 2012). Under the American Recovery and Reinvestment Act of 2009, health care providers have been required to use EHRs for patient health information. A patient portal (i.e., ePHR) is an avenue to access individual health information and exchange this information between

providers (DHHS, 2012). Consumers should have access to, and be educated on the use of ePHRs systems and this education can be facilitated by nurses (Kim et al., 2007). Nurses also could leverage a PHR portal to accomplish tasks such as providing health education resources, and can participate in design of ePHRs. Nurses can learn about ePHRs by using them personally and promote health behavioral change for patients as a role model.

Despite this, there is no available research that examines health care professionals' use of ePHRs for their own personal health management. Assessing nurses' use of ePHRs as patients themselves is very important since nurses can endorse and engage their patients to use ePHRs, which are supported by the National Coordinator for Health Information Technology and the American Nurses Association (ANA, 2014). Therefore, the purpose of this study was to examine factors associated with ePHR use by nurses' characteristics for their own health management. Assessing nurses' detailed characteristics on ePHR use may identify benefits and barriers of using ePHRs for their own health management.

2.2 Methods

2.2.1 Study Design and Sample

We conducted an anonymous self-administered online survey of registered nurses about ePHRs use for their own health management from December 2013 to January 2014 in 12 hospitals, located in the Maryland and Washington D.C. area. Retired, currently unemployed (including students) nurses were excluded. Registered nurses (RN) were informed about the survey through their hospital LISTSERV (email-list). The invitation email and follow-up reminders were sent out by the research director in each hospital. In

total 664 nurses participated. Two participants received iPad Minis from a raffle offered as an incentive to participate. Institutional Review Board approval was provided by the University of Maryland, Baltimore and each facility.

2.2.2 Survey Development

To ensure reliability and validity, items selected for the questionnaire were adopted from empirically reliable and valid instrument (Norman & Skinner, 2006) and reliable consumer surveys (CHCF, 2010b; Patel et al., 2011). For the work related information, we adopted items from the Nurses Worklife and Health Study (Trinkoff, Geiger-Brown, Brady, Lipscomb, & Muntaner, 2006) and the website of hospital of the University of Pennsylvania (HUP, 2013). Original instruments were modified and reworded as necessary to appropriately reflect nurse and ePHR context. The 37 item survey took approximately 15 minutes to complete.

2.2.3 Survey Domains

The main outcome of interest was RN's general use of ePHR for their own personal health management. We defined ePHR users and nonusers based on their response to the question: "Have you ever used an ePHR to view, update, or manage your health information?" The survey defined an ePHR as follows: "unlike an EHR used by health providers, an ePHR is used by you to enter and view your own data, update your health information, and manage your health care. An ePHR requires you to assign yourself a user name and password to access it" (HIMSS, 2007; NAHIT, 2008). One example of an ePHR image was shown after the description of an ePHR.

The survey began with several questions about the respondent's demographic characteristics and job information. Health and health care experience were assessed

with self-rated health status, chronic conditions and medication use, and decision making preferences for themselves as well as their dependents (eg., children or elderly parents) for health care. Because of the overlap, chronic medical conditions and taking prescribed medications were combined into one health variable 0= neither condition, 1= either one, and 2= both.

The next portion of the survey inquired about technology experience and awareness of new technology and attitudes about privacy of electronic health information. The format was tailored for both ePHR users and ePHR nonusers to be able to respond, with yes/no questions and 4-point Likert-type response items. To assess technology experience, items asked about work place EHR experience, computer and internet usage, frustration when learning new applications and eHealth literacy. eHealth literacy was assessed using four items (Cronbach's $\alpha = 0.91$) selected from the original 8 item scale (Cronbach's $\alpha = 0.88$) of Norman and Skinner (2006). Awareness of new technology (eg., meaningful use policy by the U.S. government to encourage health care providers and hospitals to use more technology) and health care provider's use of EHR were also asked as single items.

We also asked RNs about attitudes about general privacy and security of health information online. Again, the format was tailored for both ePHR users and ePHR nonusers to be able to respond, with yes/no responses. For privacy permission, we asked ePHR users "who they have given permission to view their ePHR" and asked ePHR nonusers "if they had an ePHR, who they would give permission to view their ePHR" (e.g., designated family or friends, primary care providers, other providers who care for them, pharmacist, health insurance company, or employer).

2.2.4 Analysis

Descriptive statistics examined the distribution and frequency of variables. Differences in group means between ePHR users and nonusers were tested with t-tests for continuous variables and χ^2 tests (Yate's correction for continuity, or Fisher's exact test) where appropriate for categorical variables, with 2-sided tests. Odds ratios examined the magnitude of the associations between RN characteristics and ePHR use. Variables found to be significantly associated with ePHR use ($p \leq 0.20$) in bivariate association were included in the multiple logistic regression model using a forced entry method. To examine factors associated with ePHR use, four models were generated. Model 1 concentrated on the health variables. Model 2 contained the variables related to technology experiences. Model 3 contained general concern for privacy and security of health information online. Model 4 included important variables from Model 1 through Model 3. All models were adjusted for demographics (e.g., age, marital status) and job information (e.g., current position, specialty area). No multicollinearity across the covariates was found, omnibus tests were all significant ($p < 0.05$) and Hosmer-Lemeshow tests were not violated ($p > 0.05$). SPSS 21 was used for all data analyses.

2.3 Results

Forty-one percent of respondents ($n=269$) were ePHRs users. There was no variation between ePHR users and nonusers by age, gender, ethnicity or race, education, marital status, and job related information (Table 2.1).

Table 2.1: *Characteristics of Hospital Nurses by Personal Use of ePHR*

Characteristic	n (%) ^a			χ^2	p
	Total	ePHR	ePHR		
	(n=664) n (%) ^a	Nonuser (n=395)	User (n=269)		
Demographics					
Age (years), Mean (SD)	43.5 (12.8)	43.5 (12.9)	43.4 (12.7)	t= 0.17	0.87
21-34	208 (31.4)	121 (30.7)	87 (32.5)	5.66	0.13
35-44	121 (18.3)	68 (17.3)	53 (19.8)		
45-54	157 (23.7)	106 (26.9)	51 (19.0)		
55+	176 (26.6)	99 (25.1)	77 (28.7)		
Female	632 (95.5)	258 (96.3)	374 (94.9)	0.39 ^b	0.53
White	482 (73.1)	285 (73.1)	197 (73.2)	<0.01 ^b	1.00
Education					
Diploma/Associate's degree	103 (15.6)	67 (17.0)	36 (13.4)	1.69	0.43
Bachelor's degree	400 (60.4)	232 (59.0)	168 (62.5)		
Master's/Doctoral	159 (24.0)	94 (23.9)	65 (24.2)		
Marital status					
Never married	154 (23.3)	100 (25.4)	54 (20.1)	3.38	0.19
Divorced/separated/widowed	80 (12.1)	50 (12.7)	30 (11.2)		
Currently married/living with partner	427 (64.6)	243 (61.8)	184 (68.7)		
Job information					
Full-time employed, yes ^d	608 (91.6)	366 (92.7)	242 (90.0)	1.18 ^b	0.28
Years of working as RN, Mean (SD)	17.1 (12.7)	17.0 (12.7)	17.2 (12.7)	t= -0.22	0.83
Current position					
Staff/General duty/Private duty	497 (74.8)	303 (76.7)	194 (72.1)	3.42	0.18
Nurse practitioners/Other ^e	69 (10.4)	42 (10.6)	27 (10.0)		

Table 2.1: *Characteristics of Hospital Nurses by Personal Use of ePHR (Cont.)*

Characteristic	Total (n=664) n (%) ^a	n (%) ^a		χ^2	p
		ePHR Nonuser (n=395)	ePHR User (n=269)		
Nurse manager/supervisor/ Administrator	98 (14.8)	50 (12.7)	48 (17.8)		
Specialty area					
Noncritical care	485 (73.0)	298 (75.4)	187 (69.5)	5.43 ^c	0.07
Critical care	169 (25.5)	94 (23.8)	75 (27.9)		
Nursing Informatics	10 (1.5)	3 (0.8)	7 (2.6)		
Health					
No chronic medical condition or taking prescribed medication	216 (32.6)	138 (35.0)	78 (29.0)	8.38	0.02
Either chronic medical condition or taking prescribed medication	228 (34.4)	143 (36.3)	85 (31.6)		
Both chronic medical condition and taking prescribed medication	219 (33.0)	113 (28.7)	106 (39.4)		
Healthcare experience					
Collaborative medical decision making: PCP and I decide together	459 (69.2)	275 (69.8)	184 (68.4)	0.09 ^b	0.77
Primary caregiver for child/elderly	284 (42.8)	161 (40.8)	123 (45.7)	1.42 ^b	0.23
Make medical decision for child/elderly	194 (29.2)	107 (27.1)	87 (32.3)	1.89 ^b	0.17

PCP=primary care provider. ^aPercentage may not sum to 100 because of rounding; numbers may not sum to totals due to missing responses; ^bYate's Correction for continuity; ^cFisher's exact test: 1 cell < 5 count; ^dFull-time employed: vs. No (Part-time, PRN, Other); ^eNurse practitioners/Other (informatics specialists, educators, researcher, others).

The majority of respondents were white (73%) and female (96%) and half were ages 45 and over. The majority of respondents had Bachelor's or above degree (84%) and were currently married or living with partner (65%). Ninety-two percent (n=608) of respondents were employed full-time, with average years worked of 17 (SD=12.7). The majority of respondents were staff RNs (75%) with specialties in noncritical care (73%).

2.3.1 Health and Healthcare Experience

The vast majority of RNs (96%) reported they were in excellent, very good, or good health, but one-third of respondents (34%) have either have chronic conditions or take prescribed medications and one-third of nurses (33%) have both chronic conditions and prescribed medications use. There was significant variation between ePHR users and nonusers regarding chronic conditions and taking prescribed medications ($p<0.05$). More than three-quarters (69%) of respondents reported that they collaboratively made decisions about their health care with their primary care providers. Less than half (43%) reported that they were primary caregivers for children or elderly parents and less than one-third (29%) made medical decision for their children or elderly parents. However, there was no difference in those healthcare experiences between ePHR users and nonusers.

2.3.2 Technology Experience and Awareness of New Technology

As seen in Table 2.2, 76% of respondents (n=503) reported using EHRs for patients as part of their job, for an average of 4 years (SD=3.8), and personal computer (PC) use for any purpose of 15 years (SD=7.4), which indicate no difference between ePHR users and nonusers. Eighty-five percent of respondents (n=561) reported using internet several times a day, and a larger portion of ePHR users used internet frequently compared to ePHR nonusers ($p<0.05$).

Table 2.2: *Technology Use and Attitudes of Hospital Nurses by Personal ePHR use*

Characteristic	n (%) ^a			χ^2	p
	Total (n=664) n (%) ^a	ePHR Nonuser (n=395)	ePHR User (n=269)		
Technology experience					
EHRs used for patients as part of job	503 (75.8)	292 (73.9)	211 (78.4)	1.54 ^b	0.22
EHRs use for patients (years), Mean (SD)	4.01 (3.8)	4.3 (3.9)	3.8 (3.6)	t= 1.29	0.20
PC use (years), Mean (SD)	15.4 (7.4)	15.3 (7.2)	15.5 (7.7)	t= -0.41	0.68
Internet use: Several times a day ^c	561 (84.5)	324 (82.0)	237 (88.1)	4.06 ^b	0.04
Frustrated as learning new applications	240 (36.1)	146 (37.0)	94 (34.9)	0.20 ^b	0.65
eHealth literacy (Higher score is better) ^d	13.0 (2.8)	12.9 (3.0)	13.2 (2.6)	t= -1.43	0.15
Awareness of new technology					
Heard about meaningful use	337 (50.8)	185 (46.8)	152 (56.5)	5.61 ^b	0.02
My health care providers use EHR	426 (64.2)	211 (53.4)	215 (79.9)	47.75	<0.01
Attitudes about privacy of health information					
Concerned about privacy and security of health information online ^e	456 (68.7)	283 (71.6)	173 (64.3)	3.68 ^b	0.06

EHR=electronic health record. PC= Personal computer.

^aPercentage may not sum to 100 because of rounding; numbers may not sum to totals due to missing responses; ^bYate's Correction for continuity; ^cFrequency of Internet use: <=Once a day (about once a day/Several times per week/Several times per month/Rarely or not at all) vs. several times a day; ^deHealth literacy (scale : 4 items, Response items: 0=Not sure, 1= Strongly disagree, 2=Disagree, 3=Agree, 4=Strongly agree, Range 0-16, Cronbach's alpha=0.91; ^eConcerned (Very concerned/Somewhat concerned) vs. Not concerned (Not at all concerned/Not very concerned/Not sure).

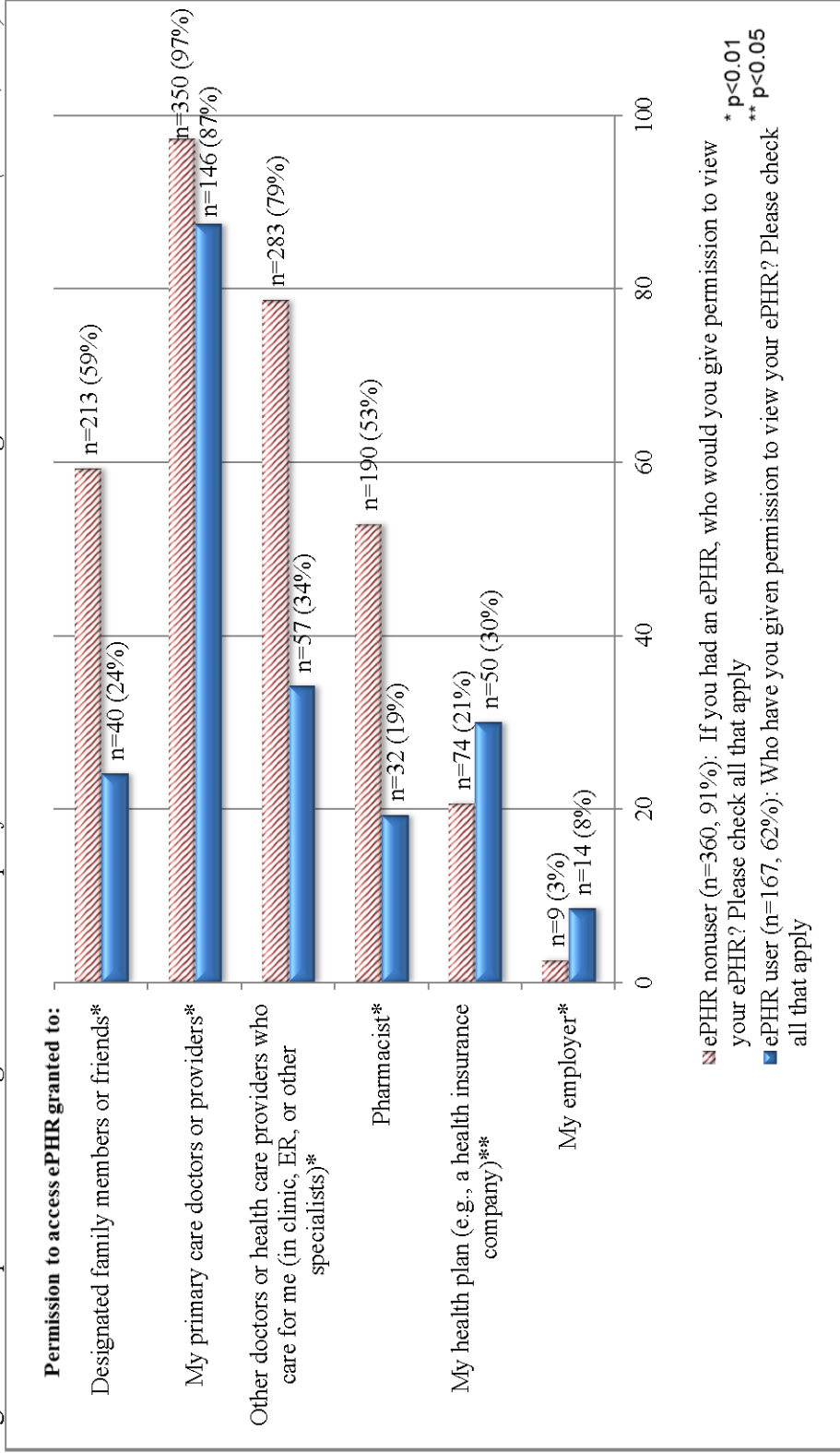
One-third (36%) respondents reported that they had frustration in learning new applications. Although nurses who used ePHRs had slightly higher health literacy scores (mean score=13.2 out of a maximum of 16) compared to ePHR nonusers (mean

score=12.9), both groups had similar distribution from range 0 to 16 in summative scale (higher score means better in eHealth literacy) ($p=0.15$). Half ($n=51\%$) said they had heard about meaningful use and almost two-thirds (64%) reported that their primary care providers currently use an EHR, which shows a significant variation between ePHR users and nonusers ($p<0.05$).

2.3.3 Attitudes about Privacy of Electronic Health Information

Almost 70% of respondents ($n=456$) had general concerns for privacy and security of health information online. ePHR users were less concerned for general privacy and security of health information online compared to nonusers ($p=0.06$) (Table 2.2). More than three-quarters (79%) of respondents ($n=527$) reported that they granted (ePHR users, $n=167$, 62%) or would grant (ePHR nonusers, $n=360$, 91%) permission to anyone to view their ePHRs (Figure 2.1).

Figure 2.1: Proportion Granting Permission to Specific Entities to View ePHR among Users and Nonusers (n=527, 79%)



Among those who granted or would grant permission (n=527), fewer ePHR users granted permission to designated family members or friends (24% vs. 59%), their primary care providers (87% vs. 97%), other healthcare providers who care for them (34% vs. 79%), or pharmacist (19% vs. 53%) compared to nonusers ($p<0.01$).

Meanwhile, more ePHR users granted permission to a health insurance company (30% vs. 21%) or their employer (8% vs. 3%) compared to nonusers ($p<0.05$).

2.3.4 Factors Associated with ePHR Use

Models for testing factors associated with ePHR use were adjusted for potential confounders as summarized in Table 2.3.

Table 2.3: Adjusted^a Odds Ratios of Factors Associated with ePHRs Use by Hospital Nurses (n=660)

	Model 1		Model 2		Model 3		Model 4	
	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
Health								
No chronic medical condition or taking prescribed medication	1.0						1.0	
Either chronic medical condition or taking prescribed medication	1.06 (0.71-1.57)	0.79					1.04 (0.68-1.58)	0.86
Both chronic medical condition and taking prescribed medication	1.74 (1.15-2.64)	0.01					1.64 (1.06-2.53)	0.03
Technology experience								
EHR use for patients as part of job (Yes vs. No)			0.97 (0.65-1.46)	0.90			0.98 (0.65-1.47)	0.91
Internet use (Several times a day vs. <= Once a day)			1.34 (0.80-2.22)	0.26			1.33 (0.80-2.22)	0.28
eHealth literacy (Higher score is better) ^b			1.01 (0.94-1.07)	0.86			1.01 (0.94-1.07)	0.85
Heard about meaningful use (Yes vs. No)			1.13 (0.79-1.62)	0.51			1.16 (0.80-1.66)	0.44

Table 2.3: Adjusted^a Odds Ratios of Factors Associated with ePHRs Use by Hospital Nurses (n=660) Cont.

	Model 1		Model 2		Model 3		Model 4	
	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
My health care providers use EHR (Yes vs. No)			3.77 (2.55-5.56)	<0.01			3.62 (2.45-5.36)	<0.01
Attitudes about privacy of health information								
General concern for privacy and security of health information online (Concerned vs. Not concerned) ^c					0.73 (0.51-1.04)	0.08	0.87 (0.60-1.26)	0.46

ePHR=electronic personal health record. EHR=electronic health record. ^aAdjusted for age, marital status, current position, and specialty area.

^beHealth literacy (scale: 4 items, Response items: 0=Not sure, 1= Strongly disagree, 2=Disagree, 3=Agree, 4=Strongly agree, Range 0-16, Cronbach's alpha=0.91); ^cConcerned (Very concerned/Somewhat concerned) vs. Not concerned (Not at all concerned/Not very concerned/Not sure)

For Model 1, both existing chronic medical condition and taking prescribed medications was significantly associated with ePHR use (OR=1.74, 95% CI=1.15-2.64). For technology experience (Model 2), those whose health care providers used EHR for care were more likely to use ePHRs (OR=3.77, 95% CI=2.55-5.56). For attitudes about privacy of electronic health information (Model 3), although it was not significant ePHR users were less concerned about general privacy and security of health information online (OR=0.73, 95% CI=0.51-1.04). In the full model (Model 4) that incorporated all predictors, ePHR users were significantly more likely to both have chronic medical condition and take prescribed medications (OR=1.64, 95% CI=1.06-2.53) and health care providers that used EHR for their care (OR=3.62, 95% CI=2.45-5.36).

2.4 Discussion

Our study is the first to characterize hospital nurses' ePHR use for their own health management. We found that 41% of hospital RNs use an ePHR to view, update, or manage their own health care. National surveys show that use of ePHRs among consumers ranges from 7% in 2010 California HealthCare Foundation study (CHCF, 2010a) to 10% in Markle's 2010 survey (Markle Foundation survey, 2011). All demographic and job information in our survey did not show significant variation between ePHR users and nonusers. However, our survey indicates that more than half of ePHR users were under age 45 and majority of nurses had Bachelor's or above degree. In similar way, the national consumer survey (CHCF, 2010a) reports that more than half of ePHR users were under age 45 and more than half of them were college graduated. In our survey RNs were reflected, as hospital RNs are predominantly female, White, staff

position, and noncritical care specialty. These are similar to the national workforce 2013 survey of RNs (Health Resources and Services Administration [HRSA], 2013).

Our survey indicated that both existing chronic medical condition and taking prescribed medication among hospital RNs were significant factors for use of ePHR compared to nonusers. The national consumer survey found that those who are older, with less education or income, and chronically ill consumers have the most to gain from using ePHR (CHCF, 2010a). It has been shown that ePHRs are valuable for chronic disease management (e.g., diabetes, heart failure, and multiple sclerosis) (Fonda, Kedziora, Vigersky, & Bursell, 2010; Miller et al., 2011; Ross, Moore, Earnest, Wittevrongel, & Lin, 2004). Chronic disease management based on ambulatory healthcare technology and care coordinators reduced emergency room visits, hospital admissions and length of hospitalizations (Meyers, Kobb, & Ryan, 2002). A survey in ten counties in Kentucky indicated that 53% of households managing a chronic illness were willing to pay to use a community wide ePHR that had been implemented (Thornewill & Baluch, 2007). Also 56% of respondents that had chronic conditions among consumers went online to find specific information about their medical conditions or prescription medications (CHCF, 2008). ePHR can be a useful tool for chronic disease self-management as an example of active engagement in managing health among patients and nurses as well. Two-thirds of ePHR users among nurses indicated that they collaboratively make medical decisions about their care with their primary care providers. This result is similar to the findings from the potential ePHR users of New York Buffalo (Patel et al., 2011). Less than half of our surveyed ePHR users were primary caregivers

for their child or elderly parents and making medical decisions for their child or elderly parents, though in general our ePHR users were fairly young for RNs (age < 45).

Our survey indicated there was no variation between ePHR users and nonusers in technology experience. Not surprisingly, more ePHR users were frequent internet users (several times a day) than ePHR nonusers. The national consumer survey indicated that frequent internet users are more likely to express interest in using ePHRs (CHCF, 2010a). Although eHealth literacy among nurses did not show significant variation between ePHR users and nonusers, addressing gaps in eHealth literacy may require additional efforts to help those who are not savvy with technology to ensure they get the benefits of ePHRs (Kahn et al., 2009).

Health care providers adoption and meaningful use of EHRs allow patients to access the health information via patient portal (i.e., ePHR) (DHHS, 2012). In our sample, more than half of ePHR users heard about meaningful use. More than three-quarters of nurses had providers that used EHR and it was significantly associated with ePHR use compared to nonusers. The national survey also reported that consumers who had their providers use EHR for them were more likely than others to be interested in use of ePHRs (CHCF, 2010a). Doctors and hospitals are the most common ePHR suppliers for those who use ePHR (Markle Foundation, 2011), thus providers who use EHR may be more likely to offer ePHR to patients. Physicians who used EHRs were more likely to be aware of ePHRs than physicians who plan to use or have no intention to use EHRs (Fuji et al., 2008). Our findings support that as more health care providers adopt EHRs, patients will have more interest in ePHR use (Jamoom et al., 2011). We did not ask RNs about what type of ePHR they used (e.g., integrated ePHR to providers' EHR vs. non-

tethered), which may address valuable information because an integrated ePHR with providers EHR is preferred from literature review (Kim & Nahm, 2012).

Data privacy and security protection is another critical issue for ePHRs (Kahn et al., 2009). Although our survey indicated that two-thirds of ePHRs users generally concerned for privacy and security of health information online, ePHRs users slightly less concerned about general privacy of electronic health information online compared to ePHR nonusers. A national consumer survey found that 63% of ePHR users concerned generally about the privacy of their medical records, but ePHR users were less worried about the privacy of information in their ePHRs, similar to our findings (CHCF, 2010a). Our survey indicated that fewer ePHR users granted permission to designated family members or friends, their primary care providers, other healthcare providers who care for them, or pharmacist compared to nonusers. However, more ePHR users granted permission to a health insurance company or their employer than ePHR nonusers. Our survey showed that greater portion of ePHR nonusers would grant permission to their primary care providers or other providers who care for them. This result is similar to the findings from potential ePHR users of New York Buffalo (Patel et al., 2011). This might be explained by that ePHR users actually control over who they grant permission to view their ePHR specifically, meanwhile ePHR nonusers do not have this experience or are unaware this feature. Therefore nonuser responses are hypothetical not actual. Atkinson et al. (2007) found that users mistrusted credibility and privacy of the ePHRs used, because of the lack of clear and concise information in the privacy policy and consent form. A survey found that many participants would like limits on the distribution of their personal health information for purposes other than clinical care, and suggested

incorporating sophisticated access control (i.e., multi-step authentication) into the ePHR (Whiddett, Hunter, Engelbrecht, & Handy, 2006). Privacy of ePHRs and comfort with using them depends on adequate security. There should be stringent security services required by the HIPAA security standard (U.S. Department of Health & Human Services [DHHS], 2006a) to give consumers control over access to their records.

2.5 Limitations

The study design has some limitations, however, the completely anonymous design with a short online survey strengthened our ability to obtain valuable data on factors related to ePHR use in hospital RNs. Foremost, generalizability of this study's results may be limited because our sample consisted of a convenience sample of healthy employed RNs working in hospitals in the Maryland/Washington DC area. It is probable that RNs who are on the computer more and interested in the topic of ePHRs might be more likely to have participated in this survey, therefore the estimates of the proportion of ePHR users (41%, n=269) should be cautiously viewed because of an estimated low participation rate (6.6%). Many of the factors studied were single item questions, however the questions were adapted from a survey of consumers to allow comparisons of the results. The logistic models did not incorporate the potential of clustering effects attributed to employees working at the same hospital.

2.6 Conclusions

Our study provides a baseline of understanding hospital RNs' ePHR use in Maryland/Washington DC area, and is the first to identify factors associated with ePHR use for nurses own health management. We found that hospital RNs' chronic medical condition and prescribed medications use, and their providers' use of EHR for care

(perhaps increasing their access to an ePHR) were significantly associated with ePHR use. Although the security and privacy permissions are problems to overcome in using ePHR, promoting the wide adoption and use of providers EHRs may leverage the more meaningful use of data in ePHRs by nurses. ePHR that has stringent internet security policy and security services on privacy of information may facilitate the use of ePHR by nurses. As a result of using ePHR, RNs can do better in managing their health and hopefully have better health outcomes. Further assessing different types of ePHRs may address important gaps. Each type of ePHR (tethered or non-tethered) has different functionality (whether it can consolidate data by consumers from providers' EHR or not) and different legal protections for ePHR privacy and security (covered entities such as health plans and health care providers vs. not covered independent ePHRs).

CHAPTER III (Manuscript 2)
ELECTRONIC PERSONAL HEALTH RECORD USE AMONG NURSES
IN THE NURSING INFORMATICS COMMUNITY¹

3.1 Introduction

There is a growing consensus that activating and engaging consumers is an essential component to health care reform in the US (Hibbard & Cunningham, 2008). The US health information technology (HIT) action agenda states that effective management of personal health information helps patients collaborate with their providers to make health care decisions, which can ultimately lead to better health outcomes (Agency for Healthcare Research and Quality [AHRQ], 2010). An electronic personal health record (ePHR) is a consumer-centric tool that enables consumers to securely access, manage and share their health information with health care providers. In addition, if they choose to, an individual ePHR user can allow significant others to access their ePHR (NAHIT, 2008). Potential benefits of ePHRs for consumers are improved consumer-provider communication (Tang et al., 2003; Wang, Lau, Matsen, & Kim, 2004), improved understanding of their own health, control over their health care (Patel et al., 2012) and ability to access their medical information in an emergency (Reti, Feldman, Ross, & Safran, 2010). ePHRs use have been supported by researcher groups to increase patient access, activate patients in their care and re-engineer patient-centered care (Johnston et al., 2007; Kaelber, DJha, Johnston, Middleton, & Bates, 2008; Pagliari, Detmer, & Singleton, 2007).

Meaningful use is the federal government's HIT policy, which supports the use of electronic health records (EHRs) by health care providers that would also allow patients

¹Gartrell, K., Trinkoff, AM., Storr, CL., & Wilson, ML. As submitted to *Online Journal of Nursing Informatics*.

to access their own health information (DHHS, 2012). The integration of ePHR with provider or hospital EHRs would consolidate data entered by a consumer with the data in the EHR to offer a more complete view of relevant health information (e.g., lab results and follow-up educational materials) (DHHS, 2010). It also can increase patient-centered care, improve patient activation, and enhance appropriate preventive services (Do, Barnhill, Heermann-Do, Salzman, & Gimbel, 2011; Roblin, Houston, Allison, Joski, & Becker, 2009; Nagykaladi et al., 2012; Wagner et al., 2012). ePHRs also have the potential to improve patient access to health information and subsequently improve health outcomes, such as chronic disease self-management and behavioral change (Dorr et al., 2007; Tenforde, Jain, & Hickner, 2011). ePHRs can help patients improve self-care by providing educational materials and explaining current clinical practice guidelines on specific diseases (NIPFC & NIU RDI, 2009). ePHRs may improve consumer adherence to medical intervention (Archer et al., 2011). Although the potential for ePHRs to improve healthcare is significant, data accuracy, data privacy and security concerns, and digital divide and literacy issues affecting ePHR usability are found to be common barriers to their widespread use (Kahn, Aulakh, & Bosworth, 2010; Tracy, Dantas, and Upshur, 2004; Lober et al., 2006; Weitzman, Kaci, & Mandl, 2009).

The U.S. Department of Health and Human Services' Office of the National Coordinator for Health Information Technology (ONC) and the American Nurses Association (ANA) asked nurses to participate in ePHR use and patient education (ANA, 2014). Currently no studies have examined adoption of ePHRs by nurses in the nursing informatics community (NIC) for their own health care. Adoption of ePHR among health care professionals can be facilitated by a champion with strong leadership, an ability to

persuade others and an entrepreneurship a role suitable for the NIC (Gagnon et al., 2010). Nursing informatics has a tremendous opportunity to assist and educate patients in establishing and leveraging ePHRs and applications for more efficient care and improved clinical outcomes (Kupchunas, 2007; Thede, 2008). ePHRs need to provide tools and services to help healthcare providers and consumers or patients make health-related decisions. It is very important for nurses to engage and assist in the development of ePHRs. Informatics nurses, who have always taken a patient-centered view, are in a prime position to influence development of ePHRs. Nurses can help to decide what information will be helpful, and what information the consumer can understand (Thede, 2008).

Meaningful use stage 2, which begins in 2014, sets the ePHR as mandatory, with an adoption rate by 10% (Kannry et al., 2012). This goal seems obtainable because a national consumer survey found that 7%-10% of the participants were already ePHR users (CHCF, 2010a; Markle Foundation, 2011). However, it is critical for patients and health care professionals to become educated on ePHR use as our nation continues to grow in its adoption of ePHR. Therefore, the purpose of this study was to examine the baseline of ePHR use among nurses in NIC and factors that are associated with ePHR use.

3.2 Methods

3.2.1 Study Design and Sample

We conducted an online survey to assess ePHR use among nurses in NIC for their own health management in the Fall of 2013. The survey was administered to nurses with memberships in AMIA (American Medical Informatics Association) and HIMSS

(Healthcare Information and Management Systems Society). Nurses were recruited through nursing informatics LISTSERV in AMIA and HIMSS to participate in the 15-minute (37 question) anonymous self-administered survey. The invitation letter and follow-up reminders were sent by the Director of Clinical Informatics for HIMSS and directly to AMIA members by one of the authors. Respondents who were retired, currently unemployed (including students) and non-nurses were excluded. In total 183 nurses in NIC participated. Institutional Review Board approval was provided by the University of Maryland, Baltimore and authorization from AMIA and HIMSS was obtained.

3.2.2 Survey Domains and Measurement

The survey domains included demographics, health and health care experience, technology experience and awareness of new technology, and attitudes about privacy of electronic health information. Questions were adopted from consumer surveys (CHCF, 2010b; Patel et al., 2011) and were tailored to appropriately reflect the nursing context as well as the context of an ePHR user or nonuser (e.g., ePHR users were asked whom they granted permission to view their ePHR, and ePHR nonusers were asked who they would grant permission to view their ePHRs). Job related information was gathered using questions adopted from the Hospital of the University of Pennsylvania website (HUP, 2013) and the Nurses' Worklife and Health Study (Trinkoff, Geiger-Brown, Brady, Lipscomb, & Muntaner, 2006). After a review by informatics experts working in the area of ePHRs and those with survey experience, pilot testing was performed prior to distribution.

An introduction to the survey defined ePHR as the tool that allows an individual to access with their user identification and password to view his or her own data, update their health information and manage their health care (HIMSS, 2007; NAHIT, 2008). An example of an ePHR screen image was shown to the participants. ePHR use and nonuse was defined based on the yes/no response to the question, “Have you ever used an ePHR to view, update, or manage your health information?”

The health and health care experience domain included a self-rated overall health status question, and several yes/no questions that inquired about any chronic conditions and prescribed medication usage. Additional items inquired about health care decision making preferences for themselves as well as their children or elderly parents.

The technology experience section began with questions that asked about work place EHR use, their own computer and Internet usage, and frustration when learning new applications. We asked whether respondents were aware of the meaningful use policy by the US government, and if their health care providers used EHR for their care. We also asked about attitudes and concerns with the privacy and security of electronic health information. Separate yes/no questions inquired about sharing information with designated family or friends, primary care providers, other providers (e.g., specialists or emergency departments), pharmacist, health insurance company, or their employer.

3.2.3 Analysis

Descriptive statistics were used to examine the distribution and frequency of the variables in the various domains. Differences in group means for continuous respondent characteristics by ePHR use were tested using t-tests and relationships for categorical variables by ePHR use were tested using χ^2 tests (Yate’s correction for continuity or

Fisher's exact test where appropriate). Variables found to be significant or nearly significantly different or associated with ePHR use in bivariate association ($p \leq 0.20$) were entered into multiple logistic regression models using forced entry method. Four multiple logistic regression models were generated to examine the magnitude of the association ePHR use: Model 1 included chronic medical conditions and prescribed medication use, Model 2 focused on technology experience factor, including health care providers' use of EHR, Model 3 contained terms for general concern for privacy and security of health information online, and the final model included terms for all these variables. All models were adjusted for ethnicity/ race and practice region in US. No multicollinearity across the variables was found, and model adequacies were met (omnibus tests, all significant $p < 0.05$; Hosmer-Lemeshow, all non-significant $p > 0.05$). SPSS 21 was used for all data analyses.

3.3 Results

Almost three-quarters of the NIC nurses (72%) used ePHRs (Table 3.1).

Table 3.1: *Characteristics of Nurses in Nursing Informatics Community by Personal use of ePHR*

Characteristic	n (%) ^a			χ^2	p
	Total	ePHR	ePHR		
	(n=183) n (%) ^a	Nonuser (n=52)	User (n=131)		
Demographics					
Age (years), Mean (SD)	51.0 (10.0)	50.1 (10.2)	51.3 (9.7)	t= -0.74	0.46
25-39	28 (15.4)	8 (15.4)	20 (15.4)	0.68	0.88
40-49	37 (20.3)	12 (23.1)	25 (19.2)		
50-59	85 (46.7)	22 (42.3)	63 (48.5)		
60+	32 (17.6)	10 (19.2)	22 (16.9)		
Female	167 (91.3)	50 (96.2)	117 (89.3)	$\chi^2=1.41^b$	0.24
White	151 (82.5)	36 (69.2)	115 (87.8)	7.64 ^b	0.01
Education					
Diploma/Associate's/ Bachelor's degree	57 (31.1)	20 (38.5)	37 (28.2)	1.37 ^b	0.24
Master's/Doctoral	126 (68.9)	32 (61.5)	94 (71.8)		
Marital status					
Never married/divorced/separated/ Widowed	38 (20.8)	8 (15.4)	30 (22.9)	0.86	0.35
Currently married/living with partner	145 (79.2)	44 (84.6)	101 (77.1)		
Job information					
Full-time employed, yes ^c	164 (89.6)	46 (88.5)	118 (90.1)	<0.01 ^b	0.96
Years of working as RN, Mean (SD)	25.4 (11.3)	25.2 (10.2)	25.4 (11.7)	t= -0.11	0.92
Region for current practice, US					
Northeast	41 (22.8)	13 (26.0)	28 (21.5)	7.19	0.07

Table 3.1: *Characteristics of Nurses in Nursing Informatics Community by Personal use of ePHR (Cont.)*

Characteristic	n (%) ^a			χ^2	p
	Total	ePHR	ePHR		
	(n=183) n (%) ^a	Nonuser (n=52)	User (n=131)		
Midwest	53 (29.4)	10 (20.0)	43 (33.1)		
South	47 (26.1)	19 (38.0)	28 (21.5)		
West	39 (21.7)	8 (16.0)	31 (23.8)		
Current position					
Staff/General/Private duty/Nurse practitioners ^d	19 (10.4)	8 (15.4)	11 (8.4)	10.69	0.03
Nurse manager/supervisor/Administrator	21 (11.5)	8 (15.4)	13 (9.9)		
Educator/Researcher	28 (15.3)	12 (23.1)	16 (12.2)		
Clinical informatics specialists ^e	76 (41.5)	19 (36.5)	57 (43.5)		
Chief nursing informatics officer/Supervisor nursing informatics/Other ^f	39 (21.3)	5 (9.6)	34 (26.0)		
Specialty area					
Direct patient care (Noncritical/Critical care)	62 (33.9)	24 (46.2)	38 (29.0)	4.15 ^b	0.04
Nursing Informatics	121 (66.1)	28 (53.8)	93 (71.0)		
Health					
No chronic medical condition or prescribed medication	50 (27.3)	22 (42.3)	28 (21.4)	8.26	0.02
Either chronic medical condition or prescribed medication	60 (32.8)	13 (25.0)	47 (35.9)		

Table 3.1: *Characteristics of Nurses in Nursing Informatics Community by Personal use of ePHR (Cont.)*

Characteristic	n (%) ^a			χ^2	p
	Total	ePHR	ePHR		
	(n=183)	Nonuser	User		
	n (%) ^a	(n=52)	(n=131)		
Both chronic medical condition and prescribed medication	73 (39.9)	17 (32.7)	56 (42.7)		
Healthcare experience					
Collaborative medical decision making:					
PCP and I decide together	130 (71.0)	36 (69.2)	94 (71.8)	0.03 ^b	0.87
Primary caregiver for child/elderly	80 (43.7)	25 (48.1)	55 (42.0)	0.34 ^b	0.56
Make medical decision for child/elderly	54 (29.5)	13 (25.0)	41 (31.3)	0.44 ^b	0.51

PCP=primary care provider. ^aPercentage may not sum to 100 because of rounding; numbers may not sum to totals due to missing responses; ^bYate's Correction for continuity; ^cFull-time employed: vs. No (Part-time, PRN, Other); ^dNurse practitioners, Certified Registered Nurse Anesthetist (CRNA)/Clinical Nurse Specialist (CNS)/Certified Nurse Midwife (CNM). ^eClinical analyst/Nursing informatics analyst/Nurse informaticist/Informatician/Informatics nurse specialist/Informatics specialist. ^fOther: Nursing informatics consultant/ Developer.

Two-thirds of the sample were age 50 or above and had Master's or Doctoral degrees.

The majority of respondents were female (91%), currently married or living with a partner (79%), employed full-time (90%), with average years worked of 25 (SD=11.3).

There was no variation between ePHR users and nonusers by age, sex, education, marital status, employment status, or years working as a nurse. A significantly larger proportion of nurses who used ePHR currently held positions as clinical informatics specialists, chief informatics officer or supervisor in nursing informatics, and reported that they specialized in informatics vs. nurses who were not using ePHR ($p < 0.05$). While the overall sample was almost equally distributed across the four major regions of the US, a larger proportion of the nonusers tended to be from the South ($p = 0.07$).

3.3.1 Health and Healthcare Experience

The vast majority of nurses (97%) reported they were in excellent, very good, or good health. However, one-third (33%) of respondents either had a chronic medical condition or used prescribed medications and 40% of respondents had both. A significantly larger portion of ePHR users had a chronic medical condition or used prescribed medications or both ($p < 0.05$). Almost three-quarters (71%) of respondents reported that they collaboratively made decisions about their health care with their primary care providers. Less than half (44%) were primary caregivers for dependents (e.g., children or elderly parents) and about one-third (30%) made medical decisions for their children or elderly parents. Those health care experiences did not vary between ePHR users and nonusers.

3.3.2 Technology Experience and Awareness of New Technology

As seen in Table 3.2, 68% of respondents reported that they used EHRs for patients as part of their job, and for an average of 8 years ($SD=5.4$).

Table 3.2: *Technology Use and Attitudes of Nurses in Nursing Informatics Community by Personal Use of ePHR*

Characteristic	n (%) ^a			χ^2	p
	Total	ePHR	ePHR		
	(n=183) n (%) ^a	Nonuser (n=52)	User (n=131)		
Technology experience					
EHRs used for patients as part of job	124 (68.1)	36 (69.2)	88 (67.7)	<0.01	0.98
EHRs use for patients (years), Mean (SD)	8.3 (5.4)	7.3 (4.5)	8.7 (5.7)	t= -1.26	0.21
PC use (years), Mean (SD)	20.5 (6.8)	20.4 (5.2)	20.6 (7.3)	t= -0.27	0.79
Internet use: Several times a day ^d	176 (96.2)	46 (88.5)	130 (99.2)	9.00 ^b	<0.01
Frustrated at learning new applications	39 (21.3)	12 (23.1)	27 (20.6)	0.03 ^c	0.87
Awareness of new technology					
Heard about meaningful use	181 (98.9)	52 (100.0)	129 (98.5)	0.01 ^b	1.00
My health care providers use EHR	171 (93.4)	45 (86.5)	126 (96.2)	4.19 ^c	0.04
Attitudes about privacy of health information					
Concerned about privacy and security of health information online ^e	98 (53.6)	37 (71.2)	61 (46.6)	8.09 ^c	<0.01

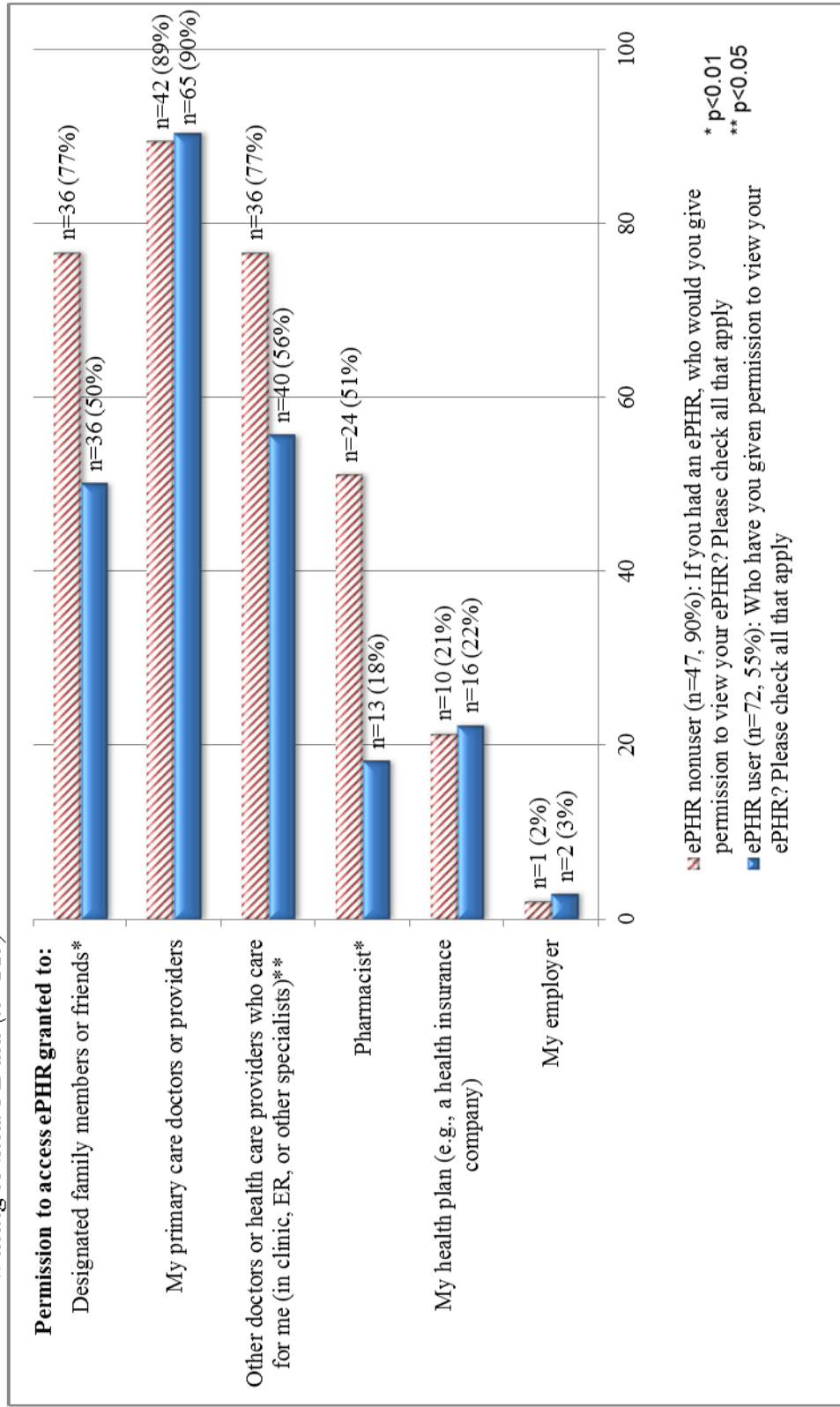
ePHR=electronic personal health record. EHR=electronic health record, PC= Personal computer. ^aPercentage may not sum to 100 because of rounding; numbers may not sum to totals due to missing responses; ^bFischer's exact test: cell count < 5; ^cYate's Correction for continuity; ^dFrequency of Internet use: Several times a day vs. <=Once a day (about once a day/Several times per week/Several times per month/Rarely or not at all); ^eConcerned (Very concerned/Somewhat concerned) vs. Not concerned (Not at all concerned/Not very concerned).

In this sample, the use of personal computers for any purpose was very common, averaging 21 years (SD=6.8), and only 21% expressed frustration when learning new applications. These factors did not vary between ePHR users and nonusers. On the other hand, a larger proportion of ePHR users were frequent (several times a day) internet users as compared to non ePHR users ($p<0.01$). As expected, the vast majority of nurses heard about meaningful use initiative. More ePHR users report that their health care providers currently use an EHR for their care than nonusers ($p<0.05$).

3.3.3 Attitudes about Privacy of Electronic Health Information

ePHR users were less concerned about privacy and security of online health information than nonusers ($p<0.01$) (Table 3.2). As seen in Figure 3.1, the majority of ePHR nonusers (90%) said they would grant permission to specific entities to view their ePHRs, however only half of ePHR users actually granted permission to specific entities to view their ePHRs.

Figure 3.1. Proportion Granting Permission to Specific Entities to View their ePHR among NIC^a Users and Nonusers Willing to Share Data (n=119)



Among those who granted or would grant permission (n=119), fewer ePHR users granted permission to designated family members or friends (50% vs. 77%), other healthcare providers (56% vs. 77%) or pharmacists (18% vs. 51%) than nonusers (p<0.05). Primary care providers were given permission or would be given permission by most respondents with no significant differences between users and nonusers. Health insurance companies and employers were least likely to get permission to view ePHRs by both groups, with no significant differences between users and nonusers.

3.3.4 Factors Associated with ePHR Use among NIC Nurses

As seen in model 1, ePHRs users were significantly more likely to either have chronic conditions or take prescribed medications (OR=2.68, 95% CI=1.10-6.53) and significantly more likely to have both (OR=2.58, 95% CI=1.10-6.06) than nonusers (Table 3.3).

Table 3.3: Adjusted^a Odds Ratios of Factors Associated with ePHRs Use by NIC Nurses (n=180)

	Model 1		Model 2		Model 3		Model 4	
	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
Health								
No chronic medical condition or taking prescribed medication	1.0						1.0	
Either chronic medical condition or taking prescribed medication	2.68 (1.10-6.53)	0.03					2.61 (1.00-6.82)	0.05
Both chronic medical condition and taking prescribed medication	2.58 (1.10-6.06)	0.03					2.00 (0.80-4.96)	0.14
Technology experience								
My health care providers use EHR (Yes vs. No)			6.07 (1.62-22.69)	<0.01			5.99 (1.40-25.61)	0.02
Attitudes about privacy of health information								
General concern for privacy and security of health information on line (Concerned vs. Not concerned)					0.35 (0.17-0.74)	<0.01	0.32 (0.14-0.70)	<0.01

ePHR=electronic personal health record. NIC= nursing informatics community. EHR=electronic health record.

^aAdjusted for ethnicity/race and practice regions.

For technology experience (Model 2), nurses whose health care providers used EHR for care were far more likely to use ePHRs than nonusers (OR=6.07, 95% CI=1.62-22.69). For attitudes about privacy of electronic health information (Model 3), ePHR users were significantly less concerned about general privacy and security of health information online than nonusers (OR=0.35, 95% CI=0.17-0.74). Several of the associations remained in the full model (Model 4) even in the presence of other factors: ePHR users were significantly more likely to have a health care provider using EHR but significantly less concerned about general privacy and security of health information online than nonusers. Chronic medical conditions and prescribed medications use were no longer significant when controlling for all other factors in model 4.

3.4 Discussion

Our study is the first to examine factors associated with ePHR use among nurses in NIC. We found that 72% responding to this survey of NIC nurses used an ePHR to manage their own health, and this estimated proportion is higher than the 7% in the CHCF consumer survey (2010a) and 10% to the Markle Foundation consumer survey (2011). Although the vast majority of respondents rated their health as good to excellent, ePHRs users were significantly more likely to either have chronic conditions or use prescribed medications or both than nonusers. Similar results were found in the national consumer survey, in which those who are older and have chronic illness have the most benefits from using ePHRs (CHCF, 2010a). About 133 million Americans live with at least one chronic illness (Centers for Disease Control and Prevention [CDC], 2009). Consumer survey reports that 56 % of respondents that had chronic conditions used online to search specific information about their chronic conditions or prescribed

medications (CHCF, 2008). Chronic disease self-management can be enhanced by using ePHR (Tang et al., 2006).

As a result of meaningful use of EHRs by providers or hospitals, there is more likely to be wide use of ePHR by patients (Blumenthal & Tavenner, 2010; DHHS, 2012). In our sample, nurses whose health care providers used EHR were significantly more likely to use ePHR. When more health care providers adopted EHRs, it resulted in enhanced patient care (Jamoom et al., 2011). Providers were more likely to be aware of ePHRs than providers who do not use EHRs (Fuji et al., 2008). Studies found that consumers who have access to their medical records have a better understanding of their health issues, better communication with their providers, have overall satisfaction with visits (Cimino, Patel, & Kushniruk, 2002), and made informed decisions as well as better quality of care (Fisher, Bhavnani, & Winfield, 2009). Our findings suggest that nurses in NIC are early adopters of ePHR for their health management, which may be benefited from their specialties in nursing informatics.

Our survey indicates that less than half of ePHRs users were concerned about general privacy and security of health information online. ePHR users were significantly less likely to be concerned about general privacy and security of electronic health information online than nonusers. However, they were also significantly less granted permission to designated family members or friends, other care providers, or pharmacists than nonusers. It is reassuring that the vast majority of both ePHR users and nonusers (90%) would grant access to their primary care providers, similar to findings from Patel et al. (2011). Also the ability of the ePHR to audit users gives them a sense of control over their privacy and confidentiality (Masys et al., 2002).

In terms of potential barriers to ePHR use, data privacy and security protection is a critical issue for both consumers and health care providers (CHCF, 2010a; Kahn et al., 2009). Privacy concerns were negatively related to the likelihood of adoption of ePHR among the general population (Angst & Agarwal, 2009). Almost two-thirds of consumer ePHR users indicated concerned about the privacy of their medical records, but they actually were less worried about the privacy of information in their ePHRs (CHCF, 2010a). Privacy of ePHRs and comfort with using them depends on adequate security, such as authentication for a tethered ePHR (Tang et al., 2006). Consumers should be educated that HIPAA outlines the legal protections for ePHR privacy and security for covered entities only (e.g., health plans and health care providers), so that it does not have control over independent ePHR systems (e.g., Microsoft HealthVault) (DHHS, 2006b; Kaelber et al., 2008). Thus, independent ePHR systems' privacy and security (e.g., Web-based ePHR, Microsoft HealthVault) have no current legal protections. However, the Office of the National Coordinator for Health Information Technology recently released ePHR Model Privacy Notice (ONC, 2011). It is designed as a standardized template that a Web-based ePHR company can use to concisely inform consumers about its privacy and security policies.

3.5 Limitations

Generalizability of these findings is a concern since this was a convenience sample of nurse members of AMIA and HIMSS. Nurses who belong to these organizations are predominantly nursing informatics specialists with common interests in informatics. However, this sample profile supports the study purpose of surveying nurses in the NIC. Nurses who are interested in the topic of ePHRs may have been more likely

to participate in this survey. Self-administered online surveys may have response biases (this survey had a low estimated response rate of 3.4% among recipients of the survey invitation emails). Furthermore, the cross-sectional design can only establish associations and findings do not reflect causal relationships. Despite these limitations, these findings can inform policy efforts to encourage informatics groups to become leaders and early adopters of ePHR.

3.6 Conclusion

Our study provides a baseline of understanding of ePHR use by nurses in NIC from AMIA and HIMSS. We found that ePHR use was related to providers' use of EHR for care and trust in privacy and security of electronic health information among NIC nurses. ePHR users were more likely to have chronic medical conditions and/or use prescribed medications than nonusers.

Promoting the wide adoption and use of ePHR by NIC nurses can benefit the general public, because these nurses are early adopters and equipped with knowledge in ePHR. Having champions with expertise in and enthusiasm for the new technology can promote the adoption of ePHRs among health care professionals as well as their patients (Gagnon et al., 2010). Further assessment of different types of ePHRs (tethered or non-tethered) might suggest important gaps in their usefulness and security. Future research can address whether tethered ePHR with providers' EHR provides more useful functionality and more stringent legal protections than non-tethered ePHR. Finally, nurses in NIC can also play an important role in practical ePHR design to enhance functionality and security in ePHR.

CHAPTER IV (Manuscript 3)
**FACTORS AFFECTING NURSES ACCEPTANCE OF ELECTRONIC
PERSONAL HEALTH RECORD FOR THEIR
OWN HEALTH MANAGEMENT¹**

4.1 Introduction

The Health Information and Technology (HIT) for Economic and Clinical Health Act's goal is to utilize HIT by providing Medicare and Medicaid incentives to physicians and hospitals that adopt and demonstrate meaningful use of electronic health record (EHR) (Blumenthal & Tavenner, 2010; CMS, 2013; DHHS, 2012). Meaningful use stage 1 made adoption of electronic personal health record (ePHR) as an option. Meaningful use stage 2, which begins in 2014, requires ePHR use mandatory by 10% (Blumenthal & Tavenner, 2010).

Markle Foundation (2003) defines ePHR as an internet-based tool that allows individuals to access and coordinate their lifelong health information and the ePHR offers an integrated and comprehensive view of health information from all providers, and is both private and secure. Health information can include allergy, immunization, family history, wellness and disease management (e.g., medications), documents from providers (e.g., discharge instructions), services (e.g., appointment), or administrative data (e.g., emergency contacts) (HIMSS, 2007; NAHIT, 2008). ePHRs can be non-tethered or tethered. Tethered ePHRs are linked to a specific health care organization's EHR system or to a health plan's information system, which allows patients to see selected data entered by providers into the EHR (Tang et al., 2006). The most common ePHR suppliers are doctors and hospitals (Markle Foundation, 2011). Both consumers and providers were

¹ Gartrell, K., Trinkoff, AM., Storr, CL., Wilson, ML., Charters, KG., & Gurses, A.
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generally positive about ePHRs in enhancing communication (Cimino, Patel, & Kushniruk, 2002; Mandl, Simons, Crawford, & Abbett, 2007; Wagner, Howard, Bentley, Seol, & Sodomka, 2010; Yau, Williams, & Brown, 2011). Although concerns regarding data accuracy and reliability arise when consumers enter and update data (Tang et al., 2006; Wynia et al., 2011), consumers who used tethered ePHR were able to find errors on their lab results and medication lists (Kahn et al., 2010). They were able to view and verify their information. ePHRs are valuable for chronic disease management (e.g., diabetes, heart failure, and multiple sclerosis). Studies found improved diabetes self-management and increased medication compliance (Fonda, Kedziora, Vigersky, & Bursell, 2010; Hess et al., 2007; Grant et al., 2008; Tenforde, Nowacki, Jain, & Hickner, 2012). Archer et al. (2011) indicated that adoption of ePHRs with guidelines for health management can improve consumer health behaviors such as less use of tobacco, regular exercise, dietary changes, and medication compliance. Although there is evidence for an association between patients active involvement on their health management and health behaviors (Hibbard, Mahoney, Stockard, & Tusler, 2005), there is minimal evidence demonstrating that increased access to ePHR increases patient activation or changes health outcomes. Increasing use of ePHR may not guarantee that patients will improve their health outcomes unless patients accept and subsequently use ePHRs (Patel et al., 2011).

4.1.1 ePHR Acceptance Research within Health Care Professionals

There are no studies that focus on health care professionals' use of ePHRs as patients themselves for their own personal health management. Nurses have a tremendous opportunity to assist and educate patients in leveraging ePHRs for more efficient care and

improved clinical outcomes (Kupchunas, 2007; Thede, 2008). Assisting patients in efforts to be more proactive in their own healthcare and personal health data record-keeping is a first step in establishing effective partnerships between patient and nurse (NIPFC & NIU RDI, 2009). Nurses can act as role models in encouraging and motivating patients to learn about their health and what they can do to take more ownership of their decisions and behaviors that ultimately affect their health. Health Resources and Services Administration [HRSA] (2013) reports that the average age of registered nurses (RN) was 44.6 years and more than half (53%) of those working nurses were age 50 or older.

Technology acceptance research for ePHR has been conducted by physicians for clinical care (Fuji, Galt, & Serocca, 2008; Hasso et al. 2004; Romano, Gesualdo, Pandolfi, Tozzi, & Ugazio, 2012; Tang & Lansky, 2005; Witry, Doucette, Daly, Levy, & Chrischilles, 2010; Wynia et al., 2011; Yau et al., 2011). Those studies found positive attitudes of providers regarding increased efficiencies, improved interaction with patients and their family, emergency access for patients care, and efficiency of medication management. Concerns were patients' privacy and security about data use, and accuracy of underlying data. In similar, Literature review by Kim and Nahm (2012) found that the most frequent barriers were data accuracy, data privacy and security concerns, and digital divide and literacy issues affecting ePHR usability among consumers.

In order to prepare meaningful use stage 2, health care professionals should be able to use ePHR for health management. In ePHRs, individuals determine who can access and view their information. ePHRs can have the ability to audit who access the ePHR, as a result consumers have a sense of control over their privacy and confidentiality (Masys et al., 2002). The HIPAA outlines the legal protections for ePHR privacy and

security for only covered entities (e.g., health plans and health care providers) (DHHS, 2006a; Kaelber et al., 2008). The Office of the National Coordinator for Health Information Technology (ONC, 2011) released ePHR Model Privacy Notice, so that a Web-based ePHR company can use a standardized template to inform consumers about its privacy and security policies.

4.1.2 Patient Acceptance of ePHR Research

Day and Gu (2012) tested technology acceptance model (TAM) and found that ePHR adoption among patients was influenced by perceived usefulness, perceived ease of use, and computer and health literacy. One nursing study used the unified theory of acceptance and use of technology (UTAUT) to assess factors related to HIT acceptance among home care patients (Or et al., 2011). This study found that perceived usefulness and perceived ease of use predicted the acceptance of a web-based HIT. The weaknesses of ePHR studies is that they do not use reliable predictors of technology acceptance (e.g., usefulness, ease of use), and they do not provide psychometrically relevant instruments.

Lack of theoretical framework that driven by empirical models is a concern in ePHR research for all ePHR research or for research about nurses. This study is an attempt to fill the gap by using an ePHR acceptance model among nurses that expands variables from an established TAM of Davis (1989). The purposes of this study were to test ePHR acceptance model among nurses with three areas. First purpose was to examine the psychometric properties of the measures in the research model. Second purpose was to examine an association of perceived usefulness, ease of use, data privacy and security protections, and health promoting role model with ePHR use. Third purpose was to

examine the moderator effect of age, chronic illness and medication use, and health care providers' use of EHR between ePHR acceptance constructs and ePHR use.

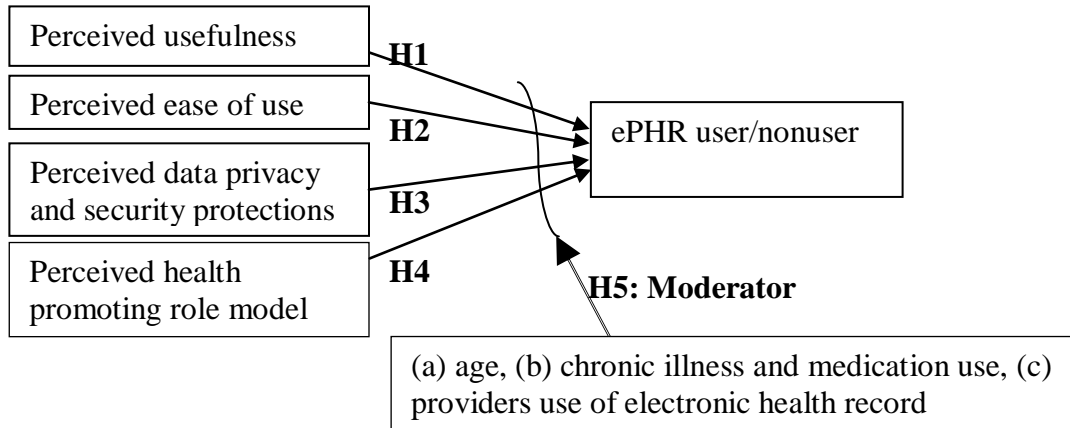
4.1.3 Research Model and Hypotheses

HIT acceptance and use has been studied using several models, which originated from different theoretical disciplines: psychology, sociology, and information systems (Holden & Karsh, 2010). Empirical support has favored the theory of reasoned action of Fishbein and Ajzen (1975), theory of planned behavior of Ajzen (1991), TAM of Davis (1989), TAM2 of Venkatesh and Davis (2000), the diffusion of innovation theory of Rogers (1995), and the UTAUT of Venkatesh, Morris, Davis, and Davis (2003). These models have reportedly explained a substantial portion of the variances in intention to use and actual use in health care. It is evident that TAM has widespread application in explaining health care professionals' intention to adopt HITs (Chismar & Wiley-Patton, 2003; Dixon & Stewart, 2000; Hu, Chau, Liu Sheng, & Kar, 1999; Pare, Sicotte, & Jacques, 2006; Van Schaik, Bettany-Saltikov, & Warren, 2002; Lu, Hsiao, & Chen, 2012; Zhang, Cocosila, & Archer, 2010; Schnall & Bakken, 2011; Jayasuriya, 1998; Liang, Xue, & Byrd, 2003; Liu & Ma, 2006). TAM was adapted for the research model for our study for three reasons. First, TAM has been repeatedly validated in health care settings and has explained fairly large proportions of variance as intention to use or use. Second, TAM is the most parsimonious model to explain intention to use or use. Third, empirical studies suggest that perceived usefulness and perceived ease of use were the most significant predictors for intention to use and use.

For the research model (Figure 4.1), TAM was expanded adding two new constructs: perceived data privacy and security protections, and perceived health

promoting role model. First, with HIPAA and increased awareness of personal health information breaches, data privacy and security has been a major concern among the patients and health care professionals.

Figure 4.1: *ePHR Acceptance Model among Nurses*



Second, nurses are involved in direct patient care and their health promoting role model in using ePHRs is very important. The research model posits these two new relationships that were not empirically tested. Those two factors are very important to be included in the research model based on the literature review. The moderating influence of age, chronic illness and medication use, health care providers' use of EHR on ePHR use were also tested.

4.1.4 Variable Definitions

4.1.4.1 Perceived Usefulness (PU)

Based on the original definition of Davis (1989), PU is the degree to which an individual believes that using an ePHR would improve their ability and enhance the effectiveness in managing their disease. PU was the strongest predictor of intention to use HITs among health care professionals (Barker, Schaik, Simpson, & Corbett, 2003; Chau

& Hu, 2002a; Chismar & Wiley-Patton, 2003; Duyck et al., 2008; Han, Mustonen, Seppänen, & Kallio, 2005; Hu et al., 1999; Schnall & Bakken, 2011; Van Schaik et al., 2002; Wu, Wang, & Lin, 2007; Yi, Jackson, Park, & Probst, 2006; Zhang et al., 2010). In general, perceived characteristics of using an innovation have been found to be relevant to technology acceptance (Moore & Benbasat, 1991; Schaper & Pervan, 2007b). PU was a strong factor that influenced use of an integrated PHR system among patients (Day & Gu, 2012). These studies suggest that people are more likely to use ePHR if they believe it is useful to manage their health (i.e., ePHR users will have higher score in the PU scale than nonusers). We hypothesized that **perceived usefulness will be positively associated with ePHR use in nurses.**

4.1.4.2 Perceived Ease of Use (PEOU)

Based on the original definition of Davis (1989), PEOU is the degree to which an individual believes that using an ePHR would be free of effort. PEOU was found to be a good secondary predictor of intention to use HITs among health care professionals (Chen et al, 2007; Dixon & Stewart, 2000; Liang et al., 2003; Liu & Ma, 2006; Lu et al., 2012; Rawstorne et al., 2000; Schaper & Pervan, 2007b; Tung et al., 2008; Wu et al., 2007; Zhang et al., 2010). PEOU was a facilitator for adoption of ePHR among family practitioners in Canada (Yau et al., 2011). Meanwhile, the majority of patients who used an ePHR indicated that the system was easy to use (Hassol et al., 2004). PEOU was one of the factors that influenced use of an integrated PHR among patients (Day & Gu, 2012). These studies suggest that nurses are more likely to use ePHRs if they feel that the system is easy to use (i.e., ePHR users will have higher score in the PEOU scale than nonusers).

We hypothesized that **perceived ease of use will be positively associated with nurses' ePHR use for their own health information.**

4.1.4.3 Perceived Data Privacy and Security Protections (PDPSP)

PDSP is defined as the degree to which an individual believes that their ePHR contains “physical, technological, and administrative security safeguards used to protect individually identifiable health information” (DHHS, 2008, ep. 11). Data privacy and security is perceived as a concern to adoption of ePHR among consumers (CHCF, 2010a), and was also found in physicians related to adoption of HITs (Gagnon et al., 2010; Wynia et al., 2011). Security and privacy issues were significant barriers for adoption of ePHRs among physicians in clinical practice (Wynia et al., 2011; Yau et al., 2011). Angst and Agarwal (2009) found that privacy concerns were negatively related to the likelihood of adoption of ePHR among the general population. These studies suggest that nurses are more likely to use ePHR if they feel their data privacy and security are protected (i.e., ePHR users will have higher score in the PDPSP scale than nonusers). We hypothesized that **perceived data privacy and security protections will be positively associated with ePHR use.**

4.1.4.4 Perceived Health Promoting Role Model (PHPRM)

Based on the original definition of Rush, Kee, and Rice (2010), PHPRM reflect nurses responsibility to model personal health promoting practices and behaviors. Bandura (1969) suggests that role modeling is a professional socialization. Nurses are an important health promoting role model for patients in health care. Awareness of one's own fitness and lifestyle behaviors is a basic premise of health promotion for nurses (Connolly et al., 1997; Rush et al., 2010; Strobl & Latter, 1998). PHPRM of nurses is an

important factor in promoting a healthy lifestyle of patients based on nurses' positive experiences (Connolly, Gulanick, Keough, & Holm, 1997) and negative experiences (Rush et al., 2010). There were no findings regarding the association of PPHRM on ePHR use. Therefore, the assumption was that nurses are more likely to use ePHR if they believe that they are health promoting role models (i.e., ePHR users will have higher score in the PPHRM scale than nonusers). We hypothesized that **perceived health promoting role model will be positively associated with ePHR use.**

4.1.4.5 ePHR Users vs. Nonusers

Based on the original definition of Davis (1989), use is a specific individual's behavior performed with regard to ePHR. For this study, ePHR use or not use is the outcome variable. The variance in actual use of HIT (55%-75%) was explained by PU and PEOU in studies for nurses, physicians, and pharmacists (Jayasuriya, 1998; Liang et al., 2003; Lu et al., 2012; Pare et al., 2006).

4.1.4.6 Moderators

Age: Moderators and covariates should be examined to check whether these affect the correlation between predictors and outcomes (Baron & Kenny, 1986). Venkatesh et al. (2003) identified key moderating variables that showed significant influence on intention to use HIT as gender, age, experience, and voluntariness of use. Age is likely to exert moderating effect in our study, and gender may not have the same influence such as other factors because females are predominant in nursing. The national workforce survey 2013 of RN indicated the average age of nurses was 50 years (Budden, Zhong, Moulton, & Cimiotti, 2013), and more than half were age 50 or older (HRSA, 2013). As our

national workforce nurses are getting older, the assumption was that the association of PU, PEOU, PDPSP, and PHPRM on ePHR use will be moderated by age.

Chronic Illness and Medication Use: The national consumer survey indicated that those who are chronically ill consumers gain benefits from using ePHR (CHCF, 2010a). More than half (53%) of households who manage a chronic illness were intent to pay to use ePHR (Thornewill & Baluch, 2007); 56% of respondents with chronic conditions searched information about their conditions or medications (CHCF, 2008). Studies report that ePHRs are valuable tool for chronic disease management such as diabetes, heart failure, or multiple sclerosis (Fonda, Kedziora, Vigersky, & Bursell, 2010; Miller et al., 2011; Ross, Moore, Earnest, Wittevrongel, & Lin, 2004). The assumption was that the associations of PU, PEOU, PDPSP, and PHPRM on ePHR use will be moderated by both chronic illness and medications use.

Health Care Providers' EHR Use: Physicians who used EHRs were more likely to be aware of ePHRs than physicians who either plan to adopt EHRs or have no intention to use EHRs (Fuji et al., 2008). More than half (54%) of physicians adopted EHR in 2011, and 74% of adopters believed enhanced patient care by using EHR (Jamoom et al., 2011). While similar research on nurses is not available, the assumption was that the associations of PU, PEOU, PDPSP, and PHPRM on ePHR use will be moderated by their health providers' use of EHR for nurses own personal healthcare. Hypotheses (**H5**) regarding all moderators were tested.

4.1.4.7 Covariates

Covariates included the nurse sampling group: whether respondents were members of the nursing informatics community (NIC) or if they were part of the hospital

nurse sampling group. Nurses in NIC collaborate on common interests in nursing informatics, are more likely to be technologically savvy and aware of the federal meaningful use initiative than hospital nurses and exhibited some demographic differences. Other covariates included all moderators in this study, which also were included as covariates, prior to testing them as moderators.

4.2 Methods

4.2.1 Research Design

The proposed model was tested using data from a cross-sectional, anonymous online survey of ePHR use among US nurses for their own health management. It was conducted from October 2013 to January 2014. The target population was 1) RNs working in hospitals and 2) NIC members. Hospital RNs were accessed from 12 sample recruiting sites in the Maryland/Washington DC area, and NICs from two specialty organizations: American Medical Informatics Association (AMIA) and Healthcare Information and Management Systems Society (HIMSS). Accessible population included ages 18 years or older of both genders, who were able to read English and were listed under the hospital LISTSERVS or AMIA and HIMSS LISTSERVS. All RNs were currently employed at the time of the survey; retired and unemployed (including students) and non-nurses were excluded. The study received Institutional Review Board approval from the University of Maryland, Baltimore and each facility, and obtained permission from AMIA and HIMSS.

4.2.2 Data Collection Procedure

RNs were informed about the survey through LISTSERVS. Online survey link, cover letter with voluntary consent information and anonymity protection for the survey

were attached in the invitation email and follow-up reminders. Of the 15,383 estimated invitations to participate, 847 usable responses were obtained, for a 5.5% estimated response rate. Two participants received iPad Minis from a drawing offered as an incentive to participate. The 37 item survey took approximately 15 minutes to complete.

4.2.3 Measurement

The ePHR acceptance online survey contained five domains: Part I. Awareness of new technology and attitudes about privacy of electronic health information, Part II. ePHR acceptance, Part III. Technology experience, Part IV. Health status and decision making preferences, and Part V. Job information and demographics.

A description of ePHR was presented in the beginning of the survey with an ePHR screen image to promote understanding of participants. ePHR users and nonusers were defined based on yes/no response for the question, “Have you ever used an ePHR to view, update, or manage your health information?” This was adopted from national consumer survey on HIT by California HealthCare Foundation (CHCF) (2010b). For ePHR users, we asked frequency of use and time spent each time to use ePHR. We reviewed the literatures and national consumer survey to choose reliable and validated measurement scales to operationalize the theoretical constructs. All measurement items were modified and reworded to reflect ePHR context and nursing in this study. Modifications were based on input from experts in methodology and informatics in PhD committee members and feedback from pre-testing among PhD students. For ePHR acceptance domain (Part II), level of measurement in response items were done with 4-point Likert summative scale for PU, PEOU, PDPSP, and PHPRM, with 30 items used to

measure these four constructs tested in the conceptual model. All questions were tailored to appropriately reflect ePHR users and nonusers.

PU was assessed with 10 items from national consumer survey on HIT by California HealthCare Foundation (CHCF) (2010b). The items were phrased, for ePHR users: “here are some useful ePHR features. How useful has each of these been to you?” and for ePHR nonusers: “if your health information were available on ePHR, how useful would these be to you?” Responses for both were answered with response options, ranging from “not at all useful” to “very useful.” PEOU was measured using 4 out of 6 items of PEOU scale of Davis (1989, Cronbach’s $\alpha=0.94$). The items were phrased, for users: “since you have used an ePHR, how much do you agree or disagree with each one?” and for nonusers: “If you had an ePHR, how much would you agree or disagree with each one?” Response options ranged from “strongly disagree” to “strongly agree.” PDSP was assessed with 8 items from national consumer survey on HIT by California HealthCare Foundation (CHCF) (2010b). The items were phrased, for users: “how protected would you feel about the privacy and security of your information given these situations?” and for nonusers: “here are some things that might affect whether you use an ePHR that helps you view, update, or manage your health information. How protected would you feel about the privacy and security of your health information given these situations?” Response options ranged from “not at all protected” to “very protected.” PHPRM was measured with 8 items among 19 items from Self as Role Model for Health Promotion subscale of Rush et al. (2010, Cronbach’s $\alpha =0.43-0.71$). Items were phrased, “how much do you agree or disagree with each one?” were answered with response options, ranged from “strongly disagree” to “strongly agree.”

4.2.4 Analysis

Descriptive statistics examined the distribution and frequency of four constructs (PU, PEOU, PDPSP, PHPRM), age, chronic illness and medication use, providers' use of EHR, and nursing group. T-tests for continuous variables and Chi-square with Yate's correction for continuity for categorical variables were used with 2-sided tests. Correlations among four constructs were checked using Pearson's correlation. Odds ratios were used to determine the significant constructs in relation to ePHR use and to examine the multiple relationships among the variables. Crude odds ratios for hypothesis testing used binary logistic regression. Multiple logistic regression models using a forced entry method were used to examine four constructs association with ePHR use and covariates. Then models were tested for interaction. For covariates found to be operating as moderators, we plotted interaction graph and calculated separate odds ratios for subgroups. No outliers (standardized residual > 3) and no multicollinearity across the covariates was found. Omnibus tests were all significant ($p < 0.05$) except PDPSP in crude odds ratios. Hosmer-Lemeshow tests indicated there was a good fit ($p > 0.05$) in all models except for PDPSP in crude odds ratios and model 2 itself. SPSS 21 was used for all data analyses.

4.3 Results

4.3.1 Sample Descriptive

The average age of nurse respondents was 45, ranging from 21 to 71 (Table 4.1).

Table 4.1: *Characteristics (n, %)^a of Nurses (n=847)*

	Total (n=847)	ePHR nonusers (n=447)	ePHR users (n=400)	χ^2	p
Age (years), Mean (SD)	45.1 (12.6)	44.3 (12.8)	46.0 (12.4)	t= -1.91	0.06
<= 50	498 (59.0)	281 (63.0)	217 (54.5)	6.26 ^b	0.01
> 50	346 (41.0)	165 (37.0)	181 (45.5)		
Chronic illness and medication use					
No	266 (31.4)	160 (35.9)	106 (26.5)	8.17 ^b	<0.01
Yes	580 (68.6)	286 (64.1)	294 (73.5)		
Providers use electronic health record					
No	250 (29.5)	191 (42.7)	59 (14.8)	78.10 ^b	<0.01
Yes	597 (70.5)	256 (57.3)	341 (85.3)		
Nursing Group					
Hospital	664 (78.4)	395 (88.4)	269 (67.3)	54.34 ^b	<0.01
Nursing informatics community	183 (21.6)	52 (11.6)	131 (32.8)		

^aPercentage may not sum to 100 because of rounding; numbers may not sum to totals due to missing responses. ^bYate's correction for continuity.

Nurses in ePHR user group were significantly older (age > 50, p<0.01), had more chronic illness and medication use (p<0.01), had their providers that used EHR for care (p<0.01), and were more likely to be in NIC (p<0.01). Forty-seven percent of respondents (n=400) were ePHR users, with the majority (82%) of them using ePHR less than once a month. ePHR users spent an average of 19 minutes (SD=17.4) each time they accessed ePHR.

4.3.2 Reliability and Validity

All correlations among ePHR acceptance constructs were small (r<0.30), positive, and significant (p<0.01) with an exception of correlation between PEOU and PDPSP with medium (r=0.39, p<0.01). ePHR acceptance constructs were measured through

All Cronbach's alpha (α) were greater than the acceptance level of 0.70 (Nunnally, 1978), which demonstrated sufficient reliability for each construct in ePHR acceptance model. There was significant difference between ePHR users and nonusers by perceptions on usefulness ($p < 0.01$), ease of use ($p < 0.05$), and health promoting role model ($p < 0.05$).

4.3.3 Model Testing

Each ePHR acceptance construct showed a significant association with ePHR use except PDSP (Table 4.3) (**Crude odds ratios**).

Table 4.3: Odds Ratios of ePHR Acceptance Constructs on ePHR use by Nurses

	Crude Odds Ratios			Model 1		Model 2	
	(n=847)			(n=847)		(n=844)	
	OR (95% CI)	p		OR (95% CI)	p	OR (95% CI)	p
H1: Perceived usefulness	0.90 (0.88-0.92)	<0.01		0.87 (0.85-0.89)	<0.01	0.87 (0.85-0.89)	<0.01
H2: Perceived ease of use	1.05 (1.01-1.09)	0.02		1.06 (1.01-1.12)	0.03	1.06 (1.00-1.12)	0.06
H3: Perceived data security and privacy protection	1.01 (0.98-1.03)	0.64		1.04 (1.01-1.07)	0.01	1.04 (1.01-1.07)	0.03
H4: Perceived health promoting role model	1.03 (1.01-1.05)	0.04		1.07 (1.04-1.11)	<0.01	1.07 (1.04-1.11)	<0.01

Model 1 was adjusted for nursing group.

Model 2 was adjusted for nursing group, age, chronic illness and medication use, health care providers' use of electronic health record.

PU had a significantly inverse association with ePHR use. ePHR users were significantly less likely to perceive useful than nonusers (OR=0.90, 95% CI=0.88-0.92). PEOU was positively associated with ePHR use. ePHR users were significantly more likely to perceive ease of use than nonusers (OR=1.05, 95% CI=1.01-1.09). PDPSP had a positive association with ePHR use, but it was not statistically significant (OR=1.01, 95% CI=0.98-1.03). PHPRM was positively associated with ePHR use. ePHR users were significantly more likely to perceive health promoting role model than nonusers (OR=1.03, 95% CI=1.01-1.05). All ePHR acceptance constructs made a unique statistically significant contribution to the model 1 after adjusting for nursing group (NIC vs. hospital) and the direction remained same as shown from **Crude odds ratios**. Those significant contributions of ePHR acceptance constructs were remained same except PEOU after adjusting nursing group, age, chronic illness and medication use, and providers' use of EHR in model 2. Those significant contributions of ePHR acceptance constructs were remained same except PEOU after adjusting nursing group, age, chronic illness and medication use, and providers' use of EHR in model 2.

We found there was a significant interaction between PDPSP and the providers' use of EHR on ePHR use ($p < 0.05$). Therefore, separate odds ratios were calculated by subgroups to evaluate the association of PDPSP and ePHR use. As seen in Table 4.4 (**crude odds ratios**), for the group of nurses whose providers did not use EHR, the estimated odds ratio of ePHR use by PDPSP was 0.96 (95% CI=0.92-1.00).

Table 4.4: *Odds Ratio^a Estimates of Perceived Data Privacy/Security Protections by ePHR use in Providers use of Electronic Health Records Subgroup*

H5	Providers do not use EHR (n=250)			Providers use EHR (n=597)		
	β	OR (95% CI)	p	β	OR (95% CI)	p
PDPSP	-0.04	0.96 (0.92-1.00)	0.06	0.01	1.01 (0.99-1.04)	0.29
(Crude odd ratios)						
PDPSP	-0.04	0.96 (0.92-0.99)	0.04	0.01	1.01 (0.98-1.03)	0.55
(Model 1)						
PDPSP	-0.05	0.95 (0.91-0.99)	0.03	0.01	1.01 (0.98-1.03)	0.72
(Model 2)						

PDPSP= Perceived data privacy and security protection, continuous total scale (higher score is better).

^aSeparate odds ratios calculated for subgroups because of positive interactions.

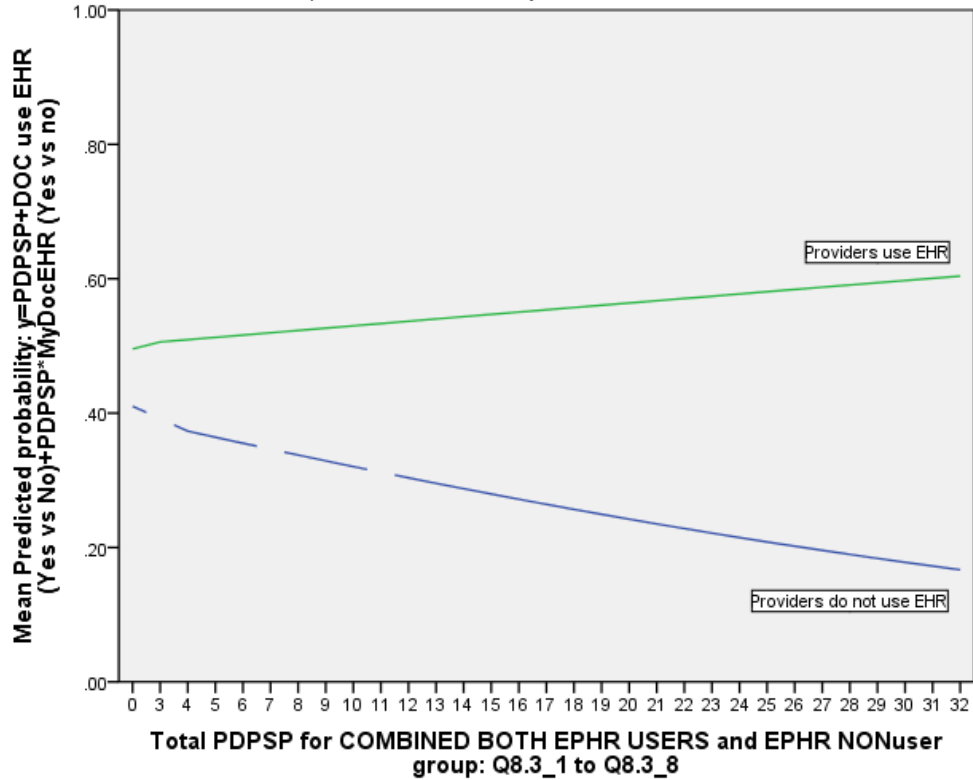
EHR=electronic health record. β =beta coefficient.

Model 1 adjusted for nursing group.

Model 2 adjusted for nursing group, age, chronic illness and medication use.

For the group of nurses whose providers used EHR, the estimated odds ratios of ePHR use by PDPSP was 1.01 (95% CI=0.99-1.04). Figure 4.2 displays the association between PDPSP and ePHR use by subgroups.

Figure 4.2: *Predicted Probability of ePHR use and Perceived Data Privacy and Security Protections by Providers use of Electronic Health Records*



The slope for the nurses whose providers did not use EHR was associated with a greater decrease in PDPSP scores than was the slope for the nurses whose providers used EHR. The models were adjusted for nursing group (Model 1) as well as for nursing group, age, and chronic illness and medication use (Model 2) in subgroups and indicated similar estimated odds ratios such as crude odds ratios. We also found there was a significant interaction between PPHRM and age on ePHR use ($p < 0.05$).

Table 4.5 shows separate odds ratios by subgroups to evaluate the association of PHPRM and ePHR use. For the younger nurse group (age≤50), the estimated odds ratios of ePHR use by PHPRM was 1.01 (95% CI=0.98-1.04). For the older nurse group (age>50), the estimated odds ratios of ePHR use by PHPRM was 1.07 (95% CI=1.02-1.11).

Table 4.5: *Odds Ratio^a Estimates of Perceived Health Promoting Role Model by ePHR use in Age Subgroup*

H5	Age (<=50) (n=498)			Age (>50) (n=346)		
	β	OR (95% CI)	p	β	OR (95% CI)	p
PHPRM	0.01	1.01 (0.98-1.04)	0.62	0.06	1.07 (1.02-1.11)	<0.01
(Crude odds ratios)						
PHPRM	-0.01	1.00 (0.96-1.03)	0.91	0.06	1.06 (1.02-1.11)	0.01
(Model 1)						
PHPRM	-0.01	0.99 (0.96-1.03)	0.64	0.05	1.05 (1.01-1.10)	0.02
(Model 2)						

PHPRM=perceived health promoting role model, continuous total scale (higher score is better).

β=beta coefficient.

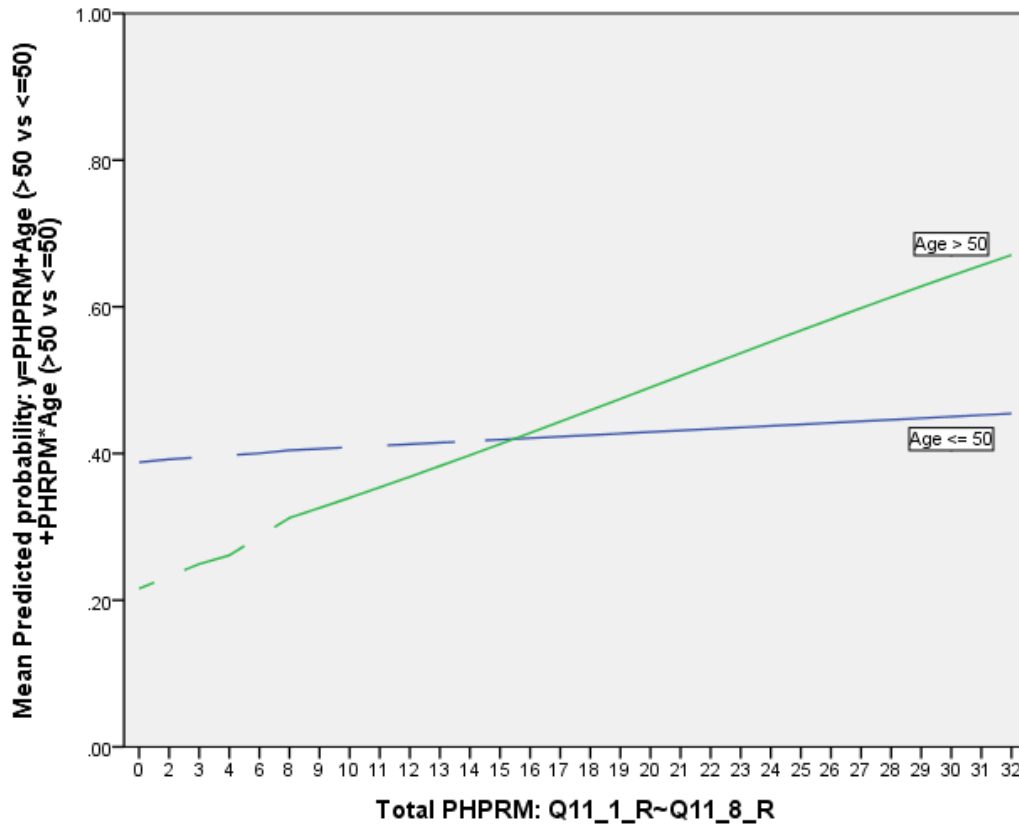
^aSeparate odds ratios calculated for subgroups because of positive interactions.

Model 1 adjusted for nursing group.

Model 2 adjusted for nursing group, chronic illness and medication use, and health care providers use electronic health record.

Figure 4.3 illustrates the association between PHPRM and ePHR use by subgroups.

Figure 4.3: *Predicted Probability of ePHR use and Perceived Health Promoting Role Model by Age*



The slope for the older nurses was associated with a greater increase in PHPRM scores than was the slope for the younger nurses. The models adjusted for nursing group (Model 1) and for nursing group, chronic illness and medication use, and providers' use of EHR indicated similar odds ratios such as crude odds ratios.

4.4 Discussion

This study expanded TAM with PDPSP and PHPRM to examine the acceptance of an ePHR among nurses for their own health management. The ePHR acceptance model overall fit the data well and showed the significant contribution of PU, PEOU and PHPRM to the ePHR use. All four constructs together significantly associated with ePHR use by adjusting nursing group. Research hypothesis related to positive association between PU and ePHR use was not supported. However, consistent with previous HIT studies (Liang et al., 2003; Lu et al., 2012; Pare et al., 2006), PU was the significant factor in use of ePHR. Health care professional used HIT when they had positive perception of the HIT's usefulness (Duyck et al., 2008; Han, Mustonen, Seppänen, & Kallio, 2005; Hu et al., 1999). Contrary to what was expected, nurses who used ePHR were significantly less likely to feel useful of ePHR for their own health management compared to nonusers. This may be explained by why majority of ePHR users used it less than once a month. Also, ePHR users might not use the functionality that we asked about in survey items.

PEOU showed a positive association with ePHR use, which supported research hypothesis. Our result, like those of others (Liang et al., 2003; Lu et al., 2012), showed that nurses in ePHR users were more likely to perceive ease of use the ePHR. PEOU was the facilitator for adoption of ePHR by family practitioners (Yau et al., 2011) and by patients (Day & Gu, 2012; Hassol et al., 2004). We did not examine the pathway between PU and PEOU, studies show that PEOU was found to be a significant antecedent of PU among health care professionals that adopt HITs (Chen et al, 2007; Dixon & Stewart,

2000; Liang et al., 2003; Liu & Ma, 2006; Lu et al., 2012; Rawstorne et al., 2000; Schaper & Pervan, 2007b; Tung et al., 2008; Wu et al., 2007; Zhang et al., 2010).

PDPSP did not show a significant association with ePHR use, thus the hypothesis was not supported. However, PDPSP showed a significant positive association with ePHR use after adjusting nursing group and with other covariates. Privacy and security concerns were barriers in adoption of HIT by physicians (Gagnon et al., 2010; Wynia et al., 2011; Yau et al., 2011). Perceived privacy concerns was a potential risk factor for willingness to use ePHRs by physicians (Wynia et al., 2011) and patients as well (Angst & Agarwal, 2009). Tung et al. (2008) found that trust has direct and positive influence on PU, and PEOU has direct and positive influence on trust when nurses adopt HIS. These directions were not included to our model, but further those directions are worth to test.

PHPRM was hypothesized to exert positive association with ePHR use, which was supported. Nurses in ePHR user group were more likely to feel health promoting role model than nonusers. A champion may be interpreted as a health care professional role model for adoption of HIT. The champion played the role of knowledge agent by transferring information they had gained from experiences and knowledge of the scientific literature into the implementation processes (Ash, Stavri, Dykstra, & Fournier, 2003; Gagnon et al., 2010). Nursing feedback and involvement in design, development and implementation of HIT was found to be critical to improve quality of care (Courtney, Alexander, & Demiris, 2008; Hsiao, Chang, & Chen, 2011; Karsh, Escoto, Beasley, & Holden, 2006). Therefore, PHPRM was very important construct in our model regarding nursing role in health care.

Significant interactions effects were found between PDPSP and providers use of EHR on ePHR use, and between PHPRM and age on ePHR use. The moderator testing hypotheses for providers' use of EHR between PDPSP and ePHR use, and for age between PHPRM and ePHR use were supported. We employed moderator testing in hypotheses based on literature review. Studies investigated moderators using the technology acceptance model (Chismar & Wiley-Patton, 2002; Schaper & Pervan, 2007a; Venkatesh & Bala, 2008; Venkatesh & Davis, 2000; Venkatesh et al., 2003). This allowed us to further investigate whether the probability of ePHR use differs with increasing total PDPSP score in nurses with and without use of EHR by providers, and whether the probability of ePHR use differs with increasing total PHPRM scores in nurses by age (older vs. younger). Our findings, like those of others suggest that nurses may prefer to use tethered ePHR because they reported feeling trust and confidence in their providers by accessing their information (Fisher et al., 2009; Kaelber et al., 2008). Our study indicated older nurses (age > 50) seem to be more likely to perceive health promoting role model than younger nurses (<=50), which influenced use of ePHR. Younger nurses may be more used to technology and are more comfortable to use than older nurses, so the higher perceptions on health promoting role among older nurses is very encouraging for the use of ePHR.

4.5 Limitations

There are number of limitations in this study. The weakness of cross-sectional design is that causal relationship cannot be concluded because it establishes associations (Rothman & Greenland, 2005). The generalizability of the results may be limited only to nurses who practice in Maryland and Washington DC area and nurses in NIC from

AMIA and HIMSS, because our sample consisted of a convenience sample of healthy employed RNs. The selected items for ePHR acceptance constructs from the original instruments may lose its psychometric properties because whole instruments were not adapted. However, the reliabilities of all constructs showed good Cronbach's α . It is possible that nurses who are technology savvy and have interests in the selection bias topic of ePHRs might be more likely to participate in this survey. Therefore, the estimated ePHR user proportion (47%) should be cautiously viewed because of an estimated low participation rate (5.5%). This study represents a rare attempt to model nurses' ePHR acceptance using TAM by adding PDPSP and PHPRM. However, this study is exploratory and no other studies assessed PDPSP and PHPRM in the TAM. Nevertheless, the over models fit data well. This study evaluated ePHR acceptance constructs using self-reported perceptions as opposed to objective measures. However, most previous HIT acceptance studies have employed self-reported measures and demonstrated acceptable reliability in the summative scale (Davis, 1989; Venkatesh & Davis, 2000). There are several variables that might help further explain ePHR acceptance and use were not explored in our study.

4.6 Conclusion

Our study presented the tested a model of ePHR acceptance among nurses for their own health management. Our study showed that perceptions on usefulness, ease of use, data security and privacy protections and role model were significantly associated with ePHR use after adjustment for nursing group (NIC nurses vs. hospital). ePHR users were positively associated with ease of use, data privacy and security protections, and role model. Meanwhile, ePHR users were inversely associated with perceived usefulness,

which may be explained that: the majority of ePHR users used it less than once a month. Further, all constructs contributed significantly to ePHR use except PEOU after adjusting nursing group, age, chronic illness and medication use, and health care providers' use of EHR. Interaction effects existed between PDPSP and providers EHR use and between PHPRM and age on ePHR use, respectively. It showed that nurses were more likely to use ePHR when they felt more data privacy and security protections among those whose providers used EHR than those whose providers did not use EHR. Nurses who were older were more likely to use ePHR when they felt perceived as a health promoting role model than younger nurses. This study is very important for those nurses and informatics specialists who want to achieve higher usability and use of ePHR. Designing a system for users that has both user-friendly interface and stringent security and privacy protection functionality may be achieved by nursing informatics specialists.

CHAPTER V DISCUSSION

This chapter begins with a brief summary of the study findings, continues with a discussion of existing literature, and finally, addresses the study limitations, implications for practice and policies and possible future research.

5.1 Summary of Findings

This study provides a baseline of understanding nurses ePHR use and is the first study to identify factors associated with nurses' ePHR use for their own health management. The study findings are summarized along the four main aims as follows:

1. To examine factors associated with ePHR use by nurses' characteristics (health, technology experience, and attitudes about privacy of electronic health information):

Overall, there was a difference between hospital nurses and nursing informatics community (NIC) nurses in demographics, job information, technology experience, and attitudes about privacy of electronic health information. For hospital nurses, the following were significant factors associated with ePHR use controlling for age, marital status, current positions and specialty area:

- chronic illness and prescribed medication use
- getting health care from a provider that uses EHR.

For informatics nurses, controlling for ethnicity, race, and practice regions, the significant factors associated with ePHR use were:

- providers' use of EHR and
- trust in privacy of online health information.

Comparing ePHR users and nonusers in both groups, fewer ePHR users in both nursing groups granted permission to designated family members or friends, other care providers who care for them, or pharmacists to view ePHRs than would nonusers who answered hypothetically. The majority of both ePHR users and nonusers would grant access to their primary care providers.

2. To examine the psychometric properties of the measures in the research model:

Many of the factors studied were single item questions, but multiple items were used in the ePHR acceptance constructs for the research model. Questions for the ePHR acceptance constructs were adapted from the California HealthCare Foundation [CHCF] survey and empirically tested scales. All correlations among ePHR acceptance constructs were small or medium, positive and significant. ePHR acceptance constructs (usefulness, ease of use, privacy and security protections, and health promoting role model) were measured through scales that were conceptually congruent. This was tested with Cronbach's alpha (α) coefficient. The findings were as follows:

- Perceived usefulness indicated Cronbach's was 0.89 with 10 items.
- Perceived ease of use among obtained high Cronbach's α (0.95) with 4 items.
- Perceived data privacy and security protections demonstrated high Cronbach's α (0.90) with 8 items.
- Perceived health promoting role model showed that Cronbach's α was 0.85 with 8 items.

All Cronbach's α were greater than the acceptance level of 0.70, which demonstrated sufficient reliability for usefulness, ease of use, and privacy and security protections, and health promoting role model in ePHR acceptance model.

eHealth literacy also showed a sufficient reliability indicating high Cronbach's α for hospital nurses ($\alpha=0.91$) and NIC nurses ($\alpha=0.81$) with 4 items. This suggests quite a strong relationship among the items in both groups. Validity refers to how well a survey measures what it sets out to measure (Aday & Cornelius, 2006). Know-groups method was used to test validity to see whether a measure shows the expected differences from groups (Hattie and Cooksey, 1994; University of South Florida [USF], 2014). There was a difference in eHealth literacy scores between NIC nurses and hospital nurses. NIC nurses had mean scores of 14.7 ranging from a minimum of 9 to a maximum 16 in eHealth literacy; however, hospital nurses had a mean of 13.0 ranging from 0-16. Those known-groups (hospital nurses and NIC nurses) mean differences in eHealth literacy can be explained by the fact that nursing informatics group tended to have more expertise in technology compared to hospital nurses. So, NIC nurses have not much variation in eHealth literacy. The NIC nurses were predominately informatician or chief nursing informatics officers and specialized in nursing informatics. Those informatics nurses play a crucial role in the development, implementation, and optimization of clinical information systems (HISS 2014). Also, those populations require a post-graduate degree in nursing informatics or other informatics fields.

3. To examine an association of ePHR acceptance constructs (perceived usefulness, ease of use, data privacy and security protections, and health promoting role model) with ePHR use:

Almost half of nurses who responded used ePHR. The majority of users used ePHR less than once a month, and spent an average of 19 minutes each time. There were significant associations between acceptance of the ePHR constructs (**perceived usefulness, ease of use, and health promoting role model**) and ePHR use. Positive associations existed between ePHR use and perceived ease of use and the health promoting role model, but inverse association was found between ePHR use and perceived usefulness. Perceived data privacy and security protection was not related to ePHR use. The association between those four constructs and ePHR use remained statistically significant after adjustment with nursing group (hospital vs. NIC). Further, all constructs were significantly related to ePHR use except perceived ease of use after adjusting for nursing group, age, chronic illness and medication use, and health care providers' use of EHR

4. To examine the moderator effect of nurses characteristics (age, chronic illness and medication use, providers use of EHR) on the relationships between ePHR acceptance constructs and ePHR use:

Significant interactions existed between perceived data privacy and security protections and providers use of EHR, and between perceived health promoting role model and age on ePHR use. Nurses who perceived more data privacy and security protections had providers that used EHR. These nurses were more likely to use ePHR than those whose providers did not use EHR. Nurses who had higher perceptions of themselves as health promoting role models were older (age > 50). These nurses were more likely to use ePHR than younger nurses (age <=50).

5.2 Discussion of Findings

This study aimed to recruit nurses from nursing informatics groups and hospital nurses to look at whether there were differences between the two groups. The assumption was that nursing informatics groups would more likely adopt ePHR than hospital nurses because of their informatics experiences. This survey sampled hospital nurses and nursing informatics nurses. The research results showed different demographics, technology experience, and attitudes about privacy of electronic health information between the two groups. Because there were differences, this discussion focuses on the two nursing groups: hospital nurses vs. nursing informatics nurses.

5.2.1 ePHR Use among Registered Nurses

Our study indicated that 41% (estimated 95% CI=0.37-0.44) of hospital RNs used an ePHR, which is higher than 7% found in the California HealthCare Foundation study (CHCF, 2010a) and 10% found in Markle's survey (Markle Foundation survey, 2011). However, the estimates of the proportion of ePHR users should be cautiously viewed because of a low estimated participation rate (6.6%).

Our study indicated that both chronic illness and medication use among hospital RNs were significant factors for ePHR users compared to nonusers. The California HealthCare Foundation [CHCF] surveyed nationwide consumers regarding ePHR use and also found that those who are older, with less education or income, and chronically ill benefit from using ePHR (CHCF, 2010a). It has been shown that ePHRs are valuable for chronic disease management among patients who have diabetes, heart failure, or multiple sclerosis (Fonda, Kedziora, Vigersky, & Bursell, 2010; Miller et al., 2011; Ross, Moore, Earnest, Wittevrongel, & Lin, 2004).

In terms of the impact of provider EHR use on nurses' use of ePHR, more than three-quarters of nurses had providers that used EHR and it was significantly associated with ePHR use compared to nonusers. The CHCF survey also reported that consumers who had providers using EHR were more likely than others to be interested in using ePHRs (CHCF, 2010a). Doctors and hospitals are the most common ePHR suppliers for those who use ePHR (Markle Foundation, 2011), thus providers who use EHR may be more likely to offer ePHR to patients. Our study's findings support the assertion that as more health care providers adopt EHRs, patients will have more interest in ePHR use (Jamoom et al., 2011).

Data privacy and security protection is another critical issue for ePHRs (Kahn et al., 2009). Our study's results indicated that two-thirds of ePHRs users were generally concerned about privacy and security of health information online. The CHCF survey found that 63% of ePHR users are generally concerned about the privacy of their medical records. However, similar to our findings, ePHR users were less worried about the privacy of information in their ePHRs (CHCF, 2010a). In our study, fewer ePHR users than nonusers granted permission to designated family members or friends, their primary care providers, other healthcare providers who care for them, or pharmacist, but more ePHR users granted permission to a health insurance company or their employer compared to nonusers. A greater portion of ePHR nonusers would grant permission to their primary care providers or to other providers who care for them, which matches similar findings from consumers (Patel et al., 2011). The consumers were willing to grant permission to primary care providers (94%) or other providers (80%) to view their information in ePHRs. This might be explained by the fact that ePHR users actually

control who they specifically grant permission to view their ePHR. Meanwhile, ePHR nonusers do not have this experience or are unaware of this feature. Therefore, nonuser responses are hypothetical, not actual.

5.2.2 ePHR Use among Nurses in Nursing Informatics Community

Our study indicated that 72% (estimated 95% CI=0.65-0.78) responding to this survey of nursing informatics community nurses used an ePHR to manage their own health, and this estimated proportion is higher than the two national consumer surveys (between 7% and 10%) (CHCF, 2010a; Markle Foundation survey, 2011). Despite the vast majority of respondents rating their health as excellent, very good, or good, more ePHRs users than nonusers either had chronic conditions or used prescribed medications; in many cases, they had both chronic conditions and prescribed medications use. The CHCF survey indicated that chronically ill consumers benefit from using ePHRs (CHCF, 2010a) and 56 % of respondents from 2008 survey reported that they had chronic conditions searched online for specific information about their chronic conditions or prescribed medications (CHCF, 2008). About 133 million Americans live with at least one chronic illness (Centers for Disease Control and Prevention [CDC], 2009). Therefore, this is a great opportunity to use ePHR to manage chronic disease since so many people in this country have chronic conditions.

In our sample, informatics nurses whose health care providers used EHR were significantly more likely to use ePHR compared to nonusers. Our findings suggest that nurses in the nursing informatics community are more likely to be early adopters of ePHR for their health management, which may be because of their specialties in nursing informatics and their awareness of the meaningful use of EHRs. As a result of

meaningful use of EHRs by providers or hospitals, there is more likely to be wide use of ePHR by patients (Blumenthal & Tavenner, 2010; DHHS, 2012). When more health care providers adopted EHRs, it resulted in enhanced patient care (Jamoom et al., 2011). Providers were more likely to be aware of ePHRs than providers who do not use EHRs (Fuji et al., 2008).

ePHR users were less concerned about general privacy and security of electronic health information online than nonusers. However, a smaller portion of ePHR users than nonusers granted viewing permission to designated family members or friends, other providers who care for them, or pharmacist. In the case of nonusers, the decision was hypothetical. It is reassuring that the vast majority of both ePHR users and nonusers would grant access to their primary care providers, similar to the findings of Patel et al. (2011). The differences might be explained by the fact that ePHR users actually determine who can access, view, modify, or transmit information from their ePHRs. Also, the ability of the ePHR to audit users gives a sense of control over privacy and confidentiality (Masys et al., 2002).

In terms of potential barriers to ePHR use (CHCF, 2010a; Kahn et al., 2009), data privacy and security protection is a critical issue for both consumers and health care providers. Privacy concerns were negatively related to the likelihood of adoption of ePHR among the general population (Angst & Agarwal, 2009). Almost two-thirds of consumer ePHR users indicated concern about the privacy of their medical records, but ePHR users were less worried about the privacy of information in their ePHRs (CHCF, 2010a).

5.2.3 Factors Affecting Nurses' Acceptance of ePHR for Their Own Health Management

This study expanded the technology acceptance model with perceived data privacy and security protections and perceived health promoting role to examine the acceptance of an ePHR model among nurses for their own health management. The ePHR acceptance model tested in our study has four constructs: perceived usefulness, ease of use, data privacy and security protections, and health promoting role model. After adjusting for nursing group (nursing informatics community vs. hospital), all four constructs together showed a significant relationship with ePHR use. However, the significant contribution of perceived ease of use no longer existed after adjustment for nursing group, age, chronic illness and medication use, and providers' use of EHR. Although perceived usefulness was the most significant factor in use of ePHR, nurses who used ePHR were significantly less likely to feel ePHR useful for their own health management compared to nonusers. Contrary to our finding, patients had strong perceptions of usefulness influenced by the use of tethered ePHR (Day & Gu, 2012). We did not assess what functionalities were available to nurses in their ePHR or which functionalities they had not used. Answers to these questions may explain why the majority of nurses in the ePHR user group used it less than once a month. ePHR users might not use or not be offered all the functionality that we asked about in our survey items. Or nurses may have felt that the items were not applicable because the vast majority of our survey nurses were healthy workforce nurses. However, the CHCF survey (2010b) indicated about 35% of each item was answered as "have not done" by ePHR users.

Another significant factor that related to ePHR use was perceptions of ease of use, which showed a positive association with ePHR use. Our result, like those of others (Liang et al., 2003; Lu et al., 2012), showed that nurses who were ePHR users were more likely to perceive ease of use. Perceived ease of use was the facilitator for adoption of ePHR by family practitioners (Yau et al., 2011) and by patients (Day & Gu, 2012; Hassol et al., 2004).

Perceived data privacy and security protections did not show a significant association with ePHR use among nurses in contrast to physicians and patients. There was not much variation of perceptions of data privacy and security by both ePHR users and nonusers. Nurses may be more aware of privacy and security of health information (e.g., HIPAA) because they directly take care of very sensitive and private health information for patients. However, research of other groups indicates that privacy and security concerns were barriers in adoption of HIT by physicians (Gagnon et al., 2010; Wynia et al., 2011; Yau et al., 2011). Perceived privacy concerns was a potential risk factor for willingness to use ePHRs by physicians (Wynia et al., 2011) and patients as well (Angst & Agarwal, 2009).

Perceived health promoting role model had a positive association with ePHR use. Nurses in the ePHR user group were more likely to feel they are health promoting role models than nonusers. Awareness of one's own fitness and lifestyle behaviors is a basis of health promotion for nurses (Connolly et al., 1997; Rush et al., 2010; Strobl & Latter, 1998). The champion played the role of knowledge agent by transferring information they had gained from experiences and knowledge of the scientific literature into the implementation processes (Ash, Stavri, Dykstra, & Fournier, 2003; Gagnon et al., 2010).

Nursing feedback and involvement in design, development and implementation of HIT was found to be critical to improve quality of care (Courtney, Alexander, & Demiris, 2008; Hsiao, Chang, & Chen, 2011; Karsh, Escoto, Beasley, & Holden, 2006).

This study showed significant interactions on ePHR use between perceived data privacy and security protections and providers use of EHR, and between perceived health promoting role model and age of nurses using ePHR. We could investigate whether the probability of ePHR use differs with increasing total privacy and security protections score in nurses with and without use of EHR by providers, and whether the probability of ePHR use differs with increasing total role model scores in nurses of varying ages (older vs. younger). Nurses whose providers used EHR seemed more likely to perceive higher data privacy and security protections. These nurses were more likely to use ePHR than those whose providers did not use EHR. Our findings, like those of others suggest that nurses may prefer to use tethered ePHR because they felt trust and confidence in their providers by accessing their information (Fisher et al., 2009; Kaelber et al., 2008). Our study indicated older nurses (age > 50) seemed more likely to have higher score on self-perception as a health promoting role than younger nurses (<=50), which influenced the use of ePHR. Younger nurses may be more used to HIT than older nurses, so the health promoting role for older nurses in our study is very encouraging regarding use of ePHR.

5.3 Limitations

5.3.1 Cross-Sectional and Convenience Sampling Design

Causality cannot be inferred because the cross-sectional design only identifies associations. Generalizability of this study's results may be limited because the sample was a convenience sample of healthy employed RNs working in hospitals in the

Maryland and Washington DC area and nurses from members of AMIA and HIMSS. It is probable that RNs who are on the computer more and interested in the topic of ePHRs might be more likely to have participated in this survey. The sampling frame was 1) all hospital RNs who were under nurses LISTSERV in hospitals and in 2) NIC nurse members of HIMSS and AMIA. Nurses in HIMSS and AMIA were selected because they are more likely to be technologically savvy than nurses in hospitals.

5.3.2 Self-administered Online Survey

Self-administered online surveys may have response biases. An online survey has unique challenges related to nonresponse error, which is the error that results when respondents differ in meaningful ways from non-respondents (Aday & Cornelius, 2006). Respondents to a survey are different from those who do not respond, so a low number of respondents may not represent a random sample (Aday & Cornelius, 2006). For instance, more technologically savvy participants are more likely to complete a survey online (Carini, Hayek, Kuh, Kennedy, & Ouimet, 2003). Online data collection has potential low response rates due to perception as junk email, technology reliance, quitting before completing, low computer literacy, or privacy and security issues (Aday & Cornelius, 2006; Vehovar & Lozar Manfreda, 2008). Therefore, the estimates of the proportion of ePHR users (47%, n=400) should be cautiously interpreted because of a low estimated participation rate (5.5%) and convenience sampling biasing the survey results. Explicitly, conclusions drawn from this study may not reflect the views of all nurses because convenience sampling was not as random as it could be and because results may be biased towards participants who are more technology savvy. Other mitigating technology issues are online surveys may look different based on a respondent's operating system,

Web browser, screen configuration, and hardware (Dillman, 2007). Finally, the logistic models in hospital nurses (manuscript #1) and NIC nurses (manuscript #2) did not incorporate the potential of clustering effects attributed to employees working at the same hospital or members at the same NIC organizations.

5.3.3 Self-Reported Data

Many factors studied were single item questions; however, most of the questions were adapted from national consumer surveys with established reliability and validity to allow comparisons of the results. The majority of nurses self-rated overall health status as excellent, very good, or good health. Although this may not reflect accurate health status, it makes sense that workforce nurses should be healthy enough to work. This study evaluated ePHR acceptance constructs using self-reported perceptions as opposed to more objective measures. The selected items for ePHR acceptance constructs from the original instruments may affect their psychometric properties because whole instruments were not adopted. However, the reliabilities of all constructs were good: with Cronbach's $\alpha > 0.70$ for all scales.

We did not ask ePHR users what type of ePHR (tether or non-tethered) they used. Also, we did not inquire what functionalities they had available to them that they did not use, in the items that asked about usefulness of specific features of ePHR. Those questions might explain why ePHR users were less likely to feel their ePHRs useful. For instance, tethered ePHRs can provide lab or test results from providers so that users can access and view them, but some providers may not offer this service. Meanwhile, non-tethered ePHR may not have this feature; therefore, users may not perceive reviewing lab results as useful.

5.4 Implications

5.4.1 Implications for Practice and Policies

Considering almost half of nurses surveyed used ePHR for their own health management, this is a very important study for those nurses and informatics specialists who want to achieve higher usability and use of ePHR. This is especially relevant because the American Nurses Association (ANA) and the U.S. Department of Health and Human Services' Office of the National Coordinator for Health Information Technology have asked nurses to participate in ePHR use and patient education (ANA, 2014).

5.4.1.1 Patient Education

We found that hospital nurses who had chronic illness and/or medications use and who had providers who used EHR for their care were significantly more likely to use ePHR. Having the experience of using ePHRs, nurses can then help patients manage chronic illness and medication with ePHRs. Kupchunas (2007) stated that the process of teaching patients how to maintain their own health records is an opportunity for nurses to capitalize on educational time spent with patients. Connolly et al. (1997) found that 70% of critical care nurses said that they would recommend their lifestyle to their patients because they had a positive experience and attitude about their healthy lifestyles (e.g., watch their weight, eat well) and felt optimistic about being role models for their patients. Meanwhile, Strobl and Latter (1998) reveal that when nurses perceive themselves negatively as role models, they are reluctant to teach and counsel patients about health-promoting behaviors, engage in implementation of a hospital smoking policy, or create healthy environments. Rush et al. (2010) show that nurses perceived that being an imperfect, but human and realistic model of health promotion was just as valuable as

being a perfect, ideal role model. Thus, regardless of personal condition, nurses can play an important role in promoting healthy lifestyles and encouraging compliance with preventive care to their patients by encouraging the use of ePHRs. For instance, nurses can help patients use ePHRs to adopt health behaviors like maintaining a healthy weight, exercising regularly, eating a healthy diet, managing depression, not smoking, and adhering to prescribed medications (NIPFC & NIU RDI, 2009). Hands-on experience using ePHRs and assistance for patients with interpretation of clinical information can be offered by nurses. Family members can be included in this educational process so that they can act as a support system to the patient in case the patient is unable to maintain his or her ePHR alone. Led by experienced nurses, ePHRs could help patients improve their quality of life and reduce health care costs (NIPFC & NIU RDI, 2009).

There are groups of researchers studying patient education in ePHRs. First, the physical medicine and rehabilitation unit at the Hospital of the University of Pennsylvania in Philadelphia has adopted a transdisciplinary approach to the development and deployment of the patient ePHR (Kupchunas, 2007). This study found that comprehensive education and user friendly ePHRs can significantly enhance accuracy of patient health information across the healthcare continuum (Kupchunas, 2007). A transdisciplinary approach aids in the development of an ePHR and fosters shared responsibility for patient education. Orthopaedic nurses have the opportunity to assist patients in establishing their ePHRs. Second, at the University of Washington in Seattle, nurses were involved in implementing a Personal Health Information Management System (PHIMS) that was deployed at a federally-funded housing authority for low-income, elderly, and disabled patients (Kim et al., 2007). With education and

support from graduate nursing students, residents showed improvement updating medications and health problems in the PHIMS. Programs such as these may foster a health promoting role for ePHR experience nurses.

5.4.1.2 ePHR Design Participation

Our study indicated that ePHR use was associated with providers' use of EHR for care and trust in privacy and security of electronic health information among the nursing informatics group. Designing a system for users that has both user-friendly interface and stringent security and privacy protection functionality may be achieved by nursing informatics specialists. With their specialty in nursing informatics (e.g., systems analysis, systems optimization, etc.), informatics nurses can also play an important role in practical ePHR design to enhance functionality and security in ePHR.

It is very important for nurses to engage and assist in the development of ePHRs. Nurses, who generally have a patient-centered view, are in a good position to influence development of ePHR. The first reason is that nurses can help to decide what information will be helpful and what information the consumer can understand (Thede, 2008). Functionality in ePHRs such as reviewing lab results and communication methods (e.g., secure messaging) can help healthcare providers and consumers or patients make health-related decisions. The second reason is that nurses provide the largest portion of direct patient care and have the ability to answer questions in a manner that gives consumers confidence in their actions (Thede, 2008).

Working with consumers and providers at various levels of health literacy will enable nurses to establish interface and data-view designs that will meet the needs of both the consumer and the provider (Thede, 2008). A well-designed ePHR could be used to

organize life-long personal health information. It is also important for nurses to address the different levels of consumer eHealth literacy. An ePHR is an opportunity for individuals to enhance their health literacy by increasing personal involvement in healthcare (Kupchunas (2007). One tool [Infobutton] was developed to explain medical diagnoses to patients and help patients understand their medical conditions via ePHRs (Baorto & Cimino, 2000). Informatics nurses can play an important role in influencing these design decisions based on their experience and knowledge in the informatics area.

There are groups of pioneers studying ePHR design from a nursing perspective. First, the University of Iowa College of Nursing was involved in designing and developing the Iowa ePHR (Lee et al., 2007). The Iowa team developed an ePHR that incorporated the unique elements of nursing information into the ePHR including nursing assessments, diagnosis, and plans of nursing care. The ePHR also provides educational materials focused on what individuals need to know about their conditions prior to admission and after discharge. In the evaluation of this ePHR, experts assigned high scores to four items: usefulness of information saved for healthcare providers in the future, ease of navigation, ability to find desired information, and site presentation. Another initiative, known as Project HealthDesign, based at the University of Wisconsin-Madison is designed to support HIT design teams in the creation of a new generation of ePHR systems. It is funded through the Robert Wood Johnson Foundation with additional support from the California HealthCare Foundation (University of Wisconsin-Madison School of Nursing, 2008). The goal is to design and test ePHR tools and applications that work together to help patients achieve better health management. For instance, breast cancer patients were able to integrate health information for scheduling appointments

from their personal electronic calendars to ePHR by synchronizing data. There are various projects for nurses to participate in and incorporate their knowledge into the user-friendly design of ePHRs, so nurses can play a role in providing feedback and counseling to patients as necessary using ePHRs.

5.4.2 Implications for Future Research

Future research in this area should focus on several areas. ePHR acceptance survey can be expanded to national samples of nurses in order to enhance generalizability to the national nursing workforce. In order to enhance response rate, we may use other data collection venues, such as where we can meet many nurses in face-to-face mode. The place could be nurses' national conferences or hospital staff meetings. To recruit nurses who are not technology savvy or eHealth literate, we could use iPads for the survey in clinics or in practice hospital units, with a study team member available to assist if necessary, or provide a paper and pencil survey option.

It is necessary to add variables that we did not examine in the current study such as social influence (e.g., peer influence), which may affect ePHR use. Studies support that social influence increases the use of technology based on interactions between individuals (Sykes, Venkatesh, & Gosain, 2009; Venkatesh, Morris, Davis, & Davis, 2003; Wang, Meister, & Gary (2013). Because nurses are very important health care workers influencing patient care, the peer influence among nurses who use ePHR is also crucial to investigate. Other items should be included to measure perceived usefulness and perceived data privacy and security protections such as whether the ePHR can be connected with other medical devices (e.g., glucose monitor) so that the data from the medical device can be transferred to the ePHR. Other privacy and security related issues

such as whether the ePHR offers multi-step authentication (e.g., user ID, password, and/or unique ID card) or whether their ePHR offers audit functions to keep track of who viewed or accessed their ePHR can also be assessed. Those items can vary depending on the type of ePHRs (tethered or non-tethered with providers EHR).

5.5 Summary

This study provided a baseline for understanding nurses use of ePHR and is the first to identify factors associated with ePHR use for nurses' own health management. We found that ePHR use was significantly associated with chronic illness and medication use and their providers' use of EHR for care among hospital nurses. Meanwhile, ePHR use was significantly associated with providers' use of EHR for the nurse's own health care, and trust in privacy and security of NIC nurses. Our study tested the theoretical basis to model ePHR acceptance among nurses, which indicated significant associations of perceived usefulness, ease of use, and health promoting role model with ePHR use individually. All four constructs (perceived usefulness, ease of use, data privacy and security protections, and health promoting role model) together showed a significant association with ePHR use. The moderating effects of data privacy and security protections and providers use of EHR and of health promoting role model and age on ePHR use were found. Those seem to reflect that ePHR users may feel more protected and less concerned about privacy and security when their providers use electronic health records. Nurses may prefer to use ePHR connected to EHR when they feel trust and confidence in their providers. Also, nurses aged 50 and over felt more like health promoting role models than younger nurses, which was related to ePHR use among the older nurses. Promoting wide adoption and use of ePHR by nurses can benefit the general

public by endorsing use of ePHR. Nurses can also use their knowledge to enhance practical ePHR design.

APPENDIX A

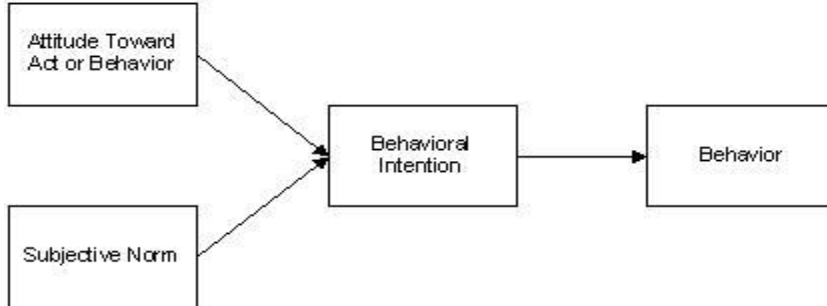
Table A.1: Definition of Personal Health Record

Source	Personal Health Record (PHR)
Markle Foundation (2003)	The Personal Health Record (PHR) is an Internet-based set of tools that allows people to access and coordinate their lifelong health information and make appropriate parts of it available to those who need it. PHRs offer an integrated and comprehensive view of health information, including information people generate themselves such as symptoms and medication use, information from doctors such as diagnoses and test results, and information from their pharmacies and insurance companies (p. 3).
AHIMA (2005)	The personal health record (PHR) is an electronic, universally available, lifelong resource of health information needed by individuals to make health decisions. Individuals own and manage the information in the PHR, which comes from healthcare providers and the individual. The PHR is maintained in a secure and private environment, with the individual determining rights of access. The PHR is separate from and does not replace the legal record of any provider (p. 2).
Tang et al. (2006)	The personal health record (PHR) is an electronic application through which individuals can access, manage and share their health information, and that of others for whom they are authorized, in a private, secure, and confidential environment (p. 2).
Clarke, Meiris, & Nash (2006)	Personal health record (PHR) is a person-centered system designed to track and support health activities across one's entire life experience; not limited to a single organization or provider (p. 7S).
HIMSS (2007)	An electronic Personal Health Record ("ePHR") is a universally accessible, layperson comprehensible, lifelong tool for managing relevant health information, promoting health maintenance and assisting with chronic disease management via an interactive, common data set of electronic health information and e-health tools. The ePHR is owned, managed, and shared by the individual or his or her legal proxy(s) and must be secure to protect the privacy and confidentiality of the health information it contains. It is not a legal record unless so defined and is subject to various legal limitations (p. 2).
NAHIT (2008)	Personal Health Record (PHR) is an electronic record of health-related information on an individual that conforms to nationally recognized interoperability standards and that can be drawn from multiple sources while being managed, shared, and controlled by the individual (p. 6).

APPENDIX B

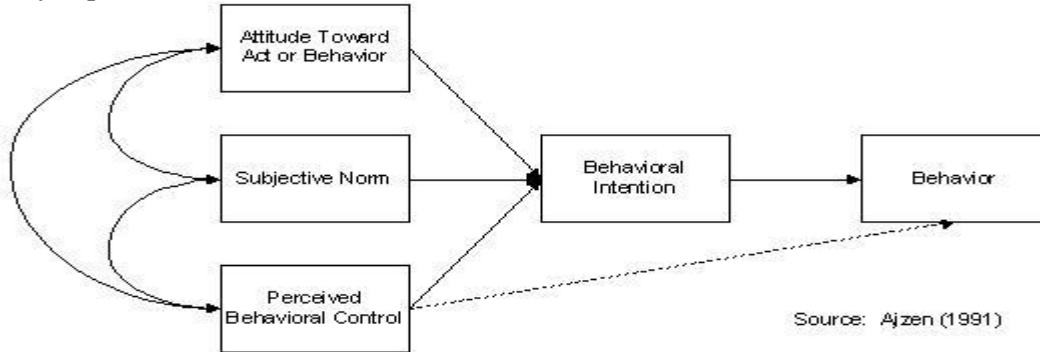
Figure A.1: Illustrations of TRA, TPB, TAM2, TAM3, UTAUT, and DIT

Theory of Reasoned Action (TRA)



Source: Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research*. Reading, Mass.; Don Mills, Ontario: Addison-Wesley Pub. Co.

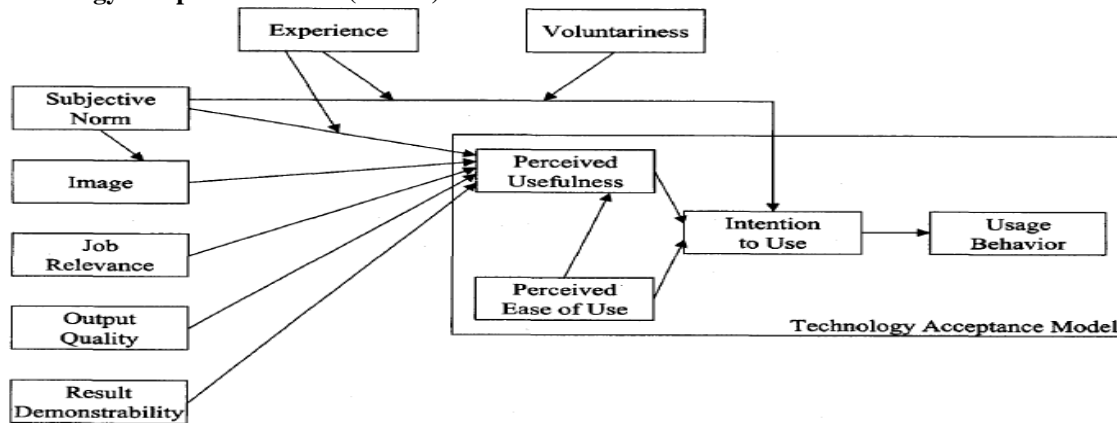
Theory of planned behavior (TPB)



Source: Ajzen (1991)

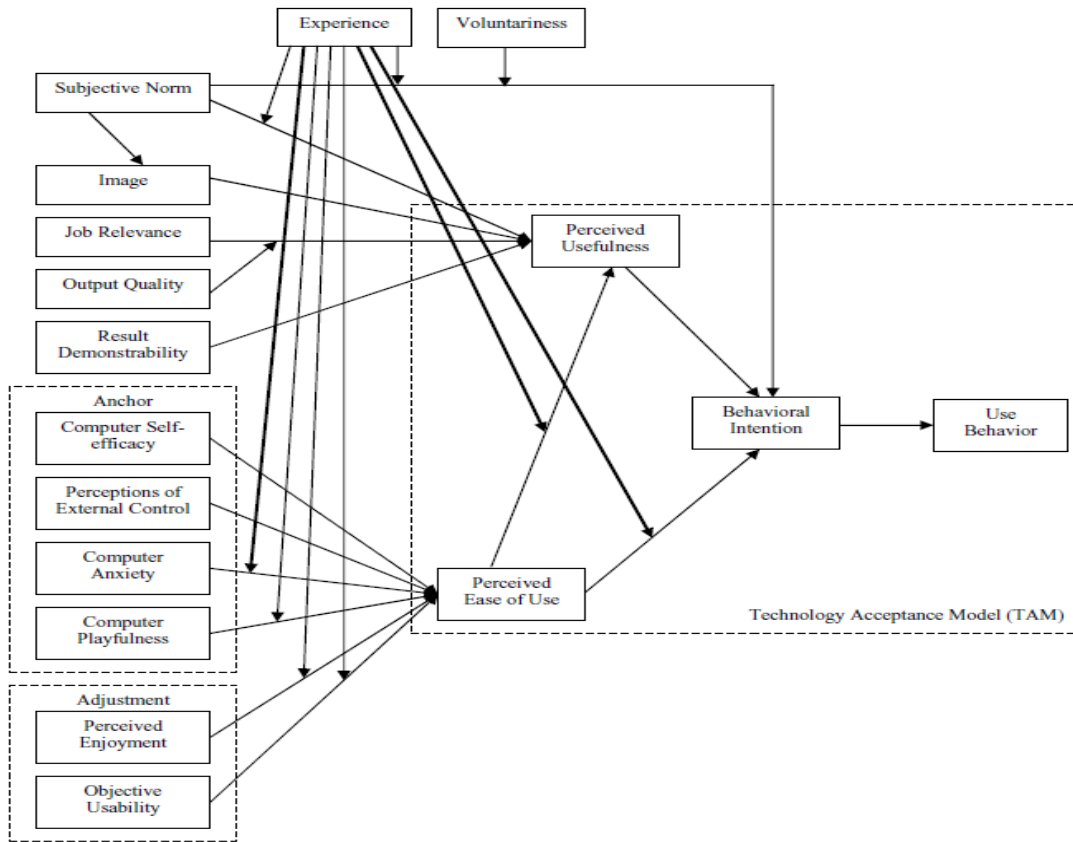
Source: Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50, 179-211

Technology acceptance model2 (TAM2)



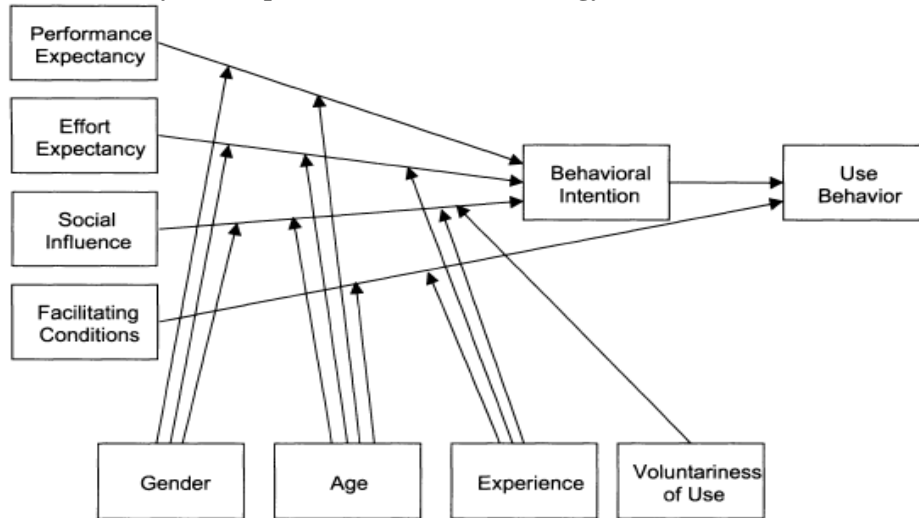
Source: Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, 46(2), 186.

Technology acceptance model3 (TAM3)



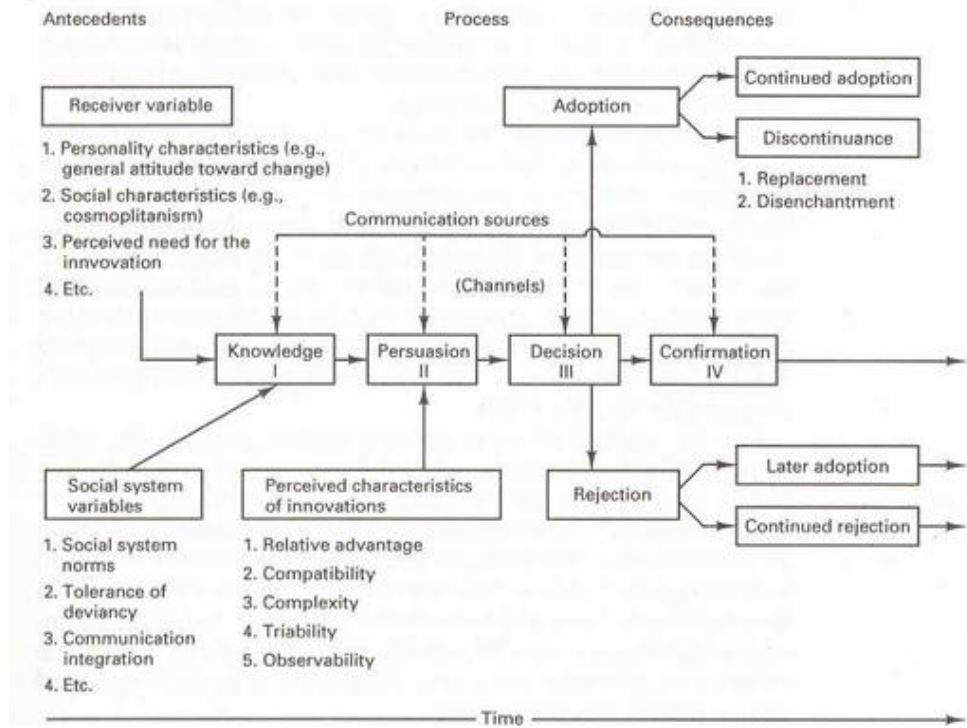
Source: Venkatesh, V., & Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. *Decision Sciences*, 39(2), 273-315. doi: 10.1111/j.1540-5915.2008.00192.x

Unified Theory of Acceptance and Use of Technology (UTAUT)



Source: Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27(3), 425-478.

Diffusion of Innovations Theory (DIT)



Source: Rogers, E.M. (1995). *Diffusion of innovations (4th edition)*. The Free Press. New York

APPENDIX C

Table A.2: Measurement Matrix for Concepts and Operational Variables

Concept	Operational definition & variable definition	Instrument Name	# item	Source	Population tested	Reliability	Validity	Level of measure
Part I. Awareness of New Technology and Attitudes about Privacy of Electronic Health Information								
Awareness of new technology: meaningful use	Since 2011, health providers have been required to use electronic health records (EHRs) for patients' health information. A patient electronic personal health record (ePHR) would allow you to access the health information in your own EHR (DHHS, 2012). Have you heard anything about the government putting money toward helping doctors and hospitals use more technology (called "meaningful use")? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not sure	National consumer survey on HIT: Awareness	1	CHCF, 2010b	Consumer	No report	No report	Nominal
Awareness of new technology: providers use of EHR	Do any of your doctors or health care providers currently use an EHR for you? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not sure	National consumer survey on HIT: HIT in doctor's office	1	CHCF, 2010b	Consumer	No report	No report	Nominal
Attitudes about privacy of electronic health information	How concerned are you in general with the privacy and security of your health information online? <input type="checkbox"/> Not at all concerned <input type="checkbox"/> Not very concerned <input type="checkbox"/> Somewhat concerned <input type="checkbox"/> Very concerned <input type="checkbox"/> Not sure	National consumer survey on HIT: privacy	1	CHCF, 2010b	Consumer	No report	No report	Nominal
Part II. Electronic Personal Health Record (ePHR) Acceptance								
ePHR use status	Have you ever used an ePHR to view, update, or manage your health information? <input type="checkbox"/> Yes <input type="checkbox"/> No ePHR users; ePHR nonusers	National consumer survey on HIT: PHR	1	CHCF, 2010b	Consumer	No report	No report	Binomial
Perceived	Here are some useful PHR features. How useful	National of	10	CHCF,	Consumer	No report	No report	Ordinal

Table A.2: Measurement Matrix for Concepts and Operational Variables Cont.

	Operational definition & variable definition	Instrument Name	# item	Source	Population tested	Reliability	Validity	Level of measure
Usefulness	has each of these been to you?: If your health information were available on ePHR, how useful would these be to you? <ol style="list-style-type: none"> 1. <i>Very useful</i>, 2. <i>Somewhat useful</i>, 3. <i>Not too useful</i>, 4. <i>Not at all useful</i>, 5. <i>Not sure</i> <ol style="list-style-type: none"> 1. Looking at the results of your lab tests or other tests 2. Making sure your information is correct 3. Scheduling a doctor's visit 4. Renewing prescription medicines 5. Keeping track of your child's health records (e.g., immunization dates and information) 6. Getting a reminder for when you need a test (e.g., a mammogram or HbA1C) 7. Sending or getting an email from a doctor or nurse 8. Managing your family's health visits, medicines, and other information in one place 9. Sharing your health information with your family 10. Seeing your providers' instructions for taking care of your health 	consumer survey on HIT: Usefulness of PHR features- among PHR users		2010b			report	(use summative scale)
Perceived Ease of Use	Since you have used an ePHR, how much do you agree or disagree with each one?: If you had an ePHR, how much would you agree or disagree with each one? <ol style="list-style-type: none"> 1. <i>Strongly agree</i>, 2. <i>Agree</i>, 3. <i>Disagree</i>, 4. <i>Strongly disagree</i>, 5. <i>Not sure</i> <ol style="list-style-type: none"> 1. Learning to use an ePHR is easy for me 2. My interaction with an ePHR is clear and understandable 3. It is easy for me to become skillful at using an ePHR 4. I find an ePHR easy to use 	Survey: PEOU	4	Davis, 1989	MBA students in Boston University using application systems	ICR: Cronbach's $\alpha=0.94$ (6 items)	Convergent, discriminant, & factorial validity were favorable	Ordinal (use summative scale)
Privacy permission	Who have you given permission to view your ePHR?: If you had an ePHR, who would you give	HITEC consumer	1	Patel et al, 2011	Adult residents	No report	No report	Ordinal

Table A.2: Measurement Matrix for Concepts and Operational Variables Cont.

Operational definition & variable definition	Instrument Name	# item	Source	Population tested	Reliability	Validity	Level of measure
<p>permission to view your ePHR? (Please check all that apply)</p> <p>___ Designated family members or friends</p> <p>___ My primary care doctors or providers</p> <p>___ Other doctors or health care providers who care for me (in clinic, ER, or other specialists)</p> <p>___ Pharmacist</p> <p>___ My health plan (e.g., a health insurance company)</p> <p>___ My employer</p> <p>___ I have not given anyone permission</p>	HIT survey: PHR	8	CHCF, 2010b	Consumer of New York State's greater Buffalo region	No report	No report	Ordinal (use summative scale)
<p>ePHR users; ePHR nonusers</p> <p>How protected would you feel about the privacy and security of your information given these situations?; Here are some things that might affect whether you use an ePHR that helps you view, update, or manage your health information. How protected would you feel about the privacy and security of your health information given these situations?</p> <p><i>1. Very protected, 2. Somewhat protected, 3. Not too protected, 4. Not at all protected, 5. Not sure</i></p> <p>1. Your doctor or other health provider told you that your information was safe</p> <p>2. Your friends or family used this kind of an ePHR and said their information was safe</p> <p>3. You saw a sign or seal of approval on an ePHR that said it was safe. The sign was like one you would see on a bank website.</p> <p>4. You trusted your doctor or the organization that provided an ePHR</p> <p>5. The ePHR had a detailed privacy policy</p> <p>6. You learned about government privacy rules about health information (e.g., HIPAA)</p> <p>7. You found that you would be told if anyone looked at your information who should not have</p> <p>8. There were strong laws and fines for ePHRs if those without permission accessed your health</p>	National consumer survey on HIT: privacy/confidentiality/security of PHRs	8	CHCF, 2010b	Consumer of New York State's greater Buffalo region	No report	No report	Ordinal (use summative scale)

Table A.2: Measurement Matrix for Concepts and Operational Variables Cont.

	Operational definition & variable definition	Instrument #	Source	Population tested	Reliability	Validity	Level of measure
information							
ePHR users							
Frequency	Approximately how often do you use ePHR to view or update your information and manage your health care? (Please choose one) ___ About once daily ___ Once weekly ___ Once monthly ___ Once every 2 to 6 months ___ Rarely (once a year) or not at all	HITEC consumer HIT survey: PHR	Patel et al, 2011	Adult residents of New York State's greater Buffalo region	No report	No report	Ordinal
Amount	On average, how much time do you spend on an ePHR each time? (e.g., 0 hours 10 minutes; 2 hours 0 minutes; 3 hours 30 minutes)	Survey: Use	Venkatesh & Bala, 2008	Employees in organizations	N/A	N/A	Interval
ePHR nonusers							
Intention to Use	How much would you agree or disagree with each one? 1. <i>Strongly agree</i> , 2. <i>Agree</i> , 3. <i>Disagree</i> , 4. <i>Strongly disagree</i> , 5. <i>Not sure</i> 1.If I have access to an ePHR, I intend to use it. 2.If I have access to an ePHR, I predict that I would use it. 3.If my health care providers advocate that I use an ePHR, I would use it 4.I would use an ePHR because I organize my life using electronic media	Survey: Intention to use	Venkatesh & Davis, 2000	Employees among 4 different organizations using different systems	ICR: Cronbach's $\alpha = 0.82-0.97$ (2 items) across studies & time periods	Construct validity was strong	Ordinal (use summative scale)
Both ePHR users and nonusers							
Perceived health promoting role model	How much do you agree or disagree with each one? 1. <i>Strongly agree</i> , 2. <i>Agree</i> , 3. <i>Disagree</i> , 4. <i>Strongly disagree</i> , 5. <i>Not sure</i> 1.I have to be knowledgeable about health related issues because patients expect it of me. 2.I feel like a role model when people ask me for health-related information. 3.I feel guilty when I teach about health behaviors	Self as Role Model for Health Promotion (SRMHP) scale: Identification of self with idealized	Rush et al, 2010	Nurses in both hospital & community settings in Eastern Canada	ICR: Cronbach's $\alpha = 0.43-0.71$ (19 items)	Construct validity was tested	Ordinal (use summative scale)

Table A.2: Measurement Matrix for Concepts and Operational Variables Cont.

Operational definition & variable definition	Instrument Name	# item	Source	Population n tested	Reliability	Validity	Level of measure
I am not practicing. 4.I have to practice a healthy lifestyle because patients expect me to. 5.I feel concerned when patients see I am not practicing what I preach. 6.To be a role model of health promotion, I should consistently attain a high standard of healthy behaviors. 7.I must “practice what I preach” because patients expect it of me. 8.I practice a healthy lifestyle because I am a nurse.							
Part III. Technology Experience							
Work place ePHR use status	At the hospital or clinic where you work, do you use ePHRs (patients’ electronic personal health records) as part of your job? Yes _____ No _____	1	New item				Binomial
Work place ePHR use years	How long have you been using patients’ ePHRs as part of your job? (e.g., 0 years 2 months; 2 years 0 months; 2 years 6 months)	1	New item				Interval
Work place EHR use status	At the hospital or clinic where you work, do you use EHRs (patients’ electronic health records) as part of your job? Yes _____ No _____	1	New item				Binomial
Work place EHR use years	How long have you been using patients’ EHRs as part of your job? (e.g., 0 years 2 months; 2 years 0 months; 2 years 6 months)	1	New item				Interval
Computer and Internet usage	How long have you been using personal computers for any purpose? (e.g., 0 years 2 months; 2 years 0 months; 2 years 6 months)	1	New item				Interval

Table A.2: Measurement Matrix for Concepts and Operational Variables Cont.

Operational definition & variable definition	Instrument Name	# item	Source	Population tested	Reliability	Validity	Level of measure
How often do you access the Internet? ___ Several times a day ___ About once a day ___ Several times per week ___ Several times per month ___ Rarely or not at all	HITEC consumer HIT survey: Use of the Internet question	1	Patel et al, 2011	Adult residents of New York State's greater Buffalo region	No report	No report	Ordinal
Frustration as learning new applications	New item	1					Nominal
Do you find learning new applications (e.g., Facebook or Twitter) on the computer to be frustrating? ___ Yes, definitely ___ Yes, somewhat ___ No ___ Not sure							
eHealth literacy	eHEALS	4	Norman & Skinner, 2006	Adolescents (age 13 to 21) in a Canadian city	ICR: Cronbach's $\alpha=0.88$ (8 items)	Test-retest reliability: modest stability over time	Ordinal (use summative scale)
How much do you agree or disagree with each one? 1. <i>Strongly agree, 2. Agree, 3. Disagree, 4. Strongly disagree, 5. Not sure</i> 1. I know where to find helpful health resources on the Internet 2. I know how to use the health information I find on the Internet to help me 3. I have the skills I need to evaluate the health resources I find on the Internet 4. I feel confident in using information from the Internet to make health decisions							
Part IV. Health Status and Decision Making							
Self-rated health status	Health State Descriptions of WHO Survey: Overall Health HITEC consumer	1	WHO, 2002	Adults in several countries	No report	No report	Ordinal
Chronic conditions	Are you currently being treated for any ongoing, or chronic medical conditions such as high blood	1	Patel et al,	Adult residents	No report	No report	Binomial

Table A.2: Measurement Matrix for Concepts and Operational Variables Cont.

Operational definition & variable definition	Instrument Name	# item	Source	Population tested	Reliability	Validity	Level of measure
pressure, diabetes, heart or lung disease, or arthritis? Yes No	HIT survey: Health	2011	2011	of New York State's greater Buffalo region			
Medication use Are you taking any medication(s) prescribed by a doctor or health care providers? Yes No	HITEC consumer HIT survey: Health	1	Patel et al, 2011	Adult residents of New York State's greater Buffalo region	No report	No report	Binomial
Decision making preference for self Which of the following best describes the way you typically make decisions about your medical care? <i>Please choose one:</i> My primary care provider(s) gives recommendations, but I make my own decisions about my medical care My primary care provider(s) and I make decisions about my medical care together as a team I leave it up to my primary care provider(s) to make the best decisions about my medical care	HITEC consumer HIT survey: Health	1	Patel et al, 2011	Adult residents of New York State's greater Buffalo region	No report	No report	Nominal
Care for family members Are you a primary caregiver for anyone other than yourself (e.g., child, elderly parents)? Yes No	Nurses' Worklife and Health Study Questionnaire: Demographic	1	Trinkoff et al, 2007	Licensed nurses from 2 US states (Illinois & North Carolina)	No report	No report	Binomial
Decision making preference for dependents Are you currently making healthcare decisions for a family member (e.g., children or elderly parents) with a debilitating or chronic illness? Yes No	HITEC consumer HIT survey: Health	1	Patel et al, 2011	Adult residents of New York State's	No report	No report	Nominal

Table A.2. Measurement Matrix for Concepts and Operational Variables Cont.

Operational definition & variable definition	Instrument Name	# item	Source	Population tested	Reliability	Validity	Level of measure
_____ Not applicable (N/A)				greater Buffalo region			
Employment status	Which best describes your current work status? _____ Full-time employed _____ Part-time employed _____ Other: (please specify: _____)	1	Trinkoff et al, 2007	Licensed nurses from 2 US states (Illinois & North Carolina)	No report	No report	Nominal
Years of working	How long have you been working as a nurse? (e.g., <u>0</u> years <u>2</u> months; <u>2</u> years <u>0</u> months; <u>2</u> years <u>6</u> months) _____ years _____ months	1	Trinkoff et al, 2007	Licensed nurses from 2 US states (Illinois & North Carolina)	No report	No report	Interval
Practice region	What region of the United States do you currently practice in? _____ Northeast _____ Midwest _____ South _____ West	1	CHCF, 2010b	Consumer	No report	No report	Nominal
Current position	What is your current position? If you work more than one position, choose the MAIN one where you spend the most time. _____ Staff/General duty/Private duty _____ Nurse manager/Supervisor/Other administrator _____ Nurse practitioner/Certified Registered Nurse Anesthetist (CRNA)/Clinical Nurse Specialist (CNS)/Certified Nurse Midwife (CNM) _____ Educator/Researcher _____ Other: (please specify: _____)	1	Trinkoff et al, 2007	Licensed nurses from 2 US states (Illinois & North Carolina)	No report	No report	Nominal
Specialty area	What is your specialty area? If you work mainly in one setting, mark the appropriate one. If you work in more than one	1	HUP, 2013	N/A	No report	No report	Nominal

Table A.2.: Measurement Matrix for Concepts and Operational Variables Cont.

Operational definition & variable definition	Instrument Name	# item	Source	Population tested	Reliability	Validity	Level of measure
setting, mark the appropriate one where you spend the most time.							
___ Emergency/Trauma/Triage							
___ Nursing informatics							
___ Medical: Advanced Medicine, Clinical Translation Research Center, General Medicine with Telemetry, Hematology/Oncology/BMT, Medicine/Telemetry, Oncology							
___ Medical Critical Care: Cardiac Care Unit (CCU), Cardiac Intermediate Care Unit (CICU), Medical Intensive Care Unit (MICU)							
___ Surgical: Adult Cardiac Progressive Care, Neurology and Neurosurgery, Surgical Progressive Care, Surgical Telemetry, Surgical Ortho Trauma, Surgical Telemetry, Transplant/Bariatric Surgery, Venous Access and Moderate Sedation Program							
___ Surgical Critical Care: General Surgical Intensive Care Unit (SICU), Heart and Vascular ICU, Cardiothoracic SICU, SICU Neurotrauma							
___ Perioperative: Operating Room (OR), Post-Anesthesia Care Unit (PACU); Ambulatory Procedure Unit (APU), Surgery Center, Endoscopy Center							
___ Women's Health: Intensive Care Nursery (ICN), Labor and Delivery (L&D), Maternity Unit, OB/GYN, Gynecologic Oncology							
___ Mental Health: Psychosocial, Psychiatry, Substance abuse							
___ Outpatient clinics: any ambulatory care (e.g., cardiology, gastroenterology, endocrinology, ophthalmology, dermatology, rheumatology, others)							
Other: (please specify: _____)							
Age	U.S. Census Bureau: Age	1	U.S. Census Bureau, 2012b	U.S. census of the population in 2010	No report	No report	Interval
How old were you on your last birthday? (e.g., 31 years=31)							
___ years old							

Table A.2: Measurement Matrix for Concepts and Operational Variables Cont.

	Operational definition & variable definition	Instrument Name	# item	Source	Population tested	Reliability	Validity	Level of measure
Gender	What is your gender? ___ Female ___ Male	U.S. Census Bureau: Gender	1	U.S. Census Bureau, 2012b	U.S. census of the population in 2010	No report	No report	Binomial
Marital status	What is your current marital status? ___ Never married ___ Currently married/living with partner ___ Divorced or separated ___ Widowed	U.S. Census Bureau: Marital status	1	U.S. Census Bureau, 2012b	U.S. census of the population in 2010	No report	No report	Nominal
Education level	What is the highest degree of education that you have completed? ___ Diploma or Associate's degree ___ Bachelor's degree ___ Master's degree ___ Doctoral degree	Nurses' Worklife and Health Study Questionnaire: Demographic	1	Trinkoff et al, 2007	Licensed nurses from 2 US states (Illinois & North Carolina)	No report	No report	Nominal
Ethnicity	Which of the following best describes your ethnicity? ___ Hispanic or Latino ___ Not Hispanic or Latino	U.S. Census Bureau: Ethnicity	1	U.S. Census Bureau, 2012b	U.S. census of the population in 2010	No report	No report	Binomial
Race	Which of the following best describes your race? <u>Please choose one:</u> ___ African American (Black) ___ Native American (American Indian, Alaskan Native) ___ Asian or Pacific Islander ___ Caucasian (White) ___ Mixed race ___ Other: (please specify: _____)	U.S. Census Bureau: Race	1	U.S. Census Bureau, 2012b	U.S. census of the population in 2010	No report	No report	Nominal

= number. ICR=Internal consistency reliability.

APPENDIX D

Survey for Nurses about Electronic Personal Health Records Acceptance

We are asking about your use of electronic personal health record (ePHR) for **your own health management**. When you answering the survey questions please refer to your use of ePHR for **your own health management**.

Unlike an electronic health record (EHR) used by health providers, an **ePHR is used by you** to enter and view your own data, update your health information, and manage your health care. An ePHR requires you to assign yourself a user name and password to access it.


Health information can include allergy, immunization, family history, wellness and disease management (e.g., medications), documents from providers (e.g., discharge instructions), services (e.g., appointment, prescription e-refills, secure messaging), or emergency contacts.


Here's what one ePHR might look like:

The screenshot displays a mobile application interface for a personal health record. At the top, it shows the user's name 'My' and a navigation bar with 'Home > Health information'. The main title is 'My's health information' with a 'More actions' dropdown. The interface is organized into several sections:

- Conditions:** A list of health conditions with expandable options: Allergy (1), Condition (1), Emotional State (1), Medical Device, and Pregnancy (1).
- Measurements:** A list of health measurements with expandable options: Blood Glucose Measurement, Blood Pressure Measurement (2), Cholesterol Measurement, Height Measurement (2), Lab Test Results, Peak Flow Measurement, and Weight Measurement (7).
- Custom Data:** A section for 'Application-Specific Information (34)'.
- Files:** A list of documents with expandable options: Continuity of Care Document (CCD), Continuity of Care Record (CCR), Documents (File) (5), and Medical Image Study.
- Fitness:** A list of fitness-related items with expandable options: Dietary Intake and Exercise.
- Medications:** A list of medications with an expandable option: Medication (1).
- Personal Profile:** A list of profile information with expandable options: Basic Demographic Information (1), Emergency or Provider Contact (1), and Health History.
- Health History:** A list of health history items with expandable options: Appointment (1), Family History (2), Immunization (1), and Procedure (1).

On the left side, there is a navigation menu with icons for Home, Health information, Apps & Devices, Sharing, and History. Below the navigation menu, there are links for 'HEALTH VIEWS' including 'Emergency profile' and 'Weight management'. At the bottom left, there is a blue header for 'My' with an 'Edit' button and options to 'Add a person' and 'Switch person'.

If you want to return to the previous page, **please click the Back button () at the bottom**

of the survey and do not click the Back button () at the top of your browser.

Part 1. Awareness of New Technology and Attitudes about Privacy of Electronic Health Information

Awareness of New Technology

Since 2011, health providers have been required to use electronic health records (EHRs) for patients' health information. A patient electronic personal health record (ePHR) would allow you to access the health information in your own EHR.

Q1. Have you heard anything about the government putting money toward helping doctors and hospitals use more technology (called "meaningful use")?

- Yes
- No
- Not sure

Q2. Do any of your doctors or health care providers currently use an EHR for you?

- Yes
- No
- Not sure

Attitudes about Privacy of Electronic Health Information

Q3. How concerned are you in general with the privacy and security of your health information online?

- Not at all concerned
- Not very concerned
- Somewhat concerned
- Very concerned
- Not sure

Part II. Electronic Personal Health Record (ePHR) Acceptance

Q4. Have you ever used an electronic personal health record (ePHR) to view, update, or manage your health information?

- Yes
- No

Perceived Usefulness (PU):

Q5.1 **ePHR USERS (YES to Q4):** Here are some useful ePHR features. How useful has each of these been to you?:

1. Very useful, 2. Somewhat useful, 3. Not too useful, 4. Not at all useful, 5. Not sure, 6. N/A

- a. Looking at the results of your lab tests or other tests.
- b. Making sure your information is correct.
- c. Scheduling a doctor's visit.
- d. Renewing prescription medicines.
- e. Keeping track of your child's health records (e.g., immunization dates and information).
- f. Getting a reminder for when you need a test (e.g., a mammogram or HbA1C).
- g. Sending or getting an email from a doctor or nurse.
- h. Managing your family's health visits, medicines, and other information in one place.
- i. Sharing your health information with your family.
- j. Seeing your providers' instructions for taking care of your health.

Perceived Usefulness (PU):

Q5.2 NON ePHR USERS (NO to Q4): If your health information were available on ePHR, how useful would these be to you?:

1. Very useful, 2. Somewhat useful, 3. Not too useful, 4. Not at all useful, 5. Not sure, 6. N/A

- a. Looking at the results of your lab tests or other tests.
- b. Making sure your information is correct.
- c. Scheduling a doctor's visit.
- d. Renewing prescription medicines.
- e. Keeping track of your child's health records (e.g., immunization dates and information).
- f. Getting a reminder for when you need a test (e.g., a mammogram or HbA1C).
- g. Sending or getting an email from a doctor or nurse.
- h. Managing your family's health visits, medicines, and other information in one place.
- i. Sharing your health information with your family.
- j. Seeing your providers' instructions for taking care of your health.

Perceived Ease of Use (PEOU):

Q6.1 ePHR USERS (YES to Q4): Since you have used an ePHR, how much do you agree or disagree with each one?

1. Strongly agree, 2. Agree, 3. Disagree, 4. Strongly disagree, 5. Not sure

- a. Learning to operate an ePHR is easy for me.
- b. My interaction with an ePHR is clear and understandable.
- c. It is easy for me to become skillful at using an ePHR.
- d. I find an ePHR easy to use.

Perceived Ease of Use (PEOU):

Q6.2 NON ePHR USERS (NO to Q4): If you had an ePHR, how much would you agree or disagree with each one?

1. Strongly agree, 2. Agree, 3. Disagree, 4. Strongly disagree, 5. Not sure

- a. Learning to operate an ePHR would be easy for me.

- b. My interaction with an ePHR would be clear and understandable.
- c. It would be easy for me to become skillful at using an ePHR.
- d. I would find an ePHR easy to use.

Perceived Data Privacy and Security Protection (PDPSP):

Q7.1 ePHR USERS (YES to Q4): Who have you given permission to view your ePHR?
(Please check all that apply)

- Designated family members or friends
- My primary care doctors or providers
- Other doctors or health care providers who care for me (in clinic, ER, or other specialists)
- Pharmacist
- My health plan (e.g., a health insurance company)
- My employer
- I have not given anyone permission

Q8.1 ePHR USERS (YES to Q4): How protected would you feel about the privacy and security of your information given these situations?

1. Very protected, 2. Somewhat protected, 3. Not too protected, 4. Not at all protected, 5. Not sure

- a. Your doctor or other health provider told you that your information was safe.
- b. Your friends or family used this kind of an ePHR and said their information was safe.
- c. You saw a sign or seal of approval on an ePHR that said it was safe. The sign was like one you would see on a bank website.
- d. You trusted your doctor or the organization that provided an ePHR.
- e. The ePHR had a detailed privacy policy.
- f. You learned about government privacy rules about health information (e.g., HIPAA).
- g. You found that you would be told if anyone looked at your information who should not have.
- h. There were strong laws and fines for ePHRs if those without permission accessed your health information.

Perceived Data Privacy and Security Protection (PDPSP):

Q7.2 NON ePHR USERS (NO to Q4): If you had an ePHR, who would you give permission to view your ePHR? *(Please check all that apply)*

- Designated family members or friends
- My primary care doctors or providers
- Other doctors or health care providers who care for me (in clinic, ER, or other specialists)
- Pharmacist
- My health plan (e.g., a health insurance company)
- My employer
- I would not give anyone permission

Q8.2 NON ePHR USERS (NO to Q4): Here are some things that might affect whether you use an ePHR that helps you view, update, or manage your health information. How

protected would you feel about the privacy and security of your information given these situations?

1. *Very protected*, 2. *Somewhat protected*, 3. *Not too protected*, 4. *Not at all protected*, 5. *Not sure*

- a. Your doctor or other health provider told you that your information was safe.
- b. Your friends or family used this kind of an ePHR and said their information was safe.
- c. You saw a sign or seal of approval on an ePHR that said it was safe. The sign was like one you would see on a bank website.
- d. You trusted your doctor or the organization that provided an ePHR.
- e. The ePHR had a detailed privacy policy.
- f. You learned about government privacy rules about health information (e.g., HIPAA).
- g. You found that you would be told if anyone looked at your information who should not have.
- h. There were strong laws and fines for ePHRs if those without permission accessed your health information.

Use Behavior (USE):

Q9.1 **ePHR USERS (YES to Q4):** Approximately how often do you use ePHR to view or update your information and manage your health care? (*Please choose one*)

- _____ About once daily
- _____ Once weekly
- _____ Once monthly
- _____ Once every 2 to 6 months
- _____ Rarely (once a year) or not at all

Q10. **ePHR USERS (YES to Q4):** On average, how much time do you spend on an ePHR each time?

(e.g., 0 hours 10 minutes; 2 hours 0 minutes; 3 hours 30 minutes)

_____ hours _____ minutes

Behavioral Intention to Use (BI):

Q9.2 **NON ePHR USERS (NO to Q4):** How much would you agree or disagree with each one?

1. *Strongly agree*, 2. *Agree*, 3. *Disagree*, 4. *Strongly disagree*, 5. *Not sure*

- a. If my health care providers advocate that I use an ePHR, I would use it.
- b. If I have access to an ePHR, I intend to use it.
- c. If I have access to an ePHR, I predict that I would use it.
- d. I would use an ePHR because I organize my life using electronic media.

Perceived Health Promoting Role Model (PHPRM):

Q11. How much do you agree or disagree with each one?

1. *Strongly agree*, 2. *Agree*, 3. *Disagree*, 4. *Strongly disagree*, 5. *Not sure*, 6. *N/A*

- a. I have to be knowledgeable about health related issues because patients expect it of me.

- b. I feel like a role model when people ask me for health-related information.
- c. I feel guilty when I teach about health behaviors I am not practicing.
- d. I have to practice a healthy lifestyle because patients expect me to.
- e. I feel concerned when patients see I am not practicing what I preach.
- f. To be a role model of health promotion, I should consistently attain a high standard of healthy behaviors.
- g. I must “practice what I preach” because patients expect it of me.
- h. I practice a healthy lifestyle because I am a nurse.

Part III. Technology Experience

Work place ePHR and EHR experience:

Q12. At the hospital or clinic where you work, do you use ePHRs (patients’ electronic personal health records) as part of your job?

- Yes
- No
- N/A

Q13. IF YES TO Q12:

How long have you been using patients’ ePHRs as part of your job?
(e.g., 0 years 2 months; 2 years 0 months; 2 years 6 months)

years months

Q14. At the hospital or clinic where you work, do you use EHRs (patients’ electronic health records) as part of your job?

- Yes
- No
- N/A

Q15. IF YES TO Q14:

How long have you been using patients’ EHRs as part of your job?
(e.g., 0 years 2 months; 2 years 0 months; 2 years 6 months)

years months

Computer and Internet usage:

Q16. How long have you been using personal computers for any purpose?
(e.g., 0 years 2 months; 2 years 0 months; 2 years 6 months)

years months

Q17. How often do you access the Internet?

- Several times a day
- About once a day
- Several times per week
- Several times per month
- Rarely or not at all

Q18. Do you find learning new applications (e.g., Facebook or Twitter) on the computer to be frustrating?

- Yes, definitely
- Yes, somewhat
- No
- Not sure

e-Health Literacy:

Q19. How much do you agree or disagree with each one?

1. Strongly agree, 2. Agree, 3. Disagree, 4. Strongly disagree, 5. Not sure

- a. I know where to find helpful health resources on the Internet.
- b. I know how to use the health information I find on the Internet to help me.
- c. I have the skills I need to evaluate the health resources I find on the Internet.
- d. I feel confident in using information from the Internet to make health decisions.

Part IV. Health Status and Decision Making Preferences

Q20. In general, how would you rate your health?

- Excellent
- Very good
- Good
- Fair
- Poor

Q21. Are you currently being treated for any ongoing, or chronic medical conditions such as high blood pressure, diabetes, heart or lung disease, or arthritis?

- Yes
- No

Q22. Are you taking any medication(s) prescribed by a doctor or health care providers?

- Yes
- No

Q23. Which of the following best describes the way you typically make decisions about your medical care?

- My primary care provider(s) gives recommendations, but I make my own decisions about my medical care.
- My primary care provider(s) and I make decisions about my medical care together as a team.
- I leave it up to my primary care provider(s) to make the best decisions about my medical care.

Q24. Are you a primary caregiver for anyone other than yourself (e.g., child, elderly parents)?

- Yes
- No

_____ Not applicable (N/A)

Q25. Are you currently making healthcare decisions for a family member (e.g., children or elderly) with a debilitating or chronic illness?

_____ Yes

_____ No

_____ Not applicable (N/A)

Part V. Job Information and Demographics

Q26. Which best describes your current work status?

_____ Full-time employed

_____ Part-time employed

_____ Other: *(please specify)*

Q27. How long have you been working as a nurse?

(e.g., 0 years 2 months; 2 years 0 months; 2 years 6 months)

_____ years _____ months

Q28. What region of the United States do you currently practice in?

Here's Map of US Regions:



_____ Northeast

_____ Midwest

_____ South

_____ West

Q29. What is your current position?

If you work more than one position, choose the MAIN one where you spend the most time.

- _____ Staff/General duty/Private duty
- _____ Nurse manager/Supervisor/Other administrator
- _____ Nurse practitioner/Certified Registered Nurse Anesthetist (CRNA)/Clinical Nurse Specialist (CNS)/Certified Nurse Midwife (CNM)
- _____ Educator/Researcher
- _____ Other: *(please specify)*

Q30. What is your specialty area?

If you work mainly in one setting, choose the appropriate one. If you work in more than one setting, choose the appropriate one where you spend the most time.

- _____ **Emergency/Trauma/Triage**
- _____ **Nursing informatics**
- _____ **Medical:** Advanced Medicine, Clinical Translation Research Center, General Medicine with Telemetry, Hematology/Oncology/BMT, Medicine/Telemetry, Oncology
- _____ **Medical Critical Care:** Cardiac Care Unit (CCU), Cardiac Intermediate Care Unit (CICU), Medical Intensive Care Unit (MICU)
- _____ **Surgical:** Adult Cardiac Progressive Care, Neurology and Neurosurgery, Surgical Progressive Care, Surgical Telemetry, Surgical Ortho Trauma, Transplant/Bariatric Surgery, Venous Access and Moderate Sedation Program
- _____ **Surgical Critical Care:** General Surgical Intensive Care Unit (SICU), Heart and Vascular ICU, Cardiothoracic SICU, SICU Neurotrauma
- _____ **Perioperative:** Operating Room (OR), Post-Anesthesia Care Unit (PACU), Ambulatory Procedure Unit (APU), Surgery Center, Endoscopy Center
- _____ **Women's Health:** Intensive Care Nursery (ICN), Labor and Delivery (L&D), Maternity Unit, OB/GYN, Gynecologic Oncology
- _____ **Mental Health:** Psychosocial, Psychiatry, Substance abuse
- _____ **Outpatient clinics:** any ambulatory care (e.g., cardiology, gastroenterology, endocrinology, ophthalmology, dermatology, rheumatology, others)
- _____ Other: *(please specify)*

Q31. How old were you on your last birthday?

(e.g., 31 years=31)

_____ **years old**

Q32. What is your gender?

_____ Female

_____ Male

Q33. What is your current marital status?

_____ Never married

_____ Currently married/living with partner

_____ Divorced or separated

_____ Widowed

Q34. What is the highest degree of education that you have completed?

- Diploma or Associate's degree
- Bachelor's degree
- Master's degree
- Doctoral degree

Q35. Which of the following best describes your ethnicity?

- Hispanic or Latino
- Not Hispanic or Latino

Q36. Which of the following best describes your race? (*Please choose one*)

- African American (Black)
- Native American (American Indian, Alaskan Native)
- Asian or Pacific Islander
- Caucasian (White)
- Mixed race
- Other: (*please specify*)

Q37. Please feel free to comment on any of the topics you found in the survey.

Thank you very much for your participation!!!

If you wish to enter the drawing for the iPad Mini, please send an e-mail to the study team at (PHRRNSTUDY@gmail.com). Please include your first and last name and e-mail address in the correspondence. This email CANNOT be linked or connected in any way to your survey responses.

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