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Medicare Rural Payment Issues: Primary Care Services and Geographic Definitions

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PREFACE

The Centers for Medicare and Medicaid Services (CMS) contracted with RAND to perform an analysis of Medicare special payment policies for rural providers. During the first year of the project, we analyzed historical trends in payments under several such policies, including bonus payments to physicians in rural health professional shortage areas (HPSAs), reimbursements to Rural Health Clinics (RHCs) and Federally Qualified Health Centers (FQHCs), special Medicare payments for rural hospitals, and capitation payments in rural counties. The results of these analyses are presented in a separate report (Farley et al., 2002).

This report presents the preliminary findings from the second year analyses examining three specific issues for Medicare rural payment policy that emerged from the trends analyses and discussions with CMS staff. These are: (1) examination of the relationships between use of primary care services (both physician and RHC/FQHC services) and the likelihood of avoidable hospitalizations; (2) examination of the extent to which RHC/FQHC services are substitutes or complements for primary care physician services; and (3) comparisons of the classification of beneficiaries and use rates for physician services under two different methods to characterize "extent of rurality" for non-metropolitan areas.

The research results presented here will be of interest to policy makers, researchers, and other parties involved with rural health policy or Medicare payment policy. The research was performed under Task 11 of Centers for Medicare and Medicaid Services Contract Number HCFA-500-96-0056, Project Officer William Buczko.

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SUMMARY

The Centers for Medicare and Medicaid Services (CMS) contracted with RAND to perform an analysis of Medicare special payment policies for rural providers. During the first year of the project, we analyzed historical trends in payments under several such policies, the results of which have been published (Farley et al., 2002). Several specific issues for Medicare rural payment policy emerged from the trends analyses and discussions with CMS staff. This report presents the findings of analyses performed in the second project year that examined three of these issues, related to access to primary care services for rural Medicare beneficiaries:

1. The extent to which Rural Health Clinic/Federally Qualified Health Center (RHC/FQHC) services are substitutes or complements for fee-for-service primary care physician services in rural counties,
2. Relationships between use of primary care services (both physician and RHC/FQHC services) and the likelihood of avoidable hospitalization, and
3. Differences in the classification of beneficiaries and use rates for physician services under two geographic classification methods to characterize "extent of rurality" for non-metropolitan areas.

BACKGROUND

Access to primary care services in rural areas is compromised by a variety of factors. Most notably, rural communities face difficulties recruiting and retaining physicians, due to a number of factors that make physicians reluctant to locate in rural areas (PPRC, 1991). Rural physician supply has increased over the last two decades but growth has been slower in rural areas than in urban areas. With the exception of family practice physicians, the supply of physicians in metropolitan counties is between two and three times the supply of physicians in non-metropolitan counties (Rosenblatt & Hart, 1999). Furthermore, recent analyses suggest that the "effective" supply of rural physicians has not grown significantly and that the supply of family practice physicians, the most numerous primary care specialty in rural areas, has actually decreased by 9 percent over the last ten years (Ricketts et al., 2000).

In rural areas, Medicare and Medicaid cost-based payment for RHCs and FQHCs provides additional financial support intended to protect the financial stability of rural physicians and other health care providers (and therefore their availability). Rural Health Clinics (RHCs) were established by the Rural Health Clinics Act (P.L. 95-210) in 1977 and Federally Qualified Health Centers (FQHC) were created by the Omnibus Budget Reconciliation Act (OBRA) of 1989. RHCs and FQHCs are treated similarly in the Medicare program, despite their differing origins. See Farley et al. (2002) for additional detail about the basic provisions for designation as an RHC or FQHC.

DEFINITIONS OF RURALITY

The concept of rural is multidimensional, and populations living in different parts of the United States (e.g. Alaska, Arizona, or Alabama) have very different ideas about what constitutes rural. The Census Bureau classifies as "urban" all territory, population, and housing units located within an urbanized area (UA) or an urban cluster (UC), and it defines UA and UC boundaries to encompass densely settled territory. Its classification of "rural" consists of all territory, population, and housing units located outside of UAs and UCs. The definition of rural being applied for public policy and research purposes needs to be spelled out clearly and justified (WWAMI, 2002).

For our trend analyses of Medicare special payments for rural areas, we defined rural locations at the county level, and all counties outside of a Metropolitan Statistical Area (MSA), as defined by the Office of Management and Budget, were considered to be rural (Farley et al., 2002). This definition is consistent with the county-based geographic boundaries used in many of the Medicare payment schedules for provider services. County categories were established to define differing degrees of rurality, using values of the Urban Influence Codes (UICs) developed by the Economic Research Service (ERS) of the U.S. Department of Agriculture (USDA) (Ghelfi and Parker, 1995). Codes 1 and 2 define large and small counties in the MSAs, and codes 3 through 9 define categories of counties outside the MSAs (non-metropolitan counties). The UICs classify non-metropolitan counties on two dimensions: (1) the size of the largest town in the county and (2) adjacency to a metropolitan county. (See Appendix A for additional details on coding systems.)

The UICs have been the county-based measure of rurality preferred by rural health experts. However, there is consensus among these experts that the UICs are imperfect in capturing variations in characteristics among rural counties because they are based on county boundaries (Ricketts et al., 1998). Many rural counties have large land areas, and within a given rural county, there may be large local variations in population density, demographics, and health care provider supply that become lost in the larger county aggregates.[1]

A new classification system, called the Rural-Urban Commuting Area (RUCA) codes, was under development at the time we began our research on Medicare rural payment trends (WWAMI, 2002). The RUCA codes are expected to yield classifications that capture differences in extent of rurality more precisely than the existing systems do (see Appendix A). The RUCA codes consist of 30 codes based on a combination of urban location designations and commuting patterns of local populations. In addition, the WWAMI (Washington, Wyoming, Alaska, Montana, & Idaho) Rural Health Research Center created a crosswalk between census tracts and zip codes to assign RUCA codes to zip codes, which is the geographic unit often preferred.

RESEARCH FINDINGS

In the analyses presented in this report, we examined the patterns of use of primary care providers and explored the relationship between total use of primary care services and one type of access to care measure—rates of avoidable hospitalizations for ambulatory care sensitive conditions (ACSC). The definition of rural primary care providers used in the analyses includes not only fee-for-service physicians but also RHCs and FQHCs. In addition, we examined the choice of method for grouping rural areas, with the goal of achieving relatively homogeneous geographic categories by degree of rurality to strengthen analyses of rural health issues and policy.

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[1] Therefore, we refer to these counties as "non-metropolitan" counties rather than "rural."

Relationship between Fee-for-Service Physician and RHC/FQHC Services

As discussed above, the establishment of special payment provisions for RHCs or FQHCs was intended to maintain or improve access to health care practitioners for Medicare and Medicaid beneficiaries residing in underserved areas of the country. A GAO report concluded that many RHCs were established through the conversion of existing physician practices that would have continued to operate in the absence of the special RHC reimbursement provisions (US GAO, 1996). This statement suggests that services provided to Medicare beneficiaries by an RHC physician or NPP are a substitute for rather than a complement to services provided by Medicare fee-for-service physicians in the same areas (i.e., not established as RHCs). Given that all but a few FQHCs were established out of community/migrant health centers, it is more likely that they serve as a complement to fee-for-service physicians. The analyses were designed to test the following hypotheses:

- RHC services are substitutes for primary care physician services for fee-for-service Medicare beneficiaries residing in non-metropolitan counties.
- FQHC services are complements for primary care physician services for this population.

We tested these hypotheses using two distinct analytic methods. The county was the unit of analysis for both methods, and the samples were all non-metropolitan counties located in either a health professional shortage area (HPSA) or medically underserved area (MUA). Visits for primary care physicians (fee-for-service), RHCs, and FQHCs were aggregated to the county level based on the county of beneficiary residence. In the first method, we performed separate analyses for RHCs and FQHCs, testing the difference in mean visit rates per 100 beneficiaries between a group of counties with no clinics (the control group) and a group of counties with more than one RHC (or more than one FQHC). In the second method, we estimated regression models of the relationship between county-level RHC visit rates and primary care physician visit rates to test for a substitution effect and estimate the elasticity for this effect. The same modeling analysis was performed for FQHC visit rates.

Based on both our difference-of-means and regression analyses, when RHCs are available to Medicare beneficiaries residing in non-metropolitan counties, the RHCs appear to be a substitute for primary care physician services. This relationship is strong overall, but the strength differs across the UIC-based county categories, and there is less than a one-to-one substitution in the number of visits between these two types of primary care services for all but one category. Thus, it is possible that the RHC program has helped preserve access to care for non-metropolitan Medicare beneficiaries by providing incentives for maintaining provider supply.

Neither the difference-of-means or logistic regression analyses offered any evidence that FQHCs are a substitute for primary care physician services. Rather, the results suggest that FQHCs tend to be located in counties with lower utilization rates and are complementary to physician services. Thus, FQHCs may be improving access to care by increasing the total supply of primary care providers in those counties.

Primary Care Service Use and Avoidable Hospitalizations

While Medicare special payment programs may have improved overall access to primary care services for beneficiaries in rural areas, there are still concerns that these programs do not go far enough to narrow disparities in access to those services across geographic regions.

Among the many possible consequences of poor access to primary care services is an increased likelihood of avoidable hospitalizations. Studies have shown that the elderly and disabled are considerably more at risk of an avoidable hospitalization than younger and non-disabled individuals (Kozak et al., 2001). We used two models of avoidable hospitalizations for ambulatory care sensitive conditions in this research, one developed by the Institute of Medicine (IOM) (1993) and the other developed by McCall et al. (2001). (Further description of avoidable hospitalizations defined by these two models is given in Section 2 and Appendix B.) The analyses test the following hypotheses:

- Greater use of primary care services by non-metropolitan Medicare beneficiaries will reduce the likelihood of avoidable hospitalizations for *acute conditions* sensitive to ambulatory care.
- Greater use of primary care services by non-metropolitan Medicare beneficiaries will reduce the likelihood of avoidable hospitalizations for *chronic conditions* sensitive to ambulatory care.

We tested these hypotheses by estimating logistic regression models for which the dependent variable was a dichotomous variable for having at least one hospitalization and the key predictor variables were a set of indicator variables representing different levels of primary care visits. The unit of analysis was the beneficiary, and the study sample was all beneficiaries residing in non-metropolitan counties in 1996. Primary care visits were defined as the sum of all visits to primary care physicians, RHCs, or FQHCs by a beneficiary during the year.

Among Medicare beneficiaries residing in non-metropolitan counties, we found strong and significant relationships between primary care utilization and the likelihood of having at least one avoidable hospitalizations, as well as evidence of threshold effects. However, the direction of effect differed for the acute and chronic conditions. Three or more primary care visits *reduced* the likelihood of having an avoidable hospitalization for acute conditions while three or more visits *increased* the likelihood of having an avoidable hospitalization for chronic conditions. These patterns exist for both the IOM and McCall definitions of avoidable hospitalizations, but the magnitude of effects in each set of models varied.

Our findings suggest that avoidable hospitalizations for acute conditions would be a useful indicator for monitoring changes in access to primary care. However, according to our results, increased numbers of visits for Medicare rural beneficiaries beyond 3 or 4 visits may not have additional benefit of further reduction in hospitalizations for acute conditions. This implies that initiatives for increasing primary care activity should focus on beneficiaries who are not getting any primary care rather than on increasing visit rates overall, even for those who are actively seeking care. On the other hand, avoidable hospitalizations for chronic conditions do not appear to be a signal for problems with access to primary care services. Rather, greater use of primary care may represent active disease management services for patients with higher severity of illness, who also are more likely to require hospital care than healthier individuals.

Our findings of relatively low rates of avoidable hospitalizations for acute conditions for rural Medicare beneficiaries raise a policy issue. How high a priority should be placed on using such a measure for monitoring access to care, given the relatively infrequent events and the threshold effect for primary care use rates? To the extent that a measure of avoidable hospitalizations for acute conditions also is a proxy for other health effects of poor access to primary care, then it should be a meaningful monitoring tool. In addition, monitoring changes in this measure over time could help flag locations where primary care use rates by Medicare beneficiaries may be declining below the threshold. Further consideration of this issue is advisable, including assessment of the resource investment required for monitoring.

Comparison of Definitions of Rurality

The new RUCA codes offer an alternative to the county-level geographic codes that potentially can stratify rural areas more precisely for policy making and research purposes. Assigning the 30 RUCA codes at the level of census tracts establishes highly localized units of analysis. The use of commuting flows as a dimension of the RUCA codes is intuitively appealing for health policy research because people may travel for health care services in ways similar to how they commute for work. Although MSA designations also are based on commuting flow data, the RUCA codes reflect flows for more geographically localized areas. Further, the crosswalk that assigned RUCA codes to zip codes makes the coding system more useful for research purposes.

Policymakers and researchers will require information on how the RUCA codes compare to the UICs in categorizing populations and health service use patterns by degree of rurality. In particular, CMS will need to make policy decisions regarding whether and how to use the RUCA codes as the basis for payment systems or for research addressing future Medicare and Medicaid policy. The first step in adopting such a new classification system is to examine how it changes the distribution of populations and service use patterns from those of the previously used systems. Our comparative analysis was designed to answer the following research questions:

- How do the RUCA codes and UIC codes differ in the way they classify the population of Medicare beneficiaries based on the extent of urban or rural nature of their locations?
- How do the RUCA codes and UIC codes differ in the way they estimate use rates for primary care and specialty care physician services based on the extent of urban or rural nature of the locations of Medicare beneficiaries?

The results of our comparative analysis of the RUCA codes and UICs highlight the features of the RUCA codes. We found the two sets of codes to be quite consistent in how they classified beneficiaries residing in metropolitan areas or in the most remote rural areas, because counties in these areas are fairly homogeneous with respect to composition of urbanized or rural areas. For other counties, several different RUCA codes were assigned to zip codes within the counties, resulting in distributions of beneficiaries by RUCA code within each UIC category that reflect the diverse mixes of urban and rural locations within these counties. The net effect of the differences between the two coding systems was that the RUCA codes classified 11 percent more beneficiaries as rural residents than did the UIC-based codes. Thus, analyses that use geographic coding could yield different results depending on whether they used the RUCA codes or UICs.

Some evidence for monotonicity across RUCA categories was found in the analysis of specialty care service use rates. The very different patterns of use rates for primary care and specialty care services reminds us that each measure must be considered on its own merits. Where measures vary geographically, choice of geographic coding systems become important to ensure that variations are captured as precisely as possible.

Further testing of the RUCA codes is advised, to assess how they perform in a variety of applications for research, payment system design, and other policy considerations. Rural health experts have challenged some study results as reflecting the insensitivity of the county-based classifications to local area characteristics, and they expect that such patterns should be identifiable using geographic codes that more precisely captured local differences in rural and urban characteristics. Our research—both the Medicare payment trend analyses (Farley et al., 2002) and the work presented in this report—consistently found that geographic patterns of service use or per capita costs could not be explained well by the degree of rurality as defined by the UICs. The RUCA codes offer potential to achieve such improvements.

ACKNOWLEDGEMENTS

This report contains three distinct analyses that address issues and research questions that emerged from the trend analysis of Medicare special payments for rural providers. Both the scope of the analyses and the measurement methods were aided by previous work and consultation support by several individuals as our work progressed. We wish to thank Nancy McCall for providing additional details on the specification of the avoidable hospitalization measures used in their Medicare study, to ensure that we applied them correctly. We also acknowledge with appreciation the information provided by Gary Hart on the design of the RUCA codes and method for establishing the four categories of metropolitan and rural locations, which we used in our analyses.

The CMS project officer, William Buczko, provided valuable assistance and guidance that supported our research activities. We thank him for his active involvement throughout the project. His analytic perspective and Medicare expertise enriched the research methods and helped to inform our analyses and presentation of research results.

ACRONYMS

ACSC	Ambulatory Care Sensitive Conditions
ARF	Area Resource File
BBA	Balanced Budget Act (1997)
C/MHC	Community/Migrant Health Center
CMS	Centers for Medicare and Medicaid Services
EACH	Essential Access Community Hospital
ERS	Economic Research Service
FQHC	Federally Qualified Health Center
GAO	Government Accounting Office
HCFA	Health Care Financing Administration (now the CMS)
HCPCS	HCFA's Common Procedure Coding System
HMO	Health Maintenance Organization
HPSA	Health Professional Shortage Area
HRSA	Health Resources and Services Administration
IOM	Institute of Medicine
MEDPAR	Medicare Provider Analysis and Review
MSA	Metropolitan Statistical Area
MUA	Medically Underserved Area
MUA/P	Medically Underserved Area/Population
NHSC	National Health Service Corps
NP	Nurse Practitioner
NPP	Non-Physician Providers
OBRA	Omnibus Budget Reconciliation Act
OMB	Office of Management and Budget
PA	Physician Assistant
POS	Provider of Service
RHC	Rural Health Clinic
RPCH	Rural Primary Care Hospital
RRC	Rural Referral Center
RUCA	Rural-Urban Commuting Area
RUCC	Rural-Urban Continuum Code
SCH	Sole Community Hospital
SSA	Social Security Administration
UA	Urbanized Area
UC	Urban Cluster
UIC	Urban Influence Code
USDA	U.S. Department of Agriculture
US GAO	U.S. Government Accounting Office
WWAMI	Washington, Wyoming, Alaska, Montana, & Idaho

1. INTRODUCTION

The Centers for Medicare and Medicaid Services (CMS) contracted with RAND to perform an analysis of Medicare special payment policies for rural providers. During the first year of the project, we analyzed historical trends in payments under several such policies. The special payment provisions examined included: (1) bonus payments to physicians in rural health professional shortage areas (HPSAs); (2) reimbursements to rural health clinics (RHCs) and federally qualified health centers (FQHC); (3) special payments for sole community hospitals (SCHs), Medicare-dependent hospitals (MDHs), rural referral centers (RRCs), essential access community hospital/rural primary care hospital (EACH/RPCH) networks, and medical assistance facilities (MAFs); and (4) capitation payments in rural counties, especially in underserved areas (Farley et al., 2002).

This report presents the findings from the second year of analyses that examined three specific issues for Medicare rural payment policy that emerged from the trends analyses and discussions with CMS staff. These analyses consider several issues related to access to primary care services for rural Medicare beneficiaries:

1. The extent to which RHC/FQHC services are a substitute or complement for fee-for-service primary care physician services in rural counties,
2. Relationships between use of primary care services (services by both fee-for-service physicians and RHC/FQHCs) and the likelihood of an avoidable hospitalization,
3. Differences in the classification of beneficiaries and use rates for physician services under two geographic classification methods to characterize "extent of rurality" for non-metropolitan areas.

Section 1 of the report presents background on rural provider supply issues and the policy initiatives implemented to address those issues. In Section 2, we describe the methods and data used for the analyses. Research results for the substitution effect of RHC/FQHC services for primary care physician services are presented in Section 3. Results of the analysis of the relationship between use of primary care services by non-metropolitan Medicare beneficiaries and avoidable hospitalizations are presented in Section 4. Section 5 presents results of the effects of different definitions of rurality on distributions of beneficiaries and use rates of primary care physician services.

BACKGROUND

Access to primary care services is an essential part of any health care system. Primary care physicians are most commonly the first contact for individuals with the health care system and can be an important influence on subsequent access to needed services. Both federal and state government health reform proposals have included plans for strengthening primary care, thus bringing greater attention to its importance (IOM, 1996).

Access to primary care services in rural areas is compromised by a variety of factors. Most notably, rural communities face difficulties recruiting and retaining physicians, due to a number of factors that make physicians reluctant to locate in rural areas (PPRC, 1991). Rural physician supply has increased over the last two decades but growth has been slower in rural areas than in urban areas. With the exception of family practice physicians, the supply of physicians in metropolitan counties is between two and three times the supply of physicians in non-metropolitan counties (Rosenblatt & Hart, 1999). Furthermore, recent analyses suggest that the "effective" supply of rural physicians has not grown significantly and that the supply of family practice physicians, the most numerous primary care specialty in rural areas, has actually decreased by 9 percent over the last ten years (Ricketts et al., 2000).

Efforts to improve access to primary care services in rural areas include bonus payments to physicians in underserved areas, the National Health Service Corps (NHSC), establishment of community and migrant health centers (C/MHCs), Medicare designation and payment of RHCs and FQHCs, and changes to Medicare policy that have made certain non-physician practitioners (NPPs) eligible for direct reimbursement.

Physician Incentives

Congress included language in the Omnibus Budget Reconciliation Act of 1987 (OBRA-87) to establish a five percent bonus payment to physicians practicing in rural HPSAs. In 1991, the bonus payment program was expanded to urban HPSAs and the bonus increased to ten percent of what Medicare pays physicians. Until the mid-1990s, expenditures for the bonus payment program grew, but between 1996 and 1998, expenditures declined by approximately 15 percent. Most bonus payments were made for non-primary care services but the share of dollars to primary care services did increase throughout the decade. Overall, the bonus payment program is a very small part of Medicare expenditures, comprising less than one percent of Medicare outlays for physicians' services (Farley et al., 2002).

The NHSC is a federal program intended to increase the presence of physicians serving rural and inner-city populations. Established in 1970 and operated by the Health Resources and Services Administration (HRSA), the NHSC has two programs: (a) scholarships for medical students in exchange for their services after graduation in a HPSA for the same number of years for which tuition support was provided and (b) a loan repayment program for new physicians (post-residency) who are practicing in an HPSA. As a result of reports forecasting an oversupply of physicians, the NHSC was cut back considerably in 1981. The predicted oversupply never translated into an increased supply of physicians in underserved areas. Congress subsequently enacted the NHSC Revitalization Amendment Act in 1990 (PL 101-597), which revised and extended the NHSC and resulted in increases in appropriations to the program.

While efforts have been made to expand the NHSC, it still meets only 12 percent of the need for primary health care providers in underserved areas (Politzer et al., 2000). However, analysis of AMA Masterfile data about NHSC scholarship recipients suggests that the program has helped to strengthen a health care provider infrastructure in rural areas. This study found that 20 percent of physicians remained in the rural area they were originally assigned to under NHSC and an additional 20 percent were in some other rural area (Cullen et al., 1997).

Non-Physician Practitioners

NPPs have become an important part of the health care infrastructure in rural areas. Serving as physician extenders and as independent practitioners, they have helped to increase the supply of primary care providers in many of the most underserved regions of the country (PPRC, 1994b). NPPs include physicians' assistants (PA), nurse practitioners (NP), certified nurse midwives, certified clinical nurse specialists, and certified nurse anesthetists. The NPPs' role in rural areas is increasingly important because their training in many cases emphasizes primary care services. According to a PPRC report, a larger percentage of these practitioners serve in rural areas than the percentage of physicians (PPRC, 1994b). In fact, the PA and NP professions evolved out of the need for medical professionals in areas of the country suffering from health care shortages (Baer & Smith, 1999), with growing numbers of states licensing them to perform expanded clinical functions.

Effective in 1991, federal legislation authorized Medicare reimbursement directly to non-physician practitioners in independent practice, thus expanding the role for NPPs in supplementing physician services in underserved areas.[2] They were paid at 75 percent of the Physician Fee Schedule amount through 1998, and payments were increased to 85 percent by the BBA. Physicians may bill for NPP services when the NPP works directly under the physician's supervision and the physician is actively involved in the course of treatment. NPPs are not currently eligible for bonus payments for independently billed services, although policy makers have considered this option (PPRC, 1994b).

Rural Health Clinics and Federally Qualified Health Centers

Two Medicare special payment programs for designated types of clinics were established to support providers in designated underserved areas by offering cost-based Medicare and Medicaid reimbursement (HRSA Office of Rural Health Policy, 1995). RHCs were established by the Rural Health Clinics Act (P.L. 95-210) in 1977 and FQHCs were created by the Omnibus Budget Reconciliation Act of 1989 (OBRA-89). In rural areas, Medicare cost-based payment for RHCs and FQHCs provides additional financial support intended to protect the financial stability of rural health care providers (and, therefore, their availability). RHCs and FQHCs are treated similarly in the Medicare program, despite their differing origins. See Farley et al. (2002) for additional detail about the basic provisions for designation as an RHC or FQHC.

The legislation that created RHCs had the dual objectives of protecting access to care and encouraging the use of NPPs by allowing reimbursement for NPP services when a physician was not present (HRSA Office of Rural Health Policy, 1995). Existing primary care practices and clinics staffed by nurse practitioners and physicians' assistants had not been eligible for Medicare reimbursement without immediate supervision of a physician, thus posing an additional financial barrier to practices in rural locations (GAO, 1996).

The FQHC program was created by OBRA-89 to establish cost-based reimbursement for services provided to Medicaid beneficiaries by federally funded C/MHCs, and OBRA-90 extended the provision to also cover services for Medicare beneficiaries. Under a grant program administered by the HRSA Bureau of Primary Health Care in its Consolidated Health Centers Program, C/MHCs were established to increase financial and geographical access to medical care for low-income underserved communities in both urban and rural areas. Rural C/MHCs often are staffed with providers serving through the NHSC (Earle-Richardson & Earle-Richardson, 1998; Bureau of Primary Health Care, 2001). FQHC status offered C/MHCs

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[2] Before this time, PAs and NPs could not bill Medicare directly for their services, although physicians and clinics were paid for their services. With the passage of the Balanced Budget Act of 1997 (BBA), PAs and NPs in urban areas can also now bill Medicare directly for services.

additional revenue beyond their annual federal grants to help support their financial solvency. A small number of other clinics that meet the C/MHC requirements but do not receive Federal funding also can qualify for FQHC designation. Early in the FQHC program, the FQHCs were required to provide a broader scope of services than those required for RHCs, but the service requirements have become more similar over time as the preventive services covered by Medicare increased.

A Mathematica study published in 1997 evaluated the effects of the recent growth in Rural Health Clinics on access to care and on costs for the Medicare and Medicaid programs (Cheh and Thompson, 1997). The study examined 18 RHCs in six states that were designated in 1992–1993, including both independent and provider-based clinics. They found evidence of improved access to care, including increases in health professionals in the community, increased levels of service per capita, and reduced utilization of emergency room services. Increases in Medicaid payments were primarily due to improved access to care while Medicare cost increases were due to use of cost reimbursement, rather than increased service volume. Medicare costs per encounter were higher for hospital-based clinics than for the independent clinics.

CHARACTERIZING GEOGRAPHIC AREAS

Categorizing Areas by Degree of Rurality

The concept of rural is multidimensional, and populations living in different parts of the United States (e.g. Alaska, Arizona, or Alabama) have very different ideas about what constitutes rural. The Census Bureau classifies as "urban" all territory, population, and housing units located within an urbanized area (UA) or an urban cluster (UC), and it defines UA and UC boundaries to encompass densely settled territory. Its classification of "rural" consists of all territory, population, and housing units located outside of UAs and UCs. The definition of rural being applied for public policy and research purposes needs to be spelled out clearly and justified (WWAMI, 2002).

For our trend analyses of Medicare special payments for rural areas, we defined rural locations at the county level on the basis of whether a county is part of a Metropolitan Statistical Areas (MSA), as defined by the Office of Management and Budget (OMB). All counties outside an MSA were considered to be rural. This definition is consistent with the county-based geographic boundaries used in many of the Medicare payment schedules for provider services. County categories were established using values of the Urban Influence Codes (UICs) developed by the Economic Research Service (ERS) of the U.S. Department of Agriculture (USDA), which classify counties using values from 1 through 9 (Ghelfi and Parker, 1995). Codes 1 and 2 define large and small counties in the MSAs, and codes 3 through 9 define categories of counties outside the MSAs (non-metropolitan counties). The UICs classify non-metropolitan counties on two dimensions: (1) the size of the largest town in the county and (2) adjacency to a metropolitan county. Thus, the UICs do not yield a monotonic scale of rurality, but are considered as a matrix with each dimension serving as an axis. (See Appendix A for additional discussion of geographic coding systems.)

The UICs are the county-based measure of rurality preferred by rural health experts. Given the need for a “critical mass” of urban population to establish a local health care infrastructure, the UICs represent this capability because they are based on the presence of a city of at least 50,000 population, a city of 10,000 to 49,999, or a town of at least 2,500. However, there is consensus among these experts that the UICs are imperfect in capturing variations in characteristics among rural counties because they are based on county boundaries (Ricketts et al., 1998). Many rural counties have large land areas, and within a given rural county, there may be large variations in population density, demographics, and health care provider supply that become lost in the larger county aggregates.[3] Also, many large metropolitan counties (mostly in the West) are "split" between urban and rural territory. In addition, local health service areas are not necessarily contiguous with county lines.

A new classification system, called the Rural-Urban Commuting Area (RUCA) codes, was under development at the time we began our research on Medicare rural payment trends. The RUCA codes are expected to yield classifications that capture differences in extent of rurality more precisely than the existing systems do (see Appendix A). As stated by the WWAMI (Washington, Wyoming, Alaska, Montana, & Idaho) Rural Health Research Center, "The RUCAs are designed to define rural and urban based on the Census Bureau's carefully constructed definitions of Urbanized Areas and Urban Places, which are based on complex criteria including population density, and population work commuting patterns. Thus, the RUCA taxonomy is a tool based on the sizes of cities and towns and their functional relationships as measured by work commuting flows. Within this framework, they have been devised to be applied for many different purposes" (WWAMI, 2002).

The RUCA codes consist of 30 codes based on a combination of urban-rural designations and commuting patterns of local populations. The large number of codes allows flexibility for policy makers, demographers, health care researchers, and others to aggregate the codes for application to their specific needs. Assigning the codes at the level of Census tracts allows the codes to be geographically more specific than the larger county-based definitions, which avoid the problems associated with the heterogeneity of these large units with respect to localized urban and rural areas and populations within them. In addition, the WWAMI Rural Research Center created a crosswalk between census tracts and zip codes to assign RUCA codes to zip codes, which is the geographic unit often preferred by potential users.

Health Care Shortage Areas

Eligibility for many of the rural programs and payments addressed in this report requires that service providers operate in underserved areas, which are so designated by Congressional provisions for Medically Underserved Areas/Populations (MUA/P) and Health Professional Shortage Areas (HPSAs). These areas are designated by the HRSA through its regulatory process. HRSA first designated MUA/Ps in 1973 and has added new MUA/P designations periodically through the 1990s. HPSAs were first designated in 1978 (HRSA, 1998; Goldsmith and Ricketts, 1999). HRSA reviews HPSA designations every three years, adding or deleting area designations as appropriate. In 1997, roughly 64 percent of counties outside of MSAs contained at least one region officially designated as a HPSA and roughly 10 percent of non-MSA counties had no active primary care physician (NC-RHRPAC, 1998).

A major difference between MUAs and HPSAs is that a shortage of health care providers is the primary measure for designating a HPSA, whereas MUAs are identified using other factors

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[3] Therefore, we refer to these counties as "non-metropolitan" counties rather than "rural."

as well (US GAO, 1995). To be designated a primary care HPSA, the geographic area must be rational for delivery of health services; must have a ratio of population to primary care physicians of at least 3,500 to 1 (or 3,000 to 1 under certain circumstances); and must be adjacent to areas with provider resources that are overused, more than 30 minutes travel time away, or otherwise inaccessible. To qualify for MUA designation, an area must meet four factors of health service need: primary care physician-to-population ratio, infant mortality rate, percentage of population with incomes below poverty level, and percentage of population aged 65 or older.

In response to requirements of the Health Centers Consolidation Act of 1996, HRSA is revising the criteria and procedures for designating MUA/Ps and HPSAs. Earlier proposed changes provided for the HPSAs to be a subset of the MUA/Ps and use of a consistent set of criteria to determine the two designations (HRSA, 1998). In response to extensive comments received on these proposed rules, HRSA is making substantial changes to the methodology, with plans to publish a revised proposed rule in the near future.

ISSUES ADDRESSED IN THIS REPORT

Three issues that emerged from RAND's analyses of trends in Medicare payments for rural providers are addressed in this report. These issues relate to access to care for rural beneficiaries and implications for their health status. In the special analyses presented in this report, we examined the patterns of use of primary care providers and explored the relationship between total use of primary care services and one type of access to care measure—rates of avoidable hospitalizations for ambulatory care sensitive conditions (ACSC). The definition of rural primary care providers used in the analyses includes not only physicians paid fee-for-service by Medicare but also RHC and FQHC services paid on a cost basis. In addition, a related topic examined was the choice of method for grouping rural areas, with the goal of achieving relatively homogeneous categories by degree of rurality to enhance the effectiveness of analyses of rural health issues and relevant policy implications.

Physician and RHC/FQHC Services: Substitutes or Complements?

As discussed above, the establishment of special payment provisions for RHCs or FQHCs was intended to maintain or improve access to health care providers for Medicare beneficiaries residing in underserved areas of the country. With improved cost-based reimbursement for Medicare and Medicaid patients, existing providers (physician offices or clinics) could strengthen their financial viability by becoming certified as RHCs or FQHCs and new providers would have an incentive to enter the market as RHCs or FQHCs. The option of cost-based reimbursement offers a larger potential payment increase for Medicaid patients than for Medicare patients because Medicaid generally pays less than Medicare for fee-for-service physician services.

A GAO report concluded that many RHCs were established through the conversion of existing physician practices that would have continued to operate in the absence of the special RHC reimbursement provisions (US GAO, 1996). This statement suggests that services to Medicare beneficiaries provided through an RHC are a substitute rather than a complement to services provided by Medicare fee-for-service physicians in the same areas. Given that most FQHCs are not-for-profit community/migrant health centers established to provide health care access especially for low income populations, it is more likely that they serve as a complement to physician services under fee-for-service Medicare.

Primary Care and Avoidable Hospitalizations

While the programs described above may have improved overall access to primary care services in rural areas, there are still concerns that these programs do not go far enough to narrow disparities in access to those services across geographic regions. A recent study by Asch et al. (2000) found that residents of underserved communities were more likely to underuse health care services than residents of adequately served communities. There may be differences in health care seeking behaviors in rural areas compared to those in more urban areas, but differences in utilization rates are primarily attributed to the poor access to important primary health care services in these areas. Among the many possible consequences of poor access to primary care services is an increased likelihood of avoidable hospitalizations. In its seminal study on access to health care in America, the Institute of Medicine (1993) argued that timely and appropriate outpatient care would reduce the likelihood of hospitalizations for ACSCs.

The elderly and disabled are considerably more at risk of an avoidable hospitalization than younger and non-disabled individuals. A recent study found that the rate of avoidable hospitalizations for all age groups was 13.4 per 1,000 population in 1998 while the rate for the population 65 years of age and older was 57.4 per 1,000 population (Kozak et al., 2001). The authors also found that rates of avoidable hospitalizations had grown significantly between 1980 and 1998, reflecting a 57 percent increase in avoidable hospitalizations during that time.

Two models of avoidable hospitalizations for ambulatory care sensitive conditions that we used in this research are models developed by the Institute of Medicine (IOM) (1993) and by McCall et al. (2001). The IOM model has served as the basis for many studies of avoidable hospitalizations. The McCall model was designed specifically to study the incidence of avoidable hospitalizations for Medicare beneficiaries enrolled in Medicare+Choice managed care plans; the IOM model was the starting point of the McCall model design. Further description of avoidable hospitalizations defined by these two models is given in Section 2 and Appendix B.

Numerous studies have examined individual and community-level characteristics associated with higher rates of avoidable hospitalizations. The individual characteristics examined and found to be significantly associated with higher rates of avoidable hospitalizations include: lack of insurance or use of Medicaid (Weissman et al., 1992), self-report of poor access to health care services (Bindman et al., 1995), self-report of fair or poor health (Parchman & Culler, 1999), low individual income (Shi et al., 1999), being older (Culler et al., 1998), and being black or non-white (Shi et al., 1999; Pappas et al., 1997; Gaskin & Hoffman, 2000; Cable, 2002). Community characteristics linked to higher rates of avoidable hospitalizations include: low rates of primary care physician availability in the community (Parchman & Culler, 1994; Ricketts et al., 2001), lack of ambulatory care clinics (Epstein, 2001), residence in a core MSA (Culler et al., 1998), residence in a rural area (Silver et al., 1997; Culler et al., 1998; Shi et al., 1999), residence in a primary care shortage area (Parchman & Culler, 1999), and low per capita or median income of the community (Billings et al., 1993; Pappas et al., 1997; Djojonegoro et al., 2000; Cable, 2002).

Only one study to our knowledge examined the relationship between avoidable hospitalizations and access to health care services at the individual level. In this study by Bindman et al. (1995), the authors measured access to health care as whether or not the individual had a regular source of care, had insurance, and their self-reported rating of access to services on a five-point scale. One critique of their study is that they did not actually measure use of services; rather, they measured the propensity to use services, which was characterized by how important seeing a doctor was to the respondent. Their findings point to an inverse relationship between better access to primary care and rates of avoidable hospitalizations. Communities in which individuals believed they had poor access to health care services had higher rates of avoidable hospitalizations.

Testing the Rural-Urban Commuting Area Codes

With the new RUCA codes now available, policymakers and researchers will require information on how these codes compare to the UICs in categorizing populations and health service use patterns by degree of rurality. In particular, CMS will need to make policy decisions regarding whether and how to use the RUCA codes as the basis for payment systems or for research addressing future Medicare and Medicaid policy. The first step in adopting such a new classification system is to examine how it changes the distribution of populations and service use patterns from those of the previously used systems.

2. METHODS AND DATA

The analyses presented in this report encompass three distinct areas of research. The first analysis examines the relationship between visit rates for RHC/FQHC services and primary care physician services for Medicare beneficiaries in underserved non-metropolitan counties. The second analysis focuses on the relationship between primary care utilization by beneficiaries and their likelihood of having an avoidable hospitalization. The third analysis compares two methods for classifying geographic areas by extent of rurality to assess how beneficiaries and physician service use rates are classified differently across geographic categories of non-metropolitan counties. The methods and data used for these analyses are described in this Section.

MEASURES OF RURALITY

Rural locations were defined for this research as all counties outside an MSA. This definition is consistent with the geographic boundaries used in Medicare payment schedules for many provider services. However, county boundaries obscure a wide range of local characteristics because each county contains a mix of urbanized and more truly rural locations. Counties that are not in MSAs have fewer and smaller urbanized locations than MSA counties do, but they are not uniformly rural in nature. Therefore, we refer to these counties as "non-metropolitan" counties rather than "rural."

Categories by Urban Influence Codes

Categories of metropolitan and non-metropolitan counties were defined to help characterize the extent of rural or urban nature of each U.S. county. Urban and rural categories were established using values of the Urban Influence Codes (UICs) developed by the USDA, which classify counties using values from 1 through 9 (Ghelfi and Parker, 1995). (Refer to Section 1 and Appendix A for additional discussion of coding systems.) UICs have not been updated since their publication in 1993. Consequently, the stratification of counties using these codes may not reflect the actual rural designation that would be assigned to a county based on data for later years of the study period. The advantage for the analysis is that consistent classification of counties avoids confounding study results with changes in county designations. For our categories of rural counties, we used the two UICs for metropolitan counties and collapsed the UICs for non-metropolitan counties from the original seven categories into five categories.

Metropolitan categories

- Central and fringe counties in metropolitan areas of one million population or more (UIC 1); and
- Counties in metropolitan areas of fewer than one million population (UIC 2).

Non-metropolitan categories

- Counties adjacent to an MSA with a city of at least 10,000 population (UICs 3 and 5);
- Counties adjacent to an MSA without a city of at least 10,000 population (UICs 4 and 6);
- Remote counties not adjacent to an MSA with city of at least 10,000 population (UIC 7);

- Remote counties not adjacent to an MSA with town of 2,500–9,999 population (UIC 8);
- Remote counties not adjacent to an MSA with no town of 2,500 population (UIC 9).

Categories by RUCA Codes

As described in Section 1, the RUCA codes were designed to yield classifications that capture differences in extent of rurality more precisely than the existing county-based coding systems do (See Appendix A). The 30 RUCA codes are organized as 10 primary RUCA codes with sets of subcodes. The ten primary RUCA codes are metropolitan area core (code 1), metropolitan area high commuting (code 2), metropolitan area low commuting (code 3), large town core (code 4), large town high commuting (code 5), large town low commuting (code 6), small town core (code 7), small town high commuting (code 8), small town low commuting (code 9), and rural areas (code 10).

In consultation with staff at the WWAMI Rural Health Research Center, we defined four categories of RUCA codes to establish of degree of rurality on a monotonic scale. The four categories and the codes assigned to each of them are:

- Metropolitan—RUCA codes 1.x, 2.x, 3.x, 4.1, 5.1, 7.1, 8.1, and 10.1. Zip code areas with these codes are either the cores of urbanized areas (with 50,000 or more population) or have their primary or large secondary work commuting flows to these metropolitan cores (represented by the x.1 codes).
- Large rural—RUCA codes 4.0, 5.0, and 6.0. Zip code areas with these codes are either the cores of large rural cities/towns (with 10,000 through 49,999 population) or have their primary work commuting flows to these large rural cores.
- Small rural—RUCA codes 7.x (except 7.1), 8.x (except 8.1), and 9.x. Zip code areas with these codes are either the cores of small rural towns (with 2,500 through 9,999 population) or have their primary work commuting flows to these small rural cores.
- Isolated smaller rural—RUCA codes 10.x except 10.1. Zip code areas with these codes are not a part of a city/town with population 2,500 or more and have no large primary commuting flow to any place larger than 2,500.

The last three of the RUCA categories are non-urban in nature, so they are most directly comparable to the five non-metropolitan UIC-based categories. However, because the RUCA codes are based on zip codes instead of county boundaries, some of the non-metropolitan UIC counties contain areas that the RUCA codes define as metropolitan and metropolitan UIC counties will contain areas that the RUCA codes define as rural. Each of these zip code areas is more homogeneous in its characteristics than any given county by virtue of its smaller size.

Frontier Counties

Another important descriptive characteristic of rural services is location in frontier counties, which are remote, sparsely populated rural areas. Counties were classified as frontier if they were located in a western state and had a population density of six persons per square mile or fewer based on 1990 census data on population and county land area. Only a small number of counties in the eastern portion of the country had such low population densities, and they were omitted from the frontier county definition because residents in these counties had much better access to urbanized areas than those in the western frontier counties. We also tested the extent to which frontier county classifications would change if they were based on more recent (1997) population estimates. Only 18 counties had different classifications based on the 1997 population data, with 12 counties losing the frontier classification and six counties becoming frontier counties.

DATA SOURCES

The various analyses reported here involved linking data from several sources, including the following:

- An extract of the Area Resource File (ARF extract), which provided county-level information on UICs, provider supply, population, and other environmental variables;
- Annual Medicare Provider of Service (POS) file for calendar year 1996, which identified the RHCs and FQHCs serving Medicare beneficiaries, and provided information on their location, characteristics and certification status;
- Annual Medicare Denominator File for the 5 percent sample of beneficiaries for calendar year 1996, which provided data on the months and type of Medicare eligibility;
- Medicare physician/supplier (Part B) claims for physicians' services for the 5 percent sample of beneficiaries for calendar year 1996;
- Medicare institutional outpatient claims from RHCs and FQHCs for the 5 percent sample of Medicare beneficiaries for calendar years 1996.
- Medicare Provider Analysis and Review (MEDPAR) claims for short-term inpatient hospital services for the 100 percent sample of beneficiaries for calendar year 1996, including a subset file that matched the 5 percent sample of beneficiaries in the Denominator File; and
- RUCAs by zip code, created by the WWAMI Rural Health Research Center from a crosswalk to RUCA codes by census tract established by the ERS of the USDA.

Linkages of these files were performed as required for each type of analysis. We linked provider-level data or Medicare claims to county-level measures (e.g., extent of rurality, HPSA designations) in the ARF extract file using Social Security Administration (SSA) state and county codes. For population-based analyses, the denominator file or claims data were linked to the ARF based on the state and county of residence for Medicare beneficiaries; for facility-based analyses, the linkages were based on state and county of provider location. In the comparative analysis of RUCAs and UIC categories, the RUCA codes were linked to each denominator file or claim record by zip code of beneficiary residence and the UICs were linked by state and county of residence. Thus, each record had a RUCA code and UIC code assigned to it.

The availability of certain county-level ARF data influenced the set of counties we could include in each analysis. The Medicare program recognizes a larger set of counties (or other similar geographic jurisdictions) than those included in the ARF, which is reflected in the set of counties for which AAPCCs have been established historically. The 1999 ARF contained only one record for the entire state of Alaska, even though SSA county codes exist for a number of Alaskan boroughs. A discrepancy also existed for a set of independent cities in Virginia, which the state separates legally from historical county boundaries to form their own jurisdictions. The SSA state-county codes recognize Virginia independent cities. Thus Medicare treats them as separate geographic units. We added new records for the Alaskan boroughs and the Virginia independent cities to our analysis file, for which we obtained data on the 1990 population, UICs, and MSAs.[4]

We could not obtain data for the Alaskan boroughs or Virginia independent cities on HPSAs, MUAs, or other county characteristics that were on the ARF. For any analyses that used these variables, we worked with the smaller set of counties for which we had the full set of data. Alaska boroughs were dropped from these analyses, and the Virginia independent cities were re-combined with the counties from which they were extracted.

ANALYSIS

Substitution between Fee-for-Service Physician and RHC/FQHC Services

We hypothesized that RHC primary care services were a substitute for fee-for-service primary care physician services for Medicare beneficiaries, but that FQHC primary care services were a complement to these physician services. Because location in an underserved area was one of the requirements for designation as an RHC or FQHC, we limited our analyses to services for Medicare beneficiaries residing in non-metropolitan counties with a whole or partial county HPSA or MUA.

We used two distinct analytic methods to estimate the extent to which the hypothesized substitution effects existed for RHCs or FQHCs. First, we tested the difference in mean visit rates per 100 beneficiaries between a group of counties with no clinics (the control group) and a group of counties with RHCs (or FQHCs). To avoid confounding the independent effects of RHCs and FQHCs on physician use, separate analyses were performed for the RHCs and the FQHCs using separate groups of non-metropolitan counties. The RHC analysis compared means for the control group and a group of counties that had *more than one* RHC and no FQHCs; the FQHC analysis compared means for the same control group and a separate group of counties that had *more than one* FQHC and no RHCs. Second, we estimated regression models of the relationship between county-level cost-based RHC visit rates and fee-for-service primary care physician visit rates to test for a substitution effect and estimate the elasticity for this effect. The same modeling analysis was performed for FQHC visit rates.

RHCs and FQHCs were identified by geographic location using the POS file linked with the ARF. For each county, we counted the number of RHCs and FQHCs in the county, and we defined three groups of counties that either had no RHCs or FQHCs, had only RHCs, or had only FQHCs. We then used the physician/supplier claims and institutional outpatient claims to sum the numbers of each type of primary care visits for beneficiaries residing in each county. The analysis file was created by merging the data on RHC/FQHC counts by county with the visit counts by county. For each county, mean visit rates were calculated for each type of primary care visit (i.e. for physician visits, RHC visits, or FQHC visits).

To test the difference in mean visit rates between the control and clinic county groups, we calculated for each county group the weighted mean visit rates for physician visits, RHC visits, FQHC visits, and total primary care visits, weighting by the number of beneficiaries

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4 We note that the 2001 ARF includes both the Alaskan boroughs and the Virginia independent cities, but these data were not available when we performed our analyses.

residing in each county. T-tests were performed to test the statistical significance of the difference in means for physician visit rates and total visit rates. We did not conduct statistical tests for the means of RHC or FQHC claims because they were obviously different due to the absence of these facilities in the control group of counties. If RHCs (or FQHCs) were substitutes for physician services, the county group with more than one RHC (FQHC) should have a significantly lower mean physician visit rate than the rates for the control county group, but there should be no significant difference between the two county groups in the total primary care visit rates.

The county also was the level of analysis for the regression modeling of substitution effects. The sample of counties for the RHC model included the control counties used in the first substitution analysis plus a group of counties with *at least one* RHC (instead of the more restrictively defined group with more than one RHC used in the difference-of-means analysis). The sample for the FQHC model included the control counties plus a group of counties with *at least one* FQHC. Use of this larger group in each analysis allowed us to capture a greater range of variation in RHC (or FQHC) presence across counties.

Weighted regression models were estimated with the natural log of a county's physician visit rate per 100 beneficiaries as the dependent variable and the natural log of the RHC (or FQHC) visit rate as the predictor variable of interest. The log-log transformation was necessary to conform to the assumptions for linear regression models, and it also yielded a direct estimate of the elasticity of substitution as the coefficient on the predictor variable for the clinic visit rate. The model weights were the number of Medicare beneficiaries residing in each county. The models controlled for other factors that could affect physician use rates: a set of indicator variables for UIC-based county categories, an indicator for frontier county status, the proportion of the population below the federal poverty level, and population density per square mile.

Avoidable Hospitalizations

We hypothesized that better access to primary care, as measured by total use of primary care services, would be negatively associated with avoidable hospitalizations. The population of interest for the analysis was Medicare beneficiaries residing in non-metropolitan counties in 1996. These beneficiaries may choose to use physician and clinic services in either rural or urban locations. We modeled the relationship between frequency of use of primary care services and the likelihood of having an avoidable hospitalization for Medicare beneficiaries, using beneficiary-level data. We created an analysis file with a record for each beneficiary in the sample that contained data on the beneficiary's characteristics, state and county of residence, county-level characteristics, number of primary care visits, and number of avoidable hospitalizations of each type (see below for definition of key variables).

The sample for the analysis consisted of beneficiaries in the 5 percent sample of beneficiaries who resided in non-metropolitan counties (i.e., not in an MSA), were continuously enrolled in both Medicare Part A and Part B for the entire year, were never enrolled in a Medicare health maintenance organization (HMO) during the year, and did not have end-stage renal disease. HMO enrollees were excluded because the claims data were for fee-for-service Medicare beneficiaries. End-stage renal disease patients were excluded because their unique health care needs would confound an analysis of service use for the general elderly Medicare population.

Logistic regression models were estimated in which the dependent variable was a dichotomous variable coded for having at least one avoidable hospitalization (or not), and the key predictor variables were a group of indicator variables for number of primary care visits. Other beneficiary-level predictors were variables for demographic characteristics (gender, age), the number of co-morbidities, and Medicaid eligibility. County-level measures were indicators for UIC-based county categories, frontier county designation, designation as either a HPSA or MUA, counties with 30 percent or more of the resident population in poverty, and continuous measures of median per capita income for the county and the number of hospitals in the county. Interaction terms for gender by age, gender by Medicaid status, race by Medicaid status, and county poverty by Medicaid status were also tested.

Primary care services were defined as services provided on a fee-for-service basis by primary care physicians or on a cost basis by RHC/FQHCs (see definitions of key variables). For each beneficiary, we counted the total number of primary care visits, which included fee-for-service visits to primary care physicians (claims from physician/supplier file) or visits to any RHC or FQHC (from institutional outpatient file). We did not distinguish between provider-based and freestanding RHCs.

In this analysis, we were interested in primary care services routinely provided to beneficiaries that should help prevent subsequent avoidable hospitalizations. These same primary care providers would also provide followup services after an avoidable hospitalization, but these visits had a different purpose that would confound the relationship being studied. Therefore, we adjusted the counts of primary care visits for each beneficiary by subtracting from the total counts any visits that occurred within six weeks following an avoidable hospitalization.

We analyzed avoidable hospitalizations for acute and chronic conditions separately. An additional analysis was conducted for total hospitalizations, for comparison purposes, with the dependent variable modeled as one or more hospitalizations versus no hospitalizations.

Both the IOM and the McCall definitions of avoidable hospitalizations were modeled. The principal diagnosis on the MEDPAR inpatient claims for the study sample was used to identify each type of avoidable hospitalization. Our descriptive analyses examined rates of avoidable hospitalizations for each condition. For the regression models, we collapsed the data into the two categories of avoidable conditions for acute and chronic conditions. The McCall definitions also define a third category of preventive avoidable hospitalizations, but we found very small rates in this category and therefore collapsed the preventive conditions into the acute care conditions for analysis.

Comparing Definitions of Rurality

With the introduction of the new RUCA codes, we had the opportunity to explore how these codes differ from the UIC codes in how they classify beneficiaries and use of services based on extent of rurality. Descriptive analyses were performed using 1998 data from the annual Denominator file for the 100 percent sample of Medicare beneficiaries and from the 5 percent sample physician/supplier file for primary care physician visits used by non-metropolitan beneficiaries. The RUCA code file by zip code was based on zip codes for 1998, so we used 1998 data for the analyses. The relevant RUCA code and UIC were matched to the record for each beneficiary in the Denominator file and to each physician visit claim in the physician/supplier file. RUCA codes were matched based on the beneficiary’s zip code of residence and UICs were match based on the state and county of residence. Then we performed a cross-tabulation of the denominator file records by RUCA and UIC to describe how the same set of beneficiaries was classified by each type of code. A second cross-tabulation was performed on the basis of groupings of each set of codes, where RUCA codes were collapsed into four categories and UICs were grouped into six categories.

KEY ANALYTIC VARIABLES

We describe here the key analytic variables derived for our analyses, including the key characteristics of the variables and relevant data limitations.

Non-Metropolitan Shortage Areas

Designations of counties as underserved areas form an important basis for the analyses performed in this project because many of the Medicare payment policies were established specifically for providers serving these designated areas. The federal government has established MUAs and HPSAs as two distinct designations, and the rules for their designation processes differ (see Section 1 for specifics). For both MUAs and HPSAs, designations may be made for either whole-county or partial-county areas. The ARF contains variables for HPSA designations, including coding for the whole- or partial-county status. We worked with variables for primary care HPSA designations for 1996. A data file with the MUA designations also was obtained from HRSA, which we added to our county-level analytic file. The MUA designations were cumulative as of 1999, so we did not have MUA data specific to 1996.

Dichotomous variables for HPSA or MUA designations were created for the analyses. For each shortage area definition (HPSA or MUA), if a non-metropolitan county was designated as either a whole-county or partial-county shortage area, we coded the county as a shortage area. We used these variables to select the sample of beneficiaries in HPSAs for the substitution analyses and also as predictor variables in our analysis of avoidable hospitalizations.

Variables for the Substitution Analysis

The subject of the substitution analysis was primary care services provided to Medicare beneficiaries by physicians on a fee-for-service basis or by RHCs or FQHCs on a cost basis. The analytic goal was to assess the extent to which RHC visits or FQHC visits were substitutes for visits to fee-for-service primary care physicians. For each county, we summed the number of each of these three types of primary care visits provided to beneficiaries residing in the county, and we then summed these three types of visits to obtain a value for total primary care visits. For each measure, a visit rate was calculated by dividing the visit counts by the number of Medicare beneficiaries residing in the county.

Primary Care Physicians' Services. The physician services of interest for this analysis were office visits to primary care physicians, which are the most directly comparable to visits to RHCs or FQHCs as alternative primary care resources. To measure these services, we selected fee-for-service claims from the physician/supplier file on the basis of provider specialty codes and the Health Care Financing Administration's (HCFA's) Common Procedure Coding System (HCPCS) codes for office visits. Claims were extracted for services provided by physicians with a general practice (specialty code '01'), family practice ('08'), internal medicine ('11'), or geriatric medicine ('38') specialty. Of those claims, we retained claims for Evaluation and Management (E&M) services provided in an office setting, which are considered primary care services as outlined in OBRA-87. We included all office visits for a new patient (HCPCS Codes 99201-99205) and an established patient (HCPCS Codes 99211-99215) (AMA, 1997). To estimate actual utilization as accurately as possible, we used all paid provider claims, whether or not Medicare was the primary payer (claims that were denied by Medicare were excluded).

Presence of RHCs and FQHCs. Two methods were tested for classifying counties based on the availability of RHCs and FQHCs—the number of RHC and FQHCs and the relative extent of utilization of these facilities. For the first method, we summed separately the number of RHCs and number of FQHCs in each non-metropolitan county using data from the POS on facility state and county of location. Then we created groups of counties by the numbers and types of clinic in them (e.g., no RHC/FQHCs; one or more RHCs and no FQHCs, one or more FQHCs and no RHCs, both RHCs and FQHCs). Analytic results presented in this report are based on the number of clinics in each county because this measure yielded clearer results regarding substitution effects between physician services and RHC or FQHC services.

To classify counties based on relative RHC or FQHC utilization, we determined the proportion of all primary care claims for each county that were for RHCs and FQHCs by dividing total RHC claim counts (or FQHC claims) by total primary care claims (the sum of physician and RHC/FQHC claims). We then defined groups of counties by the relative level of RHC or FQHC utilization (e.g., no RHC or FQHC claims, only RHC claims, only FQHC claims, both RHC and FQHC claims). We developed two measures using different thresholds for what defines a county with "no claims." The first measure used zero percent of claims from a clinic and the second used a minimum of 3 percent or less of all claims attributed to an RHC or FQHC. The second definition (3 percent of claims) was used in our analyses.

Variables for Analysis of Avoidable Hospitalizations

Total Primary Care Services. The primary care utilization measure used for the avoidable hospitalization analysis was defined as the total number of visits to primary care physicians, RHCs, or FQHCs for each beneficiary in our sample (see definitions of physician, RHC, and FQHC visits above). The count of primary care visits for each beneficiary was adjusted by subtracting from the total any visits that occurred within six weeks after an avoidable hospitalization (considered to be followup visits). The counts were converted to a categorical variable for the analysis with the following categories: no visits (reference group), one to two visits, three to four visits, and five or more visits. We also created separate categorical variables for counts of physician visits and counts of RHC/FQHC visits for use in an additional analysis.

Avoidable hospitalizations. Based on review of the literature, we selected two models for identifying avoidable hospitalizations for ambulatory care sensitive conditions. The first model was developed by the IOM (1993). A clinical committee convened by the IOM developed the definition of avoidable hospitalizations. The committee selected conditions that, with appropriate outpatient care, should not lead to hospitalizations. The committee developed groups of chronic and acute conditions through similar, but separate processes. Its intent was to develop a population-based rate of hospitalizations for ACSCs to study how characteristics of the local community (such as availability of primary care physicians, socio-economic status, etc.) related to these hospitalizations. This model (referred to as the IOM definition) serves as the basis for several other analyses that followed its development (Bindman et al., 1995; Cable, 2002; Culler et al., 1998; Gaskin et al., 2000; Pappas et al., 1997).

We considered an additional model developed by McCall et al. (2001) to study incidence of avoidable hospitalizations in Medicare+Choice managed care plans (referred to as the McCall definition). The authors' work was based in part on the IOM definition. From a review of the literature, they identified fifteen ACSCs and performed a clinical review of those conditions to determine if they would apply to an elderly population. They developed three groups of avoidable hospitalizations from their work: chronic, acute, and preventive.

Appendix B documents the individual conditions included in these definitions and the diagnosis codes that define them. The major distinction between the IOM and McCall definitions is that the McCall definition addresses conditions relevant to an aged population while the IOM definition concentrated on measures relevant to the under 65 population.

Total Hospitalizations. To provide a comparison for the avoidable hospitalization analysis, we also modeled the likelihood of beneficiaries having any type of hospitalization during the year, applying the same predictors used in the avoidable hospitalization models. To derive the dependent variable, we counted the total number of hospitalizations during the year for each beneficiary in the sample, using data from the MEDPAR file, and we coded the variable equal to 1 if a beneficiary had at least one inpatient stay or equal to 0 otherwise.

Beneficiary-Level Characteristics. Data on beneficiary-level characteristics were obtained from the Medicare Denominator File. The following variables were included in the avoidable hospitalization analyses or were used to select the analytic sample for the analysis:

- Gender;
- Race (two indicator variables: white, black, and other);
- Indicator variable for enrollment in Medicaid for any portion of the year (yes/no);
- Age (less than 65 years, 65-74, 75-84, and 85 and older);

Comorbidity Index. To control for case mix in the avoidable hospitalization analyses, we developed a measure of the number of co-morbidities recorded in the claims for each beneficiary (Charlson et al., 1987). We screened all inpatient, physician/supplier, and institutional outpatient claims to identify diagnostic codes for any of 16 co-morbid conditions: myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, dementia, chronic obstructive pulmonary disease, rheumatoid arthritis, peptic ulcers, chronic liver disease and cirrhosis, diabetes, hemiplegia, quadriplegia, renal failure, malignant neoplasms, metastatic cancer, and AIDS. We used all available diagnoses on the physician/supplier claims and the principal diagnosis on the institutional outpatient claims for RHC/FQHC services.[5] We used the principal diagnosis in the MEDPAR inpatient claims to identify an avoidable hospitalization. Therefore, we used only the secondary diagnoses to count co-morbidities to avoid double counting a condition as both a co-morbidity and an avoidable hospitalization. Each condition was counted once regardless of how often it appeared on the claims. The co-morbidity count derived from this process was included as a continuous control variable in our models.

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[5] Only the principal diagnosis was used from the claims for RHC/FQHC services because it was the only diagnostic code available on the main record; additional diagnoses are in trailers that were not in the data extracted from the CMS source data files.

County level characteristics. Measures of provider supply and poverty were obtained from the ARF. The following variables were included in the analyses:

- Proportion of county living below the poverty line;
- Indicator variable for those counties with 30 percent or more of the population living below the federal poverty line;
- Number of hospitals in the county per 100,000 population; and
- Population density per square mile.

3. RELATIONSHIP BETWEEN PHYSICIAN AND RHC/FQHC SERVICES

The analyses reported in this section examined the relationship between primary care physician and RHC/FQHC services used by Medicare beneficiaries residing in non-metropolitan counties. The analyses were designed to test the following hypotheses:

- Primary care services at RHCs are substitutes for primary care physician services for fee-for-service Medicare beneficiaries residing in non-metropolitan counties.
- FQHC services are complements for primary care physician services for this population.

As described in Section 2, we tested these hypotheses using two distinct analytic methods. The county was the unit of analysis for both methods, and the samples were all non-metropolitan counties located in either a HPSA or MUA. Visits for primary care physicians, RHCs, and FQHCs were aggregated to the county level based on the county of beneficiary residence. In the first method, we performed separate analyses for RHCs and FQHCs, testing the difference in mean visit rates per 100 beneficiaries between a group of counties with no clinics (the control group) and a group of counties with more than one RHC (or more than one FQHC). In the second method, we estimated regression models of the relationship between county-level RHC visit rates and primary care physician visit rates to test for a substitution effect and estimate the elasticity for this effect. The same modeling analysis was performed for FQHC visit rates.

DISTRIBUTIONS OF RHCS AND FQHCS

To provide context for this analysis, we report in Table 3.1 the number of RHCs and FQHCs in the country in 1996, with breakdowns by type of RHC (provider-based or independent) and location of FQHCs (non-metropolitan and metropolitan). Overall, there were nearly twice as many RHCs as FQHCs. Given that all but a small fraction of RHCs are located in non-metropolitan counties, they outnumber FQHCs by an even larger margin in these areas.

Table 3.1
Number of RHCs and FQHCs, 1996

Type of Clinic	Number	% of Total	% Change from Previous Year
RHCs			
All RHCs	3,361	100.0%	29.5%
Provider-based RHCs	1,590	47.3	40.0
Independent RHCs	1,771	52.7	21.3
FQHCs			
All FQHCs	1,711	100.0	10.2
Non-metropolitan	729	42.6	7.8
Metropolitan	982	57.4	11.9

SOURCE: Medicare POS files.

NOTES: Non-metropolitan counties are defined as counties not in MSAs.
Includes all certified RHCs irrespective of geographic location.

We begin by reporting the distribution of counties in the sample based on the number of RHCs and FQHCs in each county, with comparisons across UIC-based county categories. As

Table 3.2 shows, 31.1 percent of the counties in HPSAs or MUAs did not contain any RHCs or FQHCs in 1996, and 13.0 percent had both RHCs and FQHCs. Among the counties with only RHCs or only FQHCs, the largest percentages contained only RHCs, reflecting the larger number of RHCs in non-metropolitan counties (see Table 3.1). Counties with only RHCs represented 45.8 percent of the total sample, with 20.5 percent of the sample containing only one RHC and another 25.3 percent with more than one RHC. By contrast, only 10.1 percent of the sample counties had one or more FQHCs in them. The distributions differ somewhat by UIC-based county category. For example, the most remote counties with no towns are less likely to have more than one RHC or FQHC in them compared to other non-metropolitan counties.

Distributions of counties based on the percentage of primary care visits that are attributable to RHCs or FQHCs differ from those based on the number of clinic facilities, as shown in Table 3.3. The threshold we used to group counties was RHC or FQHC visits representing 3 percent of total primary care visits for beneficiaries residing in the county (see Section 2). Overall, RHC/FQHC visits were 3 percent or less of total primary care visits for 46.5 percent of counties in the sample, and RHC/FQHC visits were greater than 3 percent of the total for only 6.4 percent of the counties. Counties with only RHC visits (>3 percent of total) represented 40.6 percent of the sample, and counties with only FQHC visits were another 6.6 percent of the sample.

Table 3.2
Distribution of RHCs and FQHCs in Underserved Non-Metropolitan Counties, by County Category, 1996

	All Counties	Adjacent, city 10,000+	Adjacent, no city 10,000+	Remote, city 10,000+	Remote, town 2,500-10,000	Remote, no town
Number of counties	2,060	203	704	194	484	475
Percentage by clinic count						
No RHCs or FQHCs	31.1%	30.5%	30.0%	32.5%	30.8%	32.6%
Both RHCs & FQHCs	13.0	16.2	12.7	18.0	14.1	8.7
Only contained RHCs						
One RHC	20.5	15.3	19.0	14.4	21.5	26.3
>1 RHCs	25.3	27.6	26.9	22.7	27.3	21.3
Only contained FQHCs						
One FQHC	7.3	6.9	8.4	7.2	4.8	8.6
>1 FQHCs	2.8	3.5	3.0	5.2	1.5	2.5

SOURCE: Medicare POS File, 1996; ARF.

NOTE: Underserved counties are those with designations as either whole or partial county HPSAs or MUAs.

Table 3.3
Distribution of Visits for RHCs and FQHCs in Underserved Non-Metropolitan Counties, by County Category, 1996

	All Counties	Adjacent, city 10,000+	Adjacent, no city 10,000+	Remote, city 10,000+	Remote, town 2,500-10,000	Remote, no town
Number of counties	2,060	203	704	194	484	475
Percentage by visit count						
≤ 3% RHC/FQHC visits	46.5%	67.0%	45.3%	62.4%	47.7%	31.6%
> 3% RHC/FQHC visits	6.4	3.5	6.1	5.2	6.8	8.2
> 3% RHC visits only	40.6	25.6	40.6	27.8	40.7	52.0
> 3% FQHC visits only	6.6	3.9	8.0	4.6	4.8	8.2

SOURCE: Medicare Institutional Outpatient Claims and Physician Supplier Claims, 1996; ARF.

NOTES: Clinic claim composition was determined by dividing total RHC or FQHC visits by the total primary care visits (sum of RHC/FQHC and primary care physician visits). Underserved counties are those with designations as either whole or partial county HPSAs or MUAs.

RELATIONSHIP OF USE RATES FOR RHC/FQHC AND PHYSICIAN SERVICES

The basic sample for the substitution analysis consisted of a control group of counties that contained no RHCs or FQHCs, another group that contained only RHCs, and a third group that contained only FQHCs. For the analysis of the difference in means of primary care visit rates per 100 beneficiaries, we used two pairs of county groups. In the first analysis, we used t-tests to test for a significant difference in means between the control group and a group of counties with more than one RHC but no FQHCs (a subgroups of the RHC county group). In the second analysis, we tested the difference in means between the control group and a group with more than one FQHC but no RHCs. For each pair of county groups, the differences in means were tested for primary care physician visit rates and total visit rates (the sum of the fee-for-service physician, RHC, and FQHC visit rates).

Table 3.4 presents the number of counties in the sample groups that had no clinics, that had only more than one RHC, and that had only more than one FQHC. These counts, which are presented overall and by county category, are provided as a reference on sample sizes when examining the tables with the analytic results. Among counties with more than one FQHC, the sample size for some county categories was small, so there was limited power to detect significant differences in utilization across county groups.

Table 3.4
Number of Counties in Each County Group Used for the Difference of Means Analysis, by County Category, 1996

	Number of Counties in Analysis County Groups		
County Category	No Clinic (Control)	>1 RHC, no FQHCs	>1 FQHC, no RHCs
All Non-Metropolitan Counties	640	522	57
Adjacent, city 10,000+	62	56	7
Adjacent, no city 10,000+	211	189	21
Remote, city 10,000+	63	44	10
Remote, town 2,500-10,000	149	132	7
Remote, no town	155	101	12
Frontier County Designation	141	59	4
Non-Frontier County Designation	499	463	53

SOURCE: Medicare POS File, 1996.

Tables 3.5 to 3.7 present the county level use rates for each type of primary care service, averaged for each of the control and clinic county groups, overall and by UIC-based county category. Comparisons between the control group and the group with only RHCs are given in Table 3.5, and comparisons between the control group and the group with only FQHCs are in Table 3.6. The same results by frontier county status are presented in Table 3.7. We present the mean number of visits for physician's services, RHCs, FQHCs, and total services (the sum of the three types), and we indicate the statistical significance of the differences in means. The very low RHC and FQHC use rates in the control counties were for beneficiaries living there who used RHCs or FQHCs located in other counties.

If RHC (or FQHC) services were substitutes for primary care physician's services, we would expect to find both (1) no significant difference in the mean total primary care visit rates between the control and RHC (or FQHC) groups, and (2) a significantly lower mean visit rate for physician services for the RHC (or FQHC) group than for the control group. As shown in Table 3.5, we found both these results for the control and RHC groups as a whole, which suggests that beneficiaries in non-metropolitan underserved counties were using RHC services as a substitute for primary care physician services. Results varied across non-metropolitan county categories. We found evidence of substitution effects for counties adjacent to an MSA with no city, remote counties with a small town, and remote counties without a town. No effect was found for county categories with a city, either adjacent to an MSA or in more remote locations.

Evidence was not found for a substitution effect between FQHC services and physician services (see Table 3.6). Instead, counties with FQHCs had significantly lower utilization of both total primary care services and physician services overall than the control counties with no FQHCs. The lower use rates for the county groups with FQHCs suggests that these facilities were serving counties with low primary care use rates, due to either beneficiary preferences or other factors constraining access to primary care services. At the county category level, non-significant results were found for three of the five categories, which may be due to the small sample size of counties with FQHCs.

Table 3.5
Mean Visit Rates per 100 Medicare Beneficiaries in Underserved Non-Metropolitan Counties with More than One RHC, by County Category, 1996

County Category	Counties Characterized by Number of RHCs/FQHCs Present: No Clinic (Control)	Counties Characterized by Number of RHCs/FQHCs Present: >1 RHC Clinic, no FQHCs
All Non-Metropolitan Counties		
Total Claims	929.7	943.6
Physician Claims	922.3	827.5***
RHC Claims	6.1	113.9
FQHC Claims	1.4	2.3
Adjacent, city 10,000+		
Total Claims	851.0	930.0
Physician Claims	848.6	849.7
RHC Claims	1.7	78.8
FQHC Claims	0.7	1.5
Adjacent, no city 10,000+		
Total Claims	917.3	914.2
Physician Claims	909.8	802.5***
RHC Claims	6.3	110.0
FQHC Claims	1.2	1.8
Remote, city 10,000+		
Total Claims	942.8	1002.5
Physician Claims	937.3	921.6
RHC Claims	4.4	78.2
FQHC Claims	1.1	2.6
Remote, town 2,500-10,000		
Total Claims	992.3	938.1
Physician Claims	983.9	798.2***
RHC Claims	7.3	137.1
FQHC Claims	1.2	2.9
Remote, no town		
Total Claims	1056.8	1032.7
Physician Claims	1029.7	811.8***
RHC Claims	21.3	216.8
FQHC Claims	5.8	4.0

SOURCE: Medicare Institutional Outpatient Claims, Physician Supplier File, and POS File, 1996; ARF.

NOTES: * $p<0.05$; ** $p<0.01$; **** $p<0.001$
Underserved counties are those with designations as either whole or partial county HPSAs or MUAs. Physician's Claims include all fee-for-service office visits to primary care providers (General Practice, Family Practice, Internal Medicine, and Geriatric Medicine).

Table 3.6
Mean Visit Rates per 100 Medicare Beneficiaries in Underserved Non-Metropolitan Counties with More than One FQHC, by County Category, 1996

County Category	Counties Characterized by Number of RHCs/FQHCs Present: No Clinic (Control)	Counties Characterized by Number of RHCs/FQHCs Present: >1 FQHC Clinic, no RHCs
All Non-Metropolitan Counties		
Total Claims	929.7	847.0**
Physician Claims	922.3	796.7**
RHC Claims	6.1	6.3
FQHC Claims	1.4	44.0
Adjacent, city 10,000+		
Total Claims	851.0	815.0
Physician Claims	848.6	792.6
RHC Claims	1.7	1.1
FQHC Claims	0.7	21.3
Adjacent, no city 10,000+		
Total Claims	917.3	906.7
Physician Claims	909.8	838.4
RHC Claims	6.3	9.7
FQHC Claims	1.2	58.7
Remote, city 10,000+		
Total Claims	942.8	787.8
Physician Claims	937.3	765.8*
RHC Claims	4.4	1.9
FQHC Claims	1.1	20.1
Remote, town 2,500-10,000		
Total Claims	992.3	834.9*
Physician Claims	983.9	755.7*
RHC Claims	7.3	2.3
FQHC Claims	1.2	76.9
Remote, no town		
Total Claims	1056.8	934.2
Physician Claims	1029.7	803.3
RHC Claims	21.3	28.9
FQHC Claims	5.8	102.0

SOURCE: Medicare Institutional Outpatient Claims, Physician Supplier File, and POS File, 1996; ARF.

NOTES: * $p<0.05$; ** $p<0.01$; **** $p<0.001$
Underserved counties are those with designations as either whole or partial county HPSAs or MUAs. Physician's Claims include all fee-for-service office visits to primary care providers (General Practice, Family Practice, Internal Medicine, and Geriatric Medicine).

Tests for substitution effects by frontier county status yielded similar results, as shown in Table 3.7 rates. For RHCs in both frontier counties and non-frontier counties, total visit rates were not significantly different between the control and RHC group, but physician visit rates were significant, thus suggesting a substitution effect. For FQHCs, there are no significant differences in either total or physician visit rates between the control and RHC groups in frontier counties, while differences for both these rates were significant for non-frontier counties. Again, small sample sizes may explain the lack of significance of differences for the frontier counties.

Table 3.7
Mean Visit Rates per 100 Medicare Beneficiaries in Underserved Non-Metropolitan Counties with More than One RHC or FQHC, by Frontier County Status, 1996

County Category	Counties Groups by Number of RHCs/FQHCs		
	No Clinic (Control)	>1 RHC Clinic, no FQHCs	>1 FQHC Clinic, no RHCs
Frontier County Designation			
Total Claims	885.1	876.1	646.8
Physician Claims	865.3	650.4***	521.5
RHC Claims	15.0	225.6	40.8
FQHC Claims	4.9	1.0	84.5
Non-Frontier County Designation			
Total Claims	932.1	945.8	849.3***
Physician Claims	925.4	833.2***	799.9***
RHC Claims	5.6	110.3	5.9
FQHC Claims	1.2	2.3	43.5

SOURCE: Medicare Institutional Outpatient Claims, Physician Supplier File, and POS File, 1996.

NOTES: * $p<0.05$; ** $p<0.01$; *** $p<0.001$
Underserved counties are those with designations as either whole or partial county HPSAs or MUAs. Physician's Claims include all fee-for-service office visits to primary care providers (General Practice, Family Practice, Internal Medicine, and Geriatric Medicine).

Additional Analyses

The results presented thus far were based on the sample of all non-metropolitan counties with either a partial or whole county HPSA or MUA designation. Given that many non-metropolitan counties can be quite large, some Medicare beneficiaries residing in counties designated with partial-county HPSAs or MUAs may not have ready access to RHCs and FQHCs in those areas. We examined this issue by replicating the difference-of-means analyses for the subset of counties designated as whole county HPSAs or MUAs (data not shown). Our results yielded significant findings that also supported the hypothesis of a RHC substitution effect, similar to the results for the larger sample. Similarly, results for the FQHC analysis supported the hypothesis that FQHC services are complements for physician services, as found with the larger sample.

ELASTICITIES OF SUBSTITUTION FOR RHC/FQHC VISITS

In addition to the difference-of-means analyses, we estimated weighted linear regression models to examine directly the relationship between primary care physician use and use of either RHCs or FQHCs. The county was the unit of analysis for this analysis, and the weights were the number of beneficiaries in each county (See Section 2 for model specification details). Both the dependent variable (fee-for-service primary care physician visit rate) and the key predictor variable (RHC or FQHC visit rate, depending on the model) were transformed to natural logs. A negative coefficient for the RHC (or FQHC) visit rate variable suggests substitution between RHC (or FQHC) services and physician services. With these logged variables, the coefficient on the predictor variable of RHC (or FQHC) visit rate was an estimated elasticity of substitution, that is, the percentage change in the primary care physician visit rate for a one percent change in RHC (or FQHC) visit rate.

The county samples used for the RHC models were the control counties with no RHCs or FQHCs plus the group of counties with one or more RHCs and no FQHCs, and the samples for the FQHC analysis were the control counties plus the group of counties with one or more FQHCs and no RHCs. Separate models were estimated, one for each of the five non-metropolitan county categories. The models controlled for the proportion of the county population below the federal poverty line and population density.

Table 3.8 presents the estimates from the models of the relationship of physician visit rates to RHC visit rates, by county category. We found a significant substitution effect between RHC and physician use in all non-metropolitan county categories except the counties adjacent to an MSA with a large city. Some of the other predictors in our model also were significantly associated with primary care physician use rates. Higher county poverty rates were associated with greater physician use in non-metropolitan counties adjacent to an MSA, with or without a city, as well as in remote counties with no town. Additionally, beneficiaries in the more densely populated counties adjacent to an MSA, with or without a city, had greater physician use.

To better understand the relationship between RHC and physician services in counties with an RHC, we calculated how a 10 percent increase in mean RHC visit rates would change the average number of RHC visits and physician visits per beneficiary (Table 3.8). The substitution effect was strongest in remote counties with a large city. In these counties, RHC services were almost a one-to-one substitute for physician services. At the mean of 78.2 RHC visits per beneficiary for this county category (see Table 3.5), a 10 percent increase in mean RHC service visits per beneficiary equals an increase of 7.8 RHC visits, which is associated with a decrease of 8.4 visits for primary care physician services. The substitution effect was weaker in the other county categories—a 10 percent increase in mean RHC visit rates was associated with smaller decreases in physician service use.

Table 3.8
Estimated Models for the Elasticity of Substitution for RHC and Fee-for-Service Physician Visits in Underserved Non-Metropolitan Counties, by County Category, 1996

	Non-Metropolitan County Category				
	Adjacent, city	Adjacent, no city	Remote, city	Remote, town	Remote, no town
Model variable coefficients					
RHC use (ln)	-0.02	-0.09***	-0.09***	-0.08***	-0.11***
Percent in poverty	3.77***	1.92***	0.52	0.59	0.86*
Population density	2.08**	1.03*	0.41	-1.96	1.12
Intercept	5.92	6.66	7.03	6.93	6.94
Adjusted R^2	0.24	0.18	0.13	0.07	0.10
Change in visit rates at the mean					
10% change in RHC visits	7.9	11.0	7.8	13.7	21.7
Change in physician visits	-1.4	-7.4	-8.4	-6.2	-8.7

SOURCE: Denominator File, 1996; Physician/Supplier File, 1996; Institutional Outpatient File, 1996; ARF.

NOTES: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
Change in fee-for-service physician visits is calculated as the RHC use coefficient x 10 x mean physician visit rate (from Table 3.5).

Table 3.9 presents the estimates from the logistic regression models of the relationship between FQHC use and primary care physician use. The only significant substitution effect we found for FQHC and physician services was a small effect (coefficient=0.08) for counties adjacent to an MSA without a city. There also is a positive relationship between the county's poverty rate and physician visit rates in this county category, similar to that found in the RHC analyses (Table 3.8), which is not found for the other four county categories.

Table 3.9
Models Estimating the Elasticity of Substitution for FQHC and Fee-for-Service Physician Visits in Underserved Non-Metropolitan Counties, by County Category, 1996

	Non-Metropolitan County Category				
	Adjacent, city	Adjacent, no city	Remote, city	Remote, town	Remote, no town
Model variable coefficients					
FQHC use (ln)	-0.11	-0.08*	0.01	-0.04	-0.08
Percent in poverty	-0.83	1.84**	-1.49	0.13	-0.07
Population density	-1.41	1.26	0.73	-0.09	2.58
Intercept	7.19	6.60	6.87	6.78	6.85
Adjusted R^2	0.17	0.12	0.08	0.03	0.06

SOURCE: Denominator File, 1996; Physician/Supplier File, 1996; Institutional Outpatient File, 1996; ARF.

NOTES: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$
Rates of hospital stays are per 1,000 beneficiaries.

The separate FQHC analyses by county category provide useful comparative information, but they have less statistical power than combined model to detect a significant relationship between the FQHC and physician visit rates. We also estimated a model with all the counties in the sample, in which we included interaction terms for the natural log of FQHC visit rates and each of the county category indicators. We found no significant FQHC substitution effects in the combined model either.

POLICY ISSUES AND IMPLICATIONS

Based on both our difference-of-means and regression analyses, when RHCs are available to Medicare beneficiaries residing in non-metropolitan counties, the RHCs appear to be a substitute for fee-for-service primary care physician services. This relationship is strong overall, but the strength differs across the UIC-based county categories, and there is less than a one-to-one substitution in number of visits between these two types of primary care services for all but one category. The Government Accounting Office (GAO) conclusion (1996) that physicians already in practice in underserved areas have a financial incentive to organize as RHCs is based on the difference in the rules for RBRVS and RHC payments. The incentive is strengthened by the more favorable payment for Medicaid patients that also is available to physicians in RHCs, which may be even more important to physicians because Medicaid generally pays less than Medicare for fee-for-service primary care physician services.

Together, these financial factors may help explain the relationships observed in these study results. It is possible that the RHC program has helped preserve access to care for non-metropolitan Medicare beneficiaries by providing incentives for maintaining the supply of physicians as well as non-physician practitioners.

Neither the difference-of-means or logistic regression analyses offered any evidence that FQHCs are a substitute for primary care physician services. Rather, the results suggest that FQHCs tend to be located in counties with lower utilization rates and are complementary to physician services. Thus, FQHCs may be improving access to care by increasing the total supply of primary care providers in those counties.

4. PRIMARY CARE SERVICE USE AND AVOIDABLE HOSPITALIZATIONS

The analyses presented in this section examined the relationship between actual use of primary care services by the Medicare beneficiaries in non-metropolitan counties and their likelihood of having one or more avoidable hospitalizations for ACSCs. This analysis builds on previous work on avoidable hospitalizations by using actual utilization measures rather than self-reported access. Additionally, our analyses were for individuals residing in non-metropolitan areas, which previous studies have identified as having substantial variation in access to care and higher rates of avoidable hospitalizations. This research offers another test of the usefulness of avoidable hospitalization outcomes for monitoring access to appropriate primary care services. The analyses test the following hypotheses:

- Greater use of primary care services by non-metropolitan Medicare beneficiaries will reduce the likelihood of avoidable hospitalizations for *acute conditions* sensitive to ambulatory care.
- Greater use of primary care services by non-metropolitan Medicare beneficiaries will reduce the likelihood of avoidable hospitalizations for *chronic conditions* sensitive to ambulatory care.

As described in Section 2, we tested these hypotheses by estimating logistic regression models for which the dependent variable was a dichotomous variable for having at least one hospitalization and the key predictor variables were a set of indicator variables representing different levels of primary care visits. The unit of analysis was the individual beneficiary, and the study sample was all beneficiaries residing in non-metropolitan counties in 1996. Primary care visits were defined as the sum of all fee-for-service visits to primary care physicians and visits to RHCs or FQHCs by a beneficiary during 1996.

STUDY GROUP CHARACTERISTICS

Using the 1996 Medicare Denominator File for the 5 percent sample of beneficiaries, we subset the population to 471,890 beneficiaries who resided in non-metropolitan counties. To obtain our study sample, we excluded those who died during the year (4.7 percent), were not otherwise continuously enrolled in both Medicare Part A and B during the entire year (9.5 percent), were enrolled in managed care (2.8 percent), or had end-stage renal disease (0.6 percent). The resulting sample consisted of 390,223 beneficiaries. Table 4.1 summarizes the characteristics of the beneficiaries in the sample. Slightly more than half of the sample was female and more than 90 percent was white. Almost 50 percent of the sample was between the ages of 65 and 74 and approximately 13 percent was younger and disabled. Less than one-fifth of the sample was enrolled in Medicaid.

Table 4.1
Descriptive Characteristics of the Study Sample (N=390,223)

Sample Characteristic	Percentage of Sample
Female	56.7
White	93.5
With Medicaid	18.4
Age Group:	
Less than 65 years	13.2
65 to 74 years	47.9
75 to 84 years	29.5
85 years or older	9.3
At least one primary care visit	71.4
At least one avoidable hospitalization	
IOM Definition	
Acute Condition	2.7
Chronic Condition	3.1
McCall Definition	
Acute Condition	2.9
Chronic Condition	1.5
At least one hospitalization of any type	19.0

SOURCE: Denominator file for the 5 percent sample of beneficiaries and MEDPAR claims, 1996.

Small percentages of the beneficiaries in the sample had one or more avoidable hospitalizations during 1996. Similar percentages of beneficiaries with avoidable hospitalizations for acute conditions were identified by the IOM (2.7 percent) and McCall (2.9 percent) definitions. However, the IOM definitions identified twice as many beneficiaries with avoidable hospitalizations for chronic conditions than did the McCall definition (3.1 percent and 1.5 percent respectively).

In Table 4.2, we report total primary care visit rates per 100 beneficiaries for non-metropolitan Medicare beneficiaries, overall and by county category. Across all counties, fee-for-service physician visits represented approximately 81.8 percent of all primary care visits. The rates for physician services did not vary much across county categories, although they were somewhat lower for the most remote counties with no town. Differences across categories were statistically significant. RHC and FQHC visit rates varied across county categories, with higher rates for counties without a large city. Remote counties without a town had the highest rate of primary care visits at clinics. These variations also were statistically significant. These findings reflect a greater RHC/FQHC presence in the more remote counties (Farley et al., 2002).

We also report in Table 4.2 the rate of total primary care visits after deleting visits that occurred within six weeks of an avoidable hospitalization, which we treated as follow-up care. The variables for total primary care visits used in the regression model excluded these followup visits, which were considered to be separate from routine primary care services. On average, this exclusion resulted in a seven-visit decrease in total primary care visits per 100 beneficiaries.

Table 4.2
Rates of Primary Care Utilization Among Non-Metropolitan Medicare Beneficiaries, by County Category, 1996

Measures of Primary Care	All Counties	Non-Metropolitan County Category: Adjacent, city	Adjacent, no city	Remote, city	Remote, town	Remote, no town
Total primary care visits	340***	315	347	323	357	389
Physician visits	278***	281	278	283	278	261
RHC/FQHC visits	62***	34	69	40	79	135
Net visits after removing post-hospital care visits	333***	308	339	317	348	386

SOURCE: Physician Supplier files, Institutional Outpatient files and MEDPAR files for the 5 percent sample of beneficiaries, ARF.

NOTES: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
Primary care visit rates are per 100 beneficiaries. The total visit rates include all visits for ambulatory care as well as visits for followup care after hospital stays. The net visits in the last line of the table exclude visits that occurred within six weeks after an avoidable hospitalization, as defined by the IOM. For the McCall definition of avoidable hospitalizations, the average post-hospital care visit rate was approximately two visits less per person than for the IOM definition.

In Table 4.3, we present rates of total hospitalizations for the study sample as well as avoidable hospitalizations for each of the IOM and McCall definitions of ambulatory care sensitive conditions. All rates are presented for the total sample as well as by county category. The total hospitalization rate across counties was 301 per 1,000 beneficiaries and differences in hospitalization rates across county categories are statistically significant. Total hospitalization rates were slightly lower in adjacent and remote counties with a city and highest in remote counties without a town.

The rates of avoidable hospitalizations were small compared to total hospitalization rates. Counties in the three county categories with no city had higher avoidable hospitalization rates for both acute and chronic conditions than other county categories. Hospitalization rates for chronic conditions under the IOM definition were consistently higher than those for acute conditions, overall and for all county categories except the most remote counties. Notable differences in avoidable hospitalization rates were found for the IOM and McCall definitions. For chronic conditions, avoidable hospitalization rates based on the IOM definition were more than double those for the McCall definition. Additionally, the chronic condition avoidable hospitalization rates based on the IOM definition varied across county categories, but there was no significant variation across categories for the rates based on the McCall definition. By far the smallest avoidable hospitalizations rates were for preventive conditions in the McCall definition.

Table 4.3
Rates of Potentially Avoidable Hospitalizations Among Non-Metropolitan Medicare Beneficiaries, by County Category, 1996

		Non-Metro County Category				
	All Counties	Adjacent, city	Adjacent, no city	Remote, city	Remote, town	Remote, no town
Total hospitalization rates	301***	297	303	295	312	330
Avoidable hospitalization rates						
IOM Definition						
Acute Conditions	30***	27	31	28	32	39
Chronic Conditions	40**	38	42	37	41	41
McCall Definition						
Preventive Conditions	0.4*	0.3	0.4	0.2	0.5	0.5
Acute Conditions	33***	29	34	30	35	41
Chronic Conditions	18	17	19	18	19	19

SOURCE: MEDPAR data for the 5 percent sample of beneficiaries, ARF.

NOTES: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
Hospitalization rates are per 1,000 beneficiaries.

Few published studies allow us to directly compare rates of avoidable hospitalizations. In many cases, the studies combine avoidable hospitalization rates for acute and chronic conditions (Billings et al., 1993; Parchman and Culler, 1994; Kozak et al., 2001) and more often, they do not publish rates at all (Bindman et al., 1995; Pappas et al., 1997; Culler et al., 1998). The only study with directly comparable results was that by McCall et al. (2001). The authors produced rates that are lower than those calculated in this study. Acute condition avoidable hospitalizations were present with a rate of 20.4 per 1,000 population, chronic condition avoidable hospitalizations were present with a rate of 26.6 per 1,000 population, and preventive avoidable hospitalizations were present with a rate of 0.2 per 1,000 population. The acute and preventive condition avoidable hospitalization rates published here were higher and the chronic condition avoidable hospitalization rates were lower than these rates. It is important to note a major difference between these study samples. McCall et al. (2001) estimated its rates for a national sample of Medicare+Choice beneficiaries while our sample consisted of Medicare fee-for-service beneficiaries from non-metropolitan counties only.

Table 4.4 shows the contribution to avoidable hospitalization rates by the specific conditions included in the IOM and McCall definitions as well as to differences between them. The IOM definition of avoidable hospitalizations for chronic conditions includes angina while the McCall definition does not. Additionally, the IOM definition includes hypoglycemia in the category of chronic conditions while the McCall definition includes it in the category of acute conditions. For acute conditions, both definitions have five conditions in common. The other conditions unique to each definition are very rare events and do not contribute significantly to the total rates of hospitalizations. Appendix B presents more detailed information about which diagnoses are included in the definition of each condition for both the IOM and McCall definitions of avoidable hospitalizations.

Table 4.4
Rates of Potentially Avoidable Hospitalizations for Specific Conditions Among Non-Metropolitan Medicare Beneficiaries, by County Category, 1996

		Non-Metropolitan County Category				
	All Counties	Adjacent, city	Adjacent, no city	Remote, city	Remote, town	Remote, no town
IOM Definition						
Total Chronic Conditions**	39.6	37.8	41.5	37.3	40.5	40.9
Angina	8.2	8.3	8.3	8.3	8.0	7.8
Asthma	0.1	< 0.1	< 0.1	0.0	< 0.1	0.0
COPD	11.3	10.5	11.5	10.8	12.2	12.1
Seizure	1.7	1.7	1.6	1.9	1.7	1.5
CHF***	16.2	15.3	17.7	14.3	16.3	17.2
Diabetes*	0.6	0.5	0.7	0.4	0.7	0.7
Hypertension	1.4	1.4	1.5	1.4	1.6	1.5
Hypoglycemia	0.2	0.2	0.2	0.2	0.1	0.1
Total Acute Conditions***	30.4	27.2	31.4	27.7	32.0	38.8
Cellulitis	3.5	3.3	3.4	3.4	3.5	4.3
Dehydration**	4.7	4.5	4.7	4.3	4.8	6.2
Gastroenteritis***	1.7	1.5	1.6	1.3	1.9	2.6
Urinary Tract Infection***	4.9	4.3	5.4	4.2	5.4	5.3
Pneumonia***	15.1	13.1	15.7	14.1	16.0	19.7
Severe ENT Infection	0.1	< 0.1	0.1	0.1	< 0.1	< 0.1
Skin Graft w/Cellulitis	0.7	0.7	0.8	0.6	0.7	0.7
McCall Definition						
Total Chronic Conditions	18.4	17.3	18.8	18.0	19.4	18.9
Asthma/COPD	11.5	11.0	11.7	11.2	12.2	11.6
Seizure Disorder	1.8	1.7	1.7	1.9	1.8	1.5
CHF	1.0	1.0	0.9	1.1	0.8	0.8
Diabetes*	2.6	2.3	2.7	2.2	2.9	3.1
Hypertension	1.7	1.6	1.7	1.6	1.7	1.8
Total Acute Conditions***	32.6	29.1	33.9	29.7	34.5	41.2
Cellulitis	3.7	3.5	3.7	3.6	3.7	4.5
Dehydration**	4.7	4.5	4.7	4.4	4.8	6.2
Gastric or Duodenal Ulcer	1.0	0.8	1.0	1.0	1.1	1.3
Urinary Tract Infection***	5.3	4.8	5.9	4.5	5.9	5.9
Bacterial Pneumonia***	17.1	14.8	17.8	15.5	18.3	22.1
Severe ENT Infection	0.2	0.1	0.2	0.2	0.2	3.7
Hypoglycemia	0.2	0.2	0.2	0.2	0.1	0.2
Hypokalemia	0.4	0.3	0.4	0.3	0.5	0.6
Total Preventive Conditions*	0.4	0.3	0.4	0.2	0.5	0.5
Malnutrition	0.2	0.2	0.2	0.1	0.1	0.2
Influenza**	0.2	0.1	0.2	0.2	0.3	0.3

SOURCE: MEDPAR data for the 5 percent sample of beneficiaries, ARF.

NOTE: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
Rates of hospital stays are per 1,000 beneficiaries.

EFFECTS OF PRIMARY CARE ON AVOIDABLE HOSPITALIZATIONS

Tables 4.5 and 4.6 present the results of the logistic regression models of the relationship between at least one avoidable hospitalization and use of primary care services by non-metropolitan beneficiaries. The regression results for avoidable hospitalizations for acute conditions are in Table 4.5, and the results for chronic conditions are in Table 4.6. In both tables, we report the results for the IOM and McCall definitions side by side to assess the similarities and differences for the two definitions.

Our overall findings were that beneficiaries who had more primary care visits were less likely to have an acute condition avoidable hospitalization but were more likely to have a chronic condition avoidable hospitalization. Our use of 1996 primary care data to predict 1996 hospitalizations has implications for inferring primary care influence on avoidable hospitalizations. For acute conditions, the relationship between visits and hospital admissions is a short-term one, such that a visit today could potentially prevent an avoidable inpatient stay tomorrow. In the case of chronic conditions, the cumulative effects of continuing primary care services may be what affect inpatient stays. Therefore, primary care services in the previous year may be a better predictor of chronic condition avoidable hospitalizations in the current year, whereas current-year primary care visits may be more an indicator of acuity of illness. This scenario is a possible explanation for our findings for chronic condition avoidable hospitalizations. We did exclude from our counts of primary care visits those visits that occurred within six weeks of an inpatient stay so as to avoid confusing "follow-up" care with care that could reduce the likelihood of an avoidable hospitalization. This adjustment to the counts of primary care visits resulted in seven fewer visits per 100 beneficiaries based on the IOM definition of an avoidable hospitalization (see Table 4.2).

Avoidable Hospitalizations for Acute Conditions

The patterns of association found for avoidable hospitalizations for acute conditions were quite similar for the IOM and McCall definitions (see Table 4.5). In both cases, we observed a negative association between primary care visits and the likelihood of one or more acute condition avoidable hospitalizations. There appears to be a threshold effect rather than a linear relationship. One or two primary care visits during the year did not significantly reduce one's likelihood of having an avoidable hospitalization, but both 3 to 4 visits and 5 or more visits during the year were associated with lower likelihoods of an avoidable hospitalization, with coefficients that were similar in size and significant.[6]

[6] One to two primary care visits may very well reflect "normal" use rates for "healthy" beneficiaries.

Table 4.5
Logistic Regression Results for the Relationship Between Primary Care Visits and One or More Avoidable Hospitalizations for Acute Conditions, 1996

	IOM Definition		McCall Definition	
Variable	Coefficient	Odds Ratio	Coefficient	Odds Ratio
Primary Care Visits				
1 to 2 visits	-0.046	0.96	-0.016	0.98
3 to 4 visits	-0.120	0.89***	-0.105	0.90***
5+ visits	-0.123	0.88***	-0.108	0.89***
Beneficiary Characteristics				
Female	0.075	1.08**	0.025	1.03
Black	-0.173	0.84***	-0.147	0.86***
Other Race	-0.005	1.00	0.004	1.00
Age < 65 years	0.177	1.19***	0.127	1.14***
Age 75-84 years	0.490	1.63***	0.479	1.61***
Age 85+ years	1.013	2.75***	0.990	2.69***
Medicaid	0.635	1.89***	0.617	1.85***
Number of Co-Morbidities	0.726	2.07***	0.746	2.11***
County Characteristics				
Adjacent, No City	0.050	1.05	0.061	1.06*
Remote, City	0.023	1.02	0.027	1.03
Remote, Town	0.083	1.09*	0.094	1.10**
Remote, No Town	0.165	1.18***	0.147	1.16***
Frontier County	-0.136	0.87*	-0.145	0.87**
HPSA/MUA	-0.023	0.98	-0.018	0.98
County 30%+ Below Poverty	-0.095	0.91	-0.089	0.92
Per Capita Income	-0.025	0.98***	-0.028	0.97***
# Hospitals per 100,000 Pop.	0.016	1.02***	0.018	1.02***
Female*Medicaid (interaction)	-0.182	0.83***	-0.153	0.86**

SOURCE: 1996 5% Medicare Denominator File, 5% Medpar File, 5% Institutional Outpatient File, 5% Physician/Supplier File, ARF.

NOTE: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

For most of the beneficiary characteristics, the associations with avoidable hospitalizations for acute conditions were consistent with our expectations based on the previously published literature on this topic (see Section 1), and results were similar for the IOM and McCall definitions. Beneficiaries who were dually-eligible for both Medicare and Medicaid were almost 90 percent more likely than other beneficiaries to have an avoidable hospitalization. All older and younger age cohorts also were more likely than the 65 to 74 age cohort to have such a hospitalization. Women had a slightly higher likelihood than men of having an avoidable hospitalization, but this effect was significant only for the IOM definition. Women eligible for Medicaid were slightly less likely than others to have an avoidable hospitalization, suggesting that Medicaid eligibility may increase access to services for women that they may not have had otherwise.

A notable finding was the relationship between race (black versus white) and acute condition avoidable hospitalizations for non-metropolitan beneficiaries. Blacks were estimated to be between 14 and 16 percent less likely to have an avoidable hospitalization. This result is contrary to previously published studies, which typically used samples that included both urban and rural populations. One explanation for our findings may be that relatively more favorable health experiences for rural blacks were masked in the combined study samples, which were dominated by the larger number of urban individuals.

Beneficiaries in remote counties, with or without a town, were significantly more likely to have an avoidable hospitalization for acute conditions than those in more urbanized non-metropolitan counties. However, the most remote counties defined by frontier county status were significantly less likely to have such a hospitalization. Another surprising finding was that beneficiaries residing in counties with a HPSA or MUA designation (partial or whole county designation) were no more or less likely to have an avoidable hospitalization than beneficiaries residing in counties without such a designation. This finding was consistent with the study by Culler et al. (1998) in which the authors found that residence in a whole-county HPSA (either rural or urban) was not significantly associated with having an avoidable hospitalization. As we have observed elsewhere (Parchman and Culler, 1994), acute condition avoidable hospitalizations were less likely for beneficiaries residing in wealthier counties and were more likely for beneficiaries residing in counties with more hospitals per 100,000 population. However, the magnitude of both relationships was small.

Avoidable Hospitalizations for Chronic Conditions

In contrast to the results for avoidable hospitalizations for acute conditions, we found that more primary care visits were associated with an increased likelihood of having a chronic condition avoidable hospitalization, as shown in Table 4.6. This result was obtained for both the IOM and McCall definitions, although the relationship was larger and more significant for the IOM definition. Similar to the acute condition results, we found a threshold effect for chronic condition hospitalizations. In this case, however, both 3 to 4 visits and 5 or more visits during the year produced increases in the likelihood of chronic condition avoidable hospitalizations that were similar in size and significant.

Associations between avoidable hospitalizations for chronic conditions and beneficiary characteristics were consistent with previous research findings, although there were some inconsistencies between the IOM and McCall definitions that were not found for the acute condition avoidable hospitalizations (see Table 4.6). For both definitions, beneficiaries dually-eligible for Medicare and Medicaid were significantly more likely than other Medicare beneficiaries to have an avoidable hospitalization for chronic conditions. Additionally, beneficiaries with more co-morbidities were more likely to have a chronic condition avoidable hospitalization under both definitions. Differences were found for gender and race (black versus white), both of which were significantly and positively associated with this outcome based on the McCall definition but were not significant predictors of chronic condition avoidable hospitalizations based on the IOM definition.

Table 4.6
Logistic Regression Results for the Relationship Between Primary Care Visits and One or More Avoidable Hospitalizations for Chronic Conditions, 1996

	IOM Definition		McCall Definition	
Variable	Coefficient	Odds Ratio	Coefficient	Odds Ratio
Primary Care Visits				
1 to 2 visits	0.128	1.14***	0.025	1.03
3 to 4 visits	0.211	1.23***	0.138	1.15**
5+ visits	0.205	1.23***	0.152	1.16***
Beneficiary Characteristics				
Female	0.025	1.03	0.172	1.19***
Black	-0.058	0.94	0.128	1.14**
Other Race	-0.067	0.94	-0.116	0.89
Age < 65 years	0.277	1.32***	0.478	1.61***
Age 75-84 years	0.160	1.17***	-0.024	0.98
Age 85+ years	0.236	1.27***	-0.321	0.73***
Medicaid	0.217	1.24***	0.501	1.65***
Number of Co-Morbidities	0.943	2.57***	0.795	2.22***
County Characteristics				
Adjacent, No City	0.014	1.01	0.007	1.01
Remote, City	0.006	1.01	0.061	1.06
Remote, Town	0.042	1.04	0.055	1.06
Remote, No Town	0.047	1.05	0.003	1.00
Frontier County	-0.298	0.74***	-0.234	0.79**
HPSA/MUA	0.020	1.02	-0.016	0.98
County 30%+ Below Poverty	0.016	1.02	0.166	1.18**
Per Capita Income	-0.023	0.98***	-0.032	0.97***
# Hospitals per 100,000 Pop.	0.004	1.00	0.009	1.01**
Female*Medicaid (interaction)	-0.003	1.00	-0.172	0.84**

SOURCE: 1996 5% Medicare Denominator File, 5% MEDPAR File, 5% Institutional Outpatient File, 5% Physician/Supplier File, ARF.

NOTE: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Under the McCall definition, blacks were estimated to be about 14 percent more likely than whites to have an avoidable hospitalization for chronic conditions, which is the reverse of the effect for acute conditions. Women were also 19 percent more likely to have a chronic condition avoidable hospitalization than men. Women are more likely than men to suffer from chronic conditions as they age (Verbrugge, 1990), which may explain some of the gender differences in our findings. Interestingly, women eligible for Medicaid had a reduced risk of having an chronic condition avoidable hospitalization than men or women without Medicaid, suggesting that Medicaid may improve access for some individuals but not others.

The relationship of the age cohort variables to chronic condition avoidable hospitalizations also differed for the IOM and McCall definitions. For both models we found that younger disabled beneficiaries were more likely to have a chronic condition avoidable hospitalization than those age 65 to 74. However, the models differed for the older age cohorts.

For the IOM definition, beneficiaries age 75 to 84 had a greater likelihood of avoidable hospitalization than those age 65 to 74, and the likelihood was even greater for the oldest age group. For the McCall definition, beneficiaries age 75 to 84 did not have a different likelihood of an avoidable hospitalization from the reference group, but those in the oldest age group were significantly less likely to have one.

The differences in hospitalization rates between the IOM and McCall definitions can be attributed to differences in the conditions included in the respective chronic condition groupings. Within the McCall definition, differences in rates were small among the three groups of beneficiaries age 65 or older. The reference group of those age 65 to 74 had 15.8 avoidable hospitalizations per 1,000 beneficiaries, compared with 28.9 for those less than 65 years of age, 18.9 for those age 75 to 84, and 15.4 for those age 85 or older. Thus, the lower rates estimated for the oldest group is the independent effect of age after controlling for other variable(s) that contributed to increasing hospitalization rates for this age group.

The likelihood of having a chronic condition avoidable hospitalization was not influenced by the county category variables (see Table 4.6), but there were some effects for other county-level variables, which differed for the IOM and McCall definitions. Beneficiaries residing in frontier counties and in counties with higher per capita income were less likely to experience a chronic condition avoidable hospitalization under both the IOM and McCall definitions. Beneficiaries living in counties with a high poverty rate and those with more hospitals located in the county were significantly more likely to have an avoidable hospitalization in the McCall model only.

Additional Analyses

Two additional analyses were performed to develop additional information on issues raised in the avoidable hospitalization analysis. First, we tested whether primary care visits in an RHC or FQHC had any influence on the likelihood of an avoidable hospitalization separate from visits to primary care physicians. Second, we examined how primary care visits might affect the likelihood of having any type of hospitalization to provide a comparison for the avoidable hospitalization results.

Effects of RHC/FQHC visits. To analyze the independent effects of RHC/FQHC visits on avoidable hospitalizations, we created separate categorical variables for physician visits and RHC/FQHC visits with the same categories used for total primary care visits: no visits, one to two visits, three to four visits, and five or more visits. We also defined a dummy variable that identified beneficiaries who used both physician and RHC/FQHC visits. Thus, the coefficients on the categorical variables for physician visits and RHC/FQHC visits represented effects for beneficiaries who used only one or the other of these services. We estimated the avoidable hospitalization models with the separate sets of physician and RHC/FQHC variables as well as the dummy variable for use of both physicians and RHC/FQHCs. The results for the IOM and McCall acute condition models, shown in Table 4.7, indicate that the number of physician visits and the number of RHC/FQHC visits were independently associated with a lower likelihood of an avoidable hospitalization related to an acute condition. These models also indicate that beneficiaries who used both physician and RHC/FQHC visits were much more likely to have an avoidable hospitalization. For physician visits, we found the same pattern obtained for total primary care visits, where greater numbers of visits were associated with a smaller likelihood of avoidable hospitalization. For RHC/FQHC visits, however, a lower likelihood of avoidable hospitalization was found for 1 to 2 visits and for 3 to 4 visits, but not for 5 or more visits. The models for the chronic condition avoidable hospitalizations yielded a significant and positive relationship between both physician visits and RHC/FQHC visits avoidable hospitalizations. All these results held for both the IOM and McCall definitions.

Table 4.7
Separate Effects Estimated for Fee-for-Service Physician Visits and RHC/FQHC Visits and Avoidable Hospitalizations for Medicare Beneficiaries, 1996

	IOM Model		McCall Model	
	Coefficient	Odds Ratio	Coefficient	Odds Ratio
Physician visits				
1 to 2 visits	-0.089	0.91**	-0.064	0.94*
3 to 4 visits	-0.172	0.84***	-0.153	0.86***
5 or more visits	-0.204	0.82***	-0.196	0.82***
RHC/FQHC visits				
1 to 2 visits	0.216	0.81***	-0.188	0.83***
3 to 4 visits	-0.274	0.76***	-0.294	0.75***
5 or more visits	0.084	0.92	-0.082	0.92
Used both physicians and RHC/FQHCs	0.408	1.50***	0.412	1.51***

SOURCE: 1996 5% Medicare Denominator File, 5% MEDPAR File, 5% Institutional Outpatient File, 5% Physician/Supplier File, ARF.

NOTE: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
Only coefficients for the primary care visit variables are reported. Other control variables for beneficiary and county characteristics were included in the model

The implications of the results for the avoidable hospitalizations model for acute conditions differ depending on how beneficiaries used primary care services. As shown in Table 4.8, the study sample contained four subgroups of beneficiaries with respect to use of primary care services. An estimated 58.6 percent of the beneficiaries used only primary care physician services, and 8.9 percent used only RHC/FQHC services. Only the small fraction of beneficiaries (3.9 percent) who used both physician and RHC/FQHC services were at higher risk of avoidable hospitalization when compared to the 28.6 percent who had no primary care visits. It would be worth examining factors that might explain why those using both physician and RHC/FQHC services were more likely to have avoidable hospitalizations, such as demographic characteristics, health status, types of services received from the RHC/FQHCs, wait time for services, or other access issues.

Effects on Total Hospitalizations. We estimated logistic regression models specified as we had specified the models for the avoidable hospitalization analyses, except that the dependent variable was a dichotomous variable for having at least one hospitalization of any type. We found a significant and positive relationship between primary care visits and having a hospitalization, which was consistent regardless of the number of visits made by the beneficiary (results not shown). This result indicates that individuals who are hospitalized for a health problem may be using more outpatient services either to avoid or forestall inpatient care or to prepare for the inpatient stay.

Table 4.8
Distribution of Medicare Beneficiaries by the Type of Primary Care Providers Used, 1996

	Number of Beneficiaries	Percentage of Total
No primary care visits	111,704	28.6
Physician care visits only	228,745	58.6
RHC/FQHC visits only	34,745	8.9
Physician & RHC/FQHC visits	15,029	3.9

SOURCE: 5% Medicare Denominator File, 5% Physician/Supplier File, ARF.

POLICY ISSUES AND IMPLICATIONS

The analytic results contained in this section have identified some important relationships between primary care services and avoidable hospitalizations for ACSCs. In addition, the findings have raised policy implications regarding use of avoidable hospitalizations as a measure of poor access to care.

Among Medicare beneficiaries residing in non-metropolitan counties, we found strong and significant relationships between primary care utilization and the likelihood of having one or more avoidable hospitalizations. This relationship was negative with respect to avoidable hospitalizations related to acute conditions but positive with respect to avoidable hospitalizations related to chronic conditions. There appears to be a similar threshold effect in which three or more primary care visits *reduces* the likelihood of having an avoidable hospitalization for acute conditions while three or more visits *increases* the likelihood of having an avoidable hospitalization for chronic conditions. These patterns exist for both the IOM and McCall definitions of avoidable hospitalizations, but the magnitude of effects in each set of models varies. On average, three or more primary care visits reduced the likelihood of an acute condition avoidable hospitalization by 11 percent. For chronic conditions, three or more visits were associated with a 15 to 23 percent increased likelihood of an avoidable hospitalization (depending on the definition of avoidable hospitalization used).

To our knowledge, no prior studies have examined the relationship between the use of primary care services and the likelihood of having an avoidable hospitalization at the individual level. Several studies examined the relationship between community access or the availability of primary care providers and rates of avoidable hospitalization finding a negative relationship between better access/availability and higher rates of avoidable hospitalizations (Parchman et al., 1994; Ricketts et al., 2001; Epstein, 2001). These previous studies did not distinguish between avoidable hospitalizations resulting from acute or chronic conditions.

The IOM and others have argued that timely and appropriate outpatient care can reduce the likelihood of hospitalizations for ambulatory care-sensitive conditions (IOM, 1993). Our findings suggest that health care services provided in a primary care community setting may directly affect subsequent avoidable hospitalizations for acute conditions by providing services that can treat a condition that is already present or by avoiding acute problems through effective preventive care. However, primary care may not have the same influence on avoidable chronic care hospitalizations.

Primary care serves three general functions: preventive care, timely treatment of acute events, and disease management for chronic conditions. Whereas relatively healthy individuals can avoid hospitalizations for acute conditions with regular visits to their primary care provider, individuals living with a chronic condition have different needs, and the care they receive may be qualitatively different. Chronic conditions require disease management but such care may not guarantee that the patient will stay out of the hospital. We controlled for co-morbidities in our analyses, but we may not have adequately controlled for severity of disease. It is possible that hospitalizations for chronic conditions defined here as avoidable hospitalizations may have been completely appropriate, depending on disease severity and resources to manage disease.

While our study focus was on the relationship between the use of primary care services and the likelihood of having an avoidable hospitalization, we were also interested in knowing how other beneficiary and county characteristics might influence the likelihood of such an event. Most of our findings for the model covariates were consistent with findings from other studies, but some of our findings were inconsistent with previous research.

As with previous studies, we found that Medicaid eligibility significantly increased the likelihood of an avoidable hospitalization while the probability of having an avoidable hospitalization declined with increases in per capita income. Additionally, older age was found to significantly predict an increased likelihood of having an avoidable hospitalization (with the exception of the McCall definition of an avoidable chronic care hospitalization).

Our findings differed from previously reported analyses for race and residence in an underserved region. Our analyses were limited to those Medicare beneficiaries residing in non-metropolitan counties while other studies also included metropolitan areas. This geographic restriction may in part explain the differences across the studies, and may reflect urban-rural differences. Other design factors may also explain the different findings including population selection. For example, our sample was Medicare beneficiaries while others looked at younger populations, and our analysis was at the individual level while some only studied aggregate rates. Finally, we included a case mix variable with counts of comorbidities, which was a significant predictor of avoidable hospitalizations.

A new contribution of this study was the examination of geographic effects on the relationship between primary care use and avoidable hospitalizations, using the UIC-based county categories for extent of rurality. For acute conditions, we found that residents of remote non-metropolitan counties, with or without a town, were slightly more likely to have an avoidable acute care hospitalization than those in less remote counties. This finding suggests that access to any primary care may be limited in these more remote counties. Total primary care use rates were highest in the remote counties and these higher rates were due to higher use of RHC/FQHCs services than physician services. As we reported earlier, RHC/FQHC services did not have the same effect as physician services on reducing the likelihood of an avoidable hospitalization for acute conditions, and this may explain in part why we see these differences by county category. We found that county category did not influence whether or not one might have an avoidable chronic care hospitalization.

Another new and interesting finding was the relationship between residence in a frontier county and the likelihood of having one or more avoidable hospitalizations. Residence in a frontier county was associated with a smaller probability of having any type of avoidable hospitalization, and this finding was consistent across definitions of avoidable hospitalizations. It is not entirely clear why we observe this relationship but we might hypothesize that Medicare beneficiaries residing in these counties may be healthier on average than those living in less rural non-metropolitan counties. For example, some beneficiaries living in sparsely population areas may move into larger towns as they age to gain better access to health care.

Policy Implications

The main motivation for performing the avoidable hospitalization analysis was to better understand access to care issues for rural beneficiaries. Two basic policy implications emerged from the analysis, of which one is substantive and the other is related to measurement.

Substantively, our findings suggest that Medicare rural beneficiaries who have fewer than three primary care visits per year are more likely to have avoidable hospitalizations for acute health conditions, but that increased numbers of visits may not have additional benefit of reducing such hospitalizations further. Thus, avoidable hospitalizations for acute conditions should be a useful indicator for monitoring access to primary care. Additionally, initiatives for increasing primary care activity should focus on beneficiaries who are not getting any primary care rather than on generally increasing visit rates even for those who are actively seeking care. On the other hand, avoidable hospitalizations for chronic conditions do not appear to be a signal for problems with access to primary care services; rather, greater use of primary care use may reflect greater use of disease management services by patients with higher severity of illness who also are more likely to require hospital care that healthier individuals might avoid.

The measurement issue emerges from our finding that rural Medicare beneficiaries have had relatively low rates of avoidable hospitalizations for acute conditions. How useful is a measure based on such relatively infrequent events, and with such a threshold effect for primary care use rates, as a monitoring indicator of access to care? To the extent that a measure of avoidable hospitalizations for acute conditions also is a proxy for other health effects of poor access to primary care, then it should be a meaningful monitoring tool. In addition, monitoring of changes over time in this measure could help flag locations where primary care use rates by Medicare beneficiaries may be declining below the threshold. Further consideration of this issue is advisable, including assessment of the resource investment required for monitoring.

5. COMPARISON OF DEFINITIONS OF RURALITY

The purpose of this comparative analysis was to generate information to assist CMS in evaluating the relative merits of the new RUCA codes as an alternative to the existing county-based systems for categorizing rural areas by degree of rurality. As discussed in Section 1 and Appendix A, the RUCA codes are defined at the level of the census tract, and a crosswalk has been developed to establish codes by zip code. There are a total of 30 RUCA codes—10 primary codes with 20 subcodes associated with them. These codes were defined on the basis of the Census Bureau definitions of urban and rural locations along with patterns of commuting flows for individuals residing in each census tract.

A primary purpose of the RUCA codes was to define areas that are more geographically specific than the existing county-level codes and, therefore, to achieve greater homogeneity in the urban or rural characteristics of the areas and the populations living within them. In this context, our comparative analysis was designed to answer the following research questions:

- How do the RUCA codes and UICs differ in the way they classify the population of Medicare beneficiaries based on the extent of urban or rural nature of their locations?
- How do the RUCA codes and UICs differ in the way they estimate use rates for primary care and specialty care physician services based on the extent of urban or rural nature of the locations of Medicare beneficiaries?

BENEFICIARY CLASSIFICATION AND SERVICE USE PATTERNS

In preparation for comparing the RUCA codes and UICs, each of these codes was matched to the record for each beneficiary in the 1998 100 percent Denominator file based on the beneficiary's county (for the UIC) or zip code (for the RUCA code) of residence. We also matched the codes to the primary care physician visits for beneficiaries residing in non-metropolitan counties. We then created a RUCA code category variable that aggregated the 30 RUCA codes into four categories based on degree of rurality, which are analogous to the UIC-based county categories we had created for our trend analyses. (See Section 2 for details of the methods and code categories.)

For the basic comparison of the RUCA codes and UICs, we cross-tabulated the Medicare beneficiary records by the original RUCA codes and the UICs. The results of this analysis are reported in detailed tables in Appendix C (see Tables C.1 and C.2). In general, we found consistency between the two coding systems in how they classified beneficiaries residing in metropolitan areas or in the most remote rural areas, but they diverged in their classification of beneficiaries in non-metropolitan counties adjacent to MSAs or with cities or towns. Furthermore, by definition, individuals assigned to one of nine UICs were distributed more widely across the larger number of RUCA codes, which should contribute to more homogeneous geographical characteristics for each of those smaller designations.

The remainder of the analysis examined shifts in distributions of beneficiaries and primary care physician visits across the higher-level code categories for each of the two geographic systems. The results for distributions of beneficiaries, shown in Table 5.1, reflect the more detailed findings presented in Appendix C. Of the beneficiaries classified by the UIC-based categories as residing in Metropolitan areas, 94.1 percent were classified in the metropolitan RUCA category. Similarly, of those in the UIC-based category for remote county with no town, 94.4 percent were classified in the isolated rural RUCA category. We note that for all of the UIC-based categories, some beneficiaries were assigned to each of the four RUCA categories, reflecting differences in the two classification methods.

Table 5.1
Percentage Distribution Across RUCA Code Categories of Medicare Beneficiaries Assigned to Each UIC-Based Category, 1998

UIC-based Source Category	Number of Beneficiaries (1,000s)	Percentage by RUCA Category: Metro-politan	Large Rural	Small Rural	Isolated Rural
Metropolitan	30,060	94.2%	2.8%	1.9%	1.1%
Adjacent, city 10,000	2,392	10.1	69.9	11.9	8.1
Adjacent, no city	2,882	11.5	4.9	49.0	34.6
Remote, city 10,000	1,700	5.5	77.9	7.8	8.8
Remote, town 2,500	1,896	0.9	6.7	64.9	27.5
Remote, no town	707	0.6	4.2	0.9	94.3

NOTE: 100% Denominator File data for Medicare beneficiaries, 1998

The greatest shifts in beneficiary assignments occurred for those residing in two of the categories of UIC-based non-metropolitan counties that did not have cities. Of those in adjacent counties with no city, 49.0 percent were classified in small rural RUCA category and another 34.6 percent were classified in the isolated rural category. Similarly, of those in the remote counties with a town of 2,500 (but no city), 65.0 percent were classified in the small rural RUCA category and 27.5 percent were classified in the isolated rural category.

Another way to compare the two coding systems is to examine the direction of shift of beneficiaries from a UIC-based category to the comparable categories based on RUCAs. In this case, we collapsed the five non-metropolitan UIC categories to three by combining the two categories of counties with a city of at least 10,000 population into a large rural category and by combining the counties adjacent to an MSA without a city and the remote counties with a town of 2,500 into a small rural category. The remote rural category was retained as comparable to the isolated rural RUCA category. Presented in Table 5.2 are the counts and percentages of Medicare beneficiaries who were classified in the same category under the two coding systems, were shifted to less rural RUCAs, or were shifted to more rural RUCAs. These results reveal that, overall, 10.1 percent of beneficiaries were classified in more rural RUCAs than they were classified using the UIC-based categories, while only 2.5 percent were classified in less rural RUCAs. Thus, there was a net shift of classification toward more rural RUCA categories.

Table 5.2
Shift in the Distribution of Medicare Beneficiaries from UIC to RUCA Categories, 1998

Shift from UIC Category to RUCA Category	Beneficiaries (1,000s)	Number by RUCA Category			
		Metropolitan	Large Rural	Small Rural	Isolated Rural
Number of beneficiaries					
Same category	34,622	28,317	2,996	2,643	667
To less rural RUCA	992	688	298	6	0
To more rural RUCA	4,023	0	842	988	2,193
Total	39,637	29,004	4,136	3,637	2,859
Percentage of beneficiaries					
Same category	87.3%	97.6%	72.4%	72.7%	23.3%
To less rural RUCA	2.5	2.4	7.2	0.2	0.0
To more rural RUCA	10.1	0.0	20.4	27.2	76.7

NOTE: 100% Denominator File data for Medicare beneficiaries, 1998

The number and percentage differences in the beneficiaries classified in each of the four categories, as defined by the RUCA and the UIC-based groupings (using the same collapsed UIC-based categories), are reported in Table 5.3. Again, the RUCA codes yielded a shift toward assignments to more rural categories, in that 11.0 percent more beneficiaries were classified as rural residents under the RUCA codes than under the UIC-based codes. At the same time, 3.5 percent fewer beneficiaries were classified as urban residents by the RUCA codes.

Table 5.3
Beneficiaries Classified as Urban or Rural by the UIC and RUCA Categories, 1998

Type of Category	Number by Category (1,000s)				
	Metropolitan	Large Rural	Small Rural	Isolated Rural	All rural
UIC	30,060	4,092	4,778	707	9,577
RUCA	29,004	4,136	3,637	2,859	10,633
Difference (RUCA -- UIC)					
Number	-1,056	44	-1,141	2,152	1,056
Percentage	-3.5%	1.1%	-23.9%	304.4%	11.0%

NOTE: 100% Denominator File data for Medicare beneficiaries, 1998

The shifts in distribution of primary care and specialty care physician visits for non-metropolitan beneficiaries, shown in Tables 5.4 and 5.5, are quite similar to those for the Medicare beneficiaries (see Table 5.1). These distributions are based on the location of residence for the beneficiaries using the visits, and visits for beneficiaries in metropolitan areas are excluded. Even with the exclusion of metropolitan beneficiaries, 9.5 to 10.5 percent of primary care visits and 11.4 percent of specialty care visits for beneficiaries in UIC-based counties adjacent to MSAs were classified in the RUCA metropolitan category. This finding reflects the urbanized nature of these counties.

Table 5.4
Percentage Distribution Across RUCA Code Categories of Primary Care Physician Visits for Medicare Beneficiaries Assigned to Each UIC-Based Category, 1998

Non-metropolitan UIC-Based Source Category	Visits (1,000s)	Percentage by RUCA Category: Metro-politan	Large Rural	Small Rural	Isolated Rural
Adjacent, city 10,000	346	9.5	71.0	12.2	7.3
Adjacent, no city	416	10.5	5.3	51.3	32.8
Remote, city 10,000	253	4.6	80.7	7.1	7.6
Remote, town 2,500	282	0.8	6.7	67.9	24.6
Remote, no town	101	0.4	4.3	0.9	94.5

NOTES: For beneficiaries living in non-metropolitan counties.
Physician claims for 5% beneficiary sample for 1998.

Table 5.5
Percentage Distribution Across RUCA Code Categories of Specialty Care Physician Visits for Medicare Beneficiaries Assigned to Each UIC-Based Category, 1998

Non-metropolitan UIC-based Source Category	Visits (1,000s)	Percentage by RUCA Category: Metro-politan	Large Rural	Small Rural	Isolated Rural
Adjacent, city 10,000	298	11.4	69.8	11.5	7.3
Adjacent, no city	321	11.4	6.1	50.0	32.5
Remote, city 10,000	198	6.0	79.0	7.4	7.6
Remote, town 2,500	192	0.9	7.2	65.4	26.4
Remote, no town	64	0.9	4.7	0.9	93.6

NOTES: For beneficiaries living in non-metropolitan counties.
Physician claims for 5% beneficiary sample for 1998.

Presented in Table 5.6 are annual primary care and specialty care visit rates for Medicare beneficiaries, estimated for each of the UIC-based categories and RUCA categories. These rates are calculated for beneficiaries residing in UIC-based non-metropolitan counties. Of interest, there were no clear patterns across categories for primary care use rates for either the UIC-based or RUCA categories. However, such patterns were found for specialty care use rates.

The results for specialty care visit rates suggest that the UICs and RUCA codes may differ with respect to achieving monotonicity of measures based on extent of rurality. For the UIC-based categories, specialty care visit rates ranged from 2.5 to 1.8 visits per year. The highest rate was found for counties adjacent to an MSA and with a city of 10,000, and the second rate of 2.3 visits per year was for remote counties with a city. Thus, although both adjacency to an MSA and presence of a city affected visit rates, the presence of a city had a somewhat stronger effect. For the RUCA code categories, however, there was a monotonic decline in visit rates from 2.5 visits per year in metropolitan areas to 2.0 visits per year in isolated rural areas.

Table 5.6
Primary Care Visit Rates per Medicare Beneficiary by UIC-Based and RUCA Code Categories, 1998

Geographic Category	Annual Visits per Beneficiary: Primary Care	Specialty Care	Total
UIC-based:			
Adjacent, city 10,000	2.9	2.5	5.4
Adjacent, no city	2.9	2.2	5.1
Remote, city 10,000	3.0	2.3	5.3
Remote, town 2,500	3.0	2.0	5.0
Remote, no town	2.9	1.8	4.7
RUCA-based:			
Metropolitan	2.7	2.5	5.2
Large rural	3.0	2.4	5.4
Small rural	3.0	2.2	5.2
Isolated rural	2.7	2.0	4.7

NOTE: For the 5% sample of beneficiaries living in non-metropolitan counties, 1998.

POLICY ISSUES AND IMPLICATIONS

The new RUCA codes offer an alternative to the county-level geographic codes that potentially can provide more precise stratification of rural areas for policy making and research purposes. Assigning RUCA codes at the level of census tracts establishes much more localized units of analysis. The use of commuting flows as a dimension of the RUCA codes is intuitively appealing for health policy research because people may travel for health care services in ways similar to how they commute for work. Although MSA designations also are based on commuting flow data, the RUCA codes reflect flows for more geographically localized areas. This premise merits testing to assess the degree to which there is concordance between travel for work and travel to obtain health care services. Further, the crosswalk that assigned RUCA codes to zip codes makes the coding system more accessible for research purposes.

The results of our comparative analysis of the RUCA codes and UICs highlight the features of the RUCA codes. At the level of the basic codes, we found the two sets of codes to be quite consistent in the way they classified metropolitan areas or the most remote rural areas, because counties in these areas are fairly homogeneous in their composition of urbanized or rural areas. For other counties, however, several different RUCA codes were assigned to zip codes within the counties, resulting in distributions of RUCA codes for each category of UICs. These distributions reflect the more diverse mix of urban and rural locations within these counties. This result at the level of the basic codes (reported in Appendix C) also is reflected in the results by code categories reported in this Section. Thus, analyses that use geographic coding could yield different results depending on whether they used the RUCA codes or UICs.

The net effect of the differences between the two coding systems was that the RUCA codes classified 11 percent more beneficiaries as rural residents than did the UIC-based codes. This finding was replicated in a separate analysis, which found that a larger percentage of community health centers in five Public Health Service regions were classified in more rural RUCA categories than they were for UIC categories (Taylor, 2002).

Although most of the zip codes within each county category were assigned to a limited number of RUCA codes, smaller numbers were assigned across several other codes. As a result, analyses using geographic coding could yield different results depending on whether they used the RUCA codes or UICs. Differences in visit rates across RUCA geographic categories were found, and although the differences were small in absolute terms, they were often substantial in relative terms. For example, there is a 20 percent difference between 2.5 and 2.0 visits per year (using 2.5 visits as the denominator).

Some evidence for monotonicity across RUCA categories was found in the analysis of specialty care service use rates. However, the very different patterns of use rates for primary care and specialty care services reminds us that each measure must be considered on its own merits. Where measures vary geographically, the geographic coding systems become important to ensure that variations are being captured as precisely as possible.

Further testing of the RUCA codes is advised, to assess how they perform in a variety of applications for research, payment system design, and other policy considerations. For policy applications, geographic definitions need to be considered along with other criteria to assess the feasibility of the RUCA codes. For example, an effective payment system may need to capture geographic variations in service use or input costs, but it also needs to be administratively efficient and easy to understand by users.

Rural health experts have questioned the results of some studies that make geographic comparisons based on county boundaries because of concerns that observed variations by county are insensitive to local variations in rural and urban characteristics and related health care. Such variations should be measured more effectively by more localized geographic codes. Our research—both the Medicare payment trend analyses (Farley et al., 2002) and the work presented in this report—consistently found that patterns of service use or per capita costs could not be explained well by the degree of rurality as defined by the UICs. The RUCA codes offer the potential of achieving such improvements.

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APPENDIX

A. DEFINITIONS OF RURALITY

Historically, two principal definitions of rural have been used by the federal government. The first definition is the "urban-rural" classification of populations developed by the Census Bureau. The bureau specifies "urbanized areas" and defines as urban all territory, population, and housing units located in those areas and in places or towns of 2,500 or more persons outside urbanized areas. All other areas not classified as urban are considered to be rural. An urbanized area is a continuously built-up area with a population of 50,000 or more, comprising one or more central places and the adjacent densely settled fringes with a population density of more than 1,000 persons per square mile.[7]

The second definition is the "metropolitan/non-metropolitan" classification of counties developed by the Office of Management and Budget (OMB). Metropolitan areas contain core counties with one or more central cities of at least 50,000 population or with a Census Bureau-defined urbanized area and a total area population of 100,000 or more, as well as fringe counties that are economically tied to the core counties. All other counties are considered to be non-metropolitan.

Policy analysis and research studies generally have worked with these definitions or adaptations from them, but the populations that are defined as rural differ substantially depending on which definition is used as the basis for classification. Therefore, the choice of definition is an important aspect of study design and should support the basic research or policy issues being addressed.

For the analyses of Medicare rural payment policies, the county-based definition of metropolitan/non-metropolitan groupings is a useful organization because many Medicare payment policies and related data sources are based on county boundaries. This definition loses much of the granularity of the urbanized area definition, however, which differentiates between areas with concentrated populations and those with more sparsely distributed populations, for which local health care services are likely to be quite different.

Two methods have been available to classify the metropolitan and non-metropolitan counties according to degrees of rurality. The Department of Agriculture developed the Urban Influence Codes (UICs) and the Rural-Urban Continuum Codes (RUCCs). The categories used by these two methods are listed in Table B.1. The methods differ in how they measure a county's urban population for categorizing the county. The UICs work with the size of the largest town or city in a county, whereas the RUCCs sum the total population for all towns and cities of more than 2,500 in a county. Thus, the RUCCs would classify a county with many small towns with populations totaling 20,000, but without a city of at least 10,000 population, as more economically centralized than the UICs would classify that county.

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[7] The primary source for this discussion is Ricketts et al. (1998).

Table A.1
Two Classification Methods for Metropolitan and Non-Metropolitan Counties

Code	Definition
Urban Influence Codes	
1	Large central and fringe counties of metropolitan areas of 1 million population or more
2	Small counties in metropolitan areas of fewer than 1 million population
3	Adjacent to a large metropolitan area with a city of 10,000 or more
4	Adjacent to a large metropolitan area without a city of 10,000 or more
5	Adjacent to a small metropolitan area with a city of 10,000 or more
6	Adjacent to a small metropolitan area without a city of 10,000 or more
7	Not adjacent to a metropolitan area and with a city of 10,000 or more
8	Not adjacent to a metropolitan area and with a town of 2,500 to 9,999
9	Not adjacent to a metropolitan area and without a town of at least 2,500
Rural-Urban Continuum Codes	
0	Central counties of metropolitan areas of 1 million population or more
1	Fringe counties of metropolitan areas of 1 million population or more
2	Counties in metropolitan areas of 250,000 to 1 million population
3	Counties in metropolitan areas of fewer than 250,000 population
4	Adjacent to a metropolitan area, urban population of 20,000 or more
5	Not adjacent to a metropolitan area, urban population of 2,000 or more
6	Adjacent to a metropolitan area, urban population of 2,500 to 19,999
7	Not adjacent to a metropolitan area, urban population of 2,500 to 19,999
8	Adjacent to a metropolitan area, less than 2,500 urban population
9	Not adjacent to a metropolitan area, less than 2,500 urban population

SOURCE: Ricketts et al. (1998).

Rural health researchers tend to prefer the UICs to classify degrees of rurality for non-metropolitan counties because the availability of health service resources is strongly affected by the presence or absence of a city of substantial population. We chose to use UICs for this analysis for this reason. However, we recognize that the use of county-level boundaries sacrifices the ability to measure variations in the populations living in towns of at least 2,500 within each non-metropolitan county, which weakens our ability to capture the effects of related variations in health services and utilization.

The U.S. Department of Agriculture (USDA) recently released a new definition of "urban" and "rural" areas called the Rural-Urban Commuting Area (RUCA) codes, which were developed jointly by USDA's Economic Research Service and the HHS Office of Rural Health Policy. Like the UIC and RUCC systems, the RUCA codes are based on measures of urbanization, population density, and daily commuting. However, this set of 10 codes—three codes for metropolitan areas and seven for non-metropolitan areas—uses the much smaller census tract as its base unit instead of the county and metropolitan area. These codes are listed in Table B.2. The primary codes refer to the primary or single largest commuting share of a census tract. These codes are subdivided "to identify areas where primary flow is local but over 30 percent commute in a secondary flow to a larger area core" (Economic Research Service [ERS] web site on RUCA codes). The seven non-metropolitan codes form a unidimensional scale of rurality. Analysts are just beginning to experiment with the RUCA codes, and we hope to explore their applicability in subsequent analyses for this project.

Additional information about the various coding methods for classifying areas based on degree of rurality may be found at http://www.ers.usda.gov. Some addresses are listed here for reference.

What Is Rural?	http://www.ers.usda.gov/briefing/rurality/WhatisRural
Urban Influence Codes	http://www.ers.usda.gov/briefing/rurality/UrbanInf
Rural-Urban Continuum Codes	http://www.ers.usda.gov/briefing/rurality/RuralUrbCon
Rural-Urban Commuting Area Codes	http://www.ers.usda.gov/briefing/rural/data/desc.htm
Urbanized Area	http://www.ers.usda.gov/briefing/rural/data/urbanar.htm

Table A.2
Rural-Urban Commuting Area (RUCA) Codes

Primary Code	Sub-Code	Definition
1		Metropolitan-area core: primary flow within an urbanized area (UA)
	1.0	No additional code
	1.1	Secondary flow 30% to 50% to a larger UA
2		Metropolitan-area high commuting: primary flow 30% or more to a UA
	2.0	Primary flow to a 1.0 UA
	2.1	Primary flow to a 1.1 UA
	2.2	Combined flows to two or more UAs adding to 30% or more
3		Metropolitan-area low commuting: primary flow 5% to 30% to a UA
	3.0	No additional code
4		Large town core: primary flow within a place of 10,000 to 49,999
	4.0	No additional code
	4.1	Secondary flow 30% to 50% to a UA
5		Large town high commuting: primary flow 30% or more to a place of 10,000 to 49,999
	5.0	Primary flow to a 4.0 large town
	5.1	Primary flow to a 4.1 large town
6		Large town low commuting: primary flow 5% to 30% to a place of 10,000 to 49,999
	6.0	No additional code
7		Small town core: primary flow within a place of 2,500 to 9,999
	7.0	No additional code
	7.1	Secondary flow 30% to 50% to a UA
	7.2	Secondary flow 30% to 50% to a large town
	7.3	Secondary flow 5% to 30% to a UA
	7.4	Secondary flow 5% to 30% to a large town
8		Small town high commuting: primary flow 30% or more to a place of 2,500 to 9,999
	8.0	Primary flow to a 7.0 small town
	8.1	Primary flow to a 7.1 small town
	8.2	Primary flow to a 7.2 small town
	8.3	Primary flow to a 7.3 small town
	8.4	Primary flow to a 7.4 small town
9		Small town low commuting: primary flow 5% to 30% to a place of 2,500 to 9,999
	9.0	No additional code
	9.1	Secondary flow 5% to 30% to a UA
	9.2	Secondary flow 5% to 30% to a large town
10		Rural areas: primary flow to a tract without a place of 2,500 or more
	10.0	No additional code
	10.1	Secondary flow 30% to 50% to a UA
	10.2	Secondary flow 30% to 50% to a large town
	10.3	Secondary flow 30% to 50% to a small town
	10.4	Secondary flow 5% to 30% to a UA
	10.5	Secondary flow 5% to 30% to a large town
99		Not coded: Tracts with little or no population and no commuting flows

B. DEFINITIONS OF AVOIDABLE HOSPITALIZATIONS

Table B.1
Avoidable Hospitalizations As Defined in Institute of Medicine Report (1993)

	Diagnoses
Chronic Conditions	
Angina	411.1, 411.8, 413
Asthma	493, 493.x, 493.01
Chronic Obstructive Pulmonary Disease	466, 466.0, 491, 491.1, 491.2x, 491.8, 492.x, 494, 496
Seizure Disorders	345.x, 780.3
Congestive Heart Failure	402.x1, 428.x, 518.4
Diabetes	250.x, 250.x0, 250.x2, 250.x3
Hypertension	401.0, 401.9, 402.00, 402.10, 402.90
Hypoglycemia	251.2
Acute Conditions	
Cellulitis	681, 682.x, 683, 686
Dehydration	276.5
Gastroenteritis	558.9
Urinary Tract Infection	590, 590.2, 590.9, 590.10, 590.11, 599.0, 599.9
Pneumonia	481, 482.2, 482.3, 482.9, 483, 483.0, 485, 486
Severe Ear, Nose, Throat Infections	382.x, 382.0x, 462, 463, 464, 465, 472.1
Skin Graft and/or Debridement for Skin Ulcer or Cellulitis	DRG: 263 (w/cc), 264 (w/o cc)

Table B.2
Avoidable Hospitalizations As Defined by McCall et al. (1999)

	Diagnoses
Chronic Conditions	
Asthma/Chronic Obstructive Pulmonary Disease	491.xx, 492.xx, 493.xx, 494.xx, 496
Seizure Disorders	345.0x, 345.1x, 345.2x, 345.3x, 345.4x, 345.5x, 345.7x, 345.8x, 345.9x, 780.3x
Congestive Heart Failure	402.01, 402.11, 402.91, 518.4
Diabetes	250.0x, 250.1x, 250.3x, 250.8x, 250.9x
Hypertension	401.xx, 403.xx 405.xx, 402.00, 402.10, 402.90, 404.00, 404.02, 404.10, 404.12, 404.90, 404.92, 437.2
Acute Conditions	
Cellulitis	681.xx, 682.xx, 686.xx, 683.xx
Dehydration	276.5
Gastric or Duodenal Ulcer	531.xx, 532.xx, 533.xx
Urinary Tract Infection	590.xx, 595.0, 597.0, 597.8, 599.0, 601.0, 601.2, 601.3
Bacterial Pneumonia	481, 482.xx, 483.xx, 485, 486
Severe Ear, Nose, Throat Infections	382.xx, 462, 463, 465.xx, 472.1
Hypoglycemia	251.0, 251.1, 251.2
Hypokalemia	276.8
Preventive Conditions	
Malnutrition	260, 261, 262, 263.xx, 264.xx, 265.xx, 266.xx, 267, 268.xx, 269.xx
Influenza	487.xx

C. COMPARISON OF RUCA CODES AND UICS

Table C.1 Percentage Distribution Across RUCA Codes of Medicare Beneficiaries Assigned to Each UIC, 1998

		1993 Urban Influence Codes								
RUCA Code	Number of Beneficiaries	1-Large Metro	2-Small Metro	3-Adjacent to Large With City	4-Adjacent to Large, No City	5-Adjacent to Small With City	6-Adjacent to Small, No City	7-Remote With City	8-Remote With Town	9-Remote, No Town
Beneficiaries	1,983,341	886,150	619,027	31,012	23,903	88,156	119,455	85,144	95,108	35,386
Metropolitan										
1	1,222,145	86.1%	72.6%	5.6%	0.2%	3.6%	0.7%	4.3%	0.2%	0.2%
1.1	22,922	2.2	0.5	0.3	0.0	0.2	0.0	0.0	0.0	0.0
2	144,821	6.0	12.5	2.4	7.1	3.7	6.5	0.8	0.2	0.2
2.1	1,623	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.2	8,210	0.4	0.6	0.3	0.6	0.4	0.6	0.0	0.0	0.0
3	6,563	0.2	0.4	0.7	1.9	0.9	1.0	0.0	0.0	0.0
4.1	20,474	0.9	1.9	0.0	0.0	0.3	0.0	0.0	0.0	0.0
5.1	3,225	0.1	0.3	0.2	0.0	0.2	0.0	0.1	0.0	0.0
7.1	12,280	0.3	1.2	1.3	1.5	0.1	0.7	0.0	0.3	0.0
8.1	1,091	0.0	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.0
10.1	7,435	0.2	0.5	0.3	0.7	0.2	1.5	0.2	0.1	0.1
Large Rural										
4	153,507	1.4	3.5	49.4	2.1	52.2	2.1	60.8	3.6	0.5
5	47,920	0.3	0.7	17.6	4.4	17.0	1.4	16.8	2.5	3.4
6	6,178	0.1	0.2	1.0	0.9	1.4	1.0	0.5	0.5	0.4
Small Rural										
7	67,256	0.1	0.4	3.1	14.0	1.7	16.4	2.3	38.8	0.3
7.2	2,640	0.0	0.0	0.1	0.0	0.8	0.2	1.0	0.5	0.0
7.3	41,501	0.6	1.9	0.9	15.0	3.0	14.3	0.1	1.0	0.0
7.4	24,352	0.2	0.1	5.2	5.8	3.3	4.5	2.6	8.9	0.0
8	17,646	0.0	0.1	0.1	3.7	0.2	4.7	0.7	9.9	0.2
8.2	302	0.0	0.0	0.2	0.0	0.1	0.0	0.0	0.1	0.0
8.3	13,075	0.1	0.5	0.6	4.0	0.6	6.0	0.0	0.4	0.0
8.4	7,856	0.0	0.1	1.1	1.9	1.0	1.6	0.8	3.4	0.1
9	2,419	0.0	0.0	0.4	0.1	0.1	0.6	0.0	1.3	0.1
9.1	3,278	0.1	0.1	0.2	1.1	0.3	1.3	0.0	0.1	0.1
9.2	1,867	0.0	0.0	0.8	0.5	0.6	0.2	0.2	0.5	0.0
Isolated Rural										
10	60,476	0.0	0.1	0.8	10.9	0.7	12.6	1.4	17.0	66.2
10.2	4,418	0.1	0.0	0.7	0.2	0.7	0.3	1.9	0.4	1.1
10.3	3,508	0.0	0.0	0.1	0.0	0.0	0.8	0.4	2.2	0.2
10.4	39,068	0.5	1.2	1.8	16.9	2.2	15.3	0.1	1.1	4.6
10.5	35,285	0.1	0.3	4.8	6.3	4.3	5.7	4.9	7.0	22.3

Table C.2
Distribution of Medicare Beneficiaries by UICs and RUCA Codes, 1998

		1993 Urban Influence Codes								
RUCA Code	Number of Beneficiaries	1-Large Metro	2-Small Metro	3-Adjacent to Large With City	4-Adjacent to Large, No City	5-Adjacent to Small With City	6-Adjacent to Small, No City	7-Remote With City	8-Remote With Town	9-Remote, No Town
All beneficiaries	1,983,341	886,150	619,027	31,012	23,903	88,156	119,455	85,144	95,108	35,386
By RUCA Code										
1	1,222,145	762,819	449,559	1,733	52	3,176	820	3,699	223	64
1.1	22,922	19,365	3,305	96	3	144	4	1	3	1
2	144,821	52,815	77,571	743	1,686	3,230	7,821	684	197	74
2.1	1,623	1,343	276	1	2	0	1	0	0	0
2.2	8,210	3,488	3,442	80	154	376	665	2	2	1
3	6,563	1,429	2,507	217	453	798	1,153	3	3	0
4	153,507	12,270	21,488	15,328	502	45,992	2,539	51,774	3,450	164
4.1	20,474	8,268	11,893	3	9	285	7	2	6	1
5	47,920	2,330	4,565	5,472	1,059	15,007	1,687	14,275	2,334	1,191
5.1	3,225	774	2,073	71	5	174	16	111	1	0
6	6,178	996	1,170	301	210	1,272	1,146	452	495	136
7	67,256	446	2,362	962	3,354	1,533	19,615	1,969	36,898	117
7.1	12,280	2,997	7,316	393	360	115	802	9	282	6
7.2	2,640	1	263	44	0	743	262	885	441	1
7.3	41,501	4,939	11,990	273	3,588	2,629	17,039	53	980	10
7.4	24,352	1,591	779	1,604	1,394	2,926	5,342	2,241	8,464	11
8	17,646	67	841	34	877	215	5,572	585	9,389	66
8.1	1,091	351	462	1	0	39	233	0	5	0
8.2	302	0	2	64	0	78	19	1	138	0
8.3	13,075	1,059	2,805	184	962	516	7,184	5	355	5
8.4	7,856	5	356	347	443	878	1,865	713	3,220	29
9	2,419	3	136	112	34	109	725	28	1,222	50
9.1	3,278	579	443	56	255	250	1,562	0	102	31
9.2	1,867	95	37	250	118	506	196	185	480	0
10	60,476	306	863	262	2,614	628	15,073	1,201	16,121	23,408
10.1	7,435	1,828	3,119	83	159	148	1,834	130	91	43
10.2	4,418	742	114	205	43	599	349	1,640	340	386
10.3	3,508	10	28	45	9	36	915	301	2,107	57
10.4	39,068	4,019	7,465	562	4,048	1,963	18,258	55	1,060	1,638
10.5	35,285	1,215	1,797	1,486	1,510	3,791	6,751	4,140	6,699	7,896