

A HUMAN CAPITAL APPROACH TO EXAMINING PRIMARY CARE NURSES'  
CONTRIBUTIONS TO PRIMARY CARE AND THEIR ECONOMIC RETURNS

Yin Li

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Approved by:

Cheryl B. Jones

Barbara A. Mark

Celeste Mayer

George M. Holmes

Erin P. Fraher

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## **ABSTRACT**

Yin Li: A Human Capital Approach to Examining Primary Care Nurses' Contributions to Primary Care and Their Economic Returns  
(Under the direction of Cheryl B. Jones)

This dissertation addressed the contributions of primary care nurses (PCNs) to primary care and the economic returns to their human capital. Human capital theory was used to derive a conceptual framework that provided guidance for the three analyses conducted in this dissertation. The first analysis was an integrative literature review of PCNs' contributions to primary care, including the care they provide and the outcomes of their care. The second analysis compared the care provided by PCNs and primary care physicians (PCPs), including their functions, roles, and the diagnostic characteristics of their care recipients. The third analysis compared the wages of primary care nurse practitioners (PCNPs) working in primary care settings with those working in specialty care settings.

The findings of the first analysis indicate that PCNs perform a wide range of functions, serve in substitute, supplemental, and other roles, and manage patients with a variety of diagnoses. With respect to the outcomes of PCN care, the findings indicate that PCNs have improved the effectiveness and patient-centeredness of primary care, but that evidence is lacking with respect to the safety, timeliness, efficiency, and equity of primary care. The findings of the second analysis indicate that PCNs were more likely to provide therapeutic care but less likely to provide diagnostic care than PCPs. Moreover, when PCNs served in a substitute role for PCPs, they managed patients with similar diagnoses as those managed by PCPs, and when PCNs and PCPs served in supplemental roles, they managed

patients with different diagnoses. Finally, findings from the third analysis indicate that PCNPs working in primary care settings earned, on average, \$4.07/hour less than PCNPs working in specialty care settings, and this wage disparity was largely due to unobserved or unexplained factors.

The findings of this dissertation provide guidance for future research focusing on PCNs' contributions to primary care and the economic returns to their human capital. Organizational leaders, educators, and policymakers can use these findings to develop approaches and policies that address how PCNs' human capital is best used in the changing primary care system, and in meeting the increased demand for primary care.

To my parents:  
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## TABLE OF CONTENTS

LIST OF TABLES .....	xii
LIST OF FIGURES .....	xiii
LIST OF ABBREVIATIONS.....	xiv
CHAPTER 1: INTRODUCTION: THE CONTRIBUTIONS OF PRIMARY CARE NURSES TO PRIMARY CARE AND THEIR WAGES.....	1
Introduction.....	1
Theoretical Foundation .....	3
The Conceptual Framework of this Dissertation .....	13
Knowledge Gaps and Research Questions .....	14
An Outline of this Dissertation .....	17
Chapter Summary .....	22
CHAPTER 2: AN INTEGRATIVE LITERATURE REVIEW OF PRIMARY CARE NURSES' CONTRIBUTIONS TO THE U.S. PRIMARY CARE SYSTEM .....	24
Background .....	24
Conceptual Framework.....	27
Methods.....	28
Results.....	36
Discussion .....	55
Chapter Summary .....	65
CHAPTER 3: A COMPARISON OF CARE BETWEEN PHYSICIANS AND NURSES IN U.S. PRIMARY CARE SETTINGS .....	66
Introduction.....	66

Background .....	68
Conceptual Framework .....	74
Methods.....	75
Results.....	86
Discussion .....	97
Chapter Summary .....	106
 CHAPTER 4: A COMPARISON OF WAGES FOR PCNPS WORKING IN PRIMARY CARE AND SPECIALTY CARE SETTINGS .....	 108
Introduction.....	108
Background .....	110
Conceptual Framework .....	120
Methods.....	121
Results.....	132
Discussion .....	154
Chapter Summary .....	162
 CHAPTER 5: A REVIEW AND DISCUSSION: PRIMARY CARE NURSES’ CONTRIBUTIONS TO PRIMARY CARE AND THEIR ECONOMIC RETURNS .....	 163
Introduction.....	163
Findings of the Dissertation .....	163
Strengths of the Dissertation.....	171
Limitations of the Dissertation.....	174
Recommendations for Future Research .....	177
Implications for Organizational Leaders, Educators, and Policymakers .....	180
Conclusion .....	187

APPENDIX 2.1: A LIST OF REVIEWED STUDIES IN CHAPTER 2 .....	189
APPENDIX 2.2: THE QUALITY SCORING OF REVIEWED STUDIES IN CHAPTER 2 .....	195
APPENDIX 2.3: DESCRIPTIONS OF THE REVIEWED STUDIES .....	201
APPENDIX 2.4: THE FUNCTIONS AND ROLES OF PCNS IN THE REVIEWED STUDIES – PATIENT ASSESSMENT .....	208
APPENDIX 2.5: THE FUNCTIONS AND ROLES OF PCNS IN THE REVIEWED STUDIES – DIAGNOSIS AND TREATMENT .....	210
APPENDIX 2.6: THE FUNCTIONS AND ROLES OF PCNS IN THE REVIEWED STUDIES – CARE MANAGEMENT .....	212
APPENDIX 2.7: THE FUNCTIONS AND ROLES OF PCNS IN THE REVIEWED STUDIES – HEALTH PROMOTION AND DISEASE PREVENTION .....	215
APPENDIX 2.8: A COMPARISON BETWEEN THE STUDIES THAT REPORTED PCNS’ FUNCTIONS WITH THE STUDIES THAT DID NOT REPORT PCNS’ FUNCTIONS .....	217
APPENDIX 2.9: A COMPARISON BETWEEN THE STUDIES THAT REPORTED PCNS’ FUNCTIONS WITH THE STUDIES THAT DID NOT REPORT PCNS’ FUNCTIONS BY PCN’S ROLES .....	218
APPENDIX 2.10: A COMPARISON BETWEEN THE STUDIES THAT REPORTED PATIENTS’ DIAGNOSES WITH THE STUDIES THAT DID NOT REPORT PATIENTS’ DIAGNOSES BY PCN’S ROLES .....	220
APPENDIX 2.11: THE OUTCOMES OF PCN CARE ORGANIZED BY THE SIX AIMS OF QUALITY OF CARE .....	222
APPENDIX 3.1: SAMPLE IDENTIFICATION OF CHAPTER 3 .....	238
APPENDIX 3.2: DATA MANAGEMENT IN EACH DATA FILE OF CHAPTER 3 .....	242
APPENDIX 3.3: RESULTS OF MULTINOMIAL LOGISTIC REGRESSION OF THE DIAGNOSTIC CHARACTERISTICS OF CARE RECIPIENTS .....	247
APPENDIX 4.1: SAMPLE SELECTION AND DATA MANAGEMENT OF CHAPTER 4 .....	253
REFERENCES .....	264

## LIST OF TABLES

Table 1.1: A Summary of the Key Information in the Three Papers .....	18
Table 2.1: The Integration of PCRN's Functions from the Study of Smolowitz (2014) and PCNP's Functions from the Study of ANCC (2012) .....	34
Table 2.2: A Summary of the Outcomes of PCN Care by Their Roles .....	55
Table 3.1: The Roles of PCNs and PCPs and Four Patient Visit Scenarios .....	82
Table 3.2: Descriptive Statistics of Respondents Seeing a PCN or a PCP as Usual Source of Care (n=2,090) .....	87
Table 3.3: Functions of PCNs and PCPs (n=5,263 visits) .....	89
Table 3.4: Functions of PCNs and PCPs When They Serve a Usual Provider Role (n=4,025 visits) .....	91
Table 3.5: Functions of PCNs and PCPs When They Serve a Supplemental Role (n=1,238 visits) .....	92
Table 3.6: A Comparison Summary of PCNs and PCPs' Functions and Roles .....	94
Table 4.1: Predicted PCNP Wages and The Decomposition of Wage Disparities .....	131
Table 4.2: Descriptive statistics of PCNP Sample .....	135
Table 4.3: Feasible Generalized Least Squares Regression Analyses of the Log of Wages .....	139
Table 4.4: The Decomposition of Wage Disparities .....	149
Table 4.5: Average Predicted Weighted PCNP Wages and the Decomposition of Wage Disparities .....	153

## LIST OF FIGURES

Figure 1.1: The Conceptual Framework of this Dissertation Study .....	14
Figure 2.1: Areas of Focus in Chapter 2, from this Dissertation's Overall Conceptual Framework.....	27
Figure 2.2: Description of the Information Gathering Process.....	30
Figure 3.1: Sections Examined in Chapter 3 From the Overall Conceptual Framework of This Dissertation .....	74
Figure 3.2: The Predicted Probability of Being Diagnosed with a Certain Type of Disease (n=3,891 visits).....	96
Figure 4.1: Sections Examined in Chapter 4 From the Overall Conceptual Framework of This Dissertation Study.....	120
Figure 4.2 Wage-experience Profiles for PCNPs Working in Primary Care Settings and those Working in Specialty Care Settings.....	144
Figure 5.1 A Summary of This Dissertation's Findings .....	170

## **LIST OF ABBREVIATIONS**

AHRQ	Agency for Healthcare Research and Quality
AND	Associate's Degree in Nursing
ANP	Adult Nurse Practitioners
BSN	Bachelor's of Science degree in Nursing
CCS	Clinical Classification Software
CINAHL	Cumulative Index to Nursing & Allied Health Literature
CPS	Current Population Survey
CTS-PS	Community Tracking Study – Physician Survey
FNP	Family Nurse Practitioners
FYC	Full-Year Consolidated
GNP	Gerontology Nurse Practitioners
HCUP	Healthcare Cost and Utilization Project
HCV	Hepatitis C
HDL	High Density Lipoprotein
HMO	Health Maintenance Organization
HRSA	Health Resources and Services Administration
ICD-9-CM	International Classification of Diseases, 9th Revision, Clinical Modification
IOM	Institute of Medicine
LDL	Low Density Lipoprotein
MEPS	Medical Expenditure Panel Survey
MeSH	Medical Subject Headings
MSA	Metropolitan Statistical Area

NAMCS	National Ambulatory Medical Care Surveys
NHAMCS	National Hospital Ambulatory Medical Care Surveys
NMHC	Nurse-Managed Health Center
NNPSS	National Nurse Practitioner Sample Survey
NP	Nurse Practitioner
NSSNP	National Sample Survey of Nurse Practitioner
NSSRN	National Sample Survey of Registered Nurse
OB	Office-based
OPD	Outpatient Department
PA	Physician Assistant
PCMH	Patient-centered Medical Home
PCN	Primary Care Nurse
PCP	Primary Care Physician
PSM	Propensity Score Matching
RCT	Randomized Control Trial
RN	Registered Nurse
USC	Usual Source Care
VA	Veteran Affairs
WHNP	Women's Health Nurse Practitioners

## **CHAPTER 1: INTRODUCTION: THE CONTRIBUTIONS OF PRIMARY CARE NURSES TO PRIMARY CARE AND THEIR WAGES**

### **Introduction**

Primary care nurses (PCNs) – registered nurses (RNs) and nurse practitioners (NPs) who practice in primary care settings – are an important component of the U.S. primary care workforce (Institute of Medicine, 2011). Of the 3.9 million of nurses working in the health care system, however, only about 500,000 PCNs (approximately 463,200 RNs and 56,200 NPs) were practicing in various primary care settings in 2012, including community clinics, nurse-managed health centers, physicians’ offices, retail clinics, outpatient settings, and home health (Agency for Healthcare Research and Quality, 2011; Bureau of Labor Statistics, 2013). Primary care nurses are a key, but underutilized and underemployed, element of the U.S. primary care system (Bodenheimer & Bauer, 2016).

PCNs contribute to the quality of primary care through their “human capital” – that is, their knowledge, skills, ability, expertise, and experiences that prepare them to work in primary care (Aleshire, Wheeler, & Prevost, 2012; Ehrenberg & Smith, 2010; Hansen-Turton, Ware, & McClellan, 2009; Smolowitz et al., 2014). The literature suggests that PCNs apply their knowledge and skills in primary care by engaging in patient care activities in disease prevention, health promotion, and care coordination to improve the quality of primary care (Bodenheimer, Bauer, Olayiwola, & Syer, 2015; Ladden et al., 2013). Also, the value of PCNs’ human capital is reflected in the wages they earn in primary care settings, and according to human capital theory, the greater the human capital possessed by PCNs, the



more they should increase productivity in primary care settings, and, in turn, the higher the wages PCNs would be expected to earn in primary care (Spetz & Bates, 2013). PCNs' wages can also affect their supply in the primary care labor market, because increases in wages in the market would be expected to attract more nurses to that sector of the market, holding nurses' wages in other markets constant (Ehrenberg & Smith, 2010). Thus, understanding PCNs' wages can provide important information for addressing the supply of PCNs in primary care settings.

Despite the number of studies published on the PCN workforce over the past several decades, our knowledge regarding their contributions to primary care and wages remains limited. Most previous studies have suggested that, to some extent, PCNs can achieve outcomes similar to those of primary care physicians (PCPs) in terms of the effectiveness of care they deliver and by improving patient satisfaction in traditional primary care settings (e.g., physician offices, community clinics, and outpatient settings) (Martínez-González et al., 2014; Stanik-Hutt et al., 2013). However, researchers have not clearly defined how PCN care differs from that of other primary care professionals (e.g., PCPs, or physician assistants [PAs]), or the outcomes that distinguish the care delivered by PCNs from that delivered by other primary care professionals. Previous studies have also focused on the wages of nurses, in general, and examined how wage-generating factors (i.e., human capital, employment, and demographic characteristics) impact nursing wages, but few studies have examined PCNs' wages specifically or how PCN wages are influenced by these factors (Coomer, 2013; Muench, Sindelar, Busch, & Buerhaus, 2015; Spetz & Bates, 2013).

This dissertation addressed the knowledge gaps related to PCNs' contributions to primary care and the wages of PCNs employed in primary care settings. The remainder of

this chapter describes the theoretical foundation and guiding conceptual framework of this dissertation, outlines the knowledge gaps about PCNs' contributions to primary care and about their wages, and identifies specific research questions that arise from the identified gaps. The chapter concludes with an outline of the three papers that comprised the products of this dissertation, and an overview of the remaining chapters of the dissertation.

### **Theoretical Foundation**

Human capital theory originated in the economics field during the mid-20<sup>th</sup> century (Becker, 1962; Kiker, 1966; Mincer, 1958, 1974; Schultz, 1961). Human capital refers to an individual's personal characteristics (e.g., innate abilities and intelligence, acquired knowledge and education, job skills and abilities, work experiences, and health) and/or behaviors (e.g., job mobility) that affect their productivity and performance (Becker, 1962, 2009; Currie & Madrian, 1999; Willis, 1985). Becker (1962) conceptualized human capital as being both *general* and *specific*. General human capital refers to human capital that is transferable across a range of employers, while specific human capital is applicable to a particular firm, setting, or professional field (Becker, 2009). Individuals typically acquire general human capital through investments made in general education and training, including college coursework, and they acquire specific human capital through investments made in on-the-job training, continuing education, and work experience (Becker, 2009).

Individuals make financial (e.g., tuition payments) and non-financial (e.g., time) investments to acquire human capital<sup>1</sup>, with the expectation that they will receive a return on investment at some future point in time (Ehrenberg & Smith, 2010; Schultz, 1961). These returns typically accrue to individuals by way of increased *productivity* after they enter the

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<sup>1</sup>Unless otherwise specified, "human capital" is used throughout this dissertation to refer to both general and specific human capital.

labor market (Ehrenberg & Smith, 2010). Because individuals' human capital provides knowledge, skills, and abilities that allow them to do new and/or different work, an important assumption of human capital theory is that greater human capital investments result in higher productivity (Becker, 2009; Crook, Todd, Combs, Woehr, & Ketchen, 2011). Unfortunately, productivity is difficult to measure and directly observe. For this reason, labor economists typically consider individuals' wages as a proxy for their productivity (Becker, 2009). Human capital theory thus acknowledges that as human capital is acquired, wages also increase, as a result of increased productivity (Mincer, 1958; Schultz, 1961).

Human capital theory has been used in nursing to recognize nursing as a knowledge-based profession (Moody, 2004). Nursing human capital has been conceptualized as the knowledge, skills, abilities, expertise, and experiences that nurses possess and bring to health care (Hall, 2002; Jones & Gates, 2004). With this definition in mind, the following sections describe PCNs' human capital and its impact on PCNs' contributions to primary care and its economic returns.

### **PCNs' Human Capital**

Because the PCN workforce comprises both primary care RNs (PCRNs) and primary care NPs (PCNPs), general and specific human capital for each group is addressed. Primary care RNs acquire general human capital through their basic, entry-level nursing education and training. With few exceptions, this training includes the education that PCRNs obtain from educational programs providing a three-year diploma in nursing, a two-year associate's degree in nursing (ADN), and/or a four-year bachelor's of science degree in nursing (BSN). The training of PCRNs in each of these programs may or may not include a basic introduction to primary care that focuses on community and public health nursing, health

promotion, disease prevention, and health assessment (Bodenheimer et al., 2015). Primary care RNs prepared with a BSN degree have typically received more focused and intense education and training relevant to primary care, including community-based care, compared with RNs prepared with a diploma or ADN (American Association of Retired Persons, 2010; Institute of Medicine, 2011). After graduation from one of these entry-level nursing programs, PCNRNs acquire specific human capital in primary care by practicing and gaining additional experience in primary care settings and/or through additional education obtained through on-the-job training and continuing education in primary care.

Primary care NPs are RNs who acquire graduate-level education and training as an advanced practice nurse from programs preparing them to become adult NPs (ANP), family NPs (FNP), gerontology NPs (GNP), pediatric NPs (PNP), or women's health NPs (WHNP) (Health Resources and Services Administration, 2002; National Council of State Boards of Nursing, 2008). Primary care NPs acquire general human capital by first investing in their basic RN training and then by investing in graduate-level education in nursing and primary care. Because PCNPs must be RNs before they can become PCNPs, their general human capital as PCNPs builds on their basic RN training. PCNPs also acquire general human capital above and beyond that of their basic RN training through their graduate NP training (generally an additional 1-3 years of training), which typically includes advanced study in family and individual health in lifespan, adult/gerontology health, gender specific health, and pediatric health (National Council of State Boards of Nursing, 2008). After they enter practice, PCNPs acquire specific human capital by gaining experiences caring for and managing patients in a primary care setting, and/or through on-the-job training, and continuing education.

The human capital possessed by PCNs – both PCRNPs and PCNPs – therefore serves as the foundation of their contributions to primary care and influences the economic returns they receive after entering the labor market that acknowledge these investments. The following sections discuss the impact of PCNs’ human capital on their contributions to primary care, and their wages.

### **PCNs’ Human Capital and Their Contributions to Primary Care**

PCNs’ contributions to primary care are reflected in the care they deliver as well as the outcomes of care they achieve (Covell, 2008; Royal, 2012). The following sections describe PCN care, the outcomes of their care, and how PCNs’ human capital affects both.

**PCNs’ human capital and the care they provide.** In the context of health care, *care* generally refers to “what health professionals do for others” (Orem, Taylor, & Renpenning, 2001). Specifically, care depends on: 1) what activities the professional performs to meet the health needs of those to whom care is provided; 2) how the professional should perform the activities, given the job filled in the health care system or the situation of practice, including the services provided within the scope of license, and the collaboration with other health care professionals who also provide care; and 3) why individuals or groups need help to achieve or maintain their health (Orem et al., 2001. p.26-29). Thus, care is characterized from the perspectives of both the care provider and the recipient of care (Orem et al., 2001). Moreover, this conceptualization defines both the content and context of a provider’s care.

Similarly, researchers in the past several decades have characterized PCN care from the perspectives of both PCNs and the recipients of their care. Specifically, they have focused on the following three areas that are consistent with the above conceptualization of care. First, researchers studied the activities, or functions, that PCNs perform to help meet the health

needs of their care recipients (Aparasu & Hegge, 2001; Buerhaus, DesRoches, Dittus, & Donelan, 2014; Everett et al., 2014; Hing & Hooker, 2011; Hughes, Jiang, & Duszak, 2014; Lewis & Linn, 1977). Second, previous studies have explored how PCNs perform their activities given the job they hold in primary care; and particularly, researchers have focused on understanding PCNs' *roles* when they collaborate with physicians (Everett et al., 2014; Laurant et al., 2009; Laurant et al., 2005). Third, researchers have also examined the *diagnostic characteristics of PCNs' care recipients* – that is, why individuals or groups need care from PCNs, including their health problems (e.g., acute or chronic problems) (Hooker & McCaig, 2001), the major reasons that they make visits to PCNs (Hing & Hooker, 2011), and their specific diagnoses (Aparasu & Hegge, 2001; Deshefy-Longhi, Swartz, & Grey, 2008; Lewis & Linn, 1977; McCaig, Hooker, Sekscenski, & Woodwell, 1998).

According to this conceptualization of care and following the convention of previous studies of PCNs, this dissertation examined the above three aspects of PCN care – *functions*, *roles*, and *the diagnostic characteristics of care recipients*. Because the care that professionals deliver is also influenced by their human capital, health professionals must possess relevant theoretical and practical knowledge, expertise, and experience to understand the health problems of their care recipients and the care they may need (Orem et al., 2001). Thus, the following sections will describe each of the three aspects of PCN care and will explain how PCNs' human capital influences them.

***PCNs' functions.*** PCNs' functions include triaging patients, performing health assessments, evaluating and administering immunizations, making diagnoses, ordering and interpreting laboratory tests, prescribing medications, treating and managing disease, planning care, providing health coaching, and coordinating care (American Nurses

Credentialing Center, 2012; Smolowitz et al., 2014). Previous studies have indicated that as PCNs' increased their human capital (e.g., higher education, or more experience), their performance of certain functions also improved, including more frequent and accurate monitoring of medication side effects (Jordan, Coleman, Hardy, & Hughes, 1999), applying and transferring knowledge to practice (Wildman, Weale, Rodney, & Pritchard, 1999), and adhering to practice guidelines (Umble, Cervero, Yang, & Atkinson, 2000).

***PCNs' roles.*** Katz and Kahn (1978) defined an individual's role as the standard patterns of functions that an individual performs in an organization or system as part of his or her job. It is important to note that "role" is comprised of "functions", yet a "role" is more comprehensive and inclusive than discrete "functions" – "role" reflects the depth of individuals' knowledge about the functions performed, and how those functions vary within the jobs that individuals hold.

In keeping with the definition of Katz and Kahn (1978), this dissertation defined PCN role as the pattern of functions that an individual performs in his or her primary care job. Traditionally, researchers have categorized PCN roles as either "substitute" for or "supplement" to PCPs, depending on the degree to which the functions performed by a PCN in his or her job overlaps with or complements a PCP's functions (Laurant et al., 2005). According to Laurant and colleagues (2005), a substitute role is one in which a PCN performs a set of functions that partially or completely overlaps those performed by a PCP, and has the ability to provide certain types of care to patients instead of a PCP (Auerbach, 2000; Cawley, 2011; Cooper, Henderson, & Dietrich, 1998; Record, McCally, Schweitzer, Blomquist, & Berger, 1980). A supplement role is one in which a PCN performs a different or complementary set of functions that augments or extends PCP care, such that the care is

provided along with the care provided by a PCP (Laurant et al., 2005). In practice, PCNs often serve in both types of roles, sometimes simultaneously, with some PCN functions overlapping those of PCPs even when they serve a supplement role. Besides these two roles, PCNs may also serve other roles that are neither substitute nor supplement; for example, PCNs may serve in different roles in retail clinics.

PCNs' human capital may affect the roles that each type of PCN serves in primary care. For instance, because PCNPs have more education, training, and practice skills than PCRNPs, they are more likely than PCRNPs to substitute for PCPs, or serve as the individual's or group's usual care provider (Agency for Healthcare Research and Quality, 2013).

***Diagnostic characteristics of PCNs' care recipients.*** PCNs manage individuals or groups with a variety of diagnostic characteristics, including acute problems, chronic problems (both routine check and disease follow-up), pre-/post-surgery care, and preventive care (Hooker, Benitez, Coplan, & Dehn, 2013; McCaig et al., 1998). PCNs' human capital also prepares them to care for individuals or groups with certain diagnostic characteristics (National Council of State Boards of Nursing, 2008). For instance, WHNPs are prepared to manage the health problems related to women, while PNPs possess human capital to care for the health problems specific to infants and children.

Generally, PCNs' human capital includes the knowledge and skill foundation for the care they deliver, specifically for the functions they perform, the roles they fill, and the diagnoses of their care recipients. This also distinguishes PCN care from the care provided by other primary care professionals, such as PCPs. PCN care is both similar to and different from PCP care, since their human capital both overlaps and is distinct from that of PCPs. Given that previous studies compared PCN and PCP care in terms of their functions, roles,



and the diagnostic characteristics of their care recipients, the following sections will discuss how PCN human capital overlaps and is distinct from that of PCPs, and how PCN care and PCP care is similar and different.

***Human capital and the care they provide – PCNs vs. PCPs.*** The human capital of PCNs overlaps with or is similar to that of PCPs to some degree. It has been estimated that PCNs may have up to seven years of education and training in primary care, while PCPs have at least seven years of medical education and training; certain aspects of the training received by both PCNs and PCPs overlap, including biology and pathophysiology, and perhaps several years of clinical experience related to managing patients' diseases and physical health that they both bring (Djukic & Kovner, 2010; Noriega, 2014). PCNs' training prepares them to perform functions that are similar to those of PCPs, including managing diseases and addressing patients' physical health by performing physical examinations, ordering and interpreting lab tests, making diagnoses, prescribing medications, and treating diseases (Buerhaus et al., 2014; Djukic & Kovner, 2010; Hing, Hooker, & Ashman, 2011; Hooker & McCaig, 2001; Ladd, 2005). PCNs' education and training also prepares them to serve similar roles as PCPs, including serving as a usual care provider for individuals or groups (Everett et al., 2014). The human capital possessed by PCNs that overlaps that of PCPs also enables them to manage individuals or groups with similar diagnostic characteristics in much the same way that PCPs do, including providing care to healthy patients, patients with minor diagnoses (e.g., headaches, or upper respiratory infections), and patients with chronic diseases but without severe or complex situations (Djukic & Kovner, 2010; Morgan, Abbott, McNeil, & Fisher, 2012).

The human capital possessed by PCNs and PCPs is derived from medical and nursing models, respectively. For example, PCPs' human capital arises from patients' specific symptoms or health problems, while PCNs' human capital is more focused on patient counseling, patient education, and disease prevention (Burman et al., 2009; Noriega, 2014). This philosophical basis distinguishes PCNs' human capital from PCPs', making PCNs attuned to performing such functions as providing immunizations, preventive care, health education, and psychological counseling (Hing et al., 2011; Hooker & McCaig, 2001; Ladd, 2005). The human capital of PCNs also allows them to serve different roles than PCPs, including supplement roles or those that extend PCP care and services. Because PCNs do not possess the same level of knowledge as PCPs in terms of diagnosing and treating individuals or groups with complex, acute, or severe problems, they typically do not manage or independently care for patients with complex or severe health problems, particularly in acute situations (Deshefy-Longhi et al., 2008; Dill, Pankow, Erikson, & Shipman, 2013; Noriega, 2014). Thus, PCNs' human capital both determines the care they provide and distinguishes their care from PCP care.

**PCNs' human capital and the outcomes of their care.** Previous studies have suggested that patients cared for by PCNs with higher levels of nursing education and experience had better outcomes than those with less education, including improvements in their general health status, health behaviors, and physical and social functioning (Castle, Engberg, & Men, 2007; O'Brien-Pallas et al., 2001; O'Brien-Pallas et al., 2005). These studies indicate that the more human capital PCNs possess, the better patient outcomes they achieve.

Summary. In general, PCNs' human capital influences their contributions to primary care as reflected by the care they provide, including their functions and roles, and the diagnostic characteristics of their care recipients; PCNs' human capital also is both similar to and different from PCPs' human capital; and PCNs' human capital affects the outcomes they achieve. Moreover, PCNs receive returns to their human capital investments based on the care they provide and the positive primary care outcomes they achieve. PCNs thus benefit in economic terms from their investments in human capital, which is the focus of the next section.

### **Economic Returns to Investments in PCN Human Capital**

Studies examining the economic returns to investments in nurses' human capital have typically examined nurses' wages as a proxy for nursing productivity (Jones, 2004). Researchers reported that for nurses, in general – both PCNs and nurses in acute/specialty care settings – higher levels of nursing education (both the initial and highest nursing degree) (Graf, 2006; Spetz, 2002; Spetz & Bates, 2013), bilingual skills (Coombs & Cebula, 2010; Coomer, 2011, 2013; Kalist, 2005), increased work experience (Botelho, Jones, & Kiker, 1998; Jones & Gates, 2004), and a foreign nursing education (Schumacher, 2011; Walani, 2013) were associated with higher nursing wages. These studies suggest that when nurses, and PCNs by extension, invest in their human capital, their wages are also likely to increase, commensurate with their increased productivity.

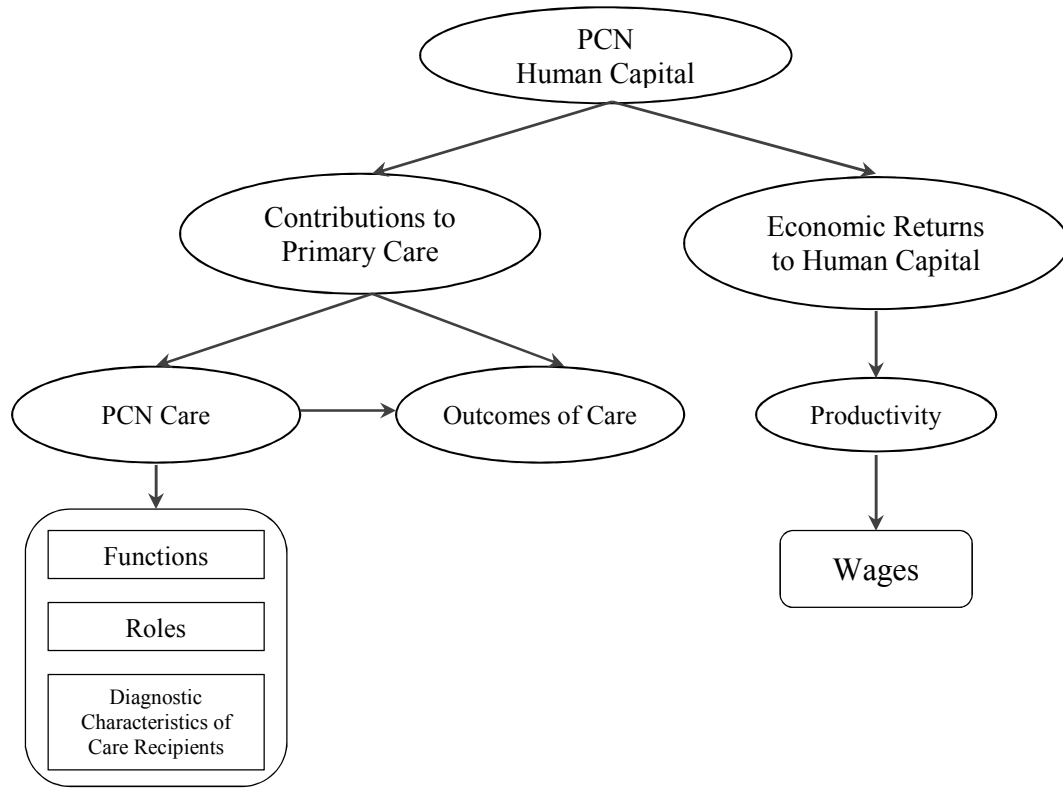
Summary. Based on prior research, this dissertation postulated that PCNs' human capital influences their contributions to primary care and their economic returns in the form of wages. The human capital framework and prior workforce research provide support for the conceptual framework that guided this dissertation. The following sections describe the

conceptual framework of this dissertation, discuss the knowledge gaps, and propose the research questions that were addressed in this dissertation.

### **The Conceptual Framework of this Dissertation**

Drawing on human capital theory and the research literature, the conceptual framework of this dissertation suggests that PCNs' human capital impacts both their contributions to primary care and their economic returns (Figure 1.1). The underlying principle is that PCNs' human capital provides the knowledge and skills that are foundational to their contributions to primary care, including *PCN care* – the *functions* they perform, the *roles* they serve, and the *diagnostic characteristics of their care recipients* they manage – and the *outcomes of care* that PCNs achieve. This conceptual framework also indicates that the *economic returns* to PCNs' investments in human capital are reflected in PCNs' *productivity* as measured by their *wages*.

**Figure 1.1: The Conceptual Framework of this Dissertation Study**



### **Knowledge Gaps and Research Questions**

The aforementioned conceptual framework represents PCNs' contributions to primary care based on their human capital, and the economic returns to PCNs' human capital. However, knowledge about some aspects of the conceptual framework, such as PCN care, the outcomes of PCN care, and PCN wages, is lacking. This knowledge deficit potentially limits the full utilization of PCNs in the primary care system. This section will discuss these knowledge gaps and propose the research questions that were addressed in this dissertation.

First, we lack a systematic and comprehensive understanding of PCNs' contributions to primary care, including the care they provide and the outcomes of PCN care. This knowledge is critical to inform their future utilization and the opportunities to fill new

positions in the transformed primary care system. Several literature reviews conducted since 1990 have studied PCNs' contributions to primary care, and suggested that, compared with PCPs, PCNs achieved similar outcomes in terms of patients' perceptions of satisfaction with and the effectiveness of primary care (Horrocks, Anderson, & Salisbury, 2002; Keleher, Parker, Abdulwadud, & Francis, 2009; Laurant et al., 2005; Martínez-González et al., 2014; Naylor & Kurtzman, 2010; Stanik-Hutt et al., 2013; Swan, Ferguson, Chang, Larson, & Smaldone, 2015). However, our understanding of PCNs' unique contributions to primary care remains limited in terms of the distinct nature of the care they provide, the new roles they fill, and their emerging contributions to new models of care delivery. These limitations hinder our understanding of PCNs' contributions to the evolving primary care system and inhibit future efforts to optimally utilize PCNs' contributions and achieve the aims of primary care system transformation. Therefore, this knowledge gap led to the first research question: **What are PCNs' contributions to primary care, including the care they provide and the outcomes of their care?**

Second, under the component of PCNs' contributions to primary care, we know little about PCN care. Specifically, little is known about how PCN care is similar to and different from PCP care. Although a few studies over the past several decades characterized and compared the care provided by PCNs and PCPs, our knowledge remains limited in terms of how the care delivered by the collective PCN workforce (both PCRNs and PCNPs) is compared with the care delivered by PCPs, how the roles of PCNs are similar to and different from those of PCPs, and what the specific diagnoses that PCNs and PCPs manage. These limitations hinder a comprehensive and informative understanding of PCN and PCP care and how tasks and patients could be better assigned between these two types of professionals.

Because PCNs are often called upon to collaborate with PCPs and coordinate the care ordered by PCPs in primary care, determining the similarities and differences between PCN care and PCP care is important to differentiate the activities of PCNs and PCPs, optimally utilize their overlapping and unique human capital, and strengthen the collaboration and coordination of these two professional groups (Institute of Medicine, 2011). Therefore, the second research question that was addressed in this dissertation was: *How is PCN care similar to and different from PCP care, in terms of their functions, roles, and the diagnostic characteristics of their care recipients?*

Third, we lack information about PCN wages because most previous studies did not focus exclusively on the PCN workforce. This knowledge gap is especially pronounced in the *PCNP* workforce, as there is minimal research on the topic despite the significant contributions that PCNPs make to primary care and the increased demand for PCNPs (Auerbach et al., 2013). Moreover, previous descriptive studies indicate that general NPs (both PCNPs and specialty care NPs) working in primary care settings may earn, on average, less than those working in specialty care settings. This wage difference may be one of the reasons that some NPs may choose not to practice in primary care settings. Lower wages may also be associated with lower job satisfaction and an increased likelihood of turnover among NPs working in primary care settings, when compared with NPs working in other settings (De Milt, Fitzpatrick, & Sister Rita, 2011; Pasaron, 2013), and may thus deter NPs and NP graduates from choosing to work in primary care settings (Budd, Wolf, & Haas, 2015; Petterson, Phillips, Bazemore, Burke, & Koinis, 2013). However, few efforts have identified whether or not this wage difference exists in PCNPs workforce. Understanding the determinants of PCNP wages and how PCNP wages vary with their human capital and other

characteristics is important to understand how future PCNP supply may be affected.

Therefore, the final research question that was addressed in this dissertation was: **Is there wage disparity between PCNPs employed in primary care settings and those employed in specialty care settings and if so, why?**

To address these research questions, this dissertation includes three related papers that reflect independent analyses. An outline of this dissertation and a brief summary of each proposed paper are provided in the following section.

### **An Outline of this Dissertation**

Chapter 1 has provided the background, theoretical foundation and conceptual framework, as well as the knowledge gaps, research questions, and an overview of this dissertation. Chapters 2, 3, and 4 were formatted as three papers that report the three different analyses addressing the aforementioned research questions, respectively. Chapter 5 provides a discussion and synthesis of the general findings of all papers, and addresses the limitations, research implications, and policy implications of the dissertation.

The following sections provide a general description of each of the three studies, including the study purpose, the proposed study methods, and the target journal. Because these three studies focused on different study populations and concepts, a summary table of the study aims, study population, main concepts, and the operationalization of the main concepts of each study is presented in Table 1.1.



**Table 1.1: A Summary of the Key Information in the Three Papers**

Study	Purpose	Population	Main Concepts in Conceptual Model	Operationalization of Main Concepts
<b>Chapter 2 (Paper 1)</b>	To conduct an integrative literature review of PCNs' contributions to primary care in terms of their care and the outcomes of their care in the U.S. primary care system.	PCNs	1. PCN care  2. Outcomes of care	<b>1. Functions:</b> PCNs' activities in the reviewed studies <b>2. Roles:</b> <ul style="list-style-type: none"> <li>• Substitute role</li> <li>• Supplement role</li> <li>• Other role</li> </ul> <b>3. Diagnostic characteristics of care recipients:</b> <ul style="list-style-type: none"> <li>• Patients' diagnoses</li> </ul> The six aims of quality of care proposed by the Institute of Medicine (2001) – <i>safe, effective, patient-centered, timely, efficient, and equitable</i> .
<b>Chapter 3 (Paper 2)</b>	To compare the functions, roles, and diagnostic characteristics of care recipients of PCNs and PCPs in primary care.	PCNs & PCPs	PCN care	<b>1. Functions:</b> The services, therapy, and procedures that PCNs provided in office-based and outpatient settings <b>2. Roles:</b> <ul style="list-style-type: none"> <li>• Usual provider role</li> <li>• Supplement role</li> </ul> <b>3. Diagnostic characteristics of care recipients:</b> <ul style="list-style-type: none"> <li>• Patients' diagnoses</li> </ul>
<b>Chapter 4 (Paper 3)</b>	To examine PCNP wages and differences in wages between PCNPs employed in primary care settings and those employed in specialty care settings.	PCNPs	Productivity	<b>PCNP hourly wages</b>

## **Chapter 2 (Paper 1): An integrative literature review of PCNs' contributions to the U.S. primary care system.**

**Study aim and method.** To address the first research question of this dissertation, this paper reviewed existing literature regarding PCNs' contributions to primary care in terms of their care and the outcomes of their care in the U.S. primary care system. The study population for this paper was PCNs – that is, both PCRNPs and PCNPs. Using integrative literature review methods of relevant studies published from 2011 until 2015, PCN care was examined by identifying the reported functions they performed, the roles they served, and the diagnoses of their care recipients. The outcomes of PCN care were examined within the context of the six aims of a quality health care system proposed by the Institute of Medicine (2001): that is, a quality health care system, and, by extension, the professionals in it, should provide care that is *safe, effective, patient-centered, timely, efficient, and equitable*. This framework was used to categorize the information from the reviewed studies.

**Target journal.** The target journal for this paper is *Nursing Outlook*. This journal was selected because it focuses on the synthesis and dissemination of knowledge on current challenges in nursing practice and education, with a particular emphasis on research addressing policy-relevant issues in nursing health care, including the presentation of solutions for care delivery problems, and the appropriate and effective utilization of the nursing workforce. This paper is consistent with the journal's focus because appropriately utilizing the PCN workforce to meet the changing needs of the primary care system is among one of the most challenging issues reported in the nursing literature (Buerhaus et al., 2014; Iglehart, 2013; Smolowitz et al., 2014). Also, improving our knowledge and understanding of PCN care and the outcomes of their care is important to inform efforts to improve PCN practice, reform policies related to PCN practice, and optimize PCNs' contributions to

primary care delivery. This paper is particularly important to this journal given that PCNs may make even greater contributions to the primary care system in the future because of their expertise in providing comprehensive, coordinated, and continuous primary care, which feature prominently in the new models of care emerging from health care reform (e.g., patient-centered medical homes and accountable care organizations) (Auerbach et al., 2013; Naylor, Aiken, Kurtzman, Olds, & Hirschman, 2011). Moreover, this journal is a highly regarded journal in the nursing field, ranked 42<sup>nd</sup> among 228 U.S. nursing journals, with an impact factor of 1.59 in 2015 (SCIMago Journal and Country Rank, 2016). Also, this paper provides a comprehensive and current understanding of PCNs' contributions to primary care, which therefore makes this journal an appropriate target for submission.

**Chapter 3 (Paper 2): A comparison of care delivered by PCNs and PCPs in primary care settings.**

**Study aim and method.** To address the second research question of this dissertation, this paper compared PCN and PCP care in U.S. primary care settings, in terms of their functions, roles, and the diagnostic characteristics of their care recipients. The study population for this paper was PCNs – that is, both PCRNs and PCNPs – and PCPs. A cross-sectional, secondary analysis was applied using data from annual *Medical Expenditure Panel Survey* (MEPS) files from 2002-2013. Propensity score matching was used to match patients who saw PCNs as a USC with patients who saw PCPs as a USC, to control for the impacts of patient demographic characteristics and health status with respect to the provider they used and the care they received. Descriptive analyses were used to: 1) compare PCN and PCP functions by examining the services, therapy, and procedure they provided to care recipients; and 2) compare the roles of PCNs and PCPs by examining their functions when they served

the usual provider role<sup>2</sup> and supplemental role, respectively. A multinomial logistic regression was used to examine the diagnostic characteristics of patients who received care from PCNs and PCPs.

**Target journal:** This paper will be submitted to the journal *Health Affairs*. This journal was selected because it is an interdisciplinary journal that publishes studies addressing current U.S. policy concerns and cross-disciplinary issues related to improving health, health care, quality, and access. This journal is an appropriate target for this study because: 1) the similarities and differences in the care between PCNs and PCPs are among the most hotly debated policy issues related to the changing primary care system (Donelan, DesRoches, Dittus, & Buerhaus, 2013); and 2) new insights on this issue are important for informing the assignment of patients to PCNs and PCPs, strengthening their collaboration and the coordination of care delivered by each, and advancing the quality of primary care. This journal is also a top health care science journal, ranked 5<sup>th</sup> out of 85 health care science and services journals, and 2<sup>nd</sup> out of 212 health policy and services journals; an impact factor of 5.23 was reported for 2015 (SCIMago Journal and Country Rank, 2016). Because this paper provides new evidence about the care delivered by both PCNs and PCPs, it is suitable to submit this manuscript to this journal.

#### **Chapter 4 (Paper 3): A comparison of wages for PCNPs working in primary care and specialty care settings.**

**Study aim and method.** To address the third research question of this dissertation, this paper examined PCNP wages and compared the wages of PCNPs employed in primary care settings with those of PCNPs employed in specialty care settings. Unlike the study

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<sup>2</sup>Usual provider role has been used in past research to reflect the substitute role of advanced practice providers (Everett et al., 2014). Using this definition, PCN roles were examined accordingly and this terminology is used throughout this dissertation.

populations of Paper 1 and Paper 2, this paper focused specifically on PCNPs. A cross-sectional, secondary analysis design was used by analyzing data from the 2012 *National Sample Survey of Nurse Practitioners* (NSSNP). To carry out such an analysis, a feasible generalized linear regression was used to first model PCNP wages as a function of their human capital, employment, and demographic characteristics. Then, the existence of a wage disparity between PCNPs working in primary care and specialty care settings was explored using a Chow-test. A common approach used to examine wage disparities, the Oaxaca-Blinder decomposition technique, was then used to investigate the factors contributing to these differences.

**Target journal:** This paper will be submitted to the journal, *Nursing Economic\$*. This journal was selected because it publishes studies focusing on management, finance, economics, and policy making in health care and nursing. It is a suitable target journal for this paper because this study focused on the economic returns to PCNPs' human capital. *Nursing Economic\$* is a highly regarded journal in nursing, ranking 82<sup>nd</sup> out of 228 U.S. nursing journals, with an impact factor of 0.59 in 2015 (SCIMago Journal and Country Rank, 2016). Because this paper reported the analysis of PCNP wages and wage disparities, it is suitable for submission to this journal.

### **Chapter Summary**

This chapter provided a general overview of this dissertation's purpose and the background information supporting its focus. This dissertation aimed to improve our understanding of PCNs' contributions to primary care and the wages of PCNs employed in primary care settings. This chapter presented the theoretical foundation of this dissertation, human capital theory, and proposed a general conceptual framework to guide the dissertation.

This dissertation included three related studies that each pertain to different aspects of the dissertation's general conceptual framework. The next three chapters describe each of the three studies in greater detail.

## **CHAPTER 2: AN INTEGRATIVE LITERATURE REVIEW OF PRIMARY CARE NURSES' CONTRIBUTIONS TO THE U.S. PRIMARY CARE SYSTEM**

### **Background**

As the largest component of the primary care workforce, primary care nurses (PCNs) play a vital role in the U.S. primary care system (Institute of Medicine, 2011). Several literature reviews conducted over the past decade have examined PCNs' contributions to primary care (Horrocks et al., 2002; Keleher et al., 2009; Laurant et al., 2005; Martínez-González et al., 2014; Naylor & Kurtzman, 2010; Shaw et al., 2014; Stanik-Hutt et al., 2013; Swan et al., 2015). These reviews analyzed findings from studies published before 2012, and examined the outcomes of PCN care in a variety of countries, including the United States, Canada, United Kingdom, Netherlands, South Africa, Australia, and Russia.

Findings of these previous literature reviews identified several important contributions of PCNs to primary care. These studies noted that when PCNs served in a *substitute* role to PCPs: 1) PCNs delivered care that achieved patient outcomes similar to those of PCPs, including patient health and functional status, mortality, and reductions in blood pressure, total cholesterol, and HbA1c; 2) patients cared for by PCNs had similar numbers of emergency room visits and hospitalizations as those cared for by PCPs; and patients cared for by PCNs reported higher levels of satisfaction, and receiving longer consultations and more frequent follow-up than patients cared for by PCPs

(Horrocks et al., 2002; Keleher et al., 2009; Laurant et al., 2005; Martínez-González et al., 2014; Naylor & Kurtzman, 2010; Stanik-Hutt et al., 2013; Swan et al., 2015). Previous literature reviews have also suggested that when PCNs served in a *supplemental* role to PCPs, patients had better outcomes on blood pressure, total cholesterol, and HbA1c greater knowledge (Shaw et al., 2014) and were more compliant with treatment than patients who received care from PCPs alone (Keleher et al., 2009).

While prior literature reviews have advanced our understanding of PCN care, we lack current knowledge about PCNs' contributions to primary care in the context of recent changes in the delivery of primary care. Previous reviews focused almost exclusively on the outcomes of PCN care; very few examined the *care* that PCNs actually provide, including their functions, roles, and the diagnostic characteristics of care recipients. It is reasonable to expect that PCNs would achieve different outcomes when performing different functions, serving in different roles and caring for patients with different diagnoses. Without examining these aspects of PCN care, it is difficult to understand the full scope of PCNs' impact on the outcomes of care, or how PCNs contribute to primary care.

Most of the previous reviews focused only on PCNs' contributions to primary care when they served as a substitute role to PCPs; only two literature review examined the outcomes of PCN care when they served as a supplemental role to PCPs (Keleher et al., 2009; Shaw et al., 2014). This lack of knowledge about the outcomes of PCN care when they serve a supplemental role makes it difficult to fully utilize PCNs' expertise in extending patient care and providing integrated and holistic primary care. Also, limiting reviews to focus only on the traditional roles of PCNs as substitute and supplemental neglects the broader contributions they make to primary care because these labels only describe PCNs'



contributions when they collaborate with PCPs (Everett et al., 2014). There are certain independent functions that PCNs perform and roles they fill that may not necessarily require collaboration with PCPs. For example, PCN-led clinics (e.g., NP-staffed clinics and retail clinics) enable PCNs to contribute to primary care by offering patients expanded access to care and more flexibility in the locations where they receive care. PCNs' roles in these clinics are designed to better meet patient care needs and do not fit in the traditional categorizations of substitute or supplemental.

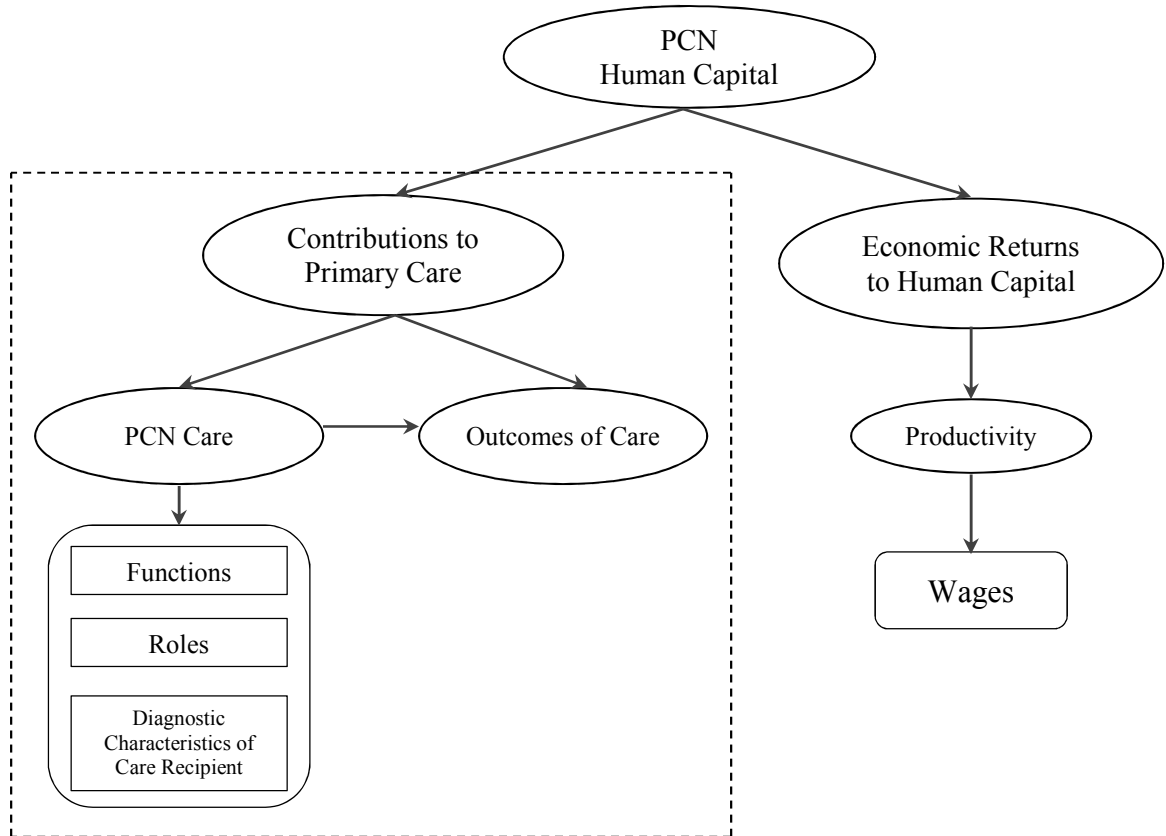
Finally, because many of the prior reviews were conducted outside of the U.S., the findings are not directly applicable to PCN care in the U.S. primary care system. All of the previous reviews merged studies from a variety of countries with differing PCN education and practice models and differing health care systems and payment models, which makes it difficult to discern their generalizability to PCNs' contributions to the U.S. primary care system.

To address these limitations, this chapter presents an integrative literature review of PCNs' contributions to the U.S. primary care system, conducted using U.S. studies published between 2011 and 2015. This integrative review examined the first research question of this dissertation: *What are PCNs' contributions to primary care, including the care they provide and the outcomes of their care?*

## Conceptual Framework

The research question addressed in this chapter focused on certain aspects of the dissertation's overall conceptual framework, as shown by the dotted line in Figure 2.1 below.

**Figure 2.1: Areas of Focus in Chapter 2, from this Dissertation's Overall Conceptual Framework**



## **Methods**

This integrative literature review used the seven-step approach of conducting a research synthesis outlined by Cooper (2009). A discussion of each step follows.

### **Step 1: Formulating the Problem**

This step was achieved through a preliminary examination of the literature, which indicated that there was sufficient literature available to conduct this review. The preliminary review also highlighted weaknesses of prior literature reviews and underscored the need for a synthesis of current literature on PCN care and the outcomes of their care. This step was augmented by reviewing related articles and discussing relevant issues with experts in the field. Taken together, this information suggested that an integrative review was warranted to better understand PCNs' contributions to primary care and the PCN workforce.

### **Step 2: Searching the Literature**

A thorough literature search was conducted by searching the following electronic databases: PubMed, the Cumulative Index to Nursing & Allied Health Literature (CINAHL), the Cochrane Library, Web of Science, and Google Scholar. The terms used in the searching process, including the medical subject headings (MeSH) used in PubMed, were “nurse practitioner,” “registered nurse,” “primary care,” “family medicine,” “ambulatory care,” “general practice,” “community health center,” “patient-centered medical home,” “transitional care,” “retail clinic,” “home health,” “accountable care organizations,” and “nurse-managed health center or nurse-led clinic.” The reference lists of all articles were scanned for additional articles that were not identified in the initial search.

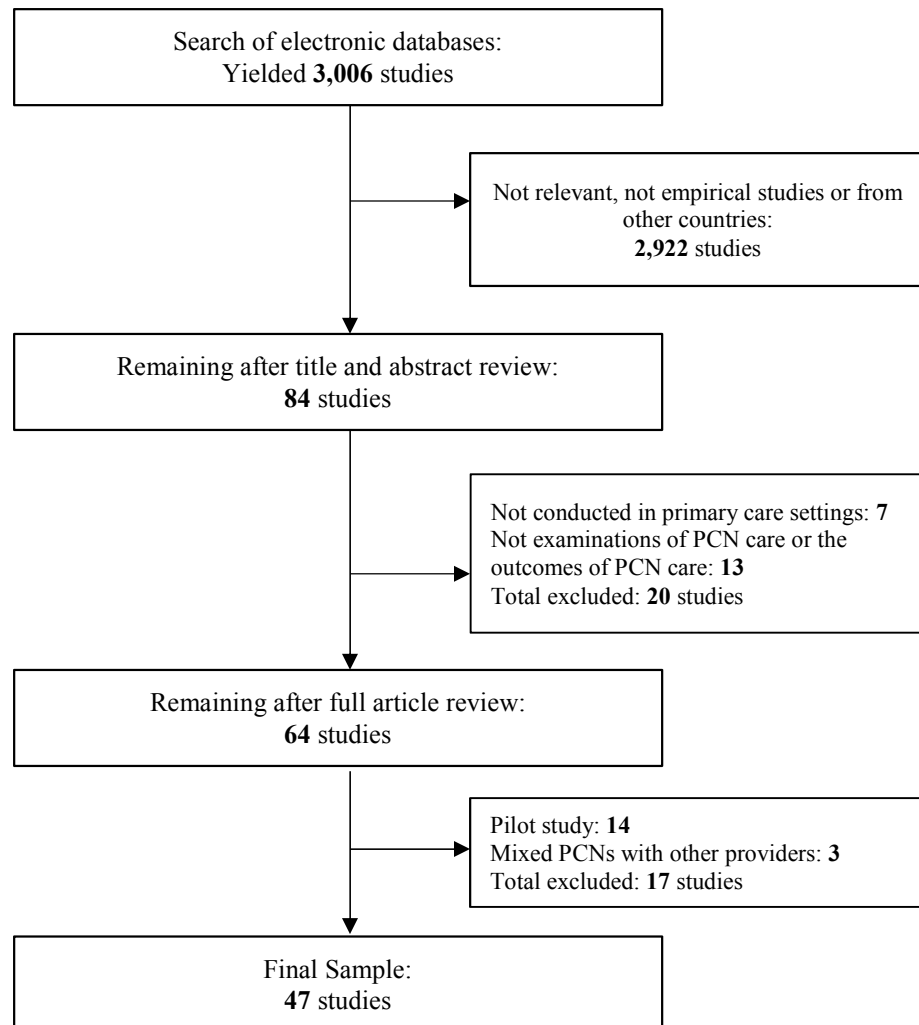
### **Step 3: Gathering Information**

The following inclusion criteria were used to select articles for this review. First, only articles reporting empirical research conducted in U.S. primary care settings were included; pilot studies were excluded because of the small sample sizes of studies. This approach was used to gather evidence specific to PCNs in the U.S. primary care system, and to minimize the variability introduced by differing education, regulatory and payment systems in other countries. Second, only articles that were published in peer-reviewed journals between January 1, 2011 and December 31, 2015 were selected for review. Limiting the dates of articles allowed the researcher to build on and expand previous literature reviews and to capture the contemporary and evolving contributions of PCNs to the transforming primary care system. Finally, this review focused on articles that reported analyses of only PCN care or the outcomes of PCN care. Articles with samples that combined PCNs and other providers (e.g., PAs and social workers) were excluded to focus on the contributions of PCNs only.

Figure 2.2 provides a flow chart of the literature-selection process based on the above inclusion criteria. Initially, the search of key words in electronic databases yielded 3,006 articles. The titles and abstracts of each article were first examined to determine relevance to the purpose of this review and to ensure that studies met the inclusion criteria. Of these studies, 2,022 were excluded because they were not empirical studies, were not consistent with the study's purpose or were conducted in other countries; after this step, there were 84 articles remaining for further review. These 84 articles were then reviewed in their entirety; 20 were excluded because they were not specific to primary care or did not examine PCN care or outcomes. Of the 64 remaining articles, 17 were excluded because they were pilot studies or examined PCNs combined with other primary care providers. This process resulted

in a final sample of 47 articles for review. Appendix 2.1 provides a list of the articles that were reviewed in this study.

**Figure 2.2: Description of the Information Gathering Process**



#### **Step 4: Evaluating the Quality of Studies**

This step was accomplished by applying the quality scoring approach developed by Kmet, Lee, and Cook (2004). Their approach includes two separate scoring systems: one for evaluating quantitative studies and one for evaluating qualitative studies. Because no qualitative studies met the inclusion criteria of this study, only the scoring system for

evaluating quantitative studies was applied. This scoring system includes items related to study purpose, study design, study subjects, analysis methods, and study results. The items in this scoring system and the calculation formulas are presented in Appendix 2.2. This approach allows the quality of studies to be assessed based on a scale ranging from 0 to 1. A study with a score equal to or greater than 0.75 is considered to be of good quality. Because most of the reviewed studies were randomized control trials (RCT), quasi-experiments, or model simulation and included more detailed analyses, the scores for the reviewed studies ranged from 0.82 to 1, indicating that all of the studies reviewed were of good quality. No study was excluded in this step.

#### **Step 5: Analyzing and Integrating Studies' Outcomes**

This step was conducted using a matrix table to consistently gather key information from each study. This matrix was used to organize the reviewed studies, outline their limitations, and draw conclusions about the status of studies in this field. This matrix table was separated into several sub-tables, as presented in Appendices 2.3 – 2.8.

#### **Steps 6: Interpreting the Evidence**

To examine the evidence of *PCN care* in each study, PCNs' functions, roles, and the diagnostic characteristics of their care recipients were identified. The *functions* of PCNs were examined by using a proposed categorization derived from two studies that examined PCNs' activities. First, Smolowitz et al. (2014) reported that PCRNs' activities included assessment and documentation of health status, telephone triage, medication reconciliation, delegating care for episodic illness management, intensive care/case management with a focus on chronic illness, hospital transition management, health coaching, practice management and staff supervision, and quality improvement and team leadership; and PCRNs performed these

functions under three contexts: 1) *episodic and preventive care*; 2) *chronic disease management*, and 3) *practice operations*<sup>3</sup>. The American Nurses Credentialing Center (2012) reported that PCNPs' activities could be summarized as: 1) *patient assessment*, including obtaining health history, performing a comprehensive evaluation/assessment/physical exams, and triaging patients; 2) *diagnosis*, including ordering/performing/interpreting diagnostic tests and developing diagnoses; 3) *clinical management*, including developing plan of care, prescribing medications, monitoring patients, educating/counseling patients, immunizing, managing health maintenance, and transitioning care; and 4) *others*, including collaborating and fostering collaboration with other professionals or stakeholders, providing social and culture support, improving quality, and engaging in scholarly/administrative/career development activities.

Because this literature review focused on PCNs – PCRNs and PCNPs combined – neither of the categorizations described in the above two studies could be used. Yet, these two studies provided a summary of PCRNs and PCNPs' activities that could be combined and integrated to derive a categorization of PCN functions that was relevant to both PCRNs and PCNPs (Table 2.1). The following five categories were derived based on the integration of PCRNs and PCNPs' functions and used in this review to categorize PCN functions: 1) patient assessment, including obtaining health history, performing a comprehensive evaluation/assessment/physical exam, and triaging patients; 2) diagnosis and treatment,

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<sup>3</sup>It should be noted that before the study of Smolowitz et al. (2014), Hackbarth, Haas, Kavanagh, and Vlasses (1995) proposed 11 dimension of PCRNs' activities in ambulatory care: enable operation, assist with procedures, nursing process (e.g., develop plan of care, and assess patient), telephone communication, care coordination, advocacy, teaching, expertise/advanced practice, quality improvement, research, and continuing education. This categorization was not applied in this paper because it might not capture the most recent PCRNs' activities and it was only focused on ambulatory care; instead, this paper used the categories proposed by Smolowitz et al. (2014) because their categories were proposed most recently and were based on an analysis from a variety of primary care settings across nationwide.

including ordering/performing/interpreting diagnostic tests, developing diagnoses, and performing treatment; 3) care management, including developing/implementing/reconciling plan of care, communicating with other professionals, transitioning care across settings or systems, following up with patients, and documenting care; 4) health promotion and disease prevention, including educating/coaching patients, providing social and culture support, and implementing health maintenance and disease prevention; and 5) others, including practice management, quality improvement, and research/teaching activities.



**Table 2.1: The Integration of PCRNS' Functions from the Study of Smolowitz (2014) and PCNPS' Functions from the Study of ANCC (2012)**

PCNs' functions examined in this study	PCRNs' functions Smolowitz et al. (2014)	PCNPs' functions ANCC (2012)
<b>Assessment</b>	Assessment of health status	<i>Assessment:</i> <ul style="list-style-type: none"> <li>• Obtain history</li> <li>• Perform exam/evaluation</li> <li>• Triage patients</li> </ul>
	Telephone triage	
<b>Diagnosis and Treatment</b>	N/A	<i>Diagnose:</i> <ul style="list-style-type: none"> <li>• Order/perform/interpret diagnostic tests</li> <li>• Develop diagnosis</li> </ul>
		<i>Clinical management:</i> <ul style="list-style-type: none"> <li>• Perform treatment</li> <li>• Prescribe medications</li> </ul>
<b>Care Management</b>	Medication reconciliation	<i>Clinical management:</i> <ul style="list-style-type: none"> <li>• Develop/implement/reconcile plan of care</li> <li>• Monitor/follow-up patients</li> <li>• Transition care</li> <li>• Document care</li> </ul>
	Delegating care for episodic illness management	<i>Others:</i> Collaborate and foster collaboration with other professionals
	Intensive care/care management	
	Hospital transition	
	Documentation of health status	
<b>Health Promotion and Disease Prevention</b>	Health coaching	<i>Clinical management:</i> <ul style="list-style-type: none"> <li>• Educate and counsel patients</li> <li>• Immunize</li> <li>• Manage health maintenance</li> </ul>
<b>Others</b>	Practice management and staff supervision	<i>Others:</i> <ul style="list-style-type: none"> <li>• Improve quality</li> <li>• Engage in scholarly/administrative/career development activities</li> </ul>
	Quality improvement and Team leadership	

The roles of PCNs were categorized as substitute or supplemental, consistent with the conceptualization of PCN role described in Chapter 1. These labels have been used to categorize PCN roles in previous literature reviews (Everett et al., 2014; Laurant et al., 2005). The label of “*substitute*” was used if: 1) PCNs' functions were similar to those of

PCPs; or 2) studies compared the care provided by PCNs only with the care provided by PCPs only. Second, the label of “supplemental” was used if: 1) PCNs extended the care provided by PCPs or by PCPs with other providers; or 2) studies compared the care provided by PCNs with those provided by PCNs and PCPs, or by PCNs, PCPs, and other professionals versus the care provided without PCNs. Third, the label “other role” was used for studies in which PCN roles could not easily be categorized as either substitute or supplemental. Then, within each PCN role, the functions reported in each study were further categorized based on the five categories listed above.

The diagnostic characteristics of PCNs’ care recipients were also extracted from each study reviewed. Specifically, patients’ diagnoses or diseases were identified from each study and summarized based on the specific role that PCNs fulfilled in each study.

To synthesize the evidence of the *outcomes of PCN care*, the Institute of Medicine (2001) six aims of a quality health care system – safe, effective, patient-centered, timely, efficient, and equitable<sup>4</sup> – were used as an organizing framework for the review. This approach has been used in previous reviews to examine the outcomes of NP or PA care (Hooker & Everett, 2012; Stanik-Hutt et al., 2013). However, the approach was expanded in this review to categorize evidence of PCNs’ contributions to the quality of primary care.

Because PCNs might achieve different outcomes when serving substitute, supplemental, or

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<sup>4</sup>**Safe** care refers to “avoiding injuries to patients from the care that is intended to help them.” **Effective** care refers to “providing services based on scientific knowledge to all who could benefit and refraining from providing services to those not likely to benefit.” **Patient-centered** care refers to “providing care that is respectful of and responsive to individual patient preferences, needs, and values and ensuring that patient values guide all clinical decisions.” **Timely** care refers to care that “reduc[es] waits and sometimes harmful delays for both those who receive and those who give care.” **Efficient** care is care that “avoid[s] waste, including waste of equipment, supplies, ideas, and energy.” **Equitable** care refers to care that “does not vary in quality because of personal characteristics such as gender, ethnicity, geographic location, and socioeconomic status.” (Institute of Medicine, 2011)

other role, the studies included in this review were examined individually according to this PCN role categorization.

### **Step 7: Presenting the Results.**

The results of this literature review are presented in the following sections. The next sections begin with a general summary of the reviewed studies, including study populations, the designs used, study samples, the settings where studies were conducted, and study purposes. Then the care that PCNs were reported to provide are presented by identifying the functions PCNs performed, the roles in which PCNs served, and the diagnostic characteristics of PCNs' care recipients from the reviewed studies. The outcomes of PCNs care are presented last, following the approach described above.

## **Results**

### **General Summary of the Reviewed Studies**

An overview of the reviewed studies is presented in Appendix 2.3. Among these 47 studies, 23 focused on PCNRNs, 20 focused on PCNPs, and four focused on both. Almost half of the reviewed studies (n=20) used a RCT design; the remaining studies used a quasi-experimental design (n=6), observational design (n=19), or model simulation (n=2). Most of the reviewed studies (n=39) had a sample size greater than 100.

These studies reflected a variety of primary care settings, including outpatient/ambulatory care/internal/family medicine clinics (n=11), PCN-led clinics (i.e., nurse-managed health centers, NP-staffed clinics, retail clinics, and nurse-run walk-in clinics in this study) (n=9), community health centers (n=8), Veteran Affairs (VA) clinics (n=6),

group health clinics (n=3), and free-standing endoscopy centers (n=1)<sup>5</sup>. These studies were also conducted for one of the following purposes: 1) to examine a PCN-led intervention (care management program) in which PCNs collaborated with PCPs and/or other professionals as part of an interprofessional team to manage patients' health (n=21); 2) to examine care delivered outside of traditional primary care settings, including home health<sup>6</sup> (n=8), transitional care<sup>7</sup> (n=3), and patient-centered medical homes (n=2); 3) to compare the care provided by PCNs with the care provided by PCPs (n=7); or 4) to examine PCN-led clinics (n=6). The following sections will review the findings of the care that PCNs delivered – their functions and roles and the diagnostic characteristics of their care recipients – and the outcomes of PCN care.

### **PCN Care**

**PCNs' functions.** The functions that PCNs performed in the reviewed studies are summarized and presented in Appendices 2.4 – 2.7. Among these 47 studies reviewed, 38 studies clearly described the functions that PCNs performed while another nine studies did not. A detailed comparison of these two types of study on their study populations, study designs, sample sizes, study settings, study purposes, and the scores of study quality is presented in Appendix 2.8.

PCNs' functions in the 38 studies, fell into the following four of the five categories as previously described:

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<sup>5</sup>The sum of these numbers is greater than the total number of studies reviewed because some studies were conducted in several different primary care settings.

<sup>6</sup>PCNs provide care in patients' homes or in home health care settings (Centers for Medicare & Medicaid Services, 2016).

<sup>7</sup>PCNs provide care for patients transferred from acute to primary care (Naylor et al., 2011).

- 1) ***Patient assessment.*** Eighteen studies reported that PCNs:
  - a. Assessed patients at their initial visit to determine their symptoms, health needs (including physical, psychosocial, and environmental aspects) and level of health knowledge (n=9);
  - b. Triaged patients (n=1); and/or
  - c. Assessed patients at follow-up visits to determine their symptoms and adherence to medication and plan of care through home visits, phone calls, home monitoring devices or provider office visits (n=11).
- 2) ***Diagnosis and treatment.*** Eight studies reported that PCNs:
  - a. Ordered, provided, and/or interpreted lab tests (n=4);
  - b. Made initial diagnoses (n=1);
  - c. Prescribed medicine (n=3); and/or
  - d. Administered medication (n=2). <sup>8</sup>
- 3) ***Care management.*** In most of the reviewed studies (n=34), PCNs:
  - a. Exchanged information with other professionals (e.g., PCPs, specialists, dietitians, or pharmacists) or with other settings or systems (e.g., acute care settings) through electronic health records (EHRs) or direct communication (n=7);
  - b. Developed plans of care alone or with other professionals, patients, and patients' family and caregivers (n=17);
  - c. Implemented and adjusted plans of care (n=10);

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<sup>8</sup>The subcategory of “ordered, provided, and/or interpreted lab tests” included three NP studies and one RN study; the subcategory of “make initial diagnoses” included one RN study; the subcategory of “prescribed medicine” included two NP studies and one RN study; and the subcategory of “administered medication” included two NP studies.

- d. Discussed and/or counseled changes in patients' situations and plan of care with other professionals (n=15);
  - e. Scheduled appointments for patients with PCNs or other professionals (n=5);
  - f. Followed up with patients via phone calls, home monitoring devices, home visits, or provider office visits (n=20); and/or
  - g. Referred patients to other professionals or settings (n=4).
- 4) ***Health promotion and disease prevention.*** In more than half of the reviewed studies (n=24), PCNs:
- a. Provided education/counseling/coaching (e.g., lifestyle and diet changes, or disease prevention) for patients and their family and caregivers through face-to-face visit, telehealth, online education programs, and home monitoring devices (n=23);
  - b. Provided cultural and social support for patients and their family and caregivers, such as helping them connect with community resources (n=3); and/or
  - c. Administered immunizations (n=1)<sup>9</sup>.
- 5) ***Others.*** No study reported PCNs' activities of such as practice management, quality improvement, and research/teaching activities (n=0).

The review of these 38 studies provides important information about PCNs' functions. First, the functions of PCNs reported in these studies were focused on four of the five functional categories described earlier: patient assessment, diagnoses and treatment, care management, and health promotion and disease prevention; also PCNs performed multiple

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<sup>9</sup>Because PCNs might have several activities under each category within one study, the sum of the numbers from each activity may be greater than the total number noted for each functions category. This is also applied to all other places where functions were described in this study.

activities under each of these four categories. Thus, with the exception of the fifth category, the proposed categorization was appropriate to use for evaluating the functions of both PCRNs and PCNPs.

Second, more than half of the reviewed studies reported that PCN functions fell into the categories of patient assessment, care management, and health promotion and disease prevention. In addition, there were three crosscutting themes about PCN functions that are noteworthy:

- a. PCNs engaged in interprofessional collaboration to care for patients, by exchanging information with other professionals, developing plans of care with other professionals, discussing and/or counseling changes in patients' situations and plan of care with other professionals.
- b. PCNs engaged in the coordination of care by following up with patients and their family and caregivers, scheduling appointment for patients with other professionals, referring patients to other professionals, and developing plans of care with patients and their family and caregivers.
- c. PCNs engaged in activities to help patients during a care transition by exchanging information with other settings, systems, and providers, and by connecting patients with community resources.

Third, more than half of the studies reported that PCNs comprehensively assessed patients' physical, psychosocial, and environmental needs, developed plans of care and provided education and counseling for patients and their family and caregivers, provided culture and social support for patients, and helped patients and their family and caregivers connect with community resources.

Fourth, several studies reported that PCNs used telehealth, online education programs, or home monitoring devices to assess and educate patients, and EHRs to collaborate and coordinate care with other professionals. Thus, PCNs performed their functions through the use of health information technology, as well as through face-to-face visits in their practices.

No study reported PCNs' *other* functions such as practice management, quality improvement, and teaching/research activities. This might be because most of the studies reviewed in this paper were focused on examining PCN care that was directly delivered to patients. Also no activity was found that did not fit within by the five categories used to describe PCN functions.

**PCNs' roles.** The roles that PCNs filled in the total reviewed studies and the functions they performed in each role are presented in Appendices 2.4 – 2.7. PCNs served as a *substitute* role in seven studies, a *supplemental* role in 34 studies, and an *other* role in six studies. Because PCNs' roles were studied by examining the functions that they performed under each role, this section only reviews the 38 studies that reported PCNs' functions, which included four studies under the substitute role, 31 studies under the supplemental role, and three studies under the other role. A detailed comparison between the studies that reported PCNs' functions and those that did not report is presented by PCNs' roles in Appendix 2.9. The following sections describe PCNs' roles by identifying the functions they performed within the five functional categories noted above.

***Substitute.*** Of the four studies that reported PCNPs' functions, those functions were focused four of the five function categories: patient assessment (n=2), diagnosis and treatment (n=3), care management (n=2), and health promotion and disease prevention



(n=3)<sup>10</sup>. These findings might suggest that PCNPs performed a wide range of functions, but it should be interpreted cautiously given the small number of studies reviewed in each category.

***Supplemental.*** Among the 31 studies that reported PCNs' functions, PCNs' activities covered four of the five function categories: patient assessment (n=16), diagnosis and treatment (n=3), care management (n=23), and health promotion and disease prevention (n=23). Similar to the functions PCNs performed in their substitute role, these findings suggest that when serving a supplemental role, PCNs also provide a wide range of functions that covered the same four function categories. However, unlike their functions under a substitute role, PCNs' functions under a supplemental role were focused on patient assessment, care management, and health promotion and disease prevention; moreover, the studies reporting PCNs' functions under a supplemental role was more abundant than those reporting PCNs' functions under a substitute role.

***Other.*** In the three studies that reported PCN functions, PCNs' activities also included four of the five function categories: patient assessment (n=1), diagnosis and treatment (n=2), care management (n=1), and health promotion and disease prevention (n=1). Similar to PCNs' functions under the substitute and supplemental role, PCNs' functions under other role also covered the same four function categories. However, these findings should be carefully interpreted due to the small number of studies available.

Comparing these three roles, PCNs were reported to perform functions in four of the five function categories across their roles; compared with their functions under a substitute or

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<sup>10</sup>Although these seven studies were only focused on PCNPs, the categorization of "PCNs' functions" was still appropriate because PCNPs' general human capital in nursing and primary care enables them to perform the functions of both PCRNPs and PCNPs.

other role, PCNs' functions under their supplemental role were focused on patient assessment, care management, and health promotion and disease prevention; but our knowledge of PCNs' functions under the substitute and other roles is still limited because of the small number of studies reviewed.

**The diagnostic characteristics of PCNs' care recipients.** The diagnoses of patients cared for by PCNs reported in each reviewed study are presented in Appendix 2.3. In 33 out of the total 47 studies, specific diagnoses examined were identified, including five studies under the substitute role, 26 studies under the supplemental role, and two studies under the other role. The rest 14 studies did not report patients' diagnosis, including two studies under the substitute role, eight studies under the supplemental role, and four studies under the other role. A detailed comparison of these two types of study by PCNs' roles is presented in Appendix 2.10. The following sections summarized patients' diagnoses in the studies reviewed based on PCNs' roles.

***Patients' diagnoses managed in the substitute role.*** The following diagnostic characteristics of PCNs' care recipients were reported in the five studies: *diabetes* (n=3), *hypertension* (n=2), and *Hepatitis C (HCV)* (n=1)<sup>11</sup>. Although studies reviewed indicated that PCNs managed some chronic diseases when they served in a substitute role, the results should be interpreted cautiously because of the small number of studies available focusing on this role.

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<sup>11</sup>Because PCNs might manage more than one diagnoses within one study, the sum of the numbers from each diagnosis may be greater than the total number noted for each role category. This is also applied to all other places where patients' diagnoses were described in this study.

***Patients' diagnoses managed under supplemental role.*** Among the 26 studies, it was reported that PCNs managed care for patients with diabetes (n=14), hypertension (n=6), depression (n=4), congestive heart failure (n=3), coronary artery or heart disease (n=3), dementia (n=2), asthma (n=1), chronic obstructive pulmonary disease (n=1), hyperlipidemia (n=1), urinary incontinence (n=1), obesity (n=1), posttraumatic stress disorder (n=1), breast/lung/colon cancer (n=1), and healthy infants (n=1). Similar to the findings under the substitute role, PCNs also managed chronic diseases when they served a supplemental role; since more than half of the reviewed studies examined chronic diseases, it suggests that PCNs focused primarily on managing chronic diseases when served a supplemental role. Unlike the findings under the substitute role, however, PCNs managed more diagnoses when served a supplemental role, including chronic diseases, mental health, and other conditions/problems that influence patients' health status.

***Patients' diagnoses managed under other role.*** In the two studies that reported patients' diagnoses, PCNs managed patients with acute sinusitis and benign breast conditions, or minor health problems/conditions, similar to findings reported under the supplemental role. However, these results should be interpreted cautiously because of the small number of studies available for review.

Comparing patients' diagnoses across PCNs' roles, the findings suggested that PCNs managed patients with chronic diseases and/or minor health problems under each of their roles. Compared with the diagnoses that PCNs managed under substitute and other roles, PCNs managed a wider range of diagnoses when served a supplemental role. However, our knowledge of the diagnoses PCNs manage under the substitute and other roles is still limited because of the small number of available studies for review.

**Summary of PCN care.** PCNs performed a wide range of functions that fit into four of the five function categories, cutting across their substitute, supplemental, and other roles. When they served in a supplemental role: 1) PCNs performed the functions that were focused on patient assessment, care management, and health promotion and disease prevention; and 2) PCNs managed patients with a variety of diagnoses but focused on chronic diseases. When they served a substitute or an other role, studies of the functions performed and the diagnoses managed by PCNs are limited number, thus limiting this review.

### **The Outcomes of PCN Care**

The outcomes of PCN care reported in each study are presented in Appendix 2.11. The following sections synthesize the outcomes of PCN care under each of the IOM's six aims of quality. The outcomes under each aim were examined by the roles that PCNs filled in the reviewed studies, because the outcomes of PCN care might vary across the three PCN role types.

**Safe.** Studies examining whether PCN care caused injuries, accidental injuries, or produced harm to patients – including malpractice, diagnoses errors, and wrong prescription and operation – were targeted for inclusion in this category. Only two studies were found in the literature pertaining to this aim (Limoges-Gonzalez et al., 2011; Singh, 2013). Both of these studies examined the provision of safe care when PCNs – and specifically PCNPs -- served a substitute role. No study was identified that examined safe care when PCNs served a supplemental or an other role.

Limoges-Gonzalez et al. (2011) conducted an RCT study (n=150) and examined whether PCNPs could provide endoscopy screening as safely as PCPs in a free-standing endoscopy center. Their results indicated that there were no immediate complications after

colonoscopy screening in either the PCNP or the PCP group. Singh et al. (2013) compared diagnostic errors between PCNPs and PCPs by performing a retrospective observational study and reviewing 190 medical records in VA and community-based clinics. These researchers reported that there was no difference in the rate of diagnostic errors between PCNPs and PCPs. Although both studies suggested that PCNPs provided care at safe levels similar to those provided by PCPs, the results should be interpreted cautiously given the small number of studies reviewed and the studies' focus on specific settings. Also no study was found that examined how PCNPs or both PCNPs and PCPs contribute to the safety of primary care.

**Effective.** Studies examining whether PCN care improved patient health status and symptoms, reduced hospitalizations and emergency room visits, and/or lowered the risk of disease were reviewed in this aim. There were 36 studies reviewed under this category, the greatest number reported for any one quality aim, including four studies where PCNs served a substitute role, 31 studies where PCNs served a supplemental role, and one study where PCNs served an other role.

***Substitute role.*** Four observational studies examined the effectiveness of PCN care when PCNs served a substitute role (Cioe, Stein, Promrat, & Friedmann, 2013; Condosta, 2012; Fletcher, Copeland, Lowery, & Reeves, 2011; Wright, Romboli, DiTulio, Wogen, & Belletti, 2011). All of these studies were focused on PCNPs and had a sample size greater than 100. The findings of these studies indicated that patients cared for by PCNPs achieved ***better*** outcomes on *blood pressure control* (Wright et al., 2011) and ***similar*** outcomes on the control of *HbA1c* (Fletcher et al., 2011), the management of both *high- and low density lipoprotein (HDL and LDL)* cholesterol levels (Condosta, 2012) and on *HCV* treatment (Cioe

et al., 2013). These results should be interpreted cautiously because of the small number of studies reviewed under this role.

***Supplemental role.*** Among the 33 studies, 19 focused on PCNRs, nine studies focused on PCNPs, and three studies focused on both. More than half of these studies (n=18) used an RCT design, and the rest of the studies used a quasi-experimental (n=4) or observational (n=9) design. Most of these studies had a sample size greater than 100 (n=23).

Fifteen of the studies indicated that when PCNs (PCNPs, PCNRs, or both) served in a supplemental role, patients who received care from PCNs, combined with other health professionals, had ***better*** outcomes in the following areas: *blood pressure* (Bosworth et al., 2011; Bray et al., 2013; Fortuna et al., 2015; Ishani et al., 2011; Piette et al., 2011; Richardson, Derouin, Vorderstrasse, Hipkens, & Thompson, 2014; Welch et al., 2011); *HbA1c* (Berry, Williams, Hall, Heroux, & Bennett-Lewis, 2015; Biernacki, Champagne, Peng, Maizel, & Turner, 2015; Bray et al., 2013; Edelman et al., 2015; Ishani et al., 2011; Jackson, Lee, Edelman, Weinberger, & Yano, 2011; Richardson et al., 2014; Tang et al., 2013; Welch et al., 2011); *HDL* (Berry et al., 2015) and *LDL* cholesterol levels (Fischer et al., 2012; Richardson et al., 2014); *triglycerides* (Berry et al., 2015); *self-efficacy* (Gellis, Kenaley, & Ten Have, 2014); *coping* (Piette et al., 2011); *self-monitoring* (Brokel, Cole, & Upmeyer, 2012; Lin et al., 2012); *physical activity* (Purath, Keller, McPherson, & Ainsworth, 2013); *quality of life* (Piette et al., 2011); *weight loss* (Jarl, Tolentino, James, Clark, & Ryan, 2014); *diet and lifestyle changes* (Jarl et al., 2014); *symptoms of post traumatic stress disorder* (Engel et al., 2015); *anxiety* (Dodge et al., 2014); *depression* (Bao, Shao, Bruce, & Press, 2014; Bruce et al., 2015; Gellis et al., 2014; Lin et al., 2012; Piette et al., 2011); and *mortality rate* (Coburn, Marcantonio, Lazansky, Keller, & Davis, 2012). Four studies

indicated that patients who received care from a team where PCNs served a supplemental role had **fewer** hospitalizations and emergency room visits (Dodge et al., 2014; Gellis et al., 2014; Glendenning-Napoli, Dowling, Pulvino, Baillargeon, & Raimer, 2012; Park, Branch, Bulat, Vyas, & Roevers, 2013).

Nine studies reported that the following patient outcomes **were not different** between patients who received care from PCPs only and patients who received care from a team where PCNs served in a supplemental role (either working with PCPs only or working with PCPs and other professionals): blood pressure and HbA1c (Edelman et al., 2015), physical and mental health (Boult et al., 2013; Edelman et al., 2015), self-care (Brokel et al., 2012), quality of life (Fortinsky et al., 2014), smoking cessation (Ridner et al., 2014), depression and anxiety symptoms (Engel et al., 2015; Fortinsky et al., 2014), hospitalization, length of stay, emergency room visits, and readmission rates (Boult et al., 2011; Fischer et al., 2012; Ornstein, Smith, Foer, Lopez-Cantor, & Soriano, 2011; Tang, Fujimoto, & Karliner, 2014).

More importantly, 14 of the 32 studies focused on care delivered in home health (n=8), transitional care (n=4), and patient-centered medical homes (n=2). Most of these studies (n=10) reported that when PCNs served in a supplemental role, patients had **better** outcomes in the following areas: blood pressure (Bosworth et al., 2011; Bray et al., 2013; Fortuna et al., 2015; Ishani et al., 2011; Piette et al., 2011; Richardson et al., 2014; Welch et al., 2011), HbA1c (Berry et al., 2015; Biernacki et al., 2015; Bray et al., 2013; Edelman et al., 2015; Ishani et al., 2011; Jackson et al., 2011; Richardson et al., 2014; Tang et al., 2013; Welch et al., 2011), self-efficacy (Gellis et al., 2014), self-monitoring (Brokel et al., 2012; Lin et al., 2012), physical activity (Purath et al., 2013), anxiety (Dodge et al., 2014), and depression (Bao et al., 2014; Bruce et al., 2015; Gellis et al., 2014; Lin et al., 2012; Piette et

al., 2011) and ***fewer*** hospitalizations and emergency room visits (Dodge et al., 2014; Gellis et al., 2014; Glendenning-Napoli et al., 2012; Park et al., 2013). However, some of these studies reported that the following patient outcomes ***were not different*** between patients who received care from PCPs only and patients who received care from a team where PCNs served in a supplemental role: *blood pressure and HbA1c* (Edelman et al., 2015), *physical and mental health* (Boult et al., 2013; Edelman et al., 2015), *self-care* (Brokel et al., 2012), *quality of life* (Fortinsky et al., 2014), *depression and anxiety symptoms* (Engel et al., 2015; Fortinsky et al., 2014), *hospitalization, length of stay, and emergency room visits* (Boult et al., 2011; Fischer et al., 2012; Ornstein et al., 2011; Tang et al., 2014).

***Other role.*** Rohrer et al. (2013) examined the effectiveness of PCNP care when serving in an other role. Using a RCT design, the EHRs of 400 family medicine patients were analyzed to examine the continuity of care (i.e., the percentage of visits involving the PCP) for patients who received care in retail clinics versus those who did not. These researchers reported that patients who visited PCNPs in retail clinics in addition to visited PCPs in standard primary care office care (n=200) had ***lower*** continuity of care, compared with patients who only visited PCPs in standard primary care offices care (n=200). Although the results suggested that seeing PCNPs in retail clinics might decrease quality of care, conclusions cannot be drawn from this single study of retail clinics.

In general, our knowledge remains limited in terms of the impact of PCN care on the effectiveness of primary care when PCNs served in a *substitute* or *other* role; when PCNs served a *supplemental* role, studies indicated that patients who were cared for by PCNs and PCPs (with or without other professionals) received more effective care than those who were cared for by PCPs only. Moreover, in home health, transitional care, and patient-centered



medical homes, PCNs also improved the effectiveness of primary care when they served in a supplemental role.

**Patient-centered.** Studies focusing on PCN care with respect to patient-centered care were evaluated by examining those studies focusing on patients' reports of satisfaction with their providers and the care they received. Patient satisfaction was used as an indicator of patient-centered care because it reflects whether patients perceived that their health needs were met during their visit, and also because it is a commonly used measure of patient-centered care (Mead & Bower, 2002). Eight studies that examined PCNs with respect to this aspect of quality were analyzed under this aim, including one study where PCNs served in a substitute role and seven studies where PCNs served in a supplemental role. No study was found that examined the provision of patient-centered care when PCNs served an other role.

***Substitute role.*** The RCT study of Limoges-Gonzalez et al. (2011), as previously described, also reported that patients who received endoscopy screening from PCNPs had ***higher*** levels of satisfaction than those who received endoscopy screening from PCPs. The findings of this study suggests that PCNPs might provide more patient-centered care when served a substitute role, but no conclusions can be drawn from the results of a single study.

***Supplemental role.*** Among the eight studies focusing on patient-centered care, three studies focused on PCNRNs, three studies focused on PCNPs, and two studies focused on both. These studies used the following study designs: RCT (n=3), quasi-experiments (n=1), observational studies (n=3), and model simulation (n=1). Five of these seven studies had a sample size greater than 100. Six studies were focused on PCN-led interventions and one study was focused on home health. All of these studies reported that when PCNs served in a supplemental role, patients who received care from the team that included PCNs reported

**greater** satisfaction with care received, compared with patients who received care from PCPs only or from the care team without PCNs.

Generally, when PCNs served a *supplemental* role, patients were more satisfied with the care they received, which suggests that they perceived care to be more patient-centered. We lack evidence about PCNs' impact on patient-centered care when they served a *substitute* or *other* role.

**Timely.** Studies examining any issue that affects timely access to primary care or the timely delivery of care, including wait times and appointment delays, were reviewed in this category. Two studies were available for review under this aim, including one study where PCNs served a supplemental role and one study where PCNs served an other role. No study was found that examined the provision of timely care when PCNs served a substitute role.

**Supplemental role.** Potts et al. (2011) conducted a model simulation (n=80,090) and compared the wait times for patients who received care from both PCNPs and PCPs, and the patients who received care from PCPs only. They reported that patients who were cared for by both PCNPs and PCPs had a 23-day wait time to receive care, which was a 30% ***lower*** wait time than the 33-day wait time for patients seeing PCPs only. This study indicates that when PCNPs served a supplemental role, patients might receive more timely care than when they do not serve in this capacity, but no conclusions can be drawn from this single study.

**Other role.** Blackmore et al. (2013) conducted a retrospective observational study that evaluated 200 patient records to compare the wait times for patients who visited a PCNP-led breast clinic versus those who received similar care in a physician office. These researchers found that women who visited a PCNP-led breast clinic waited an average of four days for diagnosis results with the PCNP, versus the average of 16 days for those who visited

a physician's office. This study suggested that PCNPs serving in an other role might improve the timeliness of care.

Although these two studies suggested that PCNPs might improve the timeliness of care by shortening patients' wait times when PCNPs served a *supplemental* or *other* role, these results must be viewed cautiously, because of the lack of evidence about PCNs' impact on patients' receipt of timely care when PCNs serve in a *substitute* role. Also, no study was found that examined how PCRNPs or both PCRNPs and PCNPs contribute to the timeliness of primary care.

**Efficient.** Studies reviewed in this category included those that examined the overuse, underuse, and misuse of resources, as well as the reduction of costs. Nine such studies were analyzed under this aim, including one study where PCNs served a substitute role, five studies where PCNs served a supplemental role, and three studies where PCNs served an other role.

***Substitute role.*** Kuo et al. (2015) compared the costs of patients cared for by PCNPs with those of patients cared for by PCPs by identifying a national sample of patients (n=64,354) from the Centers for Medicare and Medicaid Services Chronic Disease Data Warehouse. The findings of this study indicated that patients who received primary care from PCNPs had **reduced** inpatient and primary care service costs, suggesting that PCNPs might provide more cost-efficient care when they serve in a substitute role. However, no conclusion can be drawn from the findings of this single study.

***Supplemental role.*** Five studies examined the efficiency of PCN care when PCNs served in a supplemental role, including three studies that used an RCT design, one that used an observational design, and one that used model simulation. Four of these five studies had a

sample size greater than 100. These studies were conducted in community health centers (n=2), a VA clinic (n=1), and group health clinics (n=1); one study did not specify the setting because it used national datasets to conduct a model simulation (Liu & D'Aunno, 2012). Four studies examined PCN-led interventions, while one study focused on home health (Bosworth et al., 2011). Three studies focused on PCRNs and two studies focused on PCNPs.

These studies did not provide conclusive evidence regarding the efficiency of PCN care. Three studies indicated that patients who were cared for by both PCPs and PCNs had *lower* health care costs compared with patients who were managed by PCPs only (Fischer et al., 2012; Glendenning-Napoli et al., 2012; Liu & D'Aunno, 2012), while two studies indicated that patients who were cared for by both PCPs and PCNs had similar health care costs compared with patients who were cared for by PCPs only (Bosworth et al., 2011; Wagner et al., 2014).

***Other role.*** Three observational studies examined the efficiency of PCN care in PCN-led clinics (Bicki et al., 2013; Blackmore et al., 2013) and retail clinics (Spetz, Parente, Town, & Bazarko, 2013). All three of these studies had a sample size greater than 100. One study focused on PCRNs and two studies focused on PCNPs. All reported that employing PCNs in PCN-led clinics *decreased* organizational costs per patient.

Taken together, these nine studies suggest that when PCNs serve in a *substitute* or *other* role, they may provide more efficient care than when care was provided by PCPs alone; however, these results should be interpreted cautiously given the small number of studies reviewed. When serving in a supplemental role, it is unclear whether PCNs decrease healthcare costs, yet this outcome is an assumption of certain models of team-based in which care is delivered across levels of care providers. Thus, further research is needed in this area.

**Equitable.** Studies examining or comparing PCN care across different patient characteristics and populations were targeted for review under this aim. However, no study was found that examined the care delivered by PCNs with respect to equity.

**Summary of the outcomes of PCN care.** A summary of the findings of PCN outcomes is presented in Table 2.2. When PCNs served in a *substitute* role, all studies reviewed were focused on PCNPs. These studies found that: 1) PCNP care was reported to be as safe as PCP care, but more effective, patient-centered, and efficient; 2) no study has examined the contributions of PCNPs to the timeliness and equity of care; and 3) no study examined how PCNPs or both PCNPs and PCNPs contribute to any of the six areas of quality of care. Unfortunately, there is a small number of studies reviewed for the substitute role, which made it impossible to draw conclusions.

When PCNs served in a *supplemental* role, most of the reviewed studies were focused on PCNs. This review found that: 1) most of the available studies reported that PCN care improved the effectiveness and patient-centeredness of primary care; 2) a few studies reported that PCNPs might improve the timeliness of primary care; 3) studies examining PCNs' impact on the efficiency of primary care were inconclusive; and 4) no study was found that examined PCNs' contributions to the safety or equity of care.

When PCNs served an *other* role, this study found that: 1) PCNPs might lower the effectiveness but improve the timeliness of primary care; 2) PCNs might improve the efficiency of primary care; and 3) there is a lack of research examining PCNs' contributions to the safety, patient-centeredness, or equity of care. Unfortunately, because of the small number of studies available that examined PCNs serving in the "other" role, it was impossible to draw conclusions about their contributions to quality outcomes.

**Table 2.2: A Summary of the Outcomes of PCN Care by Their Roles**

Six Aims of Quality of Care	Roles		
	Substitute	Supplemental	Other
<b>Safe</b>	PCNPs (=)	?	?
<b>Effective</b>	PCNPs (+)	PCNs (+)	PCNP (–)
<b>Patient-centered</b>	PCNPs (+)	PCNs (+)	?
<b>Timely</b>	?	PCNPs (+)	PCNP (+)
<b>Efficient</b>	PCNPs (+)	PCNs (+/–)	PCN (+)
<b>Equitable</b>	?	?	?

Notes: “+” refers to that PCN care had better outcomes than PCP care or including PCN care improved care quality; “–” refers to that PCN care had worse outcomes than PCP care or including PCN care decreased care quality; “=” refers to that PCN care had similar outcomes with PCP care or including PCN care did not improve care quality; “?” refers to that there was no study found under that category.

## Discussion

This integrative literature review focused on PCNs’ contributions to primary care in the existing empirical literature published between 2011 and 2015. Compared with previous literature reviews focusing on the outcomes of PCN care, this paper added to, and extended, previous work by closely examining the care that PCNs provided.

In terms of PCNs’ *functions*, this paper found that PCNs performed a wide range of functions and that their functions focused primarily on patient assessment, care management, and health promotion and disease prevention. Moreover, PCNs functions reflected integrated interprofessional collaboration, care coordination, and care transitions. These findings were consistent with other studies that emphasized PCNs’ functions in the above areas (Anderson, St Hilaire, & Flinter, 2012; Haas, Swan, & Haynes, 2013; Swan, Conway-Phillips, & Griffin, 2006).

The findings about PCNs’ functions also indicated that PCNs interacted with patients, their families, caregivers and others in the community, and helped connect patients with needed community resources and health care services. Also, in most of the reviewed studies,

PCNs worked with PCPs or on a team in which they collaborated with different professionals and levels of care providers to coordinate care among patients, their family care caregivers, community resources, and professionals, and to facilitate care transitions among professionals, settings, and systems. These areas that cut across PCN functions provide support for prior work suggesting that PCNs may fill the role of “boundary spanner” in the primary care system by connecting patients, their families and caregivers with health care services and promote the collaboration among different types of health care professionals (Ehrlich, Kendall, & Muenchberger, 2012; Fraher, Spetz, & Naylor, 2015).

Third, this paper found that PCNs performed their functions by providing traditional face-to-face patient visits as well as by utilizing health information technology and EHRs. Such methods of care delivery as well as telehealth and online education programs, are important for improving patients’ access to primary care and promoting the efficiency of primary care (Chen, Mehrotra, & Auerbach, 2014; Friedman et al., 2014).

In terms of PCNs’ *roles*, the findings of this review suggest that PCNs served substitute, supplemental, and other roles in primary care settings. Compared with previous studies that used the role labels but without defining them, this review extended prior work by describing the functions that PCNs performed under each of their roles and compared PCNs’ functions across these three roles. Specifically, this paper revealed that under each role, PCNs’ functions covered four of the five categories developed to reflect PCN care. Compared with the functions they performed under a substitute or an other role, PCN functions were more focused on patient assessment, care management, and health promotion and disease prevention when they served a supplemental role. However, research that focuses on PCNs’ functions when they serve in substitute and other roles is still lacking, as reflected

by the small number of studies available for review for each of these roles. It is still not clear whether PCNs perform similar functions as PCPs and to what extent their functions overlap with those of PCPs when they serve in a substitute role. We also know little about PCNs' functions when they serve in an other role in PCN-led clinics and how their functions are similar to or different from their functions under a substitute or a supplemental role. Therefore, the findings of this paper emphasized PCNs' supplemental role in primary care and also informed future research on improving our understanding of PCNs' substitute and other roles in primary care.

In terms of the *diagnostic characteristics of PCNs' care recipients*, similar to the examination of PCNs' roles, this paper described patients' diagnoses that PCNs managed under each of their roles and also compared the recipients of their care across the roles that they filled. The findings of this paper suggested that PCNs managed chronic diseases and/or minor health problems across their three roles, but PCNs managed more types of diseases when served a supplemental role than when they served in a substitute role. This finding might be due to the greater number of studies reviewed in the category of supplemental role than the category of substitute or other roles, or because PCNs' supplemental role is more prevalent in the care they provide than their substitute and other roles in practice, enabling them to manage more types of diseases; or it may also follow that it is difficult for PCNs to independently manage a patient with chronic disease and multiple comorbidities.

Second, it is still unclear what diagnoses PCNs manage under a substitute or an other role due to the small number of studies reviewed. We know little about how the diagnostic characteristics of PCNs' care recipients are similar to and different from those of PCPs when PCNs serve in a substitute role; and little is known about what other diagnoses PCNs might



manage besides minor health problems when they serve in an other role in PCN-led clinics. More studies that examine the diagnostic characteristics of PCNs' care recipients are needed to provide evidence about the care PCN provide to different groups and populations, and to better guide the assignment of patient to PCNs and other care providers.

The study's findings regarding the outcomes of PCN care were similar to those of previous literature reviews: When serving in a substitute role, PCNs achieved similar levels of effectiveness and patient-centeredness in primary care as PCPs (Brown & Grimes, 1995; Horrocks et al., 2002; Laurant et al., 2005; Martínez-González et al., 2014). When serving in a supplemental role, PCNs contributed to the outcomes of effectiveness and patient-centeredness in primary care (Joo & Huber, 2014; Keleher et al., 2009; Stanik-Hutt et al., 2013). However, research regarding the safety, efficiency, and equity of PCN care across all PCN roles is lacking and the findings are inconsistent (Donald & Kilpatrick, 2014; Goryakin, Griffiths, & Maben, 2011; Martin-Misener et al., 2015; Naylor & Kurtzman, 2010; Stanik-Hutt et al., 2013). Therefore, while additional studies examining all of the six aims are needed, a particular emphasis is needed to examine the safety, efficiency, and equity of PCN care are needed to understand how PCNs help the system achieve these aims of quality of care.

This paper extended previous studies and improved our understanding of the outcomes of PCNs care in several ways. First, previous literature reviews examined the outcomes of PCN care without identifying the care that PCNs provided in each study. Thus, this paper filled an important gap by examining PCN care in greater detail. Specifically, by performing their functions under a supplemental role, this paper indicated that PCNs improved the effectiveness and patient-centeredness of primary care. Although it cannot

establish the causal relationship between the care that PCNs provided and the outcomes achieved, the results of this paper suggest that PCN care plays an important role in achieving certain outcomes and improving the quality of primary care.

This review also found that PCNs improved the quality of primary care provided in home health, transitional care, patient-centered medical homes, and PCN-led clinics. That is, PCNs who practiced in these settings collaborated with other health professionals and extended physician care, which might contribute to improvements in the effectiveness and patient-centeredness of primary care. PCNs who practiced in PCN-led clinics provided a wide range of primary care services for patients when physicians were not available, including promoting and maintaining patients' health, performing disease-prevention services, providing counseling and educational guidance for patients, and referring patients to specialists. By performing these functions, PCNs improved the access to primary care. Because PCNs costs less than physicians, moreover, PCN-led clinics may save costs for health care systems. These results are consistent with previous findings suggesting that improving the utilization of PCNs in alternative models of care could increase the capacity of primary care (Auerbach et al., 2013).

### **Study limitations**

There are several limitations of this literature review. First, this paper may not capture all studies that examined PCNs' contributions to the primary care system, because there might be some studies that were not published by the time this literature review was completed. However, this paper captured PCNs' contributions to the changing system because it conducted a comprehensive literature search and included studies published from 2011 to 2015. Second, this paper may or may not fully examine PCNs' emerging roles in the

transforming system. Yet, this paper examined PCNs' "other" role in PCN-led clinics, which is neither substitute nor supplement to PCPs but is another different role of PCNs in primary care. Third, there might be some outcomes of PCN care that were not included in this paper. Nevertheless, this paper covered a many of the outcomes of PCN care because it applied the six aims of quality of care, which is a broadly accepted and comprehensively reflected current thinking about quality.

### **Policy Implications**

The findings of this study provide evidence for primary care employers, clinicians, educators, and policymakers regarding the contributions of PCNs to primary care, especially the functions PCNs perform, the roles PCNs fill, and the diagnoses PCNs manage. This information can be used to evaluate the care of PCNs, and to guide the assignment of PCNs to capitalize on their function areas of patient assessment, care management, and health promotion and disease prevention. Primary care employers can use the findings of this review to help structure the care environment in a way that positions PCNs to perform these functions and improves PCNs' utilization. Findings from this study suggest that when serving a supplemental role, PCNs largely performed their functions of patient assessment, care management, and health promotion and disease prevention, as well as managed a variety of diseases and improved the effectiveness and patient-centeredness of primary care. Thus, primary care employers can use this information to create more opportunities for PCNs to provide care by serving in a supplemental role. Organization/system managers may make efforts to foster the interprofessional collaboration and coordination among PCNs and other professionals. Potential strategies might include improving collaboration across

teams/systems, and providing administrative support (Poghosyan, Liu, Shang, & D'Aunno, 2015).

In terms of education, educational leaders can use the findings of this review to develop future curricula for preparing PCNs to provide care. First, nursing education and training may need to reflect PCNs' functions in the four areas examined in this paper and also emphasize the functions on interprofessional collaboration, care coordination, and care transition (Yang, Woomer, & Matthews, 2012). Second, one of the findings of this review indicates that healthcare information technology is widely used by PCNs when they perform their functions, making knowledge in this important to incorporate in PCN education and training. Third, PCNs or nursing students may need to be trained for managing various diseases so that they can provide care for different patients. Moreover, PCNs education and training should be closely connected with their practice (Ricketts & Fraher, 2013). For instance, training nursing students in the context of interprofessional collaboration and patients' family and community will increase nursing students' experience of collaborating with other professionals and coordinating care among patients, community, and professionals (Bodenheimer et al., 2015).

At the policy level, the regulatory system and policies related to PCN practice are important for supporting PCN practice. More efforts are needed to support PCNs in performing their functions, serving in their various role, and managing patients with different diagnoses. For example, PCNPs may need to work with and inform legislators, policy makers, leaders and managers of health care organizations or system about which of their functions and roles are important for practice and patient care (Wyatt, 2013). Reviewing state-level scope of PCN practice laws and payment policy will be important to ensure that

PCNs can deliver their care to the top of their education and training and in an accountable way, especially in new models of care (Henderson, Princell, & Martin, 2012). In addition, the positive outcomes PCNs achieve in home health and other settings not typically viewed as “primary care” may require the expansion of payment models and policies to take advantage of these aspects of PCN practice and potentially save money (Auerbach et al., 2013).

### **Research Implications**

The limitations of the studies reviewed in this paper shed light on future research needed to more fully understand PCNs’ contributions to primary care. Generally, in terms of PCN care, it will be important for future research to examine specifics of PCN care when studying PCNs’ contributions to primary care. Several studies reviewed in this paper did not report PCN care, perhaps because researchers assumed that PCNs deliver similar care as PCPs do when serving in a substitute role, because PCNs’ human capital, to some extent, overlaps with that of PCPs (as discussed in Chapter 1). Also some study designs (e.g., model simulation and secondary data analysis) may not contain data that allows researchers to examine PCNs’ functions and patients’ diagnoses. While these studies have been important in advancing our knowledge of PCN practice, specific studies examining PCN care are needed, especially when examining the outcomes of their care, because it is otherwise difficult to build a body of evidence about the contributions of PCN care within models of primary care delivery.

In terms of PCNs’ *functions*, a few studies reviewed in this paper reported that PCNs used new technology to improve the delivery of primary care, but more research is needed to explore how PCNs use technology to deliver care to patients and the effectiveness of care delivered through this modality. Additionally, studies reviewed in this paper were focused on

the utilization of telehealth, online education program, and home monitoring devices, but little is known about whether there are newer technologies that might improve PCNs' function, such as using mobile applications to manage health or using global positioning systems to locate patients and provide health care services (MacLean et al., 2014). Thus, exploring how PCNs might apply new technologies and examine the potential contributions of new ways of delivering primary care are important.

No study was found in this review that reported PCNs' functions in the fifth functional category of *other* activities. Functions that would be included in this category include activities such as practice management, quality improvement, and research/teaching activities (American Nurses Credentialing Center, 2012; Smolowitz et al., 2014). One possible explanation for the absence of findings in this category is that the reviewed studies all focused on direct, hands-on care delivered by PCNs to patients, rather than the more indirect activities that were included in this category. While these activities are important, it could be that these duties were assumed by or assigned to others in the practice besides PCNs, so that PCNs' functions were focus exclusively on direct patient care. It might also be because that PCNs were not hired to perform these functions in practice. Future research will be important specifically to determine the degree to which these functions are present in and essential to PCNs' functions. Having that said, these functions of PCNs are important for improving the delivery of primary care, because they provide support for PCN practice and are important for examining the implementation of various interventions aimed at improving care delivery and assessing the quality and outcomes of PCN care.

In terms of PCNs' *roles*, future research is needed to further examine PCNs' roles. Although the role labels of "substitute" and "supplemental" are defined according to the

relationship between PCNs and PCPs, we know little about to what extent PCNs' functions overlap with those of PCPs when serving a substitute role; and also little is known about how PCNs' functions are similar to and different with those of PCPs when serving a supplemental role. Moreover, more efforts may be necessary to explore what functions PCNs perform under an "other" role – that is, neither a substitute nor a supplemental role. Additionally, future studies are needed to examine the changes in PCNs' roles over time, which will help to inform the future utilization of PCNs in the transforming primary care system. Moreover, because PCNs' roles vary with the patient populations they serve and the primary care settings within which they work, examining their roles across populations and settings will also be important for determining how PCNs could be most effectively deployed.

In terms of the *diagnostic characteristics of PCNs' care recipient*, there is a lack of studies examining whether PCNs manage similar or different diagnoses than PCPs when PCNs serve in a substitute, and what diagnoses PCNs manage when they serve in an other role, particularly in PCN-led clinics. Such efforts could inform the assignment of patients to PCNs and PCPs, and promote the most effective utilization of PCNs in the future.

To study the *outcomes* of PCN care, it is necessary to first improve our understanding of how PCNs contribute to the safety, timeliness, efficiency, and equity of primary care, particularly given that few studies were found under these areas of care quality. Second, most of the studies that were focused on PCNs examined their contributions to the effectiveness and patient-centeredness of care, but more studies are needed that examine their contributions to other areas of care quality. Finally, more research is needed regarding PCNs' contributions to the care settings that are related to but outside the conceptualization of traditional primary care setting. For example, inconsistent evidence was provided about

PCN's contributions to transitional care (Ornstein et al., 2011; Park et al., 2013) and home health (Brokel et al., 2012). Moreover, although there has been a great deal of funding supported for PCN practice in patient-centered medical homes, nurse-managed health centers, and federal qualifies health centers, few studies were found that how PCNs contribute to primary care in these models (Carthon, Barnes, & Sarik, 2015b; Flinter, 2012; Henderson et al., 2012). Also no study was found that examined PCNs in accountable care organization. Thus, more research is needed in this area to more broadly understand how PCNs impact primary care.

### **Chapter Summary**

This chapter presented an integrative literature review that examined PCNs' contributions to primary care, including the care they delivered and the outcomes they achieved. The findings of this literature review emphasized that when PCNs served in a supplemental role, they performed the functions that were focused on patient assessment, care management, health promotion and disease prevention, managed patients with various diagnoses, and improved the effectiveness and patient-centeredness of primary care; PCNs also contributed to the quality of primary care in non-traditional primary care settings when they served in a supplemental role, such as patient-centered medical homes, home health, and transitional care. However, we still know little about PCNs' functions, the diagnostic characteristics of their care recipients and how PCNs contribute to the six areas of quality when serve as a substitute role or an other role. Thus future research in these areas is needed. The next chapter will present a study that addresses some of these knowledge gaps by comparing the care provided by PCNs with the care provided by PCPs.



## **CHAPTER 3: A COMPARISON OF CARE BETWEEN PHYSICIANS AND NURSES IN U.S. PRIMARY CARE SETTINGS**

### **Introduction**

Primary care nurses (PCNs) – registered nurses (RNs) and nurse practitioners (NPs) who practice in primary care settings – are being called upon to collaborate and coordinate with primary care physicians (PCPs) in order to perform wide-ranging primary care functions, serve in various roles, and deliver primary care to diverse patient populations (Institute of Medicine, 2011). To meet this demand, it is important to better understand the similarities and differences of care provided by PCNs and PCPs, who represent the two largest components of the primary care workforce. Such knowledge may improve our understanding of how the contributions of these two types of providers to primary care overlap or are distinct from each other. It may also inform future workforce planning in terms of reinforcing the collaboration and coordination between PCNs and PCPs (Buerhaus et al., 2014).

Over the past two decades, an increasing number of studies have compared the care between PCNs and PCPs in terms of their functions, roles, and the diagnostic characteristics of their care recipients. Generally, these studies reported that in terms of functions, both PCNs and PCPs provided diagnostic care, prescribed medications, and administered medical treatment; however, PCNs were more likely than PCPs to provide health education and preventive care, while PCPs were more likely to provide biomedical treatment (Hing et al., 2011; Hooker & McCaig, 2001; Ladd, 2005). These studies, however, were conducted

primarily between 1990 and 2010, and an up-to-date comparison of PCNs and PCPs' functions is needed to capture any changes in health care delivery that may affect PCN and PCP practice. Regarding roles, researchers defined PCNs' roles relative to those of PCPs as "substitute" or "supplemental," but little is known about how PCNs and PCPs' roles are similar to and different from each other (Laurant et al., 2009). For the diagnostic characteristics of care recipients, past descriptive research reported that PCNs might have similar probabilities of managing common chronic diseases as PCPs (Deshefy-Longhi et al., 2008; Morgan et al., 2012). Yet, very little research used advanced analyses and provided a comprehensive examination of broader types of diseases that PCNs and PCPs manage and how these overlap and differ between these two types of providers.

These knowledge gaps of PCN and PCP care may impair our understanding of the similar and different contributions of these providers to primary care. This lack of information may also limit the availability of evidence to guide policy makers and care delivery leaders in their utilization of PCNs and PCPs (Buerhaus et al., 2014; Pohl, Hanson, Newland, & Cronenwett, 2010). Therefore, the purpose of this paper was to compare PCN care with PCP care in U.S. primary care settings. Specifically, this chapter focused on the second research question of this dissertation: **How is PCN care similar to and different from PCP care, in terms of functions, roles, and the diagnostic characteristics of their care recipients?** The following section will provide a detailed review of previous studies that compared PCN and PCP care and highlight the knowledge gaps in prior research.

## Background

Over the past two decades, several studies have characterized and compared the care provided by PCNs and PCPs in three general areas – their functions, roles, and the diagnostic characteristics of their care recipients. This section will review relevant literature in these three areas.

### Functions

Very few studies comparing the functions of PCNs, both PCRNs and PCNPs, with those of PCPs in primary care settings have been conducted. While some studies have compared the functions of NPs<sup>12</sup> and PCPs, likely because more attention has been paid to NPs' actual and potential contributions to primary care (Hing et al., 2011; Hooker & CIPHER, 2005; Hooker & McCaig, 2001; Hughes et al., 2014; Ladd, 2005), very little research has been done comparing the functions of PCRNs and PCPs.

Hooker and McCaig (2001) analyzed PCP office encounter data from the *National Ambulatory Medical Care Surveys* (NAMCS) 1995-1999 (n=768,000 visits) to compare NP care with PCP care. They reported that both NPs and PCPs ordered or provided diagnostic or screening services and prescribed medications for a similar proportion of their patient visits. However, NPs ordered or provided more therapeutic and preventive services (e.g., counseling/education and other non-medication therapy) for patients than PCPs. Hooker and CIPHER (2005) also analyzed PCP office visits reported in the NAMCS 1997-2002 (n=149,202 visits) to compare the prescription patterns of NPs and PCPs. They reported that NPs prescribed medications in a higher proportion of patient visits than PCPs but the mean number of prescriptions per patient visit was similar for both NPs and PCPs.

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<sup>12</sup>Unless otherwise specified, “NPs” is used throughout this dissertation to refer to NPs in general – both PCNPs and specialty care NPs.

Ladd (2005) also compared the prescribing patterns of NPs and PCPs using data from the *National Hospital Ambulatory Medical Care Survey* (NHAMCS) and the NAMCS for the years 1997-2001 and based on 506 NP visits and 13,692 PCP visits. Ladd's results indicated that NPs and PCPs prescribed antibiotics to similar numbers of patient visits for viral upper respiratory tract infections. Hing et al. (2011) analyzed community health center visits from NAMCS 2006-2007 (n=32,300 visits) to compare NP and PCP care, and reported that NPs and PCPs ordered diagnostic or screening services, prescribed medication, and administered non-medication treatment similarly; however, NPs provided more health education during patient visits than PCPs. In a more recent study, Hughes et al. (2014) used Medicare claims data from 2010-2011 (n=651,074 office-based visits) and reported that NPs were more likely than PCPs to order diagnostic imaging tests after adjusting for geographic variation, patient demographics, and comorbidity.

Some studies also compared the functions between PCPs and NPs when caring for a specific disease. Taliaferro et al. (2014) distributed a survey to 387 PCPs and 150 NPs in Minnesota and compared their practice on managing patients with depression. Their results suggested that for patients with depression, NPs provided more recommendations of lifestyle changes, more educational materials, more self-help suggestions and or support group referral, and more referral to psychiatrists than PCPs; however, NPs and PCPs both prescribed antidepressant medications and provided brief counseling similarly in patient visits. Kuo et al. (2015) used a national sample of Medicare beneficiaries with diabetes in 2009 (N = 64,354) and compared the functions between NPs and PCPs. Their results indicated that NPs and PCPs had similar rates of LDL-C testing and nephropathy monitoring

but NPs had lower rates of eye examinations and HbA1C testing and NPs were more likely to consult cardiologists, endocrinologists, and nephrologists.

Taken together, existing studies generally suggest that NPs and PCPs function are similar in terms of ordering or providing diagnostic, screening and medication prescription services; but unlike PCPs, NPs provide more therapeutic and preventive services during patient visits. Despite these findings, we know little about the functions of the collective PCN workforce – that is, PCRNs and PCNPs – and how the functions of PCNs compare with PCPs. PCRNs are a significant component (approximately 89%) of the PCN workforce (Agency for Healthcare Research and Quality, 2011; Bureau of Labor Statistics, 2013). Researchers have suggested that the scope of PCRN practice is similar to yet distinct from that of PCPs and advocated for additional research comparing how the functions of PCRNs overlap with or are distinct from those of PCPs (Djukic & Kovner, 2010). These gaps suggest that an understanding of how PCNs and PCPs' functions compare is needed to better understand the contributions of both PCNs and PCPs to primary care.

## **Roles**

As described in Chapter 1, “role” is the pattern of functions that an individual performs in his or her job. Traditionally, researchers have defined the roles of PCNs – both PCRNs and PCNPs – relative to PCPs and as filling either a substitute and/or a supplemental role to PCPs (Laurant et al., 2005). However, researchers have not examined the functions that PCNs performed when they served these roles.

Recently, Everett et al. (2014) used panel data from 2,603 adult Medicare patients with diabetes to characterize the roles of NPs/PAs in team-based care models. These patients saw different types of providers (210 attending PCPs, 24 PAs, 28 NPs, and 51 resident PCPs)

in a primary care clinic in 2008. The researchers constructed different patient panels by grouping together patients who saw the same type of provider as their “usual provider” for the majority of their visits. For each grouping of patients, the roles of NPs/PAs were defined as: 1) *no role*: PCPs were the usual provider and managed the majority of a patient’s visits, and NPs/PAs managed no visits; 2) *usual provider role* (interchangeable with “substitute” role): NPs/PAs managed the majority of a patient’s visits; and 3) *supplemental role*, PCPs were the usual provider and managed the majority of a patient’s visit, but NPs/PAs managed at least one patient visit during the time period. The results of this study indicated that NPs/PAs filled “no role” for approximately 45% of the panel, served in a “supplemental role” for 42% of the panel and served in a “usual provider role” for 13% of the panel. Similar to previous studies, however, this study did not identify the specific functions that NPs/PAs and PCPs performed when serving these three roles.

In general, previous studies have focused on defining or describing the roles of PCNs and PCPs as either a substitute or supplemental role. However, the actual functions provided by PCNs and PCPs in their roles have not been closely examined, nor have comparisons been made of the functions that PCNs and PCPs perform when they serve in the same or different roles. Because PCNs and PCPs performed different functions under different roles, examining how their functions vary with their roles is important for understanding how their care is similar to and different from each other under different scenarios. Additionally, previous studies only defined PCNs’ roles relative to PCPs but very few studies defined PCPs’ roles. We know little about whether PCPs served similar or different roles with PCNs and how their functions are similar to and different from those of PCNs when both served

similar roles. Therefore, further research is needed to understand the roles of these two important groups of health professionals in the future.

### **Diagnostic Characteristics of Care Recipients**

Several studies in the past two decades have compared the diagnostic characteristics (i.e., general health problems, major reasons for visit, or diagnoses) of care recipients for NPs and PCPs. However, few comparisons have been made for PCRNPs and PCPs. In their 2001 study discussed earlier, Hooker and McCaig also reported that NPs and PCPs provided care to similar proportions of patients for general medical examination, diabetes, and hypertension. Deshefy-Longhi et al. (2008) surveyed 54 NPs (1,620 visits) across 45 primary care sites in southern New England to compare the top 20 diagnoses of patients seen during NP visits with those seen during PCP visits in 19 separate physician-run clinics. They reported that general medical examinations, well-baby examinations, and cough were the top three diagnoses for both NP and PCP visits; gynecological examinations, contraceptive prescriptions, fatigue/exhaustion, and employee physical examinations were among the top 20 diagnoses for NP visits; and fever, sore throat, pain, headache, follow-up (for any diagnosis), blood pressure testing, medication, nasal congestion, diabetes, prenatal examination, and back symptoms were among the top 20 diagnoses for PCP visits.

Morgan et al. (2012) used national administrative data for primary care encounters from the Veterans Health Administration for the years 2005-2010 to characterize NP and PCP care. They reported that NPs and PCPs had a similar proportion of patient visits for each of the 10 most common primary care visit diagnoses: hypertension, musculoskeletal disorders, diabetes, cardiovascular disorders, medical examinations, dyslipidemia, mental health disorders, gastrointestinal disorders, symptoms/signs/ill-defined disorders, and chronic

obstructive pulmonary disease. More recently, Hooker et al. (2013) used data from NHAMCS 2001-2010 to describe the care of NPs/nurse midwives with PCPs. They reported that NPs and PCPs saw a similar proportion of patients for diabetes and hypertension.

Generally, previous studies have been focused on the similarities between the most common diagnoses of care recipients treated by PCNs and PCPs. However, researchers only used descriptive analysis to describe the types of diagnoses that PCNs and managed without considering other factors that may influence patients' preferences of primary care providers and provider assignments, such as patient demographics, geographic location, overall health conditions, and comorbidities (Dobbertin, Horner-Johnson, Lee, & Andresen, 2014). Some studies were also focused on a specific care delivery model or setting (e.g., the VA). This may or may not accurately reflect the diagnostic characteristics of PCN and PCP care recipients, because patients with similar diagnostic characteristics could be assigned to different providers across types of practice settings or care delivery models. The generalizability of previous studies may also be low because some researchers only focused on a specific population group or a specific geographic area. Thus, the depth of knowledge remains limited in terms of the similarities and differences of the diagnostic characteristics of PCN and PCP care recipient.

According to the above review and discussion of previous research, a study that uses the most current data and advanced study design and analyses to compare PCN care and PCP care is necessary and important for improving our understanding of how PCN care is similar to and different from PCP care. Therefore, this analysis was conducted to achieve the following aims:



**Study Aim 1:** To compare the functions of PCNs and PCPs;

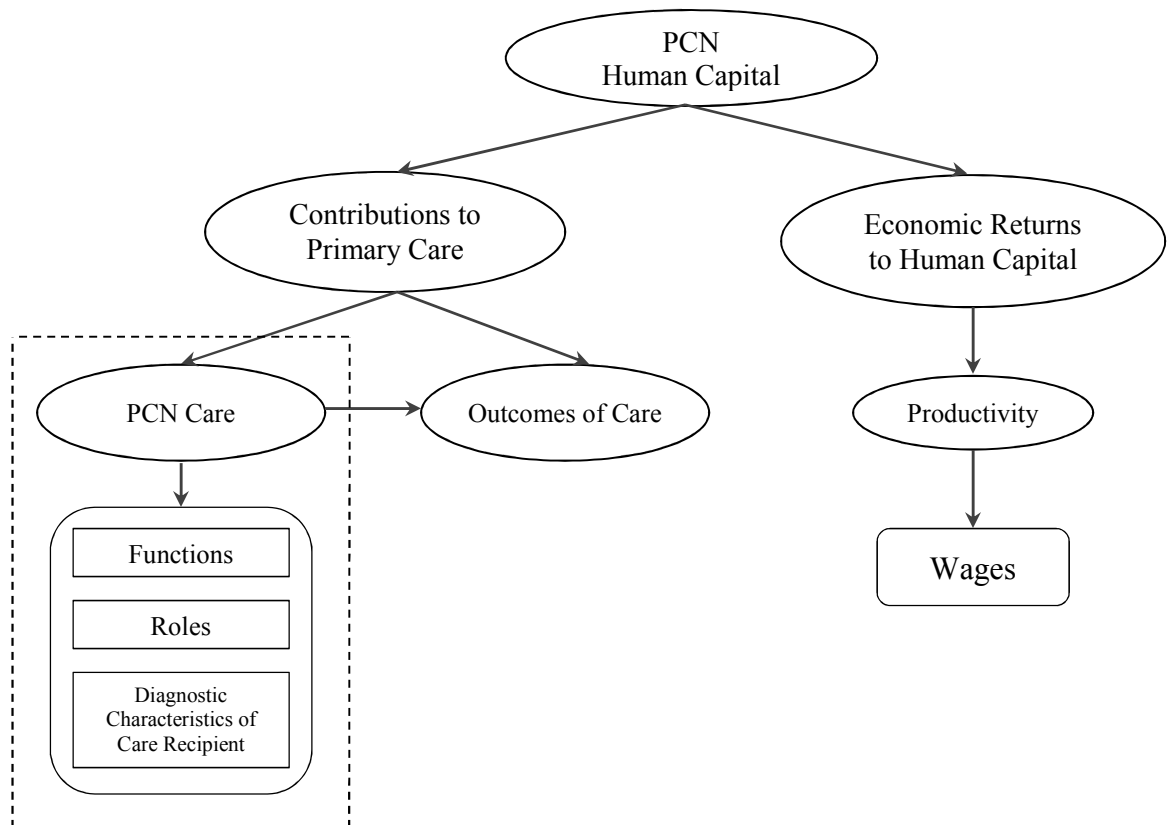
**Study Aim 2:** To compare the roles of PCNs and PCPs; and

**Study Aim 3:** To examine the diagnostic characteristics of patients who receive care from PCNs and PCPs.

### Conceptual Framework

The research question addressed in this chapter focused on specific aspects of the dissertation's overall conceptual framework, as shown by the dotted line in Figure 3.1. Namely this analysis: a) described PCN functions, roles, and the diagnostic characteristics of care recipients; and b) examined how these aspects of PCN care compared with PCP care.

**Figure 3.1: Sections Examined in Chapter 3 From the Overall Conceptual Framework of This Dissertation**



## **Methods**

This study used a cross-sectional, secondary analysis design to achieve its aims. The following sections discuss the datasets, variables, and analysis used in this study.

### **Datasets**

This study used data from two different data files to achieve its specific aims. The first data file, the *Medical Expenditure Panel Survey* (MEPS), was used to address all study aims. The MEPS, a national dataset sponsored and maintained by the Agency for Healthcare Research and Quality (AHRQ), was initiated in 1996 to provide estimates of health care use and expenditures, health insurance coverage, and health care payments for the U.S. civilian non-institutionalized population. The MEPS survey contains four components – household, insurance/employer, medical provider, and nursing home. Each component has a different focus and is released annually, except the nursing home component, which was released only once in 1996.

This study used data files from the Household Component of MEPS, which collects data from a sample of individuals and families in selected communities that were drawn from a nationally representative subsample of households that participated in the prior year's National Health Interview Survey. The MEPS Household Component is a panel survey that follows the same respondents for five interview rounds over 2.5 years. It is also an overlapping survey as new respondents are added to the panel each year, and each respondent remains in the sample for the period of 2.5 years. The methods used to gather responses to the MEPS include individual interviews with participants, plus a series of surveys completed by each participant. While the specific number of responses varies somewhat from year to year, each year of the MEPS contains approximately 30,000 observations of household

respondents. The MEPS Household Component was appropriate for use in this study because of its large and representative sample.

This study also pooled data from three public-use files from the Household Component for the years 2002-2013: the Office-Based Medical Provider Visit file (the OB file), the Outpatient Department Visit file (the OPD file), and the Full Year Consolidated file (the FYC file). The OB and OPD files provide the following data, reported by household respondents, for each office-based or outpatient department visit: dates of patient visits; types of care received, including therapies, services, and procedures received during the visit; diagnostic codes recorded at the visit; and associated expenditures. These two files were selected because this study was focused on the care provided by PCNs and PCPs in U.S. primary care settings. The FYC file provides information about: patients' demographic and socio-economic characteristics; health status; access to care; health care use and expenditures (during a year); and health insurance coverage of the household respondents. These three MEPS data files were used because they include key variables that reflect PCN and PCP functions and roles, and patients' demographics and diagnoses in primary care settings. These three data files were merged using de-identified patient information.

It was necessary to use an additional data file – the *Clinical Classification Software* (CCS) file – in conjunction with MEPS to address the third study aim. The CCS file, developed by the Healthcare Cost and Utilization Project (HCUP) of the AHRQ, provides a diagnosis and procedure categorization scheme that is used to analyze data pertaining to diagnoses and procedures. The file was used because it includes 17 general categories of diagnosis based on the *International Classification of Diseases, 9th Revision, Clinical Modification* (ICD-9-CM), which provides specific patient diagnostic information. This file

was merged with the above three MEPS files using patient diagnostic codes to address Study Aim 3. All steps of the data file merge were conducted prior to sample identification and further analysis.

## **Sample**

Several inclusion criteria were used to ensure that the sample for this study was obtained from the appropriate data files and that it closely aligned with primary care. First, this study only included respondents who saw a PCN (an RN or NP<sup>13</sup>) or a PCP (general or family practice, internal medicine, or pediatrics) as a usual source of care (USC); that is, the provider that the respondent usually went to if he/she was sick or needed advice about his/her health (Agency for Healthcare Research and Quality, 2013). Respondents who saw other types of providers (e.g., a specialist) as a USC were excluded based on data from the MEPS FYC file. Second, this study included respondents who saw a PCN or a PCP for a “current visit,” as referenced in the survey; respondents who saw other types of providers for a current visit were excluded, using data from the MEPS OB file and OPD file. Third, this study included only respondents who made office-based and outpatient visits to USC providers at outpatient clinics or non-hospital settings; respondents who saw a USC in a hospital, emergency room or inpatient settings were excluded, using data from the FYC file. Finally, this study excluded respondents who received specialty care, including chemotherapy, radiation therapy, MRI, EEG, and anesthesia, which are above and beyond the services typically provided during a primary care provider visit (from the OB and OPD files).

Detailed information of sample identification is presented in Appendix 3.1.

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<sup>13</sup>The MEPS data files do not provide the information of NPs’ specialty. This “NP” therefore refers to NPs in general, including both PCNPs and specialty care NPs.

Further analysis was conducted to explore the number of respondents available for inclusion in this study. This analysis revealed 96,517 respondents meeting the above outlined criteria, including 1,045 individuals who saw a PCN as USC and 95,472 individuals who saw a PCP as USC. For these eligible patients, propensity score matching (PSM) was used to further define the sample for this study. This statistical technique allows researchers to estimate treatment effects from observational datasets, especially when the characteristics of observations have a significant impact on the probability of receiving treatment and when there is a large discrepancy between treatment and control groups (Guo & Fraser, 2010). The PSM is appropriate for this study because: 1) this study examined the effects of a respondent seeing a PCN – that is, the care they were likely to receive and the diagnoses that respondents were likely to have if saw a PCN; 2) MEPS is an observational dataset; 3) time trend and respondents’ demographics, geographic location, and overall health status have impacts on their probability of receiving the “treatment” (i.e., saw a PCN) (Everett, Schumacher, Wright, & Smith, 2009); and 4) there is a large discrepancy between the number of respondents who saw a PCN as USC (n=1,045 to be assigned as the “treatment group”), versus those who saw a PCP as USC (n=95,472 to be assigned as the “control” or comparison group).

Propensity Score Matching resamples and matches untreated to treated respondents according to the probability of receiving a particular treatment (Guo & Fraser, 2010). First, a logistic regression model of the following type was used to estimate the probability of seeing a PCN as USC for each respondent:

$$\textit{Seeing a PCN as USC} = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \varepsilon$$

Where,

*Seeing a PCN as USC* is a dummy variable, with 1 referring to seeing a PCN as USC and 0 referring to seeing a PCP as USC;

$X_{i(i=1,2,3,...)}$  refers to each characteristic of respondents' demographics (i.e., age, gender, race, insurance status, and geographic location), prior conditions, overall health status, and time variant; and  $\varepsilon$  is a random error.

The respondent characteristics noted above were selected based on previous studies suggesting that PCNs were more likely than PCPs to provide care for patients who were younger (Hooker & McCaig, 2001), female (Hooker et al., 2013), non-white (DesRoches et al., 2013), living in rural areas (Buerhaus et al., 2014; Graves et al., 2015), uninsured (Dill et al., 2013; Hing et al., 2011), and of a better overall health status (Morgan et al., 2012). The time variant term was included to adjust for variation across time. The use of pooled data makes adjusting for the time variant particularly important as the diagnoses that PCNs managed may change over time because of the population itself (e.g., the increasing age of the population who saw PCNs) or because of the implementation of policies (e.g., health care reform) that may affect the number of patients who saw PCNs during the past decade (Auerbach et al., 2013). The operational definitions for these characteristics are presented in Appendix 3.2. Missing data for each variable was managed before PSM (see Appendix 3.2).

Second, the treatment (PCN) and control (PCP) groups were matched on the probability of a respondent seeing a PCN as their USC. Because a respondent who saw a PCN as a USC would have multiple matches within a year, one-by-one matching was conducted; and an initial value “4564654” was specified as the random-number seed that

enabled a random matching among the multiple matches.<sup>14</sup> Matching was conducted separately for the respondents who were 18 or older (958 saw a PCN as USC) and the respondents who were younger than 18 years old (87 saw a PCN as USC). Respondents who were 18 or older were matched on their demographics, prior conditions, overall health status, and year. For respondents who were younger than 18 years old, matching was conducted in two steps. First, because the number of respondents saw a PCN as a USC was smaller than 5 in each year of 2002-2012 (n=16), respondents in these years were not matched on year but only on their demographic, prior conditions, and overall health status. Second, the number of respondents who saw a PCN as a USC was 71 in the years of 2013, so the respondents in this year were separately matched on their demographic, prior conditions, and overall health status.

After PSM, the sample included 2,090 respondents: 1,045 who saw PCNs as a USC and 1,045 who saw PCPs as a USC. Because respondents may have different diagnoses and receive different care for each of their visit, the analysis of this study was conducted at the level of the *patient visit* – that is, each time the patient saw a provider. After merging with OB and OPD visit files, these 2,090 patients correspond to 7,821 visits, providing a sample size that was sufficient for further analysis. The management of missing data in the OB and OPD visit files is presented in Appendix 3.2.

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<sup>14</sup>Sensitivity analyses were conducted and the results suggested that that main conclusion of this paper did not change if different initial value was chosen.

## Variables

The variables that were used to address each study aim are described below. To address Study Aim 1 – to compare the functions between PCNs and PCPs, this study used the therapies, diagnostic exams, vaccination, prescription and procedures that a respondent reported receiving at a current visit. The types of therapy included biomedical therapies – kidney dialysis, IV therapy, drug or alcohol treatment, allergy shots, and shot other than allergy – and psychotherapy or counseling. Diagnostic exams included lab tests, sonogram or ultrasound, X-rays, mammogram, electrocardiogram, throat swab, and other diagnostic tests or exams. Also, the variables that indicated whether a patient received vaccination, prescription, and procedure (i.e., dummy variables) during his/her current visit were used. These variables were included because 1) they reflected the activities that PCNs’ and PCPs’ performed as part of their functions in primary care settings; and 2) they were examined in previous studies as the care that PCNs provided in primary care settings (Hing et al., 2011; Hooker et al., 2013; Hooker & Cipher, 2005; Hooker & McCaig, 2001; McCaig et al., 1998).

To address Study Aim 2 – to compare the roles of PCNs and PCPs, this study examined the “usual provider” and “supplemental” roles of PCNs and PCPs. These two labels were used because they are the descriptors used in the most recent studies to categorize PCN roles and are consistent with the traditional role descriptions of “substitute” and “supplemental” (Everett et al., 2013; Everett et al., 2014). Therefore, using these labels make the examination of roles consistent among chapters in this dissertation.

Unfortunately, Everett et al.’s work defined “usual provider role” and “supplemental role” merely for NPs working in team-based care models. This paper expanded the definitions of these role labels and considered that both PCNs and PCPs generally could



serve a “usual provider” role or a “supplemental” role. Specifically, a PCN or a PCP was considered as serving in a “usual provider” role if the PCN or PCP was both the patient’s USC and the specific individual provider for the respondent’s current visit; a PCN or a PCP was considered as serving in a “supplemental” role for any given visit if the PCN or PCP was noted to be the provider for the patient’s current visit but not the patient’s USC. Using this approach to determine role categories for both PCNs and PCPs made the role comparison between these two types of providers feasible. Because this study only included patients who saw either a PCN or PCP, the roles of PCNs and PCPs represent the four scenarios (shown in Table 3.1), acknowledging that a patient’s USC and the specific individual provider seen by the patient at any given visit may differ.

**Table 3.1: The Roles of PCNs and PCPs and Four Patient Visit Scenarios**

	Seeing a PCN as USC	Seeing a PCP as USC
Seeing a PCN for the current visit	Scenario 1: PCN-Usual Provider Role	Scenario 2: PCN-Supplemental Role
Seeing a PCP for the current visit	Scenario 3: PCP-Supplemental Role	Scenario 4: PCP-Usual Provider Role

This table describes the following roles for PCNs and PCPs, based on the visit information provided:

***Scenario 1: PCN-Usual Provider Role***: patients reported seeing a PCN as USC, and seeing a PCN for the current visit.

***Scenario 2: PCN-Supplemental Role***: patients reported seeing a PCP as USC, but seeing a PCN for the current visit.

***Scenario 3: PCP-Supplemental Role***: patients reported seeing a PCN as USC, but seeing a PCP for the current visit.

***Scenario 4: PCP-Usual Provider Role***: patients reported seeing a PCP as USC, and seeing a PCP for the current visit.

To address Study Aim 2, this study examined and compared the functions that PCNs and PCPs performed within their respective roles.

*To address Study Aim 3 – to examine the diagnostic characteristics of PCN and PCP care recipients*, this study used the 17 general categories of diseases from CCS file to categorize the diagnosis that the respondents reported for each of his or her provider visits. This approach was used because it provided more comprehensive information about patients' diagnostic characteristics than previous studies that focused on specific or several diseases. All the variables that were used for further analyses are presented in Appendix 3.2.

## **Analyses**

The analyses used for this study is described below by study aim.

### ***Study Aim 1: To compare the functions of PCNs and PCPs.***

First, this analysis compared the functions of PCNs and PCPs regardless of their roles. Referring to Table 3.1, PCNs' functions under scenarios 1 and 2 (visit PCNs) were compared with PCPs functions under scenarios 3 and 4 (visit PCPs). Specifically, a chi-square test was used to determine whether PCNs and PCPs had a similar number of patient visits involving therapies, diagnostic exams, vaccinations, prescriptions, or procedures.

***Study Aim 2: To compare the roles of PCNs and PCPs.***

To compare PCNs and PCPs' usual provider role, PCNs' functions under scenario 1 (PCN in usual provider role) were compared with PCPs' functions under scenario 4 (PCP in usual provider role) in Table 3.1. To compare PCNs and PCPs' supplement role, PCNs' functions under scenario 2 (PCN in supplemental role) were compared with PCPs' functions under scenario 3 (PCP in supplemental role) in Table 3.1. Specifically, a chi-square test was used for both comparisons to examine whether PCNs and PCPs had similar numbers of patient visit involving therapies, diagnostic exams, vaccinations, prescriptions, or procedures when served the same role.

***Study Aim 3: To examine the diagnostic characteristics of PCN and PCP care recipients.***

A multinomial logistic model was used to determine the diagnostic characteristics PCN and PCP care recipients. Specifically, the analytic model for this analysis had the following form:

$$Diagnoses = f(USC\_PCN, Visit\_PCN, [USC\_PCN]*[Visit\_PCN]), X_i)$$

Where

*Diagnoses* refer to a categorical variable that reflects 17 general categories of patient diagnoses from the CCS file;

*USC\_PCN* is a dummy variable that reflects whether a patient sees a PCN as the USC, where 1 corresponds to seeing a PCN as the USC (scenarios 1 and 3 in Table 3.1), and 0 corresponds to seeing a PCP as the USC (scenarios 2 and 4 in Table 3.1).

This term indicated whether PCNs were more likely to manage a specific diagnosis when patients saw them as a USC;

*Visit\_PCN* is a dummy variable that reflects whether a patient saw a PCN for the current visit, where 1 corresponds to seeing a PCN for the current visit (scenarios 1 and 2 in Table 3.1), and 0 corresponds to seeing a PCP for the current visit (scenarios 3 and 4 in Table 3.1). This term indicated whether PCNs were more likely to manage a specific diagnosis when patients saw them for a current visit;

$[USC\_PCN] * [Visit\_PCN]$  is the interaction term for *USC\_PCN* and *Visit\_PCN*, where 1 corresponds to the usual provider role of PCNs – when both *USC\_PCN* and *Visit\_PCN* equal to 1 (or scenario 1 in Table 3.1), and 0 corresponds to other roles of PCN and PCPs (scenarios 2, 3, and 4 in Table 3.1). This interaction term indicated whether PCNs were more likely to manage a specific diagnosis when served a usual provider role, compared with other patient visit scenarios;

$X_i$ , as mentioned in PSM analysis, refers to each characteristics of respondents' demographics (i.e., age, gender, race, insurance status, and geographic location), prior conditions, overall health status, and time variant; the operations of patients' demographics, prior conditions, overall health status and time variant are the same with those in PSM analysis. More detailed information of these variables is presented in Appendix 3.2.

The results of this multinomial logistic regression model were expected to indicate: how the types of diseases that PCNs managed were similar or different from those managed by PCPs when both of PCNs and PCPs served in a usual care provider role (scenarios 1 vs. 4 in Table 3.1) or in a supplemental role (scenarios 2 vs. 3 Table 3.1).

## Results

This section first presents an overview of the sample used in this paper before and after PSM. The main results of PCN care and PCP care are presented by the three study aims.

### Sample Description

The demographics, complexity, and general health status of these respondents before and after PSM are shown in Table 3.2. Before PSM, compared with those in the PCP group (n=95,469), respondents in the PCN group (n=1,045) were more likely to be younger (44.25 vs. 48.90), female (69.95% vs. 56.48%), have had private insurance (19.19% vs. 23.53%) or be uninsured (11.48% vs. 7.40%), and have lived in the Midwest (21.34% vs. 20.47%), South (42.68% vs. 39.00%), or West (23.00 vs. 19.48%). For the respondents who were older than 18 years old, respondents in the PCN group had a similar PCS score but lower MCS score (49.26 vs. 50.71) than those in the PCP group. For the respondents who were younger than 18 years old, respondents in the PCN group had better general health status than those in the PCP group. The respondents in the PCN group had a similar number of prior conditions with those in the PCP group.

After PSM, the baseline demographics, prior conditions, and overall health status of respondents in the PCN group (n=1,045) were similar to those of the respondents in the PCP group (n=1,045). These 2,090 patients corresponded to 7,821 visits, including 2,354 visits with a PCN, 2,909 visits with a PCP, and 2,558 visits without seeing either a PCN or a PCP.

Table 3.2: Descriptive Statistics of Respondents Seeing a PCN or a PCP as Usual Source of Care (n=2,090)

	Before PS Matching (n=96,514)			After PS Matching (n=2,090)		
	PCN Group (n=1,045) Mean (SD)/n(%)	PCP Group (n=95,469) Mean (SD)/n(%)	Standardized Difference	PCN Group (n=1,045) Mean (SD)/n(%)	PCP Group (n=1,045) Mean (SD)/n(%)	Standardized Difference
<b><u>Demographics</u></b>						
<b>Age</b>	44.25 (0.60)	48.91 (0.06)	-0.223 <sup>†</sup>	44.25 (0.60)	44.17 (0.17)	0.005
<b>Gender</b>						
Female	731 (69.95%)	53,921 (56.48%)		731 (69.65%)	756 (72.34%)	
Male	314 (30.05%)	41,548 (43.52%)	-0.282 <sup>†</sup>	314 (30.05%)	289 (27.66%)	0.053
<b>Race</b>						
White	809 (77.42%)	71,100 (74.47%)		809 (77.42%)	786 (75.22%)	0.052
Nonwhite	236 (22.58%)	24,365 (25.53%)	0.069	236 (22.58%)	259 (24.78%)	
<b>Insurance Coverage</b>						
Public	620 (59.33%)	66,221 (69.36%)	-0.211 <sup>†</sup>	620 (59.33%)	123 (59.62%)	-0.006
Private	305 (29.19%)	22,465 (23.53%)	0.129 <sup>†</sup>	305 (29.19%)	295 (28.23%)	0.021
Uninsured	120 (11.48%)	6,783 (7.10%)	0.151 <sup>†</sup>	120 (11.48%)	127 (12.15%)	-0.021
<b>Region</b>						
Northeast	143 (13.68%)	19,760 (20.70%)	-0.187 <sup>†</sup>	143 (13.68%)	135 (12.95%)	0.023
Midwest	223 (21.34%)	19,543 (20.47%)	0.021	223 (21.34%)	224 (21.44%)	-0.002
South	446 (42.68%)	37,229 (39.00%)	0.075	446 (42.68%)	455 (43.54%)	-0.017
West	233 (22.30%)	18,937 (19.84%)	0.060	233 (22.30%)	231 (22.11%)	0.005
<b><u>General Health Status</u></b>						
<b>PCS42</b>	46.73 (0.38)	47.20 (0.04)	-0.044	46.73 (0.38)	47.26 (0.38)	-0.045
<b>MCS42</b>	49.26 (0.34)	50.71 (0.03)	-0.142 <sup>†</sup>	49.26 (0.34)	49.40 (0.34)	-0.011
<b>SF1</b>	1.86 (0.07)	1.76 (0.01)	-0.121 <sup>†</sup>	1.86 (0.07)	1.83 (0.08)	-0.086
<b><u>Complexity</u></b>						
<b>Number of Prior Conditions</b>						
No condition	435 (41.63%)	44,265 (44.27%)	-0.053	435 (41.63%)	462 (44.21%)	-0.052
One condition	274 (26.22%)	25,377 (26.58%)	-0.008	274 (26.22%)	254 (24.31%)	0.044
Two conditions	193 (18.74%)	16,120 (16.89%)	0.042	193 (18.74%)	159 (15.22%)	0.087
Three or more conditions	143 (13.68%)	11,707 (12.26%)	0.042	143 (13.68%)	170 (16.27%)	-0.072

<sup>†</sup> Imbalance defined as absolute value greater than 0.1.

***Study Aim 1: To compare the functions of PCNs and PCPs.***

Of the 7,821 patient visits, there were 5,263 visits to PCNs (n=2,354) or PCPs (n=2,909) in which patients received therapies, diagnostic exams, vaccinations, prescriptions, or procedures (Table 3.3). Only the services that have statistically differences between PCNs and PCPs are discussed below.

The number and percentage of patient visits to PCNs were *greater* than those to PCPs for physical therapy, kidney dialysis, IV therapy, and allergy or other shots. The number and percentage of patient visits made to PCNs were *similar* to those made to PCPs for occupational therapy and drug or alcohol treatment, but the proportions of patient visits relative to total patient visits were less than 1% of the total patient visits. The number and percentage of patient visits made to PCNs also were *greater* than those made to PCPs for psychotherapy or counseling, but, again, the proportions of patient visits in which this service was received were small for both groups.

In terms of diagnostic exams, the number and percentage of patient visits made to PCNs were *less* than those made to PCPs for lab tests, X-rays, ECGs, and throat swabs. The number and percentage of patient visits made to PCNs were similar to those made to PCPs for sonograms or ultrasounds, mammograms, and other diagnostic tests or exams, but the proportions of patient visits in which these services were received were small for both groups.

The number and percentage of patient visits made to PCNs were *similar* to those made to PCPs for vaccinations. However, the number and percentage of patient visits made to PCNs were *fewer* than those made to PCPs for procedures and prescriptions.

**Table 3.3: Functions of PCNs and PCPs (n=5,263 visits)**

	Patient Visits to PCNs (n=2,354) n(%)	Patient Visits to PCPs (n=2,909) n(%)	p-Value
<b>Biomedical Therapies</b>			
Physical therapy	25 (1.06%)	7 (0.24%)	0.00*
Occupational therapy	0 (0.00%)	1 (0.03%)	0.38
Speech therapy	0 (0.00%)	0 (0.00%)	.
Kidney dialysis	5 (0.21%)	0 (0.00%)	0.01*
IV Therapy	6 (0.25%)	0 (0.00%)	0.01*
Drug or alcohol treatment	1 (0.04%)	2 (0.07%)	0.72
Allergy shot	68 (2.89%)	9 (0.31%)	0.00*
Shots other than allergy	110 (4.67%)	108 (3.71%)	0.01*
<b>Total</b>	215 (9.13%)	127 (4.37%)	0.00*
<b>Psychotherapy/counseling</b>	21 (0.89%)	6 (0.21%)	0.00*
<b>Diagnostic Exams</b>			
Lab tests	634 (26.93%)	930 (31.97%)	0.00*
Throat swab	23 (0.98%)	55 (1.89%)	0.01*
Sonogram or ultrasound	11 (0.47%)	22 (0.76%)	0.19
X-rays	48 (2.04%)	132 (4.54%)	0.00*
Mammogram	7 (0.30%)	11 (0.38%)	0.62
Electrocardiogram	24 (1.02%)	70 (2.41%)	0.00*
Other diagnostic tests or exams	240 (10.20%)	313 (10.76%)	0.51
<b>Total</b>	987 (41.93%)	1,533 (52.70%)	0.00*
<b>Vaccination</b>	62 (2.63%)	73 (2.51%)	0.78
<b>Prescription</b>	788 (33.47%)	1,215 (41.77%)	0.00*
<b>Procedure</b>	19 (0.81%)	42 (1.44%)	0.04*

\*Significant at the 0.05 level.

Note: The percent in each group may not add up to 100% because patients might receive more than one service or they might not receive any service during a particular visit.

***Study Aim 2: To compare the roles of PCNs and PCPs.***

This section presents the results of how the functions of PCNs and PCPs are similar to and different from each when they both serve a usual provider role or a supplemental role. Only the services that have statistically differences between PCNs and PCPs are discussed below.



**Usual provider role.** PCNs or PCPs served a usual provider role in 4,025 patient visits, with 1,878 patient visits for PCNs and 2,147 visits for PCPs (Table 3.4).

The number and percentage of patient visits made to PCNs were *greater* than those made to PCPs for physical therapy and allergy or other shots. The number and percentage of patient visits made to PCNs were *similar* to those made to PCPs for occupational therapy, IV therapy, and drug treatment, but the proportions of patient visits in which these services were received were small for both groups. The number and percentage of patient visits made to PCNs were *greater* than those made to PCPs for psychotherapy or counseling, but the proportions of patient visits in which this service was received were small for both groups.

The number and percentage of patient visits made to PCNs were *fewer* than those made to PCPs for lab tests, X-rays, and ECGs. The number and percentage of patient visits made to PCNs were *similar* to those made to PCPs for sonograms or ultrasounds, mammograms, throat swabs, and other diagnostic tests or exams, but the proportions of patient visits in which these services were received were small for both groups.

The number and percentage of patient visits made to PCNs were *similar* to those made to PCPs for vaccinations and procedures. However, the number and percentage of patient visits made to PCNs were *greater* than those made to PCPs for prescriptions.

**Table 3.4: Functions of PCNs and PCPs When They Serve a Usual Provider Role  
(n=4,025 visits)**

	Saw PCNs as USC and Visited PCNs (n=1,878) n(%)	Saw PCPs as USC and Visited PCPs (n=2,147) n(%)	p-value
<b>Biomedical Therapies</b>			
Physical therapy	25 (1.33%)	4 (0.19%)	0.00*
Occupational therapy	0 (0.00%)	1 (0.05%)	0.35
Speech therapy	0 (0.00%)	0 (0.00%)	.
Kidney dialysis	0 (0.00%)	0 (0.00%)	.
IV Therapy	1 (0.00%)	0 (0.00%)	0.29
Drug or alcohol treatment	1 (0.05%)	2 (0.09%)	0.64
Allergy shot	23 (1.22%)	6 (0.28%)	0.00*
Shots other than allergy	100 (5.32%)	70 (3.26%)	0.00*
<b>Total</b>	150 (8.00%)	83 (3.87%)	0.00*
<b>Psychotherapy or counseling</b>	18 (0.96%)	2 (0.09%)	0.00*
<b>Diagnostic exams</b>			
Lab tests	544 (28.97%)	724 (33.72%)	0.00*
Throat swab	21 (1.12%)	33 (1.54%)	0.39
Sonogram or ultrasound	10 (0.53%)	13 (0.61%)	0.76
X-rays	44 (2.34%)	85 (3.96%)	0.01*
Mammogram	5 (0.27%)	9 (0.42%)	0.41
Electrocardiogram	21 (1.12%)	55 (2.56%)	0.00*
Other diagnostic tests or exams	215 (11.45%)	207 (9.64%)	0.06
<b>Total</b>	860 (45.79%)	1,126 (52.45%)	0.00*
<b>Vaccination</b>	47 (2.50%)	62 (2.89%)	0.45
<b>Prescription</b>	726 (38.64%)	894 (41.64%)	0.05*
<b>Procedure</b>	19 (1.01%)	24 (1.12%)	0.85

\*Significant at the 0.05 level.

Note: The percent in each group may not add up to 100% because patients might receive more than one service or they might not receive any service during a particular visit.

**Supplemental role.** PCNs and PCPs served in a supplemental role in 1,238 patient visits, with 476 patient visits for PCNs and 762 patient visits for PCPs (Table 3.5). The number and percentage of patient visits made to PCNs were *greater* than those made to PCPs for kidney dialysis, IV therapy, and allergy shots. The number and percentage of patient visits made to PCNs were *similar* to those made to PCPs for physical therapy and other shots (other than allergy shots), but the proportions of patient visits in which these services were received were small for both groups. Moreover, the number and percentage of patient visits made to PCNs were *similar* to those made to PCPs for psychotherapy or counseling.

The number and percentage of patient visits made to PCNs were *fewer* than those made to PCPs for lab tests, X-rays, throat swab, and other diagnostic tests or exam. The number and percentage of patient visits made to PCNs were *similar* to those made to PCPs for sonograms or ultrasounds, mammograms, ECGs, and throat swabs, but the proportions of patient visits in which these services were received were small for both groups. The number and percentage of patient visits made to PCNs were *greater* than those made to PCPs for vaccinations, but *fewer* for prescriptions and procedures.

**Table 3.5: Functions of PCNs and PCPs When They Serve a Supplemental Role (n=1,238 visits)**

	Saw PCP as USC but Visited PCNs (n=476) n(%)	Saw PCN as USC but Visited PCPs (n=762) n(%)	p-value
<b>Biomedical Therapies</b>			
Physical therapy	0 (0.00%)	3 (0.39%)	0.26
Occupational therapy	0 (0.00%)	0 (0.00%)	.
Speech therapy	0 (0.00%)	0 (0.00%)	.
Kidney dialysis	5 (1.05%)	0 (0.00%)	0.00*
IV Therapy	5 (1.05%)	0 (0.00%)	0.00*
Drug or alcohol treatment	0 (0.00%)	0 (0.00%)	.
Allergy shot	45 (9.45%)	3 (0.39%)	0.00*
Shots other than allergy	10 (2.10%)	38 (4.99%)	0.12
<b>Total</b>	65 (13.66%)	44 (5.77%)	0.00*
<b>Psychotherapy or counseling</b>	3 (0.63%)	4 (0.52%)	0.46
<b>Diagnostic Exams</b>			
Lab tests	90 (18.91%)	206 (27.03%)	0.00*
Throat swab	2 (0.42%)	22 (2.89%)	0.00*
Sonogram or ultrasound	1 (0.21%)	9 (1.18%)	0.06
X-rays	4 (0.84%)	47 (6.17%)	0.00*
Mammogram	2 (0.42%)	2 (0.26%)	0.63
Electrocardiogram	3 (0.63%)	15 (1.97%)	0.06
Other diagnostic tests or exams	25 (5.25%)	106 (13.91%)	0.00*
<b>Total</b>	127 (26.68%)	407 (53.41%)	0.00*
<b>Vaccination</b>	15 (3.15%)	11 (1.44%)	0.04*
<b>Prescription</b>	62 (13.03%)	321 (42.13%)	0.00*
<b>Procedure</b>	0 (0.00%)	18 (2.36%)	0.00*

\*Significant at the 0.05 level.

Note: The percent in each group may not add up to 100% because patients might receive more than one service or they might not receive any service during a particular visit.

**Summary of functions and roles.** The findings of PCNs and PCPs' functions and roles are summarized in Table 3.6. In terms of **functions**, the number and percentage of patient visits made to PCNs were *greater* than those made to PCPs for biomedical therapies and psychotherapy or counseling but were *fewer* for diagnostic exams, prescriptions, and procedures. The number and percentage of patient visits made to PCNs were *similar* to those made to PCPs for vaccinations.

In terms of **roles**, when both PCNs and PCPs served in a *usual provider* role, the number and percent patient visits made to PCNs were *greater* than those made to PCPs for biomedical therapies and psychotherapy or counseling but were *fewer* for diagnostic exams and prescriptions; although the number and percentage of patient visits made to PCNs were *similar* to those made to PCPs for vaccinations and procedures. When both PCNs and PCPs served in a *supplemental* role, the number and percentage of patient visits made to PCNs were *greater* than those made to PCPs for biomedical therapies and vaccinations but *fewer* for diagnostic exams, prescriptions, and procedures.

**Table 3.6: A Comparison Summary of PCNs and PCPs' Functions and Roles**

	PCNs vs. PCPs					
	Biomedical Therapies	Psychotherapy/Counseling	Diagnostic Exams	Vaccination	Prescription	Procedure
<b>Functions</b>	+	+	–	≈	–	–
<b>Roles</b>						
Usual Provider Role	+	+	–	≈	–	≈
Supplemental Role	+	≈	–	+	–	–

Notes: + denotes that the number and percentage of patient visits made to PCNs were **greater** than those made to PCPs for biomedical therapies, psychotherapy/counseling, diagnostic exams, vaccinations, prescriptions, or procedures; – denotes that the number and percentage of patient visits made to PCNs were **fewer** than those made to PCPs on biomedical therapies, psychotherapy/counseling, diagnostic exams, vaccinations, prescriptions, or procedures; ≈ denotes that the number and percentage of patient visits made to PCNs were **similar** to those made to PCPs for biomedical therapies, psychotherapy/counseling, diagnostic exams, vaccinations, prescriptions, or procedures.

***Study Aim 3: To examine the diagnostic characteristics of PCN and PCP care recipients.***

In this study sample, 3,891 patient visits had a diagnosis assigned and were included in the analysis. The predicted probabilities of PCNs or PCPs managed patients with a certain type of disease were estimated under different PCNs and PCPs' roles based on the multinomial logistic regression model (Figure 3.2).<sup>15</sup>

***When PCNs and PCPs both served in a usual provider role during patient visits*** (the 1<sup>st</sup> and 2<sup>nd</sup> columns of Figure 3.2), they had a *similar* probability of managing patients with any type of the diseases examined in the model. The difference of the probability when PCNs and PCPs managed the same type of disease was smaller than 0.05.

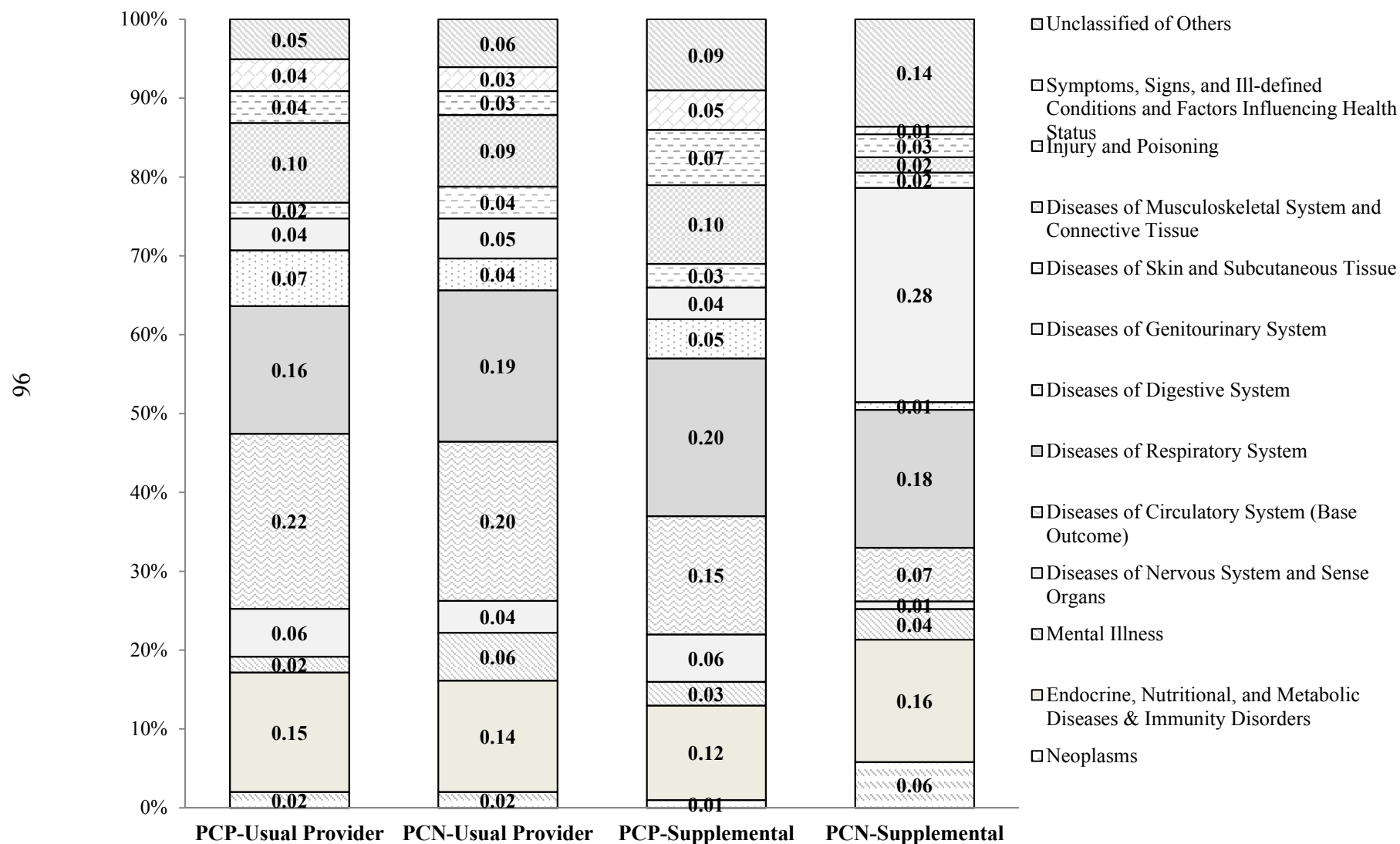
***When both PCNs and PCPs served in a supplemental role*** (the 3<sup>rd</sup> and 4<sup>th</sup> columns of Figure 3.2), the probability that they each managed patients with a specific type of diseases was different. When **PCNs** served a supplemental role, the probabilities that they managed patients with the following diseases were greater than those of PCPs: neoplasms (0.06 vs. 0.01), the diseases of genitourinary system (0.28 vs. 0.04), or other/unclassified diseases (0.14 vs. 0.09). When **PCPs** served in a supplemental role, their probabilities of managing patients with diseases of the circulatory system (0.15 vs. 0.07) and the musculoskeletal system and connective tissue (0.10 vs. 0.02) were higher than those of PCNs.<sup>16</sup>

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<sup>15</sup>The full results of this analysis are presented in Appendix 3.3.

<sup>16</sup>Only the types of disease with a more than 0.5 probability difference between PCNs and PCPs were listed here.

**Figure 3.2: The Predicted Probability of Being Diagnosed with a Certain Type of Disease (n=3,891 visits)**



## Discussion

This paper contributed important information on how the care provided by PCNs is similar to and different from the care provided by PCPs in terms of their functions and roles and the diagnostic characteristics of their care recipients. In terms of *functions*, this paper first examined a wide range of PCNs and PCPs' activities. These activities also contained those not examined in previous studies, such as the various types of biomedical therapies and whether a procedure was provided. Second, this paper used PSM, which controlled some of patients' factors that may influence PCNs and PCPs' activities, such as patients' demographics, overall health status, and prior conditions.

Third, this analysis reported that the number and percentage of patient visits made to PCNs were greater than those made to PCPs for therapeutic care (both biomedical therapies and psychological therapy or counseling) but fewer for diagnostic care, prescriptions, and procedures. Some of these findings are consistent with previous studies. For example, previous studies have reported that patients who visited PCNs received more psychotherapy or counseling than those who visited PCPs (Hooker, 2001; Taliaferro, 2014). Other findings, however, were different than previous studies. For example, findings from this paper demonstrated that the number and percentage of patient visits made to PCNs were fewer than those made to PCPs for diagnostic exams, while previous studies have reported that patients who saw PCNs received more diagnostic exams than those who saw PCPs (Hing et al., 2011; Hooker & McCaig, 2001; Hughes et al., 2014). Also, this paper reported that the number and percentage of patients visits made to PCNs was fewer than those made to PCPs for prescriptions, but previous studies reported that similar or more patients who visited PCNs received a prescription than those who visited PCPs (Hing et al., 2011; Hooker & Cipher,



2005; Hooker & McCaig, 2001; Ladd, 2005). These inconsistencies might be due to the use of different national datasets and analysis methods, the different focuses of patient populations, or practice changes that affect the functions of PCNs or PCPs. Generally, the examination of PCNs' and PCPs' functions in this paper are important additions to the body of research comparing PCN and PCP care.

In terms of *roles*, this paper examined PCNs and PCPs' roles by analyzing the functions they performed under usual provider role and supplemental role and by comparing their functions when serving the same role. Generally, this paper reported that PCNs and PCPs performed different functions under the same role. First, when PCNs and PCPs both served in a usual provider role, the number and percentage of patient visits made to PCNs were greater than those made to PCPs for biomedical therapies but fewer for diagnostic exams and prescriptions. These results were found when PCNs and PCPs cared for the patients with similar characteristics of demographics, general health status, and prior conditions. Thus, these findings indicate that PCNs and PCPs may have different practice patterns – that is, PCNs may be more likely to provide therapeutic care, while PCPs may be more likely to provide diagnostic care. For example, PCNs were more likely to provide psychological therapy than prescribe medications for patients with mental health problems; this different practice pattern may benefit patients' health outcomes (Taliaferro et al., 2013). Another reason might be that under the scope of practice law, PCNs, especially NPs, are not allowed to diagnose or prescribe to a similar extent as PCPs.

Second, PCNs and PCPs also performed different functions when they served a supplemental role for each other. The number and percentage of patient visits made to PCNs were greater than those made to PCPs for vaccinations, which suggests that PCNs in

supplemental roles practice in a way that focuses more on preventive care. This paper also applied the label of “supplemental” for describing *PCPs*’ role. It was found that the number and percentage of patient visits made to PCPs were greater than those made to PCNs for procedures. An explanation for this finding might be that patients had an acute, complex, or severe situation that needed the care delivered by PCPs. To our knowledge, this paper is the first one proposing that not only PCN care supplements PCP care but PCP care might also supplement PCN care. This examination may change the stereotype that PCN care is inferior to PCP care and suggests that PCNs and PCPs might deliver care that is appropriately supportive of each other.

In terms of the *diagnostic characteristics of their care recipients*, this paper compared patient visits with various diagnoses under different roles of PCNs and PCPs. First, compared with previous studies, the recipients of care, or patients, examined in this analysis represented a variety of geographical areas, health care settings, models of care delivery, and patient populations, which might achieve a higher generalizability.

Second, compared with previous studies that used descriptive analyses, this paper used PSM and controlled the factors that might influence patients’ diagnoses, such as patients’ demographics, overall health status, and prior conditions. Additionally, by using the 17-category of diagnoses from the CCS file, this paper included a wider range of patients’ diseases than previous studies that were merely focused on several common chronic diseases.

Third, the findings suggest that PCNs managed similar types of diseases as PCPs when both of them served a usual provider role. Previous studies have also suggested that PCNs managed the care of patients with similar chronic diseases or the most common diagnoses in primary care visits (Deshefy-Longhi et al., 2008; Hooker et al., 2013; Hooker &

McCaig, 2001; Morgan et al., 2012). However, this paper added new information by using a more comprehensive list of disease categories, and its results still suggest that PCNs and PCPs managed the care of patients with similar types of diseases. Therefore, this paper demonstrates that there is some degree of “substitutability” of PCNs for PCPs when both of them serve a usual provider role.

Lastly, this paper also determined that PCNs and PCPs managed patients with different diagnoses when both of them served in a supplemental role during patient visits. When PCNs served in a supplemental role, they were more likely to see patients who were diagnosed with diseases of the genitourinary system. This difference might be explained by the fact that PCNs are more likely than PCPs to provide care for women, such as performing gynecological examinations and providing contraceptive services (Deshefy-Longhi et al., 2008; DesRoches et al., 2013). Also, PCNs were more likely to manage patients with endocrine/nutritional/metabolic diseases or immunity disorders when serving in a supplemental role. For instance, it could be that a patient with diabetes saw a PCN for a general check-up or follow-up. When PCPs served in a supplemental role, however, patients who visited PCPs were more often diagnosed with infectious or parasitic diseases, diseases of the circulatory system, or diseases of the musculoskeletal system and connective tissues. One explanation for this finding is that patients might have a severe or acute condition that required seeing a PCP, such as acute infections, angina pectoris, or bone fracture.

Generally, this paper contributes new insights about PCN care and PCP care. The findings of this paper suggest that PCNs’ functions focused more on therapeutic care and psychological treatment, while PCPs’ functions focused more on diagnostic care, prescriptions, and procedures. These findings held when both PCNs and PCPs served a usual

provider role. Because PCNs' patients had similar diagnoses with those managed by PCPs, it also suggests that PCNs may, to some extent, substitute for PCPs when both served a usual provider role. Finally, PCNs and PCPs augmented each other's care when they each served a supplemental role, because they performed different functions and managed patients with different diagnoses.

### **Study Limitations**

Using secondary data may result in some limitations of this analysis that are worth noting. First, MEPS does not include all of the possible functions of PCNs and PCPs, especially PCNs' functions of managing chronic disease, transitioning care across settings, coordinating care among providers, patients and their family and caregivers, and collaborating with other professionals. However, MEPS still includes a wider range of PCN and PCP functions than other available national datasets. Therefore, using MEPS enabled this paper to conduct a more comprehensive examination than previous studies.

Second, MEPS does not include the characteristics of settings or regions where PCNs and PCPs practice. These characteristics may affect the care that PCNs and PCPs provide. Although other datasets may include these characteristics (e.g., Area Resources Files), they do not have information on the care that PCNs and PCPs provide, especially at the level of each patient visit.

Third, MEPS neither separately collects data for RNs and NPs nor collects information about PCNs' education, certification, and specialty. These limitations made it hard to understand what specific care that RNs or NPs provide and how nursing care varies with their education.

Fourth, measurement errors may exist because MEPS is a self-reported dataset; for example, patients might not be exactly clear about their provider types. These limitations may eventually inform MEPS researchers to improve their data collection. However, MEPS is still a better, current, and comprehensive dataset for examining PCN and PCP care compared with other datasets.

Additionally, the 17-category of patient diagnoses from the CCS file may have some degrees of heterogeneity, which may not provide detailed information of what specific diseases that PCNs and PCPs manage. Compared with previous studies that were merely focused on several chronic diseases, nevertheless, using these categories covered a broader range of diseases and thus achieved a more comprehensive examination of what diseases PCNs and PCPs manage.

Despite these limitations due to the nature of the study design, this paper still contributes information to our understanding of PCN and PCP care. It also has important implications for future policy and research, which will be discussed in the following sections.

### **Policy Implications**

The findings of this paper may inform primary care managers, clinicians, and policymakers about the utilization of PCNs and PCPs in the future. At the practice level, first, the findings may improve primary care managers and clinicians' understanding of how PCN care is similar to and different from PCP care. It may also stimulate an open conversation among clinicians and provide a great learning opportunity for both PCNs and PCPs to know about the expertise and the care that each other possesses and provides.

Second, primary care managers may need to review the utilization of PCNs and PCPs in their practice or system, such as how tasks and patients are assigned between these two

professional groups. According to their care delivery models, it may also be necessary for managers to explore how these assignments may improve and thus better utilize the expertise of PCNs and PCPs. It may be important to encourage PCNs to serve their usual provider role, because this paper reported that they managed patients with similar diseases as PCPs under this role. Such efforts may also improve the access to and efficiency of primary care (Cross & Kelly, 2015). Moreover, it may be needed to encourage both PCNs and PCPs to serve their supplemental role so that they may better collaborate and coordinate with each other and improve the continuity of care (Kutzleb et al., 2015). For example, PCNs may be given more opportunities to manage those diseases that they are more likely to manage; PCPs' works load may be shifted to the areas where they may have more expertise than PCNs, such as developing diagnoses, performing procedures, and managing patients with complex diseases.

At the public policy level, this paper also provides insights for policymakers to review and reform policies for PCN practice. First, although PCNs, especially NPs, are educated and trained to diagnose and prescribe, this paper found that they were less likely than PCPs to deliver these care even when managed patients with similar characteristics. One reason might be that NPs are not allowed to independently diagnose or prescribe without physicians' supervision in some states. In order to give PCNs more autonomy to provide the level of care that they are capable of doing, policymakers therefore may need to reform PCNs' scope of practice law (Yang & Meiners, 2014).

Second, policymakers may need to reform the payment policy for PCNs in order to support PCNs for performing their functions. PCNs perform some functions that they are more likely than PCNs to provide and are less costly, such as biomedical therapies, psychotherapies, and vaccinations. However, some of these services are not reimbursed or

not reimbursed at a similar rate with PCPs (Chapman, Wides, & Spetz, 2010; Yee, Boukus, Cross, & Samuel, 2013). Such a payment model may affect whether primary care clinics are willing to hire a PCN and devalue the PCN practice in general (Barnes et al., 2016). As the United States transforms from a fee-for-service to a value-based payment model, it is important to explore how the payment policy for PCN workforce may change.

In terms of education for PCNs and PCPs, educators may work together with clinicians, manager, and policymakers to ensure that PCNs and PCPs are well prepared for providing the care demanded in clinical practice. Some questions may need to ask during the education and training of PCNs and PCPs: Are PCNs and PCPs prepared for performing their functions? Are they prepared for serving as a usual provider for patients? Are they prepared for supplementing for each other's care? Are they prepared for managing patients with various diagnoses? Moreover, the collaboration and coordination between nursing and physician care may be an important component of didactic and clinical education for both PCNs and PCPs and may need to be included in licensure examinations as well (Yang et al., 2012).

### **Research Implications**

The findings of this paper are also useful for directing future research on PCN and PCP care. First, although the findings of this paper indicated the different functions and roles of PCNs and PCPs, some questions of how to integrate PCN and PCP care still need to be answered. For example, some studies reported that tasks are shifting from physicians to nurses in primary care, but little is known about what specific tasks can be shifted from PCPs to PCNs and to what extent (Maier & Aiken, 2016). Additionally, questions such as what kinds of patients can be assigned to PCNs or PCPs, to what extent PCNs manage patients

with complex or acute situations, and whether there is an ideal ratio of PCNs to PCPs in primary care, have not been well addressed (Morgan et al., 2012). Therefore, future efforts are important for furthering our knowledge of PCNs and PCPs' practices and integrating PCN and PCP care.

Second, the findings from this study about the diagnostic characteristics of PCN and PCP care recipients can guide future research. More specific measurements or indicators of patients' diagnoses may need to be used in future studies, because we are still unclear about what specific diseases PCNs and PCPs managed due to the heterogeneity of the 17 general categories. In addition, we also know very little about why patients choose to see a PCP or PCN for certain conditions and why the type of provider seen is similar or different with the type of patients' USC provider (Raji, Chen, Raji, & Kuo, 2016). Improving our knowledge about how patients choose or are assigned to providers is critical for understanding patients' decision-making processes and the assignment of patients to PCNs and PCPs in primary care.

Third, future examination of PCN and PCP care is needed to control factors that may influence PCN and PCP care, such as the characteristics of their practice settings and the scope of practice laws across states. More accurate measurements of patients' health status (e.g., complexity and severity) may be needed for future study as well to account for its influences on the care that patients received from PCNs or PCPs. Additionally, although this paper used data collected from 2002 to the most currently available year, 2013, it may or may not capture the changes of PCN and PCP care under the transforming health care system. Using more recent data is necessary for future studies to examine the changes of PCN and PCP care under health care reform.



Finally, the findings of this paper may also provide directions for future studies that examine the outcomes of PCN care. Future studies that compare the outcomes between PCNs and PCPs may expand to other types of diseases rather than merely focusing on several chronic diseases, as this study suggested that PCNs had a similar probability of managing each category of diagnoses as PCPs under a usual provider role. In addition, further study is warranted to explore whether PCNs achieve lower health care costs for both patients and health care organizations because they provide or order fewer diagnostic exams than PCPs. Because this reduction of health costs may be offset by the larger number of therapies that PCNs provided or ordered, it is well worth examining whether these different practice patterns between PCNs and PCPs affect the cost-effectiveness of care (DesRoches et al., 2013).

### **Chapter Summary**

This paper contributes new knowledge regarding how PCN care and PCP care is similar to and different from each other, in terms of their functions, roles, and the diagnostic characteristics of their care recipients. The findings suggest that PCNs and PCPs' functions had different focuses; PCNs and PCPs performed different functions under the same roles; and PCNs and PCPs managed patients with similar diagnostic characteristics when both served in a usual provider role, while they each managed patients with different diagnostic characteristics when both served in a supplemental role. These findings are important for primary care managers, educators, policymakers, and researchers to develop better collaboration and coordination between PCNs and PCPs.

As outlined in the conceptual framework of this dissertation, this paper further examined PCN care as one component of PCNs' contributions to primary care. Taken

together, Chapter 2 and 3 provided comprehensive knowledge of PCNs' contributions to primary care. The next chapter will examine the economic returns to PCNs' human capital, focusing on the wages of PCNPs.

## **CHAPTER 4: A COMPARISON OF WAGES FOR PCNPS WORKING IN PRIMARY CARE AND SPECIALTY CARE SETTINGS**

### **Introduction**

Primary care-certified nurse practitioners (PCNPs) are NPs who are certified in a primary care specialty such as adult, family, gerontology, pediatric, or women's health (Spetz, Fraher, Li, & Bates, 2015). Because PCNPs possess the human capital that is specific to primary care, they play an important role in the U.S. primary care system (Bodenheimer & Smith, 2013). Also, the demand for PCNPs has increased in recent years as their roles have changed under health care reform and the demand for primary care has increased (Barnes et al., 2016; Graves et al., 2015). Unfortunately, one challenge in meeting this increased demand for PCNP is that PCNPs can and often do choose to practice in a variety of settings, including specialty care settings<sup>17</sup> and other types of settings (Chattopadhyay, Zangaro, & White, 2015; Keough, Stevenson, Martinovich, Young, & Tanabe, 2011; Spetz et al., 2015). In 2011, 75% of the national supply of NPs were certified in a primary care specialty but only 49.0% of NPs<sup>18</sup> were practicing in primary care settings (Spetz et al., 2015).

One possible reason that PCNPs do not work in primary care settings is because the wages of NPs working in primary care settings are on average lower than those of NPs

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<sup>17</sup>Based on the definitions of primary care and specialty care settings in prior research, specialty care settings in this analysis include acute care settings, such as hospitals (Fraher & Li, 2014; Spetz et al., 2015).

<sup>18</sup>This may also include NPs who were certified in non-primary care specialties.

working in specialty care settings (Bodenheimer & Bauer, 2016; Goolsby, 2006, 2009; Petterson et al., 2013).<sup>19</sup> The lower wages offered in primary care settings are associated with poorer job satisfaction and an increased likelihood of turnover among NPs working in primary care settings (De Milt et al., 2011; Pasaron, 2013). Furthermore, the lower wages of PCNPs working in primary care settings may detract NPs and NP graduates from choosing to work in primary care (Budd et al., 2015; Petterson et al., 2013).

Although previous studies have suggested that nurses (both RNs and NPs) working in primary care settings earn less than those working in specialty care settings, we actually know little about whether a similar wage disparity exists among PCNPs (Li, Jones, & Holmes, 2016; Schumacher & Hirsch, 1997). Wage disparities exist if individuals are paid differently because of their human capital, demographic, and employment characteristics and they have different returns to the same characteristics in a labor market. Also, little is known about the factors contributing to these setting-based wage disparities. An examination of wage disparities between PCNPs working in primary care and specialty care settings is therefore needed to expand our knowledge and inform wage policy changes that focus on retaining currently practicing PCNPs and encouraging more PCNP graduates to practice in primary care settings.

The purpose of this chapter was to examine the wage disparities between PCNPs employed in primary care settings and those employed in specialty care settings. This chapter examined the third research question of this dissertation: **Is there a wage disparity between PCNPs employed in primary care settings and those employed in specialty care settings and if so, why?** The following sections will describe human capital theory, discuss wage and

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<sup>19</sup>Unless other specified, “wage” in this analysis refers to a fixed regular payment that is paid on an hourly basis.

wage disparities in general, review previous studies that examined nurses' wages and nursing wage disparities between primary care and specialty care settings, and discuss the potential factors contributing to these setting-based wage disparities.

## **Background**

### **Human Capital Theory**

According to human capital theory, individuals' wages vary with the amount of human capital they possess – the more individuals invest in their human capital, the more productivity they may achieve, as measured by their wages (Becker, 2009). In other words, individuals' wages are a function of the quality, or quantity, of human capital possessed by the individual in a particular labor market (Mincer, 1974).

Similarly, nurses' wage is a function of the quality and quantity of human capital that they possess; higher wages, in theory, should reflect greater human capital investments. Previous studies suggest that higher nursing wages are related to higher levels of nursing education (Jones & Gates, 2004; Spetz, 2002; Spetz & Bates, 2013), better language skills (Coombs & Cebula, 2010; Coomer, 2011; Kalist, 2005), and greater experience (Botelho et al., 1998; Walani, 2013). Nurses' wage is also associated with turnover (Jones, 1996) and reflect their investments in human capital, as they invest time and money to find new jobs, move to other locations, or immigrate to another country to pursue better wages (Becker, 2009). Thus, nurses employed in jobs where they receive lower wages relative to others with similar backgrounds may be more likely to turn over than those employed in other positions (Jones & Gates, 2004; Jones & Sherwood, 2014; Schumacher, 1997).

Human capital theory also suggests that besides their human capital, individuals' personal attributes also affect their wages, such as their sociodemographic (e.g., gender, race, marital status, and children status) and employment characteristics (e.g., work setting,

position, region, or full-time or part-time employment). For example, nurses who earn higher wages are more likely to be male (Jones & Gates, 2004; Muench et al., 2015), nonwhite (McGregory Jr, 2013), non-Hispanic (McGinnis & Moore, 2009), unmarried (Coomer, 2013; Kalist, 2002), and have children at home (Jones & Gates, 2004). Nurses who work in a hospital setting (Schumacher & Hirsch, 1997), as a nursing manager (Coombs & Cebula, 2010; Kalist, Spurr, & Wada, 2010; McGinnis & Moore, 2009), in a urban area (McGregory & Peoples, 2013), and full-time (McGregory, Niederjohn, & Peoples, 2009) are more likely to earn higher wages than others who did not.

Human capital theory has been widely applied in the nursing field to examine nursing wages and the wage disparities between certain nursing groups. Thus, it also served as the theoretical foundation of this analysis and was used for modeling PCNP wages, examining the influencing factors of PCNP wages, and exploring the wage disparities between PCNPs working in primary care and specialty care settings.

### **Wage and Wage Disparities**

Wage is one of the most important drivers of participation in a labor market (Ehrenberg & Smith, 2010). According to microeconomic theory, the quantity of labor supplied in a particular market is positively related to the wages offered in that market (Ehrenberg & Smith, 2010). In turn, when faced with a decision about entering a profession, individuals are more likely to choose one that offers a higher wage. When individuals perceive that they are not being fairly compensated for their contributions or their value in a market, they are likely to change jobs (professions, organizations, or settings) to obtain higher wages (Ehrenburg & Smith, 2011). Consequently, lower wages offered to a profession

by an organization or setting relative to others may result in decreased availability of workers.

Wage disparities are the different wages that are paid to different groups within a labor market, which may be due to groups' different characteristics, or that groups are treated differently by actors in the labor market (Ehrenberg & Smith, 2010). Specifically, wage disparities can be attributed to two main effects – endowment effects and coefficient effects (Oaxaca, 1973). Endowment effects, also called “explained factors,” refer to the contributions of wage-generating characteristics, including the human capital possessed by individuals and their personal attributes such as sociodemographic and employment characteristics (Oaxaca, 1973). Coefficient effects are also called “unexplained factors,” referring to those factors that are unrelated to individuals' productivity or are not observed or measured in wage modeling, which may result in different returns to individuals' wage-generating characteristics between groups (Jann, 2008).

Taking nurses' wage as an example, wage disparities exist when nurses possess different endowments. As discussed earlier, nurses' wage is not only a function of their human capital but also is affected by their employment and demographic characteristics. The wage disparities existing among certain nursing groups are also explained by coefficient effects. On the one hand, factors that are unobserved in wage modeling may reflect the coefficient effects or the unexplained portions of the wage disparities. Coefficient effects, on the other hand, may reflect employer prejudice or preference or monopoly power in the nursing labor market (Becker, 2010; Ehrenberg & Smith, 2010; Oaxaca, 1973). For example, parts of the wage disparities between female and male nurses are explained by the prejudice

of employers who may believe that female nurses have less education, work fewer hours, and are more likely to turnover because of a partner's relocation (Jones & Gates, 2004).

Wage disparities among certain groups are significantly associated with the supply of workers in a particular organization or profession. The physician workforce provides a good example of this relationship – that is, the lower wages paid to physicians working in primary care settings relative to those working in specialty care settings have been reported to decrease the supply of PCPs working in primary care settings (Heisler & Sarata, 2011). Some studies suggest that physicians working in primary care settings on average have a lower salary<sup>20</sup> than those working in specialty care settings. For example, Simon (1998) used data from the American Medical Association Socioeconomic Monitoring System surveys 1985-1994 to examine the changes of physician income in managed care. Simon and colleagues found that physicians (including both PCPs and specialists) working in specialty care settings (i.e., hospital-based settings) consistently earned more than those working in primary care settings over this ten-year period. Shih and Konrad (2007) used data from the restricted version of the 1996–1997 Community Tracking Study Physician Survey (CTS-PS), 1996 Area Resource File, and 1996 health maintenance organization penetration data (N=10,777) to examine the factors associated with physician salaries. They reported that physicians working in solo or two-physician practices, physician group practices, and health maintenance organizations on average had a lower wage than those working in hospital settings. Because of the wage disparities between primary care and specialty care settings, some medical students do not choose primary care as a specialty, and some who specialize in

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<sup>20</sup>Unless other specified, “salary” refers to a fixed regular payment that is paid on an annual basis. Salary can be converted to hourly wage through being divided by the product of individuals’ working hours and working weeks within a year.



primary care do not practice in primary care settings, instead choosing to work in acute/specialty care settings (Wilder et al., 2010).

The wage disparities between primary care and specialty care settings likely also influence PCNPs' choice of practice setting. Examining disparities in PCNP wages across primary care and specialty care settings can provide a better understanding of PCNPs' career choices and can inform future policies that target increasing the supply of PCNPs in primary care settings. Unfortunately, very few studies have been focused on the wages of PCNPs or the wage disparities within the PCNP workforce. The following sections will discuss prior research on the wage disparities between nurses working in primary care and specialty care settings and the potential factors contributing to the wage disparities between nurses working in primary care settings and those working in specialty care settings.

### **Nurses' Wages and Their Practice Settings**

According to the categorization of settings in prior studies, nurses' practice settings generally include primary care settings, specialty care settings, and other settings that may not be categorized as either primary care or specialty care settings (Fraher & Li, 2014; Spetz et al., 2015). These studies defined primary care settings as physician offices, home health agencies, community health centers, school health clinics, hospital outpatient departments, ambulatory care clinics, NP clinics, employee health centers, health maintenance organizations (HMO), managed care clinics, correctional facilities, federal clinics that care for the military or military veterans, or other federal clinics. Specialty care settings are acute hospitals, mental health clinics, urgent care clinics, and emergency room departments (Fraher & Li, 2014; Spetz et al., 2015).

Previous studies have suggested that nurses working in primary care settings earn a lower wage, on average, than those working in specialty care settings, relative to their human capital, demographic, and other employment characteristics. Schumacher and Hirsch (1997) used a cross-sectional design of pooled data from the Current Population Survey from 1979 to 1994 ( $n=45,687$ ), and they reported that nurses working in primary care and long-term care settings earned, on average, approximately 20% less than nurses working in specialty care settings, after controlling for their gender, race, marital status, years of schooling, experience, and working full-time ( $p<0.05$ ). These authors used the same data sets and conducted a longitudinal analysis by matching individuals in the same month over consecutive years ( $n=17,327$ ), and they reported that nurses working in primary care and other settings earned approximately 8% less than their counterparts working in specialty care settings, after adjusting for the same factors included in their cross-sectional analysis ( $p<0.05$ ).

In a more recent study, Li et al. (2016) conducted a longitudinal analysis employing public use data files from the last six quadrennial *National Sample Survey of Registered Nurses* (NSSRN) (1988-2008) ( $n=129,344$ ) to examine the wage disparities between RNs working in primary care settings and those working in specialty care settings.<sup>21</sup> Li and colleagues reported that the hourly wage of RNs working in primary care settings was, on average, 16.1% lower than that of RNs working in specialty care settings, after accounting for the human capital, employment, and demographic characteristics of RNs and the time variant (Li et al., 2016).

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<sup>21</sup>Primary care settings in this study included home health, public health, community health, school health, occupational health, and ambulatory care; and specialty care settings in this study were hospital settings.

Researchers in several other studies that did not have nurses' practice settings as their focus have nonetheless reported that nurses working in primary care settings earned lower wages than those working in specialty care settings. Jones and Gates (2004) used the NSSRN 2000 (n=24,071) to examine gender-based wage disparities and reported that nurses working in primary care settings (public or community health, ambulatory care, and school health) earned wages that were, on average, 13.5% lower than nurses working in hospitals ( $p<0.05$ ). Walani (2013) focused on examining the wage disparities of internationally educated nurses and U.S.-educated nurses using the NSSRN 2008 (n=22,703) and also reported that nurses working in primary care settings (ambulatory care) earned wages that were, on average, 15.5% lower than the wages of nurses working in specialty care settings (hospitals) ( $p<0.05$ ).

Commer (2013) used the NSSRN 1984-2004 (n=135,153) to examine wage disparities between white and black nurses and also reported that nurses working in primary care and other settings earned wages that were, on average, 15.0% lower than nurses working in specialty care settings (hospitals) ( $p<0.05$ ). Using the CPS 1994-2006 (n=20,842), McGregory (2013) also examined race-based wage disparities but reported that nurses working in primary care and other settings (physician clinics and nursing homes) earned wages that were on average 20.9% lower than nurses working in specialty care settings (hospitals) ( $p<0.05$ ).

Few prior studies have specifically focused on how nurses' wages vary with their practice setting beyond including a categorical variable for setting in wage modeling. Furthermore, some studies did not distinguish other settings (e.g., nursing homes) from primary care settings, which may affect the wage estimates of nurses practicing in primary care settings (Coomer, 2013; McGregory Jr, 2013; Schumacher & Hirsch, 1997). The data

used in prior studies were also taken from surveys conducted between 1979 and 2008. Thus, further research is needed to determine whether these relationships still hold today given that new models of care and health care reform call for greater use of nurses in primary care. The following sections will discuss the potential factors contributing to these setting-based wage disparities.

### **Determinants of Setting-based Wage Disparities**

Very few studies have examined the extent to which endowment and coefficient effects contributed to the wage disparities between primary care and specialty care settings. Researchers in the study of Li et al. (2016), as discussed earlier, applied decomposition techniques and reported that endowment effects explained –101% but that coefficient effects explained 201% of the total wage disparities.<sup>22</sup> In other words, these setting-based wage disparities were mainly explained by the coefficient effects, or the different returns to RNs' characteristics between primary care and specialty care settings. Li and colleagues also found that RNs' years of experience is the most significant factor contributing to both endowment and coefficient effects: RNs working in primary care settings on average had more years of experience than those working in specialty care settings, but the wage returns to their years of experience were lower.

Other factors that were unobserved in the wage modeling of Li et al.'s study may also influence these setting-based wage disparities. It has been suggested that a wage premium is paid to nurses working in hospitals to compensate for the unpleasant working conditions (e.g., shift work, fast pace and high stress levels) and the pension and insurance coverage of

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<sup>22</sup>These endowment effects mean that the wages of RNs working in primary care settings will decrease 101% if they had the same endowments as RNs working in specialty care settings. The coefficient effects mean that the wages of RNs working in primary care settings will increase 201% if the returns to their endowments are the same as the returns to the endowments of RNs working in specialty care settings.

hospital employers (Lehrer, White, & Young, 1991; Schumacher & Hirsch, 1997). It may also follow that nurses who work in specialty care settings may have greater “in setting” experiences that are more valued by employers, in general, than those working in primary care settings. Despite these discussions, few studies have closely or further examined the factors contributing to these setting-based wage disparities. This lack of knowledge is particularly significant for the NP workforce. The following sections review prior research that examined how NPs’ wages vary with their practice settings.

### **NPs’ Wages and Their Practice Settings**

Some studies in the past decade have compared the wages of NPs (including both PCNPs and specialty care NPs combined) working in primary care and specialty care settings. Loman and Hung (2007) conducted a survey of 199 pediatric NPs (PNPs) in a metropolitan area in the U.S. mid-west to examine their salary, benefits, and practice patterns. Researchers used a t-test and reported that for 52 full-time PNPs, there was no significant salary disparity between those working in primary care settings (physician offices) and those working in specialty care settings (hospitals).<sup>23</sup> However, these results should be interpreted cautiously due to the small sample size and the regional focus of their study.

Goolsby (2006) used the 2004 data file of the *National Nurse Practitioner Sample Survey* (NNPSS) (n=16,062) to describe the wages of NPs based on their specialty, region of employment, level of education, years of experience, and practice setting. He reported that NPs working in primary care settings earned a lower wage, on average, than those working in

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<sup>23</sup>Researchers did not provide salary estimates of PNPs practicing in these two types of settings.

specialty care settings – \$36.51 vs. \$39.59.<sup>24</sup> Later, Goolsby (2009) conducted a similar analysis of NP salary using the 2008 NNPSS file (n=6,279), and reported that the salaries of NPs working in primary care settings were, on average, \$84,771, compared to \$92,575 of NPs working in specialty care settings.<sup>25</sup>

Unfortunately, these studies of NP wages were descriptive statistics in nature and did not control for other human capital, demographic, and employment characteristics that may influence NP wages. None of the previous studies reported using human capital theory to guide their examinations of NP wages, which is the common approach for analyzing wages. Also, no study was found that explored the extent to which the endowment effects and coefficient effects contribute to the wage disparities between NPs working in primary care and specialty care settings. Moreover, we lack current information on NP wages because the data used in previous studies were all collected before 2008. These gaps of knowledge also exist within the PCNP workforce. Therefore, this analysis was conducted to achieve the following aims:

**Study Aim 1:** Examine the wages of PCNPs, including the wages of those employed in primary care and specialty care settings;

**Study Aim 2:** Compare the wages of PCNPs employed in primary care settings with the wages of PCNPs employed in specialty care settings; and

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<sup>24</sup>Calculated by taking the average of wages presented in Table 8 in their study. In keeping with the setting categorization used in prior research and in this study, private NP clinics, veteran administration clinics, occupational/employee health departments, hospital outpatient settings, other freestanding primary care clinics, correctional facilities, private physician clinics, rural health clinics, community health centers, school health clinics, public health clinics, and family planning clinics were considered primary care settings; and hospital inpatient settings and emergency departments were considered specialty care settings.

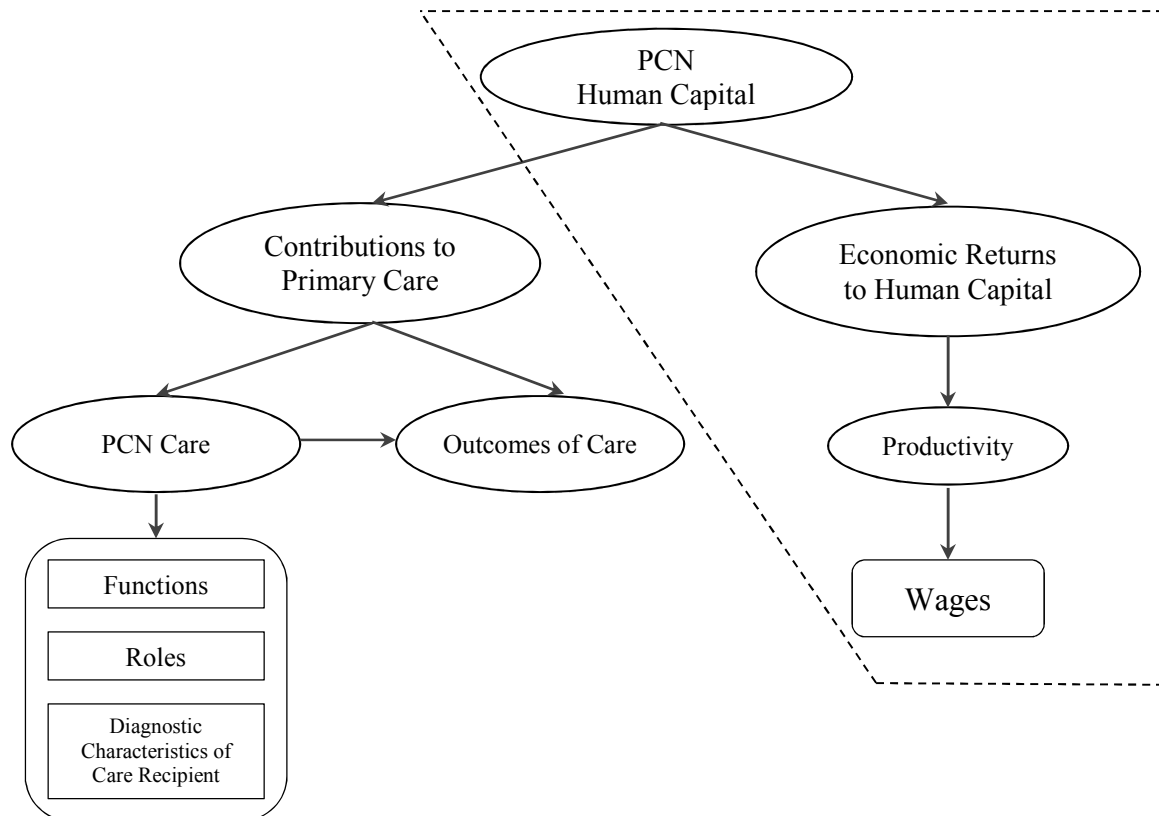
<sup>25</sup>Calculated by taking the average of salaries presented in Table 3 in their study. According to the setting categorization used in prior research and in this study, private NP clinics, veteran administration clinics, hospital outpatient settings, occupational/employee health departments, private physician clinics, and community health centers were considered primary care settings; hospital inpatient settings and emergency or urgent care were considered specialty care settings.

**Study Aim 3:** Explore the extent to which endowment effects and coefficient effects contribute to the wage disparities between primary care and specialty care settings.

### Conceptual Framework

The research question addressed in this chapter focused on certain aspects of the dissertation's overall conceptual framework, as shown by the dotted line in Figure 4.1 below. Specifically, it examined the economic returns to PCNP human capital, as reflected in their productivity as measured by their wages. The sections that follow will highlight how the study was conducted to address gaps in prior research.

**Figure 4.1: Sections Examined in Chapter 4 From the Overall Conceptual Framework of This Dissertation Study**



## Methods

This analysis used a cross-sectional, secondary analysis design to achieve its aims. Specifically, it followed a four-step examination of wage disparities proposed by Ehrenberg and Smith (2010) as outlined below:

***Step 1: Collect data for PCNPs working in primary care and specialty care settings on all human capital and other characteristics that are theoretically relevant to the determination of wages;***

The following sections discuss the data, wage model, variables (i.e., PCNPs' wages and their characteristics), and the sample of PCNPs used in this analysis:

**Data.** Data from the restricted file of the 2012 *National Sample Survey of Nurse Practitioners* (NSSNP) were used to conduct this analysis.<sup>26</sup> The NSSNP is a cross-sectional survey that was conducted in 2012 by the Health Resources and Services Administration (HRSA). Data were gathered via a survey mailed to a stratified sample of 22,000 actively licensed or certified U.S. NPs, obtained from each state licensing board. The survey achieved a response rate of 60.1%, or 12,923 NPs in the restricted data file. The data collected included information on NP demographics, socioeconomics, education, certification, employment, and practice patterns (U.S. Department of Health and Human Services, 2014). This data set was used because it provided the most current, comprehensive, and representative sample of NPs in the United States.

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<sup>26</sup>The restricted file of 2012 NSSNP is different than the public use file because it provides the variables that are not available in the public use file, such as the years of experience. This restricted file was acquired through the director, Dr. Erin Fraher, of Carolina Health Workforce Research Center at the Cecil G. Sheps center of Health Policy Research at the University of North Carolina, which has a cooperative agreement with the National Center for Health Workforce Analysis in the Bureau of Health Workforce at HRSA.



**Wage model and variables.** Based on human capital theory and the wage model of Mincer (1974), a wage model of PCNP wages was examined as a function of PCNPs' employment, human capital, and sociodemographic characteristics, of the general form:

$$Wage = f(H, E, S) + e \quad (1)$$

where

**Wage** is the hourly PCNP wage. The NSSNP survey did not specifically ask NPs for hourly wage information. Therefore, a commonly used wage calculation was used in this study to estimate PCNP wages (Jones & Gates, 2004). Specifically, an hourly PCNP wage was calculated from PCNPs' reported annual earnings from their principal NP jobs divided by the product of hours worked in a typical week and the number of weeks worked per year in their principal NP jobs. PCNPs' annual earnings and working hours from their secondary jobs were not included in this study, because PCNPs working in primary care settings as their principal job may work in specialty care settings as their secondary job,<sup>27</sup> and including their earnings from the secondary job may inflate the wage estimations of NPs working in primary care settings.

Moreover, 52 workweeks were assumed because the survey did not specifically ask NPs for the weeks they worked per year, and it was also applied in previous research (Walani, 2013).

**H** is a vector of PCNPs' human capital characteristics. The variables measuring the human capital characteristics of PCNPs in this analysis included the level of PCNPs' education preparation, intent to turnover, and experiences as an NP. These variables

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<sup>27</sup>Based on a preliminary analysis, 356 out of 10,513 primary care-certified NPs (3.4% of the sample) reported working in primary care settings from their principal NP position but in specialty care settings from their secondary NP position.

were derived from human capital theory and the findings of previous nursing studies (Jones & Gates, 2004; Spetz & Bates, 2013).

According to human capital theory, a key human capital variable is experience.

Unfortunately, the NSSNP survey does not specifically ask NPs for this information.

Several previous studies that used datasets from national surveys (e.g., NSSRN) used the number of years since nurses completed their initial nursing education program as a proxy to reflect nurses' potential experience; specifically, researchers used the survey year minus the year that nurses completed their initial nursing education program (Hirsch & Schumacher, 2012; Spetz, 2002; Spetz & Bates, 2013). This study followed the convention of previous research by using the survey year minus the year when NPs completed their initial NP education program. This continuous variable was used to reflect potential NP experience, based on the assumption that the earlier the NPs finished their NP education, the more years of experience they had if they entered the labor market after their NP education.<sup>28</sup> Moreover, the square term of this variable was also included in the wage model to capture the nonlinear relationship between years of experience and wages.

*E* is a vector of PCNP employment characteristics. The variables measuring PCNPs' employment characteristics included in this analysis were PCNP practice setting,

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<sup>28</sup>Using PCNPs' nursing experience – their years of being as an RN – may be an alternative for estimating their experience. This variable, however, was not included in this analysis for the following reasons: First, this variable is not available in NSSNP. One variable that might be used for estimating PCNPs' nursing experience is Question 58, which asked the year of when PCNPs obtained his/her initial U.S. licensure as an RN. It may be acceptable to use the survey year minus this variable to roughly estimate PCNPs' nursing experience. However, this method may not be as accurate as using NP experience, because PCNPs may stop working to acquire their NP education. Second, nursing experience reflects PCNPs' general human capital, while NP experience reflects PCNPs' specific human capital, which may more accurately measure their human capital in primary care and of being as a NP. Finally, because PCNPs' nursing experience and NP experience are highly correlated with each other, they cannot both be included in the wage modeling because of multicollinearity.

types of position, census region of employment, the specialty of clinical practice, the census region of employment, how PCNPs were paid, the Metropolitan Statistical Areas (MSA) region of employment, their practice independence, their overall satisfaction with their jobs, and whether they had a secondary RN or NP job. These variables were included because they were reported to be associated with nurse wages in prior research (Coomer, 2013; Jones & Gates, 2004). The variable of the PCNP practice setting was coded as a dummy variable (1 refers to primary care settings; 0 refers to specialty care settings) and was the key independent variable in the wage model in this study.

$S$  is a vector of PCNPs' sociodemographic characteristics. The variables included in this analysis were PCNPs' gender, race/ethnicity, and marital status, coded as categorical variables in the NSSNP file. These variables were included in wage modeling because they were reported to be associated with nursing wages in previous studies (McGinnis & Moore, 2009); and

$e$  is random error. More detailed information for each variable included in the wage model is presented in Appendix 4.1.

**Sample.** From the NSSNP data set, respondents were selected for this analysis if they met the following inclusion criteria: at the time of data collection 1) certified by a State Board of Nursing to practice as an NP; 2) certified in a primary care specialty area – family, adult, pediatrics, gerontology, or women's health (consistent with the definition of NPs' primary care specialty in Spetz et al. [2015]); 3) worked for pay as an NP; and 4) practiced in

a primary care or specialty care setting in their principal NP job. The settings under the categories of primary care and specialty care settings are presented in Appendix 4.1.

Based on a preliminary analysis, 8,175 out of 12,923 NPs met the above inclusion criteria. Of these, 600 NPs with missing data for salary and working hours were dropped, leaving 7,575 NPs. The wage calculation used in this analysis, as mentioned earlier, may yield some values that are not meaningful estimations. Previous researchers have suggested recoding the values that were less than \$5 or greater than \$100 as exactly \$5 or \$100, respectively (Jones & Gates, 2004). Using this method, the wages of 56 observations (2.0% of the sample) were recoded as \$5 or \$100.<sup>29</sup> Although doing so may reduce the variance of PCNP wages, it does not significantly bias the analysis results because only a small proportion of the sample were recoded.<sup>30</sup>

There were 1,229 out of 7,575 NPs that had missing data (i.e., their data indicated “not applicable” or “unknown” responses) for variables of interest, including annual earnings, working hours, positions, region of employment, years of experience, level of NP education, gender, race/ethnicity, and marital status.<sup>31</sup> These observations were dropped

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<sup>29</sup>Eight wage estimations were recoded as \$5 and 48 estimations were recoded as \$100. Wages ranged from \$0.01 to \$721.15.

<sup>30</sup>A sensitivity analysis was conducted using the sample with those outliers dropped. The results showed that there was no change of the main conclusions compared with the conclusions of using the method of recoding the wage outliers.

<sup>31</sup>Logistic regression was conducted to examine how these observations differ from the observations with complete information on these variables. Specifically, a dummy dependent variable was estimated as a function of PCNPs’ employment, human capital, and demographic characteristics. A preliminary analysis indicates that, compared with the observations having completed data, the PCNP observations with missing data were more likely to be PCNPs who were Asian or Black or African American, Hispanic, or single, possessed fewer years of experience as a NP, be intent to leave their position, working as an RN staff, employed in a MSA, paid hourly, worked in a primary care specialty clinic, and dissatisfied with their work.

(n=92), imputed (n=39), or recoded (n=1,589<sup>32</sup>) for analysis, leaving 7,483 observations as the final sample used in this analysis<sup>33</sup>. This final sample consists of 5,753 (76.9%) PCNPs who reported practicing in primary care settings and 1,730 (23.1%) PCNPs who reported practicing in specialty care settings. Appendix 4.1 presents the strategies of selecting the sample and managing the missing values for each variable.

***Step 2: Estimate PCNP wages and how each of the above PCNPs characteristics contribute to their wages;***

This step was conducted to examine how each of PCNPs' human capital, employment, and demographic characteristics influences their wages and to determine whether there are wage disparities between PCNPs working in primary care and specialty care settings. Therefore, this step helped to achieve study aims 1 and 2 as described below:

**To achieve study aim 1**, the wages of PCNPs were estimated using the model consistent with the above wage model (1) proposed by Mincer (1974), of the following type:

$$\ln(Wage) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \varepsilon \quad (2)$$

where ***ln(wage)*** is the natural logarithm of hourly PCNP wages; ***α*** is the constant; ***X<sub>i(i=1,2,3...)</sub>*** represents the variables that measure PCNPs' wage-generating factors – that is, PCNPs' human capital, employment, and demographic characteristics; ***β<sub>i(i=1,2,3...)</sub>*** is the coefficient of each variable; and ***ε*** is random error.

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<sup>32</sup>The number of these recoded observations is greater than the total number of observations with missing data. This is because the missing data of the variables of Q13\_state and Q13\_ruca were recoded, but these two variables were both generated by using the zip code of observations' employment region and observations were recoded twice for different variables if they did not provide zip code.

<sup>33</sup>The numbers of observations that were dropped, recoded, and imputed did not add up to the total 1,229 observations with missing data. This is because some observations had missing data on more than more variables.

Specifically, Feasible generalized least squares (FGLS) regression was used to examine this wage model (2). This analytic technique was applied because, unlike Ordinary Least Squares regression, FGLS enabled correction for heteroskedasticity in the sample<sup>34</sup> and predicted the weighted  $\ln(Wage)$ ,  $X_i$ , and  $\beta_i$ . Examining this wage model can estimate PCNP wages and examine how each of PCNPs' characteristics contributes to their wages.

**To achieve study aim 2**, a Chow-test was performed to further examine whether there is a wage disparity between PCNPs working in primary and specialty care. A Chow-test was done because it examines whether a particular independent variable in linear regression models has different effects on different subgroups of the population (Wooldridge, 2012). Identical wage models were estimated separately for PCNPs working in primary care settings and for those working in specialty care settings. Specifically, to estimate the wages of PCNPs employed in primary care and specialty care settings, FGLS regression was used to separately estimate the following two models:

$$\ln(Wage^{pcw}) = \alpha^{pcw} + \beta_1^{pcw}X_1^{pcw} + \beta_2^{pcw}X_2^{pcw} + \beta_3^{pcw}X_3^{pcw} + \dots + \varepsilon^{pcw} \quad (3)$$

$$\ln(Wage^{spw}) = \alpha^{spw} + \beta_1^{spw}X_1^{spw} + \beta_2^{spw}X_2^{spw} + \beta_3^{spw}X_3^{spw} + \dots + \varepsilon^{spw} \quad (4)$$

where in model (3),  $\ln(Wage^{pcw})$  is the weighted natural logarithm of hourly wages of PCNPs working in primary care settings;  $\alpha^{pcw}$  is the constant;  $X_i^{pcw}$  ( $i=1,2,3\dots$ ) is the vector of variables that measures the weighted PCNPs' wage-generating characteristics;  $\beta_i^{pcw}$  ( $i=1,2,3\dots$ ) is the vector of weighted coefficients for each  $X_i^{pcw}$  ( $i=1,2,3\dots$ ); and  $\varepsilon^{pcw}$  is the random error.

Observations were weighted according to the FGLS weights; and in model (4),  $\ln(Wage^{spw})$  is the weighted natural logarithm of hourly wages of PCNPs working in specialty care settings;

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<sup>34</sup>Heteroskedasticity is a term that reflects the fact that variances between PCNPs employed in primary care settings and those employed in specialty care settings are not equal. Heteroskedasticity was found in this NSSNP data on preliminary examination using the White-test.

$\alpha^{spw}$  is the constant;  $X_i^{spw}$  ( $i=1,2,3...$ ) is the vector of variables that measures the weighted PCNPs' wage-generating characteristics;  $\beta_i^{spw}$  ( $i=1,2,3...$ ) is the vector of weighted coefficients for each  $X_i^{spw}$  ( $i=1,2,3...$ ); and  $\varepsilon^{spw}$  is the random error. Observations were weighted according to the FGLS weights. The Chow test was used to determine whether the constants of model (3) and model (4), or  $\alpha^{pcw}$  and  $\alpha^{spw}$ , were equal to each other and whether the coefficients of model (3) and model (4), or  $\beta_i^{pcw}$  ( $i=1,2,3...$ ) and  $\beta_i^{spw}$  ( $i=1,2,3...$ ), were equal to each other.

***Step 3: Estimate the extent to which endowment effects and coefficient effects contribute to the wage disparities between PCNPs working in primary care settings and those working in specialty care settings;***

This step was conducted to achieve study aim 3. The following function developed by Oaxaca (1973) and refined by Holtmann and Idson (1993) was first used to predict the unweighted logged wage disparities and to examine to what extent the endowment effects and coefficient effects contribute to these disparities:

$$E(Y_i^{spu}) - E(Y_i^{pcu}) = 0.5\Sigma(\beta_i^{pcu} + \beta_i^{spu})(X_i^{spu} - X_i^{pcu}) + 0.5\Sigma(X_i^{pcu} + X_i^{spu})(\beta_i^{spu} - \beta_i^{pcu})$$

(5)

Where,

$E(Y_i^{spu})$  refers to the predicted unweighted logged wages of working in specialty care settings for PCNPs who actually worked in specialty care settings;

$E(Y_i^{pcu})$  refers to the predicted unweighted logged wages of working in primary care settings for PCNPs who actually worked in primary care settings;

$X_i^{pcu}$  ( $i=1,2,3...$ ) and  $X_i^{spu}$  ( $i=1,2,3...$ ) is the vector of variables that measures the unweighted PCNPs' wage-generating characteristics for PCNPs working in primary care settings and specialty care settings, respectively;

$\beta_i^{pcu} (i=1,2,3,...)$  and  $\beta_i^{spu} (i=1,2,3,...)$  is the vector of unweighted coefficients for each

$X_i^{pcu} (i=1,2,3,...)$  and  $X_i^{spu} (i=1,2,3,...)$ , respectively;

$E(Y_i^{spu}) - E(Y_i^{pcu})$  refers to the predicted unweighted logged wage disparities, which is the sum of endowment effects and coefficient effects;

$0.5\Sigma(\beta_i^{pcu} + \beta_i^{spu})(X_i^{spu} - X_i^{pcu})$  refers to the **endowment effects**;  $(X_i^{spu} - X_i^{pcu})$

denotes endowment differences of wage-generating characteristics between PCNPs

working in primary care settings and PCNPs working in specialty care settings

evaluated at the average returns of PCNPs working in primary care and specialty care

settings ( $0.5\Sigma(\beta_i^{pcu} + \beta_i^{spu})$ ); in other words, these endowment effects refer to how

much the wages of PCNPs working in primary care settings will change if their wage-

generating characteristics (i.e.,  $X_i^{pcu}$ ) are exactly the same as those of PCNPs working

in specialty care settings (i.e.,  $X_i^{spu}$ );

$0.5\Sigma(X_i^{pcu} + X_i^{spu})(\beta_i^{spu} - \beta_i^{pcu})$  refers to the **coefficient effects**;  $(\beta_i^{spu} - \beta_i^{pcu})$  denotes

the differences in the coefficients of or the returns to PCNPs' wage-generating

characteristics between PCNPs working in primary care and specialty care settings

evaluated at the average endowment of wage-generating characteristics ( $0.5\Sigma(X_i^{pcu} +$

$X_i^{spu})$ ); in other words, these coefficient effects refer to how much the wages of

PCNPs working in primary care settings will change if the coefficient (i.e.,  $\beta_i^{pcu}$ ) of

each of their wage-generating characteristics are exactly the same as those of PCNPs

working in specialty care settings (i.e.,  $\beta_i^{spu}$ ).

To examine this model, an unweighted regression analysis was conducted based on the wage model (2) for acquiring  $\beta_i^{pcu} (i=1,2,3,...)$  and  $\beta_i^{spu} (i=1,2,3,...)$ . This model (5) examined: 1)



the total unweighted logged wage disparities; 2) the extent to which the endowment and coefficient effects contributed to the total wage disparities, respectively; and 3) the contribution of each of PCNPs' wage-generating characteristics to endowment and coefficient effects.

***Step 4: Estimate the hypothetical average wage disparities between PCNPs working in primary care settings and those working in specialty care settings.***

This step further analyzed the wage disparities that were examined in steps 2 and 3 by predicting the average predicted weighted level wage disparities between PCNPs working in primary care settings and those working in specialty care settings. The following model was applied in a similar type with the functions used by Holtmann and Idson (1993):

$$W_i^{spw} - W_i^{pcw} = \beta_i^{spw}X_i^{spw} - \beta_i^{pcw}X_i^{pcw} = 0.5(\beta_i^{pcw} + \beta_i^{spw})(X_i^{spw} - X_i^{pcw}) + 0.5(X_i^{pcw} + X_i^{spw})(\beta_i^{spw} - \beta_i^{pcw}) \quad (6)$$

The calculations of the total wage disparities, endowment effects, and coefficient effects using this model are shown in Table 4.1 below:

**Table 4.1: Predicted PCNP Wages and The Decomposition of Wage Disparities**

	<b>If working in specialty care settings</b>	<b>If working in primary care settings</b>
<b>Actually worked in specialty care settings</b>	(1) $\beta_i^{spw} X_i^{spw}$	(2) $\beta_i^{pcw} X_i^{spw}$
<b>Actually worked in primary care settings</b>	(3) $\beta_i^{spw} X_i^{pcw}$	(4) $\beta_i^{pcw} X_i^{pcw}$
<b>Total Wage Disparities</b>	$W_i^{spw} - W_i^{pcw} = \beta_i^{spw} X_i^{spw} - \beta_i^{pcw} X_i^{pcw}$ or (1) – (4)	
<b>Endowment Effects</b>	$0.5(\beta_i^{pcw} + \beta_i^{spw})(X_i^{spw} - X_i^{pcw})$ or $0.5[(\beta_i^{spw} X_i^{spw} - \beta_i^{spw} X_i^{pcw}) + (\beta_i^{pcw} X_i^{spw} - \beta_i^{pcw} X_i^{pcw})]$ or $0.5[(1) - (3) + (2) - (4)]$	
<b>Coefficient Effects</b>	$0.5(X_i^{pcw} + X_i^{spw})(\beta_i^{spw} - \beta_i^{pcw})$ or $0.5[(\beta_i^{spw} X_i^{spw} - \beta_i^{pcw} X_i^{spw}) + (\beta_i^{spw} X_i^{pcw} - \beta_i^{pcw} X_i^{pcw})]$ or $0.5[(1) - (2) + (3) - (4)]$	

Where

*Scenario 1:*  $\beta_i^{spw} X_i^{spw}$  indicates the predicted average weighted wages of working in specialty care settings for those who actually worked in specialty care settings;

*Scenario 2:*  $\beta_i^{pcw} X_i^{spw}$  indicates the predicted average weighted wages of working in primary care settings for PCNPs who actually worked in specialty care settings;

*Scenario 3:*  $\beta_i^{spw} X_i^{pcw}$  indicates the predicted average weighted wages of working in specialty care settings for PCNPs who actually worked in primary care settings;

*Scenario 4:*  $\beta_i^{pcw} X_i^{pcw}$  indicates the predicted average weighted wages of working in primary care settings for PCNPs who actually worked in primary care settings;

$W_i^{spw} - W_i^{pcw}$  refers to  $\beta_i^{spw} X_i^{spw} - \beta_i^{pcw} X_i^{pcw}$ , which is the average predicted weighted level wage disparities between the predicted weighted wages of working in specialty

care settings for PCNPs who actually worked in specialty care settings and the predicted weighted wages of working in primary care settings for PCNPs who actually worked in primary care settings; it was decomposed as endowment effects and coefficient effects below:

$0.5(\beta_i^{pcw} + \beta_i^{spw})(X_i^{spw} - X_i^{pcw})$  refers to the **endowment effects**; it was transformed as  $0.5[(\beta_i^{spw}X_i^{spw} - \beta_i^{spw}X_i^{pcw}) + (\beta_i^{pcw}X_i^{spw} - \beta_i^{pcw}X_i^{pcw})]$ , which was calculated by using the four scenarios as discussed above;

$0.5(X_i^{pcw} + X_i^{spw})(\beta_i^{spw} - \beta_i^{pcw})$  refers to the **coefficient effects**; it was transformed as  $0.5[(\beta_i^{spw}X_i^{spw} - \beta_i^{pcw}X_i^{spw}) + (\beta_i^{spw}X_i^{pcw} - \beta_i^{pcw}X_i^{pcw})]$ , which was also calculated by using the four scenarios as discussed above.

This method predicted the average weighted level wages and wage disparities that are more informative than those were predicted in step 3. The following section presents the results of the above analyses.

## Results

This section first presents an overview of the sample used in this analysis. The main results of wage modeling and wage decomposition are presented by the three study aims.

### Sample Description

A description of the full PCNP sample, PCNPs working in primary care settings, and PCNPs working in specialty care settings is presented in Table 4.2. The median calculated hourly wage for the full PCNP sample was \$44.52/hr, with PCNPs working in primary care settings earning approximately \$43.72/hr and PCNPs working in specialty care settings earning approximately \$47.17/hr.

The demographic characteristics of the typical PCNP in the 2012 full sample was 47.1 years old (ranging from 19 to 80), female (93.5%), white (88.0%), non-Hispanic (96.5%), and married (73.4%). These findings are similar to the characteristics of both PCNPs working in primary care settings and those working in specialty care settings, except that PCNPs working in primary care settings were, on average, older than PCNPs working in specialty care setting – 47.4 years vs. 45.9 years of age.

The human capital characteristics of the full PCNP sample show that the largest proportion of PCNPs held a master's degree as their NP preparation (79.2%) and did not plan to leave their current position in the year prior to the survey (67.4%). Similar results of PCNPs' education and intent to turnover were found for both PCNPs working in primary care settings and those working in specialty care settings. In terms of their working experience, PCNPs in the full sample possessed, on average, 10.5 years of experience working as a NP (ranging from 0 to 42 years), with PCNPs working in primary care settings having on average 11.0 years of experience but PCNPs working in specialty care settings had an average of 8.8 years of experience.

In terms of the employment characteristics of the full PCNP sample, the typical PCNPs in the 2012 sample were employed in a clinic (90.1%), worked in an urban area (79.6%), were paid on an annual salary basis (59.6%), worked in clinics with primary care specialty (51.1%), were employed in the South Atlantic region (18.6%), collaborated with a physician (68.8%), were satisfied with their job (91.6%), and did not have a secondary RN or NP position (76.8%). Similar results were found for both the subsamples of PCNPs in primary care and specialty care settings.

Compared with PCNPs working in specialty care settings, PCNPs working in primary care settings were more likely to be older, female, white, and married. PCNPs working in primary care settings had a greater percentage of people who had no plan to leave their current position, worked as a NP in a clinic, practiced in rural or isolated areas, were paid by annual salary, worked in a clinic of primary care specialty, practiced independently, or had a secondary job compared with those working in specialty care settings.

**Table 4.2: Descriptive Statistics of PCNP Sample**

Variables	Mean (SD)/n(%) /Median			p-Value
	Full PCNP Sample (n=7,483)	PCNPs in Primary Care Settings (n=5,753)	PCNPs in Specialty Care Settings (n=1,730)	
<b><u>Wage</u></b>	44.52 (14.11)/42.74	43.72 (14.15)/41.92	47.17 (13.65)/45.67	0.00
<b><u>Demographic Characteristics</u></b>				
<b>Age</b>	47.05 (10.83)	47.39 (10.87)	45.94 (10.61)	0.00
<b>Gender</b>				
Non-male	6,994 (93.5%)	5,430 (94.4%)	1,564 (90.4%)	0.00
Male	489 (6.5%)	323 (5.6%)	166 (9.6%)	0.00
<b>Race</b>				
White	6,588 (88.0%)	5,111 (88.8%)	1,477 (85.4%)	0.00
Nonwhite	895 (12.0%)	642 (11.2%)	253 (14.6%)	0.00
<b>Ethnicity</b>				
Non-Hispanic	7,222 (96.5%)	5,562 (96.7%)	1,660 (96.0%)	0.15
Hispanic	261 (3.5%)	191 (3.3%)	70 (4.0%)	0.15
<b>Marital Status</b>				
Never married	746 (10.0%)	528 (9.2%)	218 (12.6%)	0.00
Married	5,496 (73.4%)	4,305 (74.8%)	1,191 (68.8%)	0.00
Separated, divorced, widowed, and other	1,241 (16.6%)	920 (16.0%)	321 (18.6%)	0.12
<b><u>Human Capital Characteristics</u></b>				
<b>Level of Education</b>				
Certificate	491 (6.6%)	440 (7.6%)	51 (2.9%)	0.00
Master's degree	5,928 (79.2%)	4,530 (78.7%)	1,398 (80.8%)	0.06
Post-master's degree	932 (12.5%)	684 (11.9%)	248 (14.3%)	0.01
DNP or other	132 (1.8%)	99 (1.7%)	33 (1.9%)	0.61
<b>Intent to Turnover</b>				
No plans to leave	5,042 (67.4%)	3,916 (68.1%)	1,126 (65.1%)	0.02

Leave in 2012	482 (6.4%)	360 (6.3%)	122 (7.1%)	0.24
Leave in next 1–2 years	955 (12.8%)	714 (12.4%)	241 (13.9%)	0.10
Undecided or unknown	1,004 (13.4%)	763 (13.3%)	241 (13.9%)	0.48
<b>Experience of Working as a NP</b>	10.52 (8.32)	11.03 (8.59)	8.81 (7.11)	0.00
<b><u>Employment Characteristics</u></b>				
<b>Types of Working Position</b>				
NP in clinic	6,739 (90.1%)	5,340 (92.8%)	1,399 (80.9%)	0.00
Other NP position	168 (2.2%)	123 (2.1%)	45 (2.6%)	0.25
Staff nurse	251 (3.4%)	94 (1.6%)	157 (9.1%)	0.00
Other non-NP position	325 (4.3%)	196 (3.4%)	129 (7.5%)	0.00
<b>MSA Region</b>				
Urban	5,955 (79.6%)	4,495 (78.1%)	1,460 (84.4%)	0.00
Large rural	663 (8.9%)	556 (9.7%)	107 (6.2%)	0.00
Small rural	302 (4.0%)	264 (4.6%)	38 (2.2%)	0.00
Isolated	191 (2.6%)	173 (3.0%)	18 (1.0%)	0.00
Unknown	372 (5.0%)	265 (4.6%)	107 (6.2%)	0.01
<b>How PCNPs were paid</b>				
Annual salary	4,460 (59.6%)	3,501 (60.9%)	959 (55.4%)	0.00
By the hour	2,065 (27.6%)	1,558 (27.1%)	507 (29.3%)	0.00
Percentage of billing	261 (3.5%)	241 (4.2%)	20 (1.2%)	0.07
Percent billing plus salary/hourly, or other	697 (9.3%)	453 (7.9%)	244 (14.1%)	0.00
<b>Specialty of Clinics</b>				
Primary care specialty	3,821 (51.1%)	3,556 (61.8%)	265 (15.3%)	0.00
Specialty care specialty	2,987 (39.9%)	1,773 (30.8%)	1,214 (70.2%)	0.00
No specialty, or Other	675 (9.0%)	424 (7.4%)	251 (14.5%)	0.00
<b>Census Region</b>				
New England	563 (7.5%)	463 (8%)	100 (5.8%)	0.00
Middle Atlantic	956 (12.8%)	659 (11.5%)	297 (17.2%)	0.00
East North Central	995 (13.3%)	761 (13.2%)	234 (13.5%)	0.75
West North Central	566 (7.6%)	419 (7.3%)	147 (8.5%)	0.09

South Atlantic	1,395 (18.6%)	1,053 (18.3%)	342 (19.8%)	0.17
East South Central	562 (7.5%)	447 (7.8%)	115 (6.6%)	0.12
West South Central	626 (8.4%)	512 (8.9%)	114 (6.6%)	0.00
Mountain	499 (6.7%)	420 (7.3%)	79 (4.6%)	0.00
Pacific	949 (12.7%)	754 (13.1%)	195 (11.3%)	0.04
Unknown	372 (5.0%)	265 (4.6%)	107 (6.2%)	0.00
<b>Degree of Practice Independence</b>				
Independent	780 (10.4%)	722 (12.6%)	58 (3.4%)	0.00
Collaborate with a physician	5,149 (68.8%)	4,132 (71.8%)	1,017 (58.8%)	0.00
Supervised by a physician	955 (12.8%)	536 (9.3%)	419 (24.2%)	0.00
Other relationship	599 (8.0%)	363 (6.3%)	236 (13.6%)	0.00
<b>Job Satisfaction</b>				
Dissatisfied	628 (8.4%)	475 (8.3%)	153 (8.8%)	0.44
Satisfied	6,855 (91.6%)	5,278 (91.7%)	1,577 (91.2%)	0.44
<b>Hold a Secondary Job</b>				
No	5,745 (76.8%)	4,517 (78.5%)	1,228 (71.0%)	0.00
Yes	1,738 (23.2%)	1,236 (21.5%)	502 (29.0%)	0.00



**Study Aim 1: *Examine the wages of PCNPs, including the wages of those employed in primary care and specialty care settings.***

The results of FGLS regression are shown in Table 4.3. These results indicated that PCNP wages were significantly associated with their human capital, employment, and sociodemographic characteristics. The following sections review these findings in detail.

Table 4.3: Feasible Generalized Least Squares Regression Analyses of the Log of Wages

Variables	Coefficient (Standard Error)		
	Full PCNP Sample (n=7,483)	PCNPs in Primary Care Settings (n=5,753)	PCNPs in Specialty Care Settings (n=1,730)
<b><u>Key Independent Variable</u></b>			
Setting	-0.069 (0.009)***		
<b><u>Demographic Characteristics</u></b>			
<b>Gender</b>			
Male	0.061 (0.011)***	0.058 (0.014)***	0.065 (0.018)***
<b>Race</b>			
Nonwhite	0.021 (0.026)	0.003 (0.016)	0.068 (0.024)**
<b>Ethnicity</b>			
Hispanic	0.028 (0.025)	0.031 (0.030)	0.009 (0.050)
<b>Marital Status</b>			
Never married	-0.021 (0.010)*	-0.023 (0.012)	-0.024 (0.018)
Separated, divorced, widowed, and other	-0.005 (0.010)	-0.007 (0.012)	0.001 (0.018)
<b><u>Human Capital Characteristics</u></b>			
<b>Level of Education</b>			
Certificate	-0.080 (0.019)***	-0.088 (0.020)***	-0.044 (0.053)
Post-master degree	0.002 (0.010)	-0.010 (0.012)	0.031 (0.019)
DNP or other	0.049 (0.038)	0.043 (0.044)	0.067 (0.074)
<b>Intent to Turnover</b>			
Leave in 2012	0.002 (0.015)	0.015 (0.018)	-0.029 (0.028)
Leave in next 1–2 years	-0.037 (0.010)***	-0.041 (0.012)**	-0.024 (0.019)
Undecided or unknown	-0.009 (0.010)	-0.010 (0.012)	-0.013 (0.021)
<b>Experience of Working as a NP</b>			
(Square term of experience)/100	0.015 (0.001)***	0.016 (0.001)***	0.014 (0.003)***
	-0.039 (0.005)***	-0.040 (0.005)***	-0.032 (0.012)**

**Employment Characteristics****Types of Working Position**

Other NP position	0.031 (0.046)	0.056 (0.055)	-0.035 (0.082)
Staff nurse	-0.119 (0.021)***	-0.183 (0.036)***	-0.136 (0.029)***
Other non-NP position	-0.016 (0.019)	-0.009 (0.024)	-0.055 (0.033)

**MSA Region**

Large rural	-0.018 (0.012)	-0.012 (0.014)	-0.062 (0.031)*
Small rural	-0.015 (0.022)	-0.009 (0.024)	-0.058 (0.058)
Isolated	0.012 (0.025)	-0.004 (0.026)	-0.019 (0.080)
Unknown	0.045 (0.018)*	0.033 (0.021)	0.074 (0.033)*

**How PCNPs Were Paid**

By the hour	0.052 (0.009)***	0.031 (0.010)***	0.112 (0.017)***
Percentage of billing	0.070 (0.052)	0.049 (0.056)	0.227 (0.157)
Percent billing plus salary/hourly or other	0.062 (0.026)*	0.055 (0.024)	0.066 (0.053)

**Specialty of Clinics**

Specialty care specialty	0.042 (0.008)***	0.050 (0.009)***	0.041 (0.018)*
No specialty, or Other	0.024 (0.015)	-0.003 (0.017)	0.080 (0.031)*

**Census Region**

New England	0.124 (0.015)***	0.120 (0.017)***	0.147 (0.034)***
Middle Atlantic	0.050 (0.012)***	0.030 (0.015)*	0.093 (0.022)***
East North Central	0.026 (0.011)*	0.032 (0.013)*	0.014 (0.021)
West North Central	-0.004 (0.013)	-0.001 (0.015)	0.0001 (0.024)
East South Central	-0.004 (0.014)	0.001 (0.016)	-0.117 (0.027)
West South Central	0.087 (0.016)***	0.080 (0.018)***	0.117 (0.035)**
Mountain	0.084 (0.013)***	0.100 (0.015)***	0.022 (0.029)
Pacific	0.168 (0.014)***	0.159 (0.016)***	0.213 (0.027)***
Other	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)

**Degree of Practice Independence**

Collaborate with a physician	-0.013 (0.016)	-0.024 (0.017)	0.048 (0.049)
Supervised by a physician	-0.036 (0.018)*	-0.057 (0.020)**	0.041 (0.050)

Other relationship	-0.060 (0.028)*	-0.080 (0.031)*	0.018 (0.068)
<b>Job Satisfaction</b>	0.070 (0.015)***	0.095 (0.017)***	0.005 (0.030)
<b>Hold a Secondary Job</b>	0.028 (0.008)***	0.030 (0.009)**	0.026 (0.014)
<b>Constant</b>	3.568 (0.020)***	3.491 (0.021)***	3.543 (0.062)***
<b>Adjusted R<sup>2</sup></b>	0.095	0.083	0.122

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\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

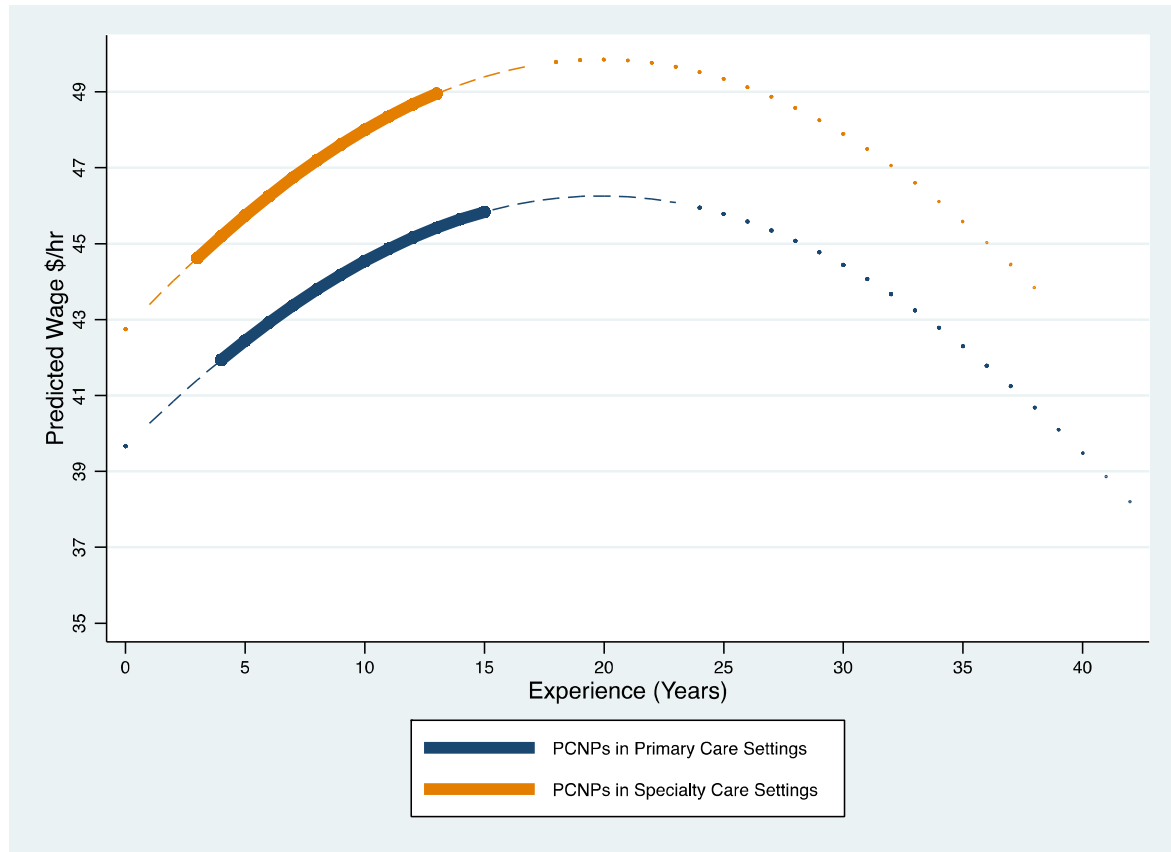
***Wages and human capital characteristics.*** For the full PCNP sample and PCNPs working in primary care settings, PCNPs prepared with a certificate program as their NP education earned wages that were approximately 8.0% and 8.8%, respectively, less than PCNPs with a master's degree. This relationship between PCNPs' level of education and their wages did not hold for PCNPs working in specialty care settings.

Years of experience working as a NP significantly impacted PCNP wages. Figure 4.2 illustrates the estimated wage-experience curves for PCNPs working in primary care settings and PCNPs working in specialty care settings. The line indicates whether the experience was within the 25<sup>th</sup> – 75<sup>th</sup> percentiles (solid and thicker lines), 10<sup>th</sup> – 90<sup>th</sup> percentiles (dashed lines), or above the 90<sup>th</sup> percentiles (dots). For those working in primary care settings, the return at the mean level of NP experience (11.0 years) was 0.7% ( $=0.016+11.03*(-0.040/100)*2$ ); that is, for a PCNP with approximately 11 years of experience, an additional year of experience resulted in a 0.7% wage increase. PCNPs earned \$39.66/hr in their first year as a NP. Early in a NP's career, each additional year of experience led to a wage increase of approximately 1.6% ( $=0.016+0*(-0.040/100)*2$ ). Because of the nonlinear relationship between PCNP experience and wage, the effect of wages diminishes gradually as years of NP experience increase, reaching a point near 20 years of experience where wages began to decrease with further increases in experience. The maximum wage predicted, \$46.26, was approximately 16.6% ( $=(46.26/39.66) - 1$ ) higher than entry-level wages, indicating that wage compression may exist in the PCNP labor market. About 25% to 75% of this PCNP subsample, indicated by the thicker line, had 4 to 15 years of experience and had expected wages between \$41.94/hr and \$45.83/hr.

The wage-experience curve for PCNPs working in specialty care settings is different than that of the PCNPs working in primary care settings. The return at the mean level of NP experience (8.8 years) was 0.8% ( $=0.014+8.8*(-0.032/100)*2$ ); that is, for a PCNP with approximately 8.8 years of experience, an additional year of experience resulted in a 0.8% wage increase, which was a little higher than those of PCNPs working in primary care settings. PCNPs working in specialty care settings earned a higher entry-level wages of \$42.74/hr, which was 7.8% ( $=(42.74/39.66)-1$ ) higher than that of PCNPs working in primary care settings. Early in the career of a NP working in a specialty care settings, each additional year of experience led to a wage increase of approximately 1.4% ( $=0.014+0*(-0.032)*2$ ), which was similar to the increase for PCNPs working in primary care settings. The wages of PCNPs working in specialty care settings also peaked near 20 years of experience at the wage of \$49.85/hr, which was 16.6% ( $=(49.85/42.74)-1$ ) higher than their entry-level wage. The peak wage for PCNPs working in specialty care settings was 7.8% ( $=(49.85/46.26)-1$ ) higher than the peak wage for PCNPs working in primary care settings. Approximately 25% to 75% of this subsample of PCNPs, indicated by the thicker line, had 3 to 13 years of experience and eared wages between \$44.62/hr and \$49.94/hr.

Generally, compared with PCNPs working in specialty care settings, PCNPs working in primary care settings started their career with a lower entry-level wage, had a similar rate of increase in wage early in their career, had a similar rate of return at the mean level of NP experience, but had a lower peak wage and a similar difference between their entry-level and peak wage. The findings also suggested that wage compression might exist in PCNP population regardless of their practice settings.

**Figure 4.2: Wage-Experience Profiles for PCNPs Working in Primary Care Settings and those Working in Specialty Care Settings**



Note: Wages were the average prediction, applied for the Duan's smearing estimators, of each subsample of PCNPs.

Parameter estimates for the PCNP turnover variables indicated a statistically significant relationship between intent to turnover and wages. For the full sample and those working in primary care settings, PCNPs who intended to leave in the next one to two years earned about 3.7% and 4.1%, respectively, less than those who did not intend to leave. However, this relationship did not hold for PCNPs working in specialty care settings.

***Wages and employment characteristics.*** Results for the full PCNP sample indicated that the wages of PCNPs working in primary care settings were **6.7% lower** ( $=100*(\exp(-0.069) - 1)$ ) than those of PCNPs working in specialty care settings, when holding their demographic, human capital, and employment characteristics constant.

PCNP wages were also associated with the types of position they held, their employment region, how they were paid, the specialty of their practice setting, and the census region where they were employed for both the subsamples of PCNPs working in primary care settings and those working in specialty care settings. For PCNPs working in primary care settings, their wages were also associated with whether they practiced independently, whether they were satisfied with their job, and whether they had a secondary job. Specifically, PCNPs who were supervised by a physician earned 5.7% less than PCNPs who practiced independently, after accounting for PCNPs' other characteristics. PCNPs who were satisfied with their job earned hourly wages approximately 9.5% more than the PCNPs who were not satisfied with their job, adjusting for PCNPs' other characteristics. However, this finding does not imply a causal relationship between PCNPs' job satisfaction and their wages, only that there is an association between these two. PCNPs who had a secondary NP or RN position earned 3.0% more than PCNPs who did not, holding their other characteristics constant. However, these relationships did not hold for PCNPs working in specialty care settings.



***Wages and demographic characteristics.*** Results for the full PCNP sample show that male PCNP wages were approximately 6.1% higher than females. Similar results were found for both PCNPs working in primary care settings (5.8%) and PCNPs working in specialty care settings (6.5%). Also, PCNPs who were nonwhite and working in specialty care settings earned approximately 6.8% more than white PCNPs working in specialty care settings. For the full PCNP sample, PCNPs who never married earned approximately 2.1% less than those PCNPs who were married.

***Summary.*** The results of wages modeling reflect how each of the wage-generating characteristics influences PCNP wages. These findings also indicated the differences in the returns to PCNPs' wage-generating characteristics between primary care and specialty care settings.

***Study Aim 2: Compare the wages of PCNPs employed in primary care settings with the wages of PCNPs employed in specialty care settings.***

Results of the Chow test indicated that there was a structural difference between the wage models (3) and (4) ( $F=2.65, p<0.01$ ). In other words, the wage disparities between PCNPs working in primary care and specialty care settings were statistically significant. This test indicated that additional steps to explore wage disparities between these two groups were appropriate.

***Study Aim 3: Explore the extent to which endowment effects and coefficient effects contribute to these wage disparities.***

This analysis first decomposed the ***unweighted logged wage disparities*** between PCNPs working in primary care settings and PCNPs working in specialty care settings using model (5). These results are presented in Table 4.4. Values in column (1) represent the

*absolute* contribution of each PCNP characteristic to the total wage disparities, while values in column (2) represent the wage disparities of each variable relative to the total wage disparities, expressed as a percent. These results showed that the wages of PCNPs working in primary care settings were approximately 9.5% lower ( $=100*(\exp(0.0903) - 1)$ ) than the wages of PCNPs working in specialty care settings. This finding is different than the 6.7% disparity found in the FGLS regression model described above (Table 4.3). That is, the 9.5% disparity was unweighted wage disparities and was not adjusted for PCNPs' wage-generating characteristics, while the 6.7% disparities was adjusted for those characteristics.

The contributions of endowment effects to this disparity is  $-0.0021$  ( $-2.3\%$  of the total wage disparities), which means that PCNPs working in primary care settings would earn 0.2% less ( $=100*\exp(-0.0021) - 1$ ) if their characteristics were exactly the same as those of PCNPs working in specialty care settings. The contribution of coefficient effects to the total wage disparities is  $0.0924$  ( $102.3\%$  of the total wage disparities), which indicates that PCNPs working in primary care settings would earn 9.7% more ( $=100*\exp(0.0924) - 1$ ) if the returns to or coefficients of PCNPs' wage-generating characteristics were applied by those of PCNPs working in specialty care settings.

The endowment effects of the wage disparities were largely explained by PCNPs' work experience. Specifically, because PCNPs working in primary care settings on average had more experience than the average PCNP in a specialty setting (Table 4.2), replacing the average experience of a PCNP in a primary care setting with that of a PCNP in a specialty setting would *reduce* expected wages. In other words, PCNPs working in primary care settings on average would earn approximately 0.6% *less* ( $7.5\%$  of the total disparities) if they had the same work experience as PCNPs working in specialty care settings. However,

PCNPs working in specialty care settings also had other characteristics that may increase the predicted wages if applied to PCNPs working in primary care settings. For example, more of PCNPs working in specialty care settings were male, nonwhite, or working in urban areas than PCNPs working in primary care settings. Therefore, these endowment differences mitigated each other and led to endowment effects that were close to zero.

The coefficient effects for the most part explained the wage disparities. These disparities were mainly due to the variables of PCNPs' job satisfaction and their independence of their practice. First, if the coefficient of job satisfaction for PCNPs working in primary care settings was applied by those of PCNPs working in specialty care settings, PCNPs working in primary care settings on average would earn approximately 8.5% *less* (94.2% of the total disparities). This is because the coefficient reflecting the association between PCNPs' job satisfaction and their wages was significant for PCNPs working in primary care settings but was not for PCNPs working in specialty care settings (Table 4.3).

Second, if the returns to PCNPs' independence of practice for those who worked in primary care settings were applied by those for PCNPs who worked in specialty care settings, the wages of PCNPs working in primary care settings would earn about 5.3% *less* ( $=(-6.26\%) + 1.90\% + (-0.89\%)$ ). This is because the coefficient reflecting the association between PCNPs' independence of practice and their wages was significant for PCNPs working in primary care settings but was not for PCNPs working in specialty care settings (Table 4.3).

Table 4.4: The Decomposition of Wage Disparities

	Endowment Effect <sup>a</sup>		Coefficient Effect <sup>b</sup>		Total Effect <sup>c</sup>	
	(1) ( $\Delta \ln \bar{w}$ )	(2) ( $\Delta \ln \bar{w}$ of the total difference)	(1) ( $\Delta \ln \bar{w}$ )	(2) ( $\Delta \ln \bar{w}$ of the total difference)	(1) ( $\Delta \ln \bar{w}$ )	(2) ( $\Delta \ln \bar{w}$ of the total difference)
<b><u>Demographic Characteristics</u></b>						
<b>Gender</b>						
Male	0.0034	3.72%	0.0005	0.51%	0.0038	4.23%
<b>Race</b>						
Nonwhite	0.0011	1.24%	0.0046	5.14%	0.0058	6.39%
<b>Ethnicity</b>						
Hispanic	0.0000	0.04%	-0.0028	-3.15%	-0.0028	-3.11%
<b>Marital Status</b>						
Never married	-0.0006	-0.72%	-0.0031	-3.38%	-0.0037	-4.10%
Separated, divorced, widowed, and other	-0.0001	-0.09%	0.0000	0.00%	-0.0001	-0.09%
<b><u>Human Capital Characteristics</u></b>						
<b>Level of Education</b>						
Certificate	0.0020	2.16%	0.0031	3.43%	0.0050	5.59%
Post-master	0.0002	0.24%	0.0039	4.35%	0.0041	4.59%
DNP or other	0.0001	0.11%	0.0014	1.53%	0.0015	1.65%
<b>Intent to Turnover</b>						
Leave in 2012	0.0000	0.00%	-0.0021	-2.37%	-0.0021	-2.37%

[illegible]

New England	-0.0030	-3.36%	0.0025	2.75%	-0.0006	-0.61%
Middle Atlantic	0.0037	4.10%	0.0066	7.31%	0.0103	11.41%
East North Central	0.0001	0.09%	-0.0028	-3.10%	-0.0027	-3.02%
West North Central	0.0001	0.09%	-0.0017	-1.92%	-0.0017	-1.83%
East South Central	-0.0001	-0.11%	-0.0007	-0.80%	-0.0008	-0.90%
West South Central	-0.0017	-1.91%	-0.0023	-2.57%	-0.0041	-4.49%
Mountain	-0.0020	-2.20%	-0.0032	-3.49%	-0.0051	-5.69%
Pacific	-0.0032	-3.54%	0.0009	0.95%	-0.0023	-2.59%
Other	0.0000	0.00%	0.0000	0.00%	0.0000	0.00%
<b>Degree of Practice Independence</b>						
Collaborate with a physician	-0.0057	-6.26%	0.0372	41.22%	0.0316	34.96%
Supervised by a physician	0.0017	1.90%	0.0122	13.54%	0.0139	15.44%
Other relationship	-0.0008	-0.89%	0.0064	7.05%	0.0056	6.16%
<b>Job Satisfaction</b>	-0.0003	-0.34%	-0.0850	-94.19%	-0.0854	-94.53%
<b>Hold a Secondary Job</b>	0.0017	1.87%	-0.0028	-3.08%	-0.0011	-1.21%
<b>Constant</b>			0.0805	89.16%		
<b>Total</b>	-0.0021	-2.29%	0.0924	102.29%	0.0903	100.00%

<sup>a</sup>  $0.5 \sum (\beta_i^{pcu} + \beta_i^{spu})(X_i^{spu} - X_i^{pcu})$  – the disparities in expected (log) wages due to PCNPs' characteristics

<sup>b</sup>  $0.5 \sum (X_i^{pcu} + X_i^{spu})(\beta_i^{spu} - \beta_i^{pcu})$  – the disparities in expected (log) wages due to differences in coefficients

<sup>c</sup>  $\sum X_i^{spu} \beta_i^{spu} - \sum X_i^{pcu} \beta_i^{pcu}$

This analysis further predicted the *average weighted level wage disparities* between PCNPs working in primary care and specialty care settings using model (6). These results are presented in Table 4.5. The average predicted weighted specialty care setting wage for PCNPs who actually worked in specialty care settings was \$47.87/hr, while the average predicted weighted primary care setting wage for PCNPs who actually worked in primary care settings was \$43.80/hr. The total disparity is \$4.07, indicating that PCNPs working in primary care settings earned 9.3%  $(=(47.87/43.80) - 1)$  less than those working in specialty care settings. The contribution of endowment effects to this disparity is  $-\$0.08$  ( $-2.0\%$  of the total disparity). The contribution of coefficient effects to the total disparity is  $\$4.15/\text{hr}$  ( $102.0\%$  of the total disparity).

Given the weighted average of each sector's coefficient and means in model (6), the findings of the percentages that endowment and coefficient effects contributed to the total disparities had a small discrepancy with those reported using model (5). However, the main conclusion of these two models was largely the same – the endowment effects hardly contributed to the total wage disparities, while the majority of these wage disparities were due to coefficient effects.

**Table 4.5: Average Predicted Weighted PCNP Wages and the Decomposition of Wage Disparities**

	<b>If working in specialty care settings</b>	<b>If working in primary care settings</b>
<b>Actually worked in specialty care settings</b>	(1) $\beta_i^{spw} X_i^{spw} = \$47.87$	(2) $\beta_i^{pcw} X_i^{spw} = \$43.31$
<b>Actually worked in primary care settings</b>	(3) $\beta_i^{spw} X_i^{pcw} = \$47.55$	(4) $\beta_i^{pcw} X_i^{pcw} = \$43.80$
<b>Total Disparities</b>	$W_i^{spw} - W_i^{pcw} = \beta_i^{spw} X_i^{spw} - \beta_i^{pcw} X_i^{pcw} = (1) - (4) = \mathbf{\$4.07}$	
Endowment Effects	$0.5[(\beta_i^{spw} X_i^{spw} - \beta_i^{spw} X_i^{pcw}) + (\beta_i^{pcw} X_i^{spw} - \beta_i^{pcw} X_i^{pcw})]$ $= 0.5[(1) - (3) + (2) - (4)]$ $= -\$0.08$ $= -2.0\% \text{ of the total disparity}$	
Coefficient Effects	$0.5[(\beta_i^{spw} X_i^{spw} - \beta_i^{pcw} X_i^{spw}) + (\beta_i^{spw} X_i^{pcw} - \beta_i^{pcw} X_i^{pcw})]$ $= 0.5[(1) - (2) + (3) - (4)]$ $= \$4.15$ $= 102.0\% \text{ of the total disparity}$	



## **Discussion**

Consistent with prior nursing research on the wage disparities between primary care and specialty care settings, this paper found that PCNPs working in primary care settings on average earned 6.7% lower wages than PCNPs working in specialty care settings, holding their demographic, human capital, and employment characteristics constant. The majority of these wage disparities were due to coefficient effects, indicating the different returns to PCNPs' wage-generating characteristics between primary care and specialty care settings.

From a theoretical perspective, the findings of this paper demonstrate that human capital theory explains the determinants of wage in the PCNP workforce. Specifically, PCNPs' wages were positively associated with their human capital assets, such as their education and years of experience. These results are also consistent with the findings of previous descriptive research on NP wages (Goolsby, 2006, 2009, 2011).

Descriptive statistics suggested that PCNPs working in primary care settings had different demographic, human capital, and employment characteristics than PCNPs working in specialty care settings. These disparities contributed to the endowment effects of the total wage disparities between primary care and specialty care settings. Specifically, PCNPs working in primary care settings had greater endowments for some characteristics (e.g., more years of experience and less likely to work as an RN staff) than PCNPs working in specialty care settings; however, they were also more likely to be female, white, and married, to have a lower level of education, and to be employed in rural areas. Therefore, these differences of endowments ended up mitigating each other and the total endowment effects were effectively zero.

The results of wage modeling regression analysis suggested that the returns to PCNPs' wage-generating characteristics were different between PCNPs working in primary care and specialty care settings. These discrepancies contributed to the coefficient effects of the wage disparities between PCNPs working in primary care and specialty care settings, largely explained by the variables of job satisfaction and the degree of PCNPs' practice independence. Job satisfaction was positively associated with the wages of PCNPs working in primary care settings, but was not associated with the wages of PCNPs working in specialty care settings. The findings of this paper thus emphasize the important relationship between wages and job satisfaction for PCNPs working in primary care settings. The job satisfaction of PCNPs working in specialty care settings may be affected by factors other than their wages, possibly because they are paid a higher wage to compensate for the more stressful working environment. Instead, their job satisfaction may be influenced by other factors, such as organizational culture and climate, relationships with other professionals and administrators, the characteristics of their organization, and the safety and workload of their job (Brewer, Kovner, Greene, Tukov-Shuser, & Djukic, 2012; Brewer & Nauenberg, 2003; De Milt et al., 2011; Schumacher & Hirsch, 1997). Therefore, the different working environments in primary care and specialty care settings may impact PCNPs' job satisfaction.

This analysis also found that PCNPs working in primary care settings who practiced independently earned more than those who were supervised by a physician. Therefore, it highlights the important relationship between the degree of PCNPs' practice independence and their wages for those working in primary care settings. However, this association between PCNPs' wages and the degree of their practice independence did not hold for

PCNPs working in specialty care settings. This might be explained by that the small percentage of PCNPs who practiced independently in specialty care settings in the 2012 sample make it statistically hard to detect wage disparities. It may also follow that the wages of PCNPs working in specialty care settings are not associated with the degree of their practice independence but other factors that were unobserved in this analysis.

Compared with the study of Li et al. (2016), this paper reported different percentages that endowment effects contributed to the setting-based wage disparities. One possible reason is that Li et al. (2016) was focused on the overall RN population (include both RNs and NPs), while this paper was only focused on PCNPs who may have different endowments than overall RN population. Another reason may be that different datasets and wage modeling were used in these two studies. This paper included some factors that were not included in the study of Li et al. (2016) but which were significantly related to PCNP wages especially for those working in primary care settings. These factors included whether PCNPs had a plan to leave their position, whether PCNPs' were satisfied with their position, and whether PCNPs practiced independently.<sup>35</sup> However, the main findings of these two studies were consistent – that is, coefficient effects largely explained the wage disparities between nurses working in primary care settings and those working in specialty care settings.

This paper reported consistent findings with previous studies that nurses' wages are not only associated with their human capital but also with their demographic and employment characteristics. Specifically, this study found that PCNPs earned more if they were male (Jones & Gates, 2004; Muench et al., 2015), nonwhite (McGregory Jr, 2013), non-Hispanic (McGinnis & Moore, 2009), unmarried (Coomer, 2013; Kalist, 2002), practiced as

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<sup>35</sup>These variables were not included in the study of Li et al. (2016) because they were not consistently collected by HRSA from 1988 to 2008.

a nurse manager (Coombs & Cebula, 2010; Kalist et al., 2010; McGinnis & Moore, 2009), and worked in an urban/metropolitan area (McGregory & Peoples, 2013). This paper also reported other important factors that were not examined by previous studies but were found to be associated with PCNP wages, such as the specialty of PCNPs' work clinics, the geographical region where PCNPs worked, how PCNPs were paid, and whether PCNPs practiced independently.

The findings of this paper also demonstrated other important findings related to PCNP wages. For example, the finding that PCNPs' peak wages were only 16.6% higher than entry-level wages, regardless of setting, may indicate wage compression in the PCNP labor market. Wage compression refers to a phenomenon whereby small differences between individuals' peak wages and entry-level wages result in the underemployment of experienced and productive workers (Pierce, Freund, Luikart, & Fondren, 1991). Wage compression is a long-standing problem in nursing and has not yet been solved: it was reported that an RNs' salary is likely to increase by less than 69% throughout their career compared with 109% for accountants and 184% for engineers (Evans & Carlson, 1992; Lynn & Redman, 2006). It may be even worse in the PCNP workforce because the wage compression found in this paper was even lower than the 27% wage compression rate for nurses in general, as reported in the study by Jones and Gates (2004). Wage compression is due to the lack of financial recognition for experience and productivity and is significantly associated with nurses' job satisfaction and retention (Greipp, 2003). That is, nurses are more likely to leave their position or even leave the health care system if they see limited opportunities for wage increases during their career (Nooney, Unruh, & Yore, 2010). More research is therefore

needed to examine wage compression in the PCNP labor market to better understand how this may affect PCNP employment.

Several questions about setting-based PCNP wage disparities still remain. First, given that the focus of health care delivery is shifting from acute care to primary care under the health care reform, one might expect that the wages of PCNPs in primary care settings would increase to attract more PCNPs (Bodenheimer & Bauer, 2016). However, PCNP wages in primary care settings reported in this paper were similar to those reported in previous studies, and the disparities in wage for NPs working in primary care and specialty care settings have been consistent throughout the past decade (Goolsby, 2006, 2009, 2011). Thus, one question is whether current wages will be sufficient to attract PCNPs to work in primary care settings. A more difficult question might be to what extent must PCNP wages change to ensure a sufficient supply of PCNPs in primary care settings? Another question might be that if primary care settings paid higher wage, will PCNPs working in specialty care settings be more inclined to move to primary care settings? Research is needed to answer these questions in the future.

### **Study Limitations**

The results of this paper should be interpreted in light of certain limitations. The use of survey data may affect the accuracy and completeness of individual reporting. For example, the calculation of an hourly wage may not be accurate given the use of self-reported data. Variables included in the wage model (e.g., years of NP experience), to some extent, may contain measurement errors. Also, the analytical methods used for modeling PCNP wages may be problematic due to potential model specification error. For example, previous studies suggest that whether or not nurses have children at home is associated with their

wages, although this variable was not included in this study's wage modeling due to its unavailability in the 2012 NSSNP data (Jones & Gates, 2004). Yet, the variables included in the wage models examined in this paper were based on human capital theory and the wage modeling examined in previous studies. Last, the results of the present study may not reflect the most current level of PCNP wages given that the survey was conducted in 2011.

Nevertheless, this 2012 dataset was the most currently available dataset of the NP workforce at the time this study was conducted. Despite these limitations, this paper still represents an important step in describing PCNP wages, examining the setting-based PCNP wage disparities, and attempting to explain why these disparities may exist.

### **Policy Implications**

The results of this paper are important for healthcare leaders and policy makers given that the focus of health care delivery is shifting from acute care to primary care and demand for NPs in primary care is increasing under health care reform (Spetz, 2014). At the organizational or system level, this paper suggests that policies of PCNPs' payment should be examined. Efforts such as increasing PCNPs' wages and adjusting wage compression may improve PCNPs' job satisfaction for currently practicing PCNPs and may attract newly graduated NP students to primary care settings. In addition, managers may need to examine PCNPs' practice pattern and work environment and explore other factors that may influence PCNP wages, such as the degree of PCNPs' practice independence. Examining the success of current PCNP recruitment and retention efforts in primary care settings may also be important in improving PCNP wages and maintaining the supply of PCNPs in primary care settings.

At the public policy level, the findings of this paper provide policy makers with insights into PCNP wages and the disparities existing between primary care and specialty care settings. The results suggest that actions may be needed to change the policies of PCNP payment, especially for those employed in primary care settings. Reforming the scope of practice laws for PCNPs may improve PCNPs' autonomy and further increase their wages. Reforming PCNPs' payment policy and improving their reimbursement rate may also be helpful for improving PCNPs' wages and participation in primary care (Barnes et al., 2016).

### **Research Implications**

The results of this paper shed light on future research targeting PCNP wages. The coefficient effects of the wage disparities between PCNPs working in primary care settings and those working in specialty care settings are due to other unobserved factors relative to PCNPs' practice. First, PCNPs might be paid differently between primary care and specialty care settings because of reimbursement policy. Under the Medicare payment system, PCNPs who work in hospitals are usually paid a fixed salary, but PCNPs who work in physician offices are reimbursed 85% to 100% of physician fees (Chapman et al., 2010). However, little is known about how these different methods of payment affect PCNPs wages across settings. Second, the specialty of PCNPs' supervised physician may also affect PCNPs' wages. For example, PCNPs who work in mental health clinics and are supervised by a psychiatrist may earn more than those who work in primary care settings and are supervised by a primary care physician, holding other characteristics constant. Moreover, PCNPs working in hospital settings are more likely to work on a night or rotation shift than those working in primary care settings and thus earn a wage premium for working off-shifts (Schumacher & Hirsch, 1997). Unfortunately, these wage-influencing factors were not

included in the wage modeling of this analysis due to their unavailability in the 2012 NSSNP data. Therefore, more study is needed to further explore how PCNPs' practice is different between primary care and specialty care settings and how these differences may affect PCNP wages.

The wage disparities between PCNPs working in primary care and specialty care settings may also be due to their unmeasured human capital. Previous studies suggested that nurses working in specialty care settings earned more because they possessed higher cognitive abilities than nurses working in primary care settings (Schumacher & Hirsch, 1997). Unfortunately, these indicators are not available in the 2012 NSSNP; and instead, this analysis was only able to use PCNPs' year of experience and level of education as proxies of their human capital. Future research is needed to further examine whether the quantity and quality of PCNPs' human capital vary with settings.

Future studies are also necessary to explore other wage-influencing factors relative to PCNP policy. Because the findings of this paper indicated that the wages of independently practicing PCNPs were higher than those of the PCNPs who were supervised by physicians, it would be interesting to explore whether PCNP wages also vary within states that have different laws governing whether PCNPs are to be supervised by physicians. Further analysis is also needed to understand how different reimbursement policies affect PCNP wages. Characterizing PCNPs' reimbursement across regions and payers would be important for understanding how their wages vary with these factors.

Finally, more research is needed to examine the changes of PCNP wages under the health care reform. The changing payment policy to primary care services may influence the wages of PCNPs working in primary care settings. For example, the Center for Medicare and



Medicaid Services implemented payment increases for evaluation and management services and nonmajor procedures and tests in 2010, but no study has been conducted to examine whether this policy change increased PCNPs' payment in primary care settings (Chapman et al., 2010). Additionally, PCNP wages might also be changing with the development of alternative care models where PCNPs are widely employed and play pivotal roles, such as nurse-managed health centers, accountable care organizations, and patient-centered medical homes. Thus, a longitudinal study examining the changes of PCNPs wages compared with the wage disparities across settings would be important in understanding the changes of PCNP wages.

### **Chapter Summary**

This chapter contributes new knowledge regarding PCNPs' wages, the wage disparities between PCNPs working in primary care and specialty care settings, and the factors contributing to these disparities. This paper also improves our understanding of the economic returns to PCNPs' human capital. The findings suggest that PCNPs working in primary care settings earned, on average, less than PCNPs working in specialty care settings, and the majority of these wage disparities were explained by the differences in returns to their wage-generating characteristics between the two types of practice settings. The next chapter will summarize the findings of this dissertation and discuss its new contributions to literatures as well as its limitations and implications for research and policy.

## **CHAPTER 5: A REVIEW AND DISCUSSION: PRIMARY CARE NURSES' CONTRIBUTIONS TO PRIMARY CARE AND THEIR ECONOMIC RETURNS**

### **Introduction**

The overarching purpose of this dissertation was to address the gaps in knowledge related to PCNs' contributions to primary care and their economic returns. Guided by a conceptual framework based in human capital theory, this dissertation included three independent analyses that were focused on PCNs' contributions to primary care, how PCN care is similar to and different from PCP care, and whether wage disparities exist between PCNPs working in primary care and specialty care settings. This chapter reviews each analysis and summarizes findings based on the dissertation's conceptual framework. The strengths and limitations of the dissertation are presented along with a discussion of the research and policy implications.

### **Findings of the Dissertation**

Each of the sections that follow presents findings by chapter and analysis included in this dissertation. The main conclusions of these analyses are also presented in Figure 5.1.

#### **Chapter 2 (Paper 1): *An integrative literature review of PCNs' contributions to the U.S. primary care system***

This analysis addressed the first research question of this dissertation: *What are PCNs' contributions to primary care, including the care they provide and the outcomes of their care?* The study population for this analysis was PCNs – that is, both PCRNs and

PCNPs. The analysis followed Cooper’s seven-step approach for conducting a research synthesis and examine relevant studies published between 2011 and 2015. The major findings from this analysis include the following:

- 1) PCNs performed a wide range of functions, focusing mainly on four functions categories of patient assessment, care management, health promotion and disease prevention, and emphasized PCNs’ functions related to care collaboration, care coordination, and care transition; no functions were reported in the fifth category of “other” activities, which include teaching, research, administrative activities, and quality improvement;
- 2) PCNs served in substitute, supplemental, and “other” roles<sup>36</sup> in primary care settings; the functions PCNs performed in the supplemental role included patient assessment, care management, health promotion and disease prevention; the functions PCNs performed in the substitute or “other” roles were less clear because of the small number of existing studies;
- 3) PCNs managed patients with a variety of diagnostic characteristics in general; when they served in a supplemental role, they provided care most often to patients with chronic diseases; when they served in a substitute or “other” role, the types of patients for whom they provided care was less clear because of the small number of existing studies; and
- 4) While existing evidence indicated that PCNs improved the effectiveness and patient-centeredness of primary care, there was little existing evidence available to draw conclusions about PCNs’ contributions to the safety, timeliness, efficiency, and equity of primary care.

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<sup>36</sup>This refers to PCNs’ role in PCN-led clinics examined in Chapter 2. It may also refer to other roles, such as when PCNs serve as both a substitute and supplemental for PCPs, or the role that is neither substitute nor supplemental. These roles were not examined Chapter 2 because no study was focused on these.

### Chapter 3 (Paper 2): *A comparison of care delivered by PCNs and PCPs in primary care settings*

This analysis addressed the second research question of this dissertation: *How is PCN care similar to and different from PCP care, in terms of the functions, roles, and the diagnostic characteristics of their care recipients?* The study population for this paper was PCNs – that is, both PCRNPs and PCNPs – as well as PCPs. A cross-sectional, secondary analysis design was used with data from the *Medical Expenditure Panel Survey* (MEPS) files from 2002-2013, and the Clinical Classification Software (CCS) file. The major findings from this analysis indicate that:

- 1) PCNs and PCPs perform different *functions*: that is, more patient visits were made to PCNs for biomedical therapies and psychotherapies than those were made to PCPs; more patient visits were made to PCPs for diagnostic exams, prescriptions, and procedures than those were made to PCNs;
- 2) When both PCNs and PCPs served in a *usual provider* (i.e., substitute) role, more patient visits were made to PCNs for biomedical therapies and psychotherapies than those were made to PCPs; alternately, more patient visits were made to PCPs for diagnostic exams than those were made to PCNs.
- 3) When both PCNs and PCPs served in a *supplemental* role to each other, more patient visits were made to PCNs for biomedical therapies, psychotherapies, and vaccinations than those were made to PCPs, while more patient visits were made to PCPs for diagnostic exams, prescriptions, and procedures than those were made to PCNs.
- 4) With respect to the *diagnostic characteristics* of the patients for whom PCNs and PCPs provided care when both served in a usual provider role, PCNs and PCPs managed patients with similar diagnostic characteristics. When serving in a supplemental role to

PCPs, PCNs were more likely to manage patients with diseases of the genitourinary system and neoplasm. When serving in a supplemental role to PCNs, PCPs were more likely to manage patients with diseases of the circulatory system, diseases of the musculoskeletal system and connective tissue, or injury and poisoning.

**Chapter 4 (Paper 3): *A comparison of wages for PCNPs working in primary care and specialty care settings***

This analysis addressed the third research question of this dissertation: *Is there a wage disparity between PCNPs employed in primary care settings and those employed in specialty care settings and if so, why?* Unlike the study populations of Chapters 2 and 3, this analysis was focused on PCNPs only. A cross-sectional, secondary analysis design was used to analyze data from the 2012 *National Sample Survey of Nurse Practitioners* (NSSNP). The findings of this analysis indicate that:

- 1) Wage modeling indicated that PCNPs working in primary care settings earned wages that were, on average, 6.7% less than those working in specialty care settings, holding other variables constant;
- 2) A Chow test indicated that there were structural differences in the wage models for PCNPs working in primary and specialty care settings, and that the wage difference between PCNPs working in primary care and specialty care settings was statistically significant;
- 3) Using the Oaxaca-Blinder technique to decompose the wage differences between primary care and specialty care settings, it was determined that a wage disparity existed between PCNPs working in primary care and specialty care settings that could not be explained by

PCNPs' wage-generating characteristics; instead, the wage disparity was due to coefficient effects or was largely unexplained by PCNPs' human capital;

- 4) PCNPs' perceptions of job satisfaction and the degree of their practice independence largely contributed to the coefficient effects. In other words, the relationships between PCNPs' job satisfaction and their wages and those between PCNPs' degree of practice independence and their wages were significant for PCNPs working in primary care settings but not for those working in specialty care settings; and
- 5) The weighted average wage predicted for PCNPs working in primary care and specialty care settings was \$43.80 and \$47.87, respectively, indicating a \$4.07 wage disparity between these two groups of PCNPs.

**Summary.** The main findings of this dissertation indicated PCNs' contributions to primary care and the economic returns to their human capital (Figure 5.1). First, PCNs make important contributions to primary care, which are reflected in the care they provide and the outcomes they achieve. Specifically, in terms of their *functions*, results from Chapter 2 indicated that PCNs' functions were focused on patient assessment, care management, health promotion and disease prevention; and the findings from Chapter 3 suggested that PCNs were more likely to provide therapeutic care but were less likely to provide diagnostic care and biomedical treatment than PCPs. The results of these two analyses suggest that PCNs perform a wide range of functions but their functions differ from those of PCPs.

In terms of *roles*, findings from Chapter 2 indicated that little is known about PCNs' functions when serving in a substitute role, as evidenced by the lack of research published in this area. The analysis presented in Chapter 3 contributed some evidence to address this

knowledge gap by noting that when PCNs served in a substitute role, they were more likely to provide therapeutic care but less likely to provide diagnostic care than PCPs. Under a supplemental role, findings from Chapter 2 indicated that PCN's functions were focused on patient assessment, care management, health promotion, and disease prevention; this conclusion was partially supported by the findings of Chapter 3, which suggested that PCNs were more likely than PCPs to provide preventive care when they served in a supplemental role. The analysis conducted in Chapter 3 also indicated that when PCNs served in a supplemental role, they were more likely to provide therapeutic care but were less likely to provide diagnostic care than PCPs. Thus, the findings of Chapter 3 expanded our understanding of both the substitute and supplemental roles of PCNs. Unfortunately, neither Chapter 2 nor Chapter 3 was able to closely examine PCNs' functions under the "other" role. Therefore, we still know very little about PCNs' functions when they serve in this role.

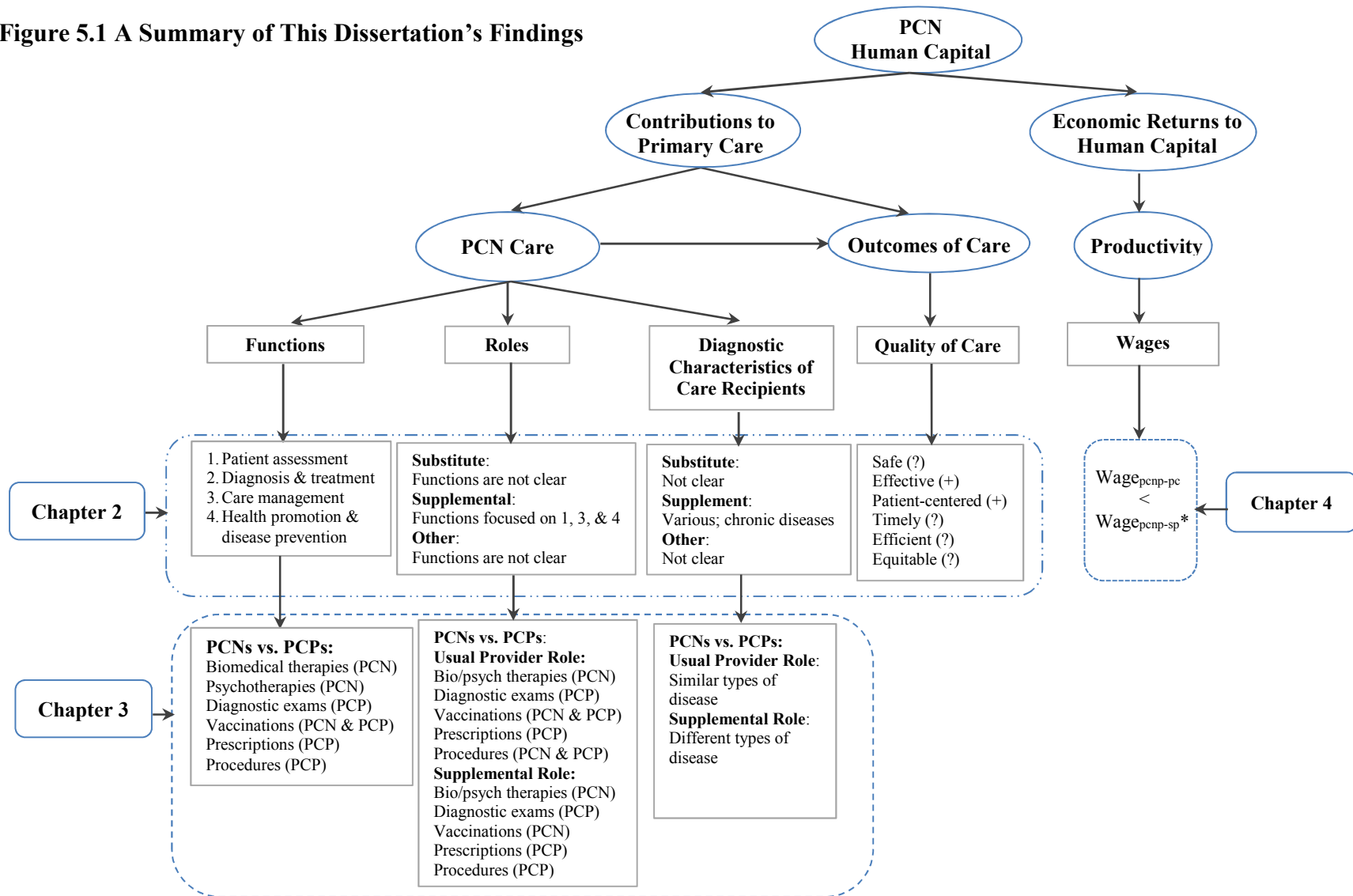
In terms of *the diagnostic characteristics of their care recipients*, findings from Chapter 2 indicated that very little research has been conducted to examine the diagnoses that PCNs manage under a substitute role, while the analysis presented in Chapter 3 reported that PCNs managed patients with similar diagnoses as PCPs. With respect to the supplemental role, Chapter 2 reported that PCNs mainly managed patients with chronic diseases when serving in this role; and the findings of analysis presented in Chapter 3 indicated that PCNs managed patients with different diagnoses than those managed by PCPs, with PCNs more often managing the care of patients with genitourinary diseases or neoplasm. However, none of these analyses examined the diagnoses that PCNs managed under the "other" role, emphasizing the need for further study.

Another area examined in Chapter 2 pertained to the *quality of care*, assessed according to the six quality aims identified by the Institute of Medicine (2001). The findings in this chapter reported that PCNs improved the effectiveness and patient-centeredness of primary care, but very little research was found that addressed how PCNs contribute to the safety, timeliness, efficiency, and equity of primary care.

Finally, this dissertation used an economic perspective to examine the returns to PCNPs' human capital, assessed through their *wages*. The findings of Chapter 4 suggested that PCNPs working in primary care settings earned wages that were, on average, less than PCNPs working in specialty care settings. The findings of this chapter also indicated that a wage disparity existed between these two groups of PCNPs and that this disparity was largely due to unexplained factors and was not explained by PCNPs' wage-generating factors (i.e., their human capital, demographic, and employment characteristics).



Figure 5.1 A Summary of This Dissertation's Findings



\*Wage<sub>pcnp-pc</sub> refers to the wage of PCNPs working in primary care settings; Wage<sub>pcnp-sp</sub> refers to the wage of PCNPs working in specialty care settings.

### **Strengths of the Dissertation**

This dissertation has several strengths. First, this dissertation used human capital theory to derive a conceptual framework that provided guidance for examining PCNs' contributions to primary care and the economic returns to their human capital. Specifically, this conceptual framework suggests that PCNs' human capital provides unique knowledge, skill, and abilities that ground PCN care and the outcomes of PCN care. Additionally, the analysis conducted in Chapter 4 was based on one of the assumptions of human capital theory – that is, the more human capital possessed by PCNs, the higher the wages they earn. The analysis conducted in Chapter 4 is unique in its use of human capital theory to examine the wages of PCNPs working in primary and specialty care. The findings of this analysis demonstrated that human capital theory explains the determinants of wage in the PCNP population.

Second, this dissertation expanded the focus of previous studies that examined PCNs' contributions to primary care. This dissertation conducted an inclusive literature review of PCNs' contributions to primary care by examining both PCN care and the outcomes of PCN care, but previous literature reviews were only focused on the outcomes of PCN care (Keleher, Parker, Abdulwadud, & Francis, 2009; Laurant et al., 2005; Stanik-Hutt et al., 2013; Swan, Ferguson, Chang, Larson, & Smaldone, 2015). By doing so, this dissertation provided a more comprehensive understanding of PCN contributions to primary care than previous research. The analyses presented in this dissertation also examined three aspects of PCN care based on Orem's conceptualization of care – that is, the functions that PCNs perform, the roles in which they serve, and the diagnostic characteristics of their care recipients (Orem, Taylor, & Renpenning, 2001). Unlike prior studies that focused on PCN

care as the functions they perform, Orem's conceptualization of "care" provided a broader understanding of from the perspectives of both providers and those for whom they provide care.

Third, this dissertation expanded our understanding of PCNs' "substitute or usual provider" role, as well as the "supplemental" role of both PCNs and PCPs. Compared with previous studies that described these two roles of PCNs (Everett et al., 2013; Laurant et al., 2005), this dissertation went beyond by further examining the functions that PCNs perform under these two roles and comparing these roles for both PCNs and PCPs. Moreover, the analysis presented in Chapter 3 examined the care provided by PCNs in a supplemental role to PCPs, as well as the care provided by PCPs in a supplemental role to PCNs. This approach is unique in its examination and characterization of the supplemental roles of both PCNs and PCPs.

Fourth, this dissertation used the most current data available on PCNs across all analyses. The analysis conducted in Chapter 2 systematically reviewed the empirical studies published from 2011 to 2015 and captured some of PCNs' emerging contributions to primary care. Compared with previous literature reviews that only examined PCNs' contributions in traditional primary care settings (e.g., physician office, ambulatory care) (Stanik-Hutt et al., 2013; Swan et al., 2015), Chapter 2 reported new and expanded information on PCNs' evolving functions, roles, and contributions in nontraditional primary care settings, including patient-centered medical homes, transitional care, and PCN-led clinics. Likewise, the analyses conducted in both Chapters 3 and 4 extended prior research (collected before 2010) by using the most currently available data to examine PCN care and PCNP wages (Hooker &

Cipher, 2005; Hooker & Everett, 2012; Kuo et al., 2015; Ritsema, 2014). This enabled the examination of the most current state of PCN care and level of PCNP wages.

Fifth, this dissertation conducted advanced analyses of PCN care and PCNP wages compared with prior work. The analysis conducted in Chapter 3 used propensity score matching (PSM) to compare PCN and PCP care, which adjusted for the impacts of patient characteristics on whether they receive care from a PCN or a PCP. This analysis advanced our understanding of how PCN care is similar to and different from PCP care by controlling for patient characteristics, which was not possible with the methods and data used in previous studies. Moreover, this analysis categorized patients' diagnoses into a greater number of common chronic disease and patient diagnosis categories than those were used in previous studies (Deshefy-Longhi, Swartz, & Grey, 2008; Morgan, Abbott, McNeil, & Fisher, 2012), which focused on the diseases and diagnoses for whom PCNs and PCPs likely manage care today.

The analysis conducted in Chapter 4 also went beyond describing PCNPs' wages and comparing wages between PCNPs working in primary care settings with those working in specialty care settings to explore wage differences between these two groups. Specifically, this analysis used a four-step examination of wage differences by: 1) modeling wages for all PCNPs, which revealed a difference in wages for PCNPs working in primary care settings and those working in specialty care settings, after controlling for wage-generating and other relevant factors; 2) estimating separate models for PCNPs working in primary care and in specialty care settings and conducting a Chow test, which determined that there were structural differences in the two models estimated; 3) decomposing the wages for PCNPs working in primary care and specialty care settings to examine if differences were

attributable to wage-generating factors (i.e., endowment effects) or unexplained factors (i.e., coefficient effects); and 4) estimating the wage difference between these two groups of PCNPs. These steps demonstrated that a wage disparity does exist between PCNPs working in primary care and in specialty care settings, which could not be explained by wage-generating or human capital factors but was largely due to unexplained or unobserved factors. These findings help us better understand PCNP wages and the setting-based wage disparity that exists in the PCNP workforce. This analysis also went well beyond the descriptive work that had been reported in previous studies (Goolsby, 2006, 2009; Loman & Hung, 2007).

In summary, the strengths of this dissertation are its theoretical grounding, its extension of prior work, and the use of data and methods not used in prior research. This dissertation also contributes knowledge that expands our understanding of PCNs' contributions to primary care and the economic returns to their human capital.

### **Limitations of the Dissertation**

Despite its strengths, this dissertation has some limitations that are worth noting. ***In terms of PCNs' contributions to primary care***, this dissertation did not separately examine the contributions that PCNRNs and PCNPs made to primary care due to data limitations. Yet, PCNRNs and PCNPs clearly make different contributions to primary care because their human capital is different. Unfortunately, combining these two categories of PCNs limits our understanding of how each contributes to primary care. In the analysis presented in Chapter 2, it was not possible to separately examine PCNRNs and PCNPs because there was an insufficient number of studies to review for either PCNRNs or PCNPs in the time period, and many of the studies reviewed did not separately examine PCNRNs and PCNPs. Also, it was

not possible to separately examine PCNRs and PCNPs in the analysis presented in Chapter 3 because these two categories of the nursing workforce were combined in the MEPS datasets.

In terms of *PCN care*, this dissertation was not able to fully examine PCNs' functions. For example, the literature review presented in Chapter 2 included but could not examine PCNs' "other" functions (the fifth category of PCNs' functions described in Chapter 2). This is because there was no study found that reported such functions. Moreover, the functions examined in Chapter 3 focused on therapeutic care, diagnostic care, and biomedical treatments but data were not available to examine how other functions of PCNs and PCPs are similar to and different from each other, including functions such as care management, health promotion, and disease prevention. This limitation was, again, due to data limitations and the difficulty in using a secondary data analysis design – that is, the MEPS datasets do not include a wider range of functions that PCNs and PCPs perform.

This dissertation also was not able to closely examine PCNs' "other" role, which included the functions that PCNs perform and the diagnostic characteristics of care recipients that PCNs manage under this role. This is because only a small number of studies reviewed in Chapter 2 examined this PCN role, which made it difficult to reach any conclusions about their performance in this role. Also, the MEPS datasets used in Chapter 3 did not allow the construction and examination of this role of PCNs.

This dissertation also may not provide detailed information of the diagnoses that PCNs manage, because of the limitations imposed by using the 17 general diagnosis categories from the CCS file in the analysis in Chapter 3. These broad diagnostic categories did not allow an examination of the specific diagnoses that PCNs and PCPs managed during patient visits. However, the CCS file still provides comprehensive information of patient

diagnoses compared with other available national datasets at the time this dissertation was conducted.

*In terms of the economic returns to PCNs' human capital*, this study was limited by the use of a secondary data analysis design. First, there may be some measurement errors in the variables extracted from NSSNP dataset. For instance, the hourly wage was calculated by using NPs' annual earnings divided by the product of the hours they worked per week and the weeks they worked per year, which may not be accurate. This is because the NSSNP does not collect the data on how many weeks a NP worked per year (52 weeks were assumed). Also, the data of annual earnings may not accurately reflect the earnings of a NP because they were self-reported.

Second, there may also be some important variables that were omitted from the analyses, because they were unavailable in the NSSNP. For instance, there may be other factors shown to be a determinant of wages in prior research but were not included in the wage modeling because they are not available in NSSNP, such as whether PCNPs have children at home and the percent of billing for PCNP practice (Jones & Gates, 2004; Spetz, Skillman, & Andrilla, 2016). Having said that, the NSSNP is the most current and comprehensive NP dataset relative to other national datasets at the time this dissertation was conducted.

Overall, these limitations suggest that additional research is needed to more fully examine PCNs' contributions to primary care and the economic returns to their human capital. The following section will discuss the recommendations for future research.

## **Recommendations for Future Research**

The findings from this dissertation point to several research recommendations. To further our understanding of *PCNs' contributions to primary care*, first, studies are needed that examine PCRNs and PCNPs separately to distinguish their unique contributions to primary care and to inform the utilization of these two different types of PCNs. Such research could highlight the different contributions that both PCRNs and PCNPs make to primary care and suggest how PCRN and PCNP human capital and care may be better assigned to collaborate and complement each other in practice.

Second, more research is needed to address the gaps uncovered in this dissertation related to PCN care. In terms of PCNs' functions, it will be important to examine PCNs' "other" activities, including quality improvement, administrative activities, teaching, and research. These activities may be important components of PCNs' functions in the future and also important for the delivery of primary care. Further research is also needed to explore PCNs' "other" role, especially the functions that PCNs perform and the patient populations they manage under this role. Studies that use qualitative approaches to examine PCNs' perceptions of the care they provide, including their roles and functions, may also help further define and explain PCNs' contributions to primary care.

Third, a comprehensive analysis of PCN and PCP care should include more types of functions and more specific information about patients' diagnoses than those examined in this dissertation. A more inclusive comparison of PCN and PCP functions would examine additional PCN functions described in the literature, including care management, care coordination, care collaboration, health promotion, administrative activities, and quality improvement (Haas et al., 2013). More detailed information about the patients and the



specific diagnostic groups that PCNs and PCPs manage is also needed to better understand the patient populations for whom PCNs and PCPs provide care. For example, examining the top diagnoses that PCNs and PCPs manage under each on the 17 general categories using CCS file may provide more detailed information of what specific diseases that PCNs and PCPs manage. Additionally, future study should examine what kinds of functions and tasks that are currently performed by PCPs but can be shifted to PCNs (e.g., tasks related to disease prevention and health promotion) and the extent to which this shifting can be made.

Fourth, research addressing the knowledge gaps related to the outcomes of PCN care, especially safety, timeliness, efficiency, and equity, is also needed. For example, PCNs trained to provide culturally responsive care could help eliminate disparities in the care delivered to different groups of patients by recognizing and addressing implicit bias when it occurs (Josiah Macy Jr. Foundation, 2016). However, few studies have examined how PCNs contribute to the timeliness and equity of primary care. Examining these and other outcomes is important for improving patients' access to care and understanding PCN's unique contributions to primary care.

Fifth, further research is needed to examine PCNs' contributions to nontraditional primary care settings and models of care, including PCN-led clinics, patient-centered medical homes, transitional care, and accountable care organizations. Although some studies have examined PCNs' contributions in these settings and care models, there is a lack of a scrutiny of the new functions PCNs perform, the emerging roles they fill, the patient populations they manage, and their impacts on the quality of care in these new models of care. Little is known about how PCNs collaborate with other professionals or coordinate care in order to provide care appropriately and reduce costs. Understanding PCNs' contributions to nontraditional

primary care settings and care models is important to inform how to optimize the utilization of PCNs' in the changing health care system and to shape the delivery of primary care in the future.

To further expand our understanding of the *economic returns to PCNs' human capital*, additional research is needed to explore the factors that were not included in this dissertation but may influence PCNP wages. For example, because PCNP wages in this dissertation were associated with the degree of PCNP practice independence, further research is needed to examine whether PCNP wages vary based on the state-level scope of practice laws and regulations. Moreover, the reimbursement policies of third-party payers may also influence PCNP wages, which suggests that research is needed to examine whether PCNP wages vary with different payment policy. Improving our understanding of how these and other factors affect PCNP wages is important to more accurately measure and predict PCNP wages.

Moreover, future research is needed to more accurately examine and measure PCNPs' human capital and the economic returns to their human capital. Except PCNPs' education level and years of experience that were included in Chapter 4, other indicators may also reflect PCNPs' human capital, such as good communication skills and a "can-do" ability (Spetz, 2016). Because these characteristics are difficult to measure, efforts to specifically gather these data or develop appropriate instrumental variables are therefore needed to explore how different aspects of PCNPs' human capital can be assessed. PCNPs' wages may also not fully reflect their productivity in primary care, even though wages are typically used as a proxy of the economic returns to human capital. Thus, exploring other measures of PCNPs' productivity that may be more sensitive to their work in primary care is needed. For

instance, using relative value units divided by the full-time equivalent of PCNPs may be a better indicator of PCNPs' productivity (Moran et al., 2016).

Researchers should also collaborate with educators, organizational managers, federal agencies and policymakers to further develop, collect, and organize PCN workforce data and improve other datasets that are helpful for examining PCN workforce. Such efforts are needed to overcome the limitations of the current available national datasets. Based on the analyses conducted in this dissertation, several recommendations can be made: data are needed on PCNRNs and PCNPs that allows for the examination of each group separately; data on the PCN workforce should include more detailed information on PCN practice, including the characteristics of their practice setting (e.g., size, type, location, number of practitioners), how they are paid (e.g., by annual salary or by the percent of billing and if the latter, the percentage of billing required), the care they provide (e.g., the functions performed, the roles filled, and the patients managed), the patient populations they manage, and the patient outcomes they achieve. These efforts to improve data collection will help overcome the limitations of the current datasets on the PCN workforce, further our understandings of PCNs' contributions, and inform their utilization in the future primary care system.

### **Implications for Organizational Leaders, Educators, and Policymakers**

The findings of this dissertation call attention to the importance of PCNs in the U.S. primary care system. The following section discusses the strategies that organizational leaders, educators, and policymakers may consider to improve the utilization of PCNs in practice, education, and regulatory areas.

## **PCN Practice**

The findings from this dissertation suggested that PCNs provided important care and improve the quality of primary care. This information is important for managers of primary care organizations who may want to create work environments, models of care delivery, and structures and policies in their organizations that best utilize PCNs' human capital.

One of this study's findings is that PCNs perform a wide range of functions in primary care. In order to balance their time among these functions, a supportive and creative system is needed that allows PCNs to meet their different patient care obligations. PCNs in the current system spend more time on triaging patients but less time on care management, care coordination, care collaboration, care transition, disease prevention and health promotion, all areas of high importance in primary care today (Josiah Macy Jr. Foundation, 2016). Managers should create systems that allow and encourage PCNs to perform all of these functions because they have the general and specific human capital to do so.

This dissertation also found that PCNs performed the functions of diagnostic care and biomedical treatment (e.g., prescription and procedure) but were less likely to do these than PCPs. This suggests that barriers exist and prevent PCNs from practicing to their full scope of practice. For example, even when state law supports full practice authority, PCNs may still not be allowed by their organizations to make clinical decisions independently, such as ordering laboratory tests or other diagnostic exams, referring patients to physicians, or prescribing medicines. These restrictions of PCNs' practice affect their productivity and limit their contribution to primary care (Poghosyan, Nannini, & Clarke, 2013). Therefore, managers of primary care practices should identify and reduce barriers for PCN practice by

reviewing and changing their organizational structure and policies and by providing a supportive environment to encourage more autonomous practice for PCNs.

The findings of this dissertation reported that PCNs served substitute/usual provider and supplemental roles in the primary care system. Managers should thus consider how models of care could be reconfigured to support these PCNs' roles. For example, the findings of this dissertation indicated that PCNs might substitute for PCPs in administering therapeutic care and providing patient counselling. Creating opportunities for PCNs to serve in a substitute role for PCPs to perform these functions will therefore enhance their roles.

This dissertation also found that PCN care and PCP care were appropriately supplemental to each other. This suggests that managers should explore how to better integrate PCN care with PCP care so that PCNs can fully serve in a supplemental role. For example, promoting interprofessional conversations and communication may help PCPs and other professionals better understand PCNs' work and contributions to patient care (Buerhaus et al., 2014). Also, some tasks that are performed by PCPs may be more appropriately shifted to PCNs. For example, this dissertation reported that PCNs' functions were focused on patient assessment, care management, care transition, and care collaboration under a supplemental role. This may inform managers throughout the health care system to support PCNs leading care delivery for such activities as pre-visit planning, engaging patients and their caregivers, helping care transitions across settings, managing patients' follow-up visits, collaborating care delivery across care providers, and coordinating care among professionals, patients, and their family (Josiah Macy Jr. Foundation, 2016).

Fourth, the findings of this dissertation indicated that PCNs managed a variety of diseases and provide care for patients with similar diseases as those managed by PCPs under

a substitute role. Therefore, managers are encouraged to assign patients with various diseases to PCNs in order to fully utilize their human capital. Moreover, this dissertation reported that PCNs were more likely to manage patients with chronic disease under a supplemental role. This may inform managers to improve the utilization of PCNs in managing chronic diseases and serving a supplemental role to extend patient care. PCNs not only possess general human capital to manage the care of different diseases, but also some of them have the specific human capital to manage patients with chronic disease (Josiah Macy Jr. Foundation, 2016). For example, some PCNs are specialized in managing diabetes, hypertension, and asthma. Therefore, efforts such as engaging PCNs in a multidisciplinary team care will improve the utilization of PCNs' human capital and promote better management of patient diseases.

### **PCN Education**

The findings of this dissertation suggest that PCNs make important contributions to primary care in terms of performing wide-ranging functions, serving various roles, managing the care for a myriad of patient populations, and improving the quality of care. These findings indicate that the education and training for both currently practicing PCNs and nursing students should be closely aligned to reflect these important PCN contributions (Bodenheimer & Bauer, 2016).

This dissertation reported that PCNs performed various functions and particularly focused on patient assessment, care management, health promotion, and disease prevention. Unfortunately, most of the current nursing programs do not educate or train their students on performing such important primary care functions; instead, the programs are largely focused on the functions relative to acute care (Bodenheimer et al., 2015). Leaders of nursing educational programs (e.g., pre-licensure or RN-BSN education programs) should make

efforts to reform their programs to ensure that nursing students are well prepared to perform these important functions in primary care. In order to further reflect and strengthen these critical components of primary care, educators and policymakers should also work together to include these components in the National Council Licensure Examination (Fraher et al., 2015). Moreover, continuing education should be available for the currently practicing PCNs to increase their human capital of performing emerging functions such as care management, interprofessional collaboration, care coordination, and care transition (Fraher et al., 2015).

Besides didactic education, nursing students also should be given more opportunities to be trained in clinical practice in the primary care system. This dissertation reported that PCNs managed patients with various diseases, which may indicate that future PCNs should be prepared to manage different diseases in practice. However, others have noted that nursing students lack clinical experiences in primary care due to the lack of clinical placements and preceptors (Forsberg, Swartwout, Murphy, Danko, & Delaney, 2015). Strengthening the partnership between nursing education programs and clinical practice could potentially increase nursing students' experience in primary care settings. For example, the *Patient Protection and Affordable Care Act* (PPACA) funded Graduate Nursing Education demonstration projects supported nursing clinical training and facilitated graduate nursing programs through securing clinical placements for their students in primary care settings (Centers for Medicare & Medicaid Services, 2012). One-year residency programs are also helpful in training new graduates to take charge of a panel of patients and to transition from school to clinical practice (Bodenheimer & Bauer, 2016). Therefore, policymakers, nursing educators and leaders in primary care practices should collaborate to expand such efforts and

also consider other strategies to establish more opportunities for PCNs' clinical training in primary care settings.

The findings of this dissertation also indicated that PCN care and PCP care were appropriately supplemental to each other. In order to better prepare PCNs and PCPs for collaborating with each other, this finding suggests that PCNs and PCPs' should be trained in the context of interprofessional education, so that both medical and nursing students are engaged in class discussions and clinical practice. For the currently practicing PCNs, leaders of nursing educational programs and primary care practices may want to consider developing partnership and creating clinical interprofessional opportunities, such as integrating PCNs and PCPs to work with a shared panel of patients together (Josiah Macy Jr. Foundation, 2016).

### **PCN Regulation**

Although the findings of this dissertation emphasize PCNs' important contributions to primary care, the current regulation of PCN practice may not support PCNs making their contributions to the fullest. This dissertation found that PCNs performed the functions of making diagnoses, ordering and interpreting diagnostic tests, and prescribing as PCPs but were less likely to do these activities than PCPs. Physicians' resistance to allowing PCNs to perform these services is suggested as one of the barriers to supporting and expanding PCNs' independent practice (Iglehart, 2013). Expanding PCNs' independent practice not only can fully utilize PCNs' human capital but also can relieve some of physicians' workload, freeing the physician to be more productive and efficient in managing patients who more highly need their care (Pohl, Thomas, Barksdale, & Werner, 2016). Also, it is a waste of PCNs' human capital if they are educated and trained to provide these services but are not allowed to do so



in clinical practice. Therefore, policymakers and regulators need to review PCN scope of practice regulations and remove barriers that prohibit the full utilization of PCNs' human capital.

Reforming PCN payment policy – that is, improving the reimbursement policy of their care – is also necessary to promote the full utilization of PCNs, especially as the payment model shifts from a fee-for-service to a value-based system. This dissertation reported that PCNs' functions were focused on care management, care collaboration, care coordination, disease prevention, and health promotion, but PCNs are not being reimbursed for providing these services by some third-party payers or in some regions (Yee et al., 2013). The current payment policy does not allow tracking of PCN care, does not encourage independent billing for PCN care, and cannot distinguish PCNs' contributions to primary care with those of other professionals, making PCNs “invisible” in the primary care system (Poghosyan et al., 2013). This dissertation also found that a wage disparity exists between PCNPs working in primary care and specialty care settings. One possible reason for this wage disparity is that PCNP working in primary care are reimbursed less than those working in specialty care (Chapman et al., 2010). Therefore, it is recommended that policymakers, clinicians, organizational leaders, and educators work together to identify PCN care that is vital to patient health and to assess how PCN care should be reimbursed to reflect PCNs' important contributions to primary care. Such efforts will support PCNs delivering their care, perhaps minimize the wage disparities between primary care and specialty care, and further maintain and improve the supply of PCNs in the primary care system (Barnes et al., 2016)

Finally, because this dissertation reported that PCNs made important contributions to the quality of care in patient-centered medical homes and PCN-led clinics, it suggests that

continued funding support is particularly needed to encourage and support PCN practice in these settings or care models. For example, the PPACA originally authorized \$50 million to support nurse-managed health centers (NMHCs) in 2010, but only \$15 million was released to 10 such centers; this funding was not renewed in the next following years. PCNs in NMHCs can improve access to primary care, examine patient's physical and psychosocial health, assess patients' living environments, and provide care that is highly needed by the population, especially for underserved people (Hansen-Turton, 2012). Continued funding support, therefore, is required for developing these models of care (Carthon, Barnes, & Sarik, 2015a; Esperat, Hanson-Turton, Richardson, Tyree Debisette, & Rupinta, 2012). Supporting PCN practice in these care models may also require the reform of PCNs' scope of practice laws and payment policies in order to optimize their practice in these settings.

### **Conclusion**

This dissertation examined PCNs' contributions to the U.S. primary care system and their wages by conducting three independent analyses. The first analysis systematically reviewed PCN's contributions to primary care, including the care they provided via their functions, roles, and the patient populations for whom they provided care, and the quality of their care. The second analysis compared the care provided by PCNs and PCPs in terms of their functions, roles, and the diagnostic characteristics of their care recipients. The third paper compared the wages of PCNPs working in primary care settings with the wages of PCNPs working in specialty care settings.

The findings of these analyses suggest that PCNs perform a wide range of functions, and serve in a substitute (i.e., usual provider) role, a supplemental role, and in other roles in the primary care system. The findings from this work also indicate that PCNs manage

patients with a variety of diseases and diagnoses. PCNs also make important contributions that improve the effectiveness and patient-centeredness of primary care. PCN care, to some extent, overlaps with PCP care, and PCNs and PCPs both serve in supplemental roles to each other. PCNPs working in primary care settings also earned, on average, less than PCNPs working in specialty care settings, and these wage disparities were not associated with their wage-generating characteristics, or their human capital, but were largely due to unobserved or unexplained factors.

Information gleaned from this dissertation demonstrates PCNs' importance in the U.S. primary care system and sheds light on future research focusing on PCNs' contributions to primary care and the economic returns to their human capital. Organizational leaders, educators, and policymakers are also called on to better utilize PCNs' human capital in the changing primary care system in order to improve patients' experiences in primary care, enhance the health of the population, and reduce health care costs.

## APPENDIX 2.1: A LIST OF REVIEWED STUDIES IN CHAPTER 2

1. Bao, Y., Shao, H., Bruce, M. L., & Press, M. J. (2014). Antidepressant Medication Management Among Older Patients Receiving Home Health Care. *Am J Geriatr Psychiatry*. doi:10.1016/j.jagp.2014.07.001
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## APPENDIX 2.2: THE QUALITY SCORING OF REVIEWED STUDIES IN CHAPTER 2

### *Manual for Quality Scoring of Quantitative Studies\**

#### *Definitions and Instructions for Quality Assessment Scoring*

##### **How to calculate the summary score:**

**Total sum** = (number of “yes” x 2) + (number of “partials” x 1)

**Total possible sum** = 28 – (number of “N/A” \* 2)

**Summary score** = Total Sum Score / Total Possible Sum Score

#### **Quality assessment:**

Items	Criteria			
	Yes (score=2)	Partial (score=1)	No (score=0)	N/A
1. <i>Question or objective sufficiently described?</i>	Is easily identified in the introductory section (or first paragraph of methods section). Specifies (where applicable, depending on study design) <i>all</i> of the following: purpose, subjects/target population, and the <i>specific</i> intervention(s) /association(s)/descriptive parameter(s) under investigation. A study purpose that only becomes apparent after studying other parts of the paper is <i>not</i> considered sufficiently described.	Vaguely/incompletely reported (e.g. “describe the effect of” or “examine the role of” or “assess opinion on many issues” or “explore the general attitudes”...); <i>or</i> some information has to be gathered from parts of the paper other than the introduction/background/objective section.	Question or objective is not reported, or is incomprehensible.	Should not be checked for this question.
2. <i>Design evident and appropriate to answer study question? (If the study question is not given, infer from the conclusions).</i>	Design is easily identified and is appropriate to address the study question / objective.	Design and /or study question not clearly identified, but gross inappropriateness is not evident; <i>or</i> design is easily identified but only partially addresses the study question.	Design used does not answer study question (e.g., a comparison group is required to answer the study question, but none was used); <i>or</i> design cannot be identified.	Should not be checked for this question.

<p>3. <i>Method of subject selection (and comparison group selection, if applicable) or source of information/input variables (e.g., for decision analysis) is described and appropriate.</i></p>	<p>Described and appropriate. Selection strategy <i>designed</i> (i.e., consider sampling frame and strategy) to obtain an unbiased sample of the relevant target population or the entire target population of interest (e.g., consecutive patients for clinical trials, population-based random sample for case-control studies or surveys). Where applicable, inclusion/exclusion criteria are described and defined (e.g., “cancer” -- ICD code or equivalent should be provided). <i>Studies of volunteers</i>: methods and setting of recruitment reported. <i>Surveys</i>: sampling frame/strategy clearly described and appropriate.</p>	<p>Selection methods (and inclusion/exclusion criteria, where applicable) are not completely described, but no obvious inappropriateness. Or selection strategy is not ideal (i.e., likely introduced bias) but did not likely seriously distort the results (e.g., telephone survey sampled from listed phone numbers only; hospital based case-control study identified all cases admitted during the study period, but recruited controls admitted during the day/evening only). Any study describing participants only as “volunteers” or “healthy volunteers”. <i>Surveys</i>: target population mentioned but sampling strategy unclear.</p>	<p>No information provided. Or obviously inappropriate selection procedures (e.g., inappropriate comparison group if intervention in women is compared to intervention in men). Or presence of selection bias which likely seriously distorted the results (e.g., obvious selection on “exposure” in a case-control study).</p>	<p>Descriptive case series/reports.</p>
<p>4. <i>Subject (and comparison group, if applicable) characteristics or input variables/information (e.g., for decision analyses) sufficiently described?</i></p>	<p>Sufficient relevant baseline/demographic information clearly characterizing the participants is provided (or reference to previously published baseline data is provided). Where applicable, reproducible criteria used to describe/categorize the participants are clearly defined (e.g., ever-smokers, depression scores, systolic blood pressure &gt; 140). If “healthy volunteers” are used, age and sex must be reported (at minimum). <i>Decision analyses</i>: baseline estimates for input variables are clearly specified.</p>	<p>Poorly defined criteria (e.g. “hypertension”, “healthy volunteers”, “smoking”). Or incomplete relevant baseline / demographic information (e.g., information on likely confounders not reported). <i>Decision analyses</i>: incomplete reporting of baseline estimates for input variables.</p>	<p>No baseline / demographic information provided. <i>Decision analyses</i>: baseline estimates of input variables not given.</p>	<p>Should not be checked for this question.</p>

5. <i>If random allocation to treatment group was possible, is it described?</i>	True randomization done - requires a description of the method used (e.g., use of random numbers).	Randomization mentioned, but method is not (i.e. it may have been possible that randomization was not true).	Random allocation not mentioned although it would have been feasible and appropriate (and was possibly done).	Observational analytic studies. Uncontrolled experimental studies. Surveys. Descriptive case series / reports. Decision analyses.
6. <i>If interventional and blinding of investigators to intervention was possible, is it reported?</i>	Blinding reported.	Blinding reported but it is not clear who was blinded.	Blinding would have been possible (and was possibly done) but is not reported.	Observational analytic studies. Uncontrolled experimental studies. Surveys. Descriptive case series / reports. Decision analyses.
7. <i>Outcome and (if applicable) exposure measure(s) well defined and robust to measurement / misclassification bias? Means of assessment reported?</i>	Defined (or reference to complete definitions is provided) and measured according to reproducible, “objective” criteria (e.g., death, test completion – yes/no, clinical scores). Little or minimal potential for measurement / misclassification errors. Surveys: clear description (or reference to clear description) of questionnaire/interview content and response options. Decision analyses: sources of uncertainty are defined for all input variables.	Definition of measures leaves room for subjectivity, or not sure (i.e., <input type="checkbox"/> not reported in detail, but probably acceptable). Or precise definition(s) are missing, but no evidence or problems in the paper that would lead one to assume major problems. Or instrument/mode of assessment(s) not reported. Or misclassification errors may have occurred, but they did not likely seriously distort the results (e.g., slight difficulty with recall of long-ago events; exposure is measured only at baseline in a long cohort study). Surveys: description of questionnaire/interview content incomplete; response options unclear. Decision analyses: sources of uncertainty are defined only for some input variables.	Measures not defined, or are inconsistent throughout the paper. Or measures employ only ill-defined, subjective assessments, e.g. “anxiety” or “pain.” Or obvious misclassification errors/measurement bias likely seriously distorted the results (e.g., a prospective cohort relies on self-reported outcomes among the “unexposed” but requires clinical assessment of the “exposed”). Surveys: no description of questionnaire/interview content or response options. Decision analyses: sources of uncertainty are not defined for input variables.	Descriptive case series / reports.
8. <i>Sample size appropriate?</i>	Seems reasonable with respect to the outcome under study and the study design. When statistically significant results	Insufficient data to assess sample size (e.g., sample seems “small” and there is no mention of power/sample size/effect size of interest and/or variance	Obviously inadequate (e.g., statistically non-significant results and standard errors > 1/2 effect size; or standard	Most surveys (except surveys comparing responses between groups or change over

	are achieved for major outcomes, appropriate sample size can usually be assumed, unless large standard errors (SE > 1/2 effect size) and/or problems with multiple testing are evident. <i>Decision analyses:</i> size of modeled cohort / number of iterations specified and justified.	estimates aren't provided). <i>Or</i> some statistically significant results with standard errors > 1/2 effect size (i.e., imprecise results). <i>Or</i> some statistically significant results in the absence of variance estimates. <i>Decision analyses:</i> incomplete description or justification of size of modeled cohort / number of iterations.	deviations > _ of effect size; or statistically non-significant results with no variance estimates and obviously inadequate sample size). <i>Decision analyses:</i> size of modeled cohort / number of iterations not specified.	time). Descriptive case series / reports.
9. <i>Analysis described and appropriate?</i>	Analytic methods are described (e.g. "chi square"/ "t-tests"/ "Kaplan-Meier with log rank tests", etc.) and appropriate.	Analytic methods are not reported and have to be guessed at, but are probably appropriate. <i>Or</i> minor flaws or some tests appropriate, some not (e.g., parametric tests used, but unsure whether appropriate; control group exists but is not used for statistical analysis). <i>Or</i> multiple testing problems not addressed.	Analysis methods not described and cannot be determined. <i>Or</i> obviously inappropriate analysis methods (e.g., chi-square tests for continuous data, SE given where normality is highly unlikely, etc.). <i>Or</i> a study with a descriptive goal / objective is over-analyzed.	Descriptive case series / reports.
10. <i>Some estimate of variance (e.g., confidence intervals, standard errors) is reported for the main results/outcomes (i.e., those directly addressing the study question/ objective upon which the conclusions are based)?</i>	Appropriate variances estimate(s) is/are provided (e.g., range, distribution, confidence intervals, etc.). <i>Decision analyses:</i> sensitivity analysis includes all variables in the model.	Undefined "+/-" expressions. <i>Or</i> no specific data given, but insufficient power acknowledged as a problem. <i>Or</i> variance estimates not provided for all main results/outcomes. <i>Or</i> inappropriate variance estimates (e.g., a study examining change over time provides a variance around the parameter of interest at "time 1" or "time 2", but does not provide an estimate of the variance around the difference). <i>Decision analyses:</i> sensitivity analysis is limited, including only some variables in the model.	No information regarding uncertainty of the estimates. <i>Decision analyses:</i> No sensitivity analysis.	Descriptive case series / reports. Descriptive surveys collecting information using open-ended questions.
11. <i>Controlled for confounding?</i>	Randomized study, with comparability of baseline characteristics reported (or non-comparability controlled	Incomplete control of confounding. <i>Or</i> control of confounding reportedly done but not completely described. <i>Or</i> randomized study without report of	Confounding not considered, and may have seriously distorted the results. <i>Decision analyses:</i>	Cross-sectional surveys of a single group (i.e., surveys examining change

	for in the analysis). <i>Or</i> appropriate control at the design or analysis stage (e.g., matching, subgroup analysis, multivariate models, etc.). <i>Decision analyses:</i> dependencies between variables fully accounted for (e.g., joint variables are considered).	comparability of baseline characteristics. <i>Or</i> confounding not considered, but not likely to have seriously distorted the results. <i>Decision analyses:</i> incomplete consideration of dependencies between variables.	dependencies between variables not considered.	over time or surveys comparing different groups should address the potential for confounding). Descriptive studies. Studies explicitly stating the analysis is strictly descriptive/exploratory in nature.
12. Results reported in sufficient detail?	Results include major outcomes and all mentioned secondary outcomes.	Quantitative results reported only for some outcomes. <i>Or</i> difficult to assess as study question/objective not fully described (and is not made clear in the methods section), but results seem appropriate.	Quantitative results are reported for a subsample only, or “n” changes continually across the denominator (e.g., reported proportions do not account for the entire study sample, but are reported only for those with complete data -- i.e., the category of “unknown” is not used where needed). <i>Or</i> results for some major or mentioned secondary outcomes are only qualitatively reported when quantitative reporting would have been possible (e.g., results include vague comments such as “more likely” without quantitative report of actual numbers).	Should not be checked for this question.
13. Do the results support the conclusions?	All the conclusions are supported by the data (even if analysis was inappropriate). Conclusions are based on all results relevant to the study	Some of the major conclusions are supported by the data, some are not. <i>Or</i> speculative interpretations are not indicated as such. <i>Or</i> low (or unreported) response rates call into	None or a very small minority of the major conclusions are supported by the data. <i>Or</i> negative findings clearly due to low	Should not be checked for this question.

	question, negative as well as positive ones (e.g., they aren't based on the sole significant finding while ignoring the negative results). Part of the conclusions may expand beyond the results, if made <i>in addition to</i> rather than instead of those strictly supported by data, and if including indicators of their interpretative nature (e.g., "suggesting," "possibly").	question the validity of generalizing the results to the target population of interest (i.e., the population defined by the sampling frame/strategy).	power are reported as definitive evidence against the alternate hypothesis. <i>Or</i> conclusions are missing. <i>Or</i> extremely low response rates invalidate generalizing the results to the target population of interest (i.e., the population defined by the sampling frame/ strategy).	
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### APPENDIX 2.3: DESCRIPTIONS OF THE REVIEWED STUDIES

Author (Year)	Purpose	Setting	Method/ Design	Sample Size	Patients' Diagnoses
Bosworth et al. (2011)	To examine the intervention of home blood pressure management provided by MD and NPs versus MD alone	VA general internal medicine clinics	RCT	N=591 (control=147, intervention 1=148, intervention 2=149, intervention 3=147)	Hypertension
Boult et al. (2011)	To evaluate a team-based care intervention on older patients' use of health services provided by MD and RN versus MD alone	14 primary care teams in eight community-based primary care practices	RCT	N=850 (control =404, intervention=446)	Not specify
Fletcher et al. (2011)	(1) To compare the outcomes of NP care with those of MD care for patients with hypertension and/ or diabetes in VA health care system; and (2) to assess if NPs and MDs have different perceptions of NPs' role and scope of practice in VA.	VA clinics	Observational/ Cross-sectional national survey	N=104,226 (NP group=24,160; MD group=80,066)	Hypertension and diabetes
Ishani et al. (2011)	To examine whether nurse case management (combined with MD care) can effectively improve the control of hypertension, hyperglycemia, and hyperlipidemia	VA clinics	RCT	N=556 (intervention=278, control=278)	Diabetes
Jackson et al. (2011)	To examine whether including PAs and NPs with MDs in the U.S. VA primary care programs can improve diabetes control.	VA primary care programs at VA facilities	Observational/ Retrospective cohort study	N=88,682 (visits)	Diabetes
Limoges-Gonzalez et al. (2011)	To compare accuracy, safety, and patient satisfaction in screening colonoscopy performed by board certified gastroenterologists (GI-MD) and a gastroenterology trained nurse practitioner (GI-NP)	Free standing endoscopy center	RCT	N=150 (NP=50, MD=100)	Not specify



Ornstein et al. (2011)	To examine the feasibility, effectiveness, and costs of a transitional care program	A NP-led transitional care program embedded within an existing home-based primary care program	Observational	N=532	Not specify
Piette et al. (2011)	To evaluate the impact of a RN-led telephone-delivered cognitive behavioral therapy (CBT) targeting patients' management of depressive symptoms, physical activity levels, and diabetes-related outcomes.	Primary care clinics	RCT	N=291 (control=146, intervention=145)	Diabetes
Potts et al. (2011)	To understand how the Ohio Permanente medical group use NPs to support its primary care physicians and the outcomes of including NPs	Ohio Permanente medical group	Model simulation	varied with models	Not specify
Welch et al. (2011)	To evaluate the clinical usefulness of a nurse-led diabetes care program (Comprehensive Diabetes Management Program, CDMP) for poorly controlled Hispanic type 2 diabetes (T2DM) patients in an urban community health center setting.	Community health center	RCT	N=46 (control=21, treatment=25)	Diabetes
Wright et al. (2011)	To assess BP control between patients managed by NPs versus physicians.	Three NP-based clinics and 21 PCPs-based clinics	Observational/Retrospective chart review	N=1246 (physician group=623, NP group=623)	Hypertension
Brokel et al. (2012)	To examine the outcomes of chronically ill patients receiving community-based case management services from RNs and NPs	Home and primary care clinics	Observational	N=512	Not specify

Condosta (2012)	To examine if a NP-run free diabetic clinic can improve diabetes control	NP-run diabetic clinic	Observational/ Retrospective chart review	NP group=262, MD group=52	Diabetes
Fischer et al. (2012)	To evaluate an intervention of a RN-led telephone care on improving the lipid control in patients with diabetes, compared with those only cared by MDs	Community health center	RCT	N=792 (intervention=381, control=381)	Diabetes
Glendenning-Napoli et al. (2012)	To examine the effects of a RN-led community-based case management program on acute health care utilization and associated costs in uninsured patients with 1 or more chronic diseases.	Community health program in an academic health center	Observational/ Retrospective	N=83	Diabetes, hypertension, congestive heart failure, or coronary artery disease
Lin et al. (2012)	To evaluate a RN-led intervention on improving medication adherence, consistent patient-self-monitoring, and treatment adjustment.	14 Group Health primary care clinics	RCT	N=181 (Intervention=90, control=91)	Diabetes, coronary heart disease, and depression
Liu & D'Aunno (2012)	To evaluate the productivity and cost-efficiencies of including NPs with MDs in primary care practices.	Not applicable	Model simulation	varied with models (Model I: 2380-2440 patients; Model II and III: 2400-4600 patients)	Not specify
Rohrer et al. (2012)	To compare the return visits within 2 weeks between patients visited NPs in retail clinics and patients visited MDs in standard medical office	Retail clinic	Observational/ Retrospective cohort study	N=1705 (retail clinic group=581; standard outpatient primary care clinics=1124)	Acute sinusitis
Bicki et al. (2013)	To evaluate a RN-led walk-in non-acute care clinic	Nurse-run walk-in clinic	Observational/ Retrospective cross-sectional analysis	N=256	Not specify
Blackmore et al. (2013)	To examine if a NP-staffed breast clinic can improve care timeliness and efficiency for women with	NP-staffed breast clinic	Observational/ Retrospective cohort	N=200 (Control=100 historical controls; using NP-staffed	Benign breast condition

	symptomatic benign breast conditions		evaluation	breast clinic=100)	
Bary et al. (2013)	To determine the effectiveness of a redesigned primary care model (MDs, RNs, and other professionals) on patients' glycemic, blood pressure, and lipid level control	Primary care clinics	Quasi-experiment	N=N=727 (control=359, intervention=368)	Diabetes
Cioe et al. (2013)	To compare the treatment outcomes of HCV between MDs and NPs	Two outpatient clinics	Observational/ Retrospective cohort study	N=155 (control=58, intervention=97)	HCV
Coburn et al. (2013)	To evaluate a community-based nursing intervention of a comprehensive, integrated, and tightly managed system of care coordination, disease management, and preventive services provided by community-based nurse care managers working collaboratively with primary care providers.	93 primary care practices	RCT	N=1736 (control=863; intervention=873)	Heart failure, coronary heart disease, asthma, diabetes, hypertension, or hyperlipidemia
Park et al. (2013)	To evaluate a NP-led intervention of transitional care at the time of skilled nursing facility (SNF) discharge.	Transitional care program	Quasi-experiment	N=351 (Pre=134; post=217)	Not specify
Purath et al. (2013)	To evaluate the efficacy and feasibility of a RN-led 24-week intervention on physical activity and physical fitness in a group of community-dwelling older adults	Nurse-managed clinic	RCT	N=72 (control=36, intervention=36)	Not specify
Reuben et al. (2013)	To evaluate a community-based PCP-NP comanagement program	Two community-based primary care practices	Quasi-experiment	N=485 (control=247; intervention=238)	Falls, urinary incontinence (UI), dementia, and /or depression.
Rohrer et al. (2013)	To compare the continuity of care between patients visited NPs in retail clinic and those who did not	Retail clinic	RCT	N=400 (using retail clinic=200; not using=200)	Not specify
Singh et al. (2013)	To compare the characteristics of	A large urban	Observational/	N=190	Not specify

	diagnostic errors between NPs and MDs in primary care settings	VA facility and four community-based clinics.	Retrospective medical record review		
Spetz et al. (2013)	To examine whether patients visited NPs in retail clinic was associated with ER visits, hospitalization, and cost saving;	Not applicable	Observational	N=9,503	Not specify
Tang (2013)	To evaluate a nurse-led intervention of online diabetes management	Primary care sites	RCT	N=415 (control=189, intervention=193)	Diabetes
Bao (2014)	To compare the two ways to antidepressant medication management: nurse-physician collaboration vs. physician alone	Home healthcare setting	Observational/ Retrospective/ Cross-sectional secondary data analysis	N=7,389	Depression
Boult et al. (2014)	To evaluate whether a nurse-led intervention of Guided Care can produce better quality of care and less costs, compared with MD care alone.	Eight Community-based primary care practices	RCT	N=477 (control=203; intervention=274)	Not specify
Dodge et al. (2014)	To evaluate a nurse-led intervention of a postnatal nurse home-visiting can prevent emergency health care services and improve parenting for 6 months infants, compared with MD care alone.	Home healthcare setting	RCT	N=531 (control=271, intervention=260)	Healthy infants
Edelman et al. (2014)	To assess the effectiveness of nurse behavioral management of diabetes and hypertension in community practices among patients with both diseases.	Nine primary care practices	RCT	N=377 (control=184; intervention=193)	Diabetes and hypertension
Fortinsky et al. (2014)	To determine the preliminary efficacy of PPDC on health-related outcomes in patients and their family caregivers; and to determine the acceptability of PPDC based on satisfaction expressed by physicians, patients, and caregivers.	Three primary care practices	Quasi-experiment	N=31 dyads (control=10, intervention=21)	Dementia

Gellis et al. (2014)	To evaluate a nurse-led integrated telehealth intervention to improve chronic illness (congestive heart failure, chronic obstructive pulmonary disease) and comorbid depression in the home healthcare setting.	Home healthcare setting	RCT	N=115 (control=58, intervention=57)	Heart failure, or COPD
Jarl et al. (2014)	To examine a NP-led intervention on changing diet and lifestyle of hypertension and obese patients.	A family medicine clinic	Quasi-experiment	N=26	Hypertension and obesity
Richardson et al. (2014)	To evaluate whether NPs in collaborative practices with MDs are effective in helping improve control of HbA1c, blood pressure, and LDL-C in adults with uncontrolled hyperglycemia, and to assess whether nurse practitioner-guided care affects depression and self-efficacy in these patients.	Two ambulatory internal medicine clinics in a managed care organization	Observational/prospective	N=26	Diabetes
Ridner et al. (2014)	To compare the effects of MD+RN with MD only care counseling approach on current smokers' behaviors, self-efficacy to quit smoking, and nicotine dependence.	Two primary care clinics	Quasi-experiment	N=60 (control=20, intervention 1=20, intervention 2=20)	Smokers
Tang (2014)	To evaluate a RN-led and primary-care based transitional care program	A transitional program embedded in a primary care practice	Observational	N=486	Not specify
Wagner et al. (2014)	To determine whether a nurse navigator intervention improves quality of life and patient experience with care	Group health in an integrated, nonprofit delivery system	RCT	N=251 (control=118, intervention=133)	Breast, colorectal, or lung cancer.
Berry et al. (2015)	To evaluate an interdisciplinary approach (MD+NP+RN+others) and test the efficacy of diabetes group visits	Community-based medical center	RCT	N=80 (control=80, intervention=80)	Diabetes

	tailored to low-income patients in a community-based medical practice.				
Biernacki et al. (2015)	To evaluate a care delivery model integrating RN into a patient-centered medical home (including MD + NP + PA + RN + Others)	Family practice	Observational	N=937	Diabetes
Bruce et al. (2015)	To determine whether a RN-led intervention have greater improvement in depressive symptoms during 1 year	Home healthcare setting	RCT	N=306 (control=121, intervention=185)	Depression
Engle et al. (2015)	To examine the effectiveness of a RN-led online cognitive-behavioral self-management intervention for war-related posttraumatic stress disorder (PTSD), compared to optimized usual primary care PTSD Treatment (OUC) to reduce PTSD symptoms	Three VA clinics and four Army clinics	RCT	N=80 (control=37, treatment=43)	War-related PTSD
Fortuna et al. (2015)	To examine the effectiveness of a patient-centered, multidisciplinary intervention (MD+RN+pharmacists) on blood pressure control	Internal medicine clinic	Observational	N=13,404	Hypertension
Kuo et al. (2015)	To compare processes and cost of care of older adults with diabetes mellitus cared for by NPs with processes and cost of those cared for by MDs.	Not applicable	Observational/ Retrospective cohorts study	N=64,354	Diabetes

## APPENDIX 2.4: THE FUNCTIONS AND ROLES OF PCNS IN THE REVIEWED STUDIES – PATIENT ASSESSMENT

Author (Year)	Role	Patient Assessment		
		Assess patient (e.g., symptoms, needs, and knowledge level)	Triage patient	Assess patient in follow-up visits
Fletcher et al. (2011)	Substitute			
Limoges-Gonzalez et al. (2011)	Substitute			
Wright et al. (2011)	Substitute	X		
Condosta (2012)	Substitute			
Cioe et al. (2013)	Substitute			X
Singh et al. (2013)	Substitute			
Kuo et al. (2015)	Substitute			
Bosworth et al. (2011)	Supplemental			
Boult et al. (2011)	Supplemental	X		X
Ishani et al. (2011)	Supplemental			
Jackson et al. (2011)	Supplemental			
Ornstein et al. (2011)	Supplemental			
Piette et al. (2011)	Supplemental			
Potts et al. (2011)	Supplemental			
Welch et al. (2011)	Supplemental			
Brokel et al. (2012)	Supplemental	X		
Fischer et al. (2012)	Supplemental			X
Glendenning-Napoli et al. (2012)	Supplemental	X		
Lin et al. (2012)	Supplemental			X
Liu & D'Aunno (2012)	Supplemental			
Bray et al. (2013)	Supplemental			
Coburn et al. (2013)	Supplemental	X		X
Park et al. (2013)	Supplemental			
Purath et al. (2013)	Supplemental			X

Reuben et al. (2013)	Supplemental			X
Tang (2013)	Supplemental			X
Bao (2014)	Supplemental	X		X
Boult et al. (2014)	Supplemental			
Dodge et al. (2014)	Supplemental	X		
Edelman et al. (2014)	Supplemental			
Fortinsky et al. (2014)	Supplemental	X		
Gellis et al. (2014)	Supplemental			
Jarl et al. (2014)	Supplemental			
Richardson et al. (2014)	Supplemental			
Ridner et al. (2014)	Supplemental			
Tang (2014)	Supplemental	X		
Wagner et al. (2014)	Supplemental			X
Berry et al. (2015)	Supplemental			
Biernacki et al. (2015)	Supplemental			
Bruce et al. (2015)	Supplemental			X
Engle et al. (2015)	Supplemental			
Fortuna et al. (2015)	Supplemental			
Rohrer et al. (2012)	Other			
Bicki et al. (2013)	Other		X	
Blackmore et al. (2013)	Other			
Rohrer et al. (2013)	Other			
Spetz et al. (2013)	Other			



## APPENDIX 2.5: THE FUNCTIONS AND ROLES OF PCNS IN THE REVIEWED STUDIES – DIAGNOSIS AND TREATMENT

Author (Year)	Role	Diagnosis and Treatment			
		Diagnose	Prescribe	Administer medication	Order, provide, and/or interpret lab tests
Fletcher et al. (2011)	Substitute				
Limoges-Gonzalez et al. (2011)	Substitute				X
Wright et al. (2011)	Substitute		X		
Condosta (2012)	Substitute				
Cioe et al. (2013)	Substitute		X	X	
Singh et al. (2013)	Substitute				
Kuo et al. (2015)	Substitute				
Bosworth et al. (2011)	Supplemental				
Boult et al. (2011)	Supplemental				
Ishani et al. (2011)	Supplemental				
Jackson et al. (2011)	Supplemental				
Ornstein et al. (2011)	Supplemental				
Piette et al. (2011)	Supplemental				
Potts et al. (2011)	Supplemental				
Welch et al. (2011)	Supplemental				
Brokel et al. (2012)	Supplemental				
Fischer et al. (2012)	Supplemental		X		
Glendenning-Napoli et al. (2012)	Supplemental				
Lin et al. (2012)	Supplemental				
Liu & D'Aunno (2012)	Supplemental				
Bray et al. (2013)	Supplemental				
Coburn et al. (2013)	Supplemental				
Park et al. (2013)	Supplemental			X	

Purath et al. (2013)	Supplemental		
Reuben et al. (2013)	Supplemental		
Tang (2013)	Supplemental		
Bao (2014)	Supplemental		
Boult et al. (2014)	Supplemental		
Dodge et al. (2014)	Supplemental		
Edelman et al. (2014)	Supplemental		
Fortinsky et al. (2014)	Supplemental		
Gellis et al. (2014)	Supplemental		
Jarl et al. (2014)	Supplemental		
Richardson et al. (2014)	Supplemental		X
Ridner et al. (2014)	Supplemental		
Tang (2014)	Supplemental		
Wagner et al. (2014)	Supplemental		
Berry et al. (2015)	Supplemental		
Biernacki et al. (2015)	Supplemental		
Bruce et al. (2015)	Supplemental		
Engle et al. (2015)	Supplemental		
Fortuna et al. (2015)	Supplemental		
Rohrer et al. (2012)	Other		
Bicki et al. (2013)	Other	X	X
Blackmore et al. (2013)	Other		X
Rohrer et al. (2013)	Other		
Spetz et al. (2013)	Other		

## APPENDIX 2.6: THE FUNCTIONS AND ROLES OF PCNS IN THE REVIEWED STUDIES – CARE MANAGEMENT

Author (Year)	Role	Care Management						
		Information exchange with PCPs, specialists, or other settings and systems	Develop plan of care (alone or with PCPs, specialists, and other professionals)	Implement and adjust plan of care	Discuss changes in patient's situation and care plan with PCPs, specialists, and other professionals and provide counseling regarding these changes	Schedule appointments with PCNs, PCPs, or other professionals	Follow up (e.g., monitor symptoms and adherence)	Refer patients to PCPs, specialists, or other settings
Fletcher et al. (2011)	Substitute							
Limoges-Gonzalez et al. (2011)	Substitute							
Wright et al. (2011)	Substitute							
Condosta (2012)	Substitute		X				X	
Cioe et al. (2013)	Substitute						X	
Singh et al. (2013)	Substitute							
Kuo et al. (2015)	Substitute							
Bosworth et al. (2011)	Supplemental			X	X		X	
Boult et al. (2011)	Supplemental	X		X	X		X	
Ishani et al. (2011)	Supplemental		X	X			X	
Jackson et al. (2011)	Supplemental							
Ornstein et al. (2011)	Supplemental	X					X	
Piette et al. (2011)	Supplemental			X				
Potts et al. (2011)	Supplemental							
Welch et al. (2011)	Supplemental	X	X		X			
Brokel et al. (2012)	Supplemental		X					

Fischer et al. (2012)	Supplemental					X		X
Glendenning-Napoli et al. (2012)	Supplemental		X			X	X	
Lin et al. (2012)	Supplemental		X				X	
Liu & D'Aunno (2012)	Supplemental							
Bray et al. (2013)	Supplemental		X	X	X			
Coburn et al. (2013)	Supplemental		X		X			X
Park et al. (2013)	Supplemental	X		X				
Purath et al. (2013)	Supplemental		X				X	
Reuben et al. (2013)	Supplemental						X	
Tang (2013)	Supplemental			X	X			
Bao (2014)	Supplemental	X			X			
Boult et al. (2014)	Supplemental	X	X		X		X	
Dodge et al. (2014)	Supplemental						X	X
Edelman et al. (2014)	Supplemental		X					
Fortinsky et al. (2014)	Supplemental	X	X		X			
Gellis et al. (2014)	Supplemental			X			X	
Jarl et al. (2014)	Supplemental						X	
Richardson et al. (2014)	Supplemental		X		X		X	X
Ridner et al. (2014)	Supplemental						X	
Tang (2014)	Supplemental			X	X	X	X	
Wagner et al. (2014)	Supplemental		X			X		
Berry et al. (2015)	Supplemental							
Biernacki et al. (2015)	Supplemental		X				X	
Bruce et al. (2015)	Supplemental		X	X	X			
Engle et al. (2015)	Supplemental						X	
Fortuna et al. (2015)	Supplemental				X	X	X	
Rohrer et al. (2012)	Other							
Bicki et al. (2013)	Other				X			
Blackmore et al. (2013)	Other							

Rohrer et al. (2013)	Other
Spetz et al. (2013)	Other

**APPENDIX 2.7: THE FUNCTIONS AND ROLES OF PCNS IN THE REVIEWED STUDIES – HEALTH PROMOTION AND DISEASE PREVENTION**

Author (Year)	Role	Health Promotion and Disease Prevention		
		Patient, family, or caregiver education and counseling	Cultural and social support	Immunization
Fletcher et al. (2011)	Substitute			
Limoges-Gonzalez et al. (2011)	Substitute			
Wright et al. (2011)	Substitute	X		
Condosta (2012)	Substitute	X		
Cioe et al. (2013)	Substitute	X		
Singh et al. (2013)	Substitute			
Kuo et al. (2015)	Substitute			
Bosworth et al. (2011)	Supplemental	X		
Boult et al. (2011)	Supplemental	X	X	
Ishani et al. (2011)	Supplemental			
Jackson et al. (2011)	Supplemental			
Ornstein et al. (2011)	Supplemental			
Piette et al. (2011)	Supplemental	X		
Potts et al. (2011)	Supplemental			
Welch et al. (2011)	Supplemental			
Brokel et al. (2012)	Supplemental			
Fischer et al. (2012)	Supplemental	X		X
Glendenning-Napoli et al. (2012)	Supplemental			
Lin et al. (2012)	Supplemental	X		
Liu & D'Aunno (2012)	Supplemental			
Bray et al. (2013)	Supplemental	X		
Coburn et al. (2013)	Supplemental	X		
Park et al. (2013)	Supplemental	X		

Purath et al. (2013)	Supplemental	X	X
Reuben et al. (2013)	Supplemental		
Tang (2013)	Supplemental	X	
Bao (2014)	Supplemental		
Boult et al. (2014)	Supplemental	X	
Dodge et al. (2014)	Supplemental		X
Edelman et al. (2014)	Supplemental		
Fortinsky et al. (2014)	Supplemental		
Gellis et al. (2014)	Supplemental	X	
Jarl et al. (2014)	Supplemental	X	
Richardson et al. (2014)	Supplemental	X	
Ridner et al. (2014)	Supplemental		
Tang (2014)	Supplemental		
Wagner et al. (2014)	Supplemental		
Berry et al. (2015)	Supplemental	X	
Biernacki et al. (2015)	Supplemental	X	
Bruce et al. (2015)	Supplemental	X	
Engle et al. (2015)	Supplemental	X	
Fortuna et al. (2015)	Supplemental	X	
Rohrer et al. (2012)	Other		
Bicki et al. (2013)	Other		
Blackmore et al. (2013)	Other	X	
Rohrer et al. (2013)	Other		
Spetz et al. (2013)	Other		

## APPENDIX 2.8: A COMPARISON BETWEEN THE STUDIES THAT REPORTED PCNS' FUNCTIONS WITH THE STUDIES THAT DID NOT REPORT PCNS' FUNCTIONS

	Reported Functions (N=38) (n)	Did Not Report Functions (N=9) (n)
<b>Study Population</b>		
PCRN	23	0
PCNP	11	9
PCRN and PCNP	4	0
<b>Study Design</b>		
RCT	19	1
Quasi-experimental	6	0
Observational	13	6
Model simulation	0	2
<b>Sample Size</b>		
Greater than 100	30	9
Smaller than 100	8	0
<b>Setting</b>		
Outpatient/ambulatory care/internal/family medicine clinics	11	0
Community health centers	8	0
PCN-led clinics	6	0
VA clinics	3	3
Group health clinics	3	2
Retail clinics	1	1
Free-standing endoscopy centers	1	0
Not applicable (e.g., using model simulation)	0	3
<b>Study Purpose</b>		
Examine a PCN-led intervention	18	3
Examine PCN care in non-traditional settings	13	0
Examine PCN-led clinics	4	3
Compare PCN care only with PCP care only	3	3
<b>Average Score of Study Quality</b>	0.91	0.95



**APPENDIX 2.9: A COMPARISON BETWEEN THE STUDIES THAT REPORTED PCNS' FUNCTIONS WITH THE STUDIES THAT DID NOT REPORT PCNS' FUNCTIONS BY PCN'S ROLES**

	Substitute (N=7) (n)		Supplemental (N=34) (n)		Other (N=6) (n)	
	Reported functions (n=4)	Did not report functions (n=3)	Reported functions (n=31)	Did not report functions (n=3)	Reported functions (n=3)	Did not report functions (n=3)
<b>Study Population</b>						
PCRN	0	0	20	0	1	0
PCNP	4	4	10	3	2	3
PCRN and PCNP	0	0	4	0	0	0
<b>Study Design</b>						
RCT	1	0	17	0	1	2
Quasi-experimental	0	0	4	0	0	0
Observational	3	4	9	1	2	1
Model simulation	0	0	0	2	0	0
<b>Sample Size</b>						
Greater than 100	4	4	25	3	2	3
Smaller than 100	0	0	6	0	1	0
<b>Setting</b>						
Outpatient/ambulatory care/internal/family medicine clinics	1	0	10	0	0	0
Community health centers	0	0	7	0	0	0
PCN-led clinics	2	0	0	0	3	3
VA clinics	0	1	4	1	0	0
Group health clinics	0	0	3	0	0	0
Retail clinics	0	0	0	0	0	0
Free-standing endoscopy centers	1	0	0	0	0	0
Not applicable (e.g., using model simulation)	0	1	0	2	0	0
<b>Study Purpose</b>						
Examine a PCN-led intervention	0	0	18	3	0	0
Examine PCN care in non-traditional settings	0	0	13	0	0	0
Examine PCN-led clinics	0	0	0	0	3	3

Compare PCN care only with PCP care only	4	3	0	0	0	0
<b>Average Score of Study Quality</b>	0.89	0.95	0.91	0.97	0.89	0.94

**APPENDIX 2.10: A COMPARISON BETWEEN THE STUDIES THAT REPORTED PATIENTS' DIAGNOSES WITH THE STUDIES THAT DID NOT REPORT PATIENTS' DIAGNOSES BY PCN'S ROLES**

	<b>Substitute (n=7)</b>		<b>Supplemental (n=34)</b>		<b>Other (n=6)</b>	
	Reported diagnoses (n=5)	Did not report diagnosis (n=2)	Reported diagnoses (n=26)	Did not report diagnosis (n=8)	Reported diagnoses (n=2)	Did not report diagnosis (n=4)
<b>Study Population</b>						
PCRN	0	0	17	3	1	2
PCNP	5	2	7	5	1	2
PCRN and PCNP	0	0	2	0	0	0
<b>Study Design</b>						
RCT	0	1	14	2	0	2
Quasi-experimental	0	0	5	1	0	0
Observational	5	1	6	0	2	2
Model simulation	0	0	1	2	0	0
<b>Sample Size</b>						
Greater than 100	5	2	19	8	2	4
Smaller than 100	0	0	7	0	0	0
<b>Setting</b>						
Outpatient/ambulatory care/internal/family medicine clinics	1	0	15	6	0	0
Community health centers	0	0	5	0	0	0
PCN-led clinics	2	0	0	0	1	2
VA clinics	1	1	4	0	0	0
Group health clinics	0	0	2	0	0	0
Retail clinics	0	0	0	0	1	2
Free-standing endoscopy centers	0	1	0	0	0	0
Not applicable (e.g., using model simulation)	1	0	0	2	0	0
<b>Study Purpose</b>						
Examine a PCN-led intervention	0	0	18	1	0	0
Examine PCN care in non-traditional settings	0	0	8	0	0	0
Examine PCN-led clinics	0	0	0	0	2	4
Compare PCN care only with PCP care only	5	2	0	0	0	0

<b>Average Score of Study Quality</b>	0.95	0.95	0.91	0.94	0.89	0.93
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# APPENDIX 2.11: THE OUTCOMES OF PCN CARE ORGANIZED BY THE SIX AIMS OF QUALITY OF CARE

Author (Year)	Purpose	Results	Safety	Effectiveness	Patient-centeredness	Timeliness	Efficiency
Bosworth et al. (2011)	To examine the intervention of home blood pressure management	All three intervention-groups had significant improvement of BP control than control groups; there was no significant difference in median 18-month total medical VA costs between intervention groups and control group.		X			X
Boult et al. (2011)	To evaluate a team-based care intervention on older patients' use of health services.	In short run, the intervention did not decrease the utilization of health services significantly, such as hospitalization, ER visits, primary care visits, and specialist visits; but it did reduce the episodes of home health utilization.		X			
Fletcher et al. (2011)	To compare the outcomes of NP care with those of MD care for patients with hypertension and/or diabetes in VA health care system	NPs and MDs had comparable outcomes on the elevated blood pressure and HbA1c.		X			

Ishani et al. (2011)	To examine whether nurse case management can effectively improve the control of hypertension, hyperglycemia, and hyperlipidemia	More patients in intervention group achieved their individual goals of HbA1c and blood pressure (but not for HDL), compared with patients in control group.		X			
Jackson et al. (2011)	To examine whether including PAs and NPs in the U.S. VA primary care programs can improve diabetes control.	Including NPs was associated with HbA1c lower by 0.31 percentage points.		X			
Limoges-Gonzalez et al. (2011)	To compare accuracy, safety, and patient satisfaction in screening colonoscopy performed by board certified GI-MD and a GI-NP	Cecal intubation rates, duration of procedure, sedative, and analgesic use, and patient reported procedural pain scores were similar between NP and MD group. NP group had a higher adenoma detection rate compared with MD groups and a higher satisfaction score than MD groups. There were no immediate complications reported in any group.	X		X		

Ornstein et al. (2011)	To examine the feasibility, effectiveness, and costs of a transitional care program	The transitional care program improved communication between home-based primary care providers and inpatient providers and improve the timely and accurate transfer of patient information. However, the program did not decrease hospital LOS and readmission rate.		X			
Piette et al. (2011)	To evaluate the impact of telephone-delivered cognitive behavioral therapy targeting patients' management of depressive symptoms, physical activity levels, and diabetes-related outcomes.	Intervention group had significant improvement on blood pressure but not on HbA1c. Intervention group had significant decreases on depressive symptoms and improvements on coping and quality of life.		X			
Potts et al. (2011)	To understand how the Ohio Permanente medical group use NPs to support its primary care physicians and the outcomes of including NPs	Patients' satisfaction with the access to care went from 68% to 77%; the average wait length was shortened from 33 to 23 days--a 30% decrease.			X	X	

Welch et al. (2011)	To evaluate the clinical usefulness of a nurse-led diabetes care program for poorly controlled Hispanic type 2 diabetes patients in an urban community health center setting.	Patients in the intervention group had a significant improvement in A1C from baseline to 12-month follow-up compared with the patients in control group. The proportion of intervention patients meeting clinical goals at follow-up tended to be higher than control patients for HbA1c, systolic blood pressure, eye screening, and foot screening. Diabetes distress and treatment satisfaction also showed greater improvement for intervention than control, with no differences for depression.		X	X		
Wright et al. (2011)	To assess BP control between patients managed by NPs vs. physicians.	70.5% in NP group had controlled BP, but 63.2% in physician group; the mean number of antihypertensive medications was lower among NP-group. The adjusted odds of controlled BP were slightly lower for physician group.		X			
Brokel et al. (2012)	To examine the outcomes of chronically ill patients receiving community-based case management services	Patients had greater satisfaction with quality of life and personal well-being and controlled their symptoms better, but no significant changes of their self-care activities of daily living and self-care instrumental activities of daily living.		X	X		



Condosta (2012)	To examine if a NP-run free diabetic clinic can improve diabetes control	NP visits and the volunteer MD visits did not differ statistically for A1c, HDL, or LDL goal attainment.		X			
Fischer et al. (2012)	To evaluate an intervention of telephone care by nurses on improving the lipid control in patients with diabetes.	The intervention group had more patients with lower level of lipids, compared with the control group; the intervention group also had fewer per patient costs on health care; the intervention group patients might have fewer visits to hospital (close to statistically significant results)		X			X
Glendenning-Napoli et al. (2012)	To examine the effects of a community-based case management program on acute health care utilization and associated costs in uninsured patients with 1 or more chronic diseases.	Patients' acute outpatient visit and inpatient admission decreased by 62% and 53%, respectively; but patients' primary care visits increased by 162%. Participation in the case management program was also associated with a 41% reduction in overall aggregate costs, from \$16,208 pre-intervention to \$9,541 post-intervention.		X			X

Lin et al. (2012)	To evaluate an intervention to improve medication adherence, consistent patient-self-monitoring, and treatment adjustment.	The intervention group had more frequently and timely treatment adjustment, increased self-monitoring, and improved control of diabetes, depression, and heart disease. But there was no significant change on medication adherence between control and intervention groups.		X			
Liu & D'Aunno (2012)	To evaluate the productivity and cost-efficiencies of including NPs in primary care practices.	Compared with solo MD model, model 1 (supervision model) is 19% more productive but 40% more costly; Compared with model 1 (supervision model), model 2 (shared-panel model) is 3%-73% more productive and 3-42% more cost-efficient;					X
Rohrer et al. (2012)	To compare the return visits within 2 weeks between patients using retail clinics and patients using standard medical office	After adjustment for case mix, the odds of a return visit within 2 weeks were not different net between retail clinic and standard primary care clinic.		X			

Bicki et al. (2013)	To evaluate a walk-in non-acute care clinic	Within the first 5 months, the walk-in clinic run by nurses saved \$1.28 million future healthcare costs after incorporating the quality-adjusted-life-year value of preventive services rendered. The mean return on investment of this clinic was \$34 per \$1 invested. This clinic also improved the access to healthcare for uninsured patients and was cost-effective for both the clinic and the patient.					X
Blackmore et al. (2013)	To examine if a NP-staffed breast clinic can improve care timeliness and efficiency for women with symptomatic benign breast conditions	Women visit this NP-staffed breast clinic on average had four for waiting rather than sixteen days, had fewer imaging studies and physician visits. The employed had savings of \$316 per woman, which was mainly from the increased work productivity. The direct costs of care decreased \$213 per woman – 19% decrease.				X	X
Bray et al. (2013)	To determine the effectiveness of a redesigned primary care model on patients' glycemic, blood pressure, and lipid level control	Intervention patients had a greater reduction in HbA1c compared with control patients; more patients in intervention groups achieved their goals of HbA1c and blood pressure compare with control patients		X			

Cioe et al. (2013)	To compare two treatment protocols and examine predictors of sustained virology response	Patients treated by NPs trained in HCV care and seen weekly for interferon injections have comparable treatment outcomes to patients treated by specialists.		X			
Coburn et al. (2013)	To evaluate a community-based nursing intervention by community-based nurse care managers working collaboratively with primary care providers.	The mortality rate of intervention group is 9.9%, compared with 12.9% of control group – 0.75 unadjusted hazard ratio and 0.73 adjusted hazard ratio.		X			
Park et al. (2013)	To evaluate an intervention of transitional care at the time of skilled nursing facility discharge.	The intervention group had lower rate of rehospitalization, fewer acute care inpatient days, lower number of ER visits;		X			
Purath et al. (2013)	To evaluate the efficacy and feasibility of a 24-week intervention on physical activity and physical fitness in a group of community-dwelling older adults	After adjusting patients' age, gender, income, BMI, and support for physical activity, the intervention group significantly increased frequency of all physical activity as well as the fitness outcomes of lower body strength and aerobic endurance.		X			

Reuben et al. (2013)	To evaluate a community-based PCP-NP comanagement program	The intervention group had better quality of care for geriatric conditions in community-based primary care than the control group.		X			
Rohrer et al. (2013)	To compare the continuity of care between patients using retail clinic with those not using	Patients using retail clinic had lower level of continuity of care than patients using standard primary care office.		X			
Singh et al. (2013)	To determine the characteristics of diagnostic errors in primary care settings	Diagnostic errors were not significantly different between NPs and PCPs.	X				
Spetz et al. (2013)	To examine whether retail clinic use is associated with ER visits, hospitalization, and cost saving; and whether the scope-of-practice law limit the cost savings	Retail clinic use was associated with lower costs per episode, compared with the episodes did not begin with a visit of retail clinic. The costs were even lower in the states where NPs can practice independently.					X
Tang (2013)	To evaluate an intervention of online diabetes management	The intervention group had a significant reduced HbA1c than the control group at the 6 months post but not at the 12 months post;		X			

Bao (2014)	To evaluate compare the two ways to antidepressant medication management: nurse-physician collaboration vs. physician alone	Nurse-physician collaboration contributed to the antidepressant medication changes;		X			
Boult et al. (2014)	To evaluate whether the intervention of Guided Care can produce better quality of care and less costs.	The intervention did not significantly improve patients' physical and mental health, but patients' rating of quality of care. The intervention also reduced patients' use of home health.		X			
Dodge et al. (2014)	To evaluate an intervention of a postnatal nurse home-visiting can prevent emergency health care services and improve parenting for 6 months infants.	Infants in the intervention group had less use of emergency, more positive parenting, lower anxiety of mothers than infants in the control group		X			
Edelman et al. (2014)	To assess the effectiveness of nurse behavioral management of diabetes and hypertension in community practices among patients with both diseases.	Intervention patients had similar A1c and SBP values compared to control patients. Blood pressure, weight, and physical activity levels were similar between control and intervention patients.		X			

Fortinsky et al. (2014)	To determine the preliminary efficacy of PPDC on health-related outcomes in patients and their family caregivers; and to determine the acceptability of PPDC based on satisfaction expressed by physicians, patients, and caregivers.	No outcome difference on patient neuropsychiatric symptom and quality of life changes, and caregiver depression, burden, and self-efficacy changes were found; however, the NP intervention was deemed highly satisfactory by patients, caregivers, and PCPs.		X	X		
Gellis et al. (2014)	To evaluate an integrated telehealth intervention to improve chronic illness and comorbid depression in the home healthcare setting.	Depression scores were 50% lower in the intervention group than in the control group at 3 and 6 months. Patients in intervention group significantly improved their problem-solving skills and self-efficacy in managing their medical condition. Patients in intervention group had significantly fewer ED visits but did not have significantly fewer days in the hospital at 12 months after baseline.		X			

Jarl et al. (2014)	To examine a NP-led intervention on changing diet and lifestyle of hypertension and obese patients.	Participants had significant improvements in diet and lifestyle and weight loss over the 2-month intervention period.		X			
Richardson et al. (2014)	To evaluate whether NPs in collaborative practices with primary care clinicians are effective in helping improve control of HbA1c, blood pressure, and low-density LDL-C in adults with uncontrolled hyperglycemia, and to assess whether nurse practitioner-guided care affects depression and self-efficacy in these patients.	After intervention, 50% of 26 patients achieved HbA1c benchmarks, 95.6% achieved systolic and diastolic BP benchmarks, and 57.8% achieved LDL-C benchmarks. Patients' self-efficacy showed significantly increased self-efficacy from preintervention to postintervention.		X			



Ridner et al. (2014)	To compare the effects of resident physician motivational interviewing, resident physician MI plus RN, and the standard of care counseling approach on current smokers' behaviors, self-efficacy to quit smoking, and nicotine dependence.	There were no differences among the three groups in the proportion of participants who quit smoking. Participants in the MD+RN follow-up group had significant positive changes in satisfaction scores.		X	X		
Tang (2014)	To evaluate a primary-care based transitional care program	During the phone call, nurses identified new symptoms or medication issues for 76% of the participants; patients had this nurse phone call had better attendance of follow-up visits than those did not make this phone call; but there were no significant differences on the 30-day hospital readmission rate.		X			

Wagner et al. (2014)	To determine whether a nurse navigator intervention improves quality of life and patient experience with care	Nurse navigator patients reported significantly higher scores on the Patient Assessment of Chronic Illness Care and reported significantly fewer problems with care, especially psychosocial care, care coordination, and information. Cumulative costs after diagnosis did not differ significantly between groups, but lung cancer costs were \$6,852 less among nurse navigator patients.			X		X
Berry et al. (2015)	To evaluate an interdisciplinary approach and test the efficacy of diabetes group visits tailored to low-income patients in a community-based medical practice.	Intervention group decreased their A1C, triglycerides, and heart rate and maintained their high-density lipoprotein significantly more than the control group. In exit interviews, the patients said that the group diabetes visits helped them be more accountable about their diabetes self- management goals.		X			

Biernacki et al. (2015)	To implement and evaluate a care delivery model integrating the registered nurse care coordinator into a family practice that is certified as a patient-centered medical home by the National Committee for Quality Assurance	There were statistically significant differences in the pre and post scores for HbA1c. Post intervention, patient and health care team satisfaction with the RNCC role was high.		X	X		
Bruce et al. (2015)	To determine whether a nurse intervention have greater improvement in depressive symptoms during 1 year	Intervention group had significant decrease on depression severity score at 12-month post; for intervention patients with severe depression scores, their depression severity significantly decrease at all points of time -- 3 months, 6 months, and 12 months.		X			

Engle et al. (2015)	To examine the effectiveness of a nurse assisted online cognitive-behavioral self-management intervention for war-related PTSD, compared to optimized usual primary care PTSD Treatment to reduce PTSD symptoms	Intervention group was associated with a significantly greater decrease in PTSD symptoms compared to control group; but depression, anxiety, somatic symptoms, and functional status did not show statistically significant improvement;		X			
Fortuna et al. (2015)	To examine the effectiveness of a patient-centered, multidisciplinary intervention on blood pressure control	BP control rates increased from 51.0% to 67.4% by the end of the intervention phase and were maintained during the post-intervention phase. Medication adherence scores increased across the intervention.		X			
Kuo et al. (2015)	To compare processes and cost of care of older adults with diabetes mellitus cared for by NPs with processes and cost of those cared for by primary care physicians.	The costs for primary care professional services and inpatient care were significantly lower for the NP patient, but the outpatient facility costs were significantly higher due to the charges for rural hospitals, freestanding clinics, laboratory tests, cardiology tests, and medications.					X

### APPENDIX 3.1: SAMPLE IDENTIFICATION OF CHAPTER 3

	Variables in MEPS	Included for Analysis	Excluded
<b>Seeing a PCN or PCP as a USC</b>	<p>The types of provider the individual usually goes to if he/she is sick or needs advice about his/her health:</p> <ol style="list-style-type: none"> <li>MD – General/Family Practice</li> <li>MD – Internal Medicine</li> <li>MD – Pediatrics</li> <li>MD – OB/Gyn</li> <li>MD – Surgery</li> <li>MD – Other</li> <li>Chiropractor</li> <li>Nurse</li> <li>Nurse Practitioner</li> <li>Physician’s Assistant</li> <li>Other Non-MD Provider</li> <li>Unknown</li> <li>MD - Cardiologist</li> <li>Doctor of Osteopathy</li> <li>MD – Endocrinologist</li> <li>MD – Gastroenterologist</li> <li>MD – Geriatrician</li> <li>MD – Nephrologist</li> <li>MD – Oncologist</li> <li>MD – Pulmonologist</li> <li>MD – Rheumatologist</li> <li>Psychiatrist/Psychologist</li> <li>MD – Neurologist</li> <li>Alternative Care Provider</li> </ol>	<p>Only patients seeing the following types of providers as their USC are included:</p> <ol style="list-style-type: none"> <li>MD – General/Family Practice</li> <li>MD – Internal Medicine</li> <li>MD – Pediatrics</li> <li>Nurse</li> <li>Nurse Practitioner*</li> </ol> <p>* The data do not specify whether they are primary care certified or specialty care certified</p>	<p>Patients seeing the following types of providers are excluded:</p> <ol style="list-style-type: none"> <li>MD – OB/Gyn</li> <li>MD – Surgery</li> <li>MD – Other</li> <li>Chiropractor</li> <li>Physician’s Assistant</li> <li>Other Non-MD Provider</li> <li>Unknown</li> <li>MD - Cardiologist</li> <li>Doctor of Osteopathy</li> <li>MD – Endocrinologist</li> <li>MD – Gastroenterologist</li> <li>MD – Geriatrician</li> <li>MD – Nephrologist</li> <li>MD – Oncologist</li> <li>MD – Pulmonologist</li> <li>MD – Rheumatologist</li> <li>Psychiatrist/Psychologist</li> <li>MD – Neurologist</li> <li>Alternative Care Provider</li> </ol>
<b>Seeing a PCN or PCP for the Current Visit</b>	<p>For the types of visit provider, the MEPS OB and OPD files describe the visit doctor’s specialty and the types of other providers, as follows:</p> <p>The specialty of the visit doctor:</p> <ol style="list-style-type: none"> <li>Allergy/immunology</li> </ol>	<p>Only patients seeing a PCP or PCN for the visit are included:</p> <p>The specialty of the visit doctor:</p> <ol style="list-style-type: none"> <li>Family practice</li> </ol>	<p>Patients seeing the following specialists and other types of providers for the visit are excluded:</p> <p>The specialty of the visit doctor:</p> <ol style="list-style-type: none"> <li>Allergy/immunology</li> </ol>

2	Anesthesiology	8	General practice	2	Anesthesiology
3	Cardiology (heart)	10	Geriatrics (elderly)	3	Cardiology (heart)
4	Dermatology (skin)	14	Internal medicine	4	Dermatology (skin)
5	Endocrinology/metabolism	24	Pediatrician	5	Endocrinology/metabolism
6	Family practice			7	Gastroenterology
7	Gastroenterology			9	General surgery
8	General practice			11	Gynecology/obstetrics
9	General surgery			12	Hematology (blood)
10	Geriatrics (elderly)			13	Hospital residence
11	Gynecology/obstetrics			15	Nephrology (kidneys)
12	Hematology (blood)			16	Neurology
13	Hospital residence			17	Nuclear medicine
14	Internal medicine			18	Oncology
15	Nephrology (kidneys)			19	Ophthalmology
16	Neurology			20	Orthopedics
17	Nuclear medicine			21	Osteopathy
18	Oncology			22	Otorhinolaryngology
19	Ophthalmology			23	Pathology
20	Orthopedics			24	Physical medicine/rehab
21	Osteopathy			25	Plastic surgery
22	Otorhinolaryngology			26	Proctology
23	Pathology			27	Psychiatry
24	Pediatrician			28	Pulmonary
25	Physical medicine/rehab				
26	Plastic surgery				
27	Proctology				
28	Psychiatry				
29	Pulmonary				
The types of other visit providers:		The types of other visit providers:		The types of other providers:	
1	Chiropractor	3	Nurse/nurse practitioner	1	Chiropractor
2	Dentist/dental care person			2	Dentist/dental care person
3	Midwife			3	Midwife
4	Nurse/nurse practitioner			5	Optometrist
5	Optometrist			6	Podiatrist
6	Podiatrist			7	Physician's assistant
7	Physician's assistant			8	Physical therapist
8	Physical therapist			9	Occupational therapist
9	Occupational therapist			10	Psychologist

	10 Psychologist 11 Social worker 12 Technician 13 Acupuncturist 14 Massage therapist 15 Other alternative/complementary care provider 16 Other		11 Social worker 12 Technician 13 Acupuncturist 14 Massage therapist 15 Other alternative/complementary care provider 16 Other
<b>The Location of PCNs and PCPs</b>	The location of the USC provider: 1. Hospital clinic/outpatient department 2. Hospital emergency room 3. Non-hospital location	Only patients whose USC provider is in the following locations are included: 1. Hospital clinic/outpatient department 3. Non-hospital location	The patients whose USC provider is in the following location are excluded: 2. Hospital emergency room
<b>The Therapy, Services, and Procedures Provided by PCNs and PCPs</b>	1. Types of therapy the patient received for the visit: a. Physical therapy b. Occupational therapy c. Speech therapy d. Chemotherapy e. Radiation therapy f. Kidney dialysis g. IV therapy h. Drug or alcohol treatment i. Allergy shots j. Psychotherapy/counseling k. Shots other than allergy  2. The services the patient received for the visit: a. Lab tests b. Sonogram or ultrasound c. X-rays d. Mammogram e. MRI or a CAT scan f. Electrocardiogram g. Electroencephalogram	1. Types of therapy the patient received for the visit: f. Kidney dialysis g. IV therapy h. Drug or alcohol treatment i. Allergy shots j. Psychotherapy/counseling k. Shots other than allergy  2. The services the patient received for the visit: a. Lab tests b. Sonogram or ultrasound c. X-rays d. Mammogram f. Electrocardiogram h. Vaccination j. Throat swab	1. Types of therapy the patient received for the visit: a. Physical therapy b. Occupational therapy c. Speech therapy d. Chemotherapy e. Radiation therapy  2. The services the patient received for the visit: e. MRI or a CAT scan g. Electroencephalogram i. Anesthesia

h. Vaccination

i. Anesthesia

j. Throat swab

k. Other diagnostic tests or exams

k. Other diagnostic tests or exams

3. Whether the patient received a surgical procedure during the visit:

a. Yes

b. No

3. Whether the patient received a surgical procedure during the visit:

a. Yes

b. No

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### APPENDIX 3.2: DATA MANAGEMENT IN EACH DATA FILE OF CHAPTER 3

Constructs	Variables	Data File	Sample Size	Missing/Small number of observations	Strategy	Operationalization
<b>Functions of PCNs and PCPs</b>	1. Types of Therapy 2. Types of Services 3. Whether received a surgery	MEPS OB file & OPD file	n=7821 after PSM	Varied with each variable	Recode “don’t know”, “not applicable”, “not ascertained”, and “no treatment received” to “0 – No”.	Please refer to Appendix 3.1.
<b>Roles of PCNs and PCPs</b>	1. Usual Provider Role 2. Supplemental Role	MEPS FYC file MEPS OB file & OPD file	n=96517 before PSM n=7821 after PSM	2558 patient visits did not see either PCN or PCP, with 1312 patient visits seeing a PCN as USC and 1246 seeing a PCP as USC.	These patient visits were not included for the analysis of each study aim.	<p>First, two dummy variables are created to indicate the patients’ USC provider and the provider for their current visit, respectively:</p> <p><b>1. USC_PCN:</b>  <b>1</b>=Seeing a PCN as the USC  <b>0</b>=Seeing a PCP as the USC</p> <p><b>2. Visit_PCN:</b>  <b>1</b>=Seeing a PCN for the current visit  <b>0</b>=Seeing a PCP for the current visit</p> <p>Second, the roles of PCNs and PCPs correspond to the following scenarios based on the above two dummy variables:</p> <p><b>1. PCN-Usual Provider Role:</b> USC_PCN=1 &amp; Visit_PCN=1  <b>2. PCN-Supplemental Role:</b> USC_PCN=0 &amp; Visit_PCN=1  <b>3. PCP-Usual Provider Role:</b> USC_PCN=0 &amp; Visit_PCN=0  <b>4. PCP-Supplemental Role:</b> USC_PCN=1 &amp;</p>

<b>Patients' Diagnostic Characteristics</b>	<p>Descriptions of Patient's Diagnoses for Each Visit: Using 17 general categories from the CCS file, the patient's diagnoses were entered as categorical variables into the multinomial logistic regression model.</p> <ol style="list-style-type: none"> <li>1. Infectious and parasitic diseases</li> <li>2. Neoplasms</li> <li>3. Endocrine, nutritional, and metabolic diseases and immunity disorders</li> </ol>	MEPS OB file & OPD file	n=7821 after PSM	<p>The following categories have less than 75 patient visits, which do not allow for a successful multinomial logistic regression analysis:</p> <p>4) Diseases of the blood and blood-forming organs (n=32)</p> <p>11) Complications of pregnancy, childbirth, and puerperium (n=54)</p> <p>14) Congenital anomalies (n=3)</p> <p>15) Certain conditions originating in the perinatal</p>	These categories were not included for multinomial logistic regression analysis.	<p>Visit_PCN=0</p> <p>Third, an interaction term of USC_PCN and Visit_PCN were created for addressing study aim 3. According to the above four scenarios and roles,</p> <p><b>[USC_PCN]*[Visit_PCN]=1</b> if PCN serve usual provider role</p> <p><b>[USC_PCN]*[Visit_PCN]=0</b> if PCN serve supplemental role</p> <p><b>[USC_PCN]*[Visit_PCN]=0</b> if PCP serve usual provider role</p> <p><b>[USC_PCN]*[Visit_PCN]=0</b> if PCP serve supplemental role</p> <p>All of these categories were included for multinomial logistic regression analysis; but the categories with less than 75 visits were recoded as the 18<sup>th</sup> category. These categories include:</p> <p>4. Diseases of the blood and blood-forming organs</p> <p>11. Complications of pregnancy, childbirth, and puerperium</p> <p>14. Congenital anomalies</p> <p>15. Certain conditions originating in the perinatal period</p> <p>Moreover, the category of infectious and parasitic diseases was also recoded as</p>
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4. Diseases of the blood and blood-forming organs
5. Mental illness
6. Diseases of the nervous system and sense organs
7. Diseases of the circulatory system
8. Diseases of the respiratory system
9. Diseases of the digestive system
10. Diseases of the genitourinary system
11. Complications of pregnancy, childbirth, and puerperium
12. Diseases of the skin and subcutaneous tissue
13. Diseases of the musculoskeletal system and connective tissue
14. Congenital anomalies
15. Certain conditions originating in the perinatal period
16. Injury and poisoning
17. Symptoms, signs, and ill-defined conditions and factors influencing health status

period (n=0)

18) Unclassified (n=47)

the 18<sup>th</sup> category because it includes a perfect predictor that does not allow for multinomial logistic regression analysis.

	18. Other, or non-classified diagnoses					
<b>Patients' Demographics</b>	Age	MEPS FYC file	n=96517 before PSM	3	Dropped	Age as of the end of the survey year.
	Gender	MEPS FYC file	n=96517 before PSM	No missing	N/A	<b>1</b> =Male <b>0</b> =Female
	Race	MEPS FYC file	n=96517 before PSM	No missing	N/A	<b>1</b> =White <b>0</b> =Non-White
	Insurance status	MEPS FYC file	n=96517 before PSM	No missing	N/A	<b>1</b> =Any private <b>2</b> =Public only <b>3</b> =Uninsured
	Geographic Location	MEPS FYC file	n=96517 before PSM	No missing	N/A	<b>1</b> =MSA <b>0</b> =non-MSA
<b>Patients' Health Status</b>	Overall Health Status	MEPS FYC file	n=96517 before PSM	For adults: PCS42: 5654 (147 in PCN group and 5507 in PCP group) MCS42: 5654 (147 in PCN group and 5507 in PCP group)  For kids: no missing	For adults, missing data on PCS42 and MCS42 were imputed using the prediction values from these regression models: PCS42/MCS42 = $f$ (demographics, prior conditions)	For adults: The scores of Physical Component Summary and Mental Component Summary in Short-Form 12 Version  For kids: SF1 was created using the mean of variables rthlth31, rthlth42, and rthlth35, which indicated respondents' general health status – excellent, very good, good, fair, and poor.
<b>Patient's Complexity</b>	Prior conditions	MEPS FYC file	n=96517 before	Not applicable or not ascertained:	Recode to “0 - No”	Prior conditions that were collected from every year of

			PSM	Diabetes: 4748 Asthma: 272 Hypertension: 5803 CHD: 5839 Stroke: 5777 Emphysema: 5765 Arthritis: 5908		2002-2013 were included: diabetes, asthma, hypertension, CHD, stroke, emphysema, and arthritis.  A new variable of prior conditions was created, of which “0” is equal to no prior condition, “1” is equal to one prior condition, “2” is equal to two prior conditions, and “3” is equal to three or more prior conditions.
<b>Time</b>	Year	MEPS FYC file MEPS OB file & OPD file	n=96517 before PSM n=7821 after PSM	No missing	N/A	<p>“Year” was entered as a categorical variable: For the data in 2002, year=2002 For the data in 2003, year=2003 For the data in 2004, year=2004 For the data in 2005, year=2005 For the data in 2006, year=2006 For the data in 2007, year=2007 For the data in 2008, year=2008 For the data in 2009, year=2009 For the data in 2010, year=2010 For the data in 2011, year=2011 For the data in 2012, year=2012 For the data in 2013, year=2013</p>

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### APPENDIX 3.3: RESULTS OF MULTINOMIAL LOGISTIC REGRESSION OF THE DIAGNOSTIC CHARACTERISTICS OF CARE RECIPIENTS

	Relative Risk Ratio	Standard Error	z	p> z	95% Confidence Interval	
Neoplasms						
PCN_USC	0.97	0.43	-0.08	0.94	0.40	2.31
PCN_VISIT	10.44	4.01	6.10	0.00	4.92	22.18
PCN_USC_VISIT	0.12	0.07	-3.73	0.00	0.04	0.36
Age	1.08	0.06	1.47	0.14	0.97	1.20
Age Squared	1.00	0.00	-1.19	0.23	1.00	1.00
Male	0.86	0.23	-0.55	0.58	0.51	1.45
White	2.16	0.86	1.93	0.05	0.99	4.73
Public Insurance	1.15	0.32	0.52	0.61	0.67	1.99
Uninsured	0.69	0.35	-0.73	0.46	0.25	1.87
Northeast	1.79	0.75	1.39	0.16	0.79	4.08
Midwest	2.59	0.99	2.50	0.01	1.23	5.46
South	0.68	0.26	-1.02	0.31	0.32	1.44
PCS42	1.02	0.01	1.19	0.24	0.99	1.04
MCS42	1.02	0.01	1.59	0.11	1.00	1.05
Year	0.91	0.03	-2.62	0.01	0.85	0.98
Year Squared	1.00	(omitted)				
Have one prior conditions	0.27	0.11	-3.31	0.00	0.13	0.59
Have two prior conditions	0.06	0.02	-6.48	0.00	0.02	0.13
Have three or more prior conditions	0.03	0.01	-6.96	0.00	0.01	0.08
Constant	1.33E+78	9.38E+79	2.55	0.01	1.02E+18	1.70E+138
Endocrine/nutritional/metabolic diseases & immunity disorders						
PCN_USC	1.29	0.25	1.35	0.18	0.89	1.89
PCN_VISIT	3.81	0.98	5.18	0.00	2.30	6.31
PCN_USC_VISIT	0.21	0.07	-4.85	0.00	0.11	0.39
Age	1.01	0.03	0.39	0.70	0.96	1.06
Age Squared	1.00	0.00	-0.88	0.38	1.00	1.00
Male	0.72	0.09	-2.54	0.01	0.56	0.93
White	1.49	0.21	2.83	0.01	1.13	1.97
Public Insurance	0.50	0.07	-5.03	0.00	0.38	0.66
Uninsured	0.40	0.09	-3.94	0.00	0.25	0.63
Northeast	0.48	0.10	-3.37	0.00	0.31	0.74
Midwest	0.43	0.08	-4.49	0.00	0.30	0.62
South	0.59	0.09	-3.30	0.00	0.44	0.81
PCS42	1.01	0.01	1.88	0.06	1.00	1.02
MCS42	1.00	0.01	0.66	0.51	0.99	1.01
Year	0.98	0.02	-1.20	0.23	0.94	1.01
Year Squared	1.00	(omitted)				

Have one prior conditions	0.30	0.09	-3.89	0.00	0.17	0.55
Have two prior conditions	0.25	0.08	-4.51	0.00	0.14	0.46
Have three or more prior conditions	0.36	0.11	-3.30	0.00	0.20	0.66
Constant	7.52E+20	2.95E+22	1.23	0.22	3.03E-13	1.87E+54
<b>Mental illness</b>						
PCN_USC	2.54	0.89	2.66	0.01	1.28	5.04
PCN_VISIT	9.49	4.18	5.10	0.00	4.00	22.50
PCN_USC_VISIT	0.14	0.08	-3.63	0.00	0.05	0.41
Age	0.91	0.03	-2.50	0.01	0.85	0.98
Age Squared	1.00	0.00	1.10	0.27	1.00	1.00
Male	0.56	0.15	-2.22	0.03	0.34	0.93
White	2.63	0.84	3.03	0.00	1.41	4.90
Public Insurance	0.66	0.16	-1.73	0.08	0.41	1.06
Uninsured	0.36	0.17	-2.23	0.03	0.14	0.88
Northeast	0.65	0.23	-1.25	0.21	0.33	1.28
Midwest	0.73	0.22	-1.07	0.29	0.40	1.31
South	0.42	0.12	-3.01	0.00	0.24	0.74
PCS42	0.99	0.01	-0.52	0.60	0.97	1.02
MCS42	0.96	0.01	-4.87	0.00	0.94	0.98
Year	1.07	0.04	2.04	0.04	1.00	1.15
Year Squared	1.00	(omitted)				
Have one prior conditions	0.14	0.05	-5.57	0.00	0.07	0.28
Have two prior conditions	0.04	0.02	-7.71	0.00	0.02	0.09
Have three or more prior conditions	0.05	0.02	-7.29	0.00	0.02	0.11
Constant	4.19E-60	2.92E-58	-1.96	0.05	1.80E-119	0.96
<b>Diseases of the nervous system &amp; sense organs</b>						
PCN_USC	1.80	0.44	2.40	0.02	1.11	2.91
PCN_VISIT	0.52	0.40	-0.85	0.39	0.12	2.30
PCN_USC_VISIT	0.85	0.68	-0.20	0.84	0.18	4.06
Age	0.93	0.03	-2.25	0.03	0.87	0.99
Age Squared	1.00	0.00	0.92	0.36	1.00	1.00
Male	0.28	0.07	-5.08	0.00	0.17	0.46
White	2.15	0.49	3.34	0.00	1.37	3.36
Public Insurance	0.53	0.11	-3.05	0.00	0.35	0.80
Uninsured	0.50	0.16	-2.11	0.04	0.27	0.95
Northeast	0.44	0.14	-2.63	0.01	0.24	0.81
Midwest	0.51	0.13	-2.59	0.01	0.30	0.85
South	0.40	0.09	-4.10	0.00	0.26	0.62
PCS42	0.96	0.01	-4.93	0.00	0.95	0.98
MCS42	0.99	0.01	-0.83	0.41	0.98	1.01
Year	0.97	0.03	-1.27	0.20	0.92	1.02
Year Squared	1.00	(omitted)				
Have one prior conditions	0.20	0.06	-5.08	0.00	0.10	0.37

Have two prior conditions	0.06	0.02	-8.12	0.00	0.03	0.11
Have three or more prior conditions	0.03	0.01	-8.94	0.00	0.02	0.07
Constant	6.96E+32	3.79E+34	1.39	0.17	3.21E-14	1.51E+79
<b>Diseases of the circulatory system (Base Outcome)</b>						
<b>Diseases of the respiratory system</b>						
PCN_USC	2.43	0.46	4.66	0.00	1.67	3.52
PCN_VISIT	5.39	1.50	6.07	0.00	3.13	9.28
PCN_USC_VISIT	0.11	0.04	-6.57	0.00	0.06	0.21
Age	1.01	0.03	0.47	0.64	0.96	1.07
Age Squared	1.00	0.00	-2.02	0.04	1.00	1.00
Male	0.35	0.05	-6.87	0.00	0.26	0.48
White	1.43	0.21	2.38	0.02	1.06	1.91
Public Insurance	0.32	0.05	-7.19	0.00	0.24	0.44
Uninsured	0.38	0.09	-4.14	0.00	0.24	0.60
Northeast	0.87	0.19	-0.62	0.54	0.57	1.34
Midwest	0.44	0.09	-3.99	0.00	0.29	0.66
South	0.64	0.11	-2.62	0.01	0.46	0.89
PCS42	1.00	0.01	-0.23	0.82	0.99	1.01
MCS42	1.02	0.01	3.05	0.00	1.01	1.03
Year	1.00	0.02	-0.08	0.94	0.96	1.04
Year Squared	1.00	(omitted)				
Have one prior conditions	0.13	0.04	-7.13	0.00	0.08	0.23
Have two prior conditions	0.05	0.01	-10.53	0.00	0.03	0.08
Have three or more prior conditions	0.05	0.02	-9.79	0.00	0.03	0.10
Constant	299.99	12300.85	0.14	0.89	3.75E-33	2.40E+37
<b>Diseases of the digestive system</b>						
PCN_USC	1.46	0.38	1.46	0.14	0.88	2.43
PCN_VISIT	0.75	0.42	-0.50	0.62	0.25	2.27
PCN_USC_VISIT	0.70	0.43	-0.58	0.57	0.21	2.36
Age	0.90	0.03	-3.42	0.00	0.84	0.96
Age Squared	1.00	0.00	3.00	0.00	1.00	1.00
Male	0.49	0.11	-3.24	0.00	0.32	0.76
White	1.58	0.35	2.09	0.04	1.03	2.44
Public Insurance	0.67	0.13	-2.02	0.04	0.45	0.99
Uninsured	0.29	0.12	-2.95	0.00	0.13	0.66
Northeast	0.58	0.20	-1.61	0.11	0.30	1.12
Midwest	0.96	0.26	-0.14	0.89	0.57	1.63
South	0.71	0.17	-1.44	0.15	0.45	1.13
PCS42	0.99	0.01	-0.73	0.46	0.98	1.01
MCS42	1.00	0.01	0.39	0.70	0.99	1.02
Year	0.94	0.02	-2.41	0.02	0.89	0.99
Year Squared	1.00	(omitted)				
Have one prior conditions	0.22	0.07	-4.62	0.00	0.12	0.42



Have two prior conditions	0.06	0.02	-7.67	0.00	0.03	0.13
Have three or more prior conditions	0.05	0.02	-7.76	0.00	0.03	0.11
Constant	3.02E+57	1.61E+59	2.49	0.01	1.53E+12	6.00E+102
<b>Diseases of the genitourinary system</b>						
PCN_USC	1.94	0.59	2.18	0.03	1.07	3.51
PCN_VISIT	35.15	9.97	12.54	0.00	20.15	61.30
PCN_USC_VISIT	0.03	0.01	-8.98	0.00	0.01	0.06
Age	0.93	0.03	-2.17	0.03	0.88	0.99
Age Squared	1.00	0.00	1.27	0.21	1.00	1.00
Male	0.18	0.05	-5.92	0.00	0.11	0.32
White	2.04	0.48	3.03	0.00	1.29	3.22
Public Insurance	0.79	0.16	-1.17	0.24	0.54	1.17
Uninsured	1.16	0.34	0.51	0.61	0.65	2.08
Northeast	0.38	0.13	-2.84	0.00	0.19	0.74
Midwest	0.59	0.16	-1.94	0.05	0.35	1.00
South	0.63	0.14	-2.01	0.05	0.40	0.99
PCS42	0.98	0.01	-3.02	0.00	0.96	0.99
MCS42	1.00	0.01	-0.42	0.68	0.98	1.01
Year	1.00	0.03	-0.07	0.94	0.94	1.05
Year Squared	1.00	(omitted)				
Have one prior conditions	0.11	0.04	-6.56	0.00	0.05	0.21
Have two prior conditions	0.04	0.01	-8.75	0.00	0.02	0.08
Have three or more prior conditions	0.08	0.03	-7.02	0.00	0.04	0.16
Constant	4257.45	239106.20	0.15	0.88	6.67E-45	2.72E+51
<b>Diseases of the skin &amp; subcutaneous tissue</b>						
PCN_USC	2.86	1.09	2.76	0.01	1.36	6.04
PCN_VISIT	3.07	2.05	1.68	0.09	0.83	11.35
PCN_USC_VISIT	0.27	0.20	-1.74	0.08	0.06	1.19
Age	0.90	0.04	-2.47	0.01	0.82	0.98
Age Squared	1.00	0.00	0.91	0.36	1.00	1.00
Male	0.23	0.07	-4.61	0.00	0.12	0.43
White	4.10	1.55	3.72	0.00	1.95	8.62
Public Insurance	1.06	0.29	0.20	0.84	0.62	1.80
Uninsured	0.50	0.26	-1.34	0.18	0.18	1.37
Northeast	0.13	0.05	-4.99	0.00	0.06	0.29
Midwest	0.07	0.03	-6.69	0.00	0.03	0.15
South	0.13	0.04	-7.05	0.00	0.08	0.23
PCS42	1.07	0.01	5.19	0.00	1.04	1.09
MCS42	1.05	0.01	4.17	0.00	1.03	1.08
Year	1.00	0.04	-0.08	0.94	0.93	1.07
Year Squared	1.00	(omitted)				
Have one prior conditions	0.11	0.05	-4.57	0.00	0.04	0.28
Have two prior conditions	0.36	0.16	-2.28	0.02	0.15	0.87

Have three or more prior conditions	1.59	0.70	1.07	0.29	0.68	3.75
Constant	65.47	4998.87	0.05	0.96	6.60E-64	6.49E+66
<b>Diseases of the musculoskeletal system &amp; connective tissue</b>						
PCN_USC	1.82	0.37	2.97	0.00	1.23	2.70
PCN_VISIT	0.58	0.32	-0.99	0.32	0.19	1.71
PCN_USC_VISIT	1.08	0.64	0.13	0.90	0.34	3.43
Age	1.04	0.03	1.25	0.21	0.98	1.11
Age Squared	1.00	0.00	-2.23	0.03	1.00	1.00
Male	0.35	0.06	-6.15	0.00	0.25	0.48
White	2.15	0.38	4.35	0.00	1.52	3.03
Public Insurance	0.43	0.07	-5.32	0.00	0.31	0.58
Uninsured	0.43	0.11	-3.29	0.00	0.26	0.71
Northeast	1.26	0.29	1.01	0.31	0.80	1.98
Midwest	0.77	0.17	-1.22	0.22	0.50	1.17
South	0.63	0.12	-2.54	0.01	0.44	0.90
PCS42	0.95	0.01	-8.54	0.00	0.94	0.96
MCS42	0.98	0.01	-4.07	0.00	0.97	0.99
Year	0.96	0.02	-1.73	0.08	0.92	1.01
Year Squared	1.00	(omitted)				
Have one prior conditions	0.37	0.12	-3.10	0.00	0.20	0.70
Have two prior conditions	0.24	0.08	-4.44	0.00	0.13	0.45
Have three or more prior conditions	0.07	0.02	-8.02	0.00	0.03	0.13
Constant	2.55E+36	1.17E+38	1.82	0.07	0.00	3.83E+75
<b>Injury &amp; poisoning</b>						
PCN_USC	2.79	0.70	4.11	0.00	1.71	4.56
PCN_VISIT	2.49	1.16	1.96	0.05	1.00	6.19
PCN_USC_VISIT	0.13	0.07	-3.87	0.00	0.04	0.36
Age	0.94	0.03	-1.77	0.08	0.88	1.01
Age Squared	1.00	0.00	0.55	0.58	1.00	1.00
Male	0.87	0.18	-0.66	0.51	0.59	1.31
White	2.23	0.57	3.10	0.00	1.34	3.69
Public Insurance	0.33	0.08	-4.62	0.00	0.20	0.53
Uninsured	0.65	0.21	-1.36	0.17	0.35	1.21
Northeast	0.82	0.25	-0.65	0.52	0.45	1.49
Midwest	0.73	0.20	-1.16	0.25	0.43	1.24
South	0.36	0.09	-3.96	0.00	0.22	0.60
PCS42	0.98	0.01	-2.08	0.04	0.96	1.00
MCS42	1.01	0.01	1.18	0.24	0.99	1.03
Year	0.94	0.03	-2.14	0.03	0.89	0.99
Year Squared	1.00	(omitted)				
Have one prior conditions	0.21	0.07	-4.49	0.00	0.11	0.41
Have two prior conditions	0.09	0.04	-6.27	0.00	0.04	0.19
Have three or more prior conditions	0.14	0.05	-5.19	0.00	0.06	0.29

Constant	1.79E+56	1.05E+58	2.2	0.03	1205311	2.60E+106
<b>Symptoms, signs, &amp; ill-defined conditions &amp; factors influencing health status</b>						
PCN_USC	2.60	0.74	3.34	0.00	1.48	4.56
PCN_VISIT	1.24	0.66	0.41	0.68	0.44	3.51
PCN_USC_VISIT	0.32	0.19	-1.88	0.06	0.10	1.05
Age	0.91	0.03	-2.58	0.01	0.85	0.98
Age Squared	1.00	0.00	2.37	0.02	1.00	1.00
Male	0.43	0.11	-3.27	0.00	0.26	0.71
White	3.02	0.98	3.39	0.00	1.59	5.72
Public Insurance	0.35	0.09	-3.89	0.00	0.21	0.59
Uninsured	0.42	0.18	-2.04	0.04	0.18	0.97
Northeast	1.44	0.52	1.00	0.32	0.70	2.94
Midwest	0.98	0.34	-0.06	0.95	0.50	1.93
South	0.93	0.28	-0.24	0.81	0.51	1.69
PCS42	1.01	0.01	0.82	0.42	0.99	1.03
MCS42	1.00	0.01	-0.10	0.92	0.98	1.02
Year	0.98	0.03	-0.66	0.51	0.92	1.04
Year Squared	1.00	(omitted)				
Have one prior conditions	0.17	0.06	-4.94	0.00	0.08	0.34
Have two prior conditions	0.06	0.03	-6.98	0.00	0.03	0.14
Have three or more prior conditions	0.05	0.02	-6.86	0.00	0.02	0.12
Constant	1.65E+19	1.06E+21	0.69	0.49	4.10E-36	6.63E+73
<b>Other or non-classified diagnoses</b>						
PCN_USC	4.01	0.98	5.67	0.00	2.48	6.48
PCN_VISIT	14.96	5.04	8.02	0.00	7.72	28.97
PCN_USC_VISIT	0.03	0.01	-8.82	0.00	0.01	0.06
Age	0.91	0.03	-2.97	0.00	0.86	0.97
Age Squared	1.00	0.00	1.54	0.13	1.00	1.00
Male	0.40	0.09	-4.02	0.00	0.26	0.63
White	1.52	0.33	1.96	0.05	1.00	2.32
Public Insurance	1.01	0.21	0.04	0.97	0.67	1.52
Uninsured	1.56	0.41	1.67	0.10	0.93	2.61
Northeast	0.74	0.21	-1.04	0.30	0.42	1.30
Midwest	0.31	0.09	-4.04	0.00	0.18	0.55
South	0.60	0.13	-2.32	0.02	0.39	0.92
PCS42	1.00	0.01	-0.30	0.77	0.98	1.01
MCS42	1.00	0.01	-0.49	0.62	0.98	1.01
Year	0.99	0.03	-0.53	0.60	0.94	1.04
Year Squared	1.00	(omitted)				
Have one prior conditions	0.11	0.03	-6.96	0.00	0.06	0.20
Have two prior conditions	0.07	0.02	-7.87	0.00	0.04	0.13
Have three or more prior conditions	0.02	0.01	-9.42	0.00	0.01	0.05
Constant	2.22E+14	1.18E+16	0.62	0.54	7.53E-32	6.52E+59

## APPENDIX 4.1: SAMPLE SELECTION AND DATA MANAGEMENT OF CHAPTER 4

Variable	Survey Question	Number of Missing/Excluded	Strategy	Operation
<b><i>Sample selection</i></b>				
Currently certified in State Board of Nursing to practice as an NP	Q1: Do you have a current certification, licensure, or other legal recognition from a State Board of Nursing to practice as a Nurse Practitioner (NP)? 1 = Yes 2 = No	0 excluded	0 dropped	N/A
Certified in primary care specialties: adult, family, gerontology, pediatric, and women's health	Q5: In which area(s) have you ever received certification from a national certifying organization for NPs? Q5A = Acute care adult Q5B = Acute care pediatric Q5C = Adult Q5D = Gerontology Q5E = Family Q5F = Pediatrics Q5G = Neonatal Q5H = Psych/mental health Q5I = Women's health Q5J = Other Q5K = None Q5L = Oncology Q5M = Diabetes Q5N = Hospice/Palliative care	2410 excluded	Dropped	The following certifications were kept: Q5C = Adult Q5D = Gerontology Q5E = Family Q5F = Pediatrics Q5I = Women's health
Work for pay in nursing as an RN or NP	Q10: Do you work for pay in nursing, as a Registered Nurse (RN) or as an NP?	680 excluded	Dropped	N/A

Work in primary care or specialty care settings	<p>1 = Yes 2 = No</p> <p>Q12: In what type of setting do you work in your principal position?</p> <p>1 = Private physician office/practice 2 = Private NP office/practice 3 = Nurse managed clinic 4 = Retail based clinic 5 = Urgent care clinic 6 = Ambulatory surgery center 7 = Federal clinic (Federally Qualified Health Centers, Veterans Affairs [VA] Medical Centers, and the Indian Health Service [IHS]) 8 = Hospital inpatient unit 9 = Hospital outpatient 10 = Hospital emergency department 11 = Hospital-other 12 = Federal hospital (Military, VA, IHS) 13 = Long term care facility 14 = Hospice 15 = Home care agency 16 = Community clinic 17 = Correctional facility 18 = Health department 19 = Mental health center 20 = Rural health clinic 21 = Academic (university/college) education program 22 = Health maintenance organization/managed care</p>	1658 excluded	Dropped	<p><b>Primary Care Setting*:</b> 1=Private physician office/practice 2=Private NP office/practice 3=Nurse managed clinic 4=Retail based clinic 6=Ambulatory surgery center 7=Federal clinic (Federally Qualified Health Centers, Veterans Affairs [VA] Medical Centers, and the Indian Health Service [IHS]) 15=Home care agency 16=Community clinic 17=Correctional facility 18=Health department 20=Rural health clinic 22=Health maintenance organization/managed care 23=Occupational/employee health 24=School/college health service</p> <p><b>Specialty Care Settings -- Hospital Settings:</b> 5=Urgent care clinic 8=Hospital inpatient unit 9=Hospital outpatient 10=Hospital emergency department 11=Hospital-other 12=Federal hospital (Military, VA, IHS) 19=Mental health center 26=Hospital surgical setting</p>
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23 = Occupational/employee health	27=Hospital other clinical role
24 = School/college health service	28=Hospital non-clinical
26 = Hospital surgical setting	
27 = Hospital other clinical role	
28 = Hospital non-clinical	
29 = Clinic unclassified	

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Together 4748 out 12923 observations were dropped based on the above inclusion criteria, leaving 8175 observations for next steps.

**Dependent Variable**

Wage	Q17 – Salary: Pre-tax annual earnings from the principal NP position (include overtime, on-call earnings, and bonuses) in 2011	576 not ascertained	Dropped	$Wage = \frac{Q17}{Q16*52}$
	Q16 – Working Hours per Week: (The number of hours worked in the principal NP position during a typical week)	76 not ascertained	Dropped	

Together 600 observations were dropped based on the missing of salary and working hours, leaving 7575 observations for next steps. The number of missing noted for each independent variable as follows is from the PCNP subsample of 7575.

**Independent Variables**

**Demographic Characteristics**

Gender	Q52: Are you...(Gender)? 1 = Male 2 = Female	58 not ascertained	Recoded to “non-male”	1 = Male 0 = non-male (reference)
Ethnicity	Q54: Are you of Latino or Hispanic Ethnicity	52 not ascertained	Recoded to “non-Hispanic”	1 = Hispanic 0 = non-Hispanic (reference)

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	1 = Yes 2 = No			
Race	Q55: Which one or more of the following would you use to describe your race? Q55A: 1 = American Indian or Alaska Native Race Q55B: 1 = Asian Q55C: 1 = Black or African-American Race Q55D: 1 = Native Hawaiian or Other Pacific Islander Race Q55E: 1 = White (reference)	111 not ascertained	Recoded to “nonwhite”	0 = white (reference) 1 = nonwhite
Marital Status	Q56: What is your marital status? 1 = Never married 2 = Married (reference) 3 = Separated 4 = Divorced 5 = Widowed	85 not ascertained	Recoded to “separated, divorced, widowed, and other”	1 = Never married 2 = Married (reference) 3 = Separated, divorced, widowed, and other
<b>Human Capital Characteristics</b>				
NP Education Preparation	Q3: NP education preparation Q3A: 1 = Certificate program Q3B: 1 = Master’s degree (reference) Q3C: 1 = Post Master’s degree Q3D: 1 = Doctor of nursing practice degree Q3E: 1 = Other	3 not ascertained	These missing data were imputed by observations’ ages. These 3 observations were aged 31, 57, and 65 years old, respectively. The education level was tabulated with the categorical variable of age, which was categorized by each 10 ten years. The	1 = Certificate program 2 = Master’s degree (reference) 3 = Post Master’s degree 4 = Doctor of nursing practice degree and other

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			results showed that most of the observations in the categories of 30-40 years old, 50-60 years old, and older than 60 years old hold a master degree as their NP education. Thus, the education levels of these three observations were recoded as “master”.	
Working Experiences as NPs	Q4: In what year complete the initial NP education program	40 not ascertained; and 3 observations reported as “2012”	Dropped	2011-Q4
Intent to Turnover	Q22: Plan to leave the principal NP position 1 = Yes, will leave in 2012 (reference) 2 = Yes, will leave in 1-2 years 3 = No plans to leave in next 2 years 4 = Undecided or unknown	46 not ascertained	Recoded as “undecided or unknown”	1 = Yes, will leave in 2012 (reference) 2 = Yes, will leave in 1-2 years 3 = No plans to leave in next 2 years 4 = Undecided or unknown
<b>Employment Characteristics</b> Work Position	Q11: The principal NP position in which the NP worked the most hours per week (only the nursing positions for which they are paid): 1 = NP in clinical practice	45 not ascertained	Recoded to “other non-NP position”	1 = NP in clinical practice (reference) 2 = other NP position 3 = RN staff 4 = other non-NP position

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	2 = Faculty requiring an NP credential 3 = Researcher requiring an NP credential 4 = Administrator requiring an NP credential 5 = Other nursing position requiring an NP credential 6 = RN staff nurse not requiring an NP credential 7 = Faculty not requiring an NP credential 8 = Administrator/Manager not requiring an NP credential 9 = Patient Care Coordinator not requiring an NP credential 10 = Other APRN role not requiring an NP credential 11 = Researcher not requiring an NP credential 12 = Consultant not requiring an NP credential 13 = Other nursing position not requiring NP credential			
Area of Employment	Q13_RUCA: (defined by zip code) 1 = Urban (reference) 2 = Large Rural 3 = Small Rural 4 = Isolated	376 not ascertained	Recoded as "unknown"	1 = Urban (reference) 2 = Large Rural 3 = Small Rural 4 = Isolated 5 = Unknown
Job Satisfaction	Q21: What is your overall level of satisfaction with your principal position? 1 = Very satisfied 2 = Satisfied (reference)	45 not ascertained	Dropped	0 = Dissatisfied 1 = Satisfied (reference)

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	3 = Dissatisfied 4 = Very dissatisfied			
How PCNPs are paid	Q41: How are you paid in your main NP position? 1 = Annual salary (reference) 2 = By the hour 3 = Percentage of billing 4 = Other 5 = Percent billing plus salary/hourly	187 not ascertained; 342 valid skip	Recoded as “other”	1 = Annual salary (reference) 2 = By the hour 3 = Percentage of billing 4 = Other, or percent billing plus salary/hourly
Clinical specialty	Q31: the specialty of the practice/facility in which you work for your main NP position 0 = Not working in a clinical specialty 1 = Internal medicine 2 = Family practice 3 = Geriatrics 4 = General pediatrics 5 = Pediatric subspecialties 6 = Adolescent medicine 7 = Cardiology 8 = Endocrinology 9 = Gastroenterology 10 = Hematology/oncology 11 = Infectious disease 12 = Pulmonary/respiratory 13 = Renal/nephrology 14 = Rheumatology 15 = OB/GYN women’s health 16 = General surgery 17 = Urology 18 = Orthopedics	191 not ascertained; 251 valid skip	Recoded as “other, or no specialty”	0 = Primary care specialty • 1 = Internal medicine • 2 = Family practice • 3 = Geriatrics • 4 = General pediatrics • 15 = OB/GYN women’s health • 32 = School health  1 = Specialty care specialty: • 5 = Pediatric subspecialties • 6 = Adolescent medicine • 7 = Cardiology • 8 = Endocrinology • 9 = Gastroenterology • 10 = Hematology /oncology • 11 = Infectious disease • 12 = Pulmonary /respiratory • 13 = Renal/nephrology • 14 = Rheumatology

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19 = Other surgical specialties  
 20 = Allergy & immunology  
 21 = Dermatology  
 22 = Emergency care  
 23 = Hospitalist  
 24 = Intensive care  
 25 = Long term care  
 26 = Neonatal  
 27 = Neurology  
 28 = Occupational health  
 29 = Palliative care/pain management  
 30 = Psychiatry/mental health  
 31 = Rehabilitation  
 32 = School health  
 33 = Urgent care  
 34 = Wound/ostomy  
 35 = Other  
 36 = Surgical: anesthesia  
 37 = Surgical: cardio, cardiothoracic, vascular, thoracic  
 38 = Surgical: neurological  
 39 = Radiology

- 16 = General surgery
- 17 = Urology
- 18 = Orthopedics
- 19 = Other surgical specialties
- 20 = Allergy & immunology
- 21 = Dermatology
- 22 = Emergency care
- 23 = Hospitalist
- 24 = Intensive care
- 26 = Neonatal
- 27 = Neurology
- 28 = Occupational health
- 29 = Palliative care/pain management
- 30 = Psychiatry/mental health
- 31 = Rehabilitation
- 33 = Urgent care
- 34 = Wound/ostomy
- 36 = Surgical: anesthesia
- 37 = Surgical: cardio, cardiothoracic, vascular, thoracic
- 38 = Surgical: neurological
- 39 = Radiology
- 2 = Other
- 0 = Not working in a clinical specialty
- 25 = Long term care
- 35 = Other

Geographical region

Q13\_state

376 not ascertained

 Recoded as  
 “Unknown”

 Using Census of Region and  
 categorized Q13\_state as:

- 1 = New England

- 
- Division: Connecticut,  
Maine, Massachusetts,  
New Hampshire, Rhode  
Island and Vermont
  - 2 = Middle Atlantic  
Division: New Jersey,  
New York and  
Pennsylvania
  - 3 = East North Central  
Division: Illinois, Indiana,  
Michigan, Ohio and  
Wisconsin
  - 4 = West North Central  
Division: Iowa, Kansas,  
Minnesota, Missouri,  
Nebraska, North Dakota  
and South Dakota
  - 5 = South Atlantic  
Division: Delaware,  
District of Columbia,  
Florida, Georgia,  
Maryland, North Carolina,  
South Carolina, Virginia  
and West Virginia
  - 6 = East South Central  
Division: Alabama,  
Kentucky, Mississippi and  
Tennessee
  - 7 = West South Central  
Division: Arkansas,  
Louisiana, Oklahoma and  
Texas
  - 8 = Mountain Division:  
Arizona, Colorado, Idaho,  
Montana, Nevada, New  
Mexico, Utah and  
Wyoming
  - 9 = Pacific Division:
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				Alaska, California, Hawaii, Oregon and Washington
Degree of Practice independence	Q38. What type of professional relationship do you have with the physician(s) in your main NP position?	549 missing	Recoded to “other relationship with physician”	A new categorical variable was created with the following categories: 0 = Independent if Q38a or Q38b=1  1 = worked with a physician as a team member if Q38c or q38d or q38e is checked  2 = supervised by a physician if Q38f or Q38g is checked;  3= other relationship with a physician if Q38h or Q38i is checked or if Q38os is not missing
	Q38a = no physician in my practice			
	Q38b = collaborate with a physician at another site			
	Q38c = collaborate with a physician on site			
	Q38d = Equal colleagues/no hierarchy			
	Q38e = S/he is the medical director who oversees all of our practice and I am accountable to the medical director, as are all other providers			
	Q38f = Hierarchical/ supervisory in which I must accept his/her clinical decision about the patients I see			
	Q38g = Physician sees and signs off on the patients I see			

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Q38h = Other (specify) type  
of professional relationship

Q38i = Collaborate, location  
unspecified

Q38os = Other specified  
type of professional  
relationship (in text)

For all the above options:

-1 = Inapplicable (Valid  
Skip)

-9 = Not Ascertained  
(Missing)

0 = Not Checked

1 = Checked

Hold more than one position

Q24: Aside from the  
principal position you just  
described, are you working  
for pay in any other nursing  
(RN or NP) positions?

1 = Yes

2 = No

58 not ascertained

Recoded as “no”

1 = Yes

0 = No (reference)

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