Ingredients for Optimal Care: Exploring Factors Associated with Patient Quality Outcomes among Federally-Qualified Health Centers

by Michelle Proser

B.A. in International Affairs, May 1999, The George Washington University
M.P.P in Health Policy, May 2004, The George Washington University

A Dissertation submitted to

The Faculty of
The Columbian College of Arts and Sciences
of The George Washington University in partial fulfillment of
the requirements for the degree of the Doctor of Philosophy

January 31, 2015

Dissertation directed by

Joseph J. Cordes
Professor of Economics, of Public Policy and Public Administration,
and of International Affairs

The Columbian College of Arts and Sciences of The George Washington University certifies that Emily B. Jones has passed the Final Examination for the degree of Doctor of Philosophy as of December 12, 2014. This is the final and approved form of the dissertation.

Ingredients for Optimal Care: Exploring Factors Associated with Patient Quality Outcomes among Federally-Qualified Health Centers

by Michelle Proser, MPP

Dissertation Research Committee:

Joseph J. Cordes, Professor of Economics, of Public Policy and Public Administration, and of International Affairs, Dissertation Director

Peter Shin, Associate Professor of Health Policy, Committee Member

Deborah Gurewich, Assistant Professor of Family Medicine and Community Health, University of Massachusetts Medical School, Committee Member

© Copyright 2015 by Michelle Proser.
All rights reserved

Dedication

To Alan, for his constant love, support, and encouragement.

And to Rachel, the greatest motivation for completing my dissertation.

Acknowledgements

This dissertation would not have been possible without the advice and encouragement of many. I would first like to thank my committee chair, Dr. Joseph Cordes, for his valuable class instruction and dissertation guidance. I've been fortunate to have had Dr. Cordes as a professor of several classes throughout my graduate career. He has taught me principles and particulars of research methods, economics, and the application of policy analysis – all lessons that I now apply in my professional career. His dissertation counseling came through that class instruction and countless meetings, emails, phone calls, and even Stata code.

My other committee members also played strong roles in structuring and strengthening my dissertation. I've had the pleasure of working with Dr. Peter Shin for many years, and he continues to educate me on data and policy analysis. Much of my professional research activities are guided by his expertise. Dr. Deborah Gurewich first peaked my interest in understanding and narrowing performance variation several years ago, and I hope to continue working with and learning from her. I would also like to thank my external readers, Sara Rosenbaum and Dr. David Stevens, whose helpful input expanded my thinking on the interpretations and contributions of this research.

I also heartily thank the National Association of Community Health Centers for their enthusiastic interest in my dissertation. In particular, Daniel R. Hawkins, Senior Vice President for Public Policy and Research, grounded my thinking in the context in which health centers operate and the role they play in improving the health and well-being of the underserved.

Many others provided practical and technical advice. Many of them were “study buddies” who kept me focused. I extend special thanks to Dr. Emily B. Jones, my close friend, who always had great tips, kept me motivated, and who never got sick of my preferred study locations. She and DaShawn Groves served as helpful sounding boards and Stata resources. Other colleagues, including Dr. Marshall Chin and Robert Nocon at the University of Chicago, provided useful suggestions.

Most of all, I would like to thank my husband, Alan. With his love, support, and patience, he constantly encouraged my pursuing a PhD. My PhD program experience spans our entire marriage, including the birth of our daughter Rachel, who waited until after I submitted my first draft of Chapter 4 to arrive. She is already a Colonials Basketball fan. I am grateful to have more time to spend with them.

Abstract of Dissertation

Ingredients for Optimal Care: Exploring Factors Associated with Patient Quality Outcomes among Federally-Qualified Health Centers

Primary care practices nationally vary in their performance along key clinical measures. For this reason, policymakers, payers, and providers are increasingly focused on performance accountability and aligning payment to recognize value. The Affordable Care Act (ACA) of 2010 heavily invests in primary care infrastructure, including a major expansion of the Federally-Qualified Health Center program. Health centers already serve more than 20 million predominately low income, minority, and publicly insured or uninsured patients across the country. Despite their high-risk patient population, health centers are not immune to the accountability expectations that come with public investment and increased visibility.

This dissertation is the first to thoroughly examine the factors associated with health centers' higher performance on two patient outcome measures: diabetes and hypertension control. It draws from three years of programmatic data from 1000+ health center organizations, as well as state-level data representing key environmental factors that may influence health center capacity for quality improvement. The two performance measures are quartiled and health center differences between quartiles descriptively determined. Analyses then explore the external-, organizational-, and patient-level factors statistically related to achieving high performance as well as the circumstances in which a health center increases the odds of high performance.

Findings reveal that high performance on one measure does not necessarily indicate high performance on the other, yet certain common inputs are necessary to support quality improvement efforts across both chronic conditions. Those that increase

the odds include state Medicaid adult enrollment rate, number of encounters per hypertensive or diabetic patient, and use of sampling rather than full population data to report the outcome measures. Those that decrease the odds of high performance include dependency on federal health center grant funding and percents of patients who are homeless and racial/ethnic minority. Several others factors are statistically significant for only one particular measure.

Findings suggest that more visits for diabetic and hypertensive patients may be the most important contributor to improving patient outcomes. Visit frequency appears to moderate or even overcome patient complexity factors, including chronic illness, homelessness, insurance status, and minority. Results also suggest that state-level environmental factors, principally Medicaid enrollment policy, underlie organizational- and patient-level factors related to quality performance in hypertension and diabetes control. Medicaid expansion states are therefore more likely to see the most gains in quality performance and disparities reduction than non-expansion states. However, findings also indicate that federal health center funding is needed to ensure access to care, particularly for patients with high burdens of chronic illness.

Table of Contents

Dedication iv

Acknowledgements v

Abstract of Dissertation vii

List of Figures xii

List of Tables xiii

Chapter 1: Introduction and Policy Problem 1

The State of the US Health Care System and Primary Care 1

The U.S. Health Center Program 7

Comparing Health Centers to Other Provider Types 20

Expectations of Health Center Participation in National Improvement Efforts 25

Dissertation Purpose and Approach 29

Conclusion 33

Chapter 2: Review of Relevant Literature 35

Dimensions Driving Primary Care Performance Nationally 35

Transforming to Adaptive Patient-Centered Medical Homes 47

Health Center Quality of Care 55

Factors Associated with Health Center Performance and Drivers of Performance Variation 62

Conclusion 82

Chapter 3: Conceptual Framework and Research Design 86

Conceptual Framework 86

Dependent Variables 88

Specifying the Model 90
Data Sources 97
Empirical Approach 100
Anticipated Issues and Possible Limitations 106
Chapter 4: Results 112
Quartiling Outcome Variables 112
Descriptive Findings 115
Ordinal Logistic Regression Results: Hypertension Performance 123
Predicted Probabilities: Hypertension 128
Ordinal Logistic Regression Results: Diabetes Performance 131
Predicted Probabilities: Diabetes 138
Limitations 141
Chapter 5: Conclusion and Policy Implications 149
Main Findings 151
Policy Implications 160
Policy Recommendations 163
Future Research 169
Research Contributions 171
Conclusion 172
References 174
Appendix 3A: Explanatory and Control Variables 182
Appendix 4A: Descriptive Findings, Pooled 2009-2011 188
Appendix 4B: Comparison of Means 190

Appendix 4C: Performance Nested Models After Including Patient-Centered Medical Home Survey Data.....193

List of Figures

Figure 1.1. Share of the Nation's Vulnerable Population Served by Health Centers 8

Figure 1.2 Hospital and Health Center Average Operating Margins 12

Figure 1.3 Federally-Funded Health Center Revenue and Patient Population, 2010 12

Figure 2.1 Shortell et al (2005) Proposed Drivers of Physician Organization Performance 37

Figure 2.2 Conceptual Framework of Depression Care Organization in Primary Care Settings by Post et al (2009) 40

Figure 2.3 Health Center Capacity in NCQA Indicators of a Medical Home, as of 2009 53

Figure 2.4 Percentage of Health Centers Meeting or Exceeding HRSA Performance Goal 55

Figure 3.1 Conceptual Framework and Examples 87

List of Tables

Table 3.2 Uniform Data System Grantees and Total Patients by Year 97

Table 4.1 Quartile Breakdown for Hypertension and Diabetes Control, Full Sample Pooled, 2009-2011 114

Table 4.2. Number and Percent of Health Centers by Diabetes and Hypertension Performance, 2009-2011.....115

Table 4.3. Descriptive Findings by Quartile, Pooled Full Sample 2009-2011, Hypertension.....120

Table 4.4. Descriptive Findings by Quartile, Pooled Full Sample 2009-2011, Diabetes.....122

Table 4.5. Ordinal Logistic Regression Results, Hypertension Control.....125

Table 4.6. Ordinal Logistic Regression Results, Diabetes Control 134

Chapter 1: Introduction and Policy Problem

This dissertation will explore the factors related to Federally-Qualified Health Centers' (FQHCs) performance on two key clinical outcomes measures: diabetes and blood pressure control. Also known simply as health centers, these provider organizations operate under the same federal program requirements and similar missions but vary in delivery of clinical and non-clinical care. Few studies have empirically evaluated drivers of health center quality of care. This exploratory dissertation seeks to understand the context of care delivery in health centers while understanding how patient, organizational, and external characteristics are related to facilitating or hindering high quality outcomes.

This chapter describes relevant national context and health center background, including pressures to improve care quality and experiences with quality improvement activities. It also describes the health center model and where it allows for flexibility in response to local circumstances and preferences. Finally, it presents the dissertation research aims, questions, methodological approach in brief, and the potential contributions.

The State of the US Health Care System and Primary Care

The United States health care system is currently underperforming. Too few receive the care they need, and quality outcomes are suboptimal. Only 55% of adults receive recommended care for acute and chronic conditions as well as preventive care

(McGlynn et al, 2003). Furthermore, just over half of US adults with diabetes have their blood sugar level under control, while less than half (43.7%) of adults with hypertension, a risk factor for heart disease and other acute health problems, have their high blood pressure under control.[1] As leading causes of death and health complications in the U.S., both of these indicators are among the priority conditions identified by Healthy People 2020 for improvement, and both currently fall short of these targets (Healthy People, 2010). Uncontrolled diabetes and hypertension often result in higher health care spending (Kim, 2007; Flack et al, 2002).

Some groups experience worse health outcomes than others. Indicators of care tend to show that receipt of preventive health care services, health outcomes, and/or health status are generally worse for poor, minority, rural or inner-city, uninsured, and Medicaid insured individuals compared to their national counterparts (AHRQ, 2011). African Americans and Hispanics, those with low income, and the uninsured tend to fair worse on diabetes and hypertension control (Healthy People, 2010).

Primary care is generally considered the foundation of a higher performing and more efficient health system. Americans get the bulk of their preventive care and chronic care management in primary care settings. Primary care can narrow many health care disparities and prevent the use of costlier, avoidable sources of care (Miller et al, 2010; Starfield, Shi, and Macinko, 2005). Use of primary care improves health at the patient and population levels (Starfield, Shi, and Macinko, 2005).

[1] Specific sources for these measure as provided in Healthy People 2020 (www.healthypeople.gov): adults aged 18 years and older with high blood pressure/hypertension had it under control in 2005–08 (age adjusted to the year 2000 standard population) from National Health and Nutrition Examination Survey (NHANES), CDC, NCHS; adults aged 18 years and older with diagnosed diabetes had an A1c value less than 7 percent in 2005–08 (age adjusted to the year 2000 standard population) from National Health and Nutrition Examination Survey (NHANES), CDC, NCHS.

Yet primary care practices vary in their performance along process of care and patient outcomes. A large-scale national study demonstrated sizeable regional differences in quality of care provided to Medicare enrollees, particularly those services shown to reduce morbidity and mortality. These variations persisted even after accounting for resource supply, access to continuous care, and overall spending (Wennberg and Cooper, 1999). US primary care physicians vary greatly in their adherence to pharmacologic management of chronic disease, preventive counseling for healthy behaviors, appropriate use of screening tests, and appropriate prescribing for elderly patients (Goldman et al, 2012).

Primary care practices themselves are complex enterprises. Over time, the breadth of preventive services has expanded, patient demographic diversity and co-morbidities broadened, and common medications changed – on top of a health care system that has become more difficult to navigate in terms of payer expectations and accountability demands, new clinical guidelines and technology, and various practice settings (Katerndahl, Wood, and Jaén, 2010). Primary care clinicians must handle complicated patients, multiple administrative duties, the reporting of quality indicators, implementation of new care delivery designs, and competing demands (Goldman et al, 2012; Litaker et al, 2006; Plsek and Greenhalgh, 2001). A typical 10-15 minute primary care visit addresses four to five health problems and delivers a broad array of services. Moreover, primary care practices must conduct practice improvement through complex interactions of multiple clinical staff, patients, and community factors (Crabtree et al, December 2011).

Primary care practices appear to be more complex than specialty care practices. Katerndahl, Wood, and Jaén (2010 and 2011) compared the complexity of general/family medicine, cardiology, and psychiatry by measuring visit and patient characteristics as well as services provided per hour.[2] In their studies, general/family medicine demonstrated a 33% higher complexity density per hour than cardiology, and a five-fold higher density per hour than psychiatry.

Added complexity in practice is particularly problematic for effective chronic care management. Some leading experts in quality improvement (QI) believe that primary care is not well designed to deliver the continuous or longitudinal care necessary for chronic conditions, but is instead organized around acute care (Bodenheimer, Wagner, and Grumbach, 2002). Looking specifically at care management for diabetes, which has notably changed over the last 20 years, Grant and colleagues (2004) found as the number of visits for most measures of care management increased or remained stable, medical regimen became considerably more complex, and the proportion of visits lasting more than 20 minutes increased. They conclude that this higher level of complexity coupled with limited visit times challenge practices' ability to reach evidence-based care goals.

The Institute of Medicine (IOM, 2001 and 2003) highlights gaps between evidence-based care and actual practice, particularly for chronic conditions. The IOM attributes much of the gaps in quality to organizational barriers in delivering continuous and coordinated care, as well as variation in clinical behavior and management. Others

[2] This study used the 2000 National Ambulatory Medical Care Survey (NAMCS).Authors measured the mean "input" (reason for visit, diagnoses, physical exam, testing, and patient demographics) to mean "output" (medication prescribed, procedures and therapies provided, and patient disposition) quantity per clinical encounter, weighted by diversity and variability of encounters within practice type. The authors then adjusted the estimates based on average duration of visits, assuming that as the input increases, system complexity increases even more dramatically. They conclude that the input drives more of the complexity than the output.

more generally point out that primary care practices experience notable degrees of uncertainty and disagreement in every day practice. This means that they practice in a so-called "the zone of complexity" where outcomes are not easily predicted (Plsek and Greenhalgh, 2001), thus explaining high variability in patient management across physicians and practices (Katerndahl, Wood, and Jaén, 2010; Katerndahl, Wood, and Jaén, 2011).

Clinical guidelines may make up for some unknowns in care delivery, though this may not overcome organizational, patient, or other differences that could be related to quality variation. The application of clinical guidelines in practice may not be effective when managing patients with multiple clinical and social needs. The greater complexity surrounding a situation, the more clinicians are faced with diagnostic uncertainty because patients cannot be expected to respond in predictable ways. Given the short amount of time primary care clinicians have to deal with seemingly more complex encounters (in terms of patient severity and extent of services provided), they will perceive greater practice burden, and are likely to apply evidence-based guidelines less frequently (Katerndahl, Wood, and Jaén, 2010; Katerndahl, Wood, and Jaén, 2011). High-volume practices tend to have shorter visit durations than low-volume practices, and the former may therefore deliver fewer preventive services as well as focus less on patient satisfaction and building positive provider-patient relationships (Zyzanski et al, 1998). It can therefore be assumed that such complex situations run great risk for medical errors and worse patient outcomes.

For these reasons, the health care system is increasingly focused on performance improvement and accountability (Berwick, Nolan, and Whittington, 2008; IOM, 2001).

Payers, policymakers, and researchers recognize that achieving performance improvement requires focus on three concurrent goals: better health and health care experiences for individuals, better population health, and reducing per-capita costs of care. Together, these make up what has been coined the Triple Aim (Berwick, Nolan, and Whittington, 2008). The nation's largest health care payer and administrator, the federal Center for Medicare and Medicaid Services, now aspires to align the agency's priorities with the Triple Aim (Fleming, 2010). Moreover, many features of the Affordable Care Act (ACA) of 2010, also known as the national healthcare reform legislation, facilitate health system redesign to meet these aims. Activities at the payer levels place added emphasis on accountability through system reform and improved care coordination.

These investments come as demand for health care, particularly primary care, is on the rise. Over the next few years, the U.S. health care system will embark on a major transformation. The ACA creates new or expands existing sources of insurance. Following the U.S. Supreme Court's summer decision on the ACA, making the Medicaid expansion optional for states, the Congressional Budget Office estimated that 29-30 million currently uninsured individuals could gain insurance coverage by the end of the decade (CBO, 2012). Many of the newly insured will enroll in Medicaid, while others will enroll in private insurance through newly established Health Insurance Exchange systems. As recently demonstrated in Massachusetts, broad insurance expansion is followed by a surge in demand for primary care services, particularly in poor communities previously affected by high uninsurance rates (Ku et al, 2009). These patients are heavily dependent on the nation's safety net system.

The U.S. Health Center Program

The ACA makes significant investments in primary care infrastructure. One such program is the national network of federally-recognized Community, Migrant, Homeless, and Public Housing Health Centers, together known as health centers or Federally-Qualified Health Centers (FQHCs).[3] The Health Center Program began over 45 years ago and was born out of the War on Poverty (HRSA, 2011). Today, health centers make up the nation's largest primary care provider type. Over 1200 health center organizations care for more than 20 million patients nationally and deliver care through over 8500 sites.[4] These sites are located in every state and territory, and spread across urban and rural areas (NACHC, July 2012).

Patients tend to be under 200 percent of poverty, members of racial/ethnic minority groups, uninsured of publicly insured, and experience complex socio-enviro-economic factors related to poor health (NACHC, July 2012) – the very populations that tend to experience acute health disparities. In fact, health centers serve disproportionately more low income, minority, uninsured, and Medicaid populations than

[3] While these terms are often used interchangeably, there are some nuanced differences. FQHCs are defined by Medicare and Medicaid statutes (Titles XVIII and XIX of the Social Security Act, respectively) and indicate that an entity is approved to be reimbursed under FQHC-specific Medicare and Medicaid methodologies (laid out in statute). Most FQHCs are also organizations that receive federal Health Center Program grants authorized under Section 330 of the Public Health Service Act. Federally-funded health centers often receive grants to serve statutorily recognized special populations (homeless, migrant and seasonal farmworkers and their families; and residents of public housing). Most receive a combination of grants to serve general and special populations. These federally-funded health centers must also meet additional programmatic expectations set by the federal Bureau of Primary Health Care. Roughly 100 FQHCs (less than 10%) do not receive federal funding under Section 330 and are generally referred to as "FQHC Look Alikes." They still meet FQHC criteria and receive many of the same benefits. For more information, see http://www.bphc.hrsa.gov/technicalassistance/healthcenterterminologysheet.pdf.

[4] Most federally-funded grantee health centers and FQHC Look Alikes operate multiple service delivery sites.

other providers (NACHC, 2012), and significant proportions of the nation's most at-risk populations (Figure 1.1). Two in five patients have Medicaid while more than a third (36%) are uninsured (NACHC, 2012). Their patients are more likely to have chronic conditions such as mental disorders, diabetes, asthma, and hypertension compared to patients of office-based physicians (Dor et al, 2008; NACHC, 2012). Health centers also serve large numbers of special populations that face unique barriers to care, such as homeless and migrant or seasonal farmworkers.

Figure 1.1

Share of the Nation's Vulnerable Population Served by Health Centers

- 1 in 7 **Medicaid** beneficiaries
- 1 in 7 **uninsured** persons, including 1 in 5 **low income** uninsured
- 1 in 3 individuals in **poverty**, including 1 in 4 **minority individuals in poverty**
- 1 in 7 **rural** Americans
- 4.7 million patients best served in **languages other than English**

Source: National Association of Community Health Centers (NACHC). *A Sketch of Community Health Centers: Chartbook 2012*. 2012. www.nachc.com/research.

The ACA invested $11 billion in the Health Center Program over five years. Most of these funds were allocated to cover operational expenses, while the remainder will cover capital infrastructure needs. Congress deemed these funds as non-discretionary, setting up a short term health center "Trust Fund" to be allocated on top of their current annual discretionary based.[5] The expectation was that health centers would use these funds to rapidly expand patient capacity. Coupled with the ACA's broad health insurance expansions, health centers' patient insurance mix will shift such that more patients will be insured, especially through Medicaid, while the share of patients without insurance will

[5] In 2011, health centers lost $600 million to their discretionary base, curtailing some expected growth.

decline. At the same time, they will serve larger proportions of the nation's uninsured, Medicaid-insured, low-income, and otherwise at-risk populations (NACHC, March 2012). Currently, the Trust Fund is set to expire at the end of Fiscal Year 2015, and health center advocates are working to maintain funding levels or minimize possible cuts.

The Health Center Model of Care

Health centers' patient base is a reflection of their model of care. In order to be recognized as FQHCs and receive federal Health Center Program grants authorized under Section 330 of the Public Health Service Act, these organizations must meet program requirements set in statute and regulation. The Bureau of Primary Health Care (BPHC), located within the Department of Health and Human Services (DHHS) Health Resources and Services Administration (HRSA), administers this grant program. These criteria (George Washington University, 2012; OIG, 2012; HRSA, 2011),[6] broadly covering need, services, management, financing, and governance, are intended to ensure that health centers improve access to affordable care in communities with insufficient primary care resources and high risk for health disparities. Some are also designed to promote high quality care.

- *Not-for-profit, community-governed entities.* While a few health centers are public entities, most are private and all are non-profit. They are run by consumer-majority governing boards, at least 51% of which are made up of actual patient users.

[6] See also, BPHC website on program requirements at http://bphc.hrsa.gov/about/requirements/index.html, as well as http://www.nachc.com/client/Background_Paper_on_CHC_Model_FINAL.pdf.

- *Serve underserved areas and populations*. Health centers must be located in or serve federally-designated Medically Underserved Areas/Populations (MUA/Ps). These are areas or populations designated by HRSA as having a primary care physician shortage, high infant mortality, and high poverty and/or high elderly population.[7] Many health centers receive targeted health center funds to reach populations recognized in statute as particularly vulnerable, including migrant/seasonal farmworkers, homeless individuals and families, and residents of public housing. Many also operate school-based health centers.
- *Open to all*. Health centers are required to serve all comers without regard to ability to pay. Self-pay patients are charged nominal fees based on a sliding fee scale, but cannot be turn away when they cannot make this fee.
- *Provide comprehensive, coordinated primary and preventive health care services.* Health centers must provide a broad array of medical services,[8] including "enabling services" that are designed to facilitate access to care, promote healthy behaviors, and address social determinants of health. Such services include translation/interpretation, transportation, case management, outreach, home visitation, and linkages to social services. Health centers are also encouraged or in some cases required to cover a comprehensive array of behavioral health,

[7] HRSA is currently revising the MUA/P designation criteria.

[8] By federal law, health centers are required to provide the following clinical services: 1) health services related to family medicine, internal medicine, pediatrics, obstetrics, or gynecology that are furnished by physicians and where appropriate, physician assistants, nurse practitioners, and nurse midwives; 2) diagnostic laboratory and radiologic services; 3) preventive health services including prenatal and perinatal services, appropriate cancer screening, well-child services, immunizations against vaccine-preventable diseases, screenings for elevated blood lead levels, communicable diseases, and cholesterol, pediatric eye, ear, and dental screenings to determine the need for vision and hearing correction and dental care, voluntary family planning services, and preventive dental services; 4) emergency medical services; and 5) pharmaceutical services as may be appropriate for particular centers. Notably, mental health and substance abuse is not a required service, except for Homeless Health Center grantees.

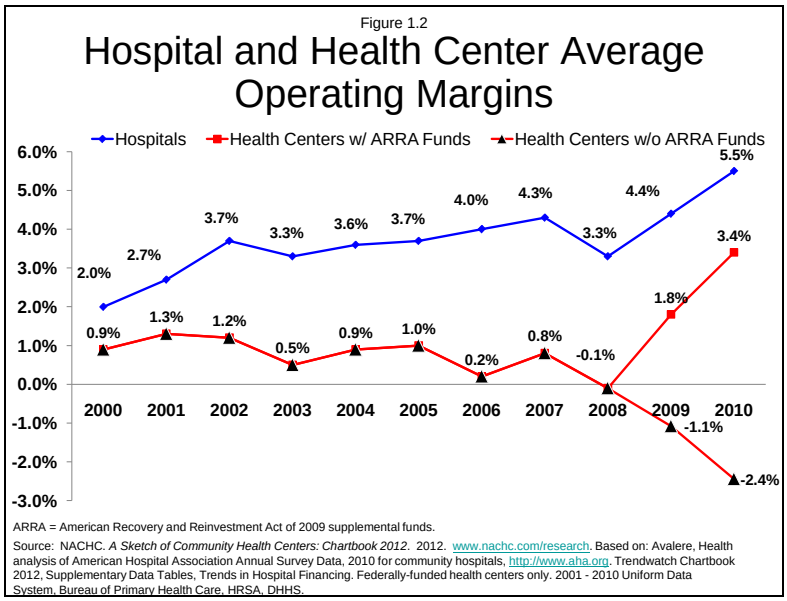
dental, vision, and pharmacy services. These services are delivered through a multidisciplinary team of health care professionals. Health centers must provide required services onsite or through contractual relationships with other providers, and collaborate with other local health and social service providers and coordinate care accordingly. For instance, health centers are expected to have referral arraignments with one or more local hospitals.

- *Deliver culturally competent care.* Health centers are required to ensure that all organizational functions – including their services, practices and policies – respect and respond to the cultural preferences of their patient populations.
- *Conduct ongoing needs and quality improvement assessments*. Program expectations include having an ongoing QI and quality assurance (QA) program and accompanying plan covering both clinical services and quality management. QA programs are to be performed through a systematic collection of patient records in order to identify and document needed changes in the utilization and quality of health services. Health centers must also conduct regular and formal assessments of the served community's needs.
- *Meet other performance and accountability requirements*. Health centers must meet other program obligations around their administrative and financial operations. For instance, federally-funded centers report data on patients services, services provided, costs and revenue annually to the BPHC.

Given their model and patient base, health centers are generally considered resource-poor, making it challenging for many to invest in quality improvement

infrastructure. Federally-funded health centers on average are heavily dependent on two sources of revenue: Medicaid and their BPHC health center grants (Figure 1.2). This reflects the fact that 75% of their patients have Medicaid or are uninsured. Many also benefit from state and local grants. Yet they average slim operating margins (Figure 1.3).

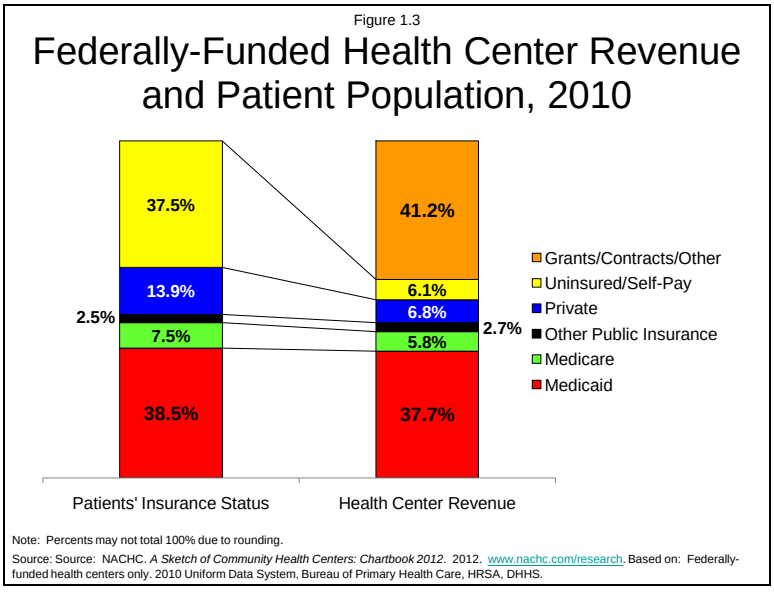
Figure 1.2



ARRA = American Recovery and Reinvestment Act of 2009 supplemental funds.

Source: NACHC. *A Sketch of Community Health Centers: Chartbook 2012*. 2012. www.nachc.com/research. Based on: Avalere, Health analysis of American Hospital Association Annual Survey Data, 2010 for community hospitals, http://www.aha.org. Trendwatch Chartbook 2012, Supplementary Data Tables, Trends in Hospital Financing. Federally-funded health centers only. 2001 - 2010 Uniform Data System, Bureau of Primary Health Care, HRSA, DHHS.

Figure 1.3



Note: Percents may not total 100% due to rounding.

Source: Source: NACHC. *A Sketch of Community Health Centers: Chartbook 2012*. 2012. www.nachc.com/research. Based on: Federally-funded health centers only. 2010 Uniform Data System, Bureau of Primary Health Care, HRSA, DHHS.

Same but Different: Benefits and Potential Consequences

Federally-mandated program requirements ensure that health centers as a single program have common features when compared to other primary care providers. However, federal program requirements leave room for each health center to design its program in a way that responds to the specific needs, preferences, and resource constraints of their diverse communities. Health centers vary greatly in terms of size, patient mix, revenue sources, services beyond traditional primary care, staffing, and geographic location. They also function under varying state policies and deliver care across different local health care markets. Differences across health centers include clinical services, particularly QI activities and capacity, clinical practice across any given service or condition, and linkages to other providers for those services not available within the health centers' walls. While program requirements mandate the minimum level of services and quality-related programs, they do not specify standards.

For example, the HDCs required centers to apply the same basic framework but allowed for great flexibility in adopting specific QI initiatives in order to tailor them to their unique populations and settings (Chin, 2010; Grossman et al, 2008; Chin et al, 2007). As a more recent example, a DHHS Office of Inspector General (OIG) report (2012) found that while nearly all of sampled health centers (N=147) had quality assurance programs (97%) and that services provided were generally appropriate for most patients, there existed some cases of insufficient medical record documentation and inconsistency in health center QA activities. Among those centers that report conducting required periodic assessments under their QA program, 46% do so once a year, and 9% do so every 6 months. Others report doing so more frequently or even continuously.

Among those that review patient medical records during their assessments (91%), less than a third (30%) review records for all patients.

Elements in health centers' QA programs also vary. Two in five grantees report assessing medical records and documentation as well as quality of care (83% and 82%, respectively), while assessing patient outcomes, service trends, and medical necessity of service are less frequently reported (61%, 57%, and 35%, respectively). Clinical protocols and patient outcomes for diabetes screening/care and hypertension screening/care are among the most frequent. For diabetes, 88.7% of sampled health centers report including this element in clinical protocol assessments, and 91.9% report including it patient outcomes assessments. Hypertension screening/care is slightly less frequently reported as included in health centers' QA program (81.4% for clinical protocols, and 72.8% for patient outcomes). Most centers assessed the accessibility of care, including availability of clinical staff, convenience of health center hours, affordability of care, availability of translation services, and wait times for scheduled appointments. And 95.1% assess patient satisfaction (OIG, 2012).

The OIG determined that the lack of detailed requirements "may have limited their usefulness in ensuring that patients receive necessary primary health services" (p.19). The OIG also reports that HRSA's current oversight and review activities provided limited information on the extent to which individual patients receive appropriate care, instead focusing on grantee program requirements, the collection of core clinical data, and efforts to improve programs generally. They recommended that HRSA provide more guidance to health centers on specific elements and requirements that should be in their quality assurance plans, and establish procedures by which health

centers can independently assess the services provided and adequacy of medical records. HRSA agreed with the OIG's assessment (OIG, 2012).

Health Center Quality Improvement Endeavors: A Recent History

Broadly speaking, the aim behind QI initiatives is to narrow practice discrepancies and augment quality. HRSA has invested heavily in health center QI, conducts health center grantee site visits, and has modified program expectations over time. These efforts are generally designed to monitor quality performance across health centers and encourage targeted improvement. Most are administered through the BPHC. However, as described below, HRSA has received criticism on the sufficiency of these efforts to ensure high-quality of care.

One means for incentivizing a culture of quality is through the Federal Tort Claims Act (FTCA). As of 1994, federally-funded health centers are eligible for free medical malpractice coverage under FTCA. FTCA coverage guarantees that the U.S. Department of Justice will handle malpractice claims filed against an eligible provider as well as bear the cost of any settlement or judgment. To receive FTCA coverage and benefit from substantial financial savings, health centers go through an annual "deeming" process through the BPHC. To be deemed, the health center must demonstrate that it has completed a thorough credentialing process of their licensed or certified clinical staff, as well as maintain clinical protocols, tracking systems, medical records review, and active quality assurance programs (GWU, 2012; HRSA, 2011).[9]

Since 1996, the BPHC has encouraged health centers to seek external accreditation for their ambulatory care programs, such as through the Joint Commission

[9] See also, http://www.bphc.hrsa.gov/ftca/healthcenters/index.html.

or the American Association for Ambulatory Care, in order to validate or identify and correct safety and quality of care. To do this, HRSA pays the fees associated with seeking accreditation. More than 1 in 4 health centers are currently accredited (HRSA, 2011).

In 1998, HRSA launched the Health Disparities Collaboratives (HDCs), which were designed to improve care management across multiple conditions in order to eliminate health disparities (HRSA, 2011). The HDCs were born out of recognition that although health centers' quality of care for chronic conditions was similar to other settings, quality across all settings could still be improved and wide variation in quality performance existed across all health centers (Chin, 2010).

The HDCs applied the Wagner Chronic Care Model, an evidence-driven framework that aligns multiple dimensions of care – community, health system or organization, patient, and practice-team – to improve clinical outcomes through informed, engaged patients and a team of proactive clinicians. The HDCs also applied models for learning and improvement, including the "Plan-Do-Study-Act (PDSA)" rapid cycle of practice testing and implementation of the Chronic Care Model. Essential elements of the HDCs included creating a core staff team with the support of the centers' senior leadership, patient self-management, system redesign, decision support, community outreach and partnerships, and clinical informational systems, such as a data registry, to track care for patients receiving the intervention. Health centers varied in the number and type of QI activities adopted under the HDCs. Health center staff spent considerable time per week working on HDC activities, including senior administrative leaders. The BPHC and state Primary Care Associations[10] (PCAs) played major roles in

[10] PCAs are organizations that provide state level support for health centers, much in partnership with the BPHC and the National Association of Community Health Centers.

supporting intensive learning communities of health center participants and building health center QI capacity. Health centers participating in the HDCs started with one focus area – diabetes, cardiovascular disease, asthma, depression, chronic disease prevention, cancer screening, as well as finance/redesign and clinical pharmacy. Many participating centers, but not all, expanded their HDC efforts to target multiple focus areas. By December 2008, 88% of federally-funded health centers had participated in at least one HDC (Chin, 2010). However, the HDCs were limited in their spread across new conditions, new sites within multi-site health centers, and possibly new patients. After about 10 years, the BPHC stopped financing the HDCs and technical support for the HDC began to wane (George Washington University, 2012).

In 2004, HRSA established a new assessment process to review health centers' clinical and financial performance, as well as provide technical assistance. HRSA staff work with individual health centers to identify and work to improve performance along three to five priority measures for each center. By 2007, HRSA created the Performance Analysis and Recommendations (PAR) review tool for tracking progress on program performance and compliance. HRSA Program Officers work with health centers to identify areas needing improvement and facilitating access to technical assistance when appropriate (HRSA, 2011).

In an attempt to track health centers' quality performance and target areas in need of improvement, HRSA added new quality measures to health centers' annual reports, the Uniform Data System (UDS), starting in calendar year 2008. These measures included diabetes and hypertension control, low birth weight, and process of care measures on pap test, immunizations, and access prenatal care. These UDS quality measures are intended

to reflect the comprehensiveness of health center services and age groups targeted, as well as HRSA prioritized primary care sensitive conditions common among low income populations. These measures are similar to those endorsed by nationally recognized quality organizations, such as the National Quality Forum, National Committee for Quality Assurance (NCQA), AQA Alliance (formerly the Ambulatory Care Quality Alliance), and Healthcare Effectiveness Data and Information Set (HEDIS) (HRSA, 2011; Shi, Lebrun, Zhu, et al, 2012). Requiring the collection of measures used by other entities allows for inter-provider comparisons.

Starting in 2009, HRSA implemented a standardized Health Care Plan and Business Plan using the 2008 UDS quality metrics as well as UDS financial measures. These plans were intended to assist health centers in establishing quality and performance goals, as well as provide HRSA staff a tool for monitoring health centers' progress toward these goals (HRSA, 2011).

HRSA also now encourages or supports health centers' attainment of health information technology that meets national "Meaningful Use" criteria and Patient Centered Medical Home (PCMH) recognition, objectives towards which providers nationally are working. Many health centers have been or are currently working towards PCMH recognition (OIG, 2012). The BPHC pays for PCMH recognition, and over the last 18 months offered two rounds of supplemental funding to support health center PCHM goals. The BPHC also provides or pays for training and assistance around attaining meaningful use certification. According to NACHC, 85 health center sites will likely receive PCMH recognition from one of two possible recognition bodies in the near future. Nearly 1000 health center sites are participating in the BPHC's PCMH funding

initiatives. However, approximately 700 missed a recognition submission date because they were not ready.[11] Five hundred health center sites from roughly 250 health center organizations are participating in federal Centers for Medicare and Medicaid Services (CMS) demonstration designed to transform health centers into PCMHs, and centers from five states are involved in a privately funded safety net PCMH demonstration supported by the Commonwealth Fund.

As for where health centers turn to receive training and technical assistance, HRSA supports national and state programs through cooperative agreements. However, the Government Accountability Office (GAO) recently criticized HRSA for poor supervision over program expectations (GAO, 2012a; GAO, 2012b).

Over the last few years, HRSA has also expanded its Health Center Controlled Network (HCCN) program. This program, funded under Section 330 of the Public Health Service Act, allows groups of three or more independent health center organizations to augment operations by pooling resources and bringing infrastructure to scale across member centers. HRSA funding is in addition to each center's federal health center grants, making it possible for member centers to remain autonomous and form separate, collaborative business entities (HRSA, n.d.).

The specific services offered by each network and organizational structure vary by members' need and level of maturity. They generally support high-cost infrastructure, specialized personnel, and operations that benefit from economies of scale. HRSA reports that most are heavily engaged in clinical quality improvement and technology. For example, HCCNs are often responsible for centers' health

[11] According to a conversation with and written summary from Dr. David Stevens, NACHC Quality Center Director, on November 5, 2012.

information technology (HIT), including acquisition and use of Electronic Health Records (EHRs), data management, network development and administration, and health information exchange. Some provide clinical services across members, such as implementation of clinical guidelines, documentation, and continual quality improvement. Other core functions may include finance, administrative services, as well as managed care contracting, credentialing, and utilization management (HRSA, n.d.).[12] According to the National Association of Community Health Centers (NACHC), there are currently 102 HCCNs, some of which are run by state health center associations.[13]

Comparing Health Centers to Other Provider Types

Much of the evidence on health center quality performance compared them to other providers. Fewer than a dozen in recent memory looked across health centers (Lebrun et al, forthcoming; Shi, Lebrun, Zhu, et al, 2012; Gold et al, 2009; Zhang et al, 2009; Shelley et al, 2011; Hicks et al, 2006; Ulmer et al, 2000). This dissertation looks exclusive across health centers, and the following chapter will review literature relevant for understanding intra-provider quality performance variation. However, inter-provider comparative studies acknowledge that health centers are major players in the health care system, and set the stage for critical explorations of variation across health centers.

[12] For more information on Health Center Controlled Networks, visit http://www.hrsa.gov/healthit/toolbox/HealthITAdoptiontoolbox/OpportunitiesCollaboration/controlnetworks.html.
[13] For a current list of HCCNs, visit http://www.nachc.com/HCCNs.cfm.

Before reviewing comparative assessments, it is important to understand that health centers may represent practices with higher levels of complexity compared to mainstream primary care providers, given that they serve patients with more clinical and social needs in resource-poor settings. For instance, health center patients have higher prevalence of diabetes, obesity, and depression compared to private office-based primary care practices. They are also more likely to be uninsured, Medicaid-insured, or members of racial/ethnic minority groups, and more likely to live in communities with lower average incomes and less education (Shi et al, 2010). Health centers also integrate a wider array of non-traditional primary care services into their clinical practice. These services include dental, behavioral health, pharmacy, enabling, and social services. Health centers, then, may face higher degrees of uncertainty and disagreement than other providers, and patients are conceivably less likely to respond in predictable ways. And as Goldman and colleagues (2012, p.143) write,

> "Adherence to recommended chronic disease and preventive care measured in performance assessments can therefore be more challenging in patients with multiple co-morbidities. These challenges are further heightened in FQHCs and look-alikes where patients frequently have limited health literacy, housing instability, and food insecurity."

Despite the challenges involved in treating complex, at-risk patients in resource-poor settings, research generally documents that patients served by health centers are associated with better outcomes and receive more preventive services compared to similar patients served by other providers. More health center patients report having a

usual source of care than other low income populations, and they are more satisfied with the overall care they receive and the hours of operation. Looking exclusively among health center patients, disparities in satisfaction generally do not exist, but one recent study showed health center uninsured patients are statistically less likely to be satisfied with their overall care compared to privately-insured patients (Lebrun, 2011). Health centers narrow racial/ethnic disparities among their patient population (Lebrun et al, forthcoming), and health center uninsured patients have better access to care compared to the uninsured nationally (NACHC, 2012; NACHC, March 2012). Both the Institute of Medicine (2003) and the Government Accountability Office (2003) cite health centers for effectively screening, diagnosing, and managing chronic conditions such as diabetes, cardiovascular disease, asthma, depression, cancer, and HIV.

A recent study compared FQHC physician performance to U.S. primary care physician performance on 18 process of care measures using the 2006-2008 National Ambulatory Medical Care Survey (NAMCS). Before adjusting for patient characteristics, health center physicians on average preformed statistically better on six measures (including blood pressure screening and depression management) but worse on one (diet counseling to at-risk adolescents). Researchers found no differences in performance between health centers and other providers along other measures studied. These findings are particularly noteworthy because health center patients have higher rates of uninsurance and Medicaid insurance, are more likely to reside in poor zip codes and have less education, and experience more chronic conditions than patients of other primary care physicians. Authors point out that these are the very same patients that are less likely to access specialty care for complex conditions and are therefore more likely to

rely on primary care. Adjusting for patient differences revealed that health centers preformed better on these seven measures and no differently on the others. However, both practice types experienced dramatic variation in quality (Goldman et al, 2012).

Another recent study echoes these findings and compares health centers to a third provider type. Drawing from the same data set, albeit using only 2006 and applying a different analytical design, researchers found that health centers perform process of care measures with comparable or higher occurrence compared to private, office-based physicians and outpatient departments. After adjusting for patient differences, such as type of visit and clinical risk, health centers had 1.38 times higher odds of prescribing medication during a visit, 1.68 times higher odds of blood pressure checks during a visit, and 1.37 times higher odds of ordering a laboratory test during a visit than physician offices. Based on difference-in-difference analysis, health centers experienced narrower racial/ethnic and insurance disparities along these measures compared to physician offices and outpatient departments, and in some cases they do not exist at health centers while they do exist across other provider types. Authors suggest that other provider types may not have the expertise and resources (such as enabling services) to effectively serve vulnerable populations (Shi, Lebrun, Hung, et al, 2012).

This study, like the last, is not without its limitations. It used two different surveys with different data collection methods in order to compare primary care providers to hospital outpatient departments.[14] This may have resulted in inconsistent comparisons. Authors also uncovered possible sampling issues for the health center population, given that patient insurance and rurality proportions in the NAMCS does not match health

[14] The one representing health centers and other primary care practices relies on self-reported questionnaires, and the other representing hospital outpatient departments uses data collected through medical records.

centers' federal data reporting. This may be explained by the fact that the NAMCS represents visits, not patients, but it could also suggest that the NAMCS is not nationally representative (Shi, Lebrun, Hung, et al, 2012). This last caveat also applies to Goldman et al. For both, response rates for private practice physicians were considerably lower than those of health centers, and physicians in either care setting may have changed practice behaviors during the study period (Goldman et al, 2012). Still, these studies offer close "apples to apples" comparisons of health center and other physicians, shedding light on the contribution health centers make towards national quality goals.

Other research demonstrated that health centers achieve higher or similar levels of screening rates for many preventive and chronic illness management services compared to other providers, including preventive services for diabetes, hypertension, vaccinations, depression, and cancer (Dor et al, 2008; Hicks et al, 2006; Shin, et al, 2008; Regan et al, 2003;[15] Frick and Regan, 2001; Politzer et al, 2001). However, these studies and the two more recent ones (Shi et al 2012; Goldman et al, 2012) investigate health center performance on process of care indicators rather than patient outcomes, such as whether their chronic conditions were under control.

Hicks et al (2006) looks at health center performance on patient outcomes. They reviewed patient medical records from a nationally representative sample of health centers (N=64) prior to their participation in the Health Disparities Collaboratives and uncovered significant gaps in receipt of needed care among health center patients, particularly the uninsured. Yet health centers achieved rates of blood pressure control

[15] Regan et al found that rural health center patients did not experience higher rates for influenza vaccination or up-to-date mammogram screening compared to the general rural population. However, health center patients did receive many other preventive screenings at higher rates compared to rural patients generally.

better than those of hospital affiliated clinics, Veterans Affairs health systems, and commercial managed care, despite serving more high-risk patients than other primary care providers in terms of socioeconomic complexity and higher rates of chronic illness. Authors found that health centers did not outperform other settings on indicators for diabetes care, but note that this may be due to patient differences.

A very recent study compared health center patient outcomes to national benchmarks. It revealed that health centers' national performance on achieving controlled diabetes (HbA1c less than or equal 9%) was lower than the national rate. Conversely, health centers on average surpassed the U.S. rate of controlled blood pressure for hypertensive patients (blood pressure less than 140/90). These may not be fair comparisons as health center measures and the national benchmarks differed slightly in measurement criteria. For instance age groups and measurement years did not match. The study also relied on organizational level rather than patient level data to assess health center performance, and health centers varied in their means of data reporting[16] (Shi, Lebrun, Zhu, et al, 2012). Yet the findings are still instructive because the researchers did not compare health centers to other low income, at-risk patients.

Expectations of Health Center Participation in National Improvement Efforts

Nationally, the health care system is increasingly focused on performance accountability in order to address poor outcomes, health disparities, performance variation, and the consequential avoidable health care costs. The ACA makes significant investments in new models of health care delivery and value-based purchasing. In

[16] Some sampled while others reported the full universe of relevant patients from their EHR.

particular, it recognizes the important role primary care plays in meeting the Triple Aim. By funding a major expansion of the Health Center Program, the ACA also ensures that health centers will play an increasingly substantial role in the health care system. However, health centers are not immune to the accountability expectations that come with public investment and increased visibility.

Evidence of variation in clinical outcomes across health centers was recently highlighted in *USA Today*, which reviewed all UDS quality measures across all health centers nationally and concluded that "hundreds of the nation's nearly 1,200 federally funded community health centers fall short on key quality of care measures." The article noted their performance on some metrics, including blood sugar control for diabetics, lagged behind national averages. The article also implied that health centers in certain states were the worst performers (Galewitz and Monies, April 17, 2012). While this analysis was not peer-reviewed and lacked sufficient explanation of what may drive poor performance, it publicly raised the question on whether federal investments in the Health Center Program were paying off.

Health centers function in the same value-based, cost-conscious world as other providers. They are expected to participate in new, nationally-emphasized initiatives aimed at augmenting quality of care and provider accountability. These include PCMH recognition, Health Information Technology Meaningful Use criteria, fully integrating behavioral health into primary care, and adopting other strategies for improving access, outcomes, and cost efficiency (Benson, Townes, and Dobbs, 2011). Many health centers are also participating in pay-for-performance programs whereby insurance payers provide health centers financial bonuses for meeting pre-identified performance benchmarks.

Some are also participating in or negotiating to participate in Accountable Care Organizations or other shared-savings arrangements.

Several demonstration initiatives currently support health centers in modifying clinical practice to meet the standards of PCMHs. This includes the CMS demonstration across 500 health center sites with sufficient numbers of Medicare patients, and a five state privately funded demonstration supported by the Commonwealth Fund. While not every health center participates in one of these demonstrations, they serve as examples of increased focus on health centers as major players in the US health care system. Moreover, the BPHC has intimated that future federal health center funding will require new QI and QA activities as prerequisites. Increased attention on patient outcomes nationally and on the growing Health Center Program persuaded the BPHC to add new clinical indicators to federally-funded health centers' annually UDS reports.

Effect of Medicaid Policy on Health Center Capacity and QI Investments

The ability to compete in today's value-based environment requires a dependable source of financing. Adoption of quality-enabling infrastructure and transforming care delivery around total patient needs are both time-consuming and costly, but transitioning to PCMH necessitates such investments and changes. One recent study pointed out that higher scoring on the safety net PCMH scale is associated with higher health center cost per patient per month (Nocon et al, 2012). Medicaid makes up the largest share of patients and revenues nationally (39% and 38%, respectively). Just over half (54%) of health center Medicaid revenue comes from managed care.[17] States vary in their generosity of eligibility for adults, and health centers in those more generous states have

[17] BPHC, HRSA, 2011 Uniform Data System.

greater capacity in terms of number of sites, patients served, employed clinical staff, and revenue (Shin et al, 2012). States also vary in their payment policies. Medicaid financing is therefore particularly germane to the consideration of factors that may enable QI.

Perhaps most alarming to health center advocates is the need to justify and maintain their cost-related Medicaid payment in the face of national and state pressures to minimize Medicaid expenditures. Federally recognized health centers are paid on a per-encounter basis, known as the Prospective Payment System (PPS). This bundled payment structure is designed to function as capitated payments in order to encourage greater efficiency in care delivery. PPS is required by federal law but set by each state based on each health centers' total costs of care for reimbursable services. This generally excludes the cost of necessary enabling services that ensure receipt of needed care in and out of the health center.[18] In spite of this, the GAO determined that PPS rates in at least one-third of all states did not include all Medicaid-covered services, and that many states did not have an adequate process for rebasing PPS as health centers' costs increase. In short, their report determined a common lack of adherence to PPS law (GAO, 2005).

Since the GAO released its report, health centers' average Medicaid cost-to-collection rate has declined more than 6 percentage points. As of 2011, health centers nationally were reimbursed 81% of their costs, with some states reimbursing significantly less on average.[19] This is far higher than the collection rate from other payers. Another payment obstacle in place across some states is the inability to bill Medicaid for multiple visits on the same day. Given that three out of every four patients are either Medicaid

[18] Includes those services under each state's scope of services under Medicaid. These generally include medical, dental, behavioral health, and pharmacy services. Some states use an "Alternative Payment Method" which cannot be less than PPS.
[19] BPHC, HRSA, 2006 and 2011 Uniform Data System.

enrolled or uninsured,[20] and that their Medicaid patients tend to have more visits compared to uninsured patients (Shi et al, 2010), health centers by and large cannot shift a loss in Medicaid revenue to other payers.

In expanding health centers, the ACA will drive an increase in both total number and proportion of health center Medicaid patients served. Many of these patients will be insured through Medicaid Managed Care, which bring a financing structure separate from fee-for-service PPS but made whole by a state "wrap around." It also may bring additional requirements on health center delivery. Regardless, expanding volume cannot be expected to make up for per-visit losses. Similarly, health centers will serve more privately insured patients under health care reform through state-based insurance exchanges. By law, insurers participating in the exchanges must pay health centers no less than their Medicaid PPS rate. The consequence of trimming Medicaid PPS rates portends financial losses that will extend beyond just Medicaid patients.

Dissertation Purpose and Approach

The drivers of health centers' clinical quality performance variation have not been thoroughly examined. Variation itself is a marker of national quality problems. Health centers have common program requirements and missions, yet deviate in care delivery, local context, and payment. It is unclear how differences across health centers, including patient, organizational, and external attributes, influence patient outcomes. This includes careful consideration of the role financing plays in attaining higher quality performance, as well as the different mechanisms related to payment, such as managed care and

[20] BPHC, HRSA, 2011 Uniform Data System.

Medicaid collection rates. While the goal for health center advocates is to maintain or improve quality performance (as well as cost-effectiveness) compared to other provider settings, variation *within* the Health Center Program must be acknowledged in order to isolate the factors that drive or inhibit higher performance. Some of those factors may be amendable to policy changes, and others, such as patient case mix, may be best left for risk adjustment because they are outside a health center's control.

For these reasons, the goals behind this dissertation include the following:

1. Explore health center clinical performance variation along key patient outcome indicators, and the patient, organizational, and environmental characteristics that improve the odds of higher performance;
2. Uncover the conditions under which health centers perform optimally; and
3. Inform health centers, strategic partners, policymakers, payers, and others about the inputs related to high performance and narrowing variation.

Defining Performance for the Purpose of this Dissertation

As previously explained, national performance goals center around a multi-prong, approach: improving the experience of care for individuals, improving health of populations, and reducing per capita costs of care. The architect of this Triple Aim elaborates that better care for individuals encompasses six dimensions of quality as described in the 2001 Institute of Medicaid report, *Crossing the Quality Chasm*: safety, effectiveness, patient-centeredness, timeliness, efficiency, and equity. Furthermore, better population health requires addressing social determinants of health and unhealthy lifestyles (Fleming, 2010). All providers are expected to deliver on these goals while

better integrating care with the full range of services patients require. Protecting payment in a value-based environment means that providers must demonstrate a return on investment. And metrics of success may gauge performance along patient, population, or practice levels.

Patient health outcomes, such as having controlled diabetes or hypertension, are especially important measures of a provider's performance and overall value to the health care system as they are complex conditions requiring care over multiple visits. Caring for patients with chronic illness is challenging, even when providers and patients are well resourced (Chin, 2010), and therefore the outcomes are complex. Process measures may be easier to improve than patient outcomes because the latter requires behavioral change on the part of both patients and providers (Chin, 2010), as well as additional wellness resources outside the health center. This denotes that process measures may in fact be more within the health centers' control than these outcome measures.

Although process of care measures (e.g., receipt of procedures or screens) are important indicators of receiving evidence-based care, they do not tell the complete story of whether the patient and provider overcame the challenges associated with delivering complex care to complex patients. This dissertation, then, narrowly defines performance along key clinical patient outcomes measures, particularly those associated with longitudinal primary care, important for health center patients, and costly should adverse outcomes result. Furthermore, process measures relevant to these chronic conditions are not available across all health centers.[21]

This is not to suggest that health centers narrowly define performance. To them, performance also includes breaking down barriers to care, community empowerment in

[21] The reasoning behind selecting these dependent measures is further discussed in Chapter 3.

the direction of the health care, and elimination of health disparities. These are encapsulated in their model of care. As one former health center director defined it, "quality is the degree of excellence of the center's processes, provider and support-staff performance, decisions, and human interactions" (Benson, Townes, and Dobbs, 2011, page 10). Nevertheless, exploring the covariates of diabetes and hypertension control may shed light on more meaningful and lasting policy changes.

Research Questions and Summary of Approach

This dissertation seeks to answer the following research questions:

1. What health center characteristics consistently increase or decrease across performance quartiles?
2. What factors are associated with higher performance on outcomes?
3. Under what scenarios does a health center reach the highest quartile of performance?

My proposed dissertation draws on three years of organizational and case mix data from roughly 1000 Community Health Center organizations, as well as supplementary data reflecting state level policies. Two common quality metrics of interest include percent of hypertensive patients with controlled blood pressure and percent of diabetic patients with low HbA1c levels. These outcomes will be quartiled and health center differences between quartiles descriptively determined. Analysis will then explore the external-, organizational-, and patient-level factors statistically related to

achieving high performance as well as the circumstances in which a health center increases the odds of high performance.

.

Conclusion

As health centers gear up for what could be the largest and most rapid growth in the program's history, policymakers at all levels, health center boards and staff, strategic partners, payers, and others seek indications of which factors aid or inhibit high performance on key quality indicators. The identification of what drives performance variation draws attention to areas where there is room for improvement, where policy changes are needed, and where risk adjustment may be necessary. Because performance variation is little understood, especially across health centers, this dissertation can support efforts to narrow gaps in performance across the entire Health Center Program while also promoting efforts to improve it.

My dissertation aspires to inform policy makers and payers, practitioners and trainers, as well as researchers. Policymakers must be assured that their investments lead to improved patient health. Payers and other providers should heed structural and patient mix challenges when making performance comparisons across providers or when designing integrated care networks, particularly when these initiatives incorporate shared-savings that financially reward the highest performing providers. Health center board members and staff may narrow performance variation by benefiting from evidence-based strategies or resources, and other provider types can learn from health centers' experiences. Strategic partners such NACHC, the BPHC, and state PCAs can then better

target training and technical assistance or other supports for health centers, including the development of infrastructure that enables quality improvement efforts to be brought to scale. This dissertation can also inform the BPHC as they refine program expectations and guidance. Finally, this dissertation seeks to advance scholarly literature on factors that influence clinical quality performance. In this endeavor, this research will test the feasibility of using quartiles for performance comparisons and predictions.

Chapter 2: Review of Relevant Literature

This chapter examines the literature on clinical quality variation generally and across health centers specifically. It begins by speculating the different domains that theoretically contribute to performance. This body of literature is critical in understanding that performance is multi-dimensional. After this conceptual grounding, it reviews research on factors that correlate with high performance on clinical indicators. This chapter informs the methods and explanatory variables to be used in this dissertation, as well as the hypotheses to be tested.

Dimensions Driving Primary Care Performance Nationally

Each practice is influenced by internal and external factors as they relate to patient outcomes and other metrics of performance. Consequently, one must account for multiple practice attributes across multiple dimensions of care when referring to practice features that influence performance. While many studies have explored the dimensions of patient and provider level factors on performance, few have focused on organizational factors or presented conceptual or empirical work on the various dimensions that affect outcomes and drive variation (Shortell et al, 2005; Post et al, 2009). An emerging body of literature offers insight into the practice traits that affect patient outcomes, and how they relate to or influence other traits. This section reviews published theoretical models depicting factors that may shape performance, as well as the extent to which variation in performance across providers exists and what factors appear to drive it.

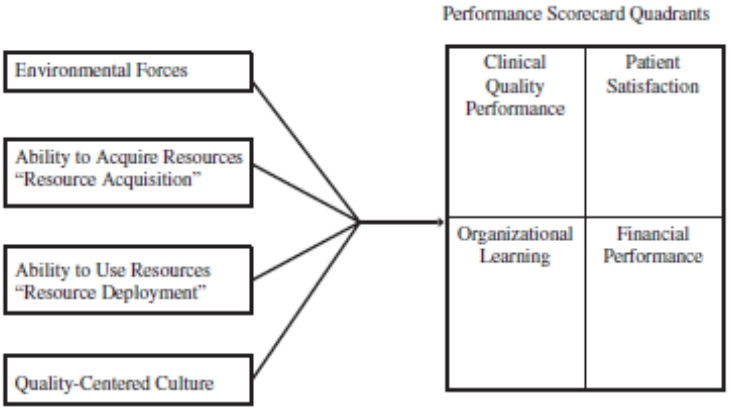
Previously Published Conceptual Models

Three papers conceptually delineate the dimensions that vary across providers and may facilitate quality improvement (Shortell et al, 2005; Yano, 2008; Post et al, 2009). While none stem from the research on health center practice and only one focuses exclusively on primary care settings (Post et al), each offers insight for crafting a model that explains performance variability among health centers, even if performance is defined differently.

Shortell and colleagues (2005) developed a multi-dimensional conceptual framework for differentiating high- versus low-performing medical groups. Drawing from organizational theory, they posit four major factors contributing to overall performance, defined as a scorecard encompassing clinical quality performance, patient satisfaction, organizational learning, and financial performance (see Figure 2.1 below). The first of these factors is the environment in which the organization operates. Health care organizations have limited resources and must meet certain normative and regulatory demands, such as accountability and reporting. This presents uncertainties and constraints. The remaining factors are internal to the organization. These include the acquisition of resources, the ability to deploy those resources and the process behind making those decisions, and commitment to a quality-driven culture (e.g., rewards for quality objectives, as well as emphasizing continuous quality improvement, patient satisfaction and learning).

Figure 2.1

Shortell et al (2005) Proposed Drivers of Physician Organization Performance



Source: Shortell SM, Schmittdiel J, Wang MC, et al. An empirical assessment of high-performing medical groups: results from a national study. *Med Care Res Rev.* 2005;62(4):407-34.

Yano (2008) describes the ways in which organizational characteristics and milieu influence clinician practice, patients' receipt of care and experience, and clinical outcomes. These factors also affect how practices can improve quality by effectively implementing evidence-based strategies. She broadly defines organizational performance as encompassing measures of process quality, intermediate outcomes, disease-related outcomes, practice- or population level measures of effectiveness (e.g., ambulatory care sensitive conditions admission rates), utilization patterns, and cost. Performance can be determined based on how patients, organizations, or even systems perform, but organizational outcomes reflect what an entire practice collectively experiences and are therefore related to evaluation activities.

According to Yano, organizational structures are generally the static resources making up the health care infrastructure. They tend to be less mutable than other health care organization attributes. She lists physical plant, functions of care incorporated into the physical plant, equipment, those employed, HIT, and governance among structural

elements. Separate from organizational structure is organizational processes. Process elements include practice arrangements, referral procedures, care coordination, and the way in which HIT is used to deliver care. These can be influenced by structure but are more mutable.

Organizational culture can be considered a structural feature (e.g., a measurable organizational average describing the context, level of organizational stress and beliefs) and a process (i.e., a way to view the "life" of the practice, relationships). Yano explains that understanding the dynamics of relationships within and outside the health care organization is fundamental to understanding how culture can affect the adoption and use of innovations. She references research that assumes it impacts effectiveness, readiness to adopt change, and behavior. However, she notes the lack of widely-accepted measures of culture or how those measures may be used to improve implementation of evidence-based practices.

While not her focus, Yano adds that environmental factors, such as geography, area resources, population characteristics, and managed care penetration, can serve two functions and therefore should not be ignored when seeking to uncover the organizational benchmarks that impact outcomes. First, environmental factors influence organizational structure. Second, they mediate the impact of environmental factors on care processes and outcomes.

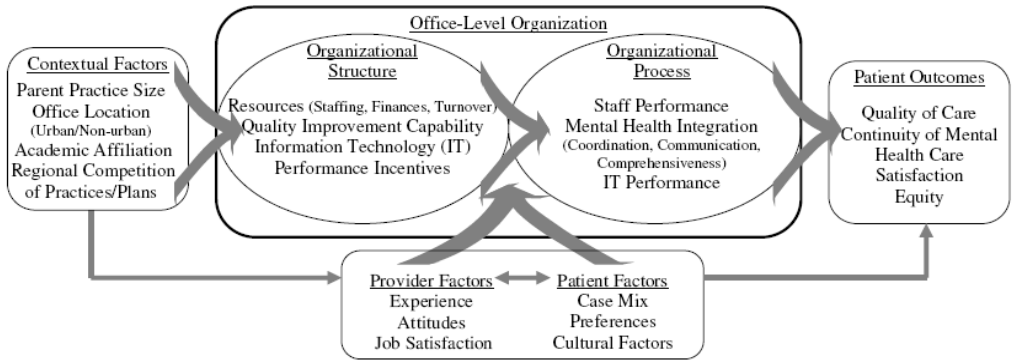
As Yano itemizes the attributes of organizational structures, process, and outcomes, as well as environment, Post et al (2009) present a framework characterizing primary care practice factors relevant to depression management. In many ways they build on Yano's descriptors and create their conceptual framework depicting the course

in which these and other domains impact quality of care. Given the variation across primary care practices in how longitudinal care is organized, their model emphasizes the underlying factors of primary care organization that facilitate or impede treatment and outcomes, in this case, for depression care. Major sources for both Yano and Post et al include literature on health services organizational research and the Donabedian quality framework, which posits a model for assessing health care quality based on the relationship between structures, processes of care, and outcomes (Donabedian, 2005).

Post and colleagues rationalize that five different domains each have some bearing on care delivery and ultimately patient level outcomes (Figure 2.2 below). Patient outcomes are intentionally defined broadly to reflect the multidimensional aspects of quality encapsulated by the Institute of Medicine's landmark *Crossing the Quality Chasm* and the Donabedian quality framework. The practice level organization makes up the heart of their conceptual framework. Similar to Yano, two domains make up this level: structure and process. Structural aspects of an organization may include resources such as staffing and finances, HIT, QI capabilities, and performance incentives. These formational aspects influence the manner in which care is delivered, including the utilization of resources. The progression of structure to process is what ultimately impacts outcomes. Post et al also acknowledge the external, contextual factors that impress upon the organization, along with the provider and patient traits that underlie organizational factors.

Figure 2.2

Conceptual Framework of Depression Care Organization in Primary Care Settings by Post et al (2009)



Source: Post EP, Kilbourne AM, Bremer RW, et al. Organizational factors and depression management in community-based primary care settings. *Implement Sci*. 2009 Dec 31;4:84.

To demonstrate the application of their framework, Post et al surveyed network-model primary care practices in order to depict the level of variation across practice inputs (specifically, external and organizational). They find considerable variation along their major domains in the delivery of longitudinal depression care among 30 practices within the same large primary care network in western Pennsylvania surveyed (90% response, representing 49 of 53 network office locations). In particular, the specific focus of QI capabilities varied, as did the application of information technology, coordination, and communication for depression management. The survey did not collect outcome data and therefore was not used to assess which variables impact outcomes and the magnitude of that impact. However, they note that even as practices adopt the Chronic Care Model,[22] heterogeneity in organizational factors can lead to variation in how that quality improvement model is applied, and this may hamper its intended effects.

[22] An evidence-driven framework that aligns community, health system or organization, patient, and practice-team level factors to improve clinical outcomes through informed, engaged patients and a team of proactive clinicians.

The conceptual models from these three published works contribute valuable insight into the everyday challenges and operations of primary care practices, as well as their relevance to outcomes. All three emphasize organizational level features. The Post et al framework is the only one of the three to explicitly list patient level factors as a contributing domain, and separates provider level influences from organizational level descriptors. In their framework, patient and provider factors underlie organizational ones. Still, their explanation of the organizational domain varies in minor ways from Shortell et al and Yano. For instance, Yano places provider incentives under organizational process, whereas the Post et al framework assumes they would fall under structure. Shortell et al's framework places organizational learning and financial performance under more broadly defined outcomes rather than factors of performance, because organizations are increasingly held accountable for care efficiency standards. What drives quality, according to Shortell et al, are those factors representative of the larger context of care delivery, practice culture and organizational process elements around resource acquisition and deployment. And across all models, domains of performance are not intended to be viewed in isolation. Instead, each has direct relevance to others.

Although largely conceptual, these papers largely echo the Institute of Medicine, which attributes gaps in quality for chronic conditions to organizational barriers in delivering continuous and coordinated care, as well as variation in clinical behavior and management (IOM, 2001 and 2003). These three models contribute to the overall framework that will guide this dissertation, including the analysis and the selection of

variables. These will be further explained in Chapter 3. In addition, these models also guide the literature reviewed and discussed in this chapter.

Practice Organizational Factors that Associate with Performance Variation

Shortell et al also demonstrated that performance along clinical quality, financial management, and organizational learning is associated with certain organizational factors. In the application of their framework, Shortell et al created performance quartiles from medical groups and independent practice associations that participated in the 2000-2001 National Study of Physician Organizations (NSPOs). Selecting only those practices with at least 20 physicians treating patients with asthma, congestive heart failure, depression, and diabetes, they analyzed data from 693 groups. To measure performance along clinical quality, one of their four performance areas, investigators created indices for overall quality, care management, and health promotion. Authors also measured the impact of organizational factors on two other performance domains: physician stability and clinical IT represented organizational learning, and profitability was used to measure financial performance.[23] Across all six outcomes measures representing the three dimensions of performance, they found few group practices were high performers on multiple dimensions.

Authors found a combination of factors is involved in differentiating the higher from the lower performing organizations. Across each outcome indicator measured, having a quality-centered culture and outside reporting were the most consistent and strongest drivers that differentiated the two groups. When investigating those providers

[23] In their analysis, Shortell et al did not explore one of their four performance domains: patient satisfaction.

who rank in the top quartile for at least four of the six outcomes measures, top performers have statistically significant higher odds of outside reporting and quality improvement involvement (odds ratio logistic regression 1.3 and 1.5 respectively, P<.001). Among the top quartile performers on at least two of the three dimensions, the characteristics that mattered most were outside reporting, involvement in quality improvement, number of physicians, age of organization, and measuring patient satisfaction.

Looking back at their categories of factors that influence performance, Shortell and colleagues also found several characteristics of group practices statistically differed between the top and bottom clinical quality performance quartiles. Under environmental factors, there was no difference in HMO penetration for top and bottom performers, but groups that participated in outside reporting were more likely to be in the top quartile for overall quality index, care management, and health promotion (all clinical quality performance measures). Groups with more physicians were slightly more likely to be in the top quartile for overall quality. Under quality-centered culture characteristics, the extent of quality improvement involvement is directly related to all three dimensions of clinical quality performance (overall quality, care management, and health promotion indices). Assessing patient satisfaction also impacts overall quality and health promotion.

At least one study compares performance variation by different practice domains. Marceau and colleagues (2011) claim that most research documenting the influence patients, providers, and organizations have on clinical decision making are done in isolation, thereby ignoring overall context. They hypothesize that patient, physician, and practice setting characteristics contribute separately and equally to the diagnosis and management of diabetes. To test this theory, they show 192 primary care physicians

"clinically authentic vignettes" of actors portraying patients presenting the same signs and symptoms strongly suggesting diabetes. Researchers interviewed the physicians during their work day and asked how they would diagnose and manage those patients in practice. Using a broad number of patient level, physician level, and organizational level variables, Marceau et al find that 20.7% of the variability in diabetes diagnosis is explained by the measures included. Most of the explained variance is related to organizational factors (14.3%). Included in this was practice culture, which was the most critical organizational level variable, though availability of resources also made a notable contribution (7.6% vs 3.2% of explained variance). Furthermore, 21.1% of the variance in appropriate management is explained by the measures used, again with organizational factors explaining the most (17.6%), which practice culture contributing the most.

Role of Electronic Health Records

Experts point to the use of Electronic Health Records (EHRs) as a critical tool for managing patients, improving health quality, and even controlling health care costs. Adopting EHRs is both capital and process intensive. Not only are they costly, in terms of both acquiring and implementing, but effective use of EHRs requires health care practices to change their workflow. In order to speed the adoption of EHR products and the full use of EHR features that enable enhanced care management, the American Recovery and Reinvestment Act of 2009 created the Medicare and Medicaid Electronic Health Record Incentive Programs, which offers financial payments to eligible providers who have adopted certified EHRs and can document "meaningful use" – that is, that they

meet certain functionality expectations.[24] Most health center physicians and nurse practitioners are eligible providers.

Evidence on the impact of EHR adoption on nationally recognized clinical indicators is mixed (Poon et al, 2010). Historically, research on the matter simply compared adopters to non-adopters and does not factor in the use of specific EHR functions, such as clinical decision supports. Research exploring the relationship between key functionalities and clinical outcomes is also mixed (Poon et al, 2010; Friedberg et al, 2009; Keyhani et al, 2008), but at least two find that they positively correlate with better outcomes (Poon et al, 2010; Friedberg et al, 2009).

Provider-Level Adaptive Reserve

Given the extent to which clinicians practice under some degree of uncertainty and disagreement (Plsek and Greenhalgh, 2001), those practices most capable of adapting to specific circumstances may yield the most gains in performance. Miller et al (2010) describe "adaptive reserve" as "the successful ability both to respond to changes in the local environment as well as to intentionally create change in that environment" (p.S70). It encompasses action and reflection cycles, facilitative leadership, a culture of learning, ability to improvise, repository of helpful stories about practice change, effective relationships and communication. The other two key elements are attentiveness to the local environment and a core inclusive of resources, organizational structure, and financial processes. They consider all but attentiveness to the environment as internal to the practice. Yet they promote adaptive reserve as what leads to sensemaking, teamwork,

[24] For more information, visit https://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/Meaningful_Use.html.

and a more positive work environment – all factors critical in transforming practices and reflective of practice culture.

Even Shortell et al, Post et al, and Yano imply that adaptive reserve is a key ingredient for high performance. Shortell and colleagues emphasize the ability to acquire and use resources as key inputs, and positions organizational learning as an outcome. Other elements of adaptive reserve appear in Post et al's framework, particularly under organizational processes and provider level features. Yano explains that problem solving is an important process features.

Patient Factors that Associate with Performance Variation

Other studies find that patient level factors explain sizeable variation in patient outcomes and provider quality performance (Landon, O'Malley, and Keegan, 2010; Hong et al, 2010; Ashworth and Armstrong, 2006; Saxena et al, 2006; Shi and Lu, 2000). Medical care itself accounts for only a small proportion of life expectancy or health status. Based on a review of literature, the widely used national County Health Rankings system attributes 40% of morbidity and mortality to social and economic factors, 30% to health behaviors, 10% to physical environment, and the rest to clinical care (Booske et al, 2010). The Centers for Disease Control and Prevention (CDC) identifies three categories of social determinants affecting population health: 1) social environment, which includes income, education level, marital status, and discrimination; 2) physical environment, including place of residence, crowding conditions, transportation systems, and unhealthy living spaces; and 3) health services, such as health insurance and access to and quality of care (CDC, 2010). Many people experience multiple, overlapping determinants, such as

homelessness, language barriers, poverty, and lack of social support. Those who are low income or living in low income neighborhoods are more likely to suffer from social, behavioral, and environmental impediments to good health and wellbeing, and they are more likely to suffer ill health and poor outcomes, even after controlling for characteristics such as age, gender, race/ethnicity, and education level (Long, Phillips, and Hoyer, 2011; Bird et al, 2010).

One study stands as a striking example of the consequences of not accounting for patient factors when comparing providers along quality outcomes. Hong and colleagues (2010) compared providers within the same, large academic primary care system for their performance on a composite of Health Plan Employer and Data Information Set (HEDIS) measures. Authors found that those providers serving greater proportions of underinsured, minority, and non-English-speaking patients were associated with lower quality rankings. Health center physicians were more likely than non-health center physicians to be among the lowest third in performance tertile ranking. After adjusting for patient panel characteristics, quality tertile rankings for 36% of sampled physicians changed. This meant that many physicians who were previously in the bottom third of quality scores were being undervalued. Authors reason that case mix adjustment "levels the playing field" (Hong et al, 2010).

Transforming to Adaptive Patient-Centered Medical Homes

As Miller and colleagues (2010) explicate, providers navigate complex systems through the adequate use of adaptive reserve, attentiveness to the local environment, and

structural and financial wherewithal. Promoting Patient-Centered Medical Homes (PCMH) as championed by primary care practice improvement experts may decrease practice complexity (Katerndahl, Wood, and Jaén, 2010; Katerndahl, Wood, and Jaén, 2011), and therefore narrow practice performance variation. PCMH represents multiple levels of care delivery, including organizational structure and process as well as provider-level adaptiveness, and is intended to be reflective of patients' comprehensive needs.

PCMH as Infrastructure and Cultural for Quality Improvement

Calls for improving the U.S. health care system along the Triple Aim goals of improved quality, reduced per capita costs, and improved care experiences are often coupled with appeals to reinvent primary care as a prerequisite for such improvements. Clinician associations, federal entities, and others have recently invested in the PCMH model as a promising innovation for achieving the Triple Aim, and even a centerpiece of health reform (Peikes et al, 2012a; Crabtree et al, January 2011; Stange et al, 2010; Carrier, Gourevitch and Shah, 2009; Berwick, Nolan, and Whittington, 2008).

There is no one single PCMH definition, although several accrediting bodies offer standards for PCMH recognition. PCMH has been broadly defined as a primary care practice that merges numerous evidence-supported systems of care to ensure that patients receive accessible, continuous, and coordinated care (Joint Principles of the PCMH, 2007). The National Committee for Quality Assurance (NCQA), a non-profit, private organization that offers provider certification, accreditation, and recognition for various quality improvement efforts, offers what may be the most widely used PCMH recognition. Various PCMH definitions emphasize the core components of primary

care,[25] patient-centeredness, team-based care delivery, utilizing health information technology to collect and storing data, decision support systems, enhanced access and communication between patients and providers, and the modification of clinical practice patterns to ensure care coordination and continuity (Carrier, Gourevitch and Shah, 2009; Katerndahl, Wood, and Jaén, 2011[26]).

Notably, prevailing definitions are process-oriented and even open-ended (Carrier, Gourevitch and Shah, 2009), making them challenging to test. As described by Stange et al (2010), PCMH builds off well-established attributes of high quality primary care and adds new organizational dimensions of care. These additional dimensions include new ways of organizing practice to be more responsive to patient needs and developing practices' internal capacities,[27] comprising core structural and processes components, adaptive reserve, and practice cultural changes such as attentiveness to the local environment and relationships, management style, and leadership development. These are essential elements for transforming into sustainable PCMHs (Stange et al, 2010; Miller et al, 2010; Crabtree et al, December 2011; Crabtree et al, January 2011). Yet some of the various elements, such as care continuity, enhanced access, and use of HIT, are each complex and difficult to interpret (Carrier, Gourevitch, and Shah, 2009).

While the concepts encompassed in the PCMH model are generally evidence-based, the assumption is that together they lead to higher performing practices along costs, quality, access, and patient or provider satisfaction. This does not rule out that

[25] These are accessibility, comprehensiveness, coordination, and continuity.
[26] Katerndahl, Wood, and Jaén (2011) add that a PCMH definition also advocates for (but does not necessarily indicate) alternate payment strategies.
[27] Stange et al (2010) also lists health care system and reimbursement changes among the newer attributes of PCMH, but these are limited to PCMH demonstrations. This attribute does not necessarily prevent a practice from becoming a PCMH, but the others may.

individual components or domains of the PCMH may also improve practice performance, but the notion is that in combination they are additive or compounding. PCMH recognition or readiness, then, appears to be a proxy for successful practice transformation, high levels of adaptive reserve, leadership, infrastructure, and provider capacity to attain superior patient outcomes. But it does not necessarily indicate high performance in any area.

Evidence on the PCMH

Research on what makes a PCMH high performing is nascent, and the evidence linking PCMH attainment, either as a full transformation process or in part, to quality improvement is mixed. A study of 36 practices randomized into facilitated or self-directed groups found that a practice's capability for change at baseline was a significant determinant of its succeeding in transformation processes, and capability was highly dependent on effective relationships (Crabtree et al, December 2011). One review of prospective, controlled evaluations of U.S.-based PCMH interventions uncovered at least four system or payer-sponsored initiatives that improved process measures and patient outcomes for diabetes, and at least one that improved care measures for hypertension (Grumbach and Grundy, 2010). Another, larger and more systematic review applying a common PCMH definition[28] found that most interventions conducted between January 2000 and September 2010 tested components of the PCMH rather than full practice transformation. Two of three rigorous evaluations using health outcome measures

[28] Criteria for this systematic review included: "the evaluation (1) tested a primary-care, practice-based intervention with three or more of five key PCMH principles and (2) used quantitative methods to examine effects on either (a) a Triple Aim outcome (quality of care, costs (or hospital use or emergency department use, two major cost drivers), and patient and caregiver experience) or (b) health care professional experience." (Peikes et al, 2012 a)

demonstrated improvements. Authors concluded that older, sicker patients may benefit the most from a PCMH model, and yet the model itself is still young and evolving. Because the study period covers the years prior and a few subsequent to the 2007 PCMH Joint Principles, the investigators note that most evaluations reviewed stand as precursors to the model as known today (Peikes et al, 2012a and Peikes et al, 2012b).

A few more recent studies add to the body of evidence but have not been reviewed for the level of methodological rigor preferred by Piekes et al. Comparing a large, Minnesota multispecialty group with 21 sites attaining NCQA level three recognition[29] to community medical groups without the same accreditation, those with accreditation were associated with modestly higher improvements in patient satisfaction but similar improvements in quality metrics for diabetes, coronary artery disease, preventive services, and generic medication use. Authors recommend tapering expectations for large and rapid improvements following PCMH attainment (Solberg et al, 2011). Jaén and colleagues (2010) determined that a national demonstration implementing the medical home in primary care practices across the U.S. led to modest improvements in diabetes and other condition-specific processes of care, but not patient experience. A recent analysis of state experiences adopting PCMH initiatives in their Medicaid programs also reveals promising results for patient satisfaction, cost containment, and improved access (Takach, 2011).

[29] NCQA's Physician Practice Connections-Patient Centered Medical Home (PPC-PCMH) Recognition Program relies on nine categories of care standards, including 10 "must pass" elements. Practices may achieve three different levels of recognition. Practices achieving level three have the highest scores and all ten must pass elements. For more information, see http://www.ncqa.org/Portals/0/PCMH%20brochure-web.pdf.

Health Centers and PCMH Recognition

Health centers may have special challenges attaining PCMH recognition given that they are resource-constrained and often do not have necessary linkages to other care settings for their patients. A 2009 national survey of all FQHCs (response rate 79%) compared health centers' quality capabilities to the five domains listed as part of the NCQA medical home standard (patient tracking and registry functions, test tracking, referral tracking, enhanced access and communication, and performance reporting and improvement). The survey provides a powerful baseline by which to monitor health centers' advancing infrastructure necessary to better support quality improvement and management. Less than 1 in 3 health centers had adequate capacity in all five domains, but more than half had capacity in at least three (Figure 2.3). Health centers nationally appear weakest on those domains that are highly dependent on costly HIT. Although 40 percent of health centers had implemented electronic health records (EHRs) at the time of this survey, not all have the same level of functionalities to enable care coordination among providers and across other systems of care (Doty et al, 2010).

Figure 2.3

Health Center Capacity in NCQA* Indicators of a Medical Home, as of 2009

Indicators of Medical Home	Total
Medical Home Capacity—Total Number of NCQA Domains	
Capacity in All 5 Domains	29%
Capacity in 3 to 4 Domains	55%
Capacity in 0 to 2 Domains	16%
1) **NCQA Domain—Patient Tracking and Registry Functions:** Can easily generate a list of patients by diagnosis with the current patient medical records system	69%
2) **NCQA Domain—Test Tracking:** Provider usually receives an alert or prompt to provide patients with test results; or laboratory test ordered are usually tracked until results reach clinicians	60%
3) **NCQA Domain—Referral Tracking:** When clinic patients are referred to specialists or subspecialists outside largest site, center usually or often tracks referrals until the consultation report returns to the referring provider	70%
4) **NCQA Domain—Enhanced Access and Communication:** Patients usually are able to receive same- or next-day appointments, can get telephone advice on clinical issues during office hours or on weekends/after hours	71%
5) **NCQA Domain—Performance Reporting and Improvement:** Performance data are collected on clinical outcomes or patient satisfaction surveys and reported at the provider or practice level	99%

Notes: Easily means they can generate information about the majority of patients in less than 24 hours. Usually means 75% to 100% of the time and Often means 50% to 74% of the time.
Source: The Commonwealth Fund National Survey of Federally Qualified Health Centers (2009).

*National Committee for Quality Assurance

Source: Doty M, Abrams MK, Hernandez SE, et al. *Enhancing the Capacity of Community Health Centers to Achieve High Performance: Findings from the 2009 Commonwealth Fund National Survey of Federally Qualified Health Centers*. May 2010.

Meeting PCMH criteria appears to be highly related to other potential factors perceived as critical for patient outcomes. The 2009 survey indicated that health centers with greater medical home capacity are less likely to report difficulty obtaining specialty care – indicating the importance of infrastructure and systems that allow a health center to reach beyond its walls. These same health centers are also less likely to report having an inadequate workforce or provider shortages (Doty et al, 2010). A follow up study created the Safety Net Medical Home Scale (SNMHS) by refining the NCQA 2008 domains and testing it with a sample of health centers across fives states involved in a PCMH demonstration. These health centers averaged 61 on the 100-point scale, which the authors deem as a strong foundation for implementing the full PCMH. Authors observed that certain clinic characteristics were significantly associated with higher SNMHS scores: size, as measured by number of provider FTEs, and participating in financial incentive programs. Patient characteristics were not found to be associated with

PCMH adoption (Birnberg et al, 2011). Another study found higher scoring on the safety net PCMH scale is associated with higher health center cost per patient per month (Nocon et al, 2012).

Even if health centers have the capacity to be PCMHs, the question of whether the PCMH model meets the needs of health center patients remains. Looking only at health centers in Los Angeles, California (N=30, not exclusively FQHCs), Clarke et al (2012) recently found no relationship between how a health center scored on the NCQA assessment tool[30] and quality of care provided to diabetes patients – specifically, HbA1c, blood pressure, and cholesterol control. None of these health centers had yet been recognized by NCQA as PCMHs. The same study determined that every health center would have reached NCQA Level 1, and 27% Level 3, under these criteria. Authors posit one possible explanation for the lack of association between NCQA score and quality of care: insufficient specificity on the actual tool. For example, because use of HIT has been shown to increase adherence to care guidelines, better patient monitoring, and reduced medication errors (Chaudhry et al, 2006), PCMH recognition tends to overemphasizes HIT and does not account for community engagement, enabling services, or other features intended to improve access and outcomes (Clarke et al, 2012; Birnberg et al, 2011). The SNMHS also may not adequately captures domains relevant to performance, including whole-person orientation, team approach to care, and engaged leadership (Birnberg et al, 2011).

[30] Authors used the 2008 NCQA Physician Practice Connections Patient Centered Medical Home tool. The tool has since been modestly revised.

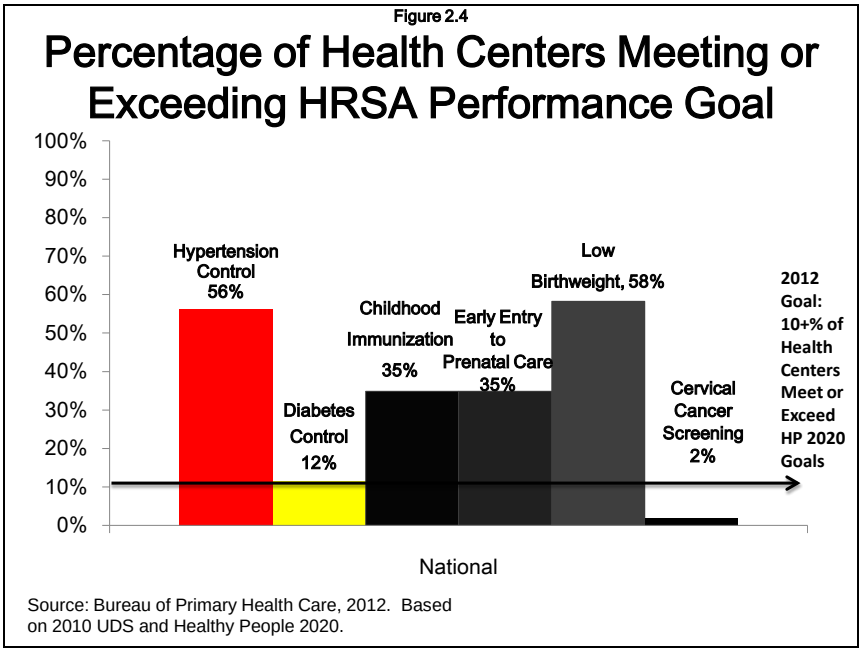
Health Center Quality of Care

Before examining the literature on factors related to health centers' clinical performance, it is helpful to briefly review the status of health center quality, particularly along the key indicators of interest in this dissertation. This body of research and the gaps it identifies demonstrate that while health centers are generally commended for high quality of care, variation in performance still exists.

Diabetes and Hypertension Control

Health center patients have high rates of diabetes and hypertension. While more than half of health centers surpass Healthy People 2020 target rate of patients with hypertension under control, only 12 percent of health centers meet the Healthy People 2020 diabetes control target (Figure 2.4).

Figure 2.4



Source: Bureau of Primary Health Care, 2012. Based on 2010 UDS and Healthy People 2020.

The Department of Health and Human Services Office of Inspector General sponsored a team of medical reviewers to review a sample of 448 patient records between January 1, 2006 and December 31, 2007 across 147 grantees reviewed – all before health centers started reporting patient outcomes measures in their Uniform Data Set (UDS). Medical reviewers determined 9.6% of patients needing blood sugar level screening did not receive it, and 10.7% of patients did not receive needed blood pressure screens (OIG, 2012).

Prior to health centers' reporting key patient outcomes in their annual Uniform Data System, studies comparing their performance in diabetes and hypertension management were generally conducting using small samples of health centers (e.g., 20 organizations or fewer). These studies found that health centers meet or exceed national average or local standard rates of HbA1c screenings provided and targeted HbA1c levels (Shin et al, 2008; Eisert, Mehler and Gabow, 2008; Ulmer et al, 2000). Ulmer and colleagues found that health centers particularly excelled on process measures for diabetes, asthma, and initial diagnosis of hypertension, conditions involving complex visits and occasionally specialized tests not always available at the health center. However, this study also discovered that as process measures involved more specialized testing or referrals to outside care, health centers became less likely to exceed national benchmarks. In contrast, a larger study drawing medical chart data from 55 Midwestern health centers found that rates of adherence to diabetes process measures were relatively low compared with American Diabetes Association-established targets (Chin, et al, 2000). This study served as a baseline for assessing quality improvement after these health centers participated in the Health Disparities Collaboratives.

Two recent studies comparing health centers to other provider types found that health centers, on average perform better than other providers on process of care measures. After adjusting for patient differences (age, gender, rural residence, race/ethnicity, health insurance type, severity of illness, and patient presentation), Shi and colleagues observed that health centers had 1.68 times higher odds of blood pressure checks during a visit compared to private, office-based physicians, but the odds were comparable to those of hospital outpatient departments. This study applied the 2006 National Ambulatory Medical Care Survey (NAMCS) for health center and private practice primary care providers, in addition to the 2006 National Hospital Ambulatory Medical Care Survey (NHAMCS). Given that the former survey instrument relies on self-reported questionnaires while the latter uses data collected through medical records, comparisons between health centers and outpatient departments must be interpreted with caution (Shi, Lebrun, Hung, et al, 2012).

Goldman and colleagues (2012) acquired the 2006-2008 NAMCS and went a step beyond Shi and colleagues to extraplate 18 process of care quality indicators. Goldman et al found that before and after controlling for patient characteristics similar to those used in Shi et al,[31] health centers on average were more likely to screen patients at risk for high blood pressure compared to private practice physicians. They were also performed better on depression management and other process indicators. Before adjusting, health center physicians on average preformed statistically better on six measures, worse on one (diet counseling to at-risk adolescents), and no differently on 11. After adjusting, health centers performed better on seven measures (including diet counseling to at-risk adolescents) and no differently on the same 11. However, both

[31] Goldman et al also included obesity as a control.

practice types experienced dramatic variation in these 18 quality indicators, ranging from 19% to 93% for private physicians and 20% to 99% for health center physicians.

Both Shi et al and Goldman et al suffer from possible sampling issues for the health center population. The first discovered that patient insurance and rurality proportions in the NAMCS do not match health centers' federal data reporting. This may be explained by the fact that the NAMCS represents visits, not patients, but it could also suggest that the NAMCS is not nationally representative (Shi, Lebrun, Hung, et al, 2012). For both, response rates for private practice physicians were considerably lower than those of health centers, and physicians in either care setting may have changed practice behaviors during the study period (Goldman et al, 2012). And some comparisons created in the Goldman study experienced very small sample sizes for health centers. In addition, neither study explores variability within or across provider types on patient outcomes measures.

The 2009 survey of health center patients determined there were no racial/ethnic disparities in receipt of and adherence to hypertension control lifestyle counseling, and no disparities in controlled hypertension. However, African American and Native American patients were statistically more likely than non-Hispanic white patients to have a hypertension-related emergency department visit or hospitalization in the past two years (Ngo-Metzger, 2011).

Evaluations of the Health Disparities Collaboratives

Many studies on health center quality performance were conducted under evaluations of the Health Disparities Collaboratives (HDCs), a multi-component

intervention targeting certain chronic conditions that many health centers participated in before HRSA stopped national funding. The HDCs may have been the most widely dispersed initiative involving the dominant conceptual model for QI, the Chronic Care Model. Health centers applied the same framework but had great flexibility in adopting many of the QI initiatives within their HDC in order to tailor them to their unique populations and settings (Chin, 2010). Research on the number of QI interventions applied and their impact on quality are mixed.

Grossman et al (2008) assess the quantity and intensity of various QI activities and the impact of quantity/intensity on quality within 40 health centers participating in the HDCs between 2000 and 2002. This study tries to get around a common threat across each of the other studies – that is, variation in treatment implementation – but is unable to determine the impact of this variation given the uniqueness of each health center. Authors point out that it might be different combinations of QI activities that lead to highest impact, something the study does not cover. Still, health centers engaged in 44 QI activities on average (range of 8-84), touching on various elements foundational to the HDC model but with special emphasis on patient registries and community linkages. However, only 3% of these activities/intensities are rated high on impact probability, and about half were spread across all health center sites. Authors found no correlation between quality improvement on clinical measures and markers of quantity, intensity, or category of HDC QI activity, nor did they identify any one activity as most impactful. Chin et al (2007) randomizes study health centers into higher intensity QI activities, and finds that more intensive QI has a marginal impact beyond what quality improvements the HDCs on their own bring.

More generally, a systematic review of health center QI interventions found that these interventions most often targeted chronic conditions and screenings. Among 14 observational and 4 randomized studies, health centers used between 1 and 11 of 14 different QI practices involving providers, staff, patients, and/or organizational changes. Unlike other studies, this review concluded that interventions employing more tactics were more successful than those employing fewer (Chien, Walter, and Chin, 2007).

The HDCs were also limited in their spread across new areas, new sites within multi-site CHCs, and possibly new patients. A survey of health center staff engaged in HDC activities revealed their perceptions on what is required to sustain, enlarge, and foster gains in quality of care. Staff members identified three themes of necessary factors: time and resources, additional tools and techniques, and financial reimbursement sufficient to cover the additional costs associated with implementing QI programs. Like Grossman and colleagues, this study acknowledges the creative approaches necessary to meet the unique needs of each community served, especially with regard to encouraging healthy and care-seeking behaviors (Chin et al, 2008).

Several studies conducted formal evaluations of the HDCs on patient care and outcomes. One major review consolidates all known published evaluations (Chin, 2010). Of the nine studies reviewed, most of which were small and did not have comparison groups, evaluations were done using either patient registry data or chart reviews of randomly selected patients, the latter of which may avoid potential selection bias. Registry studies, including one with a pre-post design, demonstrated absolute reductions in HbA1c levels over two years. The first large-scale, pre-post chart review study of the diabetes HDCs took place during the first year of operation, and found improvements in

process of care measures (e.g., HbA1c tests) but not patient outcomes (HbA1c levels) across 19 health centers. A larger pre-post chart review study of the asthma, diabetes, and hypertension HDCs built in three comparison groups across 64 centers (centers with HDC, centers with other HDCs, centers without HDCs). This study, the only one to use comparison groups, also found improvements in process of care measures over two years for diabetes and asthma, but revealed no improvements in outcomes. Finally, the only study to explore longer term impacts (that is, impacts over four years) of the diabetes HDC employed a pre-post design and pulled data through random chart reviews across 16 health centers. Process measures improved, as did some outcomes measures, including lower HbA1c levels by .45%. The author concludes that the HDCs improve clinical processes of care in just one to two years, and that patient outcomes can improve over longer periods (Chin, 2010). This implies that when health centers had the resources necessary under the HDCs, they were able to improve patient outcomes.

Appling the lessons learned from these HDC evaluations must be done with caution. First, most are not generalizable across all health centers and patients given the small number of study centers and were generally concentrated in certain regions. Even the largest study still only captured fewer than 7% of all health center grantees. And study centers generally self-selected to participate in both the study and the HDC initiative. Second, small studies are subject to low statistical power. Too small a number of study centers makes it difficult to comfortably detect a relationship between dependent and independent variables. Third, few had comparison groups, calling into question whether other factors and intervening events across all centers may have contributed to

the findings. And finally, because health centers have flexibility in carrying out components of their HDC, the full effect of the HDC could not be detected.

Factors Associated with Health Center Performance and Drivers of Performance Variation

Over the last decade and a half, less than a dozen published studies quantitatively document health center variation in clinical performance in regards to both process and outcome indicators. That is not to say that gaps in clinical quality across health centers previously went unacknowledged. In fact, the HDCs were born out of a recognition that although health centers' quality of care for chronic conditions was similar to other settings, quality across all settings could still be improved and wide variation in quality performance existed across all health centers (Chin, 2010).

The studies discussed below draw from three different data sets: 1) federally-funded health centers' annual reports, the Uniform Data System (UDS); 2) patient records sampled from paper or pulled from electronic records, and 3) claims data for all study-eligible patients. The ones utilizing the UDS explore organization-wide factors, including patient case mix, and are particularly relevant for this dissertation because they rely on the same data set, including the same quality constructs. Patient level data may be more helpful for determining actual risk adjustments needed when comparing across providers. Including both patient level and organizational level data and accounting for nesting effects may provide the most thorough examination of factors contributing to performance variation.

The UDS diabetes and hypertension indicators are commonly assessed in most of the studies. Some exclusively use process of care measures rather than patient outcomes, and others include both. Process of care measures are still helpful indicators of clinical quality because they can lead to improved patient outcomes (Donabedian, 2005). One study defines quality even more narrowly, looking at utilization of avoidable health services (Gurewich et al, 2011).

Regardless of the clinical quality measure explored, these studies shed light on the extent to which performance variation may occur, as well as the factors – patient, organizational, or external – that appear to drive it. After recapitulating the quantitative studies, this section also describes literature from qualitative and others studies on the organizational and environmental context that may facilitate high performance, particularly in building capacity for quality improvement.

Studies Using the Same Data Set

The UDS metrics for diabetes and hypertension control have not been widely used in research. This may be due to the fact these two measures were only recently included in the UDS. Two recent studies from the same team of researchers help fill this research gap using the 2009 UDS. Each explores factors related to diabetes control (HbA1c <9), hypertension control (systolic blood pressure <140 and diastolic blood pressure <90), and other UDS quality indicators. And each relies exclusively on the UDS for explanatory variables.

The first study by Shi, Lebrun, Zhu, and others (2012) explored the patient, provider, and organizational factors associated with health center quality performance.

Authors compared health centers in the top quartile of performance to all others for each outcome measure, using logistic regression and adjusting for patient, provider, and institutional characteristics (N=1039). Shi and colleagues narrowed their list of covariates to include those found to be statistically relevant in bi-variate analyses, were found in previous studies to be statistically indicative of clinical quality, and were not subject to multicollinearity.

Health centers with a great proportion of uninsured patients were less likely to be top performers in diabetes and hypertension control (OR of 0.90 and 0.94, respectively). Although not tested in their analysis, one may assume that that the reverse is true – greater proportions of Medicaid insurance is related to higher performance. Shi and colleagues also found that those with more minority patients were less likely to be among the top performers in diabetes control (OR of 0.92), but not hypertension. The proportions of health center patients who were homeless, migrant and seasonal farmworkers, low income (under 200% of poverty), and have select chronic conditions[32]did not demonstrate statistical significance. While these findings are curious, one possible explanation is that authors excluded roughly 100 health center organizations whose source of federal health center grants were solely based on special populations (homeless, migrant, and public housing). These health centers have particularly high rates of low income and at-risk patients. Still, some of these factors statistically differentiated high and low performers in bi-variate analyses.

[32] Includes primary diagnosis of diabetes, hypertension, selected heart disease, asthma, chronic bronchitis, emphysema, HIV, or hepatitis B and C.

The number of physician full-time equivalents (FTE) per 10,000 medical patients[33] was not related to performance. However, the number of enabling services staff FTE per 10,000 medical patients indicated a small but significant probability of higher performance in diabetes control (OR of 1.02). These services are critical for addressing a wide range of barriers to care through language services, case management, transportation, health education, and other patient assistance.

The most dramatic and statistically significant covariates were age of health center (less than 3 years with 330 funded vs. 3 years or more[34]) and data reporting method (use of EHR vs. manual chart review).[35] New health centers were considerably less likely to be among top performers for diabetes control (OR 0.52). This is not surprising given older health centers may have more experience and greater capacity for QI activities. At least anecdotally, the National Association of Community Health Centers finds that new health centers often experience severe operational and performance challenges.[36]

Surprisingly, manual chart review centers were much more likely to be among the top performers for both diabetes and hypertension control (OR 1.82 and 1.54, respectively). This may reflect a measurement problem impacting the dependent variables. Shi and colleagues acknowledged that most health centers still used manual chart reviews for data reporting (between 77 and 88% of centers, depending on the measure). Diabetes and hypertension control top performers were also more likely to use

[33] Excludes dental and behavioral health patients.
[34] Authors chose this cut off given that 330 funding requirements anticipate newly funded health centers be fully operational within 2 years.
[35] The data reporting method for these quality indicators is explained in Chapter 3.
[36] Based on multiple conversations over the last few years with staff of the National Association of Community Health Centers, Division of Training and Technical Assistance (2011-2012).

manual chart reviews over EHRs. Many health centers are still in the process of implementing EHRs. The UDS reporting instructions advises grantees to only use EHRs if they have "been in place throughout the reporting year, and ideally for at least three years,"[37] and authors point out that grantees have access to UDS report training. It may be that health centers relying on EHRs experience a decline in quality during the transition period because they become better able to detect and address gaps in patient care. Or health center medical records may not be complete (Devoe et al, 2011). Another possible explanation is a sizeable sampling bias. For instance, health centers select charts from high performing sites, despite reporting instructions covering random sampling.

Although descriptively, top performing health centers in diabetes control relied less on grant revenue, were smaller in size (number of patients and sites), and had lower net revenue compared to lower performers, none of these indicators factored into the odds of being a top performer in their multivariate analysis. These factors did not differentiate high and lower performing centers in hypertension control. However, a previous study using the same data set (2003-2004 UDS) established that a health center with more managed care contracts, larger staff, higher net revenue, and less reliance on grant revenue relative to third-party reimbursement provided more enabling services in terms of broader scope and higher volume (Wells, Punekar, and Vasey, 2009).

The second study using the same data set and outcome measures (Lebrun et al, 2013) looked specifically at factors related to racial/ethnic disparities across health centers.[38] They used interaction terms to estimate interaction effects between

[37] See for example, http://bphc.hrsa.gov/healthcenterdatastatistics/reporting/2011manual.PDF.
[38] The UDS requires centers to enter patient outcomes for patients across race/ethnicity groups.

race/ethnicity and three health center characteristics of interest: patient volume (above or below national median), duration of health center existence (established vs. new within last 3 years), and managed care penetration (greater or less than 5%).

Authors uncovered some racial/ethnic differences in outcomes, but these disparities are more narrow within health centers than nationally. They also discovered that patient volume, duration of existence, and managed care penetration do matter, finding more statistically significant differences across racial/ethnic groups. In no case did smaller, newer, and low managed care penetration health centers have statistically better outcomes. While larger, older centers are more likely than smaller, younger ones to have managed care penetration above 5%, the finding that managed care matters holds across smaller and newer centers.

It may be that larger health centers serve more diverse populations, reach economies of scale, are better able to specialize their staff, and have more diverse revenue streams. Moreover, duration as a health center, specifically a federally-funded FQHC, suggests that the resources that come with this status bring a certain quality-enabling capacity. Lebrun et al also theorized that higher managed care penetration may be related to more engagement in outreach for chronically ill patients, utilization of disease management techniques, and effective use of care protocols. Managed care contracts are also related to the delivery of more enabling services (Wells, Punekar, and Vasey, 2009). Yet their analysis gives equal weight to all centers regardless of patient volume, meaning that outcomes may be skewed by smaller health centers. They also note that small sample sizes at the race/ethnicity level limit their ability to add covariates as well as their ability to interpret health center effect size.

Shin and colleague's (2013) comparison of high and low performing health centers – defined as those performing above the Medicaid Managed Care Organization HEDIS 75th percentile and those performing below the 50th percentile on hypertension, diabetes, and pap screening measures – found high performing health centers had more patients under the age of 18, elderly, female, Medicare insured, privately insured, and total patients, but lower shares of uninsured and homeless patients. The two comparison groups did not differ in percent of who are low income or have Medicaid. However, Medicaid made up larger shares of total revenue for high performers, and collected 30% more revenue per Medicaid patient. High performing health centers were concentrated in states with pre-ACA Medicaid generous eligibility policies, while lower performing centers were concentrated in states with more restricted Medicaid eligibility standards. This study excluded health centers with fewer than 70 records reported for each measure, and compared the high and low groups using t-tests and chi-squared tests.

These studies endure some shared limitations. Each suffers from potential ecological fallacy given that data are reported at the grantee (organizational), not patient level. They also rely on a limited set of explanatory and control measures. Moreover, these studies used only one year of data – the second year health centers reported these outcomes variables. This limits their ability to look at the extent to which quality indicators can improve overtime as health centers adopt new practices or acquire quality-enabling infrastructure, such as EHRs generally and those that meet "Meaningful Use" criteria, or become PCMH recognized. Importantly, improvements in patient outcomes happen over several years (Chin, 2010).

Also of note is the BPHC's adjusted quartile approach to compare UDS-reported quality indicators across health centers. This methodology is based on four health center patient profiles (percent of patients who are uninsured, minority, homeless, and migrant farmrworkers) and the method of reporting the outcome in the UDS (sampling or pulling the full patient population through an EHR).[39] The research behind this methodology is not clear. As described above, Shi and colleagues (2012) found that proportions of health center patients who were homeless and migrant/seasonal farmworkers did not correlate with outcomes (Shi et al, 2012).

Studies Using Patient Records

Among the multivariate studies drawing from patient records, two approaches have been taken: sampling among patient records (often involving chart audits), or extracting data from the universe of eligible patients using an EHR. Both are relevant for this dissertation given that health centers may use either basic method when reporting patient outcomes in the UDS. Most of these studies include measures of diabetes or hypertension control, and all include related process of care measures. For the purposes of identifying variables to be tested, this dissertation assumes that factors influencing the receipt of procedures and screens for diabetes and hypertension also influence patient outcomes (Donabedian, 2005).

Among the more recent studies that extracted data from EHRs, Devoe and colleagues (2012) investigated whether patient characteristics of an individual FQHC are correlated with receipt of recommended diabetes care across a large Health Center Controlled Network (HCCN). This yet-to-be published study built on a previous analysis

[39] For more information, see http://bphc.hrsa.gov/policiesregulations/policies/pcmhwebinar06162014.pdf.

from the same network (Gold et al, 2009). Devoe et al identified 21 sites that served as primary care settings to more than 100 diabetic patients between 2005 and 2007 (N=4066 patients). Patient data come from patients seen in these sites with more than one visit each year and at least two visits associated with diabetes.[40] While Devoe looked for differences across sites and narrowed their sites for the purpose of this analysis, Gold et al looked at all diabetic patients with a minimum of two visits across the entire network of 100-plus clinic sites (N=6127 patients) between 2004 and 2005. This older analysis extracted data from the network's practice management system, which predates their EHR.

Both Devoe et al and Gold et al[41] found evidence of inter-site variation in the percent of diabetic patients that received recommended care. The more recent analysis found that a percent of patients who are Spanish speaking were not related to the clinic's rate of services provided. However, the earlier study found that racial/ethnic minorities were more likely to receive the bulk of these services compared to white patients. Unlike Gold et al, Devoe et al discovered that continuous insurance coverage was positively and significantly correlated with HbA1c screening, as well as receipt of cholesterol screen and influenza vaccination, and that lack of insurance was significantly associated with fewer screens for some services, but not HbA1c screening. Both studies controlled for patient income and existence of co-morbid conditions, and measured continuous insurance as having it over multiple points in time, but this may not capture the reality of insurance "churning" for many low income patients.

[40] Using common diabetes mellitus ICD-9 diagnostic codes.
[41] Devoe and Gold were each second authors on the other's paper.

Another smaller study drawing from EHR data explores factors related to patient outcomes for hypertension – the same hypertension control measure also used in the UDS (systolic blood pressure <140 and diastolic blood pressure <90). They also used a more stringent measure of 130/80 for those patients with diabetes. Shelley et al (2011) looked exclusively at patient data from four sites of one large health center organization with a diagnosis of hypertension at last visit between June 2007 and October 2008 (N=2336 hypertensive patients).[42] Those below the poverty level where no more likely to have uncontrolled hypertension than those above it. Those patients with higher odds of uncontrolled hypertension include male gender, race/ethnicity (African American but not Hispanic), fewer clinical encounters, higher BMI, and greater number of prescribed medications. They also found diagnosis of diabetes, a common co-morbidity, is related to uncontrolled hypertension. Using the more stringent hypertension control measure against all hypertensive patients, they found blood pressure control rates were comparable between those with and without diabetes.

Earlier studies rely on medical records sampling. During 2002, Zhang et al (2009) conducted chart audits across 27 health centers in 17 states (N=2,018) in order to explore the association between insurance status and quality of diabetes care as measured by HEDIS process indicators and HbA1C >9.5%.[43] After controlling for patient age, gender, race/ethnicity, and comorbidities related to diabetes (including hypertension), the private insurance group fared best of any insurance group across all quality of care measures, and only the privately insured and those dually eligible for Medicare and

[42] The study site was Open Door in New York State. Patients were identified using the ICD-9 code for hypertension.

[43] Researchers trained health center staff at each organization to conduct chart audits of all or up to 80 randomly selected patients aged 18-75 with a diagnosis of non-gestational diabetes during 2002, depending on the total number of such patients. They excluded data on patients with missing variables.

Medicaid had statistically significant lower odds of having poor HbA1c control compared to the uninsured. These two groups and the Medicare group had higher odds of HbA1c testing. Those with Medicaid fared similarly to the uninsured. Authors assume that cost sharing requirements for Medicaid patients, unlike dual eligibles, may serve as a barrier to needed care, and may therefore explain the poor outcomes for Medicaid patients. Moreover, Zhang et al point out that patients with Medicare, Medicaid, or dually-eligible for Medicaid and Medicare had higher rates of diabetes-related co-morbidities and complications.

A smaller 2004 study from another health center network of seven independent health center organizations gleaned data from a random sample of diabetic patients (N=1817) with one or more visit between October 1, 2000 and September 30, 2001. Testing frequency and poor glycemic control varied by clinic site. Testing frequency increased with number of encounters. Females and older patients were statistically more likely to have their diabetes under control, but patient control of diabetes was not determined by ethnicity or insurance status (Maizlish, Shaw, and Hendry, 2004).

Hicks and colleagues (2006) randomly selected patients with hypertension, asthma, and diabetes (N=5,690) between 1999 and 2000 from what they consider a nationally representative sample of health centers prior to their participation in the Health Disparities Collaboratives (N=64). The analysis revealed variable performance across centers along an index of quality indicators for each condition, as well as significant gaps in receipt of needed care among health center patients, particularly the uninsured. This varies from Zhang et al's later finding. After adjusting for insurance status, there was no evidence of racial/ethnic disparities. The insured and female patients were statistically

more likely to receive recommended care. Among health center organizational characteristics and resources, those that were less than 30 years old and those with computerized decision support system offered recommended diabetes care more frequently than older health centers and those with no such support system. Findings did not hold for hypertension quality. Those with onsite pharmacies also performed better than those without, but this was not statistically significant.

Finally, Ulmer et al (2000) conducted medical record reviews of 20 health centers across 10 states, attempting to include one urban and one rural center for each state.[44] Researchers abstracted approximately 900-1,000 patient records for composite measures of process of care elements for five targeted conditions (asthma, diabetes, hypertension initial visit and follow up visit, and acute otitis media) between January 1995 and February 1996. Although statistically relevant to patient quality of care for any condition, patient and visit characteristics – age, sex, race, receipt of Medicaid, use of insulin for diabetes, first visit to the center – explained less than 1% to 5% of the difference among health centers. After controlling for specific center used, explanatory power increased, but still left between 80% to 90% of variance unexplained. This still proved more powerful than adding the health center characteristics (urban/rural location and size. After controlling for individual center, female was positively related to receipt of diabetes process of care measures but negatively related to those for hypertension initial visit. Minority was also negatively related to hypertension initial visit. Having Medicaid was negatively associated with receipt of diabetes care.

[44] The ten states were: Arizona, Georgia, Kentucky, Maine, Missouri, New Jersey, New Mexico, Pennsylvania, Tennessee, and Washington. Authors then randomly selected one urban, one rural center in each state, but it did not always work out evenly.

This collection of studies, while not without value, suffers from common caveats. These limitations in study design mean that findings may not be replicated in a national, more comprehensive analysis. They also explain some areas of inconsistent results. Eight are briefly discussed here. First, all these studies were cross-sectional, and did not account for change over time. This is best done at the patient level, but looking cross-sectionally over time may demonstrate whether certain organizational transformations, such as use of an EHR, may drive change. Hicks et al determined computerized supports are a factor in predicting receipt of care, but not patient outcomes. Second, some studies, including Devoe et al and Gold et al, exclude patients who had only one visit. Yet these patients may still be captured in the health centers' UDS reports for diabetes outcomes.

Third, these studies were small in terms of number of health center organizations involved, calling into question their external validity. Even Hicks et al sampled from fewer than 10% of all health centers. Selection bias may also be an issue, as study centers volunteer to participate and may reflect those centers with more experience and resources to devote to QI initiatives. The Ulmer et al study over-represented larger and slightly over-represented urban centers, because small health centers were less likely to have computerized billing that allowed them to pull the requested 50 cases patient sample. Shelley et al acknowledge that findings are not generalizable, especially to small, rural centers, and those where the health center has strong ties to academic settings. However, it is interesting that Hicks et al found evidence of poor quality of care across many centers, the same centers that volunteered to participate in the Health Disparities Collaboratives.

Fourth, all acknowledge key omitted variables that are likely to heavily influence quality. Ulmer and colleagues concluded that unmeasured variables contributed the most to quality of care. In guessing what these factors could be, they point to clinical leadership, degree to which providers are involved in quality assurance, physician specialty, availability of targeted case management, and use of practice guidelines and condition-specific flow sheets. They also add that other center and patient characteristics, such as severity of illness, may also contribute to explanatory power. Many, such as Zhang and colleagues, were unable to control for the number of office visits made by diabetic patients, and were unable to control for patient education and income levels. They also note they did not have data on patients' providers. This is not only a missing variable, it presents a fifth caveat – that is, these studies were not able to account for all levels of nesting.

Sixth, patient records, whether they are paper or electronic, are not always complete. Many services provided or even patient health status may be missing from them. Maizlish, Shaw, and Hendry relied on both computerized laboratory results and paper charts to complete data needed for their sample. A more recent study from Devoe, Gold, and others demonstrates that while EHR data are more complete then claims data, they still miss some critical elements of patient care provided within health centers (Devoe et al, 2011).

Seventh, factors related to receipt of care may not predict performance on patient outcomes. Although process of care measures are important indicators of receiving evidence-based care, they may be easier to improve than patient outcomes because the latter requires behavioral change and wellness resources outside the health center. And

eighth, Hicks et al and Ulmer et al created overall quality indices for each condition studied. The aggregation process itself may impact performance ranking (Reeves et al, 2007), and in the Hicks et al study, which included both process and outcomes measures, the reader is unable to determine factors that relate to outcomes once controlling for procedures provided.

Studies Using Claims Data

Researchers from Brandeis University conducted the first study to explore and compare multiple dimensions of performance – that is, total costs and appropriate utilization – across health centers, outpatient departments, and private, office-base physicians. Gurewich and colleagues (2011) pooled 2003 and 2004 Medicaid fee-for-service (FFS) claims data across three states (Massachusetts, California, and Texas). Together these states represent 20% of all health center sites. Constrained by the limited number of performance metrics available in claims data, researchers selected hospitalizations for avoidable, ambulatory care sensitive conditions as the outcome but acknowledged that utilization may not reflect patient outcomes. Researchers assigned patients to providers based on their source of usual care.[45] Multivariate analysis accounted for the following patient differences: Ambulatory Care Groups (ACGs) to adjust for co-morbidity, Aggregated Diagnostic Group (ADG) to adjust for health status, disability status, sex, age, race/ethnicity, and months of FFS Medicaid eligibility. After adjusting for patient differences, health centers as a group performed as well as the other

[45] The study population were patients enrolled in Medicaid for one or more of the study years, had continuous enrollment of at least six months, and were not dually enrolled in Medicare. Patients were assigned to providers based on source of at least 75% of their primary and preventive outpatient medical visits.

provider types on the measured quality indicator, but fell second in per-patient total costs after private practice providers.

Gurewich et al recognized their selected measures were limited and do not assess broader indicators of quality of care. Yet their study demonstrated substantial variation within the health center group, just as there existed variation within other groups. Furthermore, performance variation within provider types appeared to be more substantial than variation across provider types. Within provider types, unobserved patient level factors drive most of the performance variation, and poor health status was a significant predictor of avoidable hospitalizations. This finding evokes concerns that data collected in claims are too limited to aptly adjust for patient risk factors. Other research documents that health center claims data do not reflect the true volume of care provided (Devoe et al, 2011).

Other studies comparing measures of quality performance across provider types also find that patient level factors are key determinants of outcomes. Two separate studies using Maryland Medicaid FFS claims from the late 1980s determined that patient-mix characteristics explained significantly more of the variation in practice level utilization and charges than physician characteristics or geographic area (Weiner et al, 1996; Stuart and Steinwachs, 1993).

Qualitative Studies on Health Center Performance

Although case studies are commonly criticized for their lack of generalizability across other settings, they offer valuable insight where quantitative research often falls short. Qualitative research supplements and extends findings from the data-driven

research discussed above. Compared to quantitative analyses, qualitative research can be designed to more thoroughly capture care processes and patient and staff perspectives. For the purposes of this dissertation, topical qualitative research contributes to compilation of possible factors that influence health outcomes for health center diabetic and hypertensive patients.

Building off their earlier three state Medicaid claims study, Gurewich et al (2012) conducted case studies in 8 health centers across all three states. Each case study site preformed well on the narrowly-defined cost and utilization metrics available in claims data. The intent was to document attributes of high performance. Authors selected these sites after maximizing variation in number of patients served and urban/rural location and across centers and states. They uncovered four common program themes across all study sites, each relating to core components of the PCMH model: facilitate access to care (most commonly through extended operating hours), manage referrals (i.e., systems to support care coordination and integration), support providers and patients (e.g., care teams, enabling services for targeted high risk patients), and monitor/initiate performance improvement. Health centers varied in their employment of strategies that make up these themes. Authors attribute these differences to availability of resources and capacity, community preferences, and the population being served. In other words, health centers tailor their specific strategies to their local constraints, preferences, and needs. They also note that size and center location did not correlate with practices employed. And yet each had been identified as high performers based on quality and cost metrics, suggesting that different paths to high performance can be achieved when operational practices are

customized to reflect practice and community settings. Gurewich and colleagues did not explore whether health centers deemed as lower performers had similar PCMH features.

Another set of case studies sheds light on staff perceptions regarding the means to deliver optimal preventative cardiovascular care for racial/ethnic minority patients with hypertension or diabetes. Ndumele et al (2009) visited and interviewed staff from seven Boston-area health centers. Although documented high performance or disease management experience was not the criteria for case study selection, they observed the following patient, provider, organizational, and community level factors as commonly reported barriers: lack of sufficient resources, staff, and time; patient non-adherence to recommended therapies for diabetes and hypertension; and lack of healthy foods. Staff-perceived enablers to providing optimal care include the use of case management, community health workers, interactive patient groups, and pharmacies.

A HRSA and National Institutes of Health-sponsored meeting of hand-selected high performing health centers, defined as early HDC adopters, identified a number of structural, leadership, and process innovations that may, if spread across other health centers, drive higher performance (HRSA, 2011). Meeting proceedings were not meant to be a scientific case study, and meeting attendees were not representative of the entire Health Center Program. However, proceedings shed light on the perceptions of experienced health center leadership regarding enablers and barriers to high quality care. These factors include:

- use of expanded and interdisciplinary care teams held accountable for providing appropriate and timely care;
- patient self-management support;

- use of defined patient panels and open access scheduling;
- use of HIT for managing patient and population data;
- transparent use of performance data to monitor and drive improvements;
- active health center leadership in building a culture of and capacity for organization-wide quality improvement; and
- integration of behavioral health, dental services, and pharmacy with primary care, as well as community partnerships that facilitate care coordination.

While most health centers employ behavioral health (mental health and/or substance abuse) professional staff, they are increasingly seeking to better integrate these services with primary care (Benson, Townes, and Dobbs, 2011) given evidence that doing so improves patient outcomes for a wide variety of health clinical indicators. For instance, patients with chronic illness often are best managed in combination with treatment for depression (Benton, Staab, and Evans, 2007).

Other External Factors Related to Health Center Performance

Contextual factors, such as health care markets, state policy differences, and geography may drive quality variation across health centers nationally. For example, state and local financing of health centers may also contribute to expanding health center capacity (Katz et al, 2011). Seventeen state Medicaid initiatives apply national or state-based PCMH criteria in conjunction with incentive payments and many target specific patient populations, such those with complex conditions (Takach, 2011). In addition, generous Medicaid eligibility policies and locating in urban areas are positively

associated with the hiring of more physicians relative to nurse practitioners (NPs), physician assistants (PAs), and certified nurse midwives (CNMs) (NACHC, Robert Graham Center, and George Washington University, 2008). Affiliation with local hospitals is associated with a health center attaining PCMH, as is fewer workforce shortages (Doty et al, 2010). Provider shortage often occurs in remote or isolated areas, such as rural or inner-city communities. Of course, some geographic factors such as rurality are not easily changed by policy.

Research shows that the generosity of a state's Medicaid enrollment policies affects state level capacity for primary care, but is supportive of health centers' ability to lower state level disparities. A fairly simply comparison of health centers in states with the most generous Medicaid eligibility (12 states) to those in states with the most limited eligibility (13 states) found that the Medicaid generous states had stronger capacity as measured by sites, patients, clinicians, and revenues. Health centers in the more generous states averaged three more sites, significantly more patients, nearly twice as many clinicians of all specialties, better patient-to-clinician ratios, $155 more revenue per patient, and a greater proportion of revenue from Medicaid relative to grants compared to health centers at the other end of the range (Shin et al, 2012). Although this study did not control for other factors possibly related to capacity, the gap is notable.

Another study determined that as health centers serve more of a state's low income population, key black/white and Hispanic/white disparities at the state level declined. This study accounted for state characteristics, such as age, education levels, population density, per capita income, percent of population uninsured, and Medicaid eligibility levels as measured by Medicaid financial eligibility level for families of three

as a percent of the federal poverty level. Medicaid eligibility alone had little direct influence on disparities. Health center penetration did not impact age-adjusted death rates from diabetes and heart conditions for both black and Hispanic patients, conditions affecting adults not likely to be covered by Medicaid. Authors conclude that it is the combination of having an effective source of care and comprehensive insurance coverage that most impact state level disparities (Shin et al, 2008). This implies that under health care reform, which is expected to bring broader insurance coverage and health center expansion, state level health disparities may decline.

Beyond its role in financing and enhancing internal capacity, having insurance helps facilitate access to off-site specialty services. These services are often necessary for ensuring better outcomes for at-risk patients. A national survey of health centers found that fewer health centers reported problems ensuring access to specialists for their Medicaid fee-for-service and managed care patients compared to their uninsured patients (68%, 64%, and 88%, respectively for appointments; 71%, 67%, and 91%, respectively, for procedures). Health centers were far less likely to report specialty access problems for their Medicare and privately insured patients (Doty et al, 2010).

Conclusion

This chapter reviewed the theoretical research describing different inter-related domains – patient, provider, organizational, and environmental – that impact performance. The conceptual models contribute valuable insight into the everyday challenges, operations, and multiple components making up of primary care practices, as

well as their relevance to outcomes. They insinuate that variation in performance is reasonable, natural, and perhaps inevitable. This chapter also reviewed empirical evidence on the factors or aspects within each domain, and documents the reality of such variation. The literature reviewed here identifies and verifies the covariates that should be included in my dissertation. None of these studies, however, thoroughly examine a wide range of factors across the different domains, including infrastructure or practice components specifically designed to improve patient outcomes sensitive to longitudinal care.

Most of the quantitative research on health center quality performance tends to emphasize patient case mix, finding that insurance status, income, minority, gender, and co-morbidities rank among the traits correlating with outcomes. It is likely that these factors are not mutually exclusive and are instead highly inter-related. For instance, poverty is very relevant to insurance status, given that Medicaid eligibility is based on income. And those who are sickest may be enrolled in Medicaid. The confounding of patient factors may also reflect organizational factors, particularly given how sicker patients drive costs and how health centers desire to structure their programs to meet patient need.

In fact, the two UDS-based studies (Shi, Lebrun, Zhu et al, 2012; Lebrun et al, forthcoming) document multiple health center characteristics and patient case mix factors that relate to quality performance. Most of these – insurance status, managed care penetration, age as a federally-funded health center, and patient volume – in some way relate to financing and capacity. One also determined that investing in enabling services staff is also related to better outcomes, but Wells, Punekar, Vasey (2009) demonstrate

that the extent to which a health center provides enabling services is very much related to financing in terms of managed care contracts, third-party reimbursement relative to grant revenue, and net revenue. Other studies suggest that health centers can improve care outcomes when they have the resources necessary (Chin, 2010). Nocon et al (2012) found centers with greater PCMH capacity comes at a certain price to health centers, and Birnberg et al (2011) determined participating in financial incentives, along with center size, is associated with greater capacity. Indeed centers with greater capacity have better access to specialty care and adequate workforce (Doty et al, 2010). Interestingly, Birnberg et al found that patient mix did not matter.

At least four studies that compared performance across different provider types, including health centers, found that patient mix matters when comparing providers along performance indicators (Gurewich et al, 2011; Hong et al, 2010; Weiner et al, 1996; Stuart and Steinwachs, 1993). Three of these (Gurewich et al, 2011; Weiner et al, 1996; Stuart and Steinwachs, 1993) determined that the unobserved differences in patient mix drive most of the observed differences in outcomes. Gurewich and colleagues, in particular, noted that patient level factors drove variation in performance within and across provider settings. Yet these studies do not include a broad range of organizational level factors.

Marceau et al (2011) finds that organizational factors – including infrastructure, practice configuration, and process features – predict more patient outcomes than patient mix, but did not include safety net providers in their analysis, thereby possibly obscuring the impact of patient risk. Looking exclusively across health centers, Ulmer et al (2000) revealed that the health center itself explained more variation in clinical quality than

patient mix and visit type, though all together researchers still could not account for most of the observed differences in quality performance. However, they were limited in the organizational level factors under study. Nevertheless, Ulmer et al's finding that health center itself mattered most implies that while case mix contributes much to health outcomes, components of the organization also matter.

Although my dissertation will not test how case mix drives organizational level ones, partly given a lack of patient level data, it will affirm whether financing, capacity, as well as quality-enabling infrastructure and transformations (e.g., meaningful use of EHRs and PCMH level) can overcome the social, economic, environmental, and behavioral factors that account for the bulk of health outcomes (Booske et al, 2010). Shi, Lebrun, Zhu et al's surprising finding that chart reviews are associated with better outcomes than drawing data from EHRs is perplexing, but may be addressed with more years of data and better controls.

Chapter 3: Conceptual Framework and Research Design

The complicated nature of improving health outcomes necessitates a comprehensive exploration of factors that may contribute to or impede performance. This chapter reviews the theoretical model that will guide this dissertation, as well as the measures used and empirical approach for answering the following research questions:

1. What health center characteristics consistently increase or decrease across performance quartiles?
2. What factors are associated with higher performance on outcomes?
3. Under what scenarios does a health center reach the highest quartile of performance?

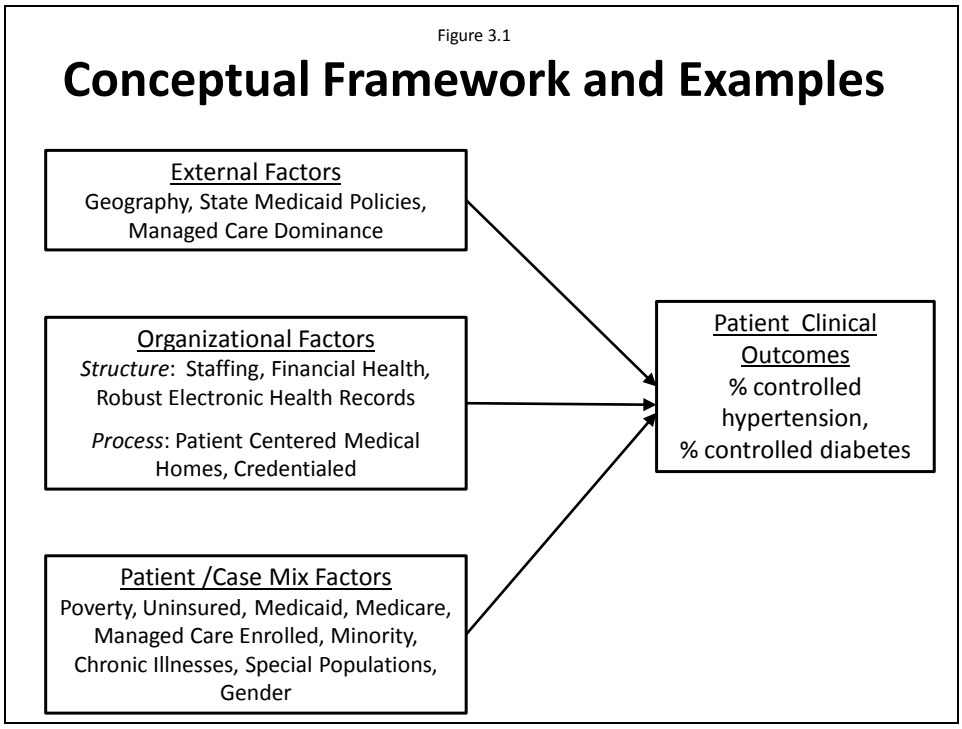
These policy questions allow me to explore the extent to which health centers vary in performance along key clinical indicators. They also aim to identify factors that matter most in driving performance variation.

Conceptual Framework

The conceptual framework used for this dissertation (Figure 3.1) summarizes the aspects that vary across health centers and, at least theoretically, impact patient outcomes. This framework adapts those used by Shortell et al (2005) and Post et al (2009), as well as the concepts from Yano (2008), to capture the factors relevant to the delivery of high-quality, longitudinal primary care. The originating frameworks place organization at the

heart of their models, serving as the conceptual core through which other factors influence outcomes (Post et al) or as the dominant theme across factors influencing outcomes (Post et al, 2009; Yano, 2008; Shortell et al, 2005). Organizational features consist of structural factors making up the "hard" resources and infrastructure, as well as process factors, denoting the manner in which care is delivered.

Figure 3.1



This framework will guide the variables chosen to answer my dissertation research questions. Variables will be selected based on the review of literature, theory, and availability of data. In essence, multivariate modeling will fall to some version of the following general model:

$$Y = f(\text{External Factors, Organizational Factors, Patient Factors}) + e.$$

This model represents the context in which care is provided in a health center. As modeled here, external-, organizational-, and patient-level factors matter to some unknown degree in predicting clinical performance. However, some are more in the centers' control than others (e.g., a health center is unable to change its location).

Dependent Variables

Hypertension and diabetes are highly prevalent nationally and among health centers. These two chronic conditions represent health conditions that lead to costly complications when not prevented or controlled, are treatable or even preventable with appropriate and timely primary care, and are used as markers for monitoring health disparities. For instance, African Americans and Hispanics, those with low income, and the uninsured tend to fair worse on for diabetes or hypertension control. Each is therefore among the priority conditions identified by Healthy People 2020 for improvement, and each currently falls short of the Healthy People 2020 targets (Healthy People, 2010), despite the existence of clinical guidelines.

Treating uncontrolled hypertension or uncontrolled diabetes is complex for several reasons. Each condition requires regular interaction with health care professionals. Caring for those with chronic illness involves a wide variety of primary care services to effectively manage them. Provider behavior and quality improvement (QI) capacity, patient self-management, and certain resources are also necessary to influence outcomes (Clarke et al, 2012; Chin, 2010). These measures, then, can also be used to assess how well the health center coordinates care among providers and across

care settings. Measures of hypertension and diabetes control are commonly used to compare provider performance and in pay for performance programs.

For these reasons, I will use the following clinical outcome measures in answering the study questions:

- Percent of patients aged 18-85 diagnosed with hypertension whose last blood pressure was less than 140/90; and
- Percent of patients aged 18-75 with Type I or Type II diabetes whose most recent HbA1c[46] test result was ≤ 9%.[47]

Each measure is consistent with those endorsed by national quality organizations, including the National Committee for Quality Assurance (Lebrun et al, 2012).

Notably, the lack of patient level data makes it difficult to account for all factors that relate to a patient's health. Process measures, such as the receipt of a procedure or test, are more within a health centers' control. This means that it may be easier to uncover the inputs necessary to "move the dial" along these factors, but it does not necessarily mean these changes are enough to change a patient's health. Additionally, process measure data related to diabetes and hypertension care do not exist across all health centers, making them unfeasible for this analysis.[48] Exploring the covariates of diabetes and hypertension control may shed light on more meaningful and lasting policy changes.

[46] Glycosylated hemoglobin (HbA1c) is a measure of glucose in the blood. HbA1c ≤ 9% is standard by which those with diabetes are at reduced risk for complications.
[47] Health centers also report the results for HbA1c <7%. However, for this analysis, I have selected to follow Shi, Lebrun, Zhu et al (2012) and focus on the less strict indicator of poor control given health centers' complex patient population and the wide array of factors that impact diabetes outcomes that fall outside the health centers' direct control.
[48] For those process measures included in health centers' annual federal reporting requirements (e.g., pap smear, childhood immunization), health center patients often receive these services elsewhere, and health centers lack the documentation necessary to account for them.

Specifying the Model

The conceptual model underlying this dissertation posits that multiple factors representing several domains impact quality outcomes. These domains include external-, organizational-, and patient-level attributes. The inputs to be employed in this analysis represent each of these domains, as well as key control variables. Most variables are measured through interval data. A few are dummy and ordinal measures. Appendix 3A walks through each independent variable construct, measure, data source, anticipated effects and explanation, and relevant sources. Chapter 2 justifies the inclusion of each. Previous research used limited numbers of variables in assessing health center performance or teasing out those that highly correlate with outcomes, and no other study includes environmental-level factors, making this dissertation the most comprehensive analysis to date. As exploratory research, only one research question generates hypotheses regarding which factors correlate with high performance. These are discussed below.

Independent Variables and Anticipated Direction

Variables representing factors external to the health center represent geography (urban/rural) and state Medicaid policy. I anticipate that the four external variables used in this analysis positively affect health center performance. Health centers located in urban areas are hypothesized to have a more sufficient workforce, experience fewer staff shortages, and have better access to other needed patient medical and social services than rural centers. State Medicaid coverage generosity, as measured by percent of adult

residents covered by Medicaid, is positively associated with health center and other provider capacity to address complex chronic conditions. Health centers in states covering more of the total adult population have greater capacity as measured by sites, patients, clinicians, and revenues. Similarly, states with more of their Medicaid population enrolled into managed care plans may facilitate a high level of provider integration and infrastructure for chronic care management. Finally, states with early experiences in Medicaid medical home demonstrations make available incentives or additional resources necessary for care coordination and patient management.

Organizational factors represent the resources, procedures, and infrastructure of the health center, particularly those likely to vary among all health centers. Nearly all are expected to be important assets associated with likelihood of higher performance. Three measures cover staffing capacity – ratio of medical patients to primary care and behavioral health, and ratio of total patients to enabling services[49] staff. Including services not typically seen in yet complementary to primary care ensures a more comprehensive assessment of the health center model of care, particularly around services related to improved care quality. Health outcomes are driven by more than just clinical care (IOM, 2014). Previous quantitative research is mixed on the impact of enabling services on UDS quality measures (Shin et al, 2013; Shi et al, 2012), but at least one study finding it does matter found only modest effects (Shi et al, 2012). Case studies on health center performance revealed that health center leaders regard enabling services as key facilitators of effective care delivery (Gurewich et al, 2012). Integrated these services into primary is particularly critical for underserved populations, and why they

[49] Enabling services are those that facilitate access to care for populations experiencing entrenched barriers to care, such as transportation, case management, health education, and home visitations.

will be included in the model. Greater staffing capacity equips a health center to better manage patients and is therefore predicted to associate with higher performance.

Markers of financial health – proportion of total revenue made up of federal health center 330 grants and proportion of Medicaid patient charges collected – also relate to health centers' ability to be adequately resourced for QI. The first measure is predicted to lower the odds of performance while the second likely increases it. Health center 330 grants are designed to ensure health center programs are comprehensive and open to all without regard to ability to pay – covering the uninsured, underinsured, and services not completely covered by public or private insurance. Nationally, 330 grant revenue per patient is less than average patient cost, whereas Medicaid revenue per Medicaid patient more closely resembles it.

Being "deemed" or credentialed under the Federal Tort Claims Act (FTCA) represents an organizational process measure. It accounts for meeting safety and quality standards as judged by an external entity,[50] and is likely to have a positively relationship with diabetes and hypertension performance – to complicated chronic conditions requiring longitudinal care. This measure also serves as a proxy for adaptive reserve, leadership, and practice culture – all factors that empirically and/or theoretically relate to provider competence in QI work.

Finally, given the expectation that robust EHRs support care management and integration, an EHR variable is an important infrastructure factor likely to be related to higher performance. This will be measured in terms of a Meaningful Use (MU) Capacity

[50] Deeming ensures a center maintains clinical protocols, patient tracking systems, medical records review, and active quality assurance programs.

Scale[51] (that is, number out of eight MU functionalities reported) because I assume the way EHRs are used is more meaningful that simply having it. In other words, reporting more MU functionalities speaks both to health center QI experience and infrastructure.

Patient-level factors generally reflect health center case mix, and by extension patient risk factors. Several measures of patient risk are expected to lower the odds of being a high performing health center because they reflect sicker patients experiencing compounding social determinants of adverse health, as well as barriers to needed services outside the health center. These measures include percent of health center patients at or below 100% of the Federal Poverty Limit, uninsured, have Medicare,[52] are members of racial/ethnic minority groups, are homeless, and are migrant/seasonal farmworkers. These populations experience acute health disparities. Other patient-level variables are associated with increased odds of being a high performing health center. As health centers serve more Medicaid insured patients, they are likely to be higher performing centers because serving more Medicaid patients is associated with expanded health center capacity, and because these patients have better access to specialty services compared with the uninsured. The ratio of total member months to total patients – a measure of managed care penetration among patients – may denote more chronic care management and financial incentives for better outcomes. Among clinically relevant factors, percent of adult patients who are female improves the odds given that female patients tend to have better health outcomes related to diabetes and hypertension than male patients, and

[51] The measure is drawn from 2010 Uniform Data System (see data source explanation below). This was the first year these data were reported. I chose 2010 rather than 2011 in order to account for longer periods of use. In bivariate analysis, the measures for 2010 and 2011 were similar in their correlations with other independent and the two dependent variables.

[52] Medicare patients are assumed to be in worse health but these patients do have better access to specialty care outside the health center compared to Medicaid and uninsured patients (Doty et al, 2010).

the proportion of visits related to chronic conditions may serve as a proxy for health center experience caring for chronically ill patients.

Finally, a series of control variables will be included given the likelihood that they moderate clinical outcomes or health center experiences. These include center size (in terms of patients and number of delivery sites), proportion of patients likely to be affected by the conditions measured, visit rate for diabetic and hypertensive patients, method of outcome measure reporting, and age of the health center.

Hypotheses

Among my three research questions, the second, "What factors are associated with higher performance on outcomes?" presents an opportunity for hypothesizing the mix of external-, organizational-, and patient-level characteristics that correlate with high performance in diabetes and hypertension control.[53] I expect that no one factor is sufficient alone to improve health. Variables selected for this exploratory research include those that previous research on health centers and other settings have shown to have some bearing on quality performance. They also include those with a strong but under-researched theoretical basis for inclusion, either as mechanisms to control for endogeneity or as direct influencers of quality performance. However, modeled together, I anticipate that certain variables will play notable and statistically significant roles in increasing the odds of being a high performing health center.

[53] The first research question, "What health center characteristics consistently increase or decrease across performance quartiles?," will be addressed through descriptive analyses. All independent variables have been selected based on previous research or given a strong theoretical basis, and each is expected to define differences across performance quartiles. Further discussion of descriptive analyses is discussed below. The third research question, "Under what scenarios does a health center reach the highest quartile of performance?," builds off those factors found statistically relevant in the second research question.

Given the high volume of Medicaid patients served by health centers and the fact that Medicaid revenue is more dependable per Medicaid patient than other revenue sources, Medicaid will play a particularly important role across all three levels of independent factors. State level Medicaid adult coverage rate (Shin et al, 2012), percent of Medicaid charges collected, and health centers' percent of patients with Medicaid insurance (Hicks et al, 2006) are hypothesized to positively relate to higher performance given the capacity that greater financing brings, as well as the greater access these patients have to needed services outside the health center (relative to the uninsured).

In contrast to Medicaid revenue, I hypothesize that lower reliance on federal health center 330 grants relative to other revenue sources will increase the odds of higher performance (Shi et al, 2012). These health centers serve fewer insured, particularly Medicaid insured, patients, and large numbers of complex, special population patients, such as homeless and migrant/seasonal farmworkers. These grant dollars do not account for the total cost of care provided to uninsured patients, and are often used to fill in reimbursement gaps left by all insurers, including Medicaid, which do not cover the full cost of health centers' comprehensive services. While 330 funding is used to expand the health center scope of services to include important but un- and under-funded services, such as enabling services or dental care, these dollars may not be invested in systems necessary for QI. Other organizational factors forecast to boost the odds of a center being a high performer include enabling services staffing capacity (Shi et al, 2012) and having a robust EHR – characteristics underlying QI capacity.

Given health centers' complex patient population, I hypothesize that many patient-level factors will also be statistically significant predictors of high performance.

Other than the percent of patients with Medicaid, penetration of managed care (Lebrun et al, 2013) and percent of patients that are female patients (Shin, Sharac, Rosenbaum, and Paradise, 2013; Shelley et al, 2011; Hicks et al, 2006; Maizlish, Shaw, and Hendy 2004; Ulmer et al, 2000) will increase the odds. Four will significantly lower the odds a center will be a high performer: percent of patients who are uninsured (Shin, Sharac, Rosenbaum, and Paradise, 2013; Shi et al, 2012; Devoe et al, 2012), minority (Shi et al, 2012), homeless (Shin, Sharac, Rosenbaum, and Paradise, 2013), and migrant/farmworkers. These four have been used by the BPHC to adjust health center performance when comparing nationally collected clinical measures across all health centers.[54]

Among the factors considered important controls for this analysis, I expect health center age (Shi et al, 2012; Lebrun et al, 2013) and size (Lebrun et al, 2013; Shin, Sharac, Rosenbaum, and Paradise, 2013) to increase odds of high performance. In addition, previous research found that the method of reporting the outcome measure, that is, the use of sampling charts or reporting on all applicable patients through the EHR, to be significantly related to health center quality metrics. Research from Shi et al (2012) revealed that those who sample from manual chart reviews perform better, and the BPHC uses this indicator in creating their adjusted health center performance comparisons.[55] I hypothesize that this indicator will have the same effect in this research.

[54] For more information, see http://bphc.hrsa.gov/healthcenterdatastatistics/reporting/ranking.html.
[55] For more information, see http://bphc.hrsa.gov/healthcenterdatastatistics/reporting/ranking.html.

Data Sources

The analysis will draw primarily from the three years of the Uniform Data Set (2009-2010 UDS),[56] to which all federally-funded health centers report annually as required under their Public Health Service Act, Section 330 funding. Over 90% of FQHCs receive this federal grant. The UDS is maintained by the BPHC. It reflects the full calendar year and houses data at the grantee, not patient or site level, permitting comparisons across health center organizations. Most health center organizations operate multiple sites. Included in the UDS are aggregate patient demographics (age, gender, insurance, income, race/ethnicity), staffing by provider type with related encounters and patients treated, revenue by source, cost by service category, encounters for and patients with certain primary diagnoses, health outcomes for diabetes and hypertension, and other measures of capacity or experience. Table 3.2 displays the total number of grantees reporting UDS in each of the four study years, as well as the total number patients served.

Table 3.2. Uniform Data System Grantees and Total Patients by Year

Calendar Year	Total # of Grantees	Total # of Patients
2011	1128	20,224,757
2010	1124	19,469,467
2009	1131	18,753,858
Source: Bureau of Primary Health Care, Health Resources and Services Administration, DHHS, 2009-2011 Uniform Data System. For more information, visit www.bphc.hrsa.gov/uds.		

Three years of data will be pooled, based on averages, to create a cross-sectional data set. While this allows for a longitudinal analysis, I have chosen to create a cross-

[56] Originally I proposed including 2008 UDS. However, paired t-tests and unpaired t-tests demonstrate that 2008 is statistically different from all other years for both diabetes and hypertension control. Because these analyses assume equal variances given the large sample size, I re-ran unpaired t-tests after adjusting for unequal variances. Findings of statistical differences in annual means are the same as unparied tests without adjusting for unequal variances. Moreover, these performance indicators were reported for the first time in 2008, and the age of patients eligible for each measure changed slightly by 2009.

sectional data set for several reasons. First, health centers generally do not experience many year-to-year changes in most of the explanatory variables. Second, pooling multiple years of data smoothes out any year-to-year performance changes for each health center.[57] These year-to-year differences may be random, or they may be expected as practices experience ups and downs in achieving higher performance (Miller et al, 2010). In other words, quality improvement happens in fits and starts. As described in Chapter 1, these inconsistencies make it difficult to predict outcomes and explain variability in patient management across physicians and practices (Katerndahl, Wood, and Jaén, 2011; Katerndahl, Wood, and Jaén, 2010; Plsek and Greenhalgh, 2001). However, it is unclear the extent to which variation should be considered reasonable. This is also a reason for quartiling the dependent variables. Third, longitudinal data are more difficult to interpret. Variables may be statistically significant some years but not others.

Health centers only recently began to report standard patient outcomes on diabetes, hypertension, and some process of care indicators in their UDS. The BPHC added these quality measures to health centers' UDS reports in calendar year 2008. Health centers also began reporting data on their EHR use in 2010.[58] Neither the quality metrics nor the EHR data have been widely used for research.

Hypertension and diabetes rank first and second, respectively, among encounters for medical conditions reported in the UDS (2009-2011 UDS).[59] In entering their UDS,

[57] Paired and unpaired t-tests demonstrate that health center quality metrics in 2009, 2010, and 2011 are similar from year to year and across health centers.
[58] For more information on the UDS, including the user manual and aggregate data at the national and state level, see www.bphc.hrsa.gov/uds.
[59] Based on primary diagnoses. In 2011 UDS, health centers reported more and 4.3 million hypertension encounters and 3.9 million diabetes encounters. Encounters, or visits, for these conditions surpass most known preventive service visits, also reported by primary diagnosis. Only oral dental exams surpasses the

health center organizations are instructed via a User Manual to report their outcome measures through a three step process. First, they report the total number of patients who fit the target population (total number of patients aged 18-75 with type I or type II diabetes and total number of patients aged 18-85 diagnosed with hypertension) and were seen at least twice for medical care during the reporting year.[60]

Second, they report the metric denominator. They do so in one of two ways. Health centers with an EHR that has been in use for at least two years may report the total number of cases.[61] Those without EHRs report the total patient population or a random sample of 70 patients who fit the criteria, whichever is lower. When sampling, health centers may not sample more than 70 patients and must sample across all patients rather than stratify across sites or providers in order to prevent oversampling. They are instructed to use one of two recommended sampling methods, and are provided steps for each: use a list of random numbers generated for the total patient population, or select a random starting point and use a calculated interval to select patients.[62] If using an EHR, the number entered for the first two steps will be equal. Third, health centers report the numerator – that is, those patients among the denominator who meet the metric and have been tested during the calendar year. Patients eligible for the metric but who have not

---

number of diabetes encounter. See http://bphc.hrsa.gov/uds/view.aspx?q=r6a&year=2011&state=. 2011 was the first year that the number diabetes encounters surpassed both the numbers of child health supervision visits and visits for selected immunizations.

[60] There are some exclusions, such as gestational diabetes for the diabetes measure. See http://bphc.hrsa.gov/healthcenterdatastatistics/reporting/2011manual.PDF.

[61] Those using EHRs must meet the following criteria: The EHR includes every patient diagnosed with diabetes or hypertension regardless of whether they have been treated, criteria for measurement is regularly recorded in the EHR, and the EHR has been in place for the entire reporting year and "ideally for at least three years" to permit identification of all diabetic and hypertensive patients. See sampling method description at http://bphc.hrsa.gov/healthcenterdatastatistics/reporting/2011manual.PDF. Health centers also report these measures by race/ethnicity.

[62] The UDS User Manual further guides health centers in replacing randomly selected patients that do not meet the measure criteria and should be excluded from the sample. This only applies to diabetes (e.g., exclude patients with gestational diabetes).

had their HbA1c or blood pressure tested during the reporting year are counted as non-compliant and are included among those who do not meet the performance metric.

Empirical Approach

Unit of Analysis and Treatment of Dependent Variables

The unit of analysis for this dissertation is grantee (aka, federally-funded health center organization) given the level in which data are reported. This dissertation relies on two distinct dependent variables, rather than creating a single composite measure. Creating composite scores is problematic because different aggregation methods lead to different results, particularly in terms of performance ranking (Reeves et al, 2007). Moreover, while each measure represents key indicators in primary care performance, they do not represent all aspects.

Each dependent variable is reported by grantees as an interval measure. The three years of data will be pooled, based on averages, to create a cross-sectional data set.[63] Prior to pooling, I will drop those health centers with an insufficient number of patient records used to report percent of patients with diabetes and hypertension under control. The UDS allows health centers to report the full numerator (patients with the condition under control) and denominator (patients with the condition), or sample up to 70 records (i.e., conduct chart reviews) from patients with the condition. In some cases health

[63] Although multiple years of UDS data make it possible to conduct a longitudinal analysis, descriptive analysis indicate that descriptive statistics – including mean and percentiles – are consistent across all three years for both hypertension and diabetes control measures. Dispersion of these values is generally, though not perfectly, normal for each year, with slightly more dispersion for diabetes than hypertension control. Kurtosis does indicates no problematic clumping.

centers report fewer than 70 records if the number of patients with the condition is below 70.

Once the variables across three years are pooled, I will transform each dependent variable from numeric percentages into ordinal ranked quartiles, using each quality measure's 25^{th}, 50^{th}, 75^{th} percentile as cut offs. This approach will allow for more consistent, comparable patterns of performance with sufficient granularity while also recognizing that minor differences are expected. Creating such quartiles calls into question how to handle those health centers with no relevant patient population of interest (i.e., no applicable patients for the denominator) and those that score 0 on the measure (i.e., those with the relevant universe for the denominator but no patients meeting the performance metric). In the first case, these centers would be left out of the analysis. In the second case, these centers will be included but would generally fall in the lowest performance quartile.

Research Methodology: Answering Each Research Question

This section walks through the empirical approach for answering each research question. The methods used are essentially sequential from question to question. It is important to keep in mind that outcome variables will be treated separately, and therefore all analyses will be run for each outcome.

RQ1. What health center characteristics consistently increase or decrease across performance quartiles?

Once dependent variables are converted into quartiles, I will descriptively determine health center differences between quartiles. This essentially creates a profile for the "typical" health center organization within each quartile. Descriptives will include mean, median, minimum, and maximum values for each explanatory variable, as well as standard deviations. In order to test whether differences in means across quartiles are significant, I will conduct post-hoc pairwise comparisons of independent variable means across all diabetes and hypertension quartiles by employing the Sidak, Bonferroni, and Scheffe tests.

RQ2. What factors are associated with higher performance on outcomes?

Although descriptive analyses paint a picture of health center characteristics across quartiles of performance, multiple regression models are used to examine each independent variable's relationship with a given dependent variable while accounting for the impact of other independent variables. I will use ordinal logistic regression (OLR) to determine the predicted odds (i.e., likelihood) of being in a higher performing quartile. OLR applies the proportional odds assumption, which maintains that the relationship between each pair of outcome quartiles is the same. This means that the predicted odds ratio between the lowest and all higher categories of dependent variables is equal to the predicted odds between the next lowest and all higher categories, and so on.[64] Logisitic regressions are common in health services research (see for example, Shi, Lebrun, Zhu, et al, 2012; Marceau et al, 2011; Shortell et al, 2005). The key statistic of interest will be the odds ratios, which measure the effect size of each input.

[64] For more information, see Institute for Digital Research and Education (IDRE), University of California, Los Angeles. "Stata Data Analyses Examples: Ordered Logistic Regression." http://www.ats.ucla.edu/stat/stata/dae/ologit.htm.

OLR assumes a non-linear relationship between primary care inputs and quality outputs. Although exploratory research commonly starts with ordinary linear regression, I chose to use OLR given the ordinal nature of my dependent variables. Conceptually, minor differences in percentage of performance are trivial and factors that influence health center performance may be compounding rather than additive. Another possible non-linear situation is that health centers might plateau in their levels of performance. At least one study found a significant curvilinear effect between clinic capacity and quality of care in Veterans Health Administration clinics. This study determined that greater resources led to better care only up to point, after which additional resources generated minimal quality gains (Mohr and Young, 2012). In the case of health centers, securing healthy outcomes for diabetes and hypertension may level off given patients' pervasive and deep-rooted social determinants of health.

For each dependent variable, I will run two OLR models in order to explore the affect of adding explanatory variables. Model 1 will be the basic model and include those variables for which previous research has demonstrated their statistically significant relationship with performance on hypertension or diabetes outcomes measures at health centers, plus the inclusion of urban/rural as an external factor typically included in other studies.[65] Model 1 is nested within less restrictive Model 2, which will add explanatory variables that have been statistically significant determinants of outcomes in non-health

[65] For both diabetes and hypertension OLR models, certain independent variables were ruled out given multicollinearity (i.e., were highly correlated with other independent variables). These include percent of patients who prefer to be served in languages other than English and whether the center has participated in a diabetes Health Disparities Collaborative between 2000-2006. The former is highly correlated with percent of patients who are minority and migrant farmworkers, while the second was highly correlated with health center age, total patients, FTCA deemed, and having a robust EHR.

center research, or have been added based on a theoretical impact on performance.[66] In order to compare the impact across both dependent variables, the explanatory variables applied in each model will be the same for hypertension and diabetes performance. The likelihood ratio (lr) test determines whether the addition of a new group of explanatory variables makes any statistically significant contribution, and is analogous to the joint F-test used in ordinary liner regression to compare explanatory power across nested models.

RQ3. Under what scenarios does a health center reach the highest quartile of performance?

I will seek to predict what inputs are necessary to move a health center up a performance quartile. In other words, how are different kinds of health centers predicted to perform? To answer this, I will use probability values (aka, pr values) to identify the circumstances by which a health center can reach the highest hypertension control performance quartile, or at least improve its odds of being a in the top quartile. Testing how a given health center may perform under certain circumstances may be more intuitive for health center audiences than explanations of odds ratios, particularly given the ordinal nature of the dependent variable. Predicted probabilities are useful tools for explaining what scenarios or inputs increase the probability of being in the highest performing quartile. They may also contribute more realistic analyses where odds ratios appear unusually large as these cases do not necessarily produce large changes in probability under new scenarios. Of course, inputs must be statistically significant to

[66] Other potential variables were excluded given a lack of sufficient research or theory, or given a failure to generate a statistically significant bivariate relationship with the dependent quartiled variables. This step was used to narrow down possible independent factors.

begin with, and the nature of this question implies that inputs are changeable (i.e., it does not work for urban/rural).

I will take three steps to create specific health center profiles. First, I will create a baseline – that is, a "typical" health center whereby all explanatory variables are set to their mean values. Second, I will create scenarios by which each statistically significant explanatory variable is set as the value minimum where odds ratios are below 1 and the value maximum where odds ratios are above 1 while holding all other independent variables at their means. This "extreme values" approach is not intended to set thresholds but instead emphasizes the sensitivity of key inputs– that is, those factors found to significantly affect the odds of quality performance. Finally, I will test policy-driven priorities while holding all other independent variables at their means. This is another way to measure the impact of having the "right" ingredients for quality improvement. It is not a worthwhile exercise, however, for patient-related variables because doing so would be counterproductive to health centers' mission. For instance, a policy goal would not be to have health centers serve zero homeless or minority patients (though eradicating homelessness is of course an admirable, long term but separate policy goal). Nor is it helpful for testing policy targets in cases where factors produce counterintuitive odds ratios.

Sensitivity Analysis

Sensitivity analyses can test the strength of findings under different circumstances. I will take at least three approaches. First, given the two models used and the multiple levels of variables (i.e., domains including external, organizational, and

patient factors), I will test whether adding groups of variables one at a time generates "better" models, and whether other explanatory variables appear to be statistically significant. To do this, I will create five different nested models in order to include each variable group one by one, starting with the same restrictive Model 1. Models 2-4 will add organizational variables, environmental variables, and patient-level variables, respectively. Model 5 will include control variables and will be the same as less restrictive Model 2 in the actual analysis.

Second, prior research points to theoretical and empirical impacts of meeting Patient Centered Medical Home (PCMH) criteria. However, including survey data on health center's PCMH capacity dramatically lowers the number of observations available to study by one-third.[67] In order to compare truly nested models, the number of observations must be the same in each model. Still, I will test the contribution of including this data.

Lastly, I will test the analytic functional form against interval, rather than ordinal, outcome measures. In doing so, I will use ordinary linear regression using the three-year average for both performance outcome measures.

Anticipated Issues and Possible Limitations

The following possible limitations must be considered as analytical constraints. However, my research design is intended to reduce the most egregious caveats.

Constraints in Interpretation

[67] For more information on this data set, see Appendix 4C.

First, the results of this dissertation must be viewed in the context of its narrow scope. This analysis explores limited measures of performance, and should not be used to explain variation in other markers of value-based health care, including cost savings, affordability, enhanced access, improved population health or patient experience, and mitigated disparities. Nor does it assess sustainability of outcomes. Moreover, it should be noted that although external, organization, and patient domains are depicted in isolation and modeled as additive, factors or domains that influence health center performance may interrelate. Consequently, it may be impossible to understand one without referencing the other. Precautions can be taken to avoid co-varying between explanatory measures, as described below. Yet this analysis does not test the interactions between them.

Second, data used for this analysis reflect organization-wide. This dissertation therefore suffers from potential ecological fallacy (as similarly noted in Lebrun et al, 2012 and Shi, Lebrun, Zhu, et al, 2012). Patient level data, though unavailable, would provide better specificity and be more helpful for determining actual risk adjustments needed when comparing across providers. Including both patient level and organizational level data and accounting for nesting effects may provide the most thorough examination of factors contributing to performance variation.

Third, this research is designed to be exploratory and predictive in nature, rather than determine cause and effect. Temporal order will therefore be unknown. Finally, the outcomes may be lagged. QI should be continuous and occurs under periods of slow and rapid periods of transformation (Miller et al, 2010). Moreover, health centers have seen

improvements in process of care measures happen more quickly than improvements in clinical outcomes (Chin, 2010).

Creating Performance Comparison Groups

Creating mathematical performance quartiles is a commonsense approach for comparing health centers. However, there may be other approaches that better group health centers into reasonable thresholds. Approaches other than mathematical quartiles will not be tested in this analysis because there is no basis for them. There is no evidence-base on what score thresholds should deem a provider as a "high" performer, especially since these values are not being risk adjusted for the purpose of this dissertation.

Transforming each dependent variable into ordinal variables based on quartiles of performance will allow for more consistent, comparable patterns of performance while also recognizing that minor differences are expected. The use of quartiles still maintains a sufficient level of granularity. It builds in ample distance between "top" and "bottom" performers for more precise comparisons, something not possible if simply grouping centers into two categories. It is also practical given the large number of grantees reporting UDS annually. Mathematically quartiling provider performance for comparison purposes has been done by other researchers, including those using UDS (Shortell et al, 2005; Shi et al, 2012[68]), as well as the BPHC when ranking health centers

[68] Shi et al (2012) actually created two ordinal groups based on quartile of performance: top 25% and all others. This was likely done to prevent a labeling of "poor performers" for those centers in the bottom quartile. Hong et al (2010) created tertiles for the same purposes.

along all UDS quality measures.[69] Once dependent variables are arranged in this ordinal fashion, I will scrutinize each quartile to verify that clustering is not a problem.

Endogeneity and Multicollinearity

Endogeneity occurs when a parameter correlates with the error term. One type of edogeneity is simultaneity, which occurs when an independent variable is jointly determined with the dependent variable. Many independent variables may not be mutually exclusive. For example, uninsurance is related to poor outcomes. The use of state policy variables, such as Medicaid coverage rate, helps thwart edogeneity bias.

In contrast, multicollinearity occurs when two or more predictor variables in a regression are jointly determined. Running bivariate correlations will help prevent this as it reduces the number of variables used to those that are not jointly determined. However, some independent variables will remain important control factors, calling into question whether they should be dropped. For instance, financing is relevant for the extent to which health centers offer enabling services (Wells, Puneker, and Vasey, 2009).

Omitted Variable Bias

Not all measures relevant to quality performance are likely to be accounted for in this analysis, often because these factors are not readily measurable. Omitted variables only matter if they correlate with the regressor and with the outcome. Examples of omitted variables include those listed here:

[69] For more information, see http://bphc.hrsa.gov/healthcenterdatastatistics/reporting/ranking.html.

- *Provider level Factors*. Available datasets do not allow me to broadly explore the impact of provider characteristics beyond type. These lacking variables include provider knowledge, training, and adherence to clinical guidelines.
- *Patient level Factors*. Unmeasured variables of patient complexity include patient illness severity and co-morbidities, level of patient engagement in care, patient medication adherence, and duration of diabetes/hypertension (including early onset). Organization or site level data do not allow a more detailed exploration of patient risk. However, the UDS provides a sufficient number of previously tested case mix factors.
- *Contextual Factors*. These include local health care market factors (e.g., extent to which other providers serve the community), partnerships with other providers, availability of social services, and strength of vertical and horizontal integration. To this last point, although this dissertation is unable to gauge the extent to which a health center is well integrated into the larger health care system, some proxy variables may account for some extent of this (e.g., FTCA deemed).
- *Organization Structural Factors*. Such omitted variables may include use of outreach workers or patient navigators, leadership commitment to quality goals, participation of the governing board in QI activities, and organization climate conducive to change and innovation.
- *Organization Process Factors.* These involve the use of effective care delivery teams and patient empanelment, extent to which clinical guidelines are incorporated into workflow, whether EHR functions are actually being used, sufficiency of care coordination services, role of the governing board, use of a

formalized Quality Management (QM) to guide care delivery and integration, degree of attentiveness to patient and community needs, adaptiveness to implementing innovations, and practice culture. Although there are no widely-accepted measures of culture or an understanding of how those measures may be used to improve quality (Yano, 2008), the use of FTCA deemed as an explanatory variable may serve as a proxy measure.

Data Reliability

Diabetes and hypertension outcomes in the UDS are reported using sampling or a centers' EHR. This reporting option and the complicated sampling technique call into question whether outcomes are being reliably reported across all centers. For this reason, I am adding certain controls, such as hypertension or diabetes encounters per patient and percent of patients eligible for the indicators. Having more years of data may also counter this, especially more recent years where health centers are more experienced with reporting these measures. While the dependent variables and EHR measures are still fairly new, the UDS is the most comprehensive data set available on health center clinic performance and organizational characteristics. It is also validated in that the BPHC conducts checks on submitted data. Most health centers also have previous experience reporting quality indicators.

Chapter 4: Results

This chapter presents the results of my empirical analysis. Multivariate models were selected after a careful review of the literature and bivariate regression results. Chapter 3 provides a description of each variable and expected relationship with health center quality quartile for the two outcomes of interest – quartiled percent of patients with hypertension and diabetes control. Chapter 3 also describes how I pulled three years of data (2009-2011) to construct one cross-sectional dataset.

This chapter answers the following:

Research Question 1: What health center characteristics consistently increase or decrease across performance quartiles?

Research Question 2: What factors are associated with higher performance on outcomes?

Research Question 3: Under what scenarios does a health center reach the highest quartile of performance?

Quartiling Outcome Variables

As explained in Chapter 3, prior to pooling the 2009-2011 Uniform Data System (UDS) data, I dropped those health centers with an insufficient number of patient records used to report the two outcome measures, percent of patients with diabetes and hypertension under control. When sampling is used to report performance measures rather than reporting on all patients with the condition, health centers randomly sample

up to 70 records. However, rather than drop all centers reporting fewer than 70 records, thereby excluding many small centers,[70] I chose 50 records as a cut off. This slightly lowered the total number of health centers reporting UDS across all three years from 1114 health centers to 1093 and 1045 for the hypertension and diabetes outcome measures, respectively. For simplicity, I refer to these samples as full samples when discussing descriptive findings. When running regression analyses, the sample sizes for each outcome measure slightly declines given that only health centers with all variables used in the regression are considered. In other words, the full samples are truly "maximum" samples for any given variable.

After dropping health centers with fewer than 50 records, I created three year averages for each outcome variable and then constructed performance quartiles in Stata. As depicted in Table 4.1 below, the total number of health centers in the pooled, three year sample differs for hypertension and diabetes. This is because more health centers reported fewer than 50 records in diabetes than hypertension. Table 4.1 also demonstrates that the percent of health centers falling into each mathematically-driven quartile is similar across all quartiles. Roughly a quarter of all health centers fall into any given quartile. Finally, the table includes quartile minimum, maximum, and mean.[71] For both hypertension and diabetes, the threshold for reaching the highest performing quartile is greater than the comparison Medicaid Managed Care Organization HEDIS Score. In

[70] Health centers reporting fewer than 70 records for each outcome measure are predominately among the smallest health centers (i.e., the lowest quartile in terms of total patients). There is one exception to this. In 2009, health centers reporting fewer than 70 records for diabetes control ranged in size. Only 12% of these health centers were among the smallest health centers and 30% were below the median, while 45% were among the largest (i.e., the highest quartile in terms of total patients). However, when pooling across the three study years, the smallest health centers continue to be most likely to report fewer than 70 records.
[71] While some health centers' actual performance places them close to the quartile cut off, dispersion pictured in histograms demonstrates there are no clear cut off points that better minimize the number of "borderline" health centers.

other words, top performing health centers perform better than many other Medicaid organizations, a more suitable comparison than population nationally given similar patient populations. Shi, Lebrun, Zhu, and colleagues (2012) found that for hypertension, health centers' average and top quartile performance rates surpass the US average. However, they did not find the same pattern for diabetes control, although top quartile performers narrow the gap. The descriptive findings provided below will document how health centers vary within each quartile.

Table 4.1. Quartile Breakdown for Hypertension and Diabetes Control, Full Sample Pooled, 2009-2011

Quartile	# of Observations	% of Centers	Minimum	Maximum	Quartile Mean
Percent of Patients with *Hypertension* Under Control					
1 (lowest)	284	25.98%	20.20%	56.67%	50.61%
2	263	24.06%	56.74%	62.86%	59.89%
3	273	24.98%	62.86%	68.74%	65.56%
4 (highest)	273	24.98%	68.74%	90.63%	74.36%
Total	1093	100.00%			
Medicaid MCO HEDIS Score 75th Percentile Threshold*			61.6%		
Percent of Patients with *Diabetes* Under Control					
1 (lowest)	265	25.36%	12.86%	64.76%	56.37%
2	258	24.69%	64.82%	72.09%	68.73%
3	261	24.98%	72.11%	77.79%	74.94%
4 (highest)	261	24.98%	77.98%	97.86%	82.87%
Total	1045	100.00%			
Medicaid MCO HEDIS Score 75th Percentile Threshold*			62.3%		

Note: May not sum to 100% due to rounding. Minimum and maximum values may appear equal but only due to rounding.
* Medicaid Managed Care Organization (MCO) HEDIS score based on 2008 data, the most recent data available.
Sources: 2009-2011 Uniform Data System, Bureau of Primary Health Care, HRSA, HHS. Shin et al, 2013.

Table 4.2 provides a comparison of health center performance across both outcome measures. Many health centers fall into the same quartile across both measures: 40.5% in quartile 1 (lowest), 28.7% in quartile 2, 33.1% in quartile 3, and 43.0% in quartile 4 (highest).When comparing across columns or rows, only quartile 2 (row) has more health centers aligned with a different quartile (slightly more hypertension quartile 2 health centers fall into diabetes quartile 1). The highest rate of matching occurs in the

highest and lowest quartiles. However, this table also demonstrates that most health centers fall into a diabetes quartile that differs from their hypertension quartile, and vice versa. Still, few perform in the highest quartile for one measure and lowest in the other. As noted by the chi2, the categories are statistically different at the p<.001 level. What this table demonstrates is that a health center "low" performer on one measure may not necessarily be a "low" performer on the other, and suggests that the factors relevant for improving performance may differ for each measure.

Table 4.2. Number and Percent of Health Centers by Diabetes and Hypertension Performance, 2009-2011

Hypertension Quartile	Diabetes Quartile				
	1 (lowest)	2	3	4 (highest)	Total
1 (lowest)	**108 (40.45%)**	72 (26.97%)	56 (20.97%)	31 (11.61%)	267 (100.00%)
2	73 (29.08%)	**72 (28.69%)**	58 (23.11%)	48 (19.12%)	251 (100.00%)
3	40 (15.56%)	63 (24.51%)	**85 (33.07%)**	69 (26.85%)	257 (100.00%)
4 (highest)	38 (14.45%)	50 (19.01%)	62 (23.57%)	**113 (42.97%)**	263 (100.00%)
Total	259 (24.95%)	257 (24.76%)	261 (25.14%)	261 (25.14%)	1038 (100.00%)

Pearson's chi2(9) = 119.2564 Pr = 0.000
Note: May not sum to 100% due to rounding.
Source: 2009-2011 Uniform Data System, Bureau of Primary Health Care, HRSA, HHS.

Descriptive Findings

Research Question 1: What health center characteristics consistently increase or decrease across performance quartiles?

Tables 4.3 and 4.4 below present descriptive findings for the total pooled full sample after dropping health centers with fewer than 50 records. Number of observations, mean, and standard deviation are presented for all independent or control variables by full sample and by quartile of outcome performance, hypertension (Table

4.3) and diabetes (Table 4.4). As discussed below with regression findings, some independent variables are not used consistently in each regression model.

Despite different number of total observations for the hypertension and diabetes full samples (N = maximum of 1093 and 1045, respectively), their characteristics are similar. On average, health centers have more than 17,000 patients and have been functioning as FQHCs for more than 6 years. Health centers' typical number of annual patient encounters per hypertensive and diabetic patient is 2.1 and 2.8, respectively, while 21.6% and 11.5% are diagnosed with hypertension and diabetes, respectively. Health centers are also likely to have relied on sampling, rather than reporting data on all patients with these conditions, for 2 of the 3 years of data collected. Across patient-level variables for the hypertension and diabetes outcome measures, on average most health center patients are in poverty (68.7% and 68.9%, respectively), percent of patients who are uninsured (39.7%and 40.1%, respectively), and minority (54.3% and 53.9%, respectively). One third of patients have Medicaid (33.4% and 33.5%, respectively), a small proportion have Medicare (8.4% and 8.3%, respectively), and health centers' ratio of total capitated managed care member months to total patients is high (0.846 and 0.839, respectively). Sizeable proportions of patients are female adults (43.3% and 43.4%, respectively) and nearly a quarter of all visits are for a chronic condition (23.8% and 23.8%, respectively). Finally, on average 7.9% of patients are homeless (for both hypertension and diabetes full samples) and 3% are migrant/seasonal farmworkers (3.2% and 3.3%, respectively).

Health centers in both hypertension and diabetes outcome full samples also have similar profiles in terms of organizational characteristics. Health centers average 1,130

patients per primary care provider in the hypertension full sample and 1,141 in the diabetes full sample. They also average over 13,000 patients per behavioral health provider and 3,600 patients per enabling services provider. Their percent of revenue for federal health center grants is also similar (23.1% and 23.2%, respectively), as is the percent of Medicaid charges collected (89.3% and 88.5%, respectively). They are similarly likely to be FTCA deemed (0.898 and 0.900, respectively) and have the same levels of EHR meaningful use capacity (3.8 for both).

Independent variables also include factors external to the health center. Across both hypertension and diabetes full samples, roughly half of health centers self identify as located in urban, as opposed to rural, locations. Health centers in both outcome groups are located in states with similar rates of adults enrolled in Medicaid (10.3% for both hypertension and diabetes full samples), percent of state Medicaid beneficiaries enrolled in managed care (71.6% and 72.0%, respectively), and have similar likelihoods of being in a state with a Medicaid PMCH initiative that began prior to the study period.

Means consistently increase or decrease across hypertension performance quartiles for some independent variables (Table 4.3), most commonly for patient-related variables such as the ratio of managed care member months to patients, percent of patients with hypertension or who are in poverty, percent of patients who are uninsured, Medicaid insured, Medicare insured, and homeless. For instance, as quartile of hypertension control performance improves, so does the percent of patients with Medicaid or Medicare. Conversely, as the proportion of patients without insurance, in poverty, and who are homeless increases, quartile of performance declines. Performance also improves as the ratio of managed care member months to patients increases.

Proportion of total health center revenue from federal 330 grants is the sole organizational variable to demonstrate a linear relationship across the four hypertension performance quartiles. In this case, the proportion of total revenue from these grants drops as performance quartile increases. As proportion of revenue from federal 330 grants declines, performance improves. Three external domain variables also have linear progression of means across quartiles. As states enroll more adults in Medicaid, performance improves. Despite the increasing pattern of means for managed care member months to patient ratio and state Medicaid managed care enrollment rate decline as performance increases. Health centers in higher performance quartiles are less urban than health centers in lower performance quartiles. Only a few of these independent variables have sizable mean differences across the quartiles. These include proportion of revenue from 330 grants, percent of patients who are uninsured and homeless, and the ratio of managed care member months to patients.

Among the dozen independent and control variables that increase or decrease linearly across quartiles of diabetes performance (Table 4.4), patient-related variables do so most often. As anticipated and discussed in Chapter 3, the rate of patients in poverty, uninsured, minority, and homeless declines as quartile of performance increases, while the opposite pattern holds for the percent of patients who have Medicare and who are female. The organizational level variable with a consistent pattern of performance is proportion of total revenue from federal 330 grants (declines as performance improves). Percent of a state's nonelderly adults covered by Medicaid and reliance on sampling techniques to report the performance metric (as opposed to using an EHR to report the full numerator and denominator) also increase with performance quartile. Likelihood of

serving an urban area and being in a state with a long established Medicaid PCMH initiative decline as performance improves. Among these 12 independent and control variables, the mean changes across the diabetes performance quartiles is substantial. These include proportion of revenue from 330 grants, urban, state Medicaid nonelderly adult coverage rate, and the proportions of patients who are in poverty, uninsured, on Medicare, minority, and homeless.

By creating four categories for each dependent variable, simple t-tests comparing means of independent variables across any quartile pair runs the risk of Type I Error – that is, a false positive when testing hypotheses or equality of means. Multiple comparison methods are therefore needed to lower the risk of Type I Errors for any pairwise comparison across any two quartiles. Running comparisons of means and comparing them to descriptive patterns presented above demonstrates that many characteristics of health centers are meaningfully different across quartiles of performance.

Appendix 4B documents post-hoc pairwise comparisons of independent variable means across all diabetes and hypertension quartiles, using the Sidak, Bonferroni, and Scheffe tests. These tests of differences in means find that quartile 4 (highest) is statistically different from other quartiles in many cases of independent variables, and in some cases, quartile 1 (lowest) is statistically different from other quartiles. For hypertension, differences between quartile 4 and others includes the same independent variables that linearly increase or decrease in means across quartiles with few exceptions: the number of years a health center used sampling to report hypertension control rather than report the full numerator and denominator through an EHR, and minority have

statistically different means across quartiles but these means do not consistently decline or increase across quartiles, and Medicaid managed care coverage rate and urban do not have statistically different means but do consistently decline or increase across quartiles. When comparing the descriptive findings of consistently increasing or decreasing patterns across diabetes quartiles and comparing the statistical difference of means between quartile 4 and others, here, too, only a few discrepancies emerge: medical patients per primary care provider, FTCA deemed, and migrant have statistically different means across quartiles but these means do not consistently decline or increase across quartiles, while the opposite is true for diabetes sampling.

Table 4.3. Descriptive Findings by Quartile, Pooled Full Sample 2009-2011, Hypertension

Variable	Total Full Sample	Quartile 1 (Lowest)	Quartile 2	Quartile 3	Quartile 4 (Highest)
	No. of Obs. Mean Standard Dev.	No. of Obs. Mean Standard Dev.	No. of Obs. Mean Standard Dev.	No. of Obs. Mean Standard Dev.	No. of Obs. Mean Standard Dev.
External Variables					
Urban or rural (dummy, 1=urban)	1093 0.511 0.500	284 0.567 0.496	263 0.510 0.501	273 0.505 0.501	273 0.462 0.499
Medicaid Coverage Rate for NonElderly Adults, 2010-2011	1066 10.279% 0.035	278 9.680% 0.031	259 9.853% 0.030	271 10.738% 0.039	258 10.868% 0.038
State Medicaid Managed Care Enrollment Rate, 2009-2011 (3 year average)	1085 71.616% 0.184	280 72.923% 0.204	262 72.254% 0.172	272 70.905% 0.181	271 70.364% 0.175
Early State Medicaid PCMH Initiatives (1= yes as of 2008)	1066 0.699 0.459	278 0.705 0.457	259 0.718 0.451	271 0.668 0.472	258 0.705 0.457
Organizational Variables					
Medical Patients per Primary Care Provider	1093 1129.857 392.406	284 1156.789 392.979	263 1146.87 350.136	273 1098.826 465.536	273 1116.48 347.161
Medical Patients per Behavioral Health Provider	1093 13357.88 42580.52	284 11661.21 45831.13	263 14823.84 44704.29	273 13936.24 42464.27	273 13132.31 36877.39
Total Patients per Enabling Services Staff	1093 3688.596 8338.635	284 2969.459 3721.074	263 3210.711 4870.753	273 4307.371 8656.491	273 4278.312 12863.38
Percent of revenue from federal 330 grants	1093 23.139% 0.144	284 27.588% 0.165	263 22.728% 0.144	273 21.479% 0.144	273 20.568% 0.108
Percent of Medicaid charges collected	1093 89.284% 0.345	284 87.731% 0.396	263 93.3546% 0.339	273 88.201% 0.296	273 88.059% 0.339
Deemed for FTCA (2009 and/or 2010)(dummy, 1=deemed)	1093 0.898 0.302	284 0.852 0.356	263 0.909 0.289	273 0.923 0.267	273 0.912 0.284

EHR Meaningful Use Capacity Scale, 2010(8 point scale)	1093 3.817 3.059	284 3.866 3.066	263 3.966 0.086	273 4.139 2.994	273 3.300 3.042
Patient Variables					
Percent Uninsured	1093 39.749% 0.19561	284 45.717% 0.207	263 40.524% 0 .180	273 37.7346% 0.187	273 34.808% 0.191
Percent Medicaid	1093 33.375% 0.15707	284 30.371% 0.15787	263 33.986% 0.1578	273 34.304% 0.150	273 34.984% 0.159
Percent Medicare	1093 8.438% 0.058	284 7.502% 0.053	263 8.273% 0.057	273 8.710% 0.056	273 9.298% 0.064
Percent Racial/Ethnic Minority	1093 54.250% 0.326	284 58.8947% 0.289	263 54.689% 0.311	273 51.027% 0.333	273 52.218% 0.364
Percent Homeless	1093 7.854% 0.216	284 14.206% 0.306	263 8.561% 0.221	273 4.587% 0.138	273 3.832% 0.129
Percent Female	1093 43.325% 0.073	284 43.095% 0.080	263 42.784% 0.068	273 44.163% 0.075	273 43.248% 0.070
Ratio of Capitated Managed Care Member Months to Patients	1093 0.846 1.653	284 0.602 1.396	263 0.871 1.523	273 0.897 1.697	273 1.023 1.931
Percent in Poverty	1093 68.731% 0.174	284 70.350% 0.180	263 70.280% 0.167	273 67.453% 0.166	273 66.831% 0.180
Percent Migrant Farmworker	1093 3.206% 0.117	284 4.082% 0.149	263 2.906% 0.088	273 3.076% 0.116	273 2.717% 0.106
Percent of Total Visits with a Chronic Condition Diagnosis*	1093 23.800% 0.107	284 24.963% 0.116	263 23.355% 0.103	273 23.594% 0.111	273 23.225% 0.097
Control Variables					
Years as 330-Funded Health Center (7 years maximum, 2005-2011)	1093 6.596 1.011	284 6.577 1.072	263 6.620 0.949	273 6.579 1.034	273 6.608 0.987
Number of Patients Served Annually, in Thousands	1093 17.692 18.972	284 15.045 18.372	263 19.284 20.015	273 19.096 18.877	273 17.507 18.436
Number of Encounters Per Hypertensive Patient	1093 2.057 0.525	284 2.064 0.517	263 2.013 0.411	273 2.003 0.413	273 2.146 0.696
Number of Years Sampling Used to Report Hypertension Metric (Out of 3 Years)	1093 2.148 1.154	284 2.042 1.18	263 2.038 1.191	273 2.110 1.161	273 2.403 1.043
Percent of Medical Patients Age 18-84 with Hypertension	1093 21.643% 0.089	284 21.212% 0.092	263 21.557% 0.084	273 21.672% 0.085	273 22.145% 0.094

* Includes visits with a chronic condition as a primary diagnosis. Chronic conditions include diabetes, hypertension, selected heart disease, asthma, chronic bronchitis, emphysema, HIV, and all behavioral health.
Sources: Pooled 2009-2011 Uniform Data System, Bureau of Primary Health Care, Health Resources and Services Administration, HHS, unless other years are stated. Three variables are drawn from other sources: Medicaid Coverage Rate for NonElderly Adults, 2010-2011 (Kaiser State Health Facts, "Medicaid Coverage Rates for Nonelderly by Age," http://kff.org/medicaid/state-indicator/rate-by-age-3/. Urban Institute and Kaiser Commission on Medicaid and the Uninsured estimates based on the Census Bureau's March 2011 and 2012 Current Population Survey); State Medicaid Managed Care Enrollment Rate, 2009-2011, 3 year average (CMS. Medicaid Managed Care Enrollment Report. Summary Statistics as of [July 1, 2011; July 1, 2010; June 30, 2009]. For 2011, see http://www.medicaid.gov/Medicaid-CHIP-Program-Information/By-Topics/Data-and-Systems/Downloads/2011-Medicaid-MC-Enrollment-Report.pdf); Early State Medicaid PCMH Initiatives (Kaye N and Takach M. Building Medical Homes in State Medicaid and CHIP Programs. June 2009. http://nashp.org/sites/default/files/medicalhomesfinal_revised.pdf).

Table 4.4. Descriptive Findings by Quartile, Pooled Full Sample 2009-2011, Diabetes

Variable	Total Full Sample	Quartile 1 (Lowest)	Quartile 2	Quartile 3	Quartile 4 (Highest)
	No. of Obs. Mean Standard Dev.	No. of Obs. Mean Standard Dev.	No. of Obs. Mean Standard Dev.	No. of Obs. Mean Standard Dev.	No. of Obs. Mean Standard Dev.
External Variables					
Urban or rural (dummy, 1=urban)	1045 0.514 0.500	265 0.608 0.489	258 0.574 0.496	261 0.533 0.500	261 0.341 0.475
Medicaid Coverage Rate for NonElderly Adults, 2010-2011	1021 10.272% 0.035	254 9.327% 0.028	252 9.806% 0.029	258 10.620% 0.034	257 11.315% 0.043
State Medicaid Managed Care Enrollment Rate, 2009-2011 (3 year average)	1039 71.992% 0.176	259 70.978% 0.189	258 73.910% 0.164	261 73.010% 0.169	261 70.0848% 0.178
Early State Medicaid PCMH Initiatives (1= yes as of 2008)	1021 0.704 0.457	254 0.756 0.430	252 0.742 0.438	258 0.663 0.474	257 0.658 0.475
Organizational Variables					
Medical Patients per Primary Care Provider	1045 1141.254 394.749	265 1186.527 413.677	258 1212.718 506.582	261 1112.242 309.795	261 1053.654 294.278
Medical Patients per Behavioral Health Provider	1045 13932.17 44073.55	265 17162.36 53483.21	258 17907.97 53124.41	261 11674.55 31884.08	261 8979.989 32141.02
Total Patients per Enabling Services Staff	1045 3666.92 8359.15	265 3257.168 6342.81	258 3453.943 6179.19	261 4185.641 12931.93	261 3774.761 5852.48
Percent of Revenue from Federal 330 Grants	1045 23.181% 0.143	265 26.766% 0.170	258 23.966% 0.154	261 21.490% 0.123	261 20.457% 0.107
Percent of Medicaid charges collected	1045 88.492% 0.326	265 86.573% 0.400	258 89.523% 0.337	261 90.545% 0.302	261 87.368% 0.245
Deemed for FTCA (2009 and/or 2010) (dummy, 1=deemed)	1045 0.900 0.300	265 0.838 0.369	258 0.922 0.268	261 0.908 0.290	261 0.935 0.247
EHR Meaningful Use Capacity Scale, 2010 (8 point scale)	1045 3.803 3.067	265 3.823 3.088	258 3.984 3.015	261 3.981 3.070	261 3.425 3.077
Patient Variables					
Percent Uninsured	1045 40.053% 0.197	265 49.104% 0.215	258 42.151% 0.193	261 38.068% 0.161	261 30.775% 0.167
Percent Medicaid	1045 33.466% 0.157	265 31.734% 0.172	258 35.875% 0.159	261 35.637% 0.139	261 30.676% 0.149
Percent Medicare	1045 8.346% 0.058	265 5.901% 0.041	258 6.745% 0.043	261 8.322% 0.052	261 12.437% 0.068
Percent Minority	1045 53.923% 0.326	265 66.154% 0.264	258 59.069% 0.299	261 53.324% 0.307	261 37.018% 0.358
Percent Homeless	1045 7.931% 0.217	265 15.176% 0.317	258 8.493% 0.222	261 5.690% 0.148	261 2.260% 0.079
Percent Female	1045 43.381% 0.074	265 42.432% 0.087	258 43.147% 0.076	261 43.430% 0.066	261 44.526% 0.061
Ratio of Capitated Managed Care Member Months to Patients	1045 0.839 1.653	265 0.709 1.564	258 1.031 1.799	261 0.984 1.736	261 0.635 1.467
Percent Poverty	1045 68.879% 0.174	265 73.316% 0.180	258 72.261% 0.139	261 68.170% 0.172	261 61.741% 0.178

Percent Migrant Farmworker	1045 3.338% 0.122	265 3.952% 0.145	258 5.009% 0.153	261 3.062% 0.103	261 1.337% 0.063
Percent of Total Visits with a Chronic Condition Diagnosis*	1045 23.771% 0.107	265 24.029% 0.108	258 23.539% 0.119	261 22.8045% 0.101	261 24.704% 0.100
Control Variables					
Years as 330-Funded Health Center (7 years maximum, 2005-2011)	1045 6.578 1.041	265 6.434 1.198	258 6.547 1.066	261 6.686 0.882	261 6.648 0.976
Number of Patients Served Annually, in Thousands	1045 17.218 18.028	265 15.927 18.729	258 19.991 21.734	261 19.410 17.901	261 13.596 11.580
Number of Encounters Per Diabetic Patient	1045 2.786 0.727	265 2.767 0.833	258 2.702 0.611	261 2.842 0.733	261 2.832 0.706
Number of Years Sampling Used to Report Diabetes Metric (Out of 3 Years)	1045 2.096 0.971	265 1.966 0.974	258 2.120 0.965	261 2.146 0.978	261 2.153 0.961
Percent of Medical Patients Age 18-74 with Type I or II Diabetes	1045 11.498% 0.046	265 11.296% 0.049	258 11.280% 0.041	261 11.359% 0.040	261 12.060 0.052

* Includes visits with a chronic condition as a primary diagnosis. Chronic conditions include diabetes, hypertension, selected heart disease, asthma, chronic bronchitis, emphysema, HIV, and all behavioral health.
Sources: Pooled 2009-2011 Uniform Data System, Bureau of Primary Health Care, Health Resources and Services Administration, HHS, unless other years are stated. Three variables are drawn from other sources: Medicaid Coverage Rate for NonElderly Adults, 2010-2011 (Kaiser State Health Facts, "Medicaid Coverage Rates for Nonelderly by Age," http://kff.org/medicaid/state-indicator/rate-by-age-3/. Urban Institute and Kaiser Commission on Medicaid and the Uninsured estimates based on the Census Bureau's March 2011 and 2012 Current Population Survey); State Medicaid Managed Care Enrollment Rate, 2009-2011, 3 year average (CMS. Medicaid Managed Care Enrollment Report. Summary Statistics as of [July 1, 2011; July 1, 2010; June 30, 2009]. For 2011, see http://www.medicaid.gov/Medicaid-CHIP-Program-Information/By-Topics/Data-and-Systems/Downloads/2011-Medicaid-MC-Enrollment-Report.pdf); Early State Medicaid PCMH Initiatives (Kaye N and Takach M. Building Medical Homes in State Medicaid and CHIP Programs. June 2009. http://nashp.org/sites/default/files/medicalhomesfinal_revised.pdf).

Ordinal Logistic Regression Results: Hypertension Performance

Research Question 2: What factors are associated with higher performance on outcomes?

As explained in Chapter 3, two nested models are used to test which factors improve the odds of higher performance, with less restrictive Model 2 testing more factors that, until now, have not been used in health center performance research. Total sample size in these OLR models is slightly lower than the full sample used in the descriptive analyses because some health centers do not report all variables. Table 4.5 presents the OLR odds ratios, z scores, and statistical significance for both hypertension models. As demonstrated by the prob<chi2, the entirety of each model is statistically

significant at the p<.001 level, thereby demonstrating that each model predicts the odds of being in a higher quartile. Model 1, the restricted model, reveals the odds of higher quartile of hypertension performance is 0.280 times lower for every percent point increase in a health centers' reliance on their federal health center 330 grants relative to other forms of revenue (p<.05), holding other explanatory variables constant. The odds are also lower for every percent point increase in minority and homeless patients (OR = 0.664, p<.1 and OR=0.390, p<.05, respectively).

Model 2 introduces more independent variables, including state-level factors excluded in the more restrictive model. Reliance on federal health center grant funding relative to other revenue sources, percent of patients who are minority, and percent of patients who are homeless continue to significantly lower the odds of being in a higher performing quartile (OR=0.277, p<.05; OR=0.559, p<.05, OR=0.293, p<.05, respectively), holding other factors constant. State-level Medicaid factors also appear to have a statistically significant impact on performance quartile. Three-year managed care enrollment rate lowers the likelihood (OR=0.558, p<.10), while coverage rate for non-elderly adults dramatically increases the likelihood of greater quartile of performance (OR=36.841, p<.10).[72]The large OR is likely explained by the fact that the proportion of adults covered in any state is already low. It is interesting that a health center's Medicaid patient case mix does not impact the odds of greater hypertension control. Certain control variables also significantly increase the likelihood of better performance quartile. Quality improves as health centers provide more encounters to patients with hypertension

[72]While the extremely large OR value may imply that health centers are more commonly located in states with more Medicaid generous eligibility, the dispersion of health centers indicates otherwise. Nearly two-thirds (61.7%) of health centers are located in states where the percent of all adults enrolled in Medicaid is less than the median (and mean) value.

(OR=1.325, p<.05), likely due to the frequency of needed treatment. Although the explanation is unclear, greater use of sampling patient records to report the hypertension quality metric also improves the odds OR=1.195, p<.05).

Table 4.5. Ordinal Logistic Regression Results, Hypertension Control

	Model 1		**Model 2**	
Number of Observations	1066		1066	
Chi^2	78.20		114.72	
Prob>chi^2	0.000		0.000	
Pseudo R^2	0.0265		0.0388	
Log Likelihood	-1438.1659		-1419.903	
Variable	Odds Ratio	Z Score	Odds Ratio	Z Score
External Variables				
Urban or rural (dummy, 1=urban)	0.960	-0.27	0.908	-0.59
Medicaid Coverage Rate for NonElderly Adults, 2010-2011	NA	NA	36.841*	1.85
State Medicaid Managed Care Enrollment Rate, 2009-2011 (3 year average)	NA	NA	0.558*	-1.77
Early State Medicaid PCMH Initiatives (1= yes as of 2008)	NA	NA	0.965	-0.28
Organizational Variables				
Medical Patients per Primary Care Provider	1.000	-0.72	1.000	-1.17
Total Patients per Enabling Services Staff	1.000	1.47	1.000	1.15
Medical Patients per Behavioral Health Provider	NA	NA	1.000	-0.53
Percent of Revenue from Federal 330 Grants	0.280**	-2.48	0.277**	-2.39
Percent of Medicaid charges collected	NA	NA	0.794	-1.27
Deemed for FTCA (2009 and/or 2010)(dummy, 1=deemed)	NA	NA	1.217	0.93
EHR Meaningful Use Capacity Scale, 2010 (8 point scale)	NA	NA	0.981	-0.94
Patient Variables				
Percent of Uninsured	0.375	-1.59	0.561	-0.83
Percent with Medicaid	1.005	0.01	0.791	-0.32
Percent with Medicare	0.463	-0.48	0.436	-0.46
Percent Minority	0.664*	-1.73	0.559**	-2.30
Percent Homeless	0.390**	-2.86	0.293**	-3.27
Percent Female	3.426	1.37	2.352	0.90
Ratio of Capitated Managed Care Member Months to Patients	1.049	1.12	1.036	0.81
Percent Poverty	NA	NA	1.237	0.48
Percent Migrant Farmworker	NA	NA	0.915	-0.15
Percent of Total Visits with a Chronic Condition Diagnosis[#]	NA	NA	0.431	-1.34
Control Variables				
Years as 330-Funded Health Center	1.048	0.81	1.037	0.60
Number of Patients Served Annually, in Thousands	0.999	-0.26	1.000	-0.04
Number of Encounters Per Hypertensive Patient	NA	NA	1.325**	2.11

Number of Years Sampling Used to Report Hypertension Metric (Out of 3 Years)	NA	NA	1.195**	3.36
Percent of Medical Patients Age 18-84 with Hypertension	NA	NA	1.501	0.52

Sources: Pooled 2009-2011 Uniform Data System, Bureau of Primary Health Care, Health Resources and Services Administration, HHS, unless other years are stated. Three variables are drawn from other sources: Medicaid Coverage Rate for NonElderly Adults, 2010-2011 (Kaiser State Health Facts, "Medicaid Coverage Rates for Nonelderly by Age," http://kff.org/medicaid/state-indicator/rate-by-age-3/. Urban Institute and Kaiser Commission on Medicaid and the Uninsured estimates based on the Census Bureau's March 2011 and 2012 Current Population Survey); State Medicaid Managed Care Enrollment Rate, 2009-2011, 3 year average (CMS. Medicaid Managed Care Enrollment Report. Summary Statistics as of [July 1, 2011; July 1, 2010; June 30, 2009]. For 2011, see http://www.medicaid.gov/Medicaid-CHIP-Program-Information/By-Topics/Data-and-Systems/Downloads/2011-Medicaid-MC-Enrollment-Report.pdf); Early State Medicaid PCMH Initiatives (Kaye N and Takach M. Building Medical Homes in State Medicaid and CHIP Programs. June 2009. http://nashp.org/sites/default/files/medicalhomesfinal_revised.pdf).

*p<.10, **p<.05, ***p<.001
NA = not applicable (not in the model)
#Includes visits with a chronic condition as a primary diagnosis. Chronic conditions include diabetes, hypertension, selected heart disease, asthma, chronic bronchitis, emphysema, HIV, and all behavioral health.

Using the lr test, the Model 2 proves to fit the data significantly better than the more restrictive and nested Model 1[LR chi2(13)=36.53; prob>chi2=0.0005]. In other words, the lr test demonstrates that Model 2 and its addition of new variables allows me to reject the null hypothesis that the coefficients of the new variables are jointly equal to zero at a confidence level of .0005. This indicates that including these additional variables significantly improves the explanatory power of Model 2 relative to Model 1.

Sensitivity and Other Analysis: Hypertension Performance

Contribution of Different Variable Domains. Although the log likelihood difference between Model 1 and Model 2 is not great (-1438.1659 vs. -1419.9032), I tested whether adding groups of variables one at a time generated "better" models, and whether other explanatory variables appeared to be statistically significant. As explained in Chapter 3, I created five different nested models in order to include each variable group one by one, starting with the same restrictive Model 1 as displayed in Table 4.5. Models 2-4 added organizational variables, environmental variables, and patient-level variables, respectively. Model 5 included control variables and is the same as Model 2

displayed in Table 4.5. The contribution of each variable groups improved the model log likelihood slightly, but Model 5 continued to have the highest. Using the lr test to compare two models at a time, each model improved the earlier model, with the exception of Models 3 and 4 (adding patient-level factors over the basic model with the addition of organizational and environmental factors). However, the lr test between Models 4 and 5 was statistically significant.

Only one additional independent variable became statistically significant. Having greater EHR meaningful use capacity slightly lowered the odds of greater performance quartile in Models 2-4 (OR between 0.951-0.958, all at $p<.05$). Although this is not intuitive, the OR is marginal and therefore not an important finding. Once health center data sampling – a measure of whether health centers relied on sampling over using all relevant data in the EHR – was included in Model 5, EHR meaningful use capacity was no longer significant. No other previously significant variable notably changed in the sensitivity analysis. These sensitivity analyses demonstrate that Model 2 as displayed in Table 4.5 is robust and can be used to measure the factors contributing to hypertension quality performance quartile.

Exploring Patient Centered Medical Home. Including survey data on health center's PCMH capacity dramatically lowers the number of observations available to study by one-third. In order to compare truly nested models, the number of observations must be the same in each model. Appendix 4C explores three nested models after including a measure of PCMH capacity. Including this measure dramatically lowers the number of observations, and is shown not to be a contributing factor in what drives hypertension control quartile.

Testing Functional Form. Linear regression models with the three-year percent average of performance yield negligible differences. The same explanatory factors are statistically significant, with few exceptions. In a restricted hypertension linear model (comparable to Model 1), percent of patients who are minority is no longer significant, and state Medicaid adult coverage rate is no longer significant in Model 2. The direction of all coefficients is the same as in the OLR models. The explanatory power of both models is modest (Model 1 Adjusted R^2=0.0849; Model 2 Adjusted R^2=0.1048).

Predicted Probabilities: Hypertension

Research Question 3: Under what scenarios does a health center reach the highest quartile of performance?

While odds ratios demonstrate the ability of an explanatory measure to increase or decrease the likelihood of being in a higher performing quartile, predicted probabilities around specific circumstances are more intuitive means of explaining the probability of actually being in the highest performing quartile. This was done for factors considered significant in Model 2.

A "typical" health center would have all explanatory variables set to the mean values. Such a health center has a 22.5% chance of being a top performer in hypertension control. This health center actually has a slightly greater chance of being in the second or third highest performing group (26.9% and 26.1% probability, respectively). This reveals that at the means, a health center has a 49.4% chance of being in the top half of performance for all health centers. When setting all statistically significant factors to

their highest quartile mean (Table 4.3), the probability of falling in the highest quartile is still only 26.0%, and health centers are slightly more likely to be in the next highest performing quartile (28.1%). Under this scenario, a health center now has a somewhat higher than 50% chance of being in the top half of all health centers.

Setting all independent factors to their highest quartile mean does not necessarily imply a "best case" scenario, especially given an apparent lack of variability in health center characteristics across the hypertension performance quartiles. Creating an extreme values scenario for each independent variable tests the sensitivity of the predicted impacts. Doing so here also generates negligible improvements in probability of falling in the top quartile, with one exception. When the hypertension encounter rate is set at its extreme value of 8.8 visits per hypertensive patient, a health center's probability of being in the highest performing quartile reaches 65.8%. It is the combination of setting each of these significant variables to their extreme values that produces the highest probability of being in the top hypertension performance quartile (90.7%). However, this exercise is largely academic in that it applies values from outlier health centers. Still, using the combination of significant variables can be used to demonstrate whether one variable is driving much of the high performance likelihood. When removing one variable at a time from this analysis, the likelihood of a center being in the top quartile falls to around 87% for all but one variable. When removing encounter rate for hypertensive patients, the probability falls to 59%, demonstrating the importance of access in general.

In some cases, the extreme value scenario may not make intuitive sense. For instance, if health centers are being encouraged to report their full numerator and denominators for quality performance measures, a sampling odds ratio of above 1 forces

me to set the extreme value as sampling all three years. Also, I hypothesized that percent of a state's Medicaid population enrolled in managed care would increase the likelihood of higher performance, so setting it to 0 as an extreme value scenario is counterintuitive.

Under Model 2, the three policy proxies are percent of revenue from federal 330 health center grants, percent of nonelderly state residents enrolled in Medicaid, and hypertension encounter rate. When set at its mean or at its highest quartile mean, health center grants produce a predicted probability of being in the highest performance quartile of 22.5-23.0%. When set to 10% of all revenue, the probability increases slightly to 25.5%. Setting the state-level non-elderly Medicaid coverage rate to 30% increases the probability of a health center falling into the top hypertension performance quartile to 37.1%. It is important to acknowledge, however, that there is no clear target of what the coverage rate should be at the state level, and will of course vary by state given post-health reform Medicaid expansion decisions and other insurance options available for adults. As demonstrated by the extreme value scenario, increasing the number of encounters for a hypertensive patient dramatically increase the probability of falling in the top quartile.

It is helpful to gauge the mechanisms that can increase a health centers' predicted probability of being in the highest performing quartile for hypertension control. It appears that this probability is highest (90.7%) when a health center has each of the significant explanatory variables set at their extreme values level.

Ordinal Logistic Regression Results: Diabetes Performance

Research Question 2: What factors are associated with higher performance on outcomes?

Table 4.6 below displays the OLR odds ratios, z scores, and statistical significance for both models exploring diabetes control. These models include the same factors as the two hypertension control performance models described above in order for me to compare factors that contribute to hypertension and diabetes outcomes performance. Each diabetes model significantly predict the odds of being in a higher performance quartile (prob>chi^2<.001).Compared to the hypertension control models, here we see a wider variety of factors that significantly increase or decrease the odds of being in a higher performance quartile, holding other explanatory variables constant.

The restricted Model 1 reveals that age as a federally-funded health center significantly increases the probability of being in a higher performing quartile by 26% (OR=1.256, p<.001). Key patient characteristics, however, significantly lower the odds of being in a higher performing quartile. These include the percent of patients who are uninsured (OR=0.129, p<.05), with Medicaid (OR=0.194, p<.05), racial/ethnic minority (OR=0.326, p<.001), and homeless (OR=0.314, p<.05). Two patient level characteristics defy this trend. Dominance of managed care marginally increases the odds of higher diabetes control (OR=1.081, p<.10), though only marginally. The percent of patients on Medicare radically increases the odds of higher performance (OR=1983.541, p<.001), possibly indicating that Medicare-enrolled patients are far healthier than patients on Medicaid or who are uninsured, or is related to the fact that Medicare health center

patients have easier access to needed specialty care compared to the uninsured and Medicaid insured patients (Doty et al, 2010). It might also indicate that having Medicare is enough to overcome other risk factors. A health centers' heavier reliance on federal 330 grants as opposed to other sources of funding lowers the odds of being in a higher performing quartile by 29.8% for every percent point increase in 330 funding (OR=0.298, $p<.05$). This finding likely stems from the fact that health centers with more uninsured and homeless patients are more 330-reliant.

Statistically significant explanatory variables in Model 2 follow the same pattern of direction as Model 1, and most continue to be significant in Model 1. Exceptions include percent of patients who are uninsured and the measure of managed care dominance, neither of which remain statistically significant. The impact of state Medicaid enrollment policy on uninsured will be discussed more below. Health center size (number of patients served in thousands) is not significant but the marginal odds ratio and how close the variable came to being significant at the 10% level in Model 1 makes this change appear negligible. Three patient-related variables actually now further lower the odds of reaching a higher performing quartile for diabetes: percent of patients with Medicaid, who are minority, and who are homeless. The odds ratio for percent of patients with Medicare grew dramatically and is the only patient-related variable that increases the odds (OR=6522.989, $p<.001$), possibly implying that having Medicare improves access to the full range of needed care and can overcome other risk factors.

Model 2 introduces more state-level factors that may influence a health centers' ability to improve quality of care. Being located in a state with an early Medicaid PCMH program lowers the odds of being in a higher performing quartile (OR=0.681,

p<.05), and being located in a state with greater adult Medicaid enrollment increases the odds by 10,796 times (p<.001). This later factor represents a remarkably higher likelihood that health centers in more Medicaid eligibility generous states are going to be higher performers,[73] while the earlier factor fails to demonstrate that state level investment in PCMH is enough to spark change on the ground in health centers. At the organizational level, newly added variable percent of Medicaid charges collected is also significant, with every percent point increase in collections lowering the odds of higher quartile performance by 0.583 (p<.05). This may be related to the fact that the percent of patients covered by Medicaid also lowers the odds (OR=0.155, p<.10). While significant, the odds of higher performance are only negligibly impacted by having a more robust EHR (OR=0.994, p<.10) and more patients per behavioral health staff (OR=1.000, p<.05). Following the trend of most other patient-related factors, the newly added percent of visits for chronic conditions lowers the likelihood of higher diabetes performance quartile (OR=0.317, p<.10). Finally, providing more encounters for diabetes patients raises the odds of higher performance quartile by almost half (OR=1.486, p<.001), and every year of sampling patients to report diabetes control increases the likelihood of being a higher performer (OR=1.189, p<.05).

Across both models, five independent variables unexpectedly produce lower likelihoods of being in a higher performing quartile. Being in a state with an early PCMH Medicaid program was theorized to provide a health centers more resources or obligations to improve care. Higher percent of patients enrolled in Medicaid and more

[73]While the extremely large OR value may imply that health centers are more commonly located in states with more Medicaid generous eligibility, the dispersion of health centers indicates otherwise. Nearly two-thirds (61.7%) of health centers are located in states where the percent of all adults enrolled in Medicaid is less than the median (and mean) value.

Medicaid costs reimbursed were expected to improve the odds of higher performance by providing health centers better access to specialty care for patients and more needed revenue. Having a more robust EHR was also expected to improve the odds given the role HIT plays in patient management, but the lower odds ratios produced here are negligible. This result may follow sampling's positive impact on the odds of higher performance. Finally, percent of visits for chronic conditions also had low ORs, despite the assumption that having more experience treating chronic illness – regardless of the kind of illness – would have a "spillover" affect and improve diabetes quality. But this is not a measure of how well care is being provided to other conditions, and the rate of diabetes visits for such patients does improve quartile of performance.

Two independent factors produced exceptionally high ORs: state Medicaid coverage rate for nonelderly adults and percent of patients with Medicare. These results are probably due to the fact that Medicaid adult coverage rates are generally low and Medicare patients do not make up large proportions of health center patients.

Table 4.6. Ordinal Logistic Regression Results, Diabetes Control

	Model 1		**Model 2**	
Number of Observations	1021		1021	
Chi^2	283.11		374.15	
Prob>chi^2	0.0000		0.0000	
Pseudo R^2	0.1000		0.1322	
Log Likelihood	-1273.8057		-1228.2861	
Variable	Odds Ratio	Z Score	Odds Ratio	Z Score
External Variables				
Urban or rural (dummy, 1=urban)	1.218	1.23	1.180	0.98
Medicaid Coverage Rate for NonElderly Adults, 2010-2011	NA	NA	10796.25***	4.30
State Medicaid Managed Care Enrollment Rate, 2009-2011 (3 year average)	NA	NA	1.096	0.25
Early State Medicaid PCMH Initiatives (1= yes as of 2008)	NA	NA	0.681**	-2.84
Organizational Variables				
Medical Patients per Primary Care Provider	1.000	0.26	1.000	0.32

Total Patients per Enabling Services Staff	1.000	-0.69	1.000	-0.86
Medical Patients per Behavioral Health Provider	NA	NA	1.000**	-2.30
Percent of Revenue from Federal 330 Grants	0.304**	-2.22	0.288**	-2.17
Percent of Medicaid charges collected	NA	NA	0.583**	-2.77
Deemed for FTCA (2009 and/or 2010)(dummy, 1=deemed)	NA	NA	0.957	-0.20
EHR Meaningful Use Capacity Scale, 2010 (8 point scale)	NA	NA	0.944**	-2.74
Patient Variables				
Percent Uninsured	0.123**	-3.17	0.335	-1.44
Percent with Medicaid	0.177**	-2.34	0.155**	-2.29
Percent with Medicare	1797.074***	4.15	6522.989***	4.37
Percent Minority	0.357***	-4.08	0.284***	-4.54
Percent Homeless	0.324**	-3.29	0.153***	-4.65
Percent Female	1.988	0.73	1.834	0.60
Ratio of Capitated Managed Care Member Months to Patients	1.101**	2.18	1.051	1.11
Percent Poverty	NA	NA	0.825	-0.42
Percent Migrant	NA	NA	0.890	-0.20
Percent of Total Visits with a Chronic Condition Diagnosis[#]	NA	NA	0.317*	-1.78
Control Variables				
Years as 330-Funded Health Center	1.257***	3.84	1.281***	3.93
Number of Patients Served Annually, in Thousands	0.994	-1.64	0.994*	-1.79
Number of Encounters Per Diabetic Patient	NA	NA	1.486***	4.12
Number of Years Sampling Used to Report Diabetes Metric (Out of 3 Years)	NA	NA	1.189**	2.62
Percent of Medical Patients Age 18-74 with Type I or II Diabetes	NA	NA	4.294	0.97

Sources: Pooled 2009-2011 Uniform Data System, Bureau of Primary Health Care, Health Resources and Services Administration, HHS, unless other years are stated. Three variables are drawn from other sources: Medicaid Coverage Rate for NonElderly Adults, 2010-2011 (Kaiser State Health Facts, "Medicaid Coverage Rates for Nonelderly by Age," http://kff.org/medicaid/state-indicator/rate-by-age-3/. Urban Institute and Kaiser Commission on Medicaid and the Uninsured estimates based on the Census Bureau's March 2011 and 2012 Current Population Survey); State Medicaid Managed Care Enrollment Rate, 2009-2011, 3 year average (CMS. Medicaid Managed Care Enrollment Report. Summary Statistics as of [July 1, 2011; July 1, 2010; June 30, 2009]. For 2011, see http://www.medicaid.gov/Medicaid-CHIP-Program-Information/By-Topics/Data-and-Systems/Downloads/2011-Medicaid-MC-Enrollment-Report.pdf); Early State Medicaid PCMH Initiatives (Kaye N and Takach M. Building Medical Homes in State Medicaid and CHIP Programs. June 2009. http://nashp.org/sites/default/files/medicalhomesfinal_revised.pdf).

*p<.10, **p<.05, ***p<.001
NA = not applicable (not in the model)
[#]Includes visits with a chronic condition as a primary diagnosis. Chronic conditions include diabetes, hypertension, selected heart disease, asthma, chronic bronchitis, emphysema, HIV, and all behavioral health.

Using the lr test, I find that in Model 2, in which Model 1 is nested, the addition of new variables allows me to reject the null hypothesis that the new variable coefficients are jointly equal to zero at a confidence level of 0.0000 [LR chi2(13)=91.04;

prob>chi2=.0000]. The less restrictive Model 2, therefore, significantly improves the explanatory power relative to the basic Model 1.

Sensitivity and Other Analysis: Diabetes Performance

Contribution of Different Variable Domains. Following the same approach as the hypertension performance analysis, I tested whether adding groups of variables generated better models than the two presented above. To do this, I created five different nested models, starting with the same restrictive Model 1, creating new Models 2-4 that added variable groups one at a time (organizational variables, environmental variables, and patient-level variables, respectively), and ended with Model 5 after adding control variables. Model 5 is the same as Model 2 in Table 4.6 above. The contribution of each variable group improved the model log likelihood slightly, but Model 5 continued to have the highest. As seen in the hypertension analysis, the lr test comparing models finds that each nested model improves on the earlier model, except for Models 3 and 4 (adding patient-level factors over the basic model with the addition of organizational and environmental factors). This demonstrates that Model 2 as displayed in Table 4.6 is robust and can be used to measure the factors contributing to hypertension quality performance quartile.

No new independent factors become statistically significant at any point. Percent of patients who are uninsured and ratio of capitated managed care member months to health center patients, the two variables that are no longer significant in Model 2 in Table 4.6, remain significant after adding organizational variables (Model 2 in the sensitivity analysis) but lose significance after adding environmental factors (Model 3 in sensitivity

analysis). This implies that the addition of environmental factors in Model 3 (Medicaid coverage rate for nonelderly adults, state Medicaid Managed Care three-year average enrollment rate, and early Medicaid PCMH initiative) somehow outweigh the contributions of uninsurance and managed care dominance at the health center level, and therefore may serve to control possible confounding (i.e., endogeniety) that arises with these two patient related variables.[74] In other words, the extent to which a health center's patient population is enrolled in managed care is largely driven by the larger insurance environment of the local market, which, for health centers, effectively means state Medicaid policy given that Medicaid patients tend to make up the bulk of health centers' insured patient population. This means that the patient related variable should not be estimated without environmental factors. The same logic applies to the percent of patients without insurance, since that is influenced by state Medicaid eligibility policies.

Exploring Patient Centered Medical Home. Appendix 4C examines the tradeoff between including a measure of PCMH capacity and severely lowering the number of observations. PCMH score does not change the odds of performance quartile level for diabetes outcomes.

Testing Functional Form. As seen with hypertension, linear regression models with the three-year percent average of performance yield negligible differences. The same explanatory factors are statistically significant, with few exceptions. In less restricted diabetes linear Model 2, percent of Medicaid charges collected and number of

[74]This means that these geography-based external variables may serve as instrument variables, a common way to address endogeniety. In fact, bivariate analysis across independent variables reveals that ratio of capitated managed care member months to health center patients is positively and significantly related to state Medicaid coverage rate for nonelderly adults and state Medicaid Managed Care three-year average enrollment rate. Bivariate analysis also reveals that percent of patients who are uninsured is negatively and significantly related to Medicaid coverage rate.

patients per thousand are no longer statistically significant. In both diabetes models, urban is now significant. The direction of all coefficients is the same as in the OLR models. Of particularly interest is the explanatory power of both models. Roughly 25% of the variance in both models is explained by the included variables (Model 1 Adjusted R^2=0.2387; Model 2 Adjusted R^2=0.2943).

Predicted Probabilities: Diabetes

Research Question 3: Under what scenarios does a health center reach the highest quartile of performance?

A "typical" health center, one with all explanatory variables set to their means, has a 20.2% chance of being in the top quartile of performance for diabetes control. This "baseline" health center has a greater chance of being in the second or third quartiles (32.2% and 28.2% probability, respectively). This means that the average health center has a 52.4% chance of being in the top half – slightly better odds than being in the bottom half. I then set each statistically significant independent variable to its highest quartile mean (Table 4.3). In this case, a health center has a 40.2% probability of being in the top performance quartile.

As described in the hypertension analysis, setting each of these variables to their highest quartile mean does not necessarily generate a "best case" scenario, especially given the lack of variability in means across performance quartiles for most variables. Setting each explanatory variable value at the minimum where odds ratios are below 1 and at the value maximum where odds ratios are above 1 produces negligible results for

most, but not all independent factors, when applying this scenario one variable at a time. This exercise is largely academic because the values used may be drawn from outlier health centers.[75] Probability of reaching the highest performing quartile for each of these extreme value scenarios do not greatly improve (25.2%, 29.0%, 31.9%, 32.9%, respectively). However it does produce some noteworthy results in terms of probability of being in the highest performing quartile for diabetes control: state Medicaid adult coverage rate set to 20% (38.4% probability); number of encounters set to 7.8 per diabetic patient (65.4% probability), and percent of patients with Medicare[76] set to 34.3% (71.1% probability). Setting all these independent factors to their extreme value yields the highest probability of a health center falling into the top diabetes control quartile. In fact, at 99.9% probability, it demonstrates that using extreme values practically guarantees it. As with the hypertension analysis, I removed one variable at a time to demonstrate whether one is driving much of the high performance likelihood. In this case, probability remains at least 99%.

The extreme values approach does not present desired thresholds but instead emphasizes key factors and supports, particularly environmental factors that represent important policies. Moreover, because four statistically significant variables yielded ORs that were unexpectedly below 1, setting these factors at the extreme values scenario is not intuitive. For instance, setting the EHR Meaningful Use capacity scale to its highest level lowers the probability of highest quartile of diabetes control performance to 16.6%. When health centers do not sample their patients to report diabetes control at any point

[75] These cases include setting total revenue from 330 funding to 0.8%, Medicaid charges collected to 0%, percent of Medicaid patients to 0%, and percent of patients who are minority to 1.5%.

[76] The jump in probability level for percent of patients with Medicare is large because health centers typically serve small numbers of Medicare patients relative to patients with other forms of insurance.

during the study period, predicted probability falls to 15.0%. And although I predicted that increasing the percent of patients with Medicaid and percent of Medicaid charges collected would improve performance, increasing a health centers' Medicaid insurance proportion to 50% actually lowers the probability of reaching the highest quartile to 15.6%, while increasing the percent of Medicaid charges collected to 100% slightly lowers the probability to 19.3%.

Turning to policy-driven strategies for improving diabetes performance, I excluded patient-related factors given that health centers are required by law to serve all community residents. As with the hypertension probabilities, I focused on those significant independent factors whose ORs "moved" in the expected and desired direction. This left two scenarios under which the predicted probability of being in the highest diabetes performance quartile should increase. First, lowering a health center's reliance on federal 330 funding to 10%, meaning that the health center is largely financed by third-party sources and possibly other grants, only slightly increases the probability that the health center will be a top quartile performer (22.9% predicted probability) when compared to the baseline. This means that high performing health centers rely on a variety of funding sources to improve patient outcomes, and therefore limits should not be set for federal funding as a percent of total revenue. Moreover, health centers serving large proportions of homeless patients, who are commonly uninsured, will have not a diverse revenue mix. Second, setting the percent of state adult residents enrolled in Medicaid to 30% yields the dramatically higher predicted probability of 61.2%. However, it is important to point out that there is no clear policy target as to the ideal share of adult

population enrolled in Medicaid, especially when many adults are enrolled or will enroll in private insurance options.

Given the surprising negative odds ratios on health center Medicaid patients and Medicaid collection, I tested the possible endogenous relationship between these factors and state level Medicaid enrollment. As explained above, increasing the proportion of patients with Medicaid and collecting 100% of Medicaid costs each independently lower the odds of high performance. However, creating a scenario that accounts for these two circumstances and a policy proxy state Medicaid enrollment rate of 30% while all other factors are set to their means yields a probability of being in the top performing quartile of 52.1%.

Although testing the impacts of these policy-driven strategies on a health center's chance of being a top quartile performer for diabetes control, probability is highest (99.9%) when all significant explanatory variables are set to their extreme value scenario level.

Limitations

This exploratory research was designed shed light on key environmental-, organizational-, and patient-level factors that influence hypertension and diabetes performance outcomes at health centers while mitigating possible analytical limitations. While Chapter 3 discussed the caveats related to my chosen model, this section reviews the limitations related to interpreting the results.

Defining Performance

This analysis defines performance as a quartiled three year aggregate given that ups and downs in performance are expected under complexity theory. It is possible that pooling three years of data may mask a health centers' change in hypertension and diabetes control performance quartile, and what factors influence this change. However, quartiling performance makes sense given that half of health centers improve in actual terms over the study period, and, while only half of centers rank in the same performance quartile across all three study years, the vast majority remains in the same quartile for two of the three years (77% for hypertension and 82% for diabetes). Performance is also defined as specific to the outcome being measured. For both outcomes, only 5% of health centers perform in the same quartile consistently across all three years. Moreover, most independent variables do not change much over the study period.

There are no standard approaches for creating meaningful performance quartiles. As exploratory research, this analysis created quartiles mathematically. This approached is routinely used by the BPHC when creating quality performance comparisons across health centers. While some health centers' actual performance places them close to the quartile cut off, histograms demonstrate dispersion with no clear way to create other performance groupings with fewer borderline health centers.

Endogenous Relationships

While this analysis may be at risk for biases driven by endogeniety, key control variables help reduce the impact of or even prevent spurious relationships or questionable temporal order. Lack of insurance, for instance, is related to poor health outcomes in

hypertension and diabetes (AHRQ, 2011; Healthy People, 2010). However, insurance status is largely a factor of state policies, which subsequently drive insurance case mix at providers such as health centers. Recent research demonstrates that broad Medicaid insurance expansions improve access to and receipt of care compared to states that do not expand coverage (Long and Dahlen, 2014; Ndumele et al, 2014; Sommers, Baicker, and Epstein, 2012). Providers treating more insured patients relative to uninsured will have more sufficient financing to cover the investments necessary to improve patient outcomes, compared to providers serving disproportionately more uninsured patients. Health centers' dependency on 330 revenue relative to third party revenue is related to patient payer mix. The fewer patients with insurance, the more a health center will be reliant on those grant funds because less of their costs will be reimbursed by insurers. These health centers do not experience the same benefits in expanded infrastructure and capacity as those whose patients have most of their costs covered by insurers. Prior research comparing health centers in Medicaid generous states to those in less generous states found that those in the generous states grew remarkably more in total patients and staff between 2005 and 2009, and also had greater total revenue and proportion of revenue from Medicaid relative to grants (Shin et al, 2012).

To control for the confounding effects of environmental factors as they influence access and outcomes, as well as a provider's financial well being, this analysis includes Medicaid coverage rate for nonelderly adults and state Medicaid Managed Care three-year average enrollment rate as environmental factors that likely drive health center patient and payer mix. In the diabetes analysis, sensitivity analyses demonstrate that uninsured and patient managed care coverage rate are not significant once these

underlying environmental factors are included. In other words, excluding these state level policy factors from the analysis would produce the erroneous conclusion that certain patient level factors alone impact outcomes. Further controlling any endogeniety associated with dependency on 330 funding is the inclusion of percent of Medicaid charges collected. In bivariate analysis, these two independent variables were statistically significant, and, as would be anticipated, in the negative direction. Health centers that collect more of their costs recouped by Medicaid do not need to use as much of their 330 funds to fill in these gaps compared to those health centers collecting less of their costs from Medicaid.

Omitted Variable Bias

As discussed in Chapter 3, some variables were excluded because available data severely lower sample size and do not represent the full study period. In other cases, factors that may be relevant to health centers' performance on hypertension and diabetes control are excluded because data are not relevant. In either case, there remains a question as to whether any missing data can overcome the impact of some of the more significant variables in this model.

Certain patient population risk characteristics, including key adverse social determinants, health status, and co-morbidities, may negatively associate with high performance in the two outcome measures of interest. In the diabetes analysis, percent of patients with Medicaid coverage significantly lowered the odds of being in a high performing quartile. This may be driven by the endogenous effect of missing patient-related variables, in which the sickest patients may be enrolled in Medicaid and health

centers design their program structures around patient need. As a proxy for patient health risk factors, this analysis did include the percent of total center visits with a chronic condition diagnosis.

Organizational structural and process factors may overcome patient- and environmental-level variables found significant. These include leadership and board commitment to quality goals, use of empanelment, care coordination arrangements, workflow that ensures adherence to clinical guidelines, use of diverse care teams, practice culture conducive to change and innovation, and availability of prescriptions. The 2009 Commonwealth Fund Survey of Health Centers revealed that some process factors, such as "performance data are collected on clinical outcomes or patient satisfaction surveys and reported at the provider or patient level" are nearly universally reported (Doty et al, 2010). It may be that many organizational factors do not vary across health centers due to common program requirements and participation in common QI-related activities, such as the Health Disparities Collaboratives, BPHC-sponsored demonstrations, and others. Key environmental factors may also be absent, including availability or accessibility of other primary care providers, specialty care, and social services. These may be particularly important moderators of factors deemed highly relevant to hypertension and diabetes performance or independent contributors of performance.

Within the measure of federal funding at the organizational level, I only included those funds that make up the Section 330 federal health center funding grants (i.e., "Total Health Center cluster"). I did not include other health center-specific federal funding. This exclusion left out a significant source of federal funding that health centers received in during the study period under the American Recovery and Reinvestment Act of 2009

(ARRA). Under ARRA, health centers nationally received $2 billion, but the vast majority of these awards ($1.5 billion) covered capital expenses, including construction, building upgrades, and health information technology. The remaining ARRA funds covered health center operations. Including these one-time operations funding would have moderately increased health center dependency on federal health center operations funding by only 8%,[77] so although the models may be distorted by their exclusion, the impact is likely to be small.

External Validity

In order to create a more robust sample, I dropped health centers reporting an insufficient number of patient records for determining the two outcome measures. My cut off was fewer than 50 records, rather than 70 records as per the UDS instructions for sampling records.[78] Reporting fewer than 70 records to report the outcomes measures indicates that the total patient population to be included in the measure is smaller than 70 patients. The effect of this 50 record threshold on analytic sample size is minor (1093 and 1045 health centers for the hypertension and diabetes outcome measures, respectively, rather than 1114), and it produces a more reliable sample. In other words, this analysis excludes those health centers with too few patients to adequately measure how environmental-, organizational-, and patient-level factors correlate with health center hypertension and diabetes performance.

[77] According to the UDS, health centers received the following amounts in ARRA operational funding: $160 million in 2009, $258 million in 2010, and $76 million in 2011. Including these funds with Total Health Center cluster each year would have increased this amount of revenue by 8% in 2009, 13% in 2010, and 4% in 2011, for an average of 8% across all three years pooled

[78] Using fewer than 70 records as a cut off produces a larger number of health centers that would have been removed from this analysis: 50% more for hypertension and 68% more for diabetes samples.

The tradeoff associated with attempting a more robust sample is the loss of small health centers. Compared to large and medium size health centers, small centers may have a different set of organizational characteristics that drive high performance than those deemed significant in this analysis, and the risk level of their patients may not be moderated by environmental affects. Nevertheless, the number of small health centers dropped from this analysis is small, and the average number of patients served was similar between the analytic sample used and the sample prior to dropping centers with fewer than 50 records.

Data Reliability

Diabetes and hypertension outcomes in the UDS are reported using sampling or reporting all records in a health centers' EHR. The fact that sampling is found to increase the odds of improved performance could call into question the reliability of the outcome measure in this analysis because it implies that those patients sampled have better outcomes than those excluded from the sample. However, health centers' have been reporting quality measures since before EHRs were broadly available. Health centers began reporting these particular measures the year prior to the study period, and the three-year study period provide more years of data to resolve any possible confusion over sampling techniques.

Possible Lagged Effects

Three independent variables may be lagged in their ability to influence outcomes. The first is robustness of EHR as measured by a meaningful use scale. EHR adoption is

time intensive and productivity may decline during implementation. Moreover, using a meaningful use scale derived by data available in the UDS may inadequately measure the intended effects of EHR use. Descriptives analyses uncover a lack of variability as measured here. However, the UDS is validated and the most complete data set on EHR use across health centers, and has been used for empirical research (Jones and Furukawa, 2014).

Second, use of sampling for reporting the outcome measure may not reflect a lack of EHR capacity, but rather the duration of which the EHR has been fully implemented.[79] This analysis' finding that sampling increases the odds of higher performance may therefore reflect the time lag of fully operational EHRs. In other words, EHRs may lower the odds of high performance because health centers may still be in the implementation phase, which is known to be disruptive to care delivery.

Third, the affect of being FTCA deemed may also be lagged. If health centers are only recently credentialed for FTCA purposes, the changes made to the manner in which care is delivered may not have sufficient time to generate organization-wide performance changes. However, most health centers are deemed and have been deemed for many years. Age of health centers was included in this model as a relevant control for this and other time-sensitive variables.

It should also be pointed out that the outcome variables themselves are lagged. It takes less time to improve process measures (e.g., number of screens provided) than outcome measures such as those used here (Chin, 2010). However, outcome measures tell a more complete picture of whether a provider can affect change in patients' health.

[79] The UDS requires that health centers sample unless they have had a fully operational EHR for at least 2 years. Even those centers that meet this requirement may still sample.

Chapter 5: Conclusion and Policy Implications

This dissertation seeks to fill an important and timely knowledge gap. As health centers undergo the largest and most rapid growth in the program's history, policymakers at all levels, health center boards and staff, strategic partners, payers, and even other provider types seek indications of which factors aid or inhibit performance on key quality indicators, and how to sustain quality improvement efforts that can narrow health disparities. Like other health care providers, health centers are not immune to the accountability expectations that come with third party payments, public investment, and increased visibility. And like other provider types, health centers vary in their clinical performance. However, their unique patient population and community-oriented model of care set them apart from other providers. Health centers serve high-risk patient populations and offer a broad range of services. To do so they rely heavily on state Medicaid reimbursements and federal health center grant funding.

Because health centers must meet the same federal program requirements in order to receive federal health center grants, and because they are reimbursed by state Medicaid programs under a federally-mandated structure, they are typically judged in the collective as a program rather than individual providers. These pressures, along with mandatory federal grant funding at risk in Congress, necessitate a defense or at least an accounting of the returns on investment they bring to the health care system. At the same time, health centers are increasingly operating in a value-based payment environment, whereby payment is dependent on achieving certain outcome goals rather than or in conjunction with payment based on visits. This research is particularly timely given the surge in demand for high-quality primary care following broad health insurance expansions under

the Affordable Care Act (ACA), and the important role health centers can play in meeting this demand for the nation's most high-risk patients.

In order to truly understand the value health center bring to the health care system, research must highlight the factors that facilitate high performance at health centers, particularly those factors that are affected by policy change or explained by patient case mix. Improved health outcomes and population health are major tenants of the Triple Aim framework for value-driven care. Accordingly, this exploratory dissertation seeks to answer the following questions:

1. What health center characteristics consistently increase or decrease across performance quartiles?
2. What factors are associated with higher performance on outcomes?
3. Under what scenarios does a health center reach the highest quartile of performance?

State-level environmental factors, particularly Medicaid policy, as well as patient- and organizational-level factors that vary across health centers serve as the foundation on which to test what drives good health care outcomes. This dissertation is one of the few to explore all three domains, and the first to do so by pooling multiple years of data. The two outcome measures of interest – rate of hypertension and diabetes control at a health center – were selected as key indicators for judging the quality and comprehensiveness of care required to reach positive outcomes for entrenched conditions common in low income and minority populations. Both conditions are complex, costly if not well managed, and require care over multiple visits as well as a need to overcome social and

behavioral determinants of poor health. They are also commonly used to compare provider performance and in pay for performance programs.

This Chapter reviews the major analytical findings, their implications for policy, and recommendations intended to both narrow quality performance variation across health centers as well as further improve it. It then discusses directions for future research, and concludes with the contributions this dissertation makes to policy, practice, and scholarly research.

Main Findings

Patients with diabetes often have hypertension. Both chronic illnesses require longitudinal care management, and both are complicated by a variety of socio-economic barriers at the patient level. These barriers may extend to the provider level if providers are resource constrained. As detailed in Chapter 4, several factors yield statistically relevant findings regarding their ability to improve or worsen a health center's odds of higher performance on both outcome measures. Although these characteristics were grouped into theoretical domains or levels – that is, environmental, organizational, and patient – as discussed below, the lines between these different levels become blurred under careful interpretation. Chapter 4 further revealed that low performance on one measure generally does not indicate low performance on the other, and vice versa. This suggests that while the complete package of factors relevant for improving performance for each measure may vary, certain common inputs are necessary to support quality improvement efforts across multiple chronic conditions.

More Encounters May Moderate Patient Risk

The number of encounters per hypertensive or diabetic patient serves as a control for how often patients are seen, and as an important measure of access. Findings reveal that encounter intensity positively increase the odds of higher performance for both conditions. Applying the maximum value of encounters in the probability analyses further demonstrates that encounters increase the odds of reaching the top quartile more so than any other change or combination of changes.

The findings confirm the importance of access to care in improving outcomes, and suggest that access may be the most critical factor. The encounter intensity measure may serve as a proxy for the health center serving as a source of regular and continuous care.

Having a regular source of care is important for chronically ill and otherwise complex patients. In fact, serving more chronically ill and complicated patients lowers a health centers' chances of reaching higher performance. The analysis finds that two patient related factors consistently lower the odds of high performance across both outcomes and all models – percents of patients who are homeless and racial/ethnic minority. The entrenched social risk factors experienced by homeless individuals make providing continuous chronic care challenging. Minority patients also experience a heavy burden of acute health disparities and other adverse social determinants. Moreover, the more chronic illness health centers treat, including behavioral health, the less likely they will be a high performing health center. However, findings suggest that although patient risk factors lower the odds of higher performance, the intensity of services may

moderate or reverse this affect. These visits could include treatment for co-morbidities, such as behavioral health needs, and indicate receipt of more preventive services.

State Medicaid Policies Compensate for Health Center Medicaid Characteristics

Medicaid stands out as an important factor for quality performance but in complicated ways. In Chapter 3, I hypothesized that Medicaid will play a particularly important and positive role across all three levels of independent factors because of the high volume of Medicaid patients served by health centers and the fact that Medicaid revenue is more dependable per Medicaid patient than other revenue sources. The analysis reveals that for both hypertension and diabetes control, state Medicaid adult coverage rate greatly increases the odds of high performance. However, percent of Medicaid charges collected and percent of patients with Medicaid are only significant in the diabetes models, and unexpectedly lower the odds.

The negative effects of proportion of Medicaid patients may be explained by a high level of health care needs among these patients. In other words, adult Medicaid patients are likely very sick, experiencing co-morbidities and complicated socioeconomic barriers to healthy behaviors (e.g., exercise, healthy foods). State variation in Medicaid eligibility makes it possible that health centers vary in the health status of their Medicaid patients, and this variation may be greater prior to national health reform. In some states, only the poorest are eligible for Medicaid, and these individuals have the highest needs while also facing cost-sharing to receive needed care. The level of illness associated with Medicaid patients and cost barriers to care are particularly relevant for those with diabetes, given the range of clinical and non-clinical services inside and outside the clinic

necessary to improve health. Using patient-level data, Zhang et al (2009) found that HbA1c levels were similar for Medicaid and uninsured health center patients, perhaps because of cost sharing requirements, and that Medicaid patients had more co-morbidities than privately insured patients. Ulmer et al (2000) also found that Medicaid was negatively associated with outcomes within health centers. Medicaid insured patients also have difficulty accessing needed services outside the health center. A survey of health center administrators ascertained that Medicaid patients had only slightly better access to specialty care than uninsured patients (Doty et al, 2010).

The rate of Medicaid patient costs collected also lowers the probability of higher performance.[80] This is likely driven by the fact that a higher volume of sicker patients does not make up for a per-patient collection rate that is below 100%. It could indicate that health centers' costs are high in response to patient needs. Importantly, cost recouped is not a measure of actual capacity. Accordingly, this finding does not denote that lowering health center Medicaid payment, the Prospective Payment System (PPS), will increase health center quality outcomes. Rather, it is simply an artifact of the measure.

The counterintuitive findings at the patient and organizational levels therefore imply that there is an endogenous and possibly simultaneous relationship between Medicaid, sickness, and diabetes outcomes. Yet the temporal order between Medicaid financing and sickness is not clear, and it is extremely difficult to control for patient-level factors with organizational-level data that aggregates patient characteristics. Because a health center's insurance mix is largely driven by state policy, I included state Medicaid

[80]In sensitivity analyses whereby actual HbA1C control rates are used instead of quartiles, proportion of Medicaid patient costs collected is no longer significant.

adult enrollment rate as a possible modifier. This variable proves to have one of the highest, positive odds ratios in both the diabetes and hypertension analyses.

In fact, probability analysis further reveals that state Medicaid coverage rate actually compensates for the negative impact that Medicaid patient mix and collections have on the diabetes outcome measure. Whereas the later two variables lower the probability a health center will achieve the highest performing quartile, the environmental variable of enrollment rate increases it dramatically – from a baseline of 20.2% when all explanatory variables are set to their means, to 38.4% when setting Medicaid adult coverage rate to the existing extreme maximum value of 20%, and 61.2% when setting it to a policy proxy of a 30% enrollment rate. When creating a scenario by which the proportion of health center patients in Medicaid is 50%, Medicaid charges collected rate set to 100%, and state Medicaid adult enrollment rate set to 30%, the probability of being in the top performing quartile reaches 52.1%. This is less than the scenario by which the enrollment rate is set to 30% and all other factors to their means, but far more than the baseline and using the patient and collected scenarios on their own.

The paradoxical finding that the state contextual factor, Medicaid eligibility generosity, improves performance while the patient- and organizational-level counterpart variables do not may ultimately mean that health centers disproportionately serve more of the state's sickest Medicaid patients. In other words, Medicaid patients seen by health centers are more at risk than Medicaid patients in general.

Dependency on Federal 330 Health Center Grant Funding May Reflect Resource Constraints

In Chapter 3, I hypothesized that lower reliance on federal health center 330 grants relative to other revenue sources will increase the odds of higher performance because dependency on 330 funding may be indicative of patient and organizational resource constraint. For the vast majority of health centers, grant revenue per patient is less than average patient cost, whereas Medicaid revenue per patient more closely resembles it (NACHC, 2012).[81] Health center grants are designed to improve access to care for communities that would otherwise go without. Although designed to facilitate access, 330 funding is often used to cover services that are not reimbursed by third party payers, such as enabling services, as well as fill gaps in third party reimbursement. As a result, health centers with more federal grant revenue relative to third party revenue are, in a sense, "spread thin" and probably less able to invest in QI capacity, such as more staff, broader scope of clinical and non-clinical services, and more hours or sites.

Chapter 4 confirmed this hypothesis. As health centers' budgets become more reliant on federal health center funding relative to other sources they are less likely to reach higher quartiles of performance on both hypertension and diabetes control. This finding echoes the negative odds ratios found for share of homeless and minority patients. Health centers that are more grant-dependent tend to serve more uninsured and homeless patients, and patients who are racial/ethnic minorities are more likely to experience uninsurance. Moreover, larger health centers are also associated with poorer outcomes, suggesting that these health centers are not utilizing their capacity to offer more intense and regular services to patients.

[81] Although Medicaid revenue per Medicaid patient on average is less than per Medicaid patient cost.

The measure of revenue related to 330 funding is endogenous to state insurance policies. Dependency on 330 funding is the inverse of high third party revenue, which is related to patient insurance mix, which in turn is driven by state Medicaid eligibility policy. This endogeniety issue and the inclusion of state Medicaid enrollment policy in the models may be why percent of patients who are uninsured is not statistically relevant except for Model 1 in the diabetes analysis, in which the odds of high performance decrease as heath centers serve more uninsured. Sensitivity analysis demonstrates that the statistical significance for this variable is lost not after introducing organizational factors, but after introducing environmental factors, including state Medicaid adult coverage rate. It is also worth mentioning that probability analysis predicts that a dramatic drop in the proportion of revenue related to 330 only slightly increases the odds of higher performance for both outcome measures, meaning that cuts to 330 funding do not generate large improvements in outcomes.

Other Organizational-Level Variables

Other than the two finance measures discussed above, no other organizational-level variable yielded statistically significant and meaningful results (e.g., robust EHRs and behavioral health staff were statistically significant but yielded marginal odds ratios). The lack of meaningful findings may be explained by a lack of measurement specificity. For instance, all health centers are required to provide enabling services, but this analysis did not explore the extent to which certain enabling services (e.g., case management, community health workers, translation) are more impactful on outcomes. Patient to staff ratios, while often used an indication of productivity, are not measures of team-based

care, a trait often considered necessary for better patient care. EHR Meaningful Use scale used here has not been previously validated, though it offers more variability that whether a center has an EHR or not. In descriptive analyses, no patterns across performance quartiles were visible for any organizational factors other than revenue from 330 funding.

PCMH score, which was not used in the full analysis, may also suffer from a lack of measurement specificity in that it may not indicate actual PCMH recognition and functioning, and may overemphasize EHR rather than other care structures. For this dissertation, data available to measure PCMH does not reflect the full sample and are lagged. Additional research is necessary, particularly as more health centers achieve PCMH recognition. However, this dissertation did reveal that higher encounter rates for patients with hypertension and diabetes leads to positive increases in performance, and this feature may relate to a health center serving as a PCMH, or at least a regular source of care.

Sampling to Report the Outcome Measure

As uncovered in previous research (Shi et al, 2012), reliance on sampling techniques to report the outcome measure instead of using an EHR to report on the total relevant patient population[82] improves the likelihood of greater performance. Although a measure of robust EHR capacity was included, the lack of variation may imply that it is not an adequate control. There are two possible explanations for why sampling appears to improve performance. First, it is possible that those health centers able to use EHRs to

[82] The UDS requires that health centers sample unless they have had a fully operational EHR for at least 2 years. Even those centers that meet this requirement may still sample.

report on their patient population have the sickest patients. Second, it is also possible that health centers are not sampling correctly and are therefore biasing the results. However, as explained in Chapter 3, health centers' have been reporting quality measures since before EHRs were broadly available. Health centers began reporting these particular measures the year prior to the study period, and the three-year study period provide more years of data to resolve any possible confusion over sampling techniques.

Third, and seemingly more likely, use of sampling for reporting the outcome measure may not reflect a lack of EHR capacity, but rather the duration of which the EHR has been fully implemented. This means that the finding may actually reflect a time lag of fully operational EHRs. In other words, EHRs may lower the odds of high performance because health centers may still be in the implementation phase, which is known to be disruptive to care delivery. During the study periods, health centers ramped up their EHR adoption and use through funding from the American Reinvestment and Recovery Act. This particular finding, then, may be reversed as health centers have more experience using their EHRs.

Other Notable Findings

Chapter 3 described Medicare enrollment among patients as a factor that drives down quality performance because these patients are likely very sick with high burdens of co-morbidities. However, this dissertation found the opposite. Medicare in fact dramatically increases the odds of performance, and this may be explained by Medicare patients having better access to needed care, including specialty care (Doty et al, 2010). Many of these individuals are poor enough to also be enrolled in Medicaid, with

eligibility levels set by the state. In the UDS, these so called "dual eligibles" are captured in Medicare data because Medicare is billed before Medicaid. Unfortunately, it is difficult to tease out how this distorts the findings.

Finally, I hypothesized that the percent of patients who are migrant/farmworkers would decrease the odds of higher performance. This factor is used by the Bureau of Primary Health Care (BPHC) to adjust health center quality outcomes. However, this does not appear statistically relevant in any model, possibly because of the inclusion of the 330 funding variable. Health centers serving disproportionately more migrant, homeless, and uninsured are more likely to be grant dependent. The BPHC quartiling approach for comparing health centers neglects to include any organizational and environmental factors that impact care outcomes.

Policy Implications

Health centers can serve as effective sources of regular care for complex patients. Findings suggest that more visits for diabetic and hypertensive patients may be the most important contributor to improving patient outcomes. Visit frequency appears to moderate or even overcome patient complexity factors, including chronic illness, homelessness, insurance status, and minority. It is possible that other patient "touches" has the same effect – that is, more group visits, phone calls, and other patient-provider interactions that are not currently encouraged through traditional reimbursement. Health centers' two largest sources of revenue – Medicaid and federal 330 funding – are both important for ensuring that they have the capacity to augment the number of visits (or "touches") for chronically ill and complex patients.

States expanding insurance coverage under the ACA will see larger proportions of adult residents enrolled in Medicaid. Given the relative power of state-level Medicaid enrollment to improve the odds of health center performance for both quality outcome measures, Medicaid expansion states will see more improvement. This will translate into more health center patients enrolled in Medicaid, which would then lower health centers' likelihood of greater performance. However, these health centers will become proportionally less dependent on 330 funding, which is related to higher performance. Other research more directly shows that dependency on third party insurance is related to higher health center performance on diabetes control (Shi et al, 2012).

Health centers in Medicaid expansion states will also collect more total revenue from Medicaid, something not measured in this dissertation, but measured in other research conducted prior to ACA insurance expansions. Compared to health centers in states with restricted adult Medicaid eligibility policies, those in states with more generous eligibility levels had Medicaid revenue relative to other revenue and total revenue (Shin et al, 2013; Shin et al, 2012). They also had more medical staff across almost all specialties and lower patient-to-clinician ratios, suggesting that they offer a more comprehensive set of services and better access to care (Shin et al, 2012). This may explain why high performing health centers, defined as those performing above the Medicaid Managed Care Organization HEDIS 75th percentile, are concentrated in states with pre-ACA Medicaid generous eligibility policies, while lower performing centers, those below the 50th percentile, are concentrated in states with more restricted Medicaid eligibility standards (Shin et al, 2013).

Although this study found no or marginal associations between staffing capacity and quality of care, it is likely that health centers in states with more generous Medicaid enrollment have broader and more targeted scope of clinical and non-clinical services, as well as more hours and sites to reduce access barriers. These resources are particularly necessary to ensure chronically ill patients are using the health center as a regular source of care, and allow health centers to serve Medicaid patients that may be sicker than Medicaid patients in general. As payment moves away from per encounter reimbursement, it must still be structured to support a flexible scope of services and investments in care management capacity. It can also reward providers for high performance.

From the patient perspective, Medicaid expansion will enable better access to needed care. In Oregon, low income residents randomly selected for Medicaid enrollment had more clinical visits than those that did not enroll, though outcomes for chronic illness other than depression did not improve after two years (Baicker et al, 2013). Cost sharing must be nominal in order not to dissuade patients' use of services.

Probability analyses reveal that while expanding the number of adult residents enrolled in Medicaid improves health center performance, it cannot guarantee it. In fact, it cannot improve the odds as much as increasing the number of patient visits. This implies that state Medicaid policies alone are not enough to improve clinical quality performance, and that other sources of funding are needed to ensure access to care.

Federal health center 330 grant funding is designed to improve access to care to a baseline of primary and enabling services. Even as third party insurers change payment to encourage enhanced encounters or "touches," grant revenue will remain essential for

covering the costs of the uninsured and complex patients, such as those experiencing homelessness, covering services not currently reimbursed by third party payers, and placing primary care resources in areas that would otherwise not be able to maintain providers. Federal grant funds are not currently structured to support quality improvement, but have the potential to ensure that expansions offer more intense care to existing patients.

Federal health center funding will be necessary regardless of whether a state expands Medicaid. Both bring needed resources to serve as a regular, frequent source of care for patients with chronic illness. Additionally, other research confirms that the effect on receipt of needed care is greatest when patients have both a regular source of care and insurance, compared to having only one (Devoe et al, 2003). However, health centers in states that do not expand Medicaid will face particularly acute revenue shortfalls.

Even with a surge of additional revenue, improving outcomes for chronic illness does not happen overnight. It can take up to four years at health centers due to the challenges involved in aligning and managing care, changing patient and provider behavior, and overcoming remaining barriers (Chin, 2010).

Policy Recommendations

In light of the implications of my dissertation findings, several actions can be taken to ensure that health centers improve access to care for chronically ill patients, achieve greater performance on key indicators of quality and health disparities, as well as ensure that quality improvement is sustainable. These steps can both diminish performance differences and improve overall quality outcomes across all health centers

by narrowing the variation that drives differences in quality performance. At the core of these recommendations is the need to ensure a continuous source of regular primary care that also includes services designed to remove barriers to care and good health, as well as a source of insurance coverage. These are essential as health centers work to fund the rising costs associated with PCMH transformation goals (Nocon et al, 2012), as well as additional costs associated with service new patients with pent up health needs. As patients benefit from improved wellbeing, taxpayers also benefit through the savings related to preventing the need for costly and avoidable care for unmanaged chronic illnesses.

Recommendations at the State and Payer Level

Medicaid Expansion. States should recognize that the role insurance coverage has in achieving quality performance goals. All states should expand Medicaid under the ACA, and patient cost sharing should not create barriers to needed visits.

Payment. This dissertation does not demonstrate that state Medicaid eligibility policies make up for lower payment, but suggests that Medicaid patients have high health needs. These needs could be more costly has health centers serve more Medicaid patients under insurance expansions. Adequate Medicaid payment allows health centers to be less reliant on federal health center 330 grants. Some state Medicaid agencies advocate lowering health centers' current payment rates because they believe the payment level is unfairly high compared to other providers, despite the more comprehensive model of care offered by health centers. The move towards value-based payment, particularly as providers are expected to meet PCMH qualifications, has been used to further advocate

for payment change. New, alternative payment methods can grant flexibility in scope of services, provide investment in needed care management infrastructure and capacity, and reward providers for high performance (NACHC, 2013). Such a strategy can be used to augment patient-provider interactions.

Payment based on outcomes should also account for the difference in patient characteristics, and even resources available to providers, when making comparisons across provider types. This dissertation establishes that some non-clinical patient characteristics do impact health centers' rates of hypertension and diabetes control, including minority status and being homeless, although data were not available at the patient level. If these variations across health centers matter for quality performance, they likely matter to a greater extent when health centers are compared to other providers. Other research demonstrates that non-clinical patient risk factors do impact outcomes (IOM, 2014). Although these risk factors are generally outside providers' control (e.g., homeless and racial/ethnic minority patients), they are not typically incorporated into risk adjustment modeling which still largely relies on clinical risk. Moreover, risk adjustment methods do not account for resource constraints experienced by the practice. A risk adjustment methodology that accounts for the social determinants and practice characteristics that impact outcomes should be factored into payment decisions.

Recommendations at the National Level

Congress Should Continue and Expand Federal Health Center 330 Grants. Mandated federal funding for this program provided under the ACA will expire by the end of Fiscal Year 2015. Besides the loss of funding to place health centers into new

communities and enlarge existing grantees' scope of services, the National Association of Community Health Centers (NACHC) estimates that current grantees would lose up to 70% of their existing federal health center funding, forcing them to cut current services, staff, or hours (NACHC, 2014). As insurance expansions change the health care landscape in many, but not all states, 330 funding will remain relevant in all states and will need to be used to cover the costs associated with caring for complex and sick patients. This includes homeless patients, for whom traditional medical care is not enough to limit risk for poor health. However, health centers in states that do not expand Medicaid will face particularly acute revenue shortfalls. Federal grant funds can ensure patients receive an adequate number of visits to improve outcomes.

Health Resources and Services Administration (HRSA) Grants Management. HRSA can play a more impactful role in improving health center quality performance while also narrowing health center performance variation. HRSA should provide health centers more detailed Quality Improvement/Quality Assurance requirements, as recommended by the Office of Inspector General (OIG, 2012). As part of these requirements, health centers should assess internal health disparities by stratifying their patient population by key characteristics, such as insurance status and homelessness.[83] Additionally, HRSA should require health centers to move away from sampling when reporting quality indicators.[84] Although found here to actually improve the odds of higher performance, sampling does not support population management goals. Furthermore, quality declines that come with the transition to EHR may be temporary.

[83] Health centers already report these quality measures by race/ethnicity in the UDS.
[84] This assumes that all health centers will soon be able to do so. UDS reporting requires that the EHR be in use for at least 2 years before moving away from sampling Given that nearly all health centers had an EHR as of 2011, requiring that all health centers report the full patient population is reasonable for the near future.

These requirements are directed towards the process in which care is delivered. They do not require that health centers meet specific quality thresholds because of the influence factors outside HRSA control has on performance. However, HRSA can ensure required quality procedures are met through improved oversight and technical assistance. The GAO (2012b) has criticized HRSA for poor supervision over program expectations. Training and technical assistance can shape clinical practice and ensure the infrastructure available to support health center QI efforts are actually used to their full potential. These efforts should be done in collaboration with the NACHC and state Primary Care Associations given the large roles these organizations play in technical assistance to support health center program goals. As an example of a potential area for training, health centers may require technical assistance around meeting and sustaining PCMH recognition requirements, as well as optimizing their EHRs even after implementation (Ryan et al, 2013).

HRSA can also incentivize high performance and target more support for underperforming health centers. First, HRSA should continue to cover the cost of PCMH recognition and EHR adoption for health centers. While not found to be very helpful in this analysis, these features are still very promising and are likely to play core roles in any Quality Improvement/Quality Assurance plan. Second, HRSA should ensure that a funding strategy targets all health centers, including incentives to reward high performing health centers and encourage continued improvement, as well as support for those health centers that would otherwise be left behind. This dual approach is needed to narrow variation in quality performance, as well as raise both national averages and quartile

averages. Inherent in this recommendation is the assumption that Congress continues to fund and grow the health center program.

HRSA is currently planning the first one-time financial awards recognizing health center quality performance.[85] Although the scoring process and eligible measures are still unknown, four awards will be given health centers covering those that 1) have the highest, unadjusted performance and do not report the measure using sampling, 2) highest performance using adjusted quartile rankings, 3) greatest improvement compared to self, and 4) clinical excellence compared to national benchmarks. This approach supports the goals of moving health centers away from sampling, general improvement, surpassing national comparisons, and rewards some health centers with more complicated patient population. Still, the BPHC should revisit the adjusted quartile methodology used to compare health centers on quality indicators because not all factors used are predictors of lower performance.[86]

Because these incentives will not actually improve performance for underperforming health centers, HRSA should use the awards as an opportunity to identify underperforming centers across these different definitions of performance and develop a strategy for addressing gaps. For example, HRSA may consider structuring future Expanded Medical Capacity (EMCs) grants to cover capacity and infrastructure necessary to support quality improvement.

---

[85] For more information, see http://bphc.hrsa.gov/policiesregulations/policies/pcmhwebinar06162014.pdf.
[86] This methodology is based on four health center patient profiles (percent of patients who are uninsured, minority, homeless, and migrant farmworkers) and the method of reporting the outcome in the UDS (sampling or pulling the full patient population through an EHR). Of the five factors used, two are not significant in this dissertation (percent of patients who are uninsured and percent who are migrant farmworkers). Other research drawing from the UDS found that proportions of health center patients who were homeless, migrant and seasonal farmworkers did not correlate with outcomes (Shi et al, 2012). For more information, see http://bphc.hrsa.gov/healthcenterdatastatistics/reporting/ranking.html.

Future Research

Caring for patients with chronic illness is challenging, even when providers and patients are well resourced (Chin, 2010), and therefore the outcomes are complex. Although this dissertation makes several important contributions to the body of evidence on policy interventions to support quality improvement, it is exploratory in nature and new research can fill important analytic gaps. Additional research should include the following areas:

- Explore the interaction between patient, organizational, and environmental characteristics on outcomes. For example, identify the pathways in which environmental and patient characteristics influence organizational structures and processes for care improvement.
- Examine how patient, organizational, and environmental characteristics influence total patient costs. Such research, when coupled with quality indicators, more completely explores the extent to which health centers vary in performance, and can identify what factors contribute to cost savings and overall value.
- Study the extent to which health center PCMH practices impact outcomes (and value more generally) independent of financing. PCMH practices including team-based staffing patterns, use of evidence based-practices, and care coordination, better use of EHRs, and even the scope of specific enabling services. Practices differ from structural infrastructure, but may be affected by them. In the same vein, research could target high performing outlier health centers that defy predicted expectations in order to learn from those with the highest risk and yet

best outcomes. Centers may become more uniform in QI activities as best practices are shared and disseminated, although health center variation may never be completely eliminated, particularly if local circumstances facilitate high performance. The ultimate question, however, is whether these QI practices can overcome financial capacity factors, or are they the result of them?

- Monitor how health reform impacts health center quality, particularly as patient insurance mix changes, and the inputs necessary to sustain high quality care. Panel design, as opposed to cross sectional, may be helpful for monitoring the impact of reform.
- Explore drivers of performance variation between health centers and other providers, and where necessary, develop risk adjustment methodologies that account for factors outside providers' control.
- Assess factors that drive prevention of hypertension or diabetes across health center patients, as well as the associated cost savings.

Answering these questions may require new data sets, including more thorough data on organizational structures and processes as well as patient health status and social determinants. Ideally, data would be at the patient level. Quality should be measured using additional indicators.

Research Contributions

Besides contributing to improved health outcomes for underserved patients experiencing acute health disparities, this dissertation makes important contribution to further the work of policymakers and payers, providers, and researchers. In highlighting what drives variation in clinical performance, stakeholders can work to address these gaps and bring best practices to scale across all health centers.

Contributions to policy and payers include:

- Underscores the role of access to care in boosting quality performance, and informs payment remodeling to support enhanced visits.
- Makes the case that Medicaid expansion can improve quality outcomes.
- Builds the body of information on what risk factors may need to be accounted for when making provider comparisons for payment purposes.
- Informs the BPHC as they refine program expectations, guidance, resource distribution, and structure an approach to compare across health centers.

Contributions to health centers and other practices include:

- Demonstrates the positive effect of more encounters for chronically ill patients on outcomes.
- Identifies key patient-level characteristics that should be used when stratifying patient population to identify and address disparities.

- Analogous to informing risk adjustment methodology for payment purposes, this dissertation builds evidence for what practice complexity characteristics – organizational and patient – may need to be accounted for when designing shared savings in integrated care systems, such as Ambulatory Care Organizations.
- Suggests the need to mitigate the social risks related to homeless, likely in partnership with other community resources.

Contribution scholarly literature:

- Builds the body of evidence on the factors that influence clinical quality performance, including the endogenous effect of state level policies.
- Demonstrates the feasibility of using quartiles for performance comparisons and predictions.
- Identifies directions for future research.

Conclusion

Understanding what drives performance variation across Federally-Qualified Health Centers is an important first step in crafting policy interventions designed to narrow performance disparities and facilitate continuous quality improvement, especially as the demand for health center care is on the rise and they will serve larger shares of the nation's at-risk patient populations. This dissertation explored quality variation in health centers' reported rates of hypertension and diabetes control, two commonly used indicators of quality performance. It reveals that high performance on one measure does

not necessarily indicate high performance on the other, yet certain common inputs are necessary to support quality improvement efforts across multiple chronic conditions. This dissertation underscores the role of financing in achieving high quality performance in hypertension and diabetes control through improved access. In identifying several key facilitators to and impediments of better hypertension and diabetes control, these findings suggest that state-level environmental factors, Medicaid enrollment policy in particular, underlie organizational- and patient-level factors related to quality performance in hypertension and diabetes control, and that higher performance can be achieved through greater access. Medicaid expansion states are therefore more likely to see the most gains in quality performance and disparities reduction than non-expansion states. However, findings also indicate the important role of federal health center funding to serve patients likely to be uninsured and with high burdens of chronic illness, and to cover those services not likely to be reimbursed by third-party payers. Additionally, findings indicate that certain patient and organizational factors, while likely driven by state level policies, may need to be accounted for in risk adjustment when payment is based on performance comparisons across providers.

References

Agency for Healthcare Research and Quality (AHRQ), Department of Health and Human Services. *2010 National Healthcare Disparities Report*. AHRQ Publication No. 11-0005. March 2011. http://www.ahrq.gov/qual/nhdr10/nhdr10.pdf

American Academy of Family Physicians, American Academy of Pediatrics, American College of Physicians, and American Osteopathic Association. "Joint Principles of the Patient-Centered Medical Home." February 2007. www.aafp.org/online/etc/medialib/aafp_org/documents/policy/fed/jointprinciplespcmh0207.Par.0001.File.tmp/022107medicalhome.pdf.

Ashworth M, Armstrong D. The relationship between general practice characteristics and quality of care: a national survey of quality indicators used in the UK Quality and Outcomes Framework, 2004-5. *BMC Fam Pract*. 2006 Nov 13;7:68.

Baicker K, Taubman SL, Allen HL, Bernstein M, et al. The Oregon experiment--effects of Medicaid on clinical outcomes. *N Engl J Med*. 2013 May 2;368(18):1713-22. doi: 10.1056/NEJMsa1212321.

Benson DS, Townes PG, and Dobbs D. *The Quality Management Plan: A Practical, Patient-Centered Template*. June 2011. Prepared for the National Association of Community Health Centers.

Benton T, Staab J, and Evans DL. Medical co-morbidity in depressive disorders. *Ann Clin Psychiatry*. 2007 Oct-Dec;19(4):289-303.

Berwick DM, Nolan TW, and Whittington J. The triple aim: care, health, and cost. *Health Aff (Millwood)*. 2008 May-Jun;27(3):759-69.

Bird CE, Seeman TE, Escarce JJ, et al. Neighborhood socioeconomic status and biological "wear and tear" in a nationally representative sample of US adults. *J Epidemiol Community Health*. 2010 Oct;64(10):860-5. Epub 2009 Sep 16.

Birnberg JM, Drum ML, Huang ES, et al. Development of a safety net medical home scale for clinics. *J Gen Intern Med*. 2011 Dec;26(12):1418-25. Epub 2011 Aug 12.

Booske, B., Athens, J., Kindig, D., Park, H., Remington, P. (Feb. 2010).Different perspectives for assigning weights to determinants of health. *County Health Rankings Working Paper*. Available from: http://www.countyhealthrankings.org/sites/default/files/differentPerspectivesForAssigningWeightsToDeterminantsOfHealth.pdf.

Bodenheimer T, Wagner EH, Grumbach K: Improving primary care for patients with chronic illness - Part 1. *JAMA* 2002, 288**:**1775-1779.

Bruen BK, Ku L, Lu X, and Shin P. No evidence that primary care physicians offer less care to Medicaid, community health center, or uninsured patients. *Health Aff (Millwood).* 2013 Sep;32(9):1624-30. doi: 10.1377/hlthaff.2012.1300.

Carrier E, Gourevitch MN, and Shah NR. Medical homes: challenges in translating theory into practice. Med Care. 2009 Jul;47(7):714-22.

Center for Disease Control and Prevention (CDC). (2010). Establishing a holistic framework to reduce inequities in HIV, Viral Hepatitis, STDs and Tuberculosis in the United States. Available from:http://www.cdc.gov/socialdeterminants/docs/SDH-White-Paper-2010.pdf.

Chaudhry B, Wang J, Wu S, et al. Systematic review: impact of health information technology on quality, efficiency, and costs of medical care. *Ann Intern Med*. 2006 May 16;144(10):742-52. Epub 2006 Apr 11.

Chin MH, Kirchhoff AC, Schlotthauer AE, et al. Sustaining quality improvement in community health centers: perceptions of leaders and staff. *J Ambul Care Manag*. 2008;31: 319-29.

Chin MH, Drum ML, Guillen M, et al. Improving and sustaining diabetes care in community health centers with the Health Disparities Collaboratives. *Med Care.* 2007;45:1135-43.

Chin MH, Auerbach SB, Cook S, et al. Quality of diabetes care in community health centers. *Am J Pub Health*. 2000 Mar;90(3):431-4.

Clarke RM, Tseng CH, Brook RH, et al. Tool used to assess how well community health centers function as medical homes may be flawed. *Health Aff (Millwood)*. 2012 Mar;31(3):627-35. Epub 2012 Feb 15.

Congressional Budget Office (CBO). *Estimates for the Insurance Coverage Provisions of the Affordable Care Act Updated for the Recent Supreme Court Decision.* Washington, D.C.: July 2012.

Crabtree BF, Chase SM, Wise CG, et al. Evaluation of patient centered medical home practice transformation initiatives. *Med Care*. 2011 Jan;49(1):10-6.

Crabtree BF, Nutting PA, Miller WL, et al. Primary care practice transformation is hard work: Insights from a 15-year developmental program of research. *Med Care.* December 2011; 49(12, Suppl 1):S28-S35.

Deo S, McInnes K, Corbett CJ, et al. Associations Between Organizational Characteristics and Quality Improvement Activities of Clinics Participating in a Quality Improvement Collaborative. September 2009 *Medical Care* 47(9):1026-1030.

DeVoe JE, Fryer GE, Phillips R, and Green L.Receipt of preventive care among adults: insurance status and usual source of care. *Am J Public Health*. 2003 May;93(5):786-91.

Devoe JE, Gold R, McIntire P, et al. Electronic health records vs Medicaid claims: completeness of diabetes preventive care data in community health centers. *Ann Fam Med*. 2011 Jul-Aug;9(4):351-8.

DeVoe J, Gold R, O'Malley J, et al. "Variability in Care Quality: Do Federally Qualified Health Center Patient Demographics Correlate with Quality of Diabetes Care?" Poster presented at the Academy Health Annual Research Meeting, Orlando, FL. June 2012.

Donabedian A. Evaluating the Quality of Medical Care. *Milbank Q*. 2005 December; 83(4): 691–729.

Dor, A, et al. "Uninsured and Medicaid Patients' Access to Preventive Care: Comparison of Health Centers and Other Primary Care Providers." RHCN Community Health Foundation. August 2008; Research Brief #4.

Doty M, Abrams MK, Hernandez SE, et al. *Enhancing the Capacity of Community Health Centers to Achieve High Performance: Findings from the 2009 Commonwealth Fund National Survey of Federally Qualified Health Centers*. May 2010. Prepared for the Commonwealth Fund. http://www.commonwealthfund.org/Publications/Fund-Reports/2010/May/Enhancing-the-Capacity-of-Community-Health-Centers-to-Achieve-High-Performance.aspx.

Eisert S, Mehler P, and Gabow P. Can America's urban safety net systems be a solution to unequal treatment? *J Urban Health*. 2008 Sep;85(5):766-78.

Finkelstein A, Taubman S, Wright B, Bernstein M, et al. The Oregon health insurance experiment: evidence from the first year. *Q J Econ*. 2012 Aug;127(3):1057-1106. Epub 2012 May 3.

Flack JM, Casciano R, Casciano J, et al. Cardiovascular disease costs associated with uncontrolled hypertension. *Manag Care Interface*. 2002 Nov;15(11):28-36.

Fleming C. Berwick Brings the "Triple Aim" to CMS. 2010 Sept 14 [cited 2012 Aug 25]. In: Health Affairs blog [Internet]. Available from: http://healthaffairs.org/blog/2010/09/14/berwick-brings-the-triple-aim-to-cms.

Frick, KD and Regan J. Whether and where community health centers users obtain screening services. *J Health Care Poor Underserved.* 2001 Nov;12(4):429-45.

Friedberg MW, Coltin KL, Safran DG, et al. Associations between structural capabilities of primary care practices and performance on selected quality measures. *Ann Intern Med*. 2009 Oct 6;151(7):456-63.

Galewitz P and Monies P. Community health centers under pressure to improve care. *USA Today*. 2012 April 17; Sect. A:1.

George Washington University (GWU), Department of Health Policy. *Quality Incentives for Federally Qualified Health Centers, Rural Health Clinics and Free Clinics.* Report to Congress. Submitted to the Office of the Secretary, Department of Health and Human Services Under Contract No. HHSP23320095635WC. January 23, 2012.

Gold, R, DeVoe J, Shah A, et al. Insurance continuity and receipt of diabetes preventive care in a network of Federally Qualified Health Centers. Medical Care. April 2009; 47:431-39.

Goldman LE, Chu PW, Tran H, et al. Federally qualified health centers and private practice performance on ambulatory care measures. *Am J Prev Med.* 2012 Aug;43(2):142-9.

Government Accountability Office (GAO). *2011 Grant Award Process Highlighted Need and Special Populations and Merits Evaluation*. Publication No. GAO-12-504. Washington, DC: May 29, 2012 (2012a).

Government Accountability Office (GAO). *Improved Oversight Needed to Ensure Grantee Compliance with Requirements*. Publication No. GAO-12-546. Washington, DC: May 29, 2012 (2012b).

General Accounting Office (now known as the Government Accountability Office, GAO). *Health Centers and Rural Clinics: State and Federal Implementation Issues for Medicaid's New Payment System*. Publication No. GAO-05-452. Washington, DC: June 2005.

General Accounting Office (now known as the Government Accountability Office, GAO). *Health Care: Approaches to Address Racial and Ethnic Disparities*. Publication No. GAO-03-862R. Washington, DC: 2003.

Grant RW, Pirraglia PA, Meigs JB, Singer DE. Trends in complexity of diabetes care in the United States from 1991 to 2000. *Arch Intern Med.* 2004 May 24;164(10):1134-9.

Grossman, E, et al. Inside the Health Disparities Collaboratives: A detailed exploration of quality improvement at Community Health Centers. *Med Care.* 2008; 46:489-96.

Grumbach K and Grundy P. *Outcomes of Implementing Patient Centered Medical Home Interventions: A Review of the Evidence from Prospective Evaluation Studies in the United States*. Updated November 16, 2010. Prepared for the Patient Centered Primary Care Collaborative.

Gurewich D, et al. Achieving excellence in community health centers: Implications for health reform. *J Health Care Poor Underserved*. 2012;23(1):446-59.

Gurewich D, Tyo KR, Zhu J, Shepard DS. Comparative performance of community health centers and other usual sources of primary care. *J Ambul Care Manage*. 2011 Oct-Dec;34(4):380-90.

Health Resources and Services Administration (HRSA), Department of Health and Human Services. *Efforts to Expand and Accelerate Health Center Program Quality Improvement*. Report to Congress, April 26, 2011. http://bphc.hrsa.gov/ftca/riskmanagement/healthcenterqualityimprovement.pdf.

Health Resources and Services Administration (HRSA), Department of Health and Human Services. "Health Center Controlled Networks Fact Sheet." No date. http://www.hrsa.gov/healthit/toolbox/HealthITAdoptiontoolbox/OpportunitiesCollaboration/abouthccns.html.

Healthy People 2020, Department of Health and Human Services. Summary of Objectives, posted December 2010, www.healthypeople.gov.

Hicks LS, O'Malley AJ, Lieu TA, et al. The quality of chronic disease care in U.S. community health centers. *Health Aff.* 2006 Nov-Dec;25(6):1712-23.

Hong CS, Atlas SJ, Chang Y, et al. Relationship between patient panel characteristics and primary care physician clinical performance rankings. *JAMA*. 2010 Sep 8;304(10):1107-13.

Institute of Medicine (IOM). *Capturing Social and Behavioral Domains in Electronic Health Records: Phase 1*. Washington, D.C.: National Academy Press; 2014.

Institute of Medicine (IOM). *Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care*. Washington, D.C.: National Academy Press; 2003.

Institute of Medicine (IOM). *Crossing the Quality Chasm: A New Health System for the 21st Century*. Washington, D.C.: National Academy Press; 2001.

Jaén CR, Ferrer RL, Miller WL, et al. Patient outcomes at 26 months in the patient-centered medical home National Demonstration Project. *Ann Fam Med*. 2010;8 Suppl 1:S57-67; S92.

Jones EB and Furukawa MF. Adoption and use of electronic health records among federally qualified health centers grew substantially during 2010-12. *Health Aff (Millwood)*. 2014 Jul;33(7):1254-61. doi: 10.1377/hlthaff.2013.1274.

Kaiser Commission on Medicaid and the Uninsured. "Medicaid and Community Health Centers: the Relationship Between Coverage for Adults and Primary Care Capacity in Medically Underserved Communities." March 2012. http://www.kff.org/medicaid/8293.cfm.

Katerndahl DA, Wood R, and Jaén CR. A Method for estimating relative complexity of ambulatory care. July/August 2010 *Ann of Fam Med.* 6(4):341-347.

Katerndahl DA, Wood R, and Jaén CR. Family medicine outpatient encounters are more complicated than those of cardiology and psychiatry. January-February 2011 *J Am Board Fam Med.* 24(1):6-15.

Katz A, Felland LE, Hill I, et al. "A Long and Winding Road: Federally Qualified Health Centers, Community Variation and Prospects Under Reform." Center for Studying Health Systems Change, November 2011: HSC Research Brief No. 21.

Keyhani S, Hebert PL, Ross JS, et al. Electronic health record components and the quality of care. *Med Care*. 2008 Dec;46(12):1267-72.

Kim S. Burden of hospitalizations primarily due to uncontrolled diabetes: implications of inadequate primary health care in the United States. *Diabetes Care*. 2007 May;30(5):1281-2. Epub 2007 Feb 8.

Ku L, Jones E, Shin P, Byrne FR, et al. Safety-net providers after health care reform: lessons from Massachusetts. Arch Intern Med. 2011 Aug 8;171(15):1379-84. doi: 10.1001/archinternmed.2011.317.

Ku L, Jones E, Finnegan, B, et al. *How Is the Primary Care Safety Net Faring in Massachusetts? Community Health Centers in the Midst of Health Reform*. Kaiser Commission on Medicaid and the Uninsured. March 2009. http://www.kff.org/healthreform/upload/7878.pdf

Landon BE, O'Malley AJ, Keegan T. Can choice of the sample population affect perceived performance: implications for performance assessment. *J Gen Intern Med*. 2010 Feb;25(2):104-9.

Landon BE, Hicks LS, O'Malley AJ, et al. Improving the management of chronic disease at community health centers. *New Engl J Med*. 2007;356:921-34.

Lebrun LA. "Reducing Disparities in Access to Primary Care: The Role of Health Centers." Presentation at the NACHC Community Health Institute & Expo, August 30, 2011.

Lebrun LA, Shi L, Zhu J, Sharma R, et al. Racial/ethnic differences in clinical quality performance among health centers. *J Ambul Care Manage*. 2013 Jan-Mar;36(1):24-34. doi: 10.1097/JAC.0b013e3182473523. .

Litaker D, et al. Using complexity theory to build interventions that improve health care delivery in primary care. *J Gen Intern Med*. 2006 Feb;21 Suppl 2:S30-4.

Long SK and Dahlen H. Expanding Coverage to Low-Income Childless Adults in Massachusetts: Implications for National Health Reform. *Health Serv Res*. 2014 May 19. doi: 10.1111/1475-6773.12189. [Epub ahead of print]

Long A, Phillips K, Hoyer D. Paying for the Medical Home Part 2: Social, Behavioral, and Environmental Factors in Payment Models. Seattle, WA: Qualis Health, August 2011. http://www.safetynetmedicalhome.org/

Maizlish NA, Shaw B, Hendry K. Glycemic control in diabetic patients served by community health centers. *Am J Med Qual*. 2004 Jul-Aug;19(4):172-9.

Marceau L, McKinlay J, Shackelton R, Link C. The relative contribution of patient, provider and organizational influences to the appropriate diagnosis and management of diabetes mellitus. *J Eval Clin Pract*. 2011 Dec;17(6):1122-8. doi: 10.1111/j.1365-2753.2010.01489.x. Epub 2010 Jul 13.

McGlynn EA, Asch SM, Adams J, et al. The quality of health care delivered to adults in the United States. N Engl J Med. 2003 Jun 26;348(26):2635-45.

Miller WL, Crabtree BF, Nutting PA, et al. Primary care practice development: a relationship-centered approach. *Ann Fam Med*. 2010;8 Suppl 1:S68-79; S92.

Mohr DC and Young GJ. Slack resources and quality of primary care. *Med Care*. 2012 Mar;50(3):203-9.

National Association of Community Health Centers (NACHC). *Access Is the Answer: Community Health Centers, Primary Care, and the Future of American Health Care*. 2014. www.nachc.com/research.

NACHC. *Health Centers and Payment Reform: A Primer*. Emerging Issues #7. Prepared by John Snow, Inc. October 2013

NACHC. "America's Health Centers." Fact Sheet. July 2012. www.nachc.com/research.

NACHC. *A Sketch of Community Health Centers: Chartbook 2012*. 2012. www.nachc.com/research.

NACHC. *Health Wanted: The State of Unmet Need for Primary Care in America*. March 2012. www.nachc.com/research.

NACHC, Robert Graham Center, and George Washington University. *Access Transformed: Building a Primary Care Workforce for the 21st Century*. August 2008. http://www.nachc.com/access-reports.cfm.

Ndumele CD, Mor V, Allen S, Burgess JF, and Trivedi AN. Effect of expansions in state Medicaid eligibility on access to care and the use of emergency department services for adult Medicaid enrollees. *JAMA Intern Med*. 2014 Jun;174(6):920-6. doi: 10.1001/jamainternmed.2014.588.

Ndumele CD, Russell BE, Ayanian JZ, et al. Strategies to improve chronic disease management in seven metro Boston community health centers. *Prog Community Health Partnersh*. 2009 Fall;3(3):203-11.

Ngo-Metzger Q. "Addressing Racial/Ethnic Disparities in Hypertensive Health Center Patients." Presentation at the NACHC Community Health Institute & Expo, August 30, 2011.

Nocon RS, Sharma R, Birnberg JM, et al. Association between patient-centered medical home rating and operating cost at federally funded health centers. *JAMA*. 2012 Jul 4;308(1):60-6.

Office of Inspector General, Department of Health and Human Services. *Quality Assurance and Care Provided at HRSA-Funded Health Centers*. Memorandum Report, OEI-09-06-00420, March 2, 2012.

Peikes D, Zutshi A, Genevro J, et al. Early Evidence on the Patient-Centered Medical Home. Final Report (Prepared by Mathematica Policy Research, under Contract Nos. HHSA290200900019I/HHSA29032002T and HHSA290200900019I/HHSA29032005T). AHRQ Publication No. 12-0020-EF. Rockville, MD: Agency for Healthcare Research and Quality. February 2012. (2012a)

Peikes D, Zutshi A, Genevro J, et al. Early evaluations of the medical home: building on a promising start. *Am J Manag Care*. 2012 Feb;18(2):105-16. (2012b)

Plsek PE and Greenhalgh T. Complexity Science: The Challenge of complexity in health care. September 15, 2001 *BMJ* 323: 625-8.

Politzer R, Yoon J, Shi L, et al. Inequality in America: the contribution of health centers in reducing and eliminating disparities in access to care. *Med Care Res Rev*. Jun 2001;58(2):234-248.

Poon E.G., Wright A, Simon SR, et al. Relationship between use of electronic health record features and health care quality: results of a statewide survey. *Med Care*. 2010 Mar;48(3):203-9.

Porterfield D.S. and Kinsinger L. Quality of care for uninsured patients with diabetes in a rural area. *Diabetes Care*. 2002 Feb;25(2): 319-23.

Post EP, Kilbourne AM, Bremer RW, et al. Organizational factors and depression management in community-based primary care settings. *Implement Sci*. 2009 Dec 31;4:84.

Reeves D, Campbell SM, Adams J, et al. Combining multiple indicators of clinical quality: an evaluation of different analytic approaches. *Med Care*. 2007 Jun;45(6):489-96.

Regan J, Schempf AH, Yoon J, Politzer RM. The role of federally funded health centers in serving the rural population. *J Rural Health.* 2003 Spring;19(2):117-24; discussion 115-6.

Ryan AM, Bishop TF, Shih S, Casalino LP. Small physician practices in New York needed sustained help to realize gains in quality from use of electronic health records.*Health Aff* (Millwood). 2013 Jan;32(1):53-62. doi: 10.1377/hlthaff.2012.0742.

Saxena S, George J, Barber J, et al. Association of population and practice factors with potentially avoidable admission rates for chronic diseases in London: cross sectional analysis. *J R Soc Med*. 2006 Feb;99(2):81-9.

Shelley D, Tseng TY, Andrews H, et al. Predictors of blood pressure control among hypertensives in community health centers. *Am J Hypertens*. 2011 Dec;24(12):1318-23. doi: 10.1038/ajh.2011.154. Epub 2011 Aug 25.

Shi L, Lebrun LA, Hung LM, et al. US primary care delivery after the Health Center Growth Initiative: comparison of health centers, hospital outpatient departments, and physicians' offices. *J Ambul Care Manage*. 2012 Jan-Mar;35(1):60-74.

Shi L, Lebrun LA, Zhu J, et al. Clinical quality performance in U.S. health centers. *Health Serv Res.* 2012 May 17. doi: 10.1111/j.1475-6773.2012.01418.x.

Shi L, Lu N. Individual sociodemographic characteristics associated with hospitalization for pediatric ambulatory care sensitive conditions. *J Health Care Poor Underserved*. 2000 Nov;11(4):373-84.

Shi L, Stevens GD, Wulu JT, et al. America's health centers: Reducing racial and ethnic disparities in perinatal care and birth outcomes. *Health Serv Res*. 2004 Dec;39(6 Pt 1):1881-901.

Shi L, Lebrun LA, Tsai J, et al. Characteristics of Ambulatory Care Patients and Services: A Comparison of Community Health Centers and Physicians' Offices. *J Health Care Poor Underserved.* 2010; 21(4): 1169 – 83.

Shin P, Sharac J, Rosenbaum S, and Paradise J. *Quality of Care in Community Health Centers and Factors Associated with Performance.* Prepared for the Kaiser Commission on Medicaid and the Uninsured. June 2013. http://kaiserfamilyfoundation.files.wordpress.com/2013/06/8447.pdf.

Shin P, Rosenbaum S, Tolbert J, Bruen B, et al. "Medicaid and Community Health Centers: The Relationship Between Coverage for Adults and Primary Care Capacity in Medically Underserved Communities." Prepared for the Kaiser Commission on Medicaid and the Uninsured. March 2012. http://www.kff.org/medicaid/8293.cfm

Shin P, Markus A, Rosenbaum S, et al. Adoption of health center performance measures and national benchmarks. *J Ambul Care Manage.* 2008 Jan-Mar; 31(1): 69-75.

Shortell SM, Schmittdiel J, Wang MC, et al. An empirical assessment of high-performing medical groups: results from a national study. *Med Care Res Rev.* 2005;62(4):407-34.

Solberg LI, Asche SE, Fontaine P, et al. Trends in quality during medical home transformation, annals of family medicine. *Ann Fam Med* November/December 2011; 9(6):515-521.

Sommers BD, Baicker K, Epstein AM. Mortality and access to care among adults after state Medicaid expansions. *N Engl J Med* 2012 Sep 13;367(11):1025-34. doi: 10.1056/NEJMsa1202099. Epub 2012 Jul 25.

Stange KC, Nutting PA, Miller WL, et al. Defining and measuring the patient-centered medical home. J Gen Intern Med. 2010 Jun;25(6):601-12.

Starfield B, Shi LY, Macinko J. Contribution of primary care to health systems and health. *Milbank Q*. 2005;**83**(3):457–502.

Stuart ME and Steinwachs DM. Patient-mix differences among ambulatory providers and their effects on utilization and payments for Maryland Medicaid users. *Med Care*. 1993 Dec;31(12):1119-37.

Takach M. Reinventing Medicaid: state innovations to qualify and pay for patient-centered medical homes show promising results. *Health Aff* 2011 Jul;30(7):1325-34.

Ulmer C, Lewis-Idema D, Von Worley A, et al. Assessing primary care content: four conditions common in community health center practice. *J Ambul Care Manage.* 2000 Jan;23(1):23-38.

Weiner JP, Starfield BH, Powe NR, et al. Ambulatory care practice variation within a Medicaid program. *Health Serv Res*. 1996 Feb;30(6):751-70.

Wells R, Punekar RS, and Vasey J. Why do some health centers provide more enabling services than others? *J Health Care Poor Underserved*. 2009 May;20(2):507-23.

Wennberg JE, Cooper MM, eds. *The quality of medical care in the United States: a report on the Medicare program*. *The Dartmouth atlas of health care*. Hanover, NH: Dartmouth Medical School, 1999:80-5. http://www.dartmouthatlas.org/downloads/atlases/99Atlas.pdf.

Yano EM. The role of organizational research in implementing evidence-based practice: QUERI Series. *Implement Sci*. 2008 May 29;3:29.

Zhang JX, Huang ES, Drum ML, et al. Insurance status and quality of diabetes care in community health centers. *Am J Pub Health* 2009 April; 99(4):742-747.

Zyzanski SJ, Stange KC, Langa D, et al. Trade-offs in high-volume primary care practice. *J Fam Pract*. 1998 May;46(5):397-402.

Appendix 3A: Explanatory and Control Variables

Construct	Measure	Anticipated Effect	Explanation/Hypothesis	Related References	Data Source*
External Factors					
Geography	Organization self-designation as Urban or Rural (dummy, 1=Urban)	+	Urban areas experience fewer provider shortages and have a more robust workforce. Urban health centers hire more physicians relative to nurse practitioners (NPs), physician assistants (PAs), and certified nurse midwives (CNMs). Urban health centers may have better access to other needed patient medical and social services than rural centers.	NACHC, Robert Graham Center, and George Washington University, 2008	2011 UDS
State Policy– Medicaid Generosity	Medicaid Coverage Rate for Adults, 2010-2011	+	Medicaid generosity is related to outcomes and center capacity. Health centers in more Medicaid generous states have greater capacity as measured by sites, patients, clinicians, and revenues.	Shin et al, 2012; NACHC, Robert Graham Center, and George Washington University, 2008	Other[1]
State Policy – Medicaid Managed Care Enrollment	Medicaid Managed Care Enrollment Rate, 2009-2011 (three year average)	+	Higher state reliance on managed care may denotes high level of provider integration and infrastructure for chronic care management		Other[2]
State Policy – early experience with Medicaid-led Medical Homes project	Early State Medicaid Medical Home Initiatives, as of 2008 (dummy, 1=yes)	+	State-led medical home initiatives bring resources necessary for care coordination and patient management.		Other[3]
Organizational Structure and Process					
Primary Care Staffing	Ratio of medical patients to Nurse Practitioners + Physician Assistants + Primary Care Physicians[4]	+	More staff indicates more time or resources to manage patients. This is a measure of capacity.	Shi et al, 2012; Shortell et al, 2005	UDS
Behavioral Health Staffing	Ratio of medical patients to behavioral health staff	+	Untreated behavioral health problems can worsen clinical outcomes.	Benton, Staab, and Evans, 2007	UDS

Construct	Measure	Antici-pated Effect	Explanation/Hypothesis	Related References	Data Source*
	(MH+SA)[5]				
Enabling Services Capacity	Total patients per enabling services staff`	+	Such staff, including community health workers, facilitate access to care and patient self management.	Shi et al, 2012	UDS
Financial Health	Proportion of total health center revenue from 330 grants (i.e., non-third party payments) (excludes capital grants, which makes up 10% of BPHC grants nationally)	-	Grant revenue per patient tends to be less than average patient cost, whereas Medicaid revenue per Medicaid patient more closely resembles it. And grant revenue fills gaps left by third party payers.	Shi et al, 2012	UDS
Financial Health	Percent of Medicaid charges collected	+	Collections close to costs allow the health center to better meet patient needs		UDS
Patient Centered Medical Home	Total MH Scale score as created by Birnbirg et al	+	PCMH is a transformative process designed to improve care outcomes.	Peikes et al, 2012a & 2012b; Gurewich et al, 2012; Silberg et al, 2011; Grumbach and Grundy, 2010; Jaen et al, 2010.	CMWF
Electronic Health Record – Robustness	EHR Meaningful Use Capacity Scale (# out of 8 MU functionality reported in UDS as being turned on),[6] 2010	+	Robust EHRs support care management and integration	Poon et al, 2010; Friedberg et al, 2009; Chaudhry et al, 2006; Hicks et al, 2006	UDS 2010
Credentiale d	Federal Tort Claims Act (FTCA) deemed (indicating	+	Deeming ensures a center maintains clinical protocols, patient tracking systems, medical records review, and active quality assurance programs, thereby		UDS 2009 & 2010

Construct	Measure	Antici-pated Effect	Explanation/Hypothesis	Related References	Data Source*
	completed thorough credentialing process of their licensed/certified clinical staff and maintain active quality assurance programs) (dummy, Yes = deemed in 2010 and/or 2009		enabling higher outcomes		
Patient-Level Factors					
Poverty	Percent of patients who are <100% FPL (among those with known income levels)	-	Poor patients experience cost barriers to improved health, including access to prescriptions, specialists, etc. Also tend to be in poorer health compared to the rest of the US, and experience health disparities.	Long, Phillips, and Hoyer, 2011; Bird et al, 2010	UDS
Uninsured	Percent of patients who are uninsured	-	Uninsured patients experience cost barriers to improved health, including access to prescriptions, specialists, etc. Also tend to be in poorer health compared to the rest of the US, and experience health disparities.	Shin, Sharac, and Rosenbaum, 2013 ; Shi et al, 2012; Devoe et al, 2012 ; Shin et al, 2013 *In BPHC quartile adjustment for comparing health center quality performance across health centers.*	UDS
Medicaid	Percent of patients who have Medicaid	+	Although poor, Medicaid patients have access to prescriptions, specialists, etc, and Medicaid is related to expanded center capacity.	Hicks et al, 2006 (but Zhang et al, 2009 found the opposite and noted that Medicaid patients had more co-morbidities than privately insured patients)	UDS
Medicare	Percent of patients who	-	Likely represent very sick patients with high burdens of co-	Zhang et al, 2009	UDS

Construct	Measure	Antici-pated Effect	Explanation/Hypothesis	Related References	Data Source*
	have Medicare		morbidities		
Managed Care Enrolled	Ratio of total member months to total patients (capitated only)	+	Denote more chronic care management and financial incentives for better outcomes	Lebrun et al, 2013	UDS
Chronic Conditions	Visit with a chronic condition as a primary diagnosis as a percent of all TOTAL visits (includes diabetes, hypertension, selected heart disease, asthma, chronic bronchitis, emphysema, HIV, and all behavioral health) (cannot be medical visits b/c of BH)	+	Health centers with high case mix burden of chronic conditions have more experience caring for these patients	Ulmer et al, 2000	UDS
Minority	Percent of patients who are Hispanic (ethnicity) or non-white (race), based on percent known	-	Racial/ethnic minority patients historically experience disparities in clinical outcomes	Shi et al, 2012 *In BPHC quartile adjustment for comparing health center quality performance across health centers.*	UDS
Special Populations	Percent of patients who are homeless	-	Such patients experience poor/ unstable living conditions and require extensive enabling and social services	Shin, Sharac, & Rosenbaum, 2013; Shin et al, 2013 *In BPHC quartile adjustment for comparing health center quality performance across health centers.*	UDS
Special	Percent of	-	Such patients are highly mobile,	*In BPHC*	UDS

Construct	Measure	Antici-pated Effect	Explanation/Hypothesis	Related References	Data Source*
Populations	patients who are migrant or seasonal farmworkers		experience harsh working conditions, and require expense enabling services	*quartile adjustment for comparing health center quality performance across health centers.*	
Gender	Percent of adult patients (age 18 and over) who are female	+	Female patients tend to have better health outcomes related to diabetes and hypertension	Shelley et al, 2011; Hicks et al, 2006; Maizlish, Shaw, and Hendy 2004; Ulmer et al, 2000; Shin et al, 2013	UDS
Control Variables					
Age of Health Center	# of years reporting UDS. Serves as a proxy for age.	+	Older centers experience better care continuity and more trusting patient relationships	Shi et al, 2012; Lebrun et al, 2013; Shortell et al, 2005	UDS (05-11)
Size	Number of patients Served Annually, in Thousands	+	Larger centers have better capacity for care coordination /integration and other QI, specialized staff, and reach economies of scale	Lebrun et al, 2013; Shin et al, 2013	UDS
Method of Reporting Outcome Measure	Sampling or use EHR to report denominato r (dummy, 1=sample)	+	Those who sample from manual chart reviews perform better	Shi et al, 2012 *In BPHC quartile adjustment for comparing health center quality performance across health centers.*	UDS
Outcome Measure Eligibility	Percent of MEDICAL patients aged 18-85 who have hypertensio n	+	Outcomes are dependent on the relevant population		UDS
Outcome Measure Eligibility	Percent of MEDICAL patients aged 18-75 with type I or type II diabetes	+	Outcomes are dependent on the relevant population		UDS
Visit rate	Average number of encounters for diabetes or	+	Outcomes are dependent on the relevant population		UDS

Construct	Measure	Anticipated Effect	Explanation/Hypothesis	Related References	Data Source*
	hypertension as the primary visit, per diabetic or hypertensive patient				

* UDS = Uniform Data System (2009-2011 unless otherwise specified). CMWF = 2009 Commonwealth Fund Survey. JC = Joint Commission. Other = specified below.

[1] Kaiser State Health Facts, "Medicaid Coverage Rates for Nonelderly by Age," http://kff.org/medicaid/state-indicator/rate-by-age-3/. Urban Institute and Kaiser Commission on Medicaid and the Uninsured estimates based on the Census Bureau's March 2011 and 2012 Current Population Survey.

[2] CMS. Medicaid Managed Care Enrollment Report. Summary Statistics as of [July 1, 2011; July 1, 2010; June 30, 2009]. For 2011, see http://www.medicaid.gov/Medicaid-CHIP-Program-Information/By-Topics/Data-and-Systems/Downloads/2011-Medicaid-MC-Enrollment-Report.pdf.

[3] Kaye N and Takach M. Building Medical Homes in State Medicaid and CHIP Programs. June 2009. http://nashp.org/sites/default/files/medicalhomesfinal_revised.pdf.

[4] This is similar to Shi et al 2012. They measured number of physician FTEs per 10,000 medical encounters, but found this was NOT related to performance. However, Shortell et al 2005 did find that the number of doctors mattered. By including PAs and NPs, I include a more inclusive and agnostic measure of staffing and avoid state scope of practice differences. This is a measure of capacity, not productivity. The later is a measure that accounts for number of encounters per staff. The problem with productivity measures is that health centers may pay for some services provided by non-center clinical staff.

[5] Behavioral health staff include mental health (psychiatrists, licensed clinical social workers, other licensed mental health providers, other mental health staff) and substances abuse providers.

[6] Includes patient history and demographic information; computerized provider order entry for lab results; reminders for guideline-based interventions or screening tests; capability to exchange key clinical information among providers of care and patient-authorized entities electronically; reporting to immunization registries done electronically; Ability to provide patients with a copy of their health information on request; Capacity to provide clinical summaries for patients for each office visit; and Protection of electronic health information.

Appendix 4A: Descriptive Findings, Pooled 2009-2011

Variable	Number of Observations	Mean	Standard Deviation
External Variables			
Urban or rural (dummy, 1=urban)	1114	.51	.500
Medicaid Coverage Rate for NonElderly Adults, 2010-2011	1087	10.28%	.0350
State Medicaid Managed Care Enrollment Rate, 2009-2011 (3 year average)	1106	71.35%	.1861
Early State Medicaid PCMH Initiatives (1= yes as of 2008)	1087	70.10%	.4580
Organizational Variables			
Medical Patients per Primary Care Provider	1114	1130.653	398.00
Medical Patients per Behavioral Health Provider	1114	13668.49	43041.08
Total Patients per Enabling Services Staff	1114	3660.676	8273.23
Percent of Revenue from Federal 330 Grants	1114	23.55%	.1495
Percent of Medicaid charges collected	1114	88.49%	.3512
EHR Meaningful Use Capacity Scale, 2010 (8 point scale)	1114	3.80	3.07
Patient Variables			
Percent of Patients Who Are Uninsured	1114	40.111%	.1991
Percent of Patients with Medicaid	1114	33.179%	.1584
Percent of Patients with Medicare	1114	8.365%	.0586
Percent Minority	1114	54.484%	.3264
Percent Homeless	1114	8.308%	.2248
Percent of Patients that are Female	1114	43.1551%	.0758
Ratio of Capitated Managed Care Member Months to Patients	1114	.8315	1.641
Percent Poverty	1114	68.836%	.1758
Percent Migrant	1114	3.461%	.1271
Percent of Total Visits with a Chronic Condition Diagnosis[#]	1114	23.778%	.1078

Control Variables			
Years as 330-Funded Health Center (7 years maximum, 2005-2011)	1114	6.58	1.033
Number of Patients Served Annually, in Thousands	1114	17.434	18.895
Number of Encounters Per Diabetic Patient	1114	2.790	.7348
Number of Encounters Per Hypertensive Patient	1114	2.0548	.5238
Number of Years Sampling Used to Report Hypertension Metric (Out of 3 Years)	1114	2.121	1.166
Number of Years Sampling Used to Report Diabetes Metric (Out of 3 Years)	1114	2.017	1.007
Percent of Medical Patients Age 18-84 with Hypertension	1114	21.379%	.0903
Percent of Medical Patients Age 18-74 with Type I or II Diabetes	1114	11.376%	.0463

[#]Includes visits with a chronic condition as a primary diagnosis. Chronic conditions include diabetes, hypertension, selected heart disease, asthma, chronic bronchitis, emphysema, HIV, and all behavioral health.
Sources: Pooled 2009-2011 Uniform Data System, Bureau of Primary Health Care, Health Resources and Services Administration, HHS, unless other years are stated. Three variables are drawn from other sources: Medicaid Coverage Rate for NonElderly Adults, 2010-2011 (Kaiser State Health Facts, "Medicaid Coverage Rates for Nonelderly by Age," http://kff.org/medicaid/state-indicator/rate-by-age-3/. Urban Institute and Kaiser Commission on Medicaid and the Uninsured estimates based on the Census Bureau's March 2011 and 2012 Current Population Survey); State Medicaid Managed Care Enrollment Rate, 2009-2011, 3 year average (CMS. Medicaid Managed Care Enrollment Report. Summary Statistics as of [July 1, 2011; July 1, 2010; June 30, 2009]. For 2011, see http://www.medicaid.gov/Medicaid-CHIP-Program-Information/By-Topics/Data-and-Systems/Downloads/2011-Medicaid-MC-Enrollment-Report.pdf); Early State Medicaid PCMH Initiatives (Kaye N and Takach M. Building Medical Homes in State Medicaid and CHIP Programs. June 2009. http://nashp.org/sites/default/files/medicalhomesfinal_revised.pdf).

Appendix 4B: Comparison of Means:

Cases Where Quartile 4 (Highest) Is Statistically Different from Other Quartiles, Using the Sidak, Bonferroni, and Scheffe Oneway Pairwise Tests

Note: Some variables in the table below are not included in any final model. In these cases, they are tested in sensitivity analyses, and are therefore included in this comparison of means table.

Independent Variable	Hypertension Performance Quartile 4 Compared to Other Quartiles				Diabetes Performance Quartile 4 Compared to Other Quartiles			
	1 (lowest)	2	3	Other	1 (lowest)	2	3	Other
External Variables								
Urban or rural (dummy, 1=urban)					X***	X***	X***	
Medicaid Coverage Rate for NonElderly Adults, 2010-2011	X*** or **	X**		1≠3**, 2≠3***	X***	X***		1≠3***, 2≠3* or **
State Medicaid Managed Care Enrollment Rate, 2009-2011 (3 year average)						X*^		
Early State Medicaid PCMH Initiatives (1= yes as of 2008)					X*^			
Hospital affiliation with referral privileges for specialist care (1=yes)					X**			1≠2**
Organizational Variables								
Medical Patients per Primary Care Provider					X*	X***		2≠3**
Total Patients per Enabling Services Staff								
Medical Patients per Behavioral Health Provider								
Percent of Revenue from Federal 330	X***				X***	X**		1≠2***

Grants								
Percent of Medicaid Charges Collected								
Deemed for FTCA (2009 and/or 2010) (dummy, 1=deemed)				1≠3** or *	X**			1≠2**, 1≠3** or *
EHR Meaningful Use Capacity Scale, 2010 (8 point scale)		X*	X**					
PCMH Scale Score								
Patient Variables								
Percent Poverty	X*^				X***	X***	X***	1≠3**, 2≠3* or **
Percent of Patients Who Are Uninsured	X***	X**		1≠3***, 1≠2**	X***	X***	X***	1≠2***, 1≠3***, 2≠3*
Percent of Patients with Medicaid	X**			1≠3**, 1≠2* or **		X**	X**	1≠2**, 1≠3**
Percent of Patients with Medicare	X**			1≠3*^	X***	X***	X***	1≠3***, 2≠3**
Percent Minority	X*^			1≠3**	X***	X***	X***	1≠2*, 1≠3***
Percent Homeless	X***	X*		1≠3***, 1≠2**	X***	X**		1≠2**, 1≠3***
Percent Migrant					X*^	X**		
Percent Female					X**			
Ratio of Capitated Managed Care Member Months to Patients	X**					X* or **	X*^	
Percent of Total Visits with a Chronic Condition Diagnosis[#]								
Control Variables								
Years as 330-Funded Health Center (7 years maximum, 2005-2011)								1≠3** or *
Number of Patients per 1000				1≠3*, 1≠2*		X*** or **	X**	1≠2**

Number of Encounters Per Hypertensive Patient		X**	X**		NA	NA	NA	
Number of Encounters Per Diabetic Patient	NA	NA	NA					
Number of Years Sampling Used to Report Hypertension Metric (Out of 3 Years)	X**	X**	X**		NA	NA	NA	
Number of Years Sampling Used to Report Diabetes Metric (Out of 3 Years)	NA	NA	NA					
Percent of Medical Patients Age 18-84 with Hypertension					NA	NA	NA	
Percent of Medical Patients Age 18-74 with Type I or II Diabetes	NA	NA	NA					

*p<.1, **p<.05, ***p<.001. ^indicates difference is not statistically comparable in all three tests (Sidak, Bonferroni, and Scheffe). NA indicates not applicable. ≠ indicates statistically significant difference between quartile means.

[#]Includes visits with a chronic condition as a primary diagnosis. Chronic conditions include diabetes, hypertension, selected heart disease, asthma, chronic bronchitis, emphysema, HIV, and all behavioral health.

Appendix 4C: Performance Nested Models After Including Patient-Centered Medical Home Survey Data

As discussed in Chapter 2, whether a health care provider organization is established as a Patient-Centered Medical Home(PCMH) may be related to a providers' ability to better manage patient care and improve health outcomes. A 2009 Commonwealth Fund Survey of FQHCs(response rate 79%) has been used to assess health centers' capacity for quality improvement and to establish a PCMH scale relevant for evaluating health centers' PCMH progression (Doty et al, 2010; Birnberg et al, 2012). The survey covered patient access to care, obtaining specialty referrals, coordination of care among providers and across care settings, quality improvement activities, and performance reporting. Health centers were asked to answer most of the survey questions from the perspective of their largest or only clinic site. Consequently, responses may not reflect organization-wide practices or infrastructure.

Including data from this survey, particularly the derived PCMH scale as developed by Birnberg et al (2012) and the environmental factor of whether a health center is affiliated with a hospital for specialty care access, substantially lower the number of observations available for ordinal linear regression by 34% for both outcome analyses. While the survey amassed a high response rate (79%), it may under-represent the full health center program. The survey data also only reflect one year – the first year – of the three year study period. This means that as health centers have rapidly invested in quality improvement over the last few years, the survey data may not reflect the state of quality improvement investment and resource capacity throughout the study period. Underrepresentation therefore becomes exacerbated as the health center program grew in 2010 and 2011. For these reasons, I chose not to include these variables in the full

analysis for these and two other reasons. First, survey data reflect a health center's largest site and not full organization, leading to potential ecological fallacy across sites. Second, PCMH score is highly correlated with the EHR measure used in this analysis.

This Appendix walks readers through the results had they been included. The first step in this analysis was demonstrating whether referral privileges or PCMH score consistently increase or decrease as performance improves. Table C1 showcases these results for hypertension, and demonstrates there is no consistent, linear increase or decrease across hypertension performance quartiles. Here, the total number of observations is higher than in the regression analysis given the inclusion of additional health centers that did not complete the survey.

Table C1. Descriptive Findings by Quartile, Hypertension

Variable	Total Sample	Quartile 1 (Lowest)	Quartile 2	Quartile 3	Quartile 4 (Highest)
	N Mean Standard Dev.	N Mean Standard Dev.	N Mean Standard Dev.	N Mean Standard Dev.	N Mean Standard Dev.
External Variables					
Hospital affiliation with referral privileges for specialist care (1=yes)	765 0.800 0.400	183 0.776 0.418	181 0.801 0.400	199 0.829 0.377	202 0.792 0.407
Organizational Variables					
PCMH Scale Score	727 61.275 12.181	176 60.004 12.401	168 62.550 11.292	190 61.340 12.484	193 61.260 12.397

Table C2 below depicts that findings are generally not comparable to Table 4.5 in the full analysis, with two exceptions. The percent of patients who are racial/ethnic minorities continues to lower the odds of higher performance across all three models with

fewer observations, and sampling continues to improve the odds of higher performance. Neither PCMH score nor hospital referral privilege is significant, and the likelihood ratio (lr) test documents that adding these two survey variables does not contribute to the explanatory power of the models. In fact, the lr test comparing Models 1 and 2 demonstrates that the addition of key variables allows me to reject the null hypothesis that their coefficients are jointly equal to zero [LR chi2(13)=30.62; prob>chi2=0.0038], despite the reduction in number of observations. While Model 2 has greater explanatory power than the more restrictive Model 1, the addition of PCMH score and hospital referral do not significantly improve explanatory power of Model 3 relative to Model 2 [LR chi2(2)=1.29; prob>chi2=0.5248].

Table C2. Ordinal Logistic Regression Results, Hypertension Control

	Model 1		**Model 2**		**Model 3**	
Number of Observations	705		705		705	
Chi^2	45.794		76.410		77.699	
Prob>chi^2	0.000		0.000		0.000	
Pseudo R^2	0.023		0.039		0.040	
Log Likelihood	-953.737		-938.429		-937.784	
Variable	Odds Ratio	Z Score	Odds Ratio	Z Score	Odds Ratio	Z Score
External Variables						
Urban or rural (dummy, 1=urban)	0.950	-0.27	0.881	-0.65	0.874	-0.69
Medicaid Coverage Rate for NonElderly Adults, 2010-2011	NA	NA	63.78*	1.74	77.02*	1.81
State Medicaid Managed Care Enrollment Rate, 2009-2011 (3 year average)	NA	NA	0.482*	-1.76	0.487*	-1.73
Early State Medicaid PCMH Initiatives (1= yes as of 2008)	NA	NA	1.203	1.15	1.197	1.12
Hospital affiliation with referral privileges for specialist care (1=yes)	NA	NA	NA	NA	0.974	-0.14
Organizational Variables						
Medical Patients per Primary Care Provider	1.000	-0.02	1.000	-0.10	1.000	-0.15
Total Patients per Enabling Services Staff	1.000	0.43	1.000	-0.17	1.000	-0.17
Medical Patients per Behavioral Health Provider	NA	NA	1.000	0.15	1.000	0.21
Percent of Revenue from Federal 330 Grants	0.376	-1.40	0.397	-1.24	0.430	-1.13
Percent of Medicaid charges collected	NA	NA	0.637*	-1.82	0.627*	-1.87

Deemed for FTCA (2009 and/or 2010)(dummy, 1=deemed)	NA	NA	0.967	-0.11	0.966	-0.11
EHR Meaningful Use Capacity Scale, 2010 (8 point scale)	NA	NA	0.994	-0.24	0.988	-0.45
PCMH Scale Score	NA	NA	NA	NA	1.007	1.13
Patient Variables						
Percent Uninsured	0.136***	-2.60	0.219*	-1.74	-1.63	0.240
Percent with Medicaid	0.609	-0.60	0.369	-1.09	0.378	-1.06
Percent with Medicare	0.0590	-1.47	0.0358	-1.49	0.0413	-1.42
Percent Minority	0.559**	-2.00	0.460**	-2.49	0.464**	-2.46
Percent Homeless	0.849	-0.35	0.629	-0.89	0.612	-0.94
Percent Female	16.12**	2.32	5.514	1.33	5.113	1.26
Ratio of Capitated Managed Care Member Months to Patients	1.053	0.97	1.065	1.16	1.065	1.18
Percent Poverty	NA	NA	1.101	0.17	1.118	0.20
Percent Migrant	NA	NA	0.381	-1.22	0.365	-1.27
Percent of Total Visits with a Chronic Condition Diagnosis[#]	NA	NA	0.299	-1.51	0.296	-1.52
Control Variables						
Years as 330-Funded Health Center	0.911	-0.68	0.877	-0.92	0.876	-0.92
Number of Patients Served Annually, in Thousands	0.998	-0.50	0.999	-0.34	0.998	-0.42
Number of Encounters Per Hypertensive Patient	NA	NA	1.253	1.44	1.241	1.38
Number of Years Sampling Used to Report Hypertension Metric (Out of 3 Years)	NA	NA	1.200***	2.86	1.224***	3.05
Percent of Medical Patients Age 18-84 with Hypertension	NA	NA	4.873	1.60	4.468	1.51

Sources: Pooled 2009-2011 Uniform Data System, Bureau of Primary Health Care, Health Resources and Services Administration, HHS, unless other years are stated. Five variables are drawn from other sources: 1) Medicaid Coverage Rate for NonElderly Adults, 2010-2011 (Kaiser State Health Facts, "Medicaid Coverage Rates for Nonelderly by Age," http://kff.org/medicaid/state-indicator/rate-by-age-3/. Urban Institute and Kaiser Commission on Medicaid and the Uninsured estimates based on the Census Bureau's March 2011 and 2012 Current Population Survey); 2) State Medicaid Managed Care Enrollment Rate, 2009-2011, 3 year average (CMS. Medicaid Managed Care Enrollment Report. Summary Statistics as of [July 1, 2011; July 1, 2010; June 30, 2009]. For 2011, see http://www.medicaid.gov/Medicaid-CHIP-Program-Information/By-Topics/Data-and-Systems/Downloads/2011-Medicaid-MC-Enrollment-Report.pdf); 3) Early State Medicaid PCMH Initiatives (Kaye N and Takach M. Building Medical Homes in State Medicaid and CHIP Programs. June 2009. http://nashp.org/sites/default/files/medicalhomesfinal_revised.pdf); 4 and 5) PCMH score and hospital affiliation with referral privileges (2009 Commonwealth Fund National Survey of Federally Qualified Health Centers).

* p<.10, ** p<.05, *** p<.01

NA = not applicable (not in the model)

[#]Includes visits with a chronic condition as a primary diagnosis. Chronic conditions include diabetes, hypertension, selected heart disease, asthma, chronic bronchitis, emphysema, HIV, and all behavioral health.

The descriptive findings indicate no clear increase or decrease in referral privileges as diabetes performance improves. However, PCMH score does improve slightly across successive quartiles. Unlike the hypertension analysis, however, the inclusion of these variables does strengthen the analysis. As the table below shows,

PCMH scale score is not statistically significant, yet having a hospital affiliation for specialty care access improves the odds of being in a higher diabetes performance quartile by nearly half (OR=1.499, p<.05). The statistical significance of most other independent factors remains the same with some exceptions. Compared to full Model 1 in the analysis (N=1021), including this survey data and lowering the number of observations means that reliance on federal health center funding and managed care dominance are no longer significant. Compared to Model 2 in the analysis, reliance on federal health center funding, percent of patients with Medicaid, and sampling techniques are no longer significant. This holds once PCMH score and hospital referral privilege are included (Model 3 in this appendix).

I used the likelihood ratio (lr) test in order to compare explanatory power of the three nested models used in this appendix. The lr test compares two nested models at a time to determine whether the addition of variables in the less restrictive model allows me to reject the null hypothesis that the coefficients of the additional variables are jointly equal to zero. In this case, the inclusion of additional variables significantly improves the explanatory power of Model 2 relative to Model 1 [LR chi2(13)=52.17; prob>chi2=0.0000], and the addition of the PCMH score and hospital referral variables significantly improves the explanatory power of Model 3 relative to Model 2 [LR chi2(2)=7.33; prob>chi2=0.0256]. Nevertheless, the intention of this additional analysis was to test the value of adding PCMH score, which does not prove to change the odds of performance quartile level for diabetes outcomes.

Table C3. Descriptive Findings by Quartile, Diabetes

Variable	Total Sample	Quartile 1 (Lowest)	Quartile 2	Quartile 3	Quartile 4 (Highest)
	N	N	N	N	N

	Mean Standard Dev.	Mean Standard Dev.	Mean Standard Dev.	Mean Standard Dev.	Mean Standard Dev.
External Variables					
Hospital affiliation with referral privileges for specialist care (1=yes)	725 0.800 0.400	154 0.708 0.456	184 0.859 0.349	189 0.772 0.420	198 0.843 0.364
Organizational Variables					
PCMH Scale Score	689 61.053 12.260	142 59.171 12.472	174 61.455 12.281	186 61.515 12.486	187 61.648 11.802

Table C4. Ordinal Logistic Regression Results, Diabetes Control

	Model 1		**Model 2**		**Model 3**	
Number of Observations	670		670		670	
Chi^2	176.373		228.538		235.869	
Prob>chi^2	0.000		0.000		0.000	
Pseudo R^2	0.095		0.124		0.128	
Log Likelihood	-836.328		-810.246		-806.580	
Variable	Odds Ratio	Z Score	Odds Ratio	Z Score	Odds Ratio	Z Score
External Variables						
Urban or rural (dummy, 1=urban)	1.410*	1.78	1.322	1.38	1.309	1.32
Medicaid Coverage Rate for NonElderly Adults, 2010-2011	NA	NA	5303.0***	3.24	4785.2***	3.18
State Medicaid Managed Care Enrollment Rate, 2009-2011 (3 year average)	NA	NA	1.194	0.40	1.205	0.42
Early State Medicaid PCMH Initiatives (1= yes as of 2008)	NA	NA	0.725*	-1.90	0.722*	-1.92
Hospital affiliation with referral privileges for specialist care (1=yes)	NA	NA	NA	NA	1.499**	2.14
Organizational Variables						
Medical Patients per Primary Care Provider	1.000	0.74	1.000	0.74	1.000	0.53
Total Patients per Enabling Services Staff	1.000	-0.45	1.000	-0.16	1.000	0.02
Medical Patients per Behavioral Health Provider	NA	NA	1.000	-1.43	1.000	-1.20
Percent of Revenue from Federal 330 Grants	0.615	-0.63	0.459	-0.95	0.451	-0.97
Percent of Medicaid charges collected	NA	NA	0.494***	-2.71	0.482***	-2.79
Deemed for FTCA (2009 and/or 2010)(dummy, 1=deemed)	NA	NA	1.266	0.74	1.322	0.88
EHR Meaningful Use Capacity Scale, 2010 (8 point scale)	NA	NA	0.947**	-2.07	0.938**	-2.36
PCMH Scale Score	NA	NA	NA	NA	1.010	1.43

Patient Variables						
Percent Uninsured	0.0737***	-3.08	0.464	-0.78	0.557	-0.59
Percent with Medicaid	0.165**	-1.97	0.229	-1.47	0.210	-1.55
Percent with Medicare	374.0***	2.78	4580.3***	3.48	6910.8***	3.63
Percent Minority	0.315***	-3.64	0.267***	-3.81	0.278***	-3.68
Percent Homeless	0.228***	-2.90	0.0981***	-4.06	0.0890***	-4.20
Percent Female	1.667	0.41	0.592	-0.39	0.419	-0.64
Ratio of Capitated Managed Care Member Months to Patients	1.079	1.36	1.053	0.91	1.054	0.92
Percent Poverty	NA	NA	0.553	-1.04	0.581	-0.95
Percent Migrant	NA	NA	0.437	-1.07	0.439	-1.06
Percent of Total Visits with a Chronic Condition Diagnosis[#]	NA	NA	0.506	-0.81	0.525	-0.76
Control Variables						
Years as 330-Funded Health Center	0.990**	-2.34	0.989***	-2.71	0.988***	-2.95
Number of Patients Served Annually, in Thousands	1.658***	3.51	1.685***	3.56	1.692***	3.57
Number of Encounters Per Diabetic Patient	NA	NA	1.478***	3.07	1.446***	2.85
Number of Years Sampling Used to Report Diabetes Metric (Out of 3 Years)	NA	NA	1.111	1.34	1.130	1.54
Percent of Medical Patients Age 18-74 with Type I or II Diabetes	NA	NA	1.134	0.07	1.232	0.11

Sources: Pooled 2009-2011 Uniform Data System, Bureau of Primary Health Care, Health Resources and Services Administration, HHS, unless other years are stated. Five variables are drawn from other sources: 1) Medicaid Coverage Rate for NonElderly Adults, 2010-2011 (Kaiser State Health Facts, "Medicaid Coverage Rates for Nonelderly by Age," http://kff.org/medicaid/state-indicator/rate-by-age-3/. Urban Institute and Kaiser Commission on Medicaid and the Uninsured estimates based on the Census Bureau's March 2011 and 2012 Current Population Survey); 2) State Medicaid Managed Care Enrollment Rate, 2009-2011, 3 year average (CMS. Medicaid Managed Care Enrollment Report. Summary Statistics as of [July 1, 2011; July 1, 2010; June 30, 2009]. For 2011, see http://www.medicaid.gov/Medicaid-CHIP-Program-Information/By-Topics/Data-and-Systems/Downloads/2011-Medicaid-MC-Enrollment-Report.pdf); 3) Early State Medicaid PCMH Initiatives (Kaye N and Takach M. Building Medical Homes in State Medicaid and CHIP Programs. June 2009. http://nashp.org/sites/default/files/medicalhomesfinal_revised.pdf); 4 and 5) PCMH score and hospital affiliation with referral privileges (2009 Commonwealth Fund National Survey of Federally Qualified Health Centers).

* p<.10, ** p<.05, *** p<.01

NA = not applicable (not in the model)

[#]Includes visits with a chronic condition as a primary diagnosis. Chronic conditions include diabetes, hypertension, selected heart disease, asthma, chronic bronchitis, emphysema, HIV, and all behavioral health.