COMPARISONS OF ACCESS TO, COST OF, AND QUALITY OF HEALTH CARE BETWEEN RURAL AND URBAN POPULATIONS

A Dissertation

by

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ABSTRACT

There are 46.2 million Americans (15% of total population) living in rural counties. Rural populations disproportionately suffer from inadequate access to, high cost of, and poor quality of health services compared to urban populations. Furthermore, rural populations have lower income, lower educational attainment, worse insurance coverage, and poor health status. In response to the goal of *Healthy People 2020* to eliminate disparities, this dissertation developed and conceptualized three topics to address rural health disparities. Using the 2004-2010 Medical Expenditure Panel Survey (MEPS), the first study found that geriatricians were less likely to be a usual source of care for both rural and urban older adults. The finding may be a result of the geriatrician shortage that exists while the aging population in the United States is growing. Also using the 2010 MEPS, the second study found that rural populations had a higher spending on prescription drugs and urban population had a higher spending on hospital emergency care. The result of quantile regression further indicated that the geographic factor might affect high spending users more than low spending users. For the third study, the 2011 California Healthcare Cost and Utilization Project (HCUP) provided evidence that rural residents had higher maternal readmissions rates in spite of the delivery mode. The maternal readmission rate seems way lower than other procedures but it is still important to monitor the quality of caesarean section deliveries. The primary limitation of this dissertation may be the poor generalizability to populations in different age groups or living in different areas from California. However, the trend data, quantile regression,

and generalized estimating equation employed in this dissertation presented rural health disparities in a different approach. Considering access, quality, and cost problems in rural areas as a whole, our research findings suggest that improving access to quality of care in rural areas should be a major priority. Moreover, addressing this healthcare deficiency should also subsequently reduce the unnecessary costs of care. In conclusion, effective strategies and actions are needed to provide more health resources and strengthen the rural health infrastructure.

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TABLE OF CONTENTS

CHAPTER Page

LIST OF FIGURES

FIGURE Page

LIST OF TABLES

TABLE Page

CHAPTER I

INTRODUCTION

Inadequate access, high cost, and poor quality of care have been identified as three major challenges in the rapidly growing U.S. healthcare system (Shi & Singh, 2010). Total national health expenditures nearly doubled from the year of 2000 to the year of 2010 (Centers for Disease Control and Prevention (CDC), 2011a). The United States spends a greater share of the gross domestic product (GDP) on health care than 12 other industrialized nations (The Commonwealth Fund, 2012). However, the change in demographics (e.g. aging and diversity) leads to the increasing demands for health services which the fragmented healthcare system fails to satisfy (Shi & Singh, 2010; Turnock, 2009). In addition, economic development caused the changes in family structure (e.g. women shift from working in family enterprises to working as paid employees), leaving a growing number of vulnerable populations (e.g. children and seniors) without needed care (Turnock, 2009). Moreover, the healthcare costs are rising and the number of Americans without financial access to health care is increasing (Kaiser Family Foundation, 2013; Turnock, 2009). This phenomenon is especially critical in rural areas (Rural Communities Explorer, 2013).

Rural Health Disparities

When people think of vulnerable subgroups within the healthcare safety net, the rural population often comes to mind for the following reasons. The first reason is geographic isolation (Daniels, Vanleit, Skipper, Sanders, & Rhyne, 2007; Fortney, Harman, Xu, & Dong, 2010; Shi & Singh, 2010). It has been a concern about who provides health care for people in rural areas where the level of care needed may exceed what can be provided (Bennett, Olatosi, & Probst, 2008; Crosby, Wendel, Vanderpool, & Casey, 2012). Although one in five Americans (around 59.5 million people) lives in rural areas (National Organization of State Offices of Rural Health, 2013), 51.2 percent of rural counties (less than 2,500 people) are defined as primary care Health Professional Shortage Areas (HPSAs; Health Resources and Services Administration [HRSA], 2013). Also, 57.7 percent are dentist HPSAs, and 55.0 percent are mental health HPSAs. As a result, rural residents consistently face geographic difficulties in accessing health care resources as well as enabling services (e.g. language translation and transportation).

The second reason is occupation (Crosby et al. 2012; Ricketts III, 1999; Slifkin, Popkin, & Dalton, 2000). The majority of rural populations are involved in agriculture, mining, forestry, and fishing activities. In addition, rural areas have fewer health care providers compared to urban areas. Furthermore, the reimbursements to healthcare practitioners are higher for the same services provided at metropolitan areas compared to nonmetropolitan areas. The discrepancy is based on the belief or perception that living expenses are higher in these areas. The lower income received in rural areas is often not appealing to healthcare professionals as well as their family members in general. As a consequence of this wage discrimination, health care workers may lose their interest in living in rural areas.

The third reason is demographics (Hart, Larson, & Lishner, 2005; Institute of Medicine (IOM), 2005; Lenardson, Ziller, Coburn, & Anderson, 2009; Ormond, Zuckerman, & Lhila, 2000; Probst, Samules, Moore, & Gdovin, 2002). Rural populations are poorer, older, or more uninsured, live in unique settlement patterns, or have lower education levels than their urban counterparts. More than one in four non-metropolitan Hispanics, African Americans, and Native Americans live in poverty. Further, education level is adversely interrelated with an individual's health status, job opportunities, and appropriate health services utilization.

The aforementioned reasons caused health disparities, defined as "differences in the incidence, prevalence, mortality, and burden of diseases and other adverse health conditions that exist among specific population groups in the United States" (Bennett, Dismuke, & Pumkam, 2010; Hauenstein, Petterson, Rovnyak, Merwin, Heise, & Wagner, 2007; Ricketts III, 1999). Rural counties have higher rates of morbidity and mortality than metropolitan counties due to culture, education, race/ethnicity, and poverty. Murray and colleagues (2006) pointed out the disparities in mortality suffered by low-income rural whites, low-income southern rural blacks, and high-risk urban blacks. These distinctly vulnerable conditions are interrelated to each other and highlight health and healthcare differences between rural and urban populations.

Framework of the Research

This dissertation will use the concept of the triad of access, quality, and cost (Asplin, 1997) for the discussion of health care services research (Figure 1). The two-direction arrows indicate that three aspects of health services research are affecting each other. The following chapters cover three topics of interest:

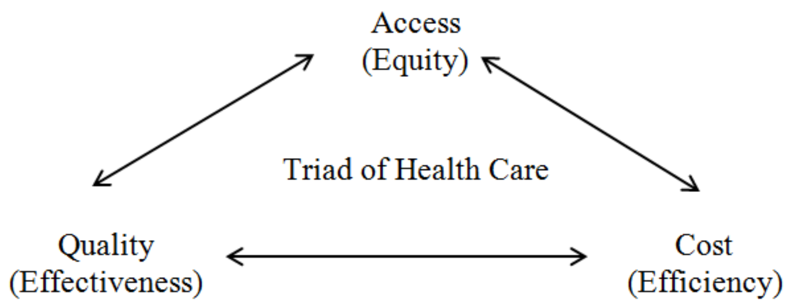


Figure 1. Concept of Triad of Health Care

1. Access: Geriatricians and Other Physician Disciplines as the Usual Source of Care (USC) for Rural and Urban Older Adults: 2004-2010 Medical Expenditure Panel Survey;
2. Cost: Rural-Urban Differences in Healthcare Expenditures: Using the 2010 Medical Expenditure Panel Survey;
3. Quality: Do Rural and Urban Women Experience Different Maternal Rehospitalizations? 2011 California Healthcare Cost and Utilization Project.

Expected Policy Significance

The findings of this dissertation are expected to provide strategies to improve and facilitate the existing public health infrastructure and medical services system for rural populations. *Health People 2020* has set a goal to eliminate health disparities that adversely affect groups of people due to their race, religion, gender, geographic location, or other characteristics linked to discrimination (U.S. Department of Health and Human Services, 2010). However, the review of literature has illustrated that little comparative research has examined the utilization of specialists as a USC, the determinants of high users consuming health services, and geographic differences in hospital readmissions. Therefore, the first study of this dissertation is on the availability of a usual source of care in urban and rural older adults (≥65 years old). This study used 2004-2010 Medical Expenditure Panel Survey (MEPS) to address the rural-urban differences in percentages of having a USC and the physician type of their USCs (i.e. geriatricians, internists, and family practitioners). The research findings will provide information about whether physician services are accessible to urban and rural older adults. The second study seeks to explore the expenditure differences in outpatient care, hospital inpatient care, hospital emergency room services, medications, and overall services consumed by rural and urban populations. A set of indicators in the 2010 MEPS were used to assess the extent of rural-urban differences and the determinants of high expenditures. The third study focuses on the quality of care provided by rural and urban community hospitals, respectively. The 2011 California Healthcare Cost and Utilization Project (California-HCUP) was used to report rural-urban differences in maternal rehospitalizations rates by two delivery modes. This study enhanced the understanding about the association of geographic areas with the likelihood of hospital readmission. It also provided insights into whether locations of hospitals or areas that patients lived had more impacts on readmission probabilities. While focusing on three specific topics, the author tends to consider rural health disparities in a broader context with respect to the triad of healthcare services. The ultimate goal is to suggest efficient, equal, and effective strategies for healthcare delivery in the United States.

CHAPTER II

GERIATRICIANS AND OTHER PHYSICIAN DISCIPLINES AS THE USUAL SOURCE OF CARE FOR RURAL AND URBAN OLDER ADULTS: 2004-2010 MEDICAL EXPENDITURE PANEL SURVEY

Background

Like those in other developed countries, the US population is aging (World Health Organization [WHO], 2012). Data from the US *Census Bureau* indicate that 40 million people were more than 65 years old in 2010; this number is expected to reach 72 million (20.3% of the total population) by 2030 (US Census Bureau, 2012). Because young adults have migrated disproportionately from rural to urban areas for education and employment, the percentage of older people in rural areas is even higher than that nationally (Kirschner, Berry, & Glasgow, 2009). The most current data indicate that 11.9% of people in metropolitan areas (urban counties of 50,000 people and more) were 65 years and older (Miller, 2009). The corresponding figure was 14.6% in micropolitan areas (rural counties with an urban core population of 10,000 to 49,999 plus surrounding counties that are linked through commuting ties), and 16.3 % in noncore areas (rural counties not classified as metro or micropolitan areas).

The rapidly growing aging population has been accompanied by an increase in the prevalence of chronic diseases, functional disabilities, and polypharmacy (CDC, 2011b). About 80 % of older adults have at least one chronic condition such as diabetes, and 50 % have at least two. Nearly half of rural Americans report having at least one major chronic disease such as hypertension (Gamm, Hutchison, Dabney, & Dorsey 2003). Due to isolation and traditional caregiver responsibilities, approximately 40% of rural older adults are depressed or anxious compared to only 13-20 % of urban women (American Psychological Association [APA], 2013). The percentage of people 65 years and over with a physical disability has also increases from 38.2 % to 46.6 % in association with the increase in the level of rurality (U.S. Census Bureau, 2010).

The increasing number of older adults (65 years and older) in the US and worldwide makes a compelling demand for access to geriatricians (Petersen, Kandelman, Arpin, & Ogawa, 2010). These specialists have been specifically trained in health care for older adults. They are certified either by the American Board of Family Medicine (ABFM) or American Board of Internal Medicine (ABIM) before fulfilling the subspecialty requirements to be certified as geriatricians (American Geriatrics Society [AGS], 2005).

However, Peterson and colleagues (2011) noted that there were 1.48 geriatricians per 10,000 older residents (≥65) in most urban counties and only 0.8 in most rural counties. The corresponding numbers declined from 27.39 to 3.85 for internist-patient ratio and from 22.02 to 14.27 for family physician-patient ratio. In addition, minimal information is known about the actual use of geriatrician services. Information is insufficient on the actual comparative use of geriatricians, family practitioners, and internists as a usual source of care (USC) for older adults, including differences in urban and rural settings.

The purpose of this study is to examine the trend of USC rates and background of people who used geriatricians or other physicians (family practitioners or general internists) as their USCs. The 2004-2010 Medical Expenditure Panel Survey (MEPS) databases were used for this analysis. Emphasis was given to the geriatricians because of their focused training and competency development with the health of the aged. Family practitioners or internists were also participants because elders commonly receive care from these physician disciplines and they have the potential to be trained to become geriatricians. The research findings were expected to yield data on the provision of quality care to the burgeoning aging population in rural and urban America.

Methods

The study was a secondary data analysis over a 7 year period that compared the percentages of rural populations using family practitioners, internists, or geriatricians as their USCs.

Data Source

Data used in this study were obtained from 2004 to 2010 Medical Expenditure Panel Survey (MEPS) with the approval of the Texas A&M Institutional Review Board. The data prior to 2004 were not used because of the lack of geriatrician information. The MEPS collects data from a nationally representative sample of household but excludes people who are in the military, institutions, or living outside the United States. The purpose of this ongoing survey is to provide national estimates of the level and distribution of health care access and expenditures.

A new panel of the MEPS sample households in each year is obtained from the previous year's National Health Interview Survey (NHIS) sample (Agency for Healthcare Research and Quality [AHRQ], 2012). Within each panel, the same household and non-institutionalized individuals are interviewed 5 times (rounds) across 2 years. In each calendar year, AHRQ compiles data from three rounds of the first panel and three rounds of second panel. The overlapping panel design facilitates the combination of data sets from 2 different panels to acquire a larger sample size for each year. For example, the file for the year 2004 consisted of data obtained in Rounds 3, 4, and 5 of Panel 8 and Rounds 1, 2, and 3 of Panel 9. For 2010, it consisted of data collected from Rounds 3-5 of Panel 13 and Rounds 1-3 of Panel 14.

The individuals and households interviewed vary from panel to panel. The MEPS uses a stratifying, clustering, multiple-stage, and disproportionate sampling design to determine the survey subjects (Ezzati-Rice, Cohen, & Cohen, 2007). This complex sampling starts with selecting geographic primary sampling units (PSUs). Then several strata within each PSU are identified for random sampling. The MEPS oversamples two racial/ethnic minority groups including African Americans and Hispanics to ensure adequate sample size. To provide nationally representative estimates, the MEPS generates sampling weights and uses the Taylor-series linearization method to estimate standard errors. For missing values, the MEPS conducts weighted hot-deck imputation procedures for each type of medical event.

Each MEPS panel has three major components: (1) the household component (HC), (2) the medical provider component (MPC), and (3) the insurance component (IC). The response rates to the MEPS-HC were about 57-63 % but more than 90 % for both MEPS-MPS and MEPS-IC (AHRQ, 2010). The MEPS-MPC was not designed to yield national estimates but served as an imputation source to supplement missing values in the MEPS-HC. In this study, we used seven consolidated files (a combination of HC, MPC, and IC) from 2004 to 2010 to estimate the percentages of people having USCs as well as their demographic and socioeconomic information. The unweighted sample size of each panel ranged from 30,964 in 2007 to 36,855 in 2009. After removing people younger than 65 years old and people who did not report their residence, the remaining sample ranged from 3,249 in 2008 to 3,759 in 2006.

Sampling Weights

The 2004-2010 MEPS data (seven years) was used for this study. Seven sampling weights were generated and employed in different year to produce national estimates (Ezzati-Rice, Cohen, & Cohen, 2007). For example, the documentation for file HC-089 (2004 full-year consolidated data file) had the person weight variable (PERWT04F) and the file HC-097 (2005 consolidated data) had another person weight variable (PERWT05F). Stratum (VARSTR) and PSU (VARPSU) variables were also generated to reflect the complex sampling design of MEPS.

Dependent Variables: Usual Source of Care

The USC variables of interest were used to reflect realized access to three types of physicians: geriatricians, family practitioners, and general internists in rural and urban areas, respectively. A single adult respondent representing all household members stated whether they had a person or a place they usually went to when they were sick or needed advice about their health (Roberts, 2002). If the answer was yes for having a healthcare professional as the USC, the respondent was further asked what type of healthcare professional their USC was. The choices of interests are family practitioners, general internists, and geriatricians. Other disciplines like chiropractor or nurse practitioners were classified into one category. As a result, each person only had one of six choices: had no USC, chose one facility as the USC, chose one geriatrician as the USC, chose one family practitioner as the USC, chose one general internist as the USC, and chose any other professional as the USC. The yearly percentages from 2004 to 2010 were then calculated by the following equations:

$$\text{Percentage of Older Adults Who Had no USC} = \frac{\text{Number of Older Adults Who Did Not Have a USC}}{\text{Total Number of Older Adults}} \tag{1}$$

$$\text{Percentage of Older Adults Who Had Facilities as the USC} = \frac{\text{Number of Older Adults Who Had Facilities}}{\text{Total Number of Older Adults}} \tag{2}$$

$$\text{Percentage of Older Adults Who Had Other Professionals as the USC} = \frac{\text{Number of Older Adults Who Had Other Professionals}}{\text{Total Number of Older Adults}} \tag{3}$$

$$\text{Percentage of Older Adults Who Had Family Practitioners as the USC} = \frac{\text{Number of Older Adults Who Had Family Practitioners}}{\text{Total Number of Older Adults}} \tag{4}$$

$$\text{Percentage of Older Adults Who Had General Internists as the USC} = \frac{\text{Number of Older Adults Who Had Internists}}{\text{Total Number of Older Adults}} \tag{5}$$

$$\text{Percentage of Older Adults Who Had Geriatricians as the USC} = \frac{\text{Number of Older Adults Who Had Geriatricians}}{\text{Total Number of Older Adults}} \quad (6)$$

Each percentage of each population in each year generated a value. Six types of percentages (five aforementioned equations) and two types of populations (rural or urban) formed ten trend lines across from 2004 to 2010. Next, a new dependent variable with three exclusive categories: (1) family practitioner (FM), (2) general internist (IM), and (3) geriatrician (GM), was generated to indicate which type of physician a respondent chose to be his/her USC.

Independent Variable: Geographic Factor

The independent variable of this study was each respondent's living area defined dichotomously in the MEPS. Urban areas or metropolitan areas were counties containing at least one urbanized area (population more than 50,000 or more habitants; AHRQ, 2004). Counties not classified as metropolitan areas were considered as rural areas.

Covariates: Individual Characteristics

We selected eight individual characteristics which were found to be related to the selection of usual source of care (Tai-Seale, 2004). Except for gender and health insurance status, other variables in the MEPS were reclassified in our study to prevent small numbers in one cell. Demographic factors included age (65-69, 70-74, 75-79, 80 and older), gender (male/female), and race (Hispanic, non-Hispanic Black, non-Hispanic White, and others such as Asian). Socioeconomic factors were education (lower than high school, high school diploma, higher than high school), health insurance held (had any private insurance, public insurance only, uninsured), and time needed to reach their usual source of care regardless of transportation methods (less than 15 minutes, 15-30 minutes, 31-60 minutes, 61 minutes and above). Health-related factors included perceived physical health status (poor/fair, good, very good/excellent) and perceived mental health status (poor/fair, good, very good/excellent) of each respondent.

Analyses

This study merged seven consolidated files and compared the aggregated results between urban and rural population. First, descriptive analyses of all measures for both rural and urban older adults were provided to characterize this study sample. Second, bivariate analyses were conducted to compare individual characteristics of people with the USCs by residence. Third, a line chart was used to demonstrate the 2004-2010 trend of using three different types of physicians as USCs. Fourth, a multinomial logistic regression model was performed to assess the association of residence with likelihoods of having any of these three physician categories as USCs, holding other individual characteristics constant. All statistical analyses were done using Microsoft Excel and Stata 12 (StataCorp, 2011). Two-tailed *p* values less than or equal to 0.05 were considered statistically significant.

Results

The study sample was drawn from seven data sets (2004-2010) and each data set accounted for a similar percentage of the final pooled database ranged from 13.7% to 15.1%. After applying the sampling weight values, the overall sample size is 24,834 (weighted N= 257,626,496), in which 20.0% of older adults resided in rural areas (weighted n= 51,463,647). A similar percentage of older adults living in urban areas had USCs than that of rural areas (93.69% vs. 93.46%).

Among rural older adults (Table 1), people with USCs were more likely than people without USCs to be younger than 80 years old (75.4% vs. 61.5%), be non-Hispanic Whites (90.0% vs. 83.2%), have private insurance coverage (55.6% vs. 39.6%), and have better mental health conditions (57.7% vs. 49.0%). Other factors have no significant differences between rural people with and without USCs. Urban older adults with USCs were more likely than urban people without USCs to be younger than 80 years old (73.7% vs. 66.5%), be female (58.0% vs. 53.3%), be non-Hispanic White (78.5% vs. 71.1%), have degree higher than high school (22.4% vs. 16.2%), have private insurance plans (54.8% vs. 40.7%), perceive good physical health (44.9% vs. 40.7%) and perceive very good mental health conditions (61.1% vs. 50.9%). People without USCs had no answers about the distance to their USC so that this variable was not reported in the Table 1.

Table 1. Rural-Urban Comparisons of Individual Characteristics in People with and without Usual Source of Care (USCs)

	Rural		Urban		Total	
	No USC N=584	Had USC N=4,737	No USC N=2,260	Had USC N=17,253	No USC N=2,844	Had USC N=21,900
Demographic Factors						
Age						
65-69	25.8%	30.3%	29.3%	29.3%	28.6%	29.5%
70-74	18.7%	24.5%	19.1%	23.4%	19.0%	23.6%
75-79	17.0%	20.7%	18.1%	21.0%	17.9%	21.0%
80+	38.5%	24.6%	33.5%	26.3%	34.5%	25.9%
Sex						
Female	54.1%	56.4%	53.3%	58.0%	53.4%	57.7%
Race/Ethnicity						
Others	3.1%	2.3%	7.1%	5.2%	6.3%	4.6%
Hispanic	6.8%	2.2%	9.5%	7.7%	8.9%	6.6%
Non-Hispanic Black	6.9%	5.5%	12.2%	8.7%	11.2%	8.0%
Non-Hispanic White	83.2%	90.0%	71.1%	78.5%	73.5%	80.8%
Socioeconomic Factors						
Education						
<High school	39.7%	37.1%	36.9%	30.9%	37.4%	32.1%
=High school	45.7%	47.8%	46.9%	46.7%	46.7%	46.9%
>High school	14.7%	15.1%	16.2%	22.4%	15.9%	21.0%
Insurance						
Private	39.6%	55.6%	40.7%	54.8%	40.5%	55.0%
Public only	59.1%	44.2%	56.62%	45.0%	56.8%	44.9%
Uninsured	1.4%	0.2%	3.0%	0.2%	2.7%	0.2%
Health Conditions						
Perceived Physical Health						
Poor/Fair	30.8%	25.0%	31.5%	23.1%	31.4%	23.5%
Good	27.8%	30.5%	28.0%	31.8%	27.9%	31.6%
Very good/ Excellent	41.5%	44.5%	40.5%	45.0%	40.7%	44.9%
Perceived Mental Health						
Poor or Fair	20.7%	9.8%	18.5%	9.1%	18.9%	9.2%
Good	30.2%	32.6%	30.2%	29.0%	30.2%	29.7%
Very Good or Excellent	49.0%	57.7%	51.3%	62.0%	50.9%	61.1%

Notes: Unweighted counts represent the actual numbers of older adults aged 65 and older. To derive national population estimates, each percentage was weighted according to person-level weights provided by AHRQ.

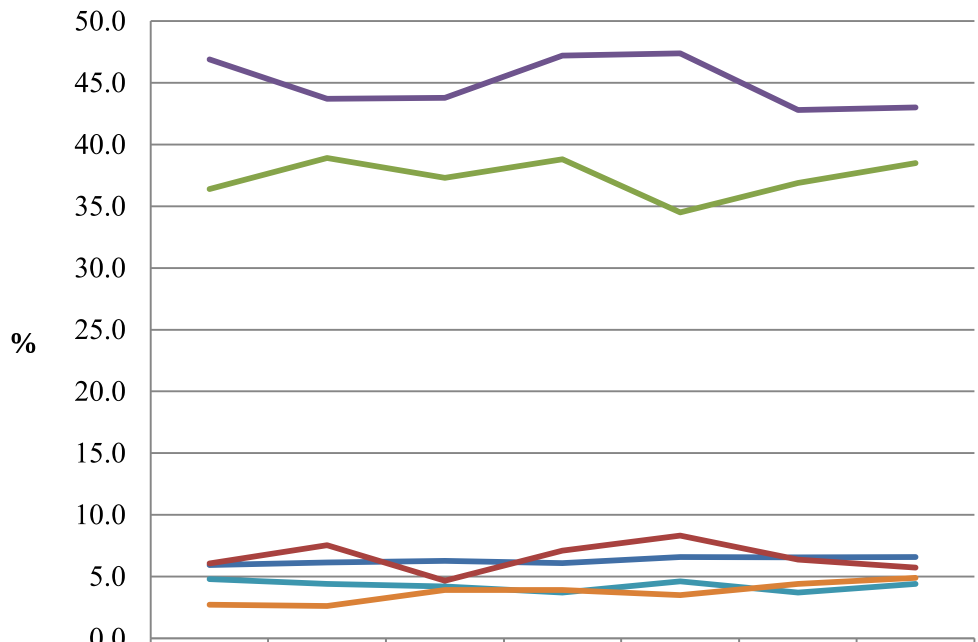
Rural and urban older adults who reported family practitioners, general internists, or geriatricians as USCs were further used in bivariate analyses. A greater proportion of older adults with USCs utilized family practitioners followed by general internists and then geriatricians. Among rural populations, only education and distance to the USC were related to which kind of physician they had as USCs (Table 2). Rural older adults who received a degree lower than high school were self-reported as more likely to use family practitioners as the USCs (40.0% vs. 32.1%) while those with higher education level were more likely to report internists as their USCs (21.1% vs. 13.3%). In addition, patients who chose family practitioners as the USCs were more likely to spend less than 15 minutes to reach their doctors (52.8% vs. 44.0%). Except for gender, all the other variables were significantly associated with the type of physician urban older adults used as a USC. Urban older adults who used geriatricians as the USCs were more likely than people who chose another two kinds of physicians (i.e. family practitioners and general internists) to be older than 80 years old, be a Hispanic, hold a degree higher than high school, be covered by private insurance plans, spend less than 30 minutes to reach the USCs, perceive excellent physical health and perceive good mental health status.

Table 2. Rural-Urban Comparisons of Individual Characteristics in People Who Used Family Practitioners, Internists, and Geriatricians as the Usual Source of Care (USCs)

Weighted Percentage	Rural			Urban		
	FM N=1,900	**IM N=475**	**GM N=2**	**FM N=6,582**	**IM N=3,098**	**GM N=86**
Demographic Factors						
Age						
65-69	28.2	29.4	66.9	28.0	28.2	2.2***
70-74	25.6	27.5	33.1	22.1	24.2	29.6***
75-79	21.1	24.2	0.0	22.4	21.1	20.7***
80+	25.2	18.6	0.0	27.5	26.5	47.5***
Sex						
Female	58.5	53.1	100.0	59.4	60.1	65.9
Race/Ethnicity						
Others	1.8	1.4	0.0	4.5	6.7	4.3***
Hispanic	2.2	2.5	0.0	7.9	4.0	10.6***
Non-Hispanic Black	6.0	2.5	0.0	8.7	6.6	7.0***
Non-Hispanic White	90.0	93.6	100.0	79.0	82.7	78.1***
SES						
Education						
<High school	40.0	32.1	33.1*	32.7	22.1	19.8***
=High school	46.7	46.8	66.9*	47.8	47.5	42.5***
>High school	13.3	21.1	0.0*	19.5	30.4	37.7***
Insurance						
Private	56.9	64.8	33.1	53.9	60.9	67.0***
Public only	42.9	35.2	66.9	46.1	39.0	33.0***
Uninsured	0.2	0.0	0.0	0.1	0.1	0.0***
Distance to USC						
<15 minutes	52.8	44.0	0.0**	49.3	43.6	48.9*
15-30	34.2	32.7	33.1**	41.7	47.6	45.0*
31-60	11.7	17.1	66.9**	7.8	7.5	5.8*
>60 minutes	1.3	6.2	0.0**	1.2	1.3	0.3*
Health Conditions						
Physical Health						
Poor	28.2	22.5	66.9	23.9	19.8	13.3**
Good	29.5	31.9	33.1	31.5	32.4	21.5**
Excellent	42.2	45.6	0.0	44.6	47.9	65.3**
Mental Health						
Poor	11.8	7.8	0.0	9.3	7.5	9.1***
Good	32.9	34.1	100.0	30.0	26.0	38.8***
Excellent	55.3	58.1	0.0	60.7	66.5	52.0***

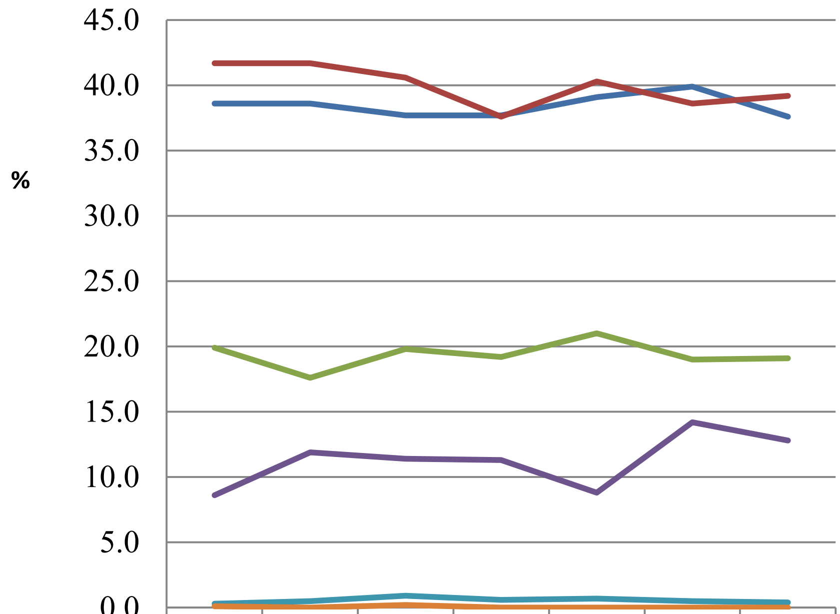
Notes: FM-Family Medicine; IM-Internal Medicine; GM-Geriatric Medicine; SES-Socioeconomic status; *, **, *** Significantly from People having family practitioners or internists as the USCs at α=0.05, 0.01, and 0.001 level; Unweighted counts represent the actual numbers of older adults aged 65 and older. To derive national population estimates, each percentage was weighted according to person-level weights provided by AHRQ.

As shown in the Figure 2, higher proportions of rural older adults than urban ones had facilities as the UCSs. The gap has been smaller from 2008. Next, the proportion of rural older adults who had internists as the USCs has increased since 2008. Of the three physician disciplines, geriatricians were the least USC for both rural and urban populations.



	2004	2005	2006	2007	2008	2009	2010
U-NoUSC	5.9	6.1	6.3	6.1	6.6	6.5	6.6
R-NoUSC	6.1	7.5	4.7	7.1	8.3	6.4	5.7
U-Facility	36.4	38.9	37.3	38.8	34.5	36.9	38.5
R-Facility	46.9	43.7	43.8	47.2	47.4	42.8	43.0
U-Others	4.8	4.4	4.2	3.7	4.6	3.7	4.4
R-Others	2.7	2.6	3.9	3.9	3.5	4.4	4.9

Figure 2. Rural-Urban Comparisons in the Trend of USC Choices
Note: R-Rural, U-Urban



	2004	2005	2006	2007	2008	2009	2010
U-Family Practitioners	38.6	38.6	37.7	37.7	39.1	39.9	37.6
R-Family Practitioners	41.7	41.7	40.6	37.6	40.3	38.6	39.2
U-General Internists	19.9	17.6	19.8	19.2	21.0	19.0	19.1
R-General Internists	8.6	11.9	11.4	11.3	8.8	14.2	12.8
U-Geriatrician	0.3	0.5	0.9	0.6	0.7	0.5	0.4
R-Geriatrician	0.1	0.0	0.2	0.0	0.0	0.0	0.0

Figure 2. Continued

A multinomial logistic regression model was used to identify whether rural/urban residence affected the decision of using what type of physician as a USC (Table 3). After controlling for all individual characteristics, the residence was still significantly related to the type of USC. The urban older adults were more likely than rural ones to have geriatricians reported as their USC (O.R.=10.752, p=0.002). Urban older adults also were more likely than their rural counterparts to have general internists as their USCs (O.R.=1.701, p<0.0001).

Table 3. Geographic Impacts on the Type of Physician as a Usual Source of Care (USC) Adjusted for Covariates

(Reference Group)	Internal Medicine O.R. (Std.)	Internal Medicine 95% C.I.	Geriatric Medicine O.R. (Std.)	Geriatric Medicine 95% C.I.
Urban Areas (Rural Areas)	1.701 (.173)***	(1.394, 2.077)	10.752 (8.211)**	(2.396, 48.242)
Age (65-69)				
70-74	1.117 (.100)	(.937, 1.332)	11.599 (7.332)***	(3.349, 40.179)
75-79	1.011 (.095)	(.840, 1.216)	8.050 (5.792)**	(1.957, 33.112)
80+	1.018 (.101)	(.839, 1.236)	15.888 (10.965)***	(4.092, 61.688)
Female (Male)	1.095 (.056)	(.990, 1.211)	1.432 (.479)	(.742, 2.765)
Race/Ethnicity (Others)				
Hispanic	.445 (.092)***	(.296, .670)	1.640 (1.685)	(.218, 12.360)
Black	.543 (.100)**	(.378, .781)	1.040 (.917)	(.184, 5.888)
White	.693 (.114)*	(.502, .956)	.784 (.662)	(.149, 4.122)
Education (< High School)				
=High	1.343 (.101)***	(1.159, 1.556)	1.554 (.591)	(.736, 3.283)
>High	2.057 (.203)***	(1.695, 2.497)	3.841 (1.996)***	(1.383, 10.669)
Insurance (Private Insurance)				
Public	.830 (.055)**	(.728, .945)	.541 (.176)	(.286, 1.024)
Uninsured	1.325 (.898)	(.350, 5.021)	omitted	Omitted
Distance (<15 minutes)				
15-30	1.311 (.093)***	(1.139, 1.508)	1.199 (.315)	(.716, 2.010)
31-60	1.265 (.161)	(.985, 1.625)	1.175 (.582)	(.443, 3.111)
>60	2.206 (.497)***	(1.417, 3.434)	.356 (.383)	(.043, 2.950)
Perceived Physical Health (Poor)				
Good	1.161 (.086)*	(1.003, 1.34)	1.222 (.661)	(.422, 3.540)
Excellent	1.050 (.081)	(.902, 1.222)	4.277 (2.535)*	(1.334, 13.709)
Perceived Mental Health (Poor)				
Good	.994 (.105)	(.808, 1.222)	1.138 (.754)	(.310, 4.185)
Excellent	1.106 (.116)	(.901, 1.359)	.352 (.247)	(.088, 1.396)

Notes: (1) Base outcome=People who chose family practitioners as the USCs. (2) *: p<0.05; **: p<0.01; ***:p<0.001. (3) O.R.=Odds Ratio; Std.=Standard error; C.I.= Confidence Interval. (4) 1 stratum omitted because it contains no population members.

Discussion

This panel survey study found that only a small number of the older noninstitutionalized U.S. population reports the lack of a usual source of care. This finding and related findings below has significant implications for the health and health care of older adults. It is emphasized by the author that these are self-reported sample data that does not necessarily indicate that the USC has been utilized or not. While the reason(s) for the above findings from this study may not be clear, there are some demographics and characteristics of the population sampled that provide potential correlates.

Physician as the Usual Source of Care

This sampling survey examined the prevalence of a usual source of care (USC) across the U.S. Three physician disciplines (i.e. geriatricians, family practitioners, and general internists) were selected as a USC based on their being considered frequent providers of health care to the aging population.

Family practitioners were the most common USC noted in this survey, followed by the general internist category and lastly, geriatricians. During the seven-year study period, the distribution of USC among the three physician disciplines analyzed was relatively stable. Regardless of geographic location (urban or rural setting), this study also found that only a very few older adults reported geriatricians as their USC (i.e. less than 1% from 2004 to 2010). This is likely related to the decreasing supply of geriatricians across the nation (Lee & Sumaya, 2013). Family practitioners are by far the most common physician discipline reported as a USC, while the general internists were in the middle ranking. Yet it is the geriatrician discipline that receives the most intensive education and training to care for older adults. It is critical to address the crisis of geriatrician shortage given that the demand for geriatric care is expected to increase (Lee & Sumaya, 2013).

Rural older adults, comprising 20% of the study sample, were less likely than urban ones to report a USC during the study period of 2004 through 2010. On the other hand, the gap between rural and urban on the presence of having general internists as the USCs has tended to narrow. This study could not identify whether rural older adults are more likely to recognize the importance of internists or whether the rural internists are more accessible than other physicians. Future studies should further understand and address these changes. Also, to ensure that rural older adults have a usual and ongoing source of care, targeted research and policies examine the geographic distribution of physicians are essential (Coburn, Lundblad, MacKinney, McBride, & Mueller, 2010).

When adjusting for all covariates, urban older adults are more likely than rural ones to have internists or geriatricians as their USCs. When considering the relationships between covariates and the likelihood of choosing geriatricians as the USC, our study found that older age, higher education level, and better physical health status are related to a higher probability of having geriatricians as USCs. These findings indicate that the importance of geriatricians might be well recognized by very old, knowledgeable, and healthy adults. It is important to begin the effort early on a national scale to enhance the geriatrician capacity, improve the recognition of a geriatrician in a team of medical care, and encourage older adults to use geriatric care provided by geriatricians. In addition to education level and physical health status, race, insurance, and distance to a USC are relevant factors to have internists as USCs. This study could not distinguish the effects of residence with those of all covariates. However, future research is recommended to further explore the association between these covariates and choice of USCs across the 3 physician disciplines in this study.

Limitations

This study had several limitations. First, reliability has always been a concern in a self-reported survey. For example, verification of the reported USC in the MEPS was lacking. Second, the MEPS included data only on non-institutionalized people. Thus caution needs to be taken in interpreting the results which might not be generalizable. Third, the study only collected data of healthcare consumers, but information of healthcare providers was not obtained. For instance, it was unknown whether an individual visited a family practitioner in the doctor’s private office or a hospital. Patient-physician relations were not addressed either which might be a reason why a patient does not like to seek for medical services (Phillips, Dodoo, Green, GRYER, Bazemore, McCoy, & Petterson, 2009). Fourth, older adults might have to rely on others such as their children or grandchildren to take them to the doctor. In those cases, the USC might be that of the children who provide transportation services. Unfortunately, this study could not address this potentially influential factor.

CHAPTER III

RURAL-URBAN DIFFERENCES IN HEALTHCARE EXPENDITURES: USING THE 2010 MEDICAL EXPENDITURE PANEL SURVEY

Background

The Center for Medicare & Medicaid Services (CMS) reported that national health expenditures have grown dramatically from $1493.3 billion in 2001 to $2700.7 billion in 2011 (CMS, 2012a). National health expenditures are projected to reach $4,781.0 billion in 2021 (CMS, 2012b). Hospital care, professional services, and prescription drugs account for the top three categories of health expenditures per capita (CMS, 2012a). On average, each individual spent $2,734 on hospital care, $1,740 on physician services (excluding dental services), and $845 on prescription drugs in 2011. The growth of healthcare expenditures is of particular concern to rural populations whose incomes are significantly lower than their urban counterparts (Hawk, 2013). This purpose of this research is to examine the extent of rural-urban differences in expenditures for of outpatient care, hospital inpatient care, hospital emergency room services, and prescription drugs.

Data for health expenditures for individuals residing in urban or rural areas were obtained from the Medical Expenditure Panel Survey (MEPS). As a nationally representative data source, MEPS data are particularly well suited for the task of estimating rural-urban differences in components of healthcare expenditures (Cohen, Monheit, Beauregard, Cohen, Lefkowitz, Potter, Sommers, Taylor, & Arnett 1996).

Among prior studies using MEPS data, findings about differences in health expenditures between rural and urban populations have been mixed. Ziller and colleagues (2006) conclude that residents in rural areas had higher out-of-pocket spending than in urban areas. However, expenditures of dental care for older adults living in large metropolitan areas were higher than those in small metropolitan and nonmetropolitan areas (Manski, 2004). On the other hand, Chevarley and colleagues (2006) pointed out that there were no geographic differences in health care expenditures for children. Another study about veterans' healthcare expenditures (West & Weeks, 2009) concluded that rural veterans (VA) younger than 65 years spent $1,100 less on average than urban VA users, but rural VA users aged 65 and older spent $250 more on average than urban veterans.

This study extends existing research in two important ways. First, the study examines urban-rural differences in total health spending for the four top categories of health spending. Second, in addition to using traditional two-part models to examine the relationship between the urban-rural residency and health expenditures, exploratory quantile regression models are used to assess the extent to which urban-rural differences vary across quantiles of the expenditure distribution. The latter may be important because a number of studies have reported an extraordinarily high concentration of healthcare costs and utilization in a small group of individuals (Bertakis, Azari, Helms, Callahan, & Robbins, 2000; Diehr, Yanez, Ash, Hornbrook, & Lin, 1999; Pasic, Russo, & Roy-Byne, 2005; Von Korff et al. 1992). For example, 15 percent of patients spent 64 percent of total healthcare costs (Von Korff, Ormel, Katon, & Lin, 1992).

Methods

Data Source

The cross-sectional data used in this study were drawn from a subsample of the 2010 Medical Expenditure Panel Survey (MEPS), a nationally representative survey of the U.S. civilian noninstitutionalizd population (AHRQ, 2013). The subsample of individual household members consisted of households in the 2010 MEPS sample who also participated in the National Health Interview Survey (NHIS) in 2008 or 2009. The sampling plan of NHIS followed a multistage area probability design but oversampled households with Blacks, Hispanics, Asians, and low income families to improve the precision of estimates for selected subgroups (CDC, 2013a). People who were in the military, born abroad, institutionalized, or who died during the reference period are not eligible for this survey.

Like NHIS, the AHRQ used a multistage stratified sampling design with variable numbers of primary sampling units (PSUs) across strata to ensure appropriate variance estimates (AHRQ, 2012). The first stage consisted of a sample of 428 PSUs drawn from 1,900 geographically defined PSU's nationwide (CDC, 2013a). Each PSU contained a county, a small group of contiguous counties, or a Metropolitan Statistical Area (MSA). The second stage sampling used either area segments or permit segments to draw survey samples. An area segment comprised about eight, twelve, or sixteen addresses. A permit segment covered housing units built after the 2000 census which generally included four addresses. This 2010 file contains the Household Component (HC) and the Medical Provider Component (MPC). Individual characteristics such as gender were collected through Computer Assisted Personal Interviewing (CAPI) technology in the HC (AHRQ, 2013). With permission from the household survey respondents, the MPC collected data about visits, diagnosis, charges, and payments from the health care providers of household members. The MPC was not designed to yield national estimates but to supplement household reported expenditure information.

Households selected through the stratified sampling approach were interviewed 5 times/rounds across two years. Data for the year 2010 came from Rounds 3-5 of Panel 14 (a subsample of the 2008 NHIS responding households) and Rounds 1-3 of Panel 15 (a subsample of the 2009 NHIS responding households) (AHRQ, 2012). The response rate of Panel 14 was 85.2% and 84.0% for Panel 15. The public use dataset pooled 18,398 families with 31,228 valid cases. This study sample was limited to adults 18 years or older who have completed health-related questions such as cancer diagnosis. The final sample was 22,772 (=n) adults representing 229,857,784 (=N) adults in the US after applying the sampling weights.

Dependent Variables: Healthcare Expenditures

This study used healthcare expenditures reported by household members and medical providers (AHRQ, 2012) as outcomes of interest. Expenditures are the sum of out-of-pocket payments and payments by private insurance, Medicaid, Medicare, TRICARE, and other sources. In addition to total health expenditures, four service types were chosen for this study: (1) individual expenses on outpatient care (both hospital-based and office-based), (2) hospital inpatient care, (3) hospital emergency room services, and (4) prescription drugs. Outpatient care data were provided by doctors practicing in either private clinics (OBDEXP10) or hospital-based outpatient departments (OPTEXP10). Expenditures of hospital inpatient care (IPTEXP10+ ZIDEXP10+ZIFEXP10) and hospital emergency room services (ERTEXP10) comprised basic hospital facility expenses and payments for physicians whose services at hospital settings were billed separately. Expenditures of prescription medicines (RXEXP10) were obtained through both household interviews and pharmacy component surveys. Only prescription forms with valid fields for national drug code (NDC), medication name, strength of medicine (amount and unit), quantity (package size and amount), and payments by source were treated as valid cases. The last type of expenditure (TOTEXP10) covered all services, including dental services and other health services which were not considered separately.

A traditional two-part model was used for expenditure data analysis. The first part of the two-part model focused on a dichotomous dependent variable indicating whether individuals had any expenditures in a particular service category (expenditure=$0 or >$0). The second part of the two-part model focused on the level of expenditures for individuals with nonzero expenditures in each of the service categories. Given skew in the distribution of expenditures, the level of nonzero health expenditures was transformed to the logarithmic scale for all of the expenditure categories.

AHRQ uses a hot-deck imputation process for missing data when both HC and MPC components were not collected or incomplete (AHRQ, 2012). Unfortunately, there was no flag put to identify which expenditure values were imputed. Regression models based on medical events with complete information were used to predict total expenses.

Variables with known values such as total charge and provider type were used as predictors to form groups of donor events on expenditures. Then, a donor event with the closest predicted payment pattern was used to impute the missing values, taking into account the sampling weights associated with the MEPS complex survey design.

Independent Variables: Geographic Factor

The main independent variable of interest is individual's residence (0=Rural, 1=Urban). Based on the 2000 report of Office of Management and Budget (OMB), urban areas in the MEPS refer to a metropolitan core based statistical area (CBSA), an area comprising at least one urbanized area that has a population of at least 50,000 (Spotila, 2000). Following that, the Office of Rural Health Policy (ORHP) determined all the rest of metropolitan counties as rural areas (ORHP, 2012).

Covariates: Individual Characteristics

According to Andersen's model for individual use of health care (Andersen, 1995; Andersen, & Newman, 1973), this study used self-reported measures: (1) predisposing characteristics−age (AGE31X: 18-44, 45-64, 65 and older), gender (SEX: female and male), race/ethnicity (RACEX, RACETHNX: Others, Hispanic, African American, White), and highest degree when first entered (HIDEG: degree lower than high school, high school, higher than high school); (2) enabling resources−poverty status (POVCAT10: poor or near poor, low income, middle income, high income) and health insurance held (INSCOV10: any private insurance, only public insurance, uninsured); and (3) healthcare needs−the average perceived health status (RTHLTH31: very good or excellent, good, poor or fair), average perceived mental health status (MNHLTH: very good or excellent, good, poor or fair), limitation in physical functioning (ANYLIM10: no limitation or ye), and numbers of chronic diseases (containing high blood pressure [HIBPDX], heart diseases [CHDDX+MIDX+OTHRT], stroke [STRKDX], emphysema [EMPHDX], chronic bronchitis [CHBRON31], high cholesterol [CHOLDX], cancer [CANCERDX], diabetes [DIABDX], joint pain [JTPAIN31], arthritis [ARTHDX], and asthma [ASTHDX]). The functional limitation variable summarized whether a person had any Activities of Daily Living (ADL), Instrumental Activities of Daily Living (IADL), or sensory limitations during any of the survey rounds (AHRQ, 2012). Participants were asked about whether they have ever been diagnosed with any heart conditions. Cancer-related questions were asked only of people aged 18 or older and the questionnaire contained 30 types of cancers. If data were missing from the target round but available in the other round, data from another round were employed in the analysis. If no valid data were available during any round, the code -9 “Not Ascertained” was assigned to that participant.

Analyses

To reflect the complex survey design, the AHRQ used the Taylor-series linearization method to produce person-level variables for analysis, including *perwt10f* for sampling weight, *varstr* for strata, and *varpsu* for PSU (AHRQ, 2012). Weighted frequencies, means, or percentages were used to illustrate the distribution of each variable. Correlations among independent variables were low enough ($r < 0.75$) to rule out multicollinearity.

Five two-part models were fit to the expenditure variables. In the first part, logistic regression models were used to determine the impact of urban-rural residency status on the likelihood of having nonzero expenditures (>$0) in 2010 for each of the five expenditure categories. In the second part, regression models were used to assess the impact of urban-rural residency status on the natural logarithm of positive expenditure among individuals with positive healthcare expenditures for each of the five expenditure categories. In both parts, the models adjusted for the personal characteristics described in detail above: age, gender, race/ethnicity, educational attainment, poverty status, insurance status, perceived physical health status, perceived mental health status, limited physical activity, and a count of comorbid conditions.

The quantile regression models were introduced to explore the relationships between urban/rural residency status for individuals with nonzero expenditure (>$0) at various quantiles of the expenditure distribution. Unfortunately, current statistical software programs do not provide the capacity to incorporate survey sampling weights (-svy- command in Stata 12.0) into quantile regression. Given the inability to account for sampling weights, standard errors for quantile regression models were estimated using the robust standard error procedure. Two-tailed *P*-values less than or equal to 0.05 were considered statistically significant. All data analyses were performed using Stata 12 (StataCorp, 2011) using the "svy" procedure to incorporate survey sampling weights (except for the quantile regression models).

Results

Table 4 provides descriptive comparisons of weighted mean health care expenditures between rural and urban areas, as well as standard errors (SE), percentage with zero expenditures, and *P*-values for bivariate tests for urban/rural differences. Overall, 15.8% of the weighted sample was from rural areas. Rural populations spent more money on prescription drugs than urban populations (urban: $1061.4; rural: $1278.3; *p*=0.007). After excluding zero users, urban populations ($1636.4) spent more than rural populations ($1167.4) on emergency room services (*p*=0.004). Next, there were higher proportions of zero users in urban areas than in rural areas in terms of emergency care, prescription drugs, and all services received (*p*<0.05). Focusing on the cumulative distribution of nonzero expenditures (>$0), the results indicate that a small percentage of people accounted for a large percentage of healthcare expenditures. For instance, less than 2% of rural or urban populations accounted for half of total hospital inpatient care and emergency room service expenditures.

Table 4. Comparisons of Weighted Individual Expenditure Distributions by Residence and Type of Service, MEPS 2010

Weighted Mean (SE) or Percentage	**Urban (N=19,561)**	**Rural (N=3,211)**	***P*-value**
Outpatient Care			
Include zero ($)	1252.7 (43.3)	1306.2 (62.2)	0.4826
Exclude zero ($)	1852.5 (60.7)	1893.5 (81.6)	0.6854
Zero users (%)	32.4%	31.0%	0.5458
Lower half of cumulative sum (%)	63.1%	64.2%	
Higher half of cumulative sum (%)	4.5%	4.8%	
Hospital Inpatient Care			
Include zero ($)	1602.8 (90.8)	1574.7 (160.4)	0.8775
Exclude zero ($)	18838.5 (853.9)	15747.0 (1293.7)	0.0538
Zero users (%)	91.5%	90.0%	0.0853
Lower half of cumulative sum (%)	7.3%	8.3%	

Table 4. Continued

Weighted Mean (SE) or Percentage	**Urban (N=19,561)**	**Rural (N=3,211)**	***P*-value**
Higher half of cumulative sum (%)	1.2%	1.7%	
Hospital Emergency Room			
Include zero ($)	187.1 (9.8)	163.4 (19.1)	0.2870
Exclude zero ($)	1636.4 (76.4)	1167.4 (113.0)	0.0011
Zero users (%)	88.6%	86.0%	0.0087
Lower half of cumulative sum (%)	10.4%	12.5%	
Higher half of cumulative sum (%)	1.1%	1.5%	
Prescription Drugs			
Include zero ($)	1061.4 (31.0)	1278.3 (71.7)	0.0073
Exclude zero ($)	1611.5 (43.8)	1741.7 (93.6)	0.2187
Zero users (%)	34.1%	26.6%	<0.0001
Lower half of cumulative sum (%)	60.9%	66.3%	
Higher half of cumulative sum (%)	4.9%	7.0%	
Total Expenditures			
Include zero ($)	4929.5 (123.1)	5172.3 (269.2)	0.4136
Exclude zero ($)	5867.1 (143.2)	6007.2 (307.6)	0.6788
Zero users (%)	16.0%	13.9%	0.0521
Lower half of cumulative sum (%)	78.3%	79.3%	
Higher half of cumulative sum (%)	5.7%	6.8%	

Note: The last item "total expenditures" is not the sum of above four services but the overall healthcare expenditure of each individual who might also use other service such as dental care.

Table 5 provides the weighted percentages and *p*-values for the personal characteristic covariates across rural and urban populations. Due to the large sample size, *p*-values for hypothesis tests of the null of no difference in means or proportions tend to be small even when the absolute differences in point estimates means or proportions are not large. On average, rural populations are more likely to be old ($p<0.001$), white ($p<0.001$), less educated ($p<0.001$), and poor ($p<0.001$), as well as to rely on public insurance ($p=0.004$), perceive poorer physical ($p<0.001$) and mental health status ($p=0.002$), have physical limitations ($p<0.001$), and have multiple chronic diseases ($p<0.001$).

Table 5. Weighted Description of Personal Characteristics by Residence, MEPS 2010

Weighted Percentage	**Urban (N=19,561)**	**Rural (N=3,211)**	***P*-value**
Predisposing			
Age			0.0003
18-44	49.0	43.0	
45-64	34.8	36.7	
65 and older	16.2	20.3	
Gender (% of women)	51.5	51.9	0.6206
Race/Ethnicity			<0.0000
Others	7.3	3.3	
Hispanic	15.4	6.4	
Non-Hispanic Black	12.2	7.6	
Non-Hispanic White	65.1	82.6	
Education level			<0.0000
Lower than high school	16.5	22.8	
Equal to high school	53.3	58.0	
Higher than high school	30.2	19.2	
Enabling			
Poverty			<0.0000
Poor or near poor	16.5	20.4	
Low income	13.0	15.3	
Middle income	29.5	34.5	
High income	41.0	29.8	
Health insurance status			0.0039
Any private insurance	68.0	63.9	
Only public insurance	16.6	21.0	
Uninsured	15.4	15.1	
Care Needs			
Perceived physical health status			0.0001
Very good or excellent	59.1	53.2	
Good	27.0	29.1	
Poor or fair	13.9	17.7	
Perceived mental health status			0.0023
Very good or excellent	70.0	65.0	
Good	22.9	26.6	
Poor or fair	7.1	8.3	
Any limitation on functions (% of having any limitation)	25.3	33.3	<0.0000
Number of chronic diseases			<0.0000
No chronic disease	35.7	30.3	
1 chronic disease	21.9	19.3	
2 and more chronic diseases	42.4	50.4	

Table 6 reports the results of two-part models by weighted coefficients for the urban (vs. rural) residency variable, and the associated confidence intervals and *p*-values. In the first part, urban residents were less likely to have zero expenditure for prescription drugs, compared to rural residents (*p*=0.012). The estimated odds-ratio is 0.80, which indicates that urban residents were 20% less likely to have zero prescription drug expenditure. In the second part, urban residents have higher levels of expenditure for emergency services (*p*=0.011). The estimated impact of urban residency is a 0.22 increase in conditional log-emergency-care-expenditure (β=0.22), compared to rural populations.

Table 6. Two-Part Model Estimated of Impact of Urban (vs. Rural) Residency, Weighted Data Adjusted for Personal Characteristics Covariates, MEPS 2010

First-Part (Logistic Regression)	**O.R. (95% C.I.)**	***P*-value**
Outpatient care	1.086 (.944, 1.249)	0.246
Hospital inpatient care	.943 (.783, 1.138)	0.542
Hospital emergency room	.933 (.787, 1.106)	0.422
Prescription drugs	.801 (.673, .953)	0.012
Total expenditures	1.020 (.830, 1.252)	0.853
Second Part (Linear Regression)	***β* (95% C.I.)**	***P*-value**
Outpatient care	0.027 (-0.056~0.111)	0.521
Hospital inpatient care	0.050 (-0.174~.274)	0.659
Hospital emergency room	0.217 (0.050~0.385)	0.011
Prescription drugs	0.023 (-0.087~0.133)	0.678
Total expenditures	0.018 (-0.058~0.095)	0.634

Note: C.I.-Confidence interval. Person characteristics covariates: age, gender, race/ethnicity, educational attainment, poverty status, insurance status, perceived physical health status, perceived mental health status, functional limitations, and a count of comorbid conditions.

Quantile regression models were used to generate five figures (Figure 3-7) that illustrate the estimated impact of urban (vs. rural) residency on expenditures at different quantiles of the expenditure distribution, adjusting for personal characteristics covariates. The estimated residency coefficient and each quantile are connected by a solid dark line along with an estimated 95% confidence interval (represented by the shaded area). The dashed lines represent the estimated mean effect and the associated confidence interval for the urban coefficient from the second part of the two-part model (reported in Table 6).

In the Figure 3, there was a trend toward decreasing outpatient care expenditures for urban (compared to rural) residents beginning around quantile 0.8 of outpatient expenditure, though in part due to the use of conservative robust standard error estimates, the effect is statistically different from zero only at very high quantiles. For the other expenditure categories, the exploratory quantile regression results suggest a tendency for urban-rural differences in expenditures to vary from low to high expenditure quantiles, but the differences are not statistically significant using the conservative robust standard error estimates.

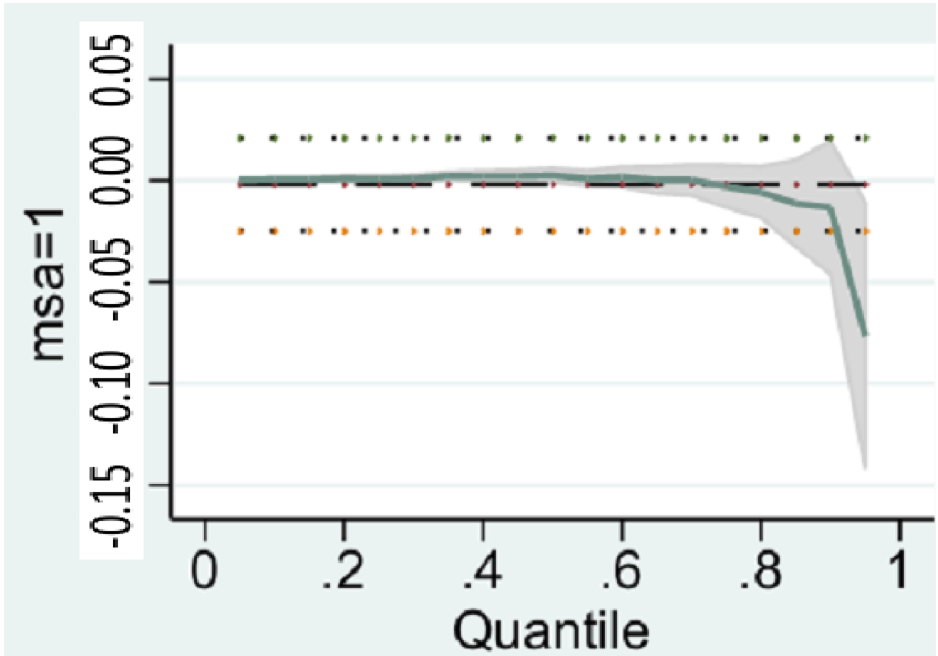


Figure 3. Unweighted Relationships between Residence and Expenditure of Outpatient Care without Zero Values Respectively, Adjusted by 10 Covariates

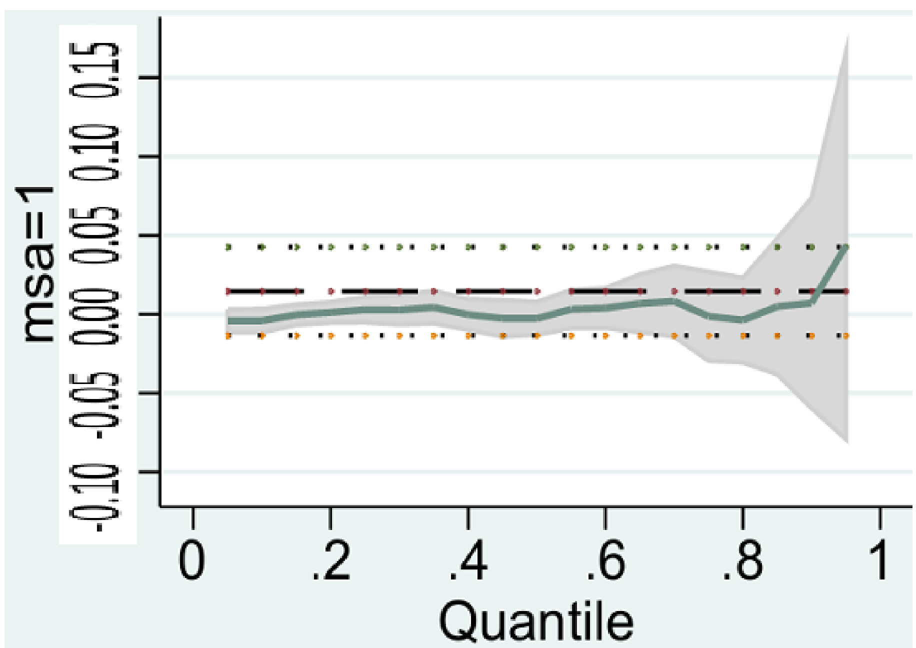


Figure 4. Unweighted Relationships between Residence and Expenditure of Hospital Inpatient Care without Zero Values Respectively, Adjusted by 10 Covariates

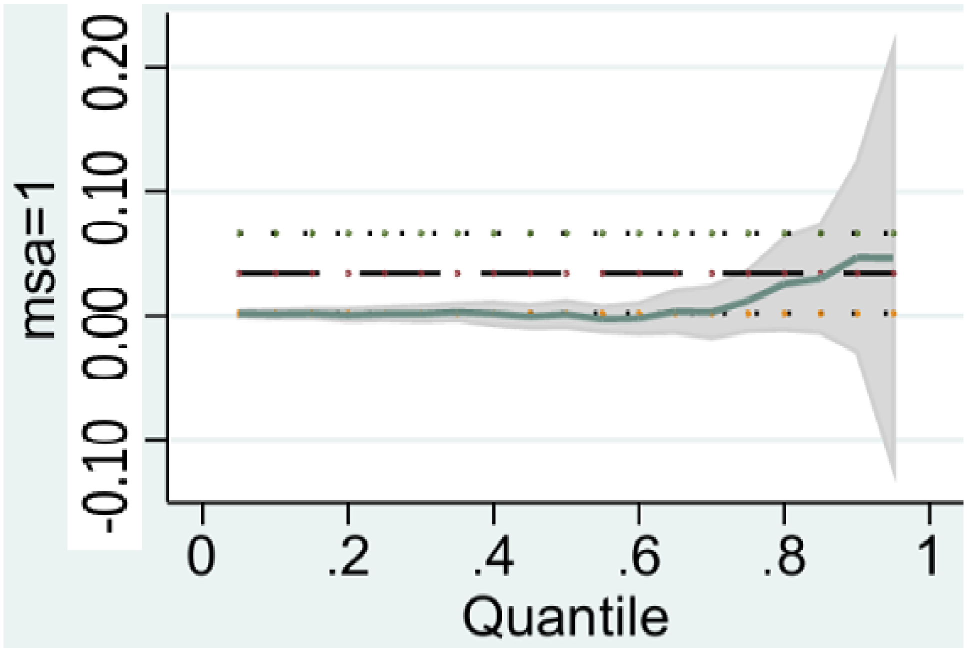


Figure 5. Unweighted Relationships between Residence and Expenditure of Hospital Emergency Room Service without Zero Values Respectively, Adjusted by 10 Covariates

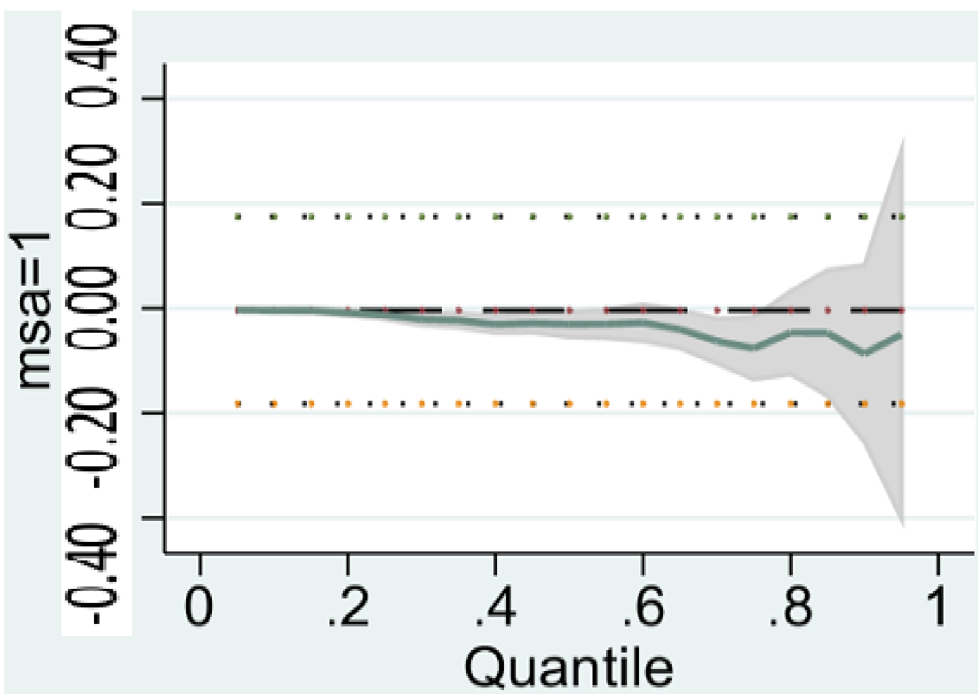


Figure 6. Unweighted Relationships between Residence and Expenditure of Prescription Drug without Zero Values Respectively, Adjusted by 10 Covariates

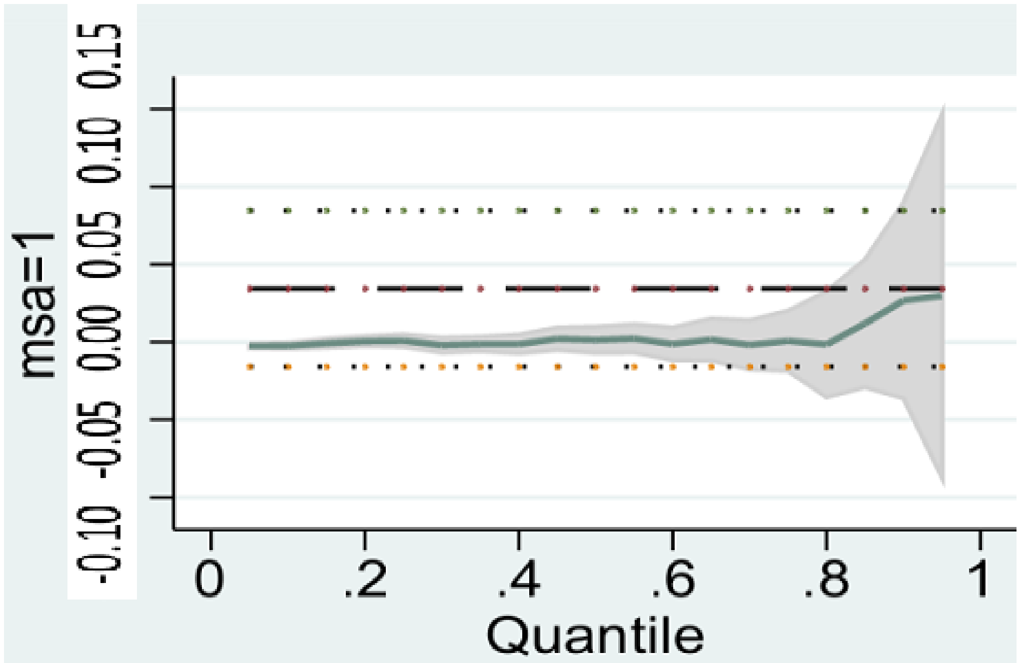


Figure 7. Unweighted Relationships between Residence and Total Expenditure without Zero Values Respectively, Adjusted by 10 Covariates

Discussion

Comparisons of Healthcare Expenditures between Rural and Urban Areas

The study compared urban and rural populations with respect to their medical expenditures overall and within four categories of services. The statistical procedures yielded population-weighted estimates and demonstrated the distributions of demographics, healthcare needs, and enabling factors. We hypothesized that expenditures would be higher for rural populations than for urban populations, possibly due to a greater prevalence of poor health status in rural populations (Crosby, 2012), or due to inferior access to (or quality of) preventative care in rural areas (Laditka, Laditka, Olatosi, & Elder, 2005). However, there was no difference in total health expenditures (including or excluding zero users) between rural-urban residents (Table 4). Although a higher proportion of urban residents had zero total health expenditures, after adjusting for personal characteristics of rural and urban residents, there was no significant rural-urban difference in the likelihood of zero total expenditure (Table 6).

Expenditures of four different service categories were also compared between rural and urban populations. Higher proportions of urban populations were zero users of hospital emergency room services and prescription drugs (Table 4), though only the prescription drug differential was statistically significant after adjusting for personal characteristics (Table 6). Urban residents using emergency care services had higher conditional emergency care expenditure for emergency room services and with-zero expenditure of prescription drugs. Rural populations had higher expenditures for prescription medications than their urban counterparts (p=0.007), which is consistent with results in previous studies that rural residents heavily rely on local pharmacies to keep themselves healthy (Hawk, 2013; McBride, 2005; National Economic Council, 2000). Since rural adults aged 18 and older in this study were older, less educated, poorer, more covered by public insurance only, and in poorer health (Table 5), the rural population were found to have higher put-of-pocket expenditures on prescription medications (Caplan & Brangan, 2004; National Economic Council, 2000; Ziller, 2006).

Regardless of type of health care and residence, large proportions of zero users presented in the sample. This is to be expected for some categories of expenditures, such as inpatient expenditures, because most urban or rural residents will not experience an acute episode requiring hospitalization over a one year period. For other expenditure categories, especially total health expenditure, zero expenditure may be less likely to reflect an absence of need for care as opposed to barriers to use of services, such as limited geographic access or lack of health insurance. Some patients paid the service in their first visits which happened before 2010 and came back to providers in 2010 to continue other treatments without any more charge (i.e. lump-sum fee) and this might also be the cause of zero expenditure in 2010 (AHRQ, 2012). To deal with high frequencies of zero expenditure, this study used both two-part models and quintile regression models with adjustment for differences in a variety of personal characteristics for rural and urban residents. The first part of two-part models demonstrated that urban adults were less likely to be non-zero users of prescription drugs than rural adults, adjusting for other personal characteristics (Table 6). The second part of two-part models indicated that hospital emergency service expenditures were higher for urban residents (Table 6). This provides strong evidence about the role of geographic factor played in the healthcare expenditures of adults aged 18 or over.

The findings of our quantile regression models must be categorized as exploratory, because a computational approach to account the complex design of MEPS data within quantile regression has yet to be developed based on the information from SAS (SAS Institute Inc., 2011) and Stata (StataCorp, 2011) acquired by the author. The quantile regression results suggested that the impact of urban-rural residency status might be more pronounced at the highest expenditure quantiles. The trend toward a greater impact of rural residency on expenditures for outpatient care and prescription drugs at higher expenditure quantiles is consistent with past studies that have concluded that pharmacies or physician clinics are particularly important providers of non-emergency care in rural areas (UnitedHealth Group, 2011). Furthermore, these providers do not require high capacity of healthcare workforce. Therefore, greater coordination among rural community clinics, pharmacies, and outpatient departments at hospital settings is imperative to tackle challenges due to limited workforce and constrained financial resources. Coordination could facilitate delivery of necessary medical services to patients who would otherwise have difficulty traveling a long distance to a provider in metropolitan areas. In the meantime, clinical integration could be a solution of specialist shortages to improve efficiency and quality of care.

Limitations

Selecting MEPS as the data source had several limitations for addressing our research questions. First of all, Franco (2004) pointed out that one quarter of rural home care users were served by an urban agency and 3 percent of urban residents were served by a rural agency. Nevertheless, the MEPS did not identify location of providers or the distances between users' homes and providers. Likewise, detailed information about direct measures of illness severity, physicians' referral patterns, hospital characteristics, and county characteristics were found to influence choice of healthcare providers (Hall, Marsteller, & Owings, 2010; Hall, Owings, & Shinogle, 2006). But the MEPS data set provides no information to assess the associations of these factors with health care expenditures. Further studies are needed to address these issues.

Second, this study only focuses on health care expenditures of four types of services used by noninstitutionalizd adults aged 18 and older. It is inappropriate to employ the research findings to interpret other kinds of health services and other age groups. The advantage of using the MEPS is its careful sampling design and weighting methods contributing to the generalizability of the results. Since research about healthcare utilization/expenditures has gathered increasing attention in recent years (Federal Trade Commission and the Department of Justice, 2004), studies using the MEPS to analyze other types of healthcare expenses as well as to include other age groups are highly recommended.

CHAPTER IV

DO RURAL AND URBAN WOMEN EXPERIENCE DIFFERENT MATERNAL REHOSPITALIZATIONS? 2011 CALIFRONIA HEALTHCARE COST AND UTILIZATION PROJECT

Background

Women who are pregnant are recognized as a distinct and fragile subgroup of women. However, this status largely ends with delivery (Brenhouse, 2013). Mothers in many countries in Asia, Africa, the Middle East, and parts of Europe could remain in hospitals at least one week before going back to work whereas the average length of stay (LOS) after delivery for American mothers is only 2.6 days (Podulka, Stranges, & Steiner, 2011). Conditions such as postpartum complications and mental disorders of mothers contribute to a relatively large number of outpatient visits, rehospitalizations, and even deaths (CDC, 2013b; Declercq, Barger, Cabral, Evans, Kotelchuck, Simon, Weiss, & Heffner, 2007; Sit, Seltman, & Wisner, 2011). Among these adverse outcomes, hospital readmissions (i.e. rehospitalizations) have been recognized as wasteful spending by payers (Sommers & Cunningham, 2011). For example, Olsen and colleagues (2010) pointed out that the attributable total hospital cost of surgical site infection (SSI) after cesarean section (C-section) was about $3,529. Qasim and Andrews (2012) also found that the first stay after a C-section procedure is $5,400 in the low-income communities. The readmission due to the C-section procedure further costs a poor patient $6,600.

The current Patient Protection and Affordable Care Act (PPACA) stressed that reducing hospital readmissions is an important strategy to improve quality of care as well as lower cost of health services (Stone & Hoffman, 2010). Only few studies have examined rural-urban differences in hospital readmissions and none of them have addressed maternal readmissions. Several studies pointed out that treatment in a rural hospital was a key factor to predict a lower risk of hospital readmission (Philbin, Dec, Jenkins, & DiSalvo, 2001; Welch, Larson, Hart, & Rosenblatt, 1992). Weeks and colleagues (2009) controversially found that older rural veterans were more likely to have 30-day readmission rates than urban veterans. On the other hand, the Congress report suggested that rural-urban differences in readmissions did not exist (Akamigbo & Stensland, 2011). The purpose of this study was to ascertain the effects of rurality on the likelihood of maternal rehospitalizations by using the 2011 California Healthcare Cost and Utilization Project (HCUP).

This study aims to analyze the rural-urban differences in maternal readmissions to hospitals in California. Four objectives are (1) to describe the respective outcomes and individual characteristics in patients with normal delivery or caesarean section (C-section) procedure, (2) to compare the differences of individual characteristics between patients who were and who were not readmitted, (3) to estimate the cumulative readmission rates within 7 days, 14 days, and 30 days by hospital locations, and (4) to identify the factors that affected the likelihood of readmission. Given that women now leave hospitals so soon after giving birth, it is imperative to detect actual and potential problems before and following hospital discharges. Proper assessment of geographic differences in readmissions would also be important for designing cost-effective interventions to reduce readmissions.

Methods

Data source

The data of this cross-sectional study was drawn from the 2011 California HCUP. The HCUP, a national pool of all-payer hospital discharge data (Jiang & Wier, 2010), is expected to provide empirical evidence of hospital readmission problems. Nevertheless, only 15 out of 50 states have continuously collected readmissions information. Next, the State of California has the largest number of total discharges in the U.S. (American Hospital Directory (AHD), 2012). The State of California's Office of Statewide Health Planning and Development (OSHPD, 2009) has investigated other types of readmissions but not the maternal rehospitalizations and related costs yet. It also remains unknown whether maternal rehospitalizations have occurred across all delivery modes and geographic areas equally. Therefore, this study chose hospitals in California as the study sample.

When a patient is admitted to a hospital for one or more conditions, a patient medical record is created with his/her demographic data. The treatment received by this patient is recorded as well. When this patient is discharged, a bill will be generated. The aforementioned information from demographic, diagnosis, treatment, to discharge becomes the basis of the HCUP databases (Allen Communication Learning Services, 2013).

The state-level Data Organizations, hospital associations, private data organizations, and the Federal government collect discharge data from community hospitals and send the data to the Agency for Healthcare Research and Quality (AHRQ) for inclusion in the overall HCUP. As defined by the American Hospital Association (AHA), community hospitals include nonfederal, short-term, general and other specialty hospitals but exclude Veterans, Department of Defense (DOD), Native American, long-term, psychiatric, Tuberculosis, and alcohol/chemical dependency treatment hospitals (HCUP, 2012).

The HCUP is composed of three components: (1) inpatient care presented in the State Inpatient Database (SID), Nationwide Inpatient Sample (NIS), and Kids' Inpatient Database (KID), (2) outpatient care presented in the State Emergency Department Database (SEDD), State Ambulatory Surgery Database (SASD), and Nationwide Emergency Department Sample (NEDS), and (3) ancillary services presented in a limited amount of International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) codes data (HCUP, 2013). This research used the SID, SEDD, and SASD from California community hospitals that assembled both clinical and nonclinical information.

Since the ICD-9-CM covers 3,900 categories, the Clinical Classifications Software (CCS) and Medicare Severity Diagnosis Related Groups (MS-DRG) for ICD-9-CM have been widely used in the HCUP to create a smaller number of clinically meaningful categories (HCUP, 2012). As developed by the AHRQ, the CCS is the tool to identify a patient's conditions diagnosed and/or procedures performed in the hospital (Elixhauser, Steiner, & Palmer, 2013). The CCS consists of two classification systems, single-level and multi-level, which are related but designed to meet different needs. This study adopted the single-level CCS aggregating 285 mutually exclusive illnesses and 231 mutually exclusive procedures. On the other hand, the MS-DRGs were consolidated into 746 categories (Sun & Friedman, 2012). This study used both single-level CCS codes for procedure and MS-DRGs systems to identify the research sample.

The research sample for this study included women admitted to inpatient departments, emergency department, or ambulatory surgery units in 2011. Female patients without geographic information (PL_UR_CAT4) and primary procedure diagnoses (PRCCS1) were excluded. The remained sample was divided into three groups, including normal delivery (CCS Procedure: 133, 136 and 137; DRG: 767, 768, 774, and 775), assisted delivery (CCS-135), and C-section (CCS-134, DRG-765, and DRG-766). Nevertheless, the sample size of assisted delivery group with readmission records was too small (n=220) to produce convergence in the multivariate analysis. In addition, only three female patients having assisted delivery procedure were readmitted. The final sample thus dropped this assisted delivery group but kept the normal delivery group and C-section group (n=481,902).

Dependent Variables: Maternal Rehospitalizations

In response to the increasing attention to readmissions issues, the AHRQ compiled HCUP Supplemental Files to provide additional information for revisit analyses (HCUP, 2013). Since each record in the HCUP represents one discharge abstract, the term "revisit" implies two or more visits of health services for a particular patient. Any patient's first admission related to delivery and occurred between Jan and Nov will be treated as the index admission. Any patient's admission to the same or different hospital that occurred within 30 days after the index admission will be treated as the30-day readmission. If a patient was discharged dead, transferred to another facility for better care or for the patient's preference on the same day, or readmitted more than 30 days after the index admission, this admission was not considered as a 30-day readmission (Halfon, Eggli, Pretre-Rohrbach, Meylan, Marazzi, & Burnand, 2006). In short, the 30-day readmission rate is the number of readmissions occurred within 30 days of the index admission divided by the number of all index admissions.

The second outcome variable of interest is to only compare readmission rates in readmitted people. This study analyzed the 7-day, 14-day, and 30-day readmissions defined as the first readmission to the same or a different hospital occurring within 7, 14, and 30 days after the previous discharge of delivery (i.e. the index event). Instead of considering all index admissions, the denominators for these rates referred to the index admissions with 7-day, 14-day, and 30-day following admissions. The patients were excluded if they were not readmitted but only had one admission records (i.e. their index/first admission).

The third outcome variable in this study is a binary measure indicating whether this patient has been readmitted or not (=1/0) in the entire year of 2011. One of the advantages using the HCUP is that the encrypted person identifier (VISITLINK) could allow researchers to track each patient's all admission records. One patient who was discharged alive and had only one admission record was coded as zero. On the other hand, one patient who was discharged alive and had any reasons/causes of readmission record was coded as one.

Independent Variables: Individual Characteristics

Limited to the California data which did not include comprehensive information, this study used eight independent variables (HCUP, 2013). A patient's age at admission was a continuous variable. Race/ethnicity is categorized into non-Hispanic White, non-Hispanic African American, Hispanic, and others. Expected primary payer, PAY1, was coded as Medicare (i.e. both fee-for-service and managed care Medicare patients), Medicaid (i.e. both fee-for-service and managed care Medicaid patients), private insurance (e.g. Blue Cross), self-pay (i.e. uninsured), and others (e.g. worker's compensation). However, one category of this measure, no charge, had zero observation based on our inclusion criteria. The categorical variable MEDINCSTQ provides a quartile classification of the estimated median household income of patients from lowest (poorest) to highest (richest) quartile.

According the 2003 version of the Urban Influence Codes (UIC), the ZIP code of each hospital was recognized in the data and all hospitals were categorized into rural (micropolitan areas or non-core areas), small metro (metropolitan areas with fewer than 1 million resident), and large metro (metropolitan areas with at least 1 million residents) areas (United States Department of Agriculture, 2013). The variable, pl_ur_cat4, was the indicator of where patients lived, but the categories micropolitan areas and non-core areas were merged into one single category to increase the number of this group.

A condition that lasts 12 months or longer and results in the need for ongoing medical intervention could be defined as a chronic condition (HCUP, 2013). The HCUP used ICD-9-CM codes to identify patients' chronic conditions which were listed on their medical records. Examples of chronic conditions include conditions such as diabetes, most forms of mental illness, and many forms of heart disease. Non-chronic conditions include conditions such as pregnancy, many neonatal conditions, and injuries. Length of stay (LOS) is equal to the number of days between the admission date and the discharge date for each admission record (HCUP, 2013). That means same-day stays are coded as 0. Both the number of chronic conditions (CHRONIC) and length of stay (LOS) were continuous variables. The former illustrates patients' health status and the later one illustrates how long they stayed right after giving birth (i.e. the index event).

Analyses

Descriptive analysis was used to demonstrate the patient-level characteristics of patients admitted due to normal delivery or C-section in 2011. The binary analysis provided the individual differences between patients readmitted or not readmitted by two delivery modes. The accumulative readmission rates were also reported based on the hospital location to demonstrate rural-urban differences. Generalized estimating equation (GEE) models were used to estimate the likelihood of being readmitted over time. Since patients might repeatedly go to the same hospital, GEE models are especially useful by estimating the average response over the population (i.e. population-averaged effects) compared to a traditional logistic regression model. To meet the research purpose, the covariance structure was set as unstructured, the link function as logit, and family as binary. Data was imported into SAS 9.3 based on the original format provided by the HCUP distributor. Then the data was transported into Stata 12.0. All analyses were conducted using Stata 12.0 (StataCorp, 2011) and a *p*-value of less than 0.05 was considered as statistical significance.

Results

The 323,051 women who delivered with minor assistance and 158,851 women who delivered by C-section were included in this study. Of those, only 7 patients died after vaginal deliveries and 14 patients after C-section procedures. Next, 1.01% of women with normal deliveries were readmitted and the corresponding number is 1.46% of women with C-section deliveries. The majority of residents living in large-metro or small-metro areas gave birth in their local hospitals. However, 77.19% of rural women were gone to rural hospitals to deliver, 15.20% to small-metro hospitals, and 7.61% to large-metro hospitals.

Table 7 denotes the distribution of each individual characteristic in both normal delivery and C-section groups. The X^2 tests were not conducted since the large sample size easily causes the significant *p*-values throughout the analysis. In average, women with C-section procedures were slightly older, non-Hispanic Black, more from large-metro areas, more admitted to large-metro hospitals, more covered by private insurance, poorer, and had more chronic conditions and longer stays during the index admissions than women with normal delivery.

Table 7. Characteristics of Patients with Maternal Diagnoses, 2011 California HCUP

	Normal Delivery (N=323,051)	**C-section (N=158,851)**
Age, years		
Mean+SD	27.95 ± 6.20	29.81 ± 6.26
Range	9 - 57	9 - 55
Race/Ethnicity, n(%)		
Non-Hispanic White	97,189 (31.82%)	47,787 (31.34%)
Non-Hispanic Black	15,850 (5.19%)	9,655 (6.33%)
Hispanic	147,814 (48.39%)	72,530 (47.57%)
Others	44,614 (14.61%)	22,506 (14.76%)
Residence of Patient, n(%)		
Large metro	239,653 (74.18%)	120,718 (75.99%)
Small metro	77,430 (23.97%)	35,786 (22.53%)
Rural	5,968 (1.85%)	2,347 (1.48%)
Hospital Location, n(%)		
Large metro	238,440 (74.88%)	120,863 (76.90%)
Small metro	75,132 (23.59%)	34,467 (21.93%)
Rural	4,872 (1.53%)	1,847 (1.18%)
Payer, n(%)		
Medicare	838 (0.26%)	659 (0.41%)
Medicaid	156,718 (48.51%)	74,922 (47.17%)
Private Insurance	153, 178 (47.42%)	77,422 (48.74%)
Self-pay	5,989 (1.85%)	2,790 (1.76%)
Others	6,317 (1.96%)	3,052 (1.92%)
Median Household Income, n(%)		
Poorest	94, 877 (29.65%)	47,008 (29.87%)
Poor	85,792 (26.81%)	42,656 (27.11%)
Wealthy	75,894 (23.71%)	36,660 (23.30%)
Wealthiest	63,464 (19.83%)	31,040 (19.72%)
No of Chronic Conditions		
Mean+SD	0.35 ± 0.76	0.63 ± 1.07
Range	0 – 11	0 - 16
Length of First Stay		
Mean+SD	2.13 ± 1.37	3.58 ± 2.87
Range	0 - 117	0 - 119

Note: SD=Standard Deviation

Within either normal delivery or C-section delivery group, women were further divided into two subgroups: (1) discharged alive but not readmitted and (2) discharged alive and then readmitted. For women with normal delivery (Table 8), the proportion of African Americans was significantly higher in the readmitted group (14.25%) than non-readmitted group (5.10%). Likewise, higher proportions of readmitted women lived in rural areas (5.27% vs. 1.81%), went to hospitals in small metro areas (28.96% vs. 23.54%), had public insurance plans (Medicare or Medicaid: 71.74% vs. 48.55%), had lower household income (37.20% vs. 29.57%). Likewise, higher proportions of women readmitted to hospitals after the C-section delivery were non-Hispanic Black than those not readmitted (16.32% vs. 6.19%). The readmitted group significantly lived in small metro areas (25.06% vs. 22.49%), received delivery procedures in small metro hospitals (23.53% vs. 21.91%), had public insurance plans (70.31% vs. 47.26%), had lower household income (38.69% vs. 29.75%), had more chronic conditions (1.24 > 0.62) and longer length of first stay (4.53 > 3.57).

Table 8. Comparisons of Characteristics between Patients With and Without Maternal Readmission, 2011 California HCUP

	Normal Delivery			C-section		
	Not readmitted (n=319,873)	Readmitted (n=3,171)	*P*-value	Not readmitted (n=156,594)	Readmitted (n=2,243)	*P*-value
Residence of Patient, n(%)			<0.001			<0.001
Large metro	237,570 (74.27)	2,076 (65.47)		119,106 (76.06)	1,602 (71.42)	
Small metro	76,502 (23.92)	928 (29.27)		35,221 (22.49)	562 (25.06)	
Rural	5,801 (1.81)	167 (5.27)		2,267 (1.45)	79 (3.52)	
Hospital Location, n(%)			<0.001			<0.001
Large metro	236,347 (74.96)	2,086 (66.60)		119,218 (76.95)	1,634 (73.37)	
Small metro	74,225 (23.54)	907 (28.96)		33.941 (21.91)	524 (23.53)	
Rural	4,733 (1.50)	139 (4.44)		1,777 (1.15)	69 (3.10)	
Age, years			0.047			0.157
Mean±SD	27.97±6.19	25.53±6.04		29.84±6.25	27.79±6.39	
Range	9-57	9-49		9-55	9-52	
Race/Ethnicity, n(%)			<0.001			<0.001
Non-Hispanic White	96,134 (31.78)	1,052 (35.10)		47,021 (31.29)	760 (34.94)	
Non-Hispanic Black	15,423 (5.10)	427 (14.25)		9,299 (6.19)	355 (16.32)	
Hispanic	146,467 (48.42)	1,344 (44.84)		71,618 (47.65)	911 (41.89)	
Others	44,439 (14.69)	174 (5.81)		22,352 (14.87)	149 (6.85)	
Payer, n(%)			<0.001			<0.001
Medicare	796 (0.25)	41 (1.29)		605 (0.39)	54 (2.41)	
Medicaid	154,479 (48.30)	2,234 (70.45)		73,391 (46.87)	1,523 (67.90)	
Private Insurance	154,400 (47.65)	777 (24.50)		76.836 (49.07)	580 (67.90)	
Self-pay	5,948 (1.86)	41 (1.29)		2,762 (1.76)	28 (1.25)	
Others	6,239 (1.95)	78 (2.46)		2,994 (1.91)	58 (2.59)	
Median Household Income, n(%)			<0.001			<0.001
Poorest	93,718 (29.57)	1,159 (37.20)		46,144 (29.75)	859 (38.69)	
Poor	84,824 (26.77)	964 (30.94)		41,988 (27.07)	667 (30.05)	
Wealthy	75,247 (23.74)	644 (20.67)		36,202 (23.34)	454 (20.45)	
Wealthiest	63,115 (19.92)	349 (11.20)		30,797 (19.85)	240 (10.81)	
No of Chronic Conditions			<0.001			<0.001
Mean±SD	0.35±0.76	0.66±1.08		0.62±1.06	1.24±1.65	
Range	0-11	0-10		0-13	0-16	
Length of First Stay			<0.001			<0.001
Mean±SD	2.12±1.35	2.47±2.26		3.57±2.82	4.53±5.17	
Range	0-117	0-44		0-117	0-44	

Note: SD=Standard Deviation

The cumulative readmission rates in patients with C-section delivery were higher than their normal delivery counterparts except in small-metro hospitals (Table 9). For example, the 30-day readmission rate in C-section patients from a large metro hospital was 33.87% while it was 31.55% in patients with normal delivery. Regardless of delivery mode, patients giving birth in a rural hospital were more likely to be readmitted. The 7-day readmission rate of women with normal delivery in rural hospitals was 20.06% but it was only 12.20% of women in urban hospitals.

Table 9. Cumulative Readmission Rates among Patient with Readmissions, 2011 California HCUP

Hospital Location	**Large Metro**	**Small Metro**	**Rural**
Normal Delivery			
7-day, n(%)	806 (12.20%)	365 (12.52%)	67 (20.06%)
14-day, n(%)	1,321(19.99%)	570 (19.55%)	87 (26.05%)
30-day, n(%)	2,086 (31.56%)	907 (31.11%)	139 (41.62%)
C-section			
7-day, n(%)	629 (13.04%)	190 (10.75%)	34 (22.22%)
14-day, n(%)	994 (20.60%)	307 (17.37%)	47 (29.01%)
30-day, n(%)	1,634 (33.87%)	524 (29.65%)	69 (42.59%)

The GEE models for both delivery groups were employed to estimate the relationships between readmission likelihood and individual characteristics (Table 10). Since very few large-metro resident went to small-metro or rural hospitals for delivery, the variable, hospital location, was reclassified into two categories only which are large-metro and non-large-metro area. When the response changes from 0 (not readmitted) to 1 (readmitted), there is a 0.96 (=exp(-0.045)) odds decrease in age for women with normal delivery. That means younger women actually have higher chance to have postpartum readmissions. Similarly, small-metro residents, non-Hispanic Blacks, women with Medicare insurance, poor women, women with more chronic conditions and longer length of first stay were more likely to be readmitted. Among women with C-section delivery (Table 10), the hospital location does not have effects on the likelihood of getting readmitted either. The number of chronic conditions (O.R.=1.37=exp(0.317)) and length of first stay (O.R.=1.04=exp(0.038)) have statistically significant effects to increase the likelihood of maternal rehospitalizations. Likewise, living in small-metro or rural areas, younger age, being non-Hispanic Blacks, having Medicare insurance, and being the poorest households are more likely to have maternal rehospitalizations after the C-section procedures.

Table 10. GEE Estimates about Associations of Readmission Likelihood with Individual Characteristics, 2011 California HCUP

(Reference group)	**Normal Delivery** **Estimate (95% C.I.)**	**C-section** **Estimate (95% C.I.)**
Residence (Large metro)		
Small metro	.299 (.008, .590)*	.236 (-.092,.565)
Rural	-.949 (.625, 1.273)***	.764 (.380, 1.147)***
Hospital Location (Small-metro, Rural)		
Large metro	.132 (-.159, .423)	.271 (-.060, .603)
Age, years	-.045 (-.052, -.038)***	-.033 (-.041, -.025)***
Race/Ethnicity (Non-Hispanic White)		
Non-Hispanic Black	.488 (.361, .615)***	.333 (.188 .477)***
Hispanic	-.514 (-.609, -.418)***	-.584 (-.698, -.469)***
Others	-.776 (-.942, -.610)***	-.650 (-.834, -.466)***
Payer (Medicare)		
Medicaid	-.808 (-1.152, -.464)***	-.837 (-1.142, -.527)***
Private Insurance	-1.732 (-2.082, -1.382)***	-1.769 (-.2079, -1.457)***

Table 10. Continued

(Reference group)	Normal Delivery Estimate (95% C.I.)	C-section Estimate (95% C.I.)
Self-pay	-1.335 (-1.813, -.856)***	-1.231 (-1.727, -.734)***
Others	-1.075 (-1.495, -.656)***	-.954 (-1.355, -.552)***
Median Household Income (Poorest)		
Poor	.140 (.049, .230)**	.015 (-.092, .122)
Wealthy	.010 (-.097, .117)	-.075 (-.201, .051)
Wealthiest	-.112 (-.254, .030)	-.331 (-.496, -.166)***
No of Chronic Conditions	.339 (.307, .371)***	.317 (.290, .345)***
Length of First Stay	.048 (.037, .059)***	.038 (.031, .045)***

Note: *: $p<.05$; **: $p<.01$; ***: $p<.001$

Discussion

This study used the 2011 California HCUP to identify women with normal delivery and C-section delivery procedures and to compare their readmission rates associated with geographic areas of hospitals providing delivery services. The research findings suggested that childbirth is a relatively safe event that caused only 1.01% readmission rate for the normal delivery group and 1.46% for the C-section group. This signifies one of our research strengths that we chose California data, which has the largest number of discharges for analysis. Accordingly, we had a sufficient number of readmitted women for statistical analyses.

Consistent with other studies (Declercq et al. 2007; Hebert, Reed, Entman, Mitchel, Berg, & Griffin, 1999; Lydon-Rochelle, Holt, Martin, & Easterling, 2000), we found the readmission rate after the C-section procedure is slightly higher than the normal delivery group. In addition, our study found that non-Hispanic African American mothers were more likely to have a C-section (Declercq et al. 2007). Taking into account the rising trend of C-section delivery (Childbirth Connection, 2013), to monitor the quality of C-section procedures is of importance especially for non-Hispanic Black women. Policymakers may also consider efforts to target hospitals with higher readmission rates after C-section by the mean of payment policy like the readmission reduction programs of Center for Medicare and Medicaid Services (CMS, 2013).

Our study also confirmed that in spite of the delivery mode, women discharged from rural hospitals had higher readmission rates than metropolitan hospitals. After discharge, health care in the postpartum period is mainly the responsibility of mothers whereas it is unknown if mothers are capable to deal with the physical, emotional, and social changes. For example, women with chronic conditions may demand more support such as special nutrition therapy (Kitzmiller, Dang-Kilduff, & Taslimi, 2007). In addition, fewer newborns and more elders in rural areas than in urban areas make the recruitment of obstetrics and gynecology (ob/gyn) doctors and related professionals difficult (Vogel, 2012). For example, the ratio of obstetricians to residents is 35/1,000 in urban counties but only 2/1,000 in rural counties (Health Resources and Services Administration, 2012). Both prenatal and postpartum services are inadequate in rural areas (Californians Allied for Patient Protection, 2013; National Rural Health Association, 2013). Therefore, public health interventions such as strengthening the capacity of obstetric workforce, the safety of delivery procedures, and the education of self-care before and after delivery in rural areas are imperative.

This study adds new findings to the literature that women with normal delivery in small metro hospitals are significantly at risk of maternal rehospitalizations controlling other individual characteristics. However, the location of a hospital is not related to the readmission likelihood for women with C-section procedures. Corresponding to the literature regarding patients' choices of hospital (Laditka et al. 2005), our study found that 15.20% of rural populations went to hospitals in small metro areas and 7.61% to large-metro hospitals for delivery. Rural patients' traveling to small metro or large metro hospitals for delivery indicates an inadequate access to quality care in their local facilities. Furthermore, a long traveling distance may increase the likelihood of maternity complications, which may subsequently cause maternal rehospitalizations (Peck & Alexander, 2003). More studies to address rural health disparities in women are necessary in the future.

There are several limitations in this secondary data analysis. First, the data drawn from medical charts might be biased due to recording or transcription errors. For instance, we found that some patients' procedure CCS was coded as C-section while their diagnose CCS coded as normal delivery. Researchers are not able to access the original data to get accurate measurements, thus this study only adopted the procedure CCS codes to divide the sample into normal delivery and C-section groups. Second, this data only contains community hospital discharges in California in 2011. Critical access hospitals (CAH), which serve in rural areas, are not required to report the discharge data to the HCUP. Generalization of research results may be problematic. Nevertheless, our findings can demonstrate the real performance of hospitals in one state. This study may provide implications for all 50 states regarding how to address geographic differences in maternal rehospitalizations as well as to improve data collection in the future. Third, this study took into account all-cause, all-area, and all-payer readmissions. For instance, we did not distinguish the diagnoses of readmissions. Studies to identify the actual diagnoses of readmissions and prevent potentially avoidable readmissions are recommended in the future. Finally, the multivariate analyses of this study have been adjusted for personal characteristics. Nevertheless, characteristics of healthcare providers such as hospital bed size, hospital ownership, and the experience of OB/GYNs are not collected into this data. Future research should include more hospital characteristics into discussion.

CHAPTER V

CONCLUSION

Rural health disparities have been existed for decades (Crosby et al. 2012). To better understand rural-urban differences in the triad of health services, this dissertation used two large data sets, MEPS and HCUP, to ensure a large enough sample size of rural residents. Based on our findings, the first study corresponds to the phenomenon that chronic diseases, functional disabilities, and medication problems disproportionately affect older adults. Furthermore, the aging population in the US has been growing dramatically and the demand for quality geriatric care is expected to increase significantly. Effective strategies to address the anticipated increased demand for geriatric care such may likely include an expansion of education and training on geriatric care across a much broader range of health professional disciplines, physicians and non-physicians, and greater geographical ranges of access to these disciplines (i.e. rural settings). The health professionals with skills and understanding as a USC are foundational pieces of the national health care infrastructure that provide quality health care to aging population. Tele-health, transportation services, and mobile medical vans have been developed to help address the limited services in rural areas with generally positive results−but many other interventions are needed to produce effective change. (Hawkins, 2007; Rural Assistance Center, 2013; Probst, Samuels, Moore, & Gdovin, 2002).

The second study sought to address whether and to what extent rural-urban differences are associated with healthcare expenditures. The study hypothesized that expenditures for rural populations were substantially more than their urban counterparts due to their worse health conditions. Nevertheless, the results suggest that total expenditures were similar in both rural and urban adults. The expenditures of rural adults were even smaller in terms of hospital inpatient care and emergency room services. Even though there were fewer nonzero users in urban areas, the higher cost of keeping healthy could be the driver of their high expenditures. The healthcare expenditures in the United States have been rising in the past three decades and are expected to grow even faster presently (Executive Office of the President of the United States, 2009). Additionally, access to care and quality of care are yet other hurdles to overcome. Therefore, it is critical that health services researchers and policymakers monitor the expenditures of healthcare in both rural and urban areas. In particular, future policies should focus on improving the quality of prescription drugs and decreasing charges in rural areas.

As to the third study, postpartum women are a vulnerable group of the population that has received insufficient attention in the past. However, their attempt to have a normal delivery or C-section could be identified in the prenatal period. Improving the quality of C-section procedures might be an approach to decrease maternal rehospitalizations. Furthermore, it is critical to address the health needs and resources of vulnerable populations such as those living in rural settings, mothers, and children, etc. Public health strategies should not be standardized across all regions without recognizing these geographic differences and disparities. In light of the importance of women's health (U.S. Department of Health and Human Services, Health Resources and Services Administration, & Maternal and Child Health Bureau, 2011), more studies are necessary to better quantify the relationships between the quality of hospital care and geographic differences as they relate to the reduction of inappropriate healthcare costs.

Overall, the author employed the triad framework to describe the importance of rural-urban comparative research in the public health field. Regardless of the significant limitations of using the MEPS and HCUP, the research findings suggest that strategies to increase financial incentives to provide affordable, efficient, and effective care for both rural and urban populations should be developed. Next, interventions to extend geriatric training and competence to a broader group of local healthcare providers, physicians and non-physicians, as well as improved coordination and collaboration among providers should be implemented, especially in rural areas. Finally, it is recommended to generate more information about geographic differences in healthcare practice patterns, spending, health behaviors, and quality of care.

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