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# Investigation of Increasing Rates of Hospitalization for Ambulatory Care Sensitive Conditions Among Medicare Fee-for-Service Beneficiaries

## Final Report

Prepared for

**Mary Kapp**
Project Officer
Centers for Medicare & Medicaid
7500 Security Boulevard
Mail Stop C3-19-07
Baltimore, MD 21244-1820

Prepared by

**Nancy T. McCall**
RTI International
1615 M Street, NW, Suite 740
Washington, DC 20036-3209

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# INVESTIGATION OF INCREASING RATES OF HOSPITALIZATION FOR AMBULATORY CARE SENSITIVE CONDITIONS AMONG MEDICARE FEE-FOR-SERVICE BENEFICIARIES

FINAL REPORT


Authors: Nancy T. McCall, Sc.D.
Erica Brody, M.P.H.
Lee Mobley, Ph.D.
Sujha Subramanian, Ph.D.

Project Director: Nancy T. McCall, Sc.D.

Scientific Reviewer: Gregory C. Pope, M.S.

Federal Project Officer: Mary Kapp

RTI International*



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# EXECUTIVE SUMMARY

## Introduction

The use of hospitalizations for ambulatory care sensitive conditions (ACSCs) has become an established tool for analyzing access to care. If treated in a timely fashion with adequate primary care and managed properly on an outpatient basis, medical practitioners broadly concur that in most instances commonly defined ACSCs should not advance to the point where hospitalization is required. Because lack of primary care for ACSCs does, in fact, often result in hospitalizations, the rate of these inpatient admissions may provide a practical way of evaluating primary care delivery and thereby identifying appropriate areas for improving access and quality in the health care delivery system.

As motivation for this project, a study conducted by Jean Kozak and colleagues at NCHS (Kozak et al, 2001) using the National Hospital Discharge Survey (NHDS) showed significant increases in the hospitalization rates for those age 65 and older for three clinical conditions: congestive heart failure, pneumonia, and cellulitis using specifications developed by Weissman and colleagues (Weissman et al.1992). Further exploration of other National Hospital Discharge Survey data by staff at the Centers for Medicare & Medicaid Services (CMS) showed substantial increases in the hospitalization rates for the elderly for the clinical conditions of sepsis, urinary tract infection, chronic bronchitis, and dehydration (http://www.cdc.gov/nchs/about/otheract/aging/trenddata.htm#Health%20Care%20 Utilization).

## Summary of Methods

CMS requested that we explore the trends in increasing rates of hospitalizations for these seven clinical conditions as well as three other ACSCs of our choosing. The purpose of this report is to summarize our research findings from an investigation of increasing rates of hospitalization for eleven ambulatory care sensitive conditions among Medicare fee-for-service (FFS) beneficiaries: (1) cellulitis, (2) asthma, (3) chronic obstructive pulmonary disease (COPD), (4) congestive heart failure (CHF), (5) dehydration, (6) pneumonia, (7) septicemia, (8) stroke, (9) urinary tract infection (UTI), (10) acute diabetic events and (11) lower limb peripheral vascular disease (PVD). The last two sets of rates were disease-specific, among only Medicare fee-for-service (FFS) beneficiaries with diabetes. Rates for all other ACSCs were calculated using all Medicare FFS beneficiaries in the denominator. In summary, we used a combination of univariate and multivariate analyses (1) to examine the trend in annual ACSC hospitalization rates for eleven selected clinical conditions from 1992 through 2000 and (2) to critically examine demand, supply, and policy factors that may have influenced the rate of ACSC hospitalizations among Medicare FFS beneficiaries age 65 and older. To do so, we first painted a broad picture of general trends and then drilled down to identify factors responsible for observed changes in ACSC hospitalization rates over time.

Descriptive statistics were produced to provide insight into actual trends in hospitalization rates among Medicare FFS enrollees. Trends in ACSC hospitalizations were calculated by beneficiary characteristics available from Medicare claims and enrollment files. Hospitalization rates were age/sex adjusted to the July 1, 1999 Medicare FFS population using the direct method of standardization. We also examined whether there have been shifts in patterns of care (i.e., hospitalization versus treatment in the emergency room and source of

admission). Incompleteness of billing data among Medicare managed care enrollees limited our ability to include these beneficiaries in our time trend analyses.

Three sets of multivariate analyses were conducted for a subset of conditions to allow for direct examination of beneficiary, demand, supply, and policy factors influence on the probability of being hospitalized. A multivariate analysis of trends in ACSC hospitalization rates from 1993 to 2000 for Medicare FFS beneficiaries examined the role of changing demographics, health status, and geographic migration patterns on the trend in hospitalizations for the clinical conditions of COPD, CHF and PVD. For the multivariate modeling, rates of hospitalization for PVD were estimated for all Medicare FFS beneficiaries, rather than for only those with diabetes. This allowed us to directly examine the influence of increasing prevalence of diabetes on hospitalization for PVD. We estimated growth in rates of ACSC hospitalizations by urban-rural designations within states using Medicare claims data. The second multivariate analysis critically examined the influence of supplemental insurance, prescription drug coverage, and patients' health-care-seeking behavior on the rate ACSC hospitalizations using survey data from the Medicare Current Beneficiary Survey (MCBS). The three clinical conditions were chronic lung disease (CLD), CHF and dehydration. Hospitalizations for COPD and asthma were combined to define CLD for the MCBS multivariate, cross-sectional analysis.

In the third multivariate analysis, we used regional-level data and aggregated ACSC hospitalizations into Hospital Referral Regions (HRRs) from the Dartmouth Atlas Project for the clinical conditions of CHF, COPD and PVD among all Medicare beneficiaries. This multivariate geographic analytic approach examined changes in the rate of ACSC hospitalizations between two time periods (1995-1997 versus 1998-2000) using RTI's existing geographic information system (GIS), which contains information on U.S. population characteristics and population density, rural versus urban designations, provider supply, competitive market factors, commercial and Medicare managed care market penetration, and provider characteristics. To this, we added population-based estimates of Medicare FFS beneficiary characteristics, utilization, and health status.

**Summary of Findings**

The use of Medicare claims and survey data allowed us to conduct a more in-depth examination of the nature of the increases in ACSC hospitalizations observed from the NHDS, identify populations most affected, and investigate the role of supply factors, access factors, and geographic patterns in care on the increasing rates of ACSC admissions. Five key research questions were asked. Summary findings from our investigation of trends in rate of hospitalization for eleven ACSCs are as follows:

1. What are the trends in age-sex adjusted rates of hospitalization and days of hospitalization for ambulatory care sensitive conditions?

   – During the nine year study period, all cause hospitalization rates increased by 6 percent in the Medicare FFS population.

   – We observed increases in the rate of hospitalization for six of the eleven ACSCs studied between 1992 and 2000; ranging from an 11 percent increase for septicemia to a 52 percent increase for COPD.

- The rate of hospitalization for congestive heart failure (CHF) remained essentially unchanged over the course of the nine year period; while declines in hospitalization rates were observed for asthma and stroke as well as for lower limb peripheral vascular disease and acute diabetic events among Medicare beneficiaries with diabetes.

- Five of the ACSCs, stroke, pneumonia, CHF, and acute diabetic events and lower limb peripheral vascular disease events among beneficiaries with diabetes, have been targeted over the past decade for quality improvement efforts led by the CMS Quality Improvement Organizations (QIOs). Conflicting trends were observed in these conditions: the rate of hospitalization for stroke decreased 14 percent; the rate of hospitalization for pneumonia increased 14 percent; the rate of admission for CHF remained essentially unchanged; the rate of admission for acute diabetic events among persons with diabetes increased by 44 percent and the rate o f hospitalization for lower limb PVD among persons with diabetes decreased by 23 percent.

- We observed differential rates of growth in the rate of hospitalization across the set of ACSCs among subpopulations of Medicare FFS beneficiaries as defined by sociodemographic, geographic, or health status characteristics. For the ACSCs that experienced rate increases, women and Blacks generally had larger percent increases in ACSC hospitalization rates than men and Whites, respectively. At the same time, for ACSCs that experienced rate decreases, women, Blacks and beneficiaries residing in rural areas did not experience as significant a decline in admission rates as those observed for men, Whites, and urban residing beneficiaries, respectively.

- The trends in rate of hospitalization for each ACSC was driven by changes in the number of beneficiaries hospitalized for each condition rather than increases or decreases in the number of hospitalizations per beneficiary.

- The average length of stay and the total number of inpatient days decreased for all conditions between 1992 and 2000. Decreases in total number of inpatient days varied more greatly by clinical condition than decreases in average length of stay.

2. What influence do medical care practice patterns have on the trend of ambulatory care sensitive condition hospitalizations?

   - There were substantial increases in rates of observation bed stays and emergency room visits for all of the eleven ACSCs studied between 1992 and 2000, with the exception of stroke, which did not change during the study period.

   - For the majority of ACSCs studied, rates of observation stay and ER visits increased more for women, persons whose races was other than Black, and beneficiaries not enrolled in Medicaid.

- As with inpatient admissions, modest changes in the number of emergency room visits and observation stays per beneficiary were observed. The increase in usage was driven by the number of beneficiaries receiving care.

- Overall, the proportion of inpatient admissions coming from the emergency room increased between 1992 and 2000, whereas the proportion of admissions from home, skilled nursing facilities, and long-term or sub-acute facilities decreased during this same time period.

- The trend in hospitalization for each condition was driven by changes in the number of persons admitted for each condition rather than increases in the number of admissions per person.

3. What is the influence of changes in selected beneficiary characteristics (e.g., sociodemographic characteristics, health status and geographic location) on the rate of hospitalization for three ambulatory care sensitive conditions: congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD) and lower limb peripheral vascular disease (PVD) among all Medicare beneficiaries?

   - Positive trends in rates of hospitalization for the three selected ACSCs over time were substantially explained by changes in beneficiary demographic characteristics, health status and place-specific factors.

   - The median age of the Medicare FFS population increased over time. The aging of the population was negatively associated with the hospitalization rates for COPD in both MSAs and non-MSAs, negatively associated with the hospitalization rates for CHF in MSAs, but positively associated with the hospitalization rates in non-MSAs, holding constant the proportion that die. This would imply that older persons in urban areas with CHF and COPD are less likely to be treated on an inpatient basis after adjusting for factors such as health status.

   - Health status as measured by the PIP-DCG risk score and proportion of the study population with end-stage renal disease were positively associated with hospitalization rates for all three ACSCs in MSAs only.

   - For PVD and CHF, the proportion with dual enrollment in Medicare and Medicaid was positively associated with hospitalization rates in non-MSAs. Dual enrollment was negatively associated with hospitalization rates for PVD in MSAs.

   - The proportion of men in MSAs was positively correlated with hospitalization rates for CHF and COPD. The proportion of Blacks was negatively associated with hospitalization rates for COPD but positively associated with CHF hospitalization rates.

   - Use of the emergency room (or observation bed stays) was positively correlated with hospitalization rates for COPD, and increasingly so over time. This suggests complimentarity rather than substitution of ER usage for inpatient admission. During the latter half of the 1990s in non-MSAs, there was a positive

ER/Admission Rate relationship for CHF, suggesting complimentarity between the two sites of care, and a negative relationship for PVD, suggesting substitution between the two sites of care.

- After controlling for beneficiary characteristics, health status, and use of the Emergency room, we continued to observe significant spatial variation in admission rates most notably for COPD and CHF across the Census Regions in both urban and rural areas.

4. What is the influence of selected beneficiary characteristics (e.g., sociodemographic and geographic factors, health status, place of usual source of care, insurance status, propensity to seek care, beneficiary assessment of unmet need) on the likelihood of hospitalization for CHF, chronic lung disease (CLD) and dehydration?

   - A prior hospitalization for an ambulatory care sensitive condition was by far the strongest predictor of hospitalization in 2000 for all three conditions. A hospital stay in 1999 increased the likelihood of another hospitalization in 2000 by about eleven-fold, thirty-seven-fold, and twenty-seven-fold for CHF, chronic lung disease, and dehydration, respectively.

   - Age was a significant predictor of hospitalization for only CHF. Beneficiaries 85 years and older were about three times more likely to have a CHF hospitalization than those younger than 75 years.

   - Beneficiaries with good or fair/poor health status were more likely than those with excellent heath status to have a CHF or CLD hospitalization.

   - The presence of medical co-morbidities significantly increased likelihood of hospitalization for all three conditions. The addition of each co-morbidity increased the likelihood of hospitalization by over 25 percent.

   - Those with supplemental insurance had a lower probability of a CLD hospitalization.

5. What is the association among selected market-level supply or demand factors and the market-area rates of ACSC hospitalization over time for three ambulatory care sensitive conditions: congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD) and lower limb peripheral vascular disease (PVD) among all Medicare beneficiaries? And, were there any changes in the associations before and after implementation of the Balance Budget Act of 1997, a time during which Medicare payment policies changed for skilled nursing facilities and home health agencies?

   - Beneficiary characteristics aggregated to HRR regions had stronger associations with rates of ACSC hospitalizations than did supply factors.

     - Three proxies of health status –proportion of the Medicare population with diabetes or end-stage renal disease and proportion that died – were strongly associated with rates of hospitalization for all three conditions.

- The rates of hospitalization for COPD and CHF were negatively associated with the proportion of the elderly greater than age 80 suggesting a lower propensity to treat this population on an inpatient basis.

- Poverty among the elderly was found to be high in places with high rates of COPD and CHF hospitalizations, but not spatially associated with PVD hospitalizations.

  - Rate of hospitalization for COPD was positively associated with the proportion of the population that said they did not visit a physician because of cost.

- Availability and use of post-acute services were found to be correlated with hospitalization rates.

  - Availability of SNF facilities was positively associated with high rates of COPD and CHF hospitalization, before and after policy reforms.

  - Availability of hospital-based rehabilitation programs was lower in places with higher rates of COPD and CHF hospitalizations, before and after policy reforms for CHF and after reforms for COPD.

  - Availability of home health agencies was not associated with hospitalization for any of the three conditions; however rates of hospitalization for PVD were positively associated with number of home health visits.

- Places with high COPD and CHF hospitalization rates were regionally clustered, while places with high PVD hospitalization rates were not clustered.

**Discussion and Policy Implications**

The use of chronic disease ambulatory care sensitive condition (ACSC) hospitalizations has become an established tool for analyzing access to care. If managed properly on an outpatient basis, medical practitioners broadly concur that in most instances commonly defined ACSCs should not advance to the point where hospitalization is required. This study explored factors that may influence ACSC hospitalizations in the Medicare FFS population using an array of Medicare claims and enrollment data, survey data, and competitive market indicators to focus upon different aspects of the ACSC hospitalization puzzle.

The multivariate modeling of the trend in ACSC hospitalizations from 1993 to 2000 using Medicare claims data showed that changes in sociodemographic characteristics and health status among elderly Medicare FFS beneficiaries explained a substantial proportion of the observed positive trend in ACSC hospitalization rates for CHF, COPD and PVD among Medicare beneficiaries. Use of the emergency room (or stays in observation beds) was strongly associated with hospitalization for COPD and more modestly for CHF; thus, it does not appear that ER visits were used as a substitute for hospitalization. Evidence of substitution between ER use and hospitalization was observed for PVD among all Medicare FFS beneficiaries during the

latter part of the time trend. Rural areas that experienced a reduction in the number of FFS beneficiaries experienced a decline in rates of hospitalization for COPD and CHF. However, after controlling for changes in beneficiary characteristics and health status, geographic variation in propensity to treat on an inpatient basis, and migration patterns of Medicare FFS beneficiaries, unexplained geographic variation in ACSC hospitalization rates remained, most notably for COPD and CHF in the eastern half of the United States. This suggests that factors not included in the trend analysis play an important role in hospitalization rates increases over time.

The cross-sectional multivariate analysis using the MCBS of likelihood of hospitalization in 2000 for an ACSC allowed us to examine beneficiary-level factors not available from Medicare claims data. A previous hospitalization for each of the three ACSCs studied was found to be the strongest predictor of an ACSC hospitalization for the same condition. Surprisingly, having a usual source of care or having supplemental health insurance, including prescription drug coverage, did not appreciably reduce the likelihood of a an ambulatory care sensitive condition hospitalization within the Medicare population. However, one is advised to use caution in interpreting these results as the number of beneficiaries in the MCBS that had a hospitalization for the selected conditions was quite small.

In our third multivariate analysis, we used regional-level claims data aggregated to the level of Hospital Referral Regions (HRRs) to examine changes in the rate of ambulatory care sensitive condition hospitalizations between two time periods (1995-1997 and 1998-2000). This analysis was designed to allow us to examine more completely the residual unexplained geographic variation in rates of ACSC hospitalization from the eight year trend analysis by incorporating market-level information on general population-based characteristics, hospital and post-acute care service availability and usage, physician and nurse supply factors, supplemental insurance take-up, and general managed care and M+C market penetration.

Not unexpectedly, findings from our market-level analysis suggested that beneficiary characteristics aggregated to the level of HRRs strongly influenced rates of hospitalization for ACSCs. Poverty appeared to have the strongest relationship with rate of ACSC hospitalization, and its influence increased over time. Supplementing this finding was the positive association between the rate of hospitalization for COPD and the proportion of the population that said they had not visited a physician due to cost in the latter part of the 1990s. Our earlier analysis of the MCBS data found no association between beneficiary estimate of unmet need and hospitalization for selected ACSCs. A mapping of the relationship between poverty and rate of hospitalization for CHF and COPD revealed a significant regional concentration throughout the Appalachian Mountain Region and the Gulf of Mexico.

However, after controlling for beneficiary characteristics, supply factors related to skilled nursing facility and rehabilitation care availability were associated with rates of hospitalization for COPD and CHF, but with opposite relationships. SNF bed availability was positively associated with rate of hospitalization for COPD and CHF; while availability of rehabilitation care was negatively associated with hospitalization rates for the same clinical conditions. HRRs with high rates of home health visits for beneficiaries with peripheral vascular disease also had high rates of hospitalization for PVD, and increasingly so in the late 1990s. Thus, home health care and SNF bed availability appear to be complements to hospitalization. The precise nature of

the relationship between availability and use of these post-acute care services and rate of hospitalization for the selected ACSCs is not immediately obvious and warrants further study.

Factors that prior research has suggested could influence the rate of ACSC hospitalizations were explored in this study using a diverse set of analytic techniques. Observed variation in the direction and strength of relationship between the explanatory factors and the selected ACSCs suggests that interventions employed to reduce hospitalization for ACSCs may have to be tailored to the specific underlying condition to be effective. With that said, there are several general policy implications that arise from the findings.

First, rates of ACSC hospitalization are strongly influenced by the health status of the Medicare population. Prior year hospitalization for the ACSCs being examined appears to be a strong proxy for severity of disease. Targeting hospitalized Medicare beneficiaries or those that have been hospitalized in the prior year for disease management programs may be a reasonable strategy to reduce future hospitalizations. However, efforts must also be made to prevent hospitalization in the first place by reducing morbidity. The presence of medical co-morbidities significantly increased the likelihood of hospitalization by over 25 percent. We also observed that the proportion of the Medicare population with diabetes or end-stage renal disease was strongly associated with rates of hospitalization for the clinical conditions of congestive heart failure, chronic obstructive pulmonary disease, and peripheral vascular disease among all FFS beneficiaries.

Second, a more aggressive clinical approach to managing chronic disease alone may not be sufficient to reduce hospitalization for chronic diseases. Poverty among the elderly was found to be highly correlated with rates of hospitalization for COPD and CHF. Living in rural areas and being dual enrolled in Medicare and Medicaid was positively associated with the rate of hospitalization for PVD and CHF. Further exploration of the relationship between poverty and hospitalization for the studied ambulatory care sensitive conditions appears warranted.

Third, observed regional clustering of rates of COPD and CHF hospitalizations suggests that interventions to improve outcomes among the elderly with these clinical conditions might be effectively targeted, rather than widespread or national in scope. Geographic mapping of univariate and bivariate clustering of hospitalization rates could guide such an intervention strategy. Such an approach would allow for greater in-depth research aimed at better understanding the influence of market-level factors, such as the availability and use of post-acute care services and level of poverty, on the hospitalization rates for ACSCs.

And, fourth, the use of ACSC hospitalization rates as a possible quality measure may require further evaluation prior to implementation. The multivariate analyses suggest that factors beyond the control of providers or health plans, such as the aging of the population, do influence the rate of hospitalization for the studied chronic conditions. Changes in general health status and number of co-morbid conditions were also predictive of hospitalization. To what degree individual plans and providers are able to make meaningful improvements in a beneficiary health status over time or prevent the development of co-morbid conditions requires further exploration.

The stark difference in the trend in age-sex adjusted hospitalization rates for COPD and for asthma also raises a question about the use of composite measures of ACSCs as a quality

improvement tool. Clinicians generally find making the clinical distinction between COPD and asthma very difficult in the elderly population; thus coding of these specific conditions is likely to be somewhat fungible. To what extent did changes in the coding of these clinical conditions or possibly payment policies affect the observed trend in rates? Were new treatment technologies introduced during the nineties that influenced the reduction in hospitalizations for Medicare beneficiaries with asthma or the increase for COPD? Did hospitalization all types of lung disease captured by the broad category of COPD increase? Answering these types of questions appears to be a prudent and necessary step to enable us to better understand to what degree do hospitalizations for ambulatory care sensitive conditions signal an access or quality of care problem.

# CHAPTER 1
# BACKGROUND AND OVERVIEW OF RESEARCH

## 1.1 Motivation for this Study

The use of ambulatory care sensitive conditions (ACSCs) has become an established tool for analyzing access to care. If treated in a timely fashion with adequate primary care and managed properly on an outpatient basis, medical practitioners broadly concur that in most instances commonly defined ACSCs should not advance to the point where hospitalization is required. Because lack of primary care for ACSCs does, in fact, often result in hospitalizations, the rate of these inpatient admissions may provide a practical way of evaluating primary care delivery and thereby identifying priority areas for improving access and quality in the health care delivery system.

Prior studies have identified several factors that may potentially affect the rate of hospitalization for ACSCs. Having a regular source of care where patients may receive preventive and primary care has shown to significantly reduce the likelihood of hospitalizations and ER visits for ACSCs (Falik et al., 2001). In addition, continuity of care, which occurs when patients concentrate their care with a single provider, can also lead to lower hospitalization rates (Gill and Mainous, 1998). Limited access to care, such as living in an area with a shortage of health professionals or primary care physicians may also lead to higher ACSC admission rates (Bindman et al, 1995; Ricketts et al., 2001; Parchman and Culler, 1999; Schreiber and Zielinski, 1997; Asch et al., 2000), as might a lack of access to prescription drugs (Kozak et al., 2001), or being uninsured (Weissman et al., 1992). An individual's propensity to seek care has also been hypothesized to be a critical factor in obtaining primary and preventive care and thereby avoiding ACSC hospitalizations (Silver et al., 1997). Low-income individuals (Shi et al., 1999; Cable, 2002; Billings et al., 1996; Billings et al., 1993; Blustein et al., 1998; Pappas et al., 1997), individuals on Medicaid (Weissman et al., 1992), and those residing in poverty areas (Asch et al., 2000; Djojonegoro et al., 2000) are reported to have more ACSC hospitalizations than their respective counterparts. Being non-white or African-American also correlates to a higher rate of ACSC hospitalizations (Schreiber and Zielinski, 1997; Asch et al., 2000; Shi et al., 1999; Cable, 2002; Pappas et al., 1997; Culler et al., 1998; Call et al., 2001). Researchers have also noted other factors such as the aging of society (Culler et al., 1998), growth in out-of-pocket spending, increasing level of frailty in the elderly, and enrollment in or disenrollment from managed care may impact rate of hospitalization for ACSCs (Kozak et al., 2001; Call et al., 2001). Living in a rural area correlates with higher rates of ACSC hospitalizations (Schreiber and Zielinski, 1997; Shi et al., 1999; Culler et al., 1998).

In an article published in Health Affairs in May 2001, Jean Kozak and her colleagues observed a significant increase in the rate for ACSC hospitalizations for the age 65+ population (Kozak et al., 2001). Between 1980 and 1998, the age/sex-adjusted rate of admission for twelve clinical conditions rose 57 percent; however, there was significant moderation in the growth rate from 1990 to 1998 compared to the first decade of study. During this latter period, the rate of growth was 15 percent. Focusing on 1990 to 1998, variation in the rate of growth was observed to vary across age, gender and race subpopulations and by geographic region of the country. The rate of growth in ACSC hospitalization rates was 14 percent for persons age 85+ compared to 8 percent for persons age 75-84; 19 percent for females compared to 11 percent for males; 12 percent for Blacks compared to 6 percent for Whites; and 22 percent in the Northeast compared

to 10 percent in the South. There was also considerable variation in the growth rate across different clinical conditions.

This research project, which uses Medicare claims, enrollment, and survey data, allowed for a detailed examination of the trends in ACSC rates and a critical examination of the factors possibly related to ACSC rates of admission that were cited by Kozak and her colleagues (Kozak et al., 2001). A thorough understanding of the factors related to ACSC admissions is critically important to CMS for two key reasons. First, the rate of increase could reflect a growing primary care access problem for Medicare beneficiaries. Second, CMS is developing performance measures for different facets of the health care delivery system for Medicare beneficiaries. Greater understanding of ACSC hospitalization rates will help inform the utility of these rates for performance measurement.

Our research questions were built upon a solid foundation of information resulting from work that RTI has been conducting for CMS and AHRQ over the past several years. We provide some illustrative examples of findings from previous research that helped to inform our research design (***Exhibit 1-1***). Using Medicare fee-for-service (FFS) hospital billing data for 1992-2000, we report admission rates for four ACSCs: CHF, pneumonia/influenza, asthma/COPD, and cellulitis/abscess (Trisolini et al., 2002). Hospitalization rates calculated from the Medicare FFS claims data are compared and contrasted with rates reported from the National Hospital Discharge Survey by Kozak and colleagues (Kozak et al, 2001). The Medicare ACSC rates are age/sex-adjusted to the July 1, 1999 Medicare FFS population distribution and are reported as admission per 1,000 enrollees. We observe rates of FFS admissions for all four conditions increasing over this 9-year period. However, there are significant differences between the two sets of rates that provide strong support for CMS's current effort to more critically examine the level of change as well as nature of the increases in ACSC hospitalizations. The observed differences in the rates of change shown in this table could be attributable to a number of factors: the population being studied, the source of hospitalization data, the clinical definition of the condition, and the reference years.

Over the 1990-1998 period, Kozak observed a 25 percent increase in the CHF hospitalization rate for those 65 years of age and over using the NHDS data. Medicare FFS rates calculated in our previous work showed a significantly smaller rate of increase of only 4 percent during 1992-1998, and the rate of increase was only 2 percent when the reference period was extended to 2000. A similar pattern, but with less difference, held for pneumonia and influenza. There was also a considerable difference in the rate of increase in hospitalization for cellulitis and abscess. However, unlike the other two conditions, the Medicare rate of increase became considerably larger when the reference period was extended to 2000.

Part of the observed difference in CHF hospitalization rates may be explained by the difference in how CHF is defined; Kozak uses a larger set of diagnosis codes. However, Kozak examined the rate of admissions for only pneumonia; while the Medicare FFS definition used in our prior study includes influenza with pneumonia. With a more expansive definition, pneumonia and influenza, or the same definition, cellulitis and abscess, one still observed a significantly lower rate of increase in hospitalizations using Medicare billing data.

To reinforce the point that clinical definition of the ACSC is critically important, we observe a stark contrast in conclusions regarding the rate of hospitalization for two clinically related conditions, asthma and COPD. In earlier work for CMS, we defined fifteen medically

appropriate ACSCs for the Medicare population. In doing so, our clinical consultants strongly recommended combining asthma and COPD because the clinical presentation of these two conditions may be quite similar, leading to diagnosis confusion or possible gaming of the admission rates. Using a combined definition, we observe a 28 percent increase over the 1992 to 1998 or 2000 period using Medicare claims data. This is in stark contrast to the 48 percent decline in the rate of admissions for asthma using the NHDS data.

Previous research that we conducted for CMS also allows us to draw some research hypotheses regarding the influence of sociodemographic characteristics, health status of the Medicare population, and Medicare managed care penetration on rates of change in ACSC admissions. One study revealed significant differences in the rates of hospitalization between the managed care and FFS populations for fifteen different conditions. (McCall, Harlow, & Lied, 2002). The ACSC admission rate during 1997/1998 was 238 per 1,000 Medicare managed care enrollees as compared to 347 per 1,000 FFS enrollees. There was significant variation in ACSC hospitalization rates across geographic regions of the country for both FFS and managed care, and the level of differences between FFS and managed care also varied (McCall, Harlow & Lied, 2002).

Examination of differences in hospitalization rates by age in both the managed care and FFS populations revealed similar patterns; the very old, 85 years of age and older, experienced statistically significant higher rates of ACSC hospitalization than younger Medicare beneficiaries. Further, the under-65 population and the disabled in both FFS and managed care experienced statistically higher rates of hospitalization for selected chronic conditions. This affirms CMS's decision to focus on just the over-65 population, as distinct from younger disabled Medicare beneficiaries.

We also observed that the oldest old were the most likely to die during an ACSC hospitalization (McCall, Harlow & Dayhoff, 2001). Across all studied conditions in the FFS population, 7 percent of the age 85+ enrollees admitted for an ACSC died during that hospitalization. This is in contrast to a 3.6 percent ACSC death rate for 65 to 74-year-olds. This likely reflects a difference in disease severity not captured by principal diagnosis alone. Other work that we conducted for CMS raised additional concerns about the adequacy of case mix adjustment of ACSC hospitalization rates through the use of age-sex adjustment alone. Among Medicare managed care enrollees, level of education and geographic location were found to be strong predictors of ACSC hospitalization rates (Pope et al., 1999).

In an AHRQ-funded project (Bernard, Brody & Savitz, 2002), we analyzed the validity and reliability of the ACSC hospitalization rates generated by the AHRQ Prevention Quality Indicators (PQIs). Specifically, we analyzed the impact of a number of factors upon the PQI rates. Our findings suggest that practice patterns, as well as insurance agreements, may influence the PQI rates because facilities may designate a patient as an observation stay (which could be a stay ranging from 20 hours in one facility to as many as 72 hours in another) resulting in hospitalization for patients that do not appear in the numerator of the condition-specific rates because observation stays are not captured by inpatient data. We also found extensive emergency room use for these conditions; however, the role of emergency room care for ACSCs has not been explored. Hospital coding practices were found to differ across regions of the country, suggesting that careful code specification may result in failure to capture relevant patients in some regions. For example, ICD-9 code 428 is Heart Failure, while 428.0 is Congestive Heart Failure. In creating the CHF PQI, we found some facilities coding the less-

specific 428 for CHF (which was not captured in the ACSC hospitalization rate), while others used the more specific code. Another issue affecting regional hospitalization rates of ACSCs involves the regionalization of services for some conditions with patients crossing MSA or state boundaries to seek inpatient services. This is less of a problem for the ACSCs than conditions that involve a high technical procedure, e.g., coronary artery bypass; for most of the PQIs we found that between 5 and 25% of discharges from hospitals in one MSA originated in areas outside the given MSA.

## 1.2 Overview of Research Design

We used a combination of univariate and multivariate analyses (1) to examine the trend in annual ACSC admission rates for eleven selected clinical conditions from 1992 through 2000 and (2) to examine demand, supply, and policy factors that may influence the rate of ACSC hospitalizations among Medicare beneficiaries age 65 and older. To do so, we used an array of Medicare data files to paint a broad picture of general trends and then drilled down for factors that may be most directly responsible for observed changes in ACSC hospitalization rates over time. The ambulatory care sensitive conditions studied in this project are: (1) cellulitis, (2) asthma, (3) chronic obstructive pulmonary disease (COPD), (4) congestive heart failure (CHF), (5) dehydration, (6) pneumonia, (7) septicemia, (8) stroke, (9) urinary tract infection (UTI), and (10) acute diabetic events and (11) lower limb peripheral vascular disease (PVD) among Medicare FFS beneficiaries with diabetes.

In this project, we examined five key sets of research questions:

1. What are the trends in rates of hospitalization and days of hospitalization for ambulatory care sensitive conditions?
   - Are differential rates of growth observed in ACSC hospitalization among subpopulations of Medicare beneficiaries as defined by sociodemographic, geographic, or health status characteristics?
   - Do changes in rates reflect changing number of beneficiaries admitted or changing number of hospitalizations per beneficiary?
   - What is the relationship between changes in rates of ACSC hospitalization and total length of stay? Is there a trend of shorter lengths of stay per beneficiary as ACSC hospitalization rates increase?
2. What influence do medical care practice patterns have on the trend of ACSC hospitalizations?
   - What are the trends in treatment of ambulatory care sensitive conditions in the emergency department or in observation beds?
   - Are differential rates of growth observed in the ER or observation bed treatment for ACSCs among subpopulations of Medicare beneficiaries as defined by sociodemographic, geographic, or health status characteristics?
   - Do changes in rates reflect changing number of beneficiaries treated in the ER or in observation beds or changing numbers of treatments per beneficiary?

- What are the trends in rates of hospitalization from post-acute or sub-acute facilities?

- Is geographic variation in trends observed?

3. What is the influence of selected beneficiary characteristics on the rate of growth of ACSC hospitalizations?
   - Sociodemographic factors

   - Health Status

   - Geographic Location

4. What is the influence of selected beneficiary characteristics on the likelihood of hospitalization for an ACSC?

   - Sociodemographic and geographic factors

   - Health Status

   - Place of usual source of care

   - Insurance status (supplemental, Medicaid, prescription drug)

   - Propensity to seek care

   - Beneficiary assessment of unmet need

5. What is the influence of selected market-level factors on the rate of ACSC hospitalizations? What is the influence of Medicare payment policies arising from the Balance Budget Act (BBA, 1997) on the rate of growth of ACSC hospitalizations?

   - Supply of providers (e.g., physicians, hospitals, post-acute and sub-acute providers)

   - Medicare managed care and private managed care penetration

   - Insurance availability for elderly and non-elderly, including Medigap affordability and availability of pharmaceutical assistance programs

   - Health status of beneficiaries in the geographic area

   - Efficacy of care provided in geographic area (e.g., the Health Plan Employer Data Information Set [HEDIS®])

   - Access factors (e.g., FFS physician caseload, urban/rural location, etc)

Descriptive statistics were produced to provide insight into actual trends in hospitalization rates among Medicare FFS enrollees. Trends in ACSC hospitalizations were

estimated by beneficiary characteristics available from Medicare claims and enrollment files. We also examined whether there have been shifts in patterns of care (i.e., hospitalization versus treatment in the emergency room and source of admission). Incompleteness of billing data among Medicare managed care enrollees limited our ability to include managed care enrollees in our time trend analyses.

Three sets of multivariate analyses were conducted for a subset of conditions to allow for direct examination of beneficiary, demand, supply, and policy factors that influence the probability of being hospitalized. A multivariate analysis of trends in ACSC hospitalization rates from 1993 to 2000 for Medicare FFS beneficiaries examined the role of changing demographics, health status, and geographic migration patterns on the trend in hospitalizations for the clinical conditions of COPD, CHF and PVD. For the multivariate modeling, rates of hospitalization for PVD was estimated fro all Medicare FFS beneficiaries, rather than for only those with diabetes. This allowed us to directly examine the influence of increasing prevalence of diabetes on hospitalization for PVD. We estimated growth in rates of ACSC hospitalizations by urban-rural designations within states using Medicare claims data.

The second multivariate analysis critically examined the influence of supplemental insurance, prescription drug coverage, and patients' health-care-seeking behavior on the rate of hospitalizations using survey data from the Medicare Current Beneficiary Survey (MCBS). The three clinical conditions were chronic lung disease (CLD), CHF and dehydration. Due to the small number of hospitalizations for COPD and asthma, they were combined into a single rate for the multivariate, cross-sectional analysis.

In the third multivariate analysis, we used regional-level claims data and aggregated ACSC hospitalizations into Hospital Referral Regions (HRRs) from the Dartmouth Atlas Project for the clinical conditions of CHF, COPD and PVD among all Medicare beneficiaries. This multivariate geographic analytic approach examined changes in the rate of hospitalizations between two time periods (1995-1997 versus 1998-2000) using RTI's existing geographic information system (GIS), which contains information on U.S. population characteristics and population density, rural versus urban designations, provider supply, competitive market factors, Medicare and commercial managed care penetration, and provider characteristics. To this, we added population-based estimates of Medicare FFS beneficiary characteristics, utilization, and health status.

### 1.3 Organization of Final Report

The remainder of this report is organized as follows. Chapter 2 provides a description of the process used by RTI to develop the list of eleven ambulatory care sensitive conditions evaluated in this project and provides the coding specifications used in calculating the ACSC hospitalization rates. Chapter 3 provides a summary of the data used to identify ambulatory care sensitive conditions and a summary of the results from our univariate and multivariate analysis of trends in rates of hospitalization and length of stay during 1992 through 2000 for the eleven selected ACSCs for Medicare FFS beneficiaries. Chapter 4 provides a summary of the results of our multivariate analysis of the influence of selected beneficiary characteristics on the likelihood of an ambulatory care sensitive condition hospitalization in 2000 for Medicare FFS beneficiaries surveyed in the 1999 Medicare Current Beneficiary Survey. Chapter 5 provides a summary of the results of our multivariate analysis of market characteristics on rates of ACSC hospitalizations in Medicare FFS building on RTI's existing geographic information system and

using spatial analytic methods. Three manuscripts have been written for submission to peer-reviewed health services research, thus the three chapters that report the results of our analytic work are intended to provide a greater level of detail on the methodology used than is possible in a manuscript as well as a general discussion of the findings that have been presented at CMS during two briefings.

**Exhibit 1-1**
**Comparison of Rate of Admission per 1,000 Medicare Fee-for-Service Beneficiaries for Selected Ambulatory Care Sensitive Conditions Calculated with Medicare Claims Data[1] with Rate of Admission per 1,000 Aged Persons Calculated from the National Hospital Discharge Survey[2]**

| | CHF[3] | | Pneumonia and Influenza[4] | | Asthma/COPD[5] | | Cellulitis & Abscess[6] | |
|---|---|---|---|---|---|---|---|---|
| Year | Kozak[7] | Trisolini | Kozak | Trisolini | Kozak | Trisolini | Kozak | Trisolini |
| 1990 | 19.7 | | 17.5 | | 3.3 | | 3.0 | |
| … | | | | | | | | |
| 1992 | | 19.4 | | 17.5 | | 10.8 | | 3.6 |
| 1993 | | 19.6 | | 18.8 | | 12.3 | | 3.6 |
| 1994 | | 19.6 | | 19.2 | | 12.4 | | 3.7 |
| 1995 | | 19.6 | | 19.5 | | 12.8 | | 3.7 |
| 1996 | | 19.8 | | 19.3 | | 12.8 | | 3.6 |
| 1997 | | 20.3 | | 19.7 | | 13.2 | | 3.6 |
| 1998 | 24.7 | 20.2 | 22.0 | 20.4 | 1.7 | 13.8 | 3.9 | 3.8 |
| 1999 | | 19.8 | | 21.8 | | 15.0 | | 3.9 |
| 2000 | | 19.8 | | 19.97 | | 13.8 | | 4.0 |

Notes

[1] Rates were calculated from a previous CMS-funded project. For details, see Trisolini et al, 2002.

[2] Kozak et al, 2001.

[3] Kozak uses a larger set of heart failure diagnoses (428x, 402.01, 402.11, 402.91) than used by Trisolini (428.0).

[4] Trisolini's definition uses influenza and pneumonia; while Kozak excludes influenza.

[5] Trioslini combines asthma/COPD conditions (clinical recommendation); Kozak is just asthma

[6] Same diagnosis codes used for both Trisolini and Kozak

[7] Kozak rates converted from per 10,000 to per 1,000

# CHAPTER 2
# IDENTIFICATION OF ELEVEN AMBULATORY CARE SENSITIVE CONDITIONS FOR STUDY

As motivation of this project, a study conducted by Jean Kozak and colleagues at NCHS (Kozak et al, 2001) using the National Hospital Discharge Survey (NHDS) showed significant increases in the hospitalization rates for those age 65 and older for three clinical conditions: congestive heart failure, pneumonia, and cellulitis using specifications developed by Weissman and colleagues (Weissman, J et al.1992). Further exploration of other National Hospital Discharge Survey data by CMS staff showed substantial increases in the hospitalization rates for the elderly for the clinical conditions of sepsis, urinary tract infection, chronic bronchitis, and dehydration (http://www.cdc.gov/nchs/about/otheract/aging/trenddata.htm#Health%20Care%20Utilization).

CMS requested that we explore the trends in increasing rates of admissions for these seven clinical conditions as well as three other ACSCs of our choosing. RTI ultimately selected four additional clinical conditions to study: asthma, stroke, and acute diabetic events and lower limb peripheral vascular disease among Medicare beneficiaries with diabetes. The purpose of this chapter is to provide a description of the process used to develop a suggested list of ambulatory care sensitive conditions (ACSCs) for critical evaluation in this project and provide the coding specifications that will be used in calculating the ACSC rates. We begin by reviewing the literature, building upon the previous literature review and updating with more recent studies examining ACSCs in the elderly population (Dayhoff and Barghout, 1999). Second, we describe the process used in an earlier CMS study to identify a set of fifteen ACSCs appropriate for an elderly population and identify our proposed criteria for selection of ACSCs (Dayhoff and Barghout, 1999). We do so as this list was our starting point for identifying additional clinical conditions. Section 2.3 contains a list of our recommended ACSCs for this study.

## 2.1 Literature Review

The purpose of this literature review was to identify a list of ambulatory care sensitive conditions that could be used for monitoring care provided to Medicare beneficiaries. Sentinel events have been used to evaluate the degree to which patients obtain all necessary care. One of the earliest of these studies was conducted by Carr et al. (1989) who examined the rate of preventable deaths and disease occurrences among persons hospitalized in New York State in 1983. The study found that the rates of these sentinel events were higher among Blacks, Medicaid recipients, and users of public hospitals. Subsequent research investigating access to primary care has focused upon rates of hospitalization for ambulatory care sensitive conditions. If treated in a timely fashion with adequate primary care and managed properly on an outpatient basis, medical practitioners broadly concur that in most instances commonly defined ACSCs should not advance to the point where hospitalization is required. Because lack of primary care for ACSCs may result in hospitalization, the rate of inpatient admissions provide a practical way of evaluating primary care delivery and thereby identifying priority areas for improving access and quality in the health care delivery system.

However, an extensive review of the literature to identify potential ACSCs was necessary for two reasons. First, there is no standard listing of ACSCs that is used in every study. Thus, it was desirable to produce a compilation of as many ACSCs from as many studies as could be

identified. Second, studies have used ACSC admissions to monitor care for a variety of populations, including all ages, those under age 65, those age 18-65, and the elderly. This literature review includes a discussion of measures that are applicable to the elderly.

To discuss our findings and display annotations of relevant citations, we adopted a classification typology that divides all ACSCs into three categories: chronic, acute, and "preventable" conditions. These conditions differ in the amount and type of services required to keep the clinical condition from developing to the point at which inpatient treatment is needed. Thus, admissions for an ambulatory care sensitive condition would tend to signal poor preventive care or poor monitoring during routine exams. Care for chronic conditions has been of special concern for managed care organizations and merits a separate category for evaluation.

### 2.1.1 Methods

RTI staff conducted an extensive search of the literature on ACSC admissions. Since we are focusing exclusively on elderly Medicare beneficiaries, we excluded conditions that lack face validity for this population. For example, low birth weight babies and ectopic pregnancies were both excluded from our analysis. For conditions that could apply to the elderly Medicare population, relevant information was abstracted into Appendix A-1: Summary of ACSC Literature. This exhibit contains 6 columns as follows:

- **Condition Number**: The conditions are numbered consecutively for easier reference.

- **Ambulatory Care Sensitive Condition**: This column gives the name of the condition. In a few cases, authors used slightly different names for what were essentially the same conditions. In these cases, we combined the conditions under one heading. For example, the conditions "hypertension," "malignant hypertension," and "uncontrolled hypertension" were combined under the heading "hypertension." Similarly, we combined "immunization-related conditions" and "immunizable conditions" under one heading.

- **Source:** To conserve space, we provide only the name of the first author of the study in this column. A complete bibliography is provided at the end of this report.

- **Population Studied**: The age groups included in the analysis. Typically, studies include either the under 65 population or the elderly Medicare population, although we found several variations in samples.

- **Sample**: The ACSCs vary substantially in the frequency for which admissions occur. Since frequency is one criterion for deciding whether to include a condition in our analysis, we attempted to report the authors' findings on how common hospitalizations were in their sample. The best measure of frequency is admissions per 1,000 population. If this was reported (or sufficient detail was provided so that it could be calculated), the rate is presented in this column. If the admission rate was not provided, but the authors provide the percentage of ACSC admissions for each individual condition, we present that proportion instead. (Of course this measure is limited, in that it depends upon the exact list of conditions used.) Unfortunately, some studies provided little or no detail on the frequency of individual conditions. For these studies, the sample column is left blank. Many of the studies had very

small samples of admissions, leading to a wide range in the rates per 1,000 population.

- **Coding of Condition**: This column provides the diagnosis codes used to identify the condition from claims or discharge abstract files. The vast majority of conditions are identified using ICD-9 codes as the principal diagnosis. However, there were a few exceptions. First, a few studies identified a condition using both principal and secondary diagnosis codes. Second, in a few instances the coding specified that no procedure be coded during the admission. Third, one condition is coded using DRG rather than ICD-9 codes. (Conditions with such definitions are noted in the table.) We also found a few studies that provided the names of conditions studied, but did not give the detailed coding used to identify the diagnoses. For these studies, we include other information as available, but the coding column is left blank.

Conditions were organized into the three broad headings: chronic conditions, acute conditions, and preventable conditions, as described above. Within each of the headings, conditions are listed in alphabetical order.

### 2.1.2 Results

Our updated literature review identified 42 ACSCs that could be applied to the aged Medicare population. Of these, eleven are chronic conditions, twenty are acute conditions, and eleven are "preventable" conditions. There is a high degree of consensus on use of many of the chronic conditions. Angina, asthma, chronic obstructive pulmonary disease, congestive heart failure, diabetes, and hypertension are all found in the majority of studies. There are slight variations, however, in the definitions of these conditions. For example, the principal diagnosis codes for angina, congestive heart failure, and hypertension are similar for all studies, but some authors added the additional requirement that no procedure be coded during the discharge. (This removes patients who have heart bypass surgery, angioplasty, or heart transplants performed during the stay.) However, none of the authors provide any discussion of the number of patients excluded using this additional criterion. COPD also varies somewhat in how it is specified; some authors use an additional criterion to select patients using secondary diagnosis codes. While the diagnostic codes used to identify diabetes tend to be similar across all studies, some authors use only one diabetes category, while others use three. These authors follow Billings's classification in which Diabetes A is diabetes with ketoacidosis or coma, Diabetes B is diabetes with other complications, and Diabetes C is diabetes with no complications (Billings, 1993).

Several studies include grand mal status and/or convulsions, although authors disagree whether the two conditions (ICD-9 codes 345 and 780.3) are included in one category or are analyzed separately. Pulmonary tuberculosis and other tuberculosis are also found in several studies, while one study (Shukla, 1996) includes only a subset of the "other tuberculosis" codes in his "other respiratory tuberculosis" category.

Among the acute conditions, pneumonia, cellulitis, dehydration, gastroenteritis, kidney/urinary tract infection, and severe ear nose and throat infections are most often studied. Kidney/urinary tract infection presented a particular problem in classification, since the codes included in the reviewed studies included both chronic and acute infections of the kidney. We have included the diagnoses under our acute disease category. The acute conditions category

also includes a number of conditions found in a relatively small number of studies. These include acute bronchitis, pelvic inflammatory disease, and perforated or bleeding ulcer.

We also found a number of acute conditions that do not seem to fit well with the definition of being ambulatory care sensitive. For example, breast cancer, endometrial cancer, and pulmonary embolism/infarction seem to be conditions for which the link between adequate outpatient care and avoidance of hospitalization is tenuous at best.

The "preventable" conditions include immunizable conditions (either as a group, or studied separately), as well as advanced conditions that should not occur if the patient is receiving adequate primary care, such as invasive cervical cancer. (Invasive cervical cancer is viewed differently than breast cancer or endometrial cancer, since adequate screening should catch cervical cancer before it reaches the invasive stage.) These conditions tend to be relatively rare.

## 2.2 Process Used to Select ACSCs for Study

### 2.2.1 Process Used in Earlier Study

In our earlier work (McCall et al, 2000), we compiled a list of fifteen ACSCs through a multi-step process:

- the conduct of a literature review to identify a preliminary list of ACSCs used by previous health services researchers to analyze access to and quality of care;
- an initial review of the preliminary list by the CMS Project Officer, Jennifer Harlow, and a CMS physician, Laurie Fineberg;
- development of a more targeted list of ACSCs for detailed specification by the RTI project team;
- a critical review by two clinicians, Drs. John Ayainan and Edward Marcantonio; and
- development of the final set of coding specifications.

Our literature review identified 42 ACSCs that could be applied to the aged Medicare population. They are as follows:

- Acute Bronchitis
- Acute Poliomyelitis
- Angina
- Asthma
- Breast Cancer
- Bronchiolitis

- Cellulitis
- Chronic Obstructive Pulmonary Disease (COPD)
- Congenital Syphilis
- Congestive Heart Failure (CHF)
- Convulsions
- Dehydration
- Dental
- Diabetes
- Drug Toxicity/Overdose
- Endometrial Cancer
- Gangrene
- Gastroenteritis
- Grand Mal Status/Epileptic Convulsions
- Hypertension
- Hypoglycemia
- Hypokalemia
- Immunizable Conditions
- Invasive Cervical Cancer
- Iron Deficiency Anemia
- Kidney/Urinary Tract Infection
- Malnutrition
- Measles
- Mumps
- Pelvic Inflammatory Disease
- Perforated or Bleeding Ulcer

- Pneumonia
- Pneumonia/Bronchitis/Respiratory Infection
- Pulmonary Embolism/Infarction
- Rheumatic Fever
- Ruptured Appendix
- Severe Ear Nose and Throat Infections
- Skin Grafts for Cellulitis
- Tetnus
- Tuberculosis – Other
- Tuberculosis – Other Pulmonary
- Tuberculosis – Pulmonary

An initial review was conducted by RTI and two CMS representatives, Jennifer Harlow, Project Officer, and Laurie Fineberg, M.D. The purpose of the review was to remove conditions from the initial list that, upon further reflection, appeared to be inappropriate for the Medicare population, were likely to occur in so few instances to make ACSC rates extremely unstable, or conditions for which the length of time between the lack of appropriate or timely ambulatory care and the appearance of the condition, e.g., breast cancer, would most likely extend beyond the length of time the beneficiary had Medicare insurance coverage. From this process, twenty-two conditions were selected for detailed coding specification and clinical review:

*Chronic Conditions*

- Angina
- Asthma
- Chronic Obstructive Pulmonary Disease (COPD)
- Congestive Heart Failure (CHF)
- Convulsions
- Diabetes
- Grand Mal Status/Epileptic Convulsions
- Hypertension
- Hypoglycemia

- Pyelonephritis
- Tuberculosis

*Acute Conditions*

- Cellulitis
- Dehydration
- Gastroenteritis
- Hypokalemia
- Kidney/Urinary Infection
- Perforated or Bleeding Ulcer
- Pneumonia
- Severe Ear Nose and Throat infections

*Preventable Conditions*

- Immunizable Conditions
- Invasive Cervical Cancer
- Iron Deficiency Anemia
- Malnutrition
- Ruptured Appendix

For each of the twenty-two potential ACSCs, we constructed a one-page sheet detailing the specifications of the indicator. Seven pieces of information were included for each potential ACSC: a proposed name for the indicator, a brief narrative description of the ACSC, specifications for constructing the denominator and numerator; a field to provide clinical rationale for each indicator, a discussion of potential data quality problems; and a listing of issues for discussion. Specific ICD-9 diagnosis codes were listed for each of the conditions (For more details, see McCall, Barghout, and Griggs, 2000).

Of particular concern were data issues related to defining the numerator. The prior RTI ACSC project used the Medicare + Choice (M+C) hospital encounter data set for Medicare managed care enrollees. During the first two reporting years, health plans were provided a number of options for submitting hospital encounter data to CMS that resulted in systematic differences in the resultant database. For example, health plans could submit full UB-92s or abbreviated UB-92s. The latter bills frequently contained only a limited number of clinical and claims processing variables such as beneficiary identification, admission and discharge date, and

principal diagnosis. Secondary diagnoses and procedures were not frequently recorded. For this reason, we were anxious to avoid selecting ACSCs that required a secondary diagnosis or the absence of a surgical procedure to accurately identify the numerator of the ACSC rates.

Most of the studies that were contained in our preliminary list were derived from two studies conducted by either Billings (Billings et al., 1993) or Weissman (Weissman et al. 1992). As such they had already undergone extensive clinical review. Billings formed a medical advisory panel consisting of six internists and pediatricians to develop a diagnostic framework for analyzing hospital use patterns. Using a modified Delphi approach, the panel identified 3 basic categories for grouping causes of hospital admission. The ACSCs were defined as "diagnoses for which timely and effective outpatient care can help to reduce the risks of hospitalization by either preventing the onset of an illness or condition, controlling an acute episodic illness or condition, or managing a chronic disease or condition." At the time of their development, the panel expressed reservations about using the list to classify hospitalizations in the elderly, since some diseases present differently in older populations. For example, pneumonia--which was included in the original list of ACSCs--is a common terminal event in older people.

Weissman et al. (1992) used a literature review and clinical guidance from physicians to select the ACSCs. Criteria for selection included the following:

- Consensus: Have previously published studies used similar indicators?
- Importance: Do the conditions represent important health problems?
- Clinical face validity: Do the conditions make clinical sense in terms of identifying potential problems related to outpatient care? Is it more likely that hospitalizations for these conditions occurred as a result of problems with ambulatory care rather than other factors such as disease prevalence or provider practice styles?
- Data clarity: Are the conditions clearly coded in an available data source covering large populations?

Using these criteria, they deleted from their list conditions appearing in the literature for which there was a tenuous link between hospitalization and care, those that could not be identified using claims data, and those that were otherwise problematic. The panel also added several indicators that they felt met their criteria.

Our clinical validation process was designed to build upon the previous clinical review undertaken by Billings and Weissman in the development of their ambulatory care sensitive condition lists. Because ACSCs were developed primarily as a measure of access to care for the non-elderly population, each measure was examined by two clinical consultants to ensure that selected ACSCs were appropriate for the elderly population, Drs. John Ayainan and Edward Marcantonio. Critical examination of the previously used specifications for identifying both the population at risk and the clinical conditions of interest was undertaken as well as an evaluation of the likely accuracy of coding of the clinical condition on hospital bills. We were specifically interested in seeking advice and counsel from our two clinical consultants with respect to the following five questions:

- Are the coding specifications accurate and complete?
- Are the conditions truly ACSCs in the elderly population?
- Are the conditions likely to be coded accurately using claims/encounter hospitalization billing data?
- Do they foresee any face validity issues in the use of the measure for the Medicare population?
- Do they have any suggestions for improving the specifications?

Of the twenty-two conditions that underwent clinical review, fifteen were deemed to be suitable for use with the Medicare population.

*Chronic Conditions*

- Asthma/Chronic Obstructive Pulmonary Disease (COPD)
- Congestive Heart Failure (CHF)
- Seizure Disorder
- Diabetes
- Hypertension

*Acute Conditions*

- Cellulitis
- Dehydration
- Hypoglycemia
- Hypokalemia
- Kidney/Urinary Tract Infection
- Perforated or Bleeding Ulcer
- Pneumonia
- Severe Ear Nose and Throat Infections

*Preventable Conditions*

- Influenza
- Malnutrition

These fifteen ACSCs were felt to represent clinical conditions or groups of conditions for which high-quality ambulatory care, including prompt evaluation and diagnostic testing, immunizations, effective therapy, and/or close monitoring, could reduce the probability of unplanned admissions for more severe forms of the condition(s).

### 2.2.2 Process to Select Proposed ACSCs for this Study

The process for selecting the final eleven ACSCs for study in this project built from the previous work that has been conducted by RTI and other researchers and involved four steps:

- develop a set of selection criteria appropriate to this study;
- update the previously conducted literature review to identify any new ACSCs used by health services researchers to analyze access to and quality of care in the elderly population;
- conduct clinical and criteria review of all potential ACSCs; and
- develop a set of coding specifications for the proposed ACSCs.

We reviewed our prior criteria for selecting conditions for this study and developed a set of four criteria that were presented to CMS staff at the project kick-off meeting. The four selection criteria for this project are as follows:

1. The clinical condition is appropriate for an aged population. Thus, there is both clinical face validity and clinical consensus of appropriateness.

2. The clinical condition meets two of Billings's actionable conditions for defining a clinical condition as being ambulatory care sensitive: c*ontrolling* an acute episodic illness or *managing* a chronic disease or condition. Thus, we focus upon identifying acute and chronic medical conditions.

   Further, we were also interested in evaluating the feasibility of defining the population (denominator) for one or two selected ACSCs based upon the presence of a chronic condition to allow for an examination of the success of *managing* a chronic condition. It was noted during the project kick-off meeting that for diabetes a lot of work has already been done in terms of identifying persons with diabetes using Medicare claims data. Thus, we could define one of the denominators based upon the presence of a clinical condition (diabetes) and then evaluate acute conditions reflecting poor outpatient care, such as ketoacidosis.

3. The clinical condition must result in a sufficient number of hospitalizations in the elderly Medicare population to produce statistically stable rates of admission to support sub-population analyses.

4. The clinical condition must be well-captured in Medicare claims data. Several previous researchers have used a combination of principal and secondary conditions. In the earlier RTI work, principal diagnosis was the only diagnosis considered. The primary reason was lack of validation of the secondary diagnosis

code on the encounter data submitted on behalf of Medicare managed care enrollees. There were concerns raised on the part of CMS staff at the project kick-off meeting that even in FFS there is not a lot of confidence with respect to the validity of the secondary diagnosis codes. The general consensus was that primary diagnosis should be the basis for identifying ACSCs. Further, clinical conditions should be selected that are consistently coded across the years as we are analyzing trends in admissions from 1992 through 2000.

The previously conducted literature review was updated as discussed in Section 2.1. Nine additional manuscripts were evaluated; however, no new ACSCs were identified as a result of the expanded literature review.

The third step involved conducting both a review of all potential ACSCs for clinical validity and whether or not the clinical condition met all of the selection criteria. The review was conducted by Drs. Douglas Kamerow and Nancy McCall. Dr. Kamerow is a Chief Scientist with RTI and was formerly a USPHS Assistant Surgeon General and Director of the Center for Practice and Technology Assessment for the Agency for Healthcare Research and Quality, where he directed the clinical practice guideline program and the Evidence-based Practice Centers. He is a board-certified family practice physician and a member of the Board of Regents of the American College of Preventive Medicine. Dr. McCall is a former practicing registered nurse and was the principal investigator for two prior CMS-funded studies investigating the use of ambulatory care sensitive conditions to assess quality of care provided to the Medicare population. In these two prior studies, Dr. McCall was responsible for developing the detailed ACSC data specifications and participating in the prior clinical review.

## 2.3 Selected ACSCs for Study

A preliminary set of proposed ACSCs was discussed with the CMS Project Officer, Mary Kapp, and an additional review was conducted following that conversation. Eleven clinical conditions were selected for further study from the initial set of seven CMS-requested conditions, our prior list of fifteen ACSCs, and additional consideration by our physician team member. We selected nine ACSCs for which the denominator in the rate calculations are all Medicare beneficiaries age 65 and older who were continuously enrolled in FFS Part A & B the full 12 month period of the year,[1] and two diabetes-specific ACSCs. Our list of ambulatory care sensitive conditions for this study is as follows:

**Asthma:** Annual rate of admission with a principal diagnosis of asthma. In our earlier work, we combined asthma and COPD into an ASCS of chronic lung disease based upon our clinicians' feelings that these two conditions are difficult to distinguish in an older population. Based upon a request by CMS, we agreed to separate asthma and COPD and evaluate their admission trends as separate ACSCs.

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[1] Beneficiaries who are age 65 as of January 1st of each reference year will be included in the sample; however we will not be including any beneficiaries who turn 65 during the calendar year because of our 12-month continuous enrollment criteria. Beneficiaries who die during the year, but who would have otherwise qualified, will be retained in the study and the denominator adjusted downward to reflect partial year enrollment. ESRD and disabled beneficiaries are included in the study if they are aged and will be analyzed as a sub-population(s) based on the variable "original reason" for entitlement. Beneficiaries who reside outside of the United States will be excluded from the study.

**Cellulitis:** Annual rate of admission with a principal diagnosis of cellulitis. This is a prior RTI-studied ACSC and a CMS-requested clinical condition. We narrowed our specification of this clinical condition to be consistent with the definition developed by Weissman and colleagues (Weissman et al. 1992).

**Chronic Obstructive Pulmonary Disease (COPD):** Annual rate of admission with a principal diagnosis of chronic obstructive pulmonary disease (COPD). CMS requested evaluation of COPD distinct from asthma.

**Congestive Heart Failure (CHF):** Annual rate of admission with a principal diagnosis of congestive heart failure. This is a prior RTI-studied ACSC and a CMS-requested clinical condition. We have a somewhat more expansive specification of this clinical condition than that developed by Weissman and colleagues (Weissman et al. 1992) based upon the work that we have done to develop CHF-specific risk adjustors for the M+C payment rates.

**Dehydration:** Annual rate of admission with a principal diagnosis of dehydration. This is a prior RTI-studied ACSC and a CMS-requested clinical condition. This condition was not studied by Kozak (Kozak et al, 2001).

**Acute Diabetic Events:** Annual rate of admission for acute diabetic events among Medicare beneficiaries with diabetes mellitus. Acute diabetic events include ketoacidosis, hypoglycemia, and hyperosmolality. Good control of diabetes should limit or eliminate admissions for these problems. This set of clinical conditions was not requested by CMS, but was studied by Kozak (Kozak et al, 2001). RTI previously studied admission for hypoglycemia among all Medicare FFS beneficiaries. The specifications for identifying the selected clinical conditions are similar but not identical to those developed by Weissman and colleagues (Weissman et al. 1992).

The denominator is based on a 5% sample of Medicare Part A and B FFS beneficiaries for 12 consecutive months with a diagnosis of diabetes mellitus. The following algorithm is used to identify Medicare beneficiaries with diabetes for CMS's QIOs' 6$^{th}$ Scope of Work related to the Diabetes Clinical Quality Improvement Project and was used to identify beneficiaries with diabetes in this project. Using the claims data, we identified beneficiaries with diabetes from the eligible Medicare FFS population as those who had (1) at least one acute face-to-face claim with a principal or secondary diagnosis of diabetes, or (2) at least two non-acute face-to-face claims at least seven days apart with a principal or secondary diagnosis of diabetes.

**Lower Limb PVD in Beneficiaries with Diabetes:** Annual rate of admission for lower limb peripheral vascular disease (PVD) and PVD-related cellulitis among Medicare beneficiaries with diabetes mellitus. Persons with diabetes have up to a 30-fold increase in incidence of peripheral vascular disease compared to those without diabetes (Gregerman, 2003). This ACSC will allow us to examine whether there may be differential access to care for chronic sequelae related to diabetes as opposed to acute sequelae related to diabetes. The diabetes denominator described for acute events was used for this ACSC as well.

**Pneumonia:** Annual rate of admission with a principal diagnosis of bacterial pneumonia. This is a prior RTI- and Kozak-studied ACSC and a CMS-requested clinical condition. We use the same specification of this clinical condition that developed by Weissman and colleagues (Weissman et al. 1992).

**Septicemia:** Annual rate of admission with a principal diagnosis of septicemia. This is a CMS-requested clinical condition. We do not have any ICD-9 codes from previous studies of ACSCs. Therefore, we selected the principal septicemia category from the ICD-9-CM manual.

**Stroke:** Annual rate of admission with a principal diagnosis of ischemic stroke. This condition was not requested by CMS nor was it studied by Kozak (Kozak et al, 2001). We suggested including stroke as an ambulatory care-sensitive condition because the risk of stroke is strongly related to hypertension. Risk of stroke is at least four times greater in hypertensives than in normotensive persons (Kannel et al, 1970). Hypertensives' risk of stroke decreases markedly if their blood pressure is controlled (Kannel et al, 1970; SHEP, 1991; VA 1967; VA 1970). Thus, good ambulatory control in a population of persons with hypertension should result in lower stroke (and stroke hospitalization) rates. Stroke is of particular concern among the elderly with the risk of dying from stroke being seven times higher for adults over the age of 65 compared to that of the general population (National Stroke Association, 2001).

We restricted our sample to those having a cerebral (ischemic) stroke. Patients with a principal diagnosis of occlusions and stenosis of pre-cerebral arteries (ICD-9 code 433) were excluded because independent medical record reviews conducted by the Stroke Outcomes Research Team (PORT) investigators at the Mayo Clinic found that very few of the patients with this diagnosis actually suffered an acute stroke (Liebson, Naessens, Brown, and Whisnanant, 1994). We use the ischemic stroke definition developed by the Stroke PORT.

**Urinary Tract Infection:** Annual rate of admission with a principal diagnosis of urinary tract infection (UTI). This is a CMS-requested clinical condition. In our earlier work, we included kidney infection. We removed all ICD-9 codes that related to kidney infection, leaving two ICD-9 codes that have been commonly used to identify urinary tract infections in other studies of ACSCs.

Appendix A-2 contains detailed specifications for the eleven selected ambulatory care sensitive conditions. The detailed coding specifications have been developed using 1997 ICD-9 codes. Any changes to coding during the 1992 – 2000 period were incorporated into the programming code.

# CHAPTER 3
# ANALYZING TRENDS IN RATES OF ADMISSION AND LENGTH OF STAY FOR SELECTED AMBULATORY CARE SENSITIVE CONDITIONS (ACSC)

## 3.1 Overview

We used a combination of univariate and multivariate analyses to conduct (1) an examination of the trend in annual ACSC hospitalization rates for eleven selected clinical conditions from 1992 through 2000 and (2) an exploration of the relationship among changes in demographics, health status, and geographic migration patterns on the trend in hospitalization for three ACSCs among Medicare FFS beneficiaries age 65 and older. The specific research questions examined include:

1. What are the trends in rates of hospitalization and days of hospitalization for ambulatory care sensitive conditions?

   - Are changes in rates of ambulatory care sensitive condition hospitalizations differentially observed among subpopulations of Medicare beneficiaries as defined by sociodemographic, geographic, or health status characteristics?

   - Do changes in rates reflect changing number of beneficiaries admitted or changing number of hospitalizations per beneficiary?

   - What is the relationship between changes in rates of ACSC hospitalizations and total length of stay? Is there a trend of shorter lengths of stay per beneficiary as ACSC rates increase?

2. What influence do medical care practice patterns have on the trend of ACSC hospitalizations?

   - What are the trends in treatment of ambulatory care sensitive conditions in the emergency department or in observation beds?

   - Are changes in rates in the ER or observation bed treatment for ACSCs differentially observed among subpopulations of Medicare beneficiaries as defined by sociodemographic, geographic, or health status characteristics?

   - Do changes in rates reflect changing number of beneficiaries treated in the ER or in observation beds or changing numbers of treatments per beneficiary?

   - What are the trends in rates of admissions from post-acute or sub-acute facilities as determined by source of admission on the hospital record?

   - Is geographic variation in trends observed?

- What is the influence of selected beneficiary characteristics on changes in the rate of ACSC hospitalizations?

- Sociodemographic factors

- Health status

- Geographic distribution of beneficiaries

Two sets of descriptive statistics were constructed to provide valuable insight into actual trends in hospitalization among Medicare FFS enrollees. One set focused upon trends in ACSC hospitalization by beneficiary characteristics available from Medicare claims and enrollment files. The second examined whether there have been shifts in patterns of care (i.e., analysis of observation stay and emergency room visits for ACSCs). We used descriptive univariate statistics to examine trends in age/sex-adjusted ACSC hospitalization rates by the age-sex categories within stratum, in total, and by sociodemographic and health status characteristics of Medicare FFS beneficiaries. These univariate statistics allowed us to examine trends in practice variation that have been observed with respect to treating ambulatory care sensitive conditions. Following the descriptive analyses, the results of our multivariate analysis of trends in admission for COPD, CHF, and peripheral vascular disease among all Medicare FFS beneficiaries from 1993 to 2000 are presented allowing for an examination of the role of changing demographics, health status, and geographic migration patterns on the trend in hospitalization.

## 3.2 Data

We used a number of Medicare claims and enrollment analytic files that RTI created for the Medicare Quality Monitoring System (MQMS) to conduct the descriptive and multivariate analysis of trends in ACSC hospitalization rates, supplemented with the CMS Standard Analytic Files for hospital outpatient services (Urato, 2002a; Urato, 2002b).

### 3.2.1 Medicare Enrollment Data

Medicare enrollment data were used to identify Medicare beneficiaries eligible for inclusion in our study, estimate the denominators for the rate construction, identify sociodemographic and enrollment characteristics of beneficiaries selected for study, and produce age-sex counts for standardizing all rates to the 1999 age/sex distribution of the Medicare FFS population. Two MQMS beneficiary characteristics files were used for the analyses.

The **1992-2000 DENOMB** Files are annual files that contain individual-level information on all persons enrolled in Medicare FFS for any part of the calendar year, including those who died during the year. Key beneficiary-level stratifying variables include age, sex, race/ethnicity, dual Medicaid/Medicare status, reason for entitlement, date of death, indicators for enrollment in Medicare Part A, Part B, Medicare managed care, urban/rural indicator, state, and Census Region and Census Division. We used these files to identify the Medicare beneficiaries eligible for inclusion in this study as well as the characteristics of elderly beneficiaries under study. We used counts of eligible beneficiaries as the denominator for our rates.

The second MQMS file, AGESEX99, contains counts of 1999 Medicare FFS beneficiaries as of July 1 within 9 age and 2 sex cross-tabulation categories. This file was used to age/sex-adjust all ACSC rates to the 1999 Medicare FFS July 1 population.

### 3.2.2 Identification of Denominator Population

The study population was defined on an annual basis as Medicare beneficiaries, age 65 and older as of January 1st of the reference year and continuously enrolled in FFS Parts A & B for the full 12-month period. Beneficiaries who died during the year, but who would have otherwise qualified, were retained in the study and partial year enrollment credit provided. Beneficiaries with ESRD and disabled beneficiaries were included in the study, if they were age 65 and older.

Because we used the MQMS Base Analytic Denominator (DENOMB) files to identify our beneficiaries, several other exclusions applied to our study population as they were exclusions in the construction of the MQMS DENOMB files:

- Beneficiaries residing outside of the United States or the District of Columbia as of March 31st of the year following the reference year, except beneficiaries residing in Guam. Residents of Guam are reported with residents of Hawaii in the MQMS.
- Missing or invalid values for the following in the Denominator file:
  - State Code
  - Beneficiary Sex
  - Beneficiary Race Code
  - Medicare Status Code
  - Date of Birth

An additional issue regarding the denominator arose when developing the specifications for the ACSCs to study. Most prior studies have used population-based denominators rather than disease-specific denominators; therefore, an increase in the prevalence of chronic disease over time may affect observed rates of hospitalization for ACSCs. The diagnosis of diabetes is showing up increasingly in claims due to increasing prevalence, expanded detection and greater awareness of the condition. In discussions at the kick-off meeting, it was noted that for the chronic condition diabetes a lot of work had been done to identify persons with diabetes through claims data (Hebert et al, 1999).

For this project, RTI followed the methodology used for the MQMS project and identified Medicare FFS beneficiaries with diabetes for a 5% sample of beneficiaries for the years 1992 – 2000. We used the 1992-2000 cohorts constructed for the MQMS project as the denominator population for two diabetes-related ACSCs: annual rate of admission for acute diabetic events among Medicare FFS beneficiaries with diabetes mellitus (acute diabetic events include ketoacidosis, hypoglycemia, and hyperosmolality); and annual rate of admission for

lower limb peripheral vascular disease (PVD) and PVD-related cellulitis among Medicare FFS beneficiaries with diabetes mellitus.

### 3.2.3 Medicare Claims Data

The principal set of claims files used to create the numerators describing the number of hospitalizations for each ACSC as well as total number of non-ACSC admissions was the **1992-2000 MQMS Base Analytic Files, MEDPRGxx**. This set of files contains discharge-level hospitalization information for all MQMS-eligible beneficiaries who had at least one discharge from an acute-care, short-stay hospital during calendar years 1992 through 2000. Transfers between two acute care hospitals were combined into a single stay to reduce the appearance of multiple admissions. Demonstration claims, stand-alone ER visits, and claims with invalid diagnoses or procedures were removed. Medicare payments and beneficiary liability amounts were constructed for all claims. All claims were cross-referenced, thereby allowing direct linkage to beneficiaries selected for study. A claims-level analytic file was constructed with beneficiary characteristics merged on to each hospitalization record to allow for maximum analytic flexibility.

Our source of data for emergency room (ER) visits and observation bed stays was the **1992-2000 100% Institutional Outpatient Standard Analytic Files (OPD-SAFs)**. We selected claims through DESY if they represented ER visits or observation bed stays for ACSCs based on revenue center codes (to identify place of location) and principal diagnosis. These claims were cross-referenced and linked to the denominator data via the cross-referenced Beneficiary Health Insurance Claim Number (HICNO). We include the emergency room visits and observation bed stays in our analysis to allow for an examination of whether practice patterns differ geographically in the use of inpatient versus emergency department to treat ACSCs.

### 3.2.4 Claims-Based Health Status Measure Construction

To assess degree of change in health status and the relationship between health status and ACSC admissions, the Principal Inpatient Diagnostic Cost Group (PIP-DCG) model, which uses both demographic information as well as the principal diagnoses of hospitalizations to predict following year medical expenditures, was used to measure health status. A risk adjustment score was calculated by dividing predicted expenditures by the average cost for the general Medicare FFS population. A risk adjustment score of 1.0 indicates an average level of predicted future expenditures. Risk adjustment scores are used as a measure of relative health status in comparison to the general Medicare population (Pope et al., 1999).

## 3.3 Descriptive Analyses of Trends in Rates of Hospitalization and Length of Stay for ACSCs

### 3.3.1 Comparison of Demographic Characteristics Across the Study Population, Beneficiaries with Diabetes, and those Admitted with an Ambulatory Care Sensitive Condition (ACSC)

***Exhibit 3-1*** provides a comparison of the demographic characteristics of three populations in 1992 and 2000. The first two columns provide percentage distribution of the main

study population across sociodemographic characteristics and geographic areas. The second set of data is specific to study beneficiaries diagnosed as having diabetes, and the third set of data is specific to study beneficiaries who had a hospitalization in either 1992 or 2000 for an ACSC. This table allows us to examine what possible role changing demographic or geographic distributions could play on the trend in hospitalizations for ACSCs.

In making comparisons cross-sectionally across the three populations of interest and longitudinally between 1992 and 2000 within each population, we use the following linkage between percentage point differences and narrative descriptors of modest, moderate, and substantial change for convenience:

- No change: < 2% points
- Modest change: 2-3% points
- Moderate change: 4-9% points
- Substantial change: 10% points or greater

Because our sample sizes are very substantial, virtually all differences are statistically significant. We have chosen to evaluate change by creating the above discrete categories of change.

*Cross-Sectional Comparison of the Full Study Population with the Study Population with a Diagnosis of Diabetes (**Exhibit 3-1).***

- The age and sex distributions of the two populations are quite similar.
- The study population with diabetes has a higher percentage of Blacks, 12.4 percent versus 7.5 percent.
- The study population with diabetes consists of a moderately higher percentage of beneficiaries dually enrolled in Medicare and Medicaid, 20.4 percent versus 12.8 percent.
- The study population with diabetes has a modestly larger proportion of beneficiaries residing in the South and a smaller proportion residing in the West as compared to full study population.

*Cross-Sectional Comparison of Full Study Population with the Study Population Hospitalized with an Ambulatory Care Sensitive Condition*

- The population of beneficiaries with an ACSC hospitalization is substantially older than the full study population.
- The population of beneficiaries with an ACSC hospitalization has a modestly higher proportion of Black beneficiaries than the full study population.

- The population of beneficiaries with an ACSC hospitalization has a modestly higher proportion of beneficiaries with ESRD than the full study population.

- The population of beneficiaries with an ACSC hospitalization has a substantially higher percentage of beneficiaries dually enrolled in Medicare and Medicaid than the full study population, 26.3 percent versus 12.8 percent.

- The proportion of beneficiaries from urban areas is similar between the two populations.

- Both populations have similar proportions of beneficiaries residing in the Northeast and Midwest. A modestly higher percentage of beneficiaries hospitalized for an ACSC reside in the South; while a modestly lower percentage of beneficiaries hospitalized for an ACSC reside in the West.

*Longitudinal Change Between 1992 and 2000 in the Study Population*

- We observe a decline in the number of FFS beneficiaries in total over the study period (i.e., decrease of 2.5 million (8%) beneficiaries) and modest changes in the distribution of the study population across demographic and geographic characteristics.

- We observe modest changes in demographics of the study population over the eight year period:

  - Modest increase in aging of the population.

  - Modest increase in the percentage of beneficiaries dually enrolled in Medicare and Medicaid.

  - Modest decrease in the proportion of beneficiaries from urban areas.

- We observe modest changes in geographic location of the study population over the eight year period:

  - Modest decline in percentage of the study population residing in the Northeast.

  - The percentage of all study beneficiaries residing in the Midwest and West did not change.

  - We observe a modest increase in the percent of beneficiaries residing in the South.

*Longitudinal Change between 1992 and 2000 in the Study Population With Diabetes*

- We observe a substantial increase between 1992 and 2000 in study beneficiaries with a diagnosis of diabetes (1 million beneficiaries, 30%). All other observations

regarding changes in the population of beneficiaries with diabetes mirror those observed in the greater study population of beneficiaries.

- We observe modest changes in demographics of the study population with diabetes over the eight year period:
  - Modest increase in the aging of the population.
  - Modest increase in the percentage of beneficiaries dually enrolled in Medicare and Medicaid.
  - Modest decrease in the proportion of beneficiaries from urban areas.
- And, we observe modest changes in geographic location of the study population with diabetes over the eight year period:
  - Modest decline in percentage of beneficiaries residing in the Northeast.
  - No change in distribution of the beneficiary population in the Midwest and West.
  - Modest increase in proportion of study beneficiaries with diabetes residing in the South.

*Longitudinal Change Between 1992 and 2000 in the Study Population Hospitalized with an Ambulatory Care Sensitive Condition*

During the study period (1992-2000), the number of beneficiaries with an ACSC-related hospitalization increased approximately 4 percent. Although not shown, between 1992 and 1994, the number of beneficiaries with an ACSC-related hospitalization increased 8 percent and then decreased modestly. Most observations regarding changes in the population characteristics of beneficiaries with an ACSC admission mirror those observed in the greater study population of beneficiaries. Geographic trends in the ACSC population mirrored those observed in the full study population. Most notably,

- Similar to the study population, the ACSC population is aging modestly.
- The ACSC hospitalized population experienced a modest decline in proportion of beneficiaries from urban areas during the study period.
- The proportion of dually enrolled beneficiaries increased moderately in the ACSC hospitalized population during the study period, an increase that was slightly higher than that observed in the full study population.
- We observe a modest decline in proportion of beneficiaries residing in the Northeast.
  - No change in distribution of the beneficiary population in the Midwest and West.

- We observe a modest increase in the proportion of study beneficiaries with diabetes residing in the South.

### 3.3.2 Trend in Rate of Hospitalizations for Ambulatory Care Sensitive Conditions from 1992 through 2000

Descriptive trends in hospitalizations and number of days of stay for Medicare beneficiaries age 65 and older are provided for 1992-2000 for the even years only to reduce the sheer volume of descriptive statistics that are reported yet still providing a reasonable number of observations from which to develop trend estimates.

***Exhibit 3-2*** provides the trend in rate of hospitalizations for eleven ambulatory care sensitive conditions (ACSCs) from 1992 through 2000 per 1,000 Medicare FFS beneficiaries selected for study. The first five columns of data contain rates per 1,000 beneficiaries and the last five columns of data contain the percentage change in the rates for the time periods 1992 vs 1994, 1994 vs 1996, 1996 vs 1998, 1998 vs 2000, and 1992 vs 2000. The first row reports all cause hospitalization rates for the study population. The second row reports rate of hospitalization for all non-ambulatory care sensitive conditions. The remaining rows report rates of hospitalizations for each of the individual ACSCs. Our key findings include:

- All cause hospitalizations increased 6 percent from 1992 to 2000; from 317 per 1,000 beneficiaries to 336 per 1,000 beneficiaries.

- Non-ACSC hospitalizations increased 4.6 percent from 1992 to 2000; from 235 per 1,000 beneficiaries to 246 per 1,000 beneficiaries.

- Summary of ACSC Trends

  - There was an increase in the hospitalization rates for six of the eleven ACSC studied between 1992 and 2000.

  - The hospitalization rate for one condition, CHF, remained essentially the same over the study period.

  - There was a decrease in hospitalization rates for four ACSCs: asthma, stroke and lower limb peripheral vascular disease and acute diabetic events among Medicare FFS beneficiaries with diabetes.

  - The trends in ACSC hospitalization rates observed were not linear over time.

- ACSC Variation

  - There was considerable variation across conditions in hospitalization rates and trends in changes in these rates during the study period.

  - Three conditions that had the highest hospitalization rates in 1992 continued to have the highest hospitalization rates in 2000

    o CHF: 22.7/1,000 versus 22.9/1,000 (no change)

- Lower limb PVD among Medicare FFS beneficiaries with diabetes: 17.09/1,000 versus 13.1/1,000 (decrease of 23.4%)
- Pneumonia: 18.2/1,000 versus 20.7/1,000 (increase of 14%)

- Chronic lung conditions (asthma & COPD))
  - In 1992, the rate of hospitalizations was 2.4 asthma per 1,000 beneficiaries and 7.6 COPD per 1,000 beneficiaries
  - By 2000, the rate of hospitalization for asthma had declined by 30 percent to 1.7 per 1,000 beneficiaries
  - In contrast, the rate of hospitalization for COPD had increased 52 percent to 11.6 per 1,000 beneficiaries

- An increase of more than 10 percent in the hospitalization rate was observed for four ACSCs between 1992 and 2000; however these were fairly small changes in actual rates because of the low frequencies of admission for these conditions in the Medicare FFS population.
  - Cellulitis increased by 12 percent from 3.3to 3.6/1,000 beneficiaries
  - Dehydration increased by 20.9 percent from 5.2 to 6.2/1,000 beneficiaries
  - Septicemia increased by 11.0 percent from 5.3 to 5.9/1,000 beneficiaries
  - UTI increased by 12.9 percent from 5.4 to 6.1/1,000 beneficiaries

- Five of the ACSCs, stroke, pneumonia, CHF, and acute diabetic events and lower peripheral vascular disease events among beneficiaries with diabetes, have been targeted for quality improvement efforts led by the CMS Quality Improvement Organizations. Conflicting trends were observed in these conditions.
  - Stroke-related hospitalizations decreased by 14.2 percent from 10.5 to 9.0 per 1,000 beneficiaries during the study period.
  - Acute diabetic event hospitalizations among persons with diabetes declined by 6 percent from 13.4 in 1994 to 12.6 per 1,000 beneficiaries in 2000. Please note that the calculation is from 1994 to 2000 as we observe an implausible increase in admission rates between 1992 and 1994, which we believe reflects a coding anomaly.
  - Hospitalizations for lower limb PVD among Medicare FFS beneficiaries with diabetes decreased by 23.4 percent; from 17.1/1,000 to 13.1/1,000.
  - Rate of hospitalization for CHF remained essentially unchanged.

- Hospitalization for pneumonia increased 14 percent, from 18.2 to 20.7/1,000 Medicare FFS beneficiaries.

### 3.3.3 Trends in Rate of Hospitalization for Ambulatory Care Sensitive Conditions from 1992 through 2000 by Sociodemographic Characteristics and Health Status

***Exhibit 3-3*** displays the percent change in rate of hospitalization per 1,000 study beneficiaries for ambulatory care sensitive conditions from 1992 through 2000 by sociodemographic characteristics and health status as measured using the PIP-DCG scores calculated from Medicare claims data.

- For the three conditions that experienced a decline from 1992 to 2000 in the rate of hospitalization, declines are generally observed across all sociodemographic and health status subpopulations.
  - Women, Blacks, and beneficiaries residing in rural areas did not experience as significant a decline in hospitalization rates as those observed for men, Whites, and urban residing beneficiaries, respectively.
- The rate of hospitalization for CHF remained relatively constant across the 1992 to 2000 time period; however there was considerable variation in the rate of change across subpopulations:
  - Rate of hospitalization increased by 4.5 percent for women but declined by 3.2 percent for men.
  - Rate of hospitalization increased by 12.9 percent for Blacks but declined by 1.5 percent for Whites.
  - Rate of hospitalization increased by 7.0 percent for beneficiaries dually enrolled in Medicare and Medicaid but declined by 3.9 percent for those not enrolled in Medicaid.
  - Trends in rates of hospitalization across the health status categories suggested a decline for the healthiest (those in the three bottom Quintiles are healthier than the average FFS beneficiary), a modest increase for those that span the average health status of FFS beneficiaries, and no change for those in the poorest health status or the top Quintile of PIP-DCG scores.
  - For the ACSCs that experienced hospitalization rate increases, women and Blacks generally had larger percent increases in ACSC hospitalization rates than men and Whites, respectively.

### 3.3.4 Trend in Source of Admission for Hospitalization for Ambulatory Care Sensitive Conditions from 1992 through 2000

***Exhibit 3-4*** presents the trend in source of admission for beneficiaries hospitalized for an ACSC. The hospital claim lists five possible sources of admission: home, acute care hospital, skilled nursing facility, long-term or subacute facility, and emergency room. The proportion of all ACSC admissions was calculated for each source in 1992 and the percent change is displayed for the 1992 through 2000 period. Overall, the greatest proportions of patients were admitted for an ACSC from home and the emergency room, and during the period between 1992 and 2000 the percentage of patients coming from home decreased while the proportion of patients coming from the emergency room increased.

- For each of these two sources, there is considerable variation in the proportion of beneficiaries coming from each admission source by condition.
  - The proportion of admissions from home ranged from 28 percent for stroke to 62 percent for lower limb PVD among Medicare FFS beneficiaries with diabetes in 1992. A high percentage of admissions for cellulitis, dehydration, and acute diabetic events also came from home (43% to 60%) in 1992.
  - The proportion of admissions from the emergency room ranged from a low of 35 percent for lower limb PVD to a high of 70 percent for stroke in 1992. For seven of the eleven conditions under study, the proportion of admissions from the emergency room exceeded 60 percent.
  - The proportions of admissions from acute care hospitals, skilled nursing facilities, and long-term or sub-acute facilities are very low. In 1992, the range of the proportions of admissions from these sources were as follows:
    - Acute care hospital – 0.28 percent to 0.95 percent
    - Skilled nursing facility – 0.85 percent to 4.71 percent
    - Long-term or sub-acute facility – 0.51 percent to 1.43 percent.
- Overall, the percentage of admissions coming from acute care hospitals and from the emergency room *increased* between 1992 and 2000, whereas the percentage of admissions from home, skilled nursing facilities, and long-term or sub-acute facilities *decreased* during this same time period.
- Despite the fact that the percentages of enrollees coming from acute care hospitals, skilled nursing facilities, and long-term or sub-acute facilities changed a lot during the 1992-2000 study period, these trends reflect small changes due to the small proportions of admissions coming from these sources.

### 3.3.5 Decomposition of ACSC Hospitalization Rates into Number of Beneficiaries Admitted per All Enrollees and Number of Admissions per Beneficiary Admitted for each ACSC from 1992 through 2000

***Exhibit 3-5*** displays the decomposition of ACSC rates into two components: (1) number of beneficiaries hospitalized per all study beneficiaries; and (2) average number of hospitalizations per beneficiary. This allows for an examination of whether the observed trend in rates is being driven more by number of beneficiaries being admitted versus a greater number of hospitalizations, i.e., intensity of treatment. We display this decomposition for the even years between 1992 and 2000 and present the percent change between 1992 and 2000.

- For all conditions, the range of the number of enrollees hospitalized for a specific ACSC during a single year was 1.5 per 1,000 beneficiaries for asthma to 19.7 per 1,000 beneficiaries for pneumonia.
  - Congestive heart failure, pneumonia, stroke, and acute diabetic events and lower limb PVD among Medicare FFS beneficiaries with diabetes had the highest proportions of persons admitted during the study period.
  - Cellulitis and asthma had the lowest proportions of persons admitted during the study period.
- For all conditions, the range of the average number of hospitalizations per Medicare beneficiary hospitalized for an ACSC was very small, 1.05 to 1.32.
  - Congestive heart failure and COPD had the highest average numbers of hospitalizations per hospitalized beneficiary, ranging from 1.25 to 1.32 admissions.
  - Stroke, dehydration, septicemia, cellulitis, and acute diabetic events among Medicare FFS beneficiaries with diabetes had the lowest average numbers of hospitalizations per hospitalized beneficiary, ranging from 1.05 to 1.08.
- Overall, the trend in hospitalization for each condition was driven by changes in the number of persons admitted for each condition rather than increases in the number of admissions per person.

### 3.3.6 Trend in Length of Stay for Hospitalizations for Ambulatory Care Sensitive Conditions, Total Inpatients Days and Average Length of Stay, from 1992 through 2000

***Exhibit 3-6*** displays total number of inpatient days and average inpatient days for each ACSC for 1992, 1994, 1996, 1998 and 2000 and the percent change in these two measures between 1992 and 2000.

- The total number of inpatient days per year ranged greatly by condition from approximately 23,000 days for asthma to 299,000 day for CHF in 2000. The average

length of stay also varied by condition from 5 days for asthma to 8.7 days for septicemia.

  - The highest numbers of inpatient days were observed for COPD, CHF, pneumonia, septicemia, and stroke.

  - The lowest numbers of inpatient days were observed for cellulitis, dehydration, UTI, and acute diabetic events and lower limb PVD among Medicare FFS beneficiaries with diabetes.

  - During 2000, the average length of stay was lowest (approximately 5 days) for asthma, dehydration, and UTI.

  - During 2000, the average length of stay was highest for lower limb PVD among Medicare FFS beneficiaries with diabetes (9 days), pneumonia (7 days), and septicemia (9 days).

- The average length of stay and the total number of inpatient days decreased for all conditions between 1992 and 2000. Decreases in the total number of inpatient days varied more greatly by condition than decreases in average length of stay.

  - The decrease in the total number of inpatient days was lowest for COPD (6%) and acute diabetic events among Medicare FFS beneficiaries with diabetes (6%) during the study period.

  - The decrease in total number of inpatient days was highest for asthma (57%) and stroke (52%).

  - The decrease in average length of stay was lowest for septicemia (26%) and highest for acute diabetic events among Medicare FFS beneficiaries with diabetes (50%).

### 3.3.7 Trends in Rates of Observation Stay and Emergency Room (ER) Utilization for Ambulatory Care Sensitive Conditions from 1992 through 2000

***Exhibit 3-7*** provides a summary of the trend in observation bed stays and ER visits for each of eleven ACSCs from 1992 through 2000. The first two columns of data contain rates per 1,000 Medicare FFS beneficiaries and the third column shows the percent change in these rates during the nine-year period. Our key findings include:

- Observation bed stays and ER utilization were most commonly observed for acute diabetic events among Medicare FFS beneficiaries with diabetes; more than 12 visits per 1,000 beneficiaries were recorded in 2000 for this condition. In contrast, observation stay and ER visits were least likely to be observed for septicemia and stroke, as seen by rates of less than 1 visit per 1,000 Medicare FFS beneficiaries for each of these conditions.

- There were substantial increases in the rate of observation stays and ER visits for all eleven ACSCs studied between 1992 and 2000, with the exception of stroke, which did not change during the study period.

- Observation bed stay and ER utilization increased more than 80 percent for dehydration and acute diabetic events among Medicare FFS beneficiaries with diabetes during the study period.

- Observation stays and ER visits increased approximately 50 percent during the study period for cellulitis, septicemia, and pneumonia.

***Exhibit 3-8*** displays the percent change in rate of observation stay or ER visit per 1,000 study beneficiaries for ACSCs from 1992 through 2000 by sociodemographic characteristics and health status as measured using the PIP-DCG scores. We observe the following:

- Rates of observation bed stay and ER visits increased more for women, persons whose race was unknown, and beneficiaries not enrolled in Medicaid, across all conditions studied.

- Age, Medicare eligibility status, residence in an urban vs. rural location, and health status had variable effects upon the different rates of ACSCs studied.

- The overall rate of observation bed stay and ER use for stroke was relatively constant between 1992 and 2000; however there was considerable variation in the rate of change across subpopulations:

  - Rate of utilization increased 4.3 percent for women but decreased by 4.7 percent for men.

  - Rate of utilization increased 2.8 percent for Whites but declined by 23.3 percent for Blacks.

  - Rates of utilization increased for those less than 80 years old and decreased for those 80 and older.

  - Rate of utilization increased by 3.0 percent for those not enrolled in Medicaid and decreased by 20.9 percent for those enrolled in Medicaid and

  - Rate of utilization increased by 4.1 percent for those residing in rural areas but decreased 5.1 percent for beneficiaries in urban areas.

***Exhibit 3-9*** displays the percent change in number of observation bed stays and ER visits per Medicare FFS beneficiary treated in an emergency room. The number of observation stay and ER visits per beneficiary treated in an emergency room increased modestly between 1992 and 2000 for septicemia (1.09 to 1.12 visits per beneficiary treated) and increased moderately for acute diabetic events among Medicare FFS beneficiaries with diabetes (1.08 to 1.13 visits per beneficiary treated). The number of observation stay and ER visits per beneficiary treated in the

emergency room did not change appreciably for any of the other nine conditions studied. This is consistent with our findings from our study of inpatient admissions that increasing rates of use in the ER is driven more by the number of unique beneficiaries being treated for the ACSCs, rather than an increasing number of treatments per beneficiary.

## 3.4 Multivariate Analyses of Trends in ACSC Hospitalization Among Medicare FFS Beneficiaries from 1993 to 2000

### 3.4.1 Overview

We conducted a critical examination of the impact of changing beneficiary-level factors, such as age, gender, and health status, on the observed change in ACSC hospitalization rates. We estimated a multivariate cross-section, time series regression model of the rate of ACSC hospitalizations as a function of sociodemographic characteristics and health status characteristics for Medicare FFS enrollees for the each year during 1993-2000. Specifically, we used a panel data set whereby the unit of analysis is MSA versus non-MSA areas within each state per year, yielding 101 observations per year for eight years for a total of 808 observations.

Three ACSCs were selected for study: congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), and peripheral vascular disease (PVD). We selected these three conditions as they displayed differential rates of change over the eight year observation period. Rate of hospitalization for CHF was the highest among the studied ACSCs in 1992 and remained stable over the nineties. The rate of hospitalization for COPD was relatively modest in 1992 but increased substantially over time. There was also a substantial increase in the rate of ER usage for COPD over the same time period. Lower limb PVD was selected because the rate of hospitalization was high in 1992 and declined over the eight year period rather dramatically, while ER visits increased 38 percent.

To capture whether the change in rate of hospitalization for PVD was being heavily influenced by the increasing prevalence rate of diabetes observed during the nineties, we re-calculated the hospitalization rates using all Medicare FFS beneficiaries for the multivariate analysis, and included the proportion of Medicare beneficiaries who have diabetes as an explanatory factor. When PVD hospitalizations are calculated using all beneficiaries in the denominator, admission rates actually rose slightly over time.

Previous research that we have conducted as well as that reported in the literature has shown that beneficiary factors such as increasing age, race, Medicaid status, health status, and geographic distribution of beneficiaries are related to variation in observed ACSC rates of hospitalization. However, there is little evidence as to what influence changes in these factors have on the number of ambulatory care sensitive condition hospitalizations. Thus, in our multivariate trend analysis, we aim to answer the following research question:

- What is the influence of changes in selected beneficiary characteristics (e.g., sociodemographic characteristics, health status and geographic location) on the rate of hospitalization for three ambulatory care sensitive conditions: congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD) and lower limb peripheral vascular disease (PVD) among all Medicare beneficiaries?

### 3.4.2 Model Specification

**Analytic File Construction.** Annual counts of ACSC hospitalizations and estimates of median health status of the Medicare FFS population were constructed using the 1993-2000 MQMS Base Analytic Files and specifications developed for the trend analyses. Rates of ACSC hospitalizations were constructed as described earlier in this chapter; however, we do note that this analysis uses hospitalization rates that have not been adjusted for age-sex differences over time so that we may observe the influence of changes in demographic characteristics on the trend admission rates. Annual estimates of the proportion of the Medicare population with specific attributes of interest and residing in geographic areas were estimated from the 1992-2000 MQMS Base Denominator Files as described earlier.

**Empirical Model.** Multivariate analyses allow for the identification and isolation of the independent effects of factors related to the change in rate of ACSC hospitalizations over time. We estimated a time series model of the general form of

$$ACSC_{jta} = f_t\ (SOCIO_{ta}, HEALTH_{ta}, ER_{ta}, POPCHG_{ta}, GEO_{ta,} TIME) \qquad (1)$$

where: $ACSC_{jta}$ = rate of hospitalization for the $j^{th}$ ambulatory care sensitive condition in the $t^{th}$ year in the $a^{th}$ area. The independent variables are comprised of a number of vectors where: SOCIO = a vector of yearly beneficiary sociodemographic characteristics in the $a^{th}$ area; HEALTH = median health status in the $a^{th}$ area; ER = count of ER/observation stays; POPCHG = change in size of beneficiary population from current year to previous year; and GEO = a set of dummy variable representing the 9 Census divisions. The ER variable was included to allow us to assess the possibility of substitution of emergency room and observation beds stays for inpatient admission.

A continuous time variable, TIME, was included in the models to capture the time trend from 1993-2000 (1992 is the reference year). In addition, time dummy variables were interacted with median age and with the rates of ER/observation stays to assess whether these factors had time-varying associations with the observed rates. We did not interact time with the median health status estimate for each year as this measure proved to be very stable over time.

A key feature of the multivariate analysis is the inclusion of a time trend variable. If time trend is not significant, then we will know that the independent variables included in the model explain fully the observed descriptive trends, e.g., health status, aging of the Medicare population, etc. If the time trend is significant, then we know that there are other factors (such as market or other geographic factors, other omitted variables, etc.) influencing the ACSC hospitalization rate.

Alternative functional forms were estimated for both the dependent and independent variables, e.g., levels, log-linear, and proportions prior to selecting the final specifications. ***Exhibit 3-10*** contains definitions of the independent and dependent variables included in the modeling. To assess whether factors associated with the observed trends were different in MSA versus non-MSA areas, we estimated separate models for each region type, and then estimated a pooled model combining MSA and non-MSA areas. We used a standard Chow test to determine that pooling across the types of areas was not appropriate.

### 3.4.3 Results from Multivariate Analysis of Trend in Hospitalization for Three Selected ACSCs

We first estimated simple regression models of ACSC hospitalization rates on the continuous time variable and found significant positive trends in the hospitalization rates for all three ACSCs. The goal of our multivariate modeling was then to determine whether these trends could be explained by beneficiary-level factors. We observe that the amount of variation explained by and the various factors that account for the observed trend in hospitalization rates vary by clinical condition and between MSA and non-MSA areas as shown in ***Exhibit 3-11,*** which displays the direction of effect of statistically significant variables on the trend in hospitalization rates.

When we controlled for sociodemographic, health status, use of the emergency room, geographic migration characteristics, and place-specific factors, the time trend became statistically insignificant for COPD and CHF, in both MSA and non-MSA areas and insignificant for lower limb PVD in MSA areas. However, a modest negative time trend in lower limb PVD rates of hospitalization in non-MSA areas remained. A summary of other key findings is as follows:

- For PVD and CHF, the proportion with dual enrollment in Medicare and Medicaid was positively associated with hospitalization rates in non-MSAs. Dual enrollment was negatively associated with hospitalization rates for PVD in MSAs.

- The proportion of men in MSAs was positively correlated with hospitalization rates for CHF and COPD. The proportion of Blacks was negatively associated with hospitalization rates for COPD but positively associated with CHF hospitalization rates.

- The median age of the Medicare FFS population increased over time. The aging of the population was negatively associated with the hospitalization rates for COPD in both MSAs and non-MSAs, negatively associated with the hospitalization rates for CHF in MSAs, but positively associated with CHF and PVD the hospitalization rates in non-MSAs.

- Health status as measured by the PIP-DCG risk score and proportion of the study population with end-stage renal disease were positively associated with hospitalization rates for all three ACSCs in MSAs only.

- Use of the emergency room (or observation bed stays) was positively correlated with hospitalization rates for COPD, and increasingly so over time. This suggests complimentarity rather than substitution of ER usage for inpatient admission for COPD. During the latter half of the 1990s in non-MSAs, there was a positive ER/Admission Rate relationship for CHF, suggesting complimentarity, and a negative relationship for PVD, suggesting substitution between sites of care.

- After controlling for beneficiary characteristics, health status, and use of the emergency room, we continued to observe significant spatial variation in admission

rates most notably for COPD and CHF across the Census Regions in both urban and rural areas.

The multivariate modeling of the trend in ACSC hospitalizations from 1993 to 2000 using Medicare claims data showed that changes in sociodemographic characteristics and health status among elderly Medicare FFS beneficiaries explained a substantial proportion of the observed positive trend in ACSC hospitalization rates for CHF, COPD and PVD among Medicare FFS beneficiaries. Use of the emergency room (or stays in observation beds) was strongly associated with hospitalization for COPD and more modestly for CHF; thus, it does not appear that ER visits were used as a substitute for hospitalization. Evidence of substitution between ER use and hospitalization was observed for PVD among during the latter part of the time trend. Rural areas that experienced a decline in Medicare FFS beneficiaries experienced a decline in rates of hospitalization for COPD and CHF. However, after controlling for changes in beneficiary characteristics and health status, geographic variation in propensity to treat on an inpatient basis, and stability of the Medicare FFS population, unexplained geographic variation in ACSC hospitalization rates remained, most notably for COPD and CHF in the eastern half of the United States. This suggests that factors not included in the trend analysis play an important role in hospitalization rates increases over time and that further exploration is warranted.

**Exhibit 3-1**
**Comparison of Demographic Characteristics of Medicare Fee-for-Service Beneficiaries Selected for Study with Beneficiaries with Diabetes Selected for Study and Study Beneficiaries Hospitalized with an Ambulatory Care Sensitive Condition (ACSC), 1992 and 2000**

| | Study Population: Full-Year Medicare Part A & B FFS Beneficiaries | | Study Beneficiaries with Diabetes | | Study Beneficiaries admitted with an ACSC | |
|---|---|---|---|---|---|---|
| Demographic and Medicare Enrollment characteristics | 1992 | 2000 | 1992 | 2000 | 1992 | 2000 |
| All Enrollees (Number enrollees) | 27,221,954 | 24,971,003 | 2,843,300 | 3,791,660 | 2,193,145 | 2,345,186 |
| | (%) | (%) | (%) | (%) | (%) | (%) |
| Age Group | | | | | | |
| 65-69 | 26.6 | 22.2 | 25.0 | 21.2 | 14.3 | 11.6 |
| 70-74 | 26.9 | 25.4 | 28.0 | 26.7 | 19.8 | 18.0 |
| 75-79 | 20.6 | 22.4 | 22.6 | 24.5 | 21.6 | 21.8 |
| 80-84 | 13.9 | 15.6 | 14.4 | 15.8 | 20.0 | 20.8 |
| 85-89 | 7.7 | 9.2 | 7.1 | 8.3 | 14.5 | 16.4 |
| 90-94 | 3.2 | 3.9 | 2.4 | 2.9 | 7.3 | 8.5 |
| 95 + | 1.1 | 1.3 | 0.6 | 0.7 | 2.6 | 2.9 |
| Sex | | | | | | |
| Male | 39.6 | 40.0 | 39.9 | 41.9 | 42.1 | 40.1 |
| Female | 60.5 | 60.0 | 60.1 | 58.1 | 58.0 | 59.9 |
| Race | | | | | | |
| White | 87.2 | 88.9 | 82.4 | 82.4 | 85.3 | 85.5 |
| Black | 7.3 | 7.5 | 12.5 | 12.4 | 10.0 | 10.8 |
| Other | 2.3 | 3.3 | 2.8 | 5.0 | 1.8 | 3.4 |
| Unknown | 3.3 | 0.2 | 2.3 | 0.2 | 3.0 | 0.4 |

(continued)

**Exhibit 3-1 (continued)**
**Comparison of Demographic Characteristics of Medicare Fee-for-Service Beneficiaries Selected for Study with Beneficiaries with Diabetes Selected for Study and Study Beneficiaries Hospitalized with an Ambulatory Care Sensitive Condition (ACSC), 1992 and 2000**

| | Study Population: Full-Year Medicare Part A & B FFS Beneficiaries | | Study Beneficiaries with Diabetes | | Study Beneficiaries admitted with an ACSC | |
|---|---|---|---|---|---|---|
| Demographic and Medicare Enrollment characteristics | 1992 | 2000 | 1992 | 2000 | 1992 | 2000 |
| Medicare Eligibility Status | | | | | | |
| Aged without ESRD | 99.7 | 99.5 | 99.0 | 98.4 | 98.5 | 97.6 |
| Aged with ESRD | 0.3 | 0.5 | 1.0 | 1.6 | 1.5 | 2.4 |
| Medicaid Enrollment Status | | | | | | |
| Enrolled in Medicaid | 10.1 | 12.8 | 17.4 | 20.4 | 21.8 | 26.3 |
| Not Enrolled in Medicaid | 89.9 | 87.2 | 82.6 | 79.6 | 78.2 | 73.7 |
| **Geographic Area** | | | | | | |
| Urban/Rural | | | | | | |
| Urban | 74.4 | 71.6 | 74.4 | 71.4 | 72.8 | 70.2 |
| Rural | 25.6 | 28.4 | 25.6 | 28.6 | 27.2 | 29.8 |
| ***Northeast*** | 22.8 | 19.9 | 23.5 | 20.6 | 23.0 | 20.7 |
| **New England** | 5.8 | 5.3 | 5.8 | 5.2 | 5.7 | 5.0 |
| Connecticut | 1.5 | 1.3 | 1.6 | 1.3 | 1.2 | 1.2 |
| Maine | 0.6 | 0.7 | 0.6 | 0.7 | 0.5 | 0.6 |
| Massachusetts | 2.6 | 2.2 | 2.4 | 2.2 | 2.9 | 2.3 |
| New Hampshire | 0.5 | 0.5 | 0.4 | 0.5 | 0.4 | 0.4 |
| Rhode Island | 0.5 | 0.3 | 0.5 | 0.4 | 0.5 | 0.4 |
| Vermont | 0.2 | 0.3 | 0.2 | 0.3 | 0.2 | 0.2 |

(continued)

**Exhibit 3-1 (continued)**
**Comparison of Demographic Characteristics of Medicare Fee-for-Service Beneficiaries Selected for Study with Beneficiaries with Diabetes Selected for Study and Study Beneficiaries Hospitalized with an Ambulatory Care Sensitive Condition (ACSC), 1992 and 2000**

| Demographic and Medicare Enrollment characteristics | Study Population: Full-Year Medicare Part A & B FFS Beneficiaries | | Study Beneficiaries with Diabetes | | Study Beneficiaries admitted with an ACSC | |
|---|---|---|---|---|---|---|
| | 1992 | 2000 | 1992 | 2000 | 1992 | 2000 |
| **Middle Atlantic** | 16.9 | 14.6 | 17.8 | 15.4 | 17.3 | 15.7 |
| New Jersey | 3.4 | 3.3 | 3.6 | 3.5 | 3.5 | 3.6 |
| New York | 7.2 | 6.4 | 7.1 | 6.5 | 7.0 | 6.5 |
| Pennsylvania | 6.3 | 4.9 | 7.0 | 5.4 | 6.9 | 5.6 |
| ***Midwest*** | 26.2 | 27.3 | 26.2 | 26.7 | 26.0 | 26.2 |
| **East North Central** | 18.1 | 18.7 | 19.5 | 19.1 | 18.5 | 18.7 |
| Illinois | 4.6 | 4.7 | 4.7 | 4.5 | 5.1 | 5.1 |
| Indiana | 2.4 | 2.7 | 2.6 | 2.8 | 2.6 | 2.7 |
| Michigan | 3.9 | 4.3 | 4.4 | 4.5 | 3.7 | 4.1 |
| Ohio | 4.9 | 4.5 | 5.7 | 5.1 | 5.2 | 4.9 |
| Wisconsin | 2.3 | 2.5 | 2.2 | 2.3 | 1.9 | 1.9 |
| **West North Central** | 8.0 | 8.6 | 6.8 | 7.6 | 7.5 | 7.5 |
| Iowa | 1.5 | 1.6 | 1.1 | 1.5 | 1.3 | 1.3 |
| Kansas | 1.2 | 1.2 | 1.0 | 1.1 | 1.1 | 1.1 |
| Minnesota | 1.5 | 1.9 | 1.2 | 1.5 | 1.3 | 1.4 |
| Missouri | 2.4 | 2.3 | 2.4 | 2.2 | 2.6 | 2.4 |
| Nebraska | 0.8 | 0.8 | 0.6 | 0.7 | 0.6 | 0.6 |
| North Dakota | 0.3 | 0.4 | 0.2 | 0.3 | 0.3 | 0.3 |
| South Dakota | 0.4 | 0.4 | 0.3 | 0.3 | 0.4 | 0.3 |

(continued)

**Exhibit 3-1 (continued)**
**Comparison of Demographic Characteristics of Medicare Fee-for-Service Beneficiaries Selected for Study with Beneficiaries with Diabetes Selected for Study and Study Beneficiaries Hospitalized with an Ambulatory Care Sensitive Condition (ACSC), 1992 and 2000**

| Demographic and Medicare Enrollment characteristics | Study Population: Full-Year Medicare Part A & B FFS Beneficiaries | | Study Beneficiaries with Diabetes | | Study Beneficiaries admitted with an ACSC | |
|---|---|---|---|---|---|---|
| | 1992 | 2000 | 1992 | 2000 | 1992 | 2000 |
| ***South*** | 35.6 | 38.2 | 37.5 | 40.0 | 38.3 | 41.4 |
| **South Atlantic** | 18.8 | 20.6 | 20.0 | 21.8 | 18.5 | 20.5 |
| Delaware | 0.3 | 0.4 | 0.3 | 0.4 | 0.3 | 0.3 |
| District of Columbia | 0.2 | 0.2 | 0.3 | 0.2 | 0.3 | 0.2 |
| Florida | 6.9 | 6.8 | 6.5 | 6.4 | 6.1 | 6.1 |
| Georgia | 2.3 | 2.6 | 2.7 | 2.9 | 2.8 | 2.9 |
| Maryland | 1.7 | 1.8 | 1.9 | 2.0 | 2.0 | 1.9 |
| North Carolina | 2.9 | 3.4 | 3.2 | 3.7 | 2.6 | 3.4 |
| South Carolina | 1.4 | 1.8 | 1.7 | 2.1 | 1.3 | 1.8 |
| Virginia | 2.3 | 2.7 | 2.5 | 3.0 | 2.3 | 2.7 |
| West Virginia | 0.9 | 1.0 | 1.0 | 1.1 | 1.0 | 1.2 |
| **East South Central** | 6.7 | 7.3 | 7.5 | 7.8 | 8.5 | 9.2 |
| Alabama | 1.8 | 1.9 | 2.1 | 2.1 | 2.2 | 2.3 |
| Kentucky | 1.6 | 1.7 | 1.7 | 1.8 | 2.1 | 2.3 |
| Mississippi | 1.1 | 1.2 | 1.4 | 1.4 | 1.5 | 1.7 |
| Tennessee | 2.2 | 2.4 | 2.4 | 2.5 | 2.7 | 2.8 |
| **West South Central** | 10.1 | 10.3 | 10.1 | 10.4 | 11.3 | 11.8 |
| Arkansas | 1.2 | 1.3 | 1.1 | 1.2 | 1.4 | 1.5 |
| Louisiana | 1.6 | 1.5 | 2.0 | 1.7 | 2.2 | 2.2 |
| Oklahoma | 1.5 | 1.5 | 1.3 | 1.4 | 1.6 | 1.6 |
| Texas | 5.8 | 6.0 | 5.6 | 6.1 | 6.2 | 6.6 |

(continued)

**Exhibit 3-1 (continued)**
**Comparison of Demographic Characteristics of Medicare Fee-for-Service Beneficiaries Selected for Study with Beneficiaries with Diabetes Selected for Study and Study Beneficiaries Hospitalized with an Ambulatory Care Sensitive Condition (ACSC), 1992 and 2000**

| Demographic and Medicare Enrollment characteristics | Study Population: Full-Year Medicare Part A & B FFS Beneficiaries | | Study Beneficiaries with Diabetes | | Study Beneficiaries admitted with an ACSC | |
|---|---|---|---|---|---|---|
| | 1992 | 2000 | 1992 | 2000 | 1992 | 2000 |
| ***West*** | 15.5 | 14.6 | 12.7 | 12.7 | 12.7 | 11.6 |
| **Mountain** | 4.8 | 5.1 | 3.6 | 4.0 | 3.6 | 3.5 |
| Arizona | 1.3 | 1.3 | 1.1 | 1.0 | 1.0 | 0.9 |
| Colorado | 1.0 | 0.9 | 0.7 | 0.7 | 0.7 | 0.6 |
| Idaho | 0.4 | 0.5 | 0.3 | 0.4 | 0.3 | 0.3 |
| Montana | 0.4 | 0.5 | 0.3 | 0.3 | 0.3 | 0.3 |
| Nevada | 0.4 | 0.5 | 0.3 | 0.4 | 0.4 | 0.4 |
| New Mexico | 0.5 | 0.6 | 0.4 | 0.5 | 0.4 | 0.4 |
| Utah | 0.5 | 0.7 | 0.4 | 0.6 | 0.3 | 0.4 |
| Wyoming | 0.2 | 0.2 | 0.1 | 0.2 | 0.1 | 0.2 |
| **Pacific** | 10.7 | 9.6 | 9.2 | 8.6 | 9.2 0.1 | 8.2 0.1 |
| Alaska | 0.1 | 0.1 | 0.1 | 0.1 | 6.9 | 6.0 |
| California | 7.5 | 6.5 | 6.5 | 5.9 | 0.2 | 0.2 |
| Hawaii | 0.3 | 0.4 | 0.4 | 0.4 | 0.7 | 0.6 |
| Oregon | 1.1 | 0.9 | 0.8 | 0.8 | 1.3 | 1.2 |
| Washington | 1.8 | 1.7 | 1.4 | 1.4 | 1.3 | 1.3 |

**NOTES:**
[1] The study population is defined as full-year, Part A and B, Medicare Fee-for-Service. Beneficiaries that died during the year, but who would have qualified otherwise, are retained in the study population.

**SOURCE:** RTI International analysis of Medicare Denominator Files for Years 1992 through 2000.

**Exhibit 3-2**
**Trend in Rate of Hospitalization for Medicare Fee-for-Service Beneficiaries from 1992 through 2000**

| | Rate of Hospitalization per 1,000 Medicare FFS Beneficiaries | | | | | Percent Change in Hospitalization Rate per 1,000 Beneficiaries | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1992 | 1994 | 1996 | 1998 | 2000 | 1992-1994 | 1994-1996 | 1996-1998 | 1998-2000 | 1992-2000[1] |
| | per 1,000 | per 1,000 | per 1,000 | per 1,000 | per 1,000 | (%) | (%) | (%) | (%) | (%) |
| **All Hospitalizations** | 317 | 316 | 323 | 331 | 336 | -0.3 | 2.3 | 2.4 | 1.4 | 6.0 |
| **Non-ACSC Hospitalizations** | 235 | 229 | 234 | 239 | 246 | -2.5 | 2.1 | 2.3 | 2.7 | 4.6 |
| **ACSCs** | | | | | | | | | | |
| Cellulitis | 3.3 | 3.3 | 3.2 | 3.4 | 3.6 | 2.5 | -4.3 | 7.4 | 6.3 | 12.0 |
| Asthma | 2.4 | 2.2 | 1.8 | 1.7 | 1.7 | -7.2 | -19.2 | -5.0 | -1.7 | -30.0 |
| COPD | 7.6 | 9.4 | 10.3 | 11.5 | 11.6 | 24.0 | 9.7 | 11.5 | 0.4 | 52.2 |
| Dehydration | 5.2 | 5.4 | 5.6 | 5.9 | 6.2 | 3.9 | 4.4 | 4.7 | 6.3 | 20.9 |
| CHF | 22.7 | 22.9 | 23.2 | 23.5 | 22.9 | 1.1 | 1.1 | 1.5 | -2.8 | 0.7 |
| Acute Diabetic Events[2] | 8.8 | 13.4 | 12.8 | 12.7 | 12.6 | 51.9 | -4.6 | -0.7 | -0.2 | -6.0 |
| Lower Limb PVD[2] | 17.1 | 16.7 | 15.4 | 14.8 | 13.1 | -2.3 | -8.1 | -3.9 | -11.2 | -23.4 |
| Pneumonia | 18.2 | 19.9 | 20.2 | 21.3 | 20.7 | 9.4 | 1.4 | 5.4 | -2.5 | 14.1 |
| Septicemia | 5.3 | 6.1 | 7.4 | 6.9 | 5.9 | 15.1 | 20.9 | -7.2 | -14.0 | 11.0 |
| Stroke | 10.5 | 10 | 10.2 | 9.5 | 9 | -4.5 | 1.6 | -6.2 | -5.6 | -14.2 |
| UTI | 5.4 | 5.5 | 5.4 | 5.9 | 6.1 | 2.0 | -1.7 | 7.9 | 4.3 | 12.9 |

Notes:
1. Due to volatility in the rates between 1992 and 1994, the percentage change is calculated between 1994 and 2000 for acute diabetic events
2. Rate is calculated using only Medicare FFS beneficiaries with diabetes in the denominator.

Source: RTI Analysis of 1992 through 2000 Medicare claims and Enrollment Data.

**Exhibit 3-3**
**Percent Change in Selected Ambulatory Care Sensitive Condition Hospitalization Rates for Medicare Fee-for-Service Beneficiaries Between 1992 and 2000 by Sociodemographic Characteristics and Health Status**

| | Percent Change in Hospitalization Rates from 1992-2000 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cellulitis | Asthma | COPD | Dehydration | CHF | Pneumonia | Septicemia | Stroke | UTI | Acute Diabetic Events[1,2] | Lower Limb PVD[1,2] |
| | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) |
| Sex | | | | | | | | | | | |
| Male | 11.0 | -43.3 | 35.5 | 12.4 | -3.2 | 7.3 | 7.7 | -19.5 | -3.1 | 25.7 | -29.0 |
| Female | 12.9 | -24.2 | 68.9 | 25.8 | 4.5 | 20.1 | 13.1 | -10.3 | 22.0 | 58.0 | -18.5 |
| Race | | | | | | | | | | | |
| White | 11.9 | -34.9 | 50.9 | 21.8 | -1.5 | 12.1 | 8.3 | -15.3 | 11.9 | 36.2 | -24.4 |
| Black | 7.0 | -17.2 | 71.3 | 12.9 | 12.2 | 33.1 | 26.4 | -8.6 | 14.5 | 60.3 | -26.2 |
| Other | 24.5 | 11.4 | 61.8 | 27.5 | 25.4 | 21.5 | 23.4 | -8.8 | 31.0 | 84.4 | -25.8 |
| Unknown | 34.1 | -6.9 | 109.2 | 64.9 | 19.6 | 48.8 | 41.7 | 3.1 | 29.6 | -31.8 | 138.4 |
| Age Group | | | | | | | | | | | |
| 65-69 | 13.5 | -34.3 | 48.1 | 27.5 | 4.0 | 20.6 | 13.5 | -10.1 | 9.6 | 42.0 | -27.2 |
| 70-74 | 14.7 | -32.6 | 50.5 | 26.5 | 0.5 | 18.7 | 13.2 | -13.9 | 15.2 | 26.9 | -21.0 |
| 75-79 | 12.1 | -32.8 | 45.2 | 20.2 | -2.1 | 12.9 | 10.6 | -17.1 | 11.5 | 55.0 | -27.9 |
| 80-84 | 12.6 | -26.8 | 54.4 | 18.8 | -1.3 | 10.3 | 8.6 | -16.9 | 10.9 | 55.2 | -20.1 |
| 85-89 | 9.7 | -14.8 | 74.4 | 19.0 | 2.6 | 12.3 | 10.1 | -13.3 | 12.7 | 75.5 | -28.6 |
| 90-94 | 8.3 | -9.7 | 81.8 | 15.0 | 6.4 | 9.4 | 7.7 | -10.9 | 10.3 | 50.0 | 13.8 |
| 95+ | 3.1 | -14.4 | 84.2 | 7.5 | 6.7 | 6.4 | 11.6 | -8.1 | 10.8 | -40.6 | -31.5 |

(continued)

**Exhibit 3-3 (continued)**
**Percent Change in Selected Ambulatory Care Sensitive Condition Hospitalization Rates for Medicare Fee-for-Service Beneficiaries Between 1992 and 2000 by Sociodemographic Characteristics and Health Status**

| | Percent Change in Hospitalization Rates from 1992-2000 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cellulitis | Asthma | COPD | Dehydration | CHF | Pneumonia | Septicemia | Stroke | UTI | Acute Diabetic Events[1,2] | Lower Limb PVD[1,2] |
| | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) |
| Medicaid Enrollment Status | | | | | | | | | | | |
| Enrolled in Medicaid | 4.4 | -28.0 | 54.2 | 11.7 | 7.0 | 7.1 | 13.5 | -16.2 | 1.5 | 41.7 | -27.8 |
| Not Enrolled in Medicaid | 10.4 | -34.4 | 42.6 | 19.9 | -3.9 | 11.8 | 5.0 | -15.7 | 11.8 | 37.6 | -25.4 |
| Medicare Eligibility Status | | | | | | | | | | | |
| Aged without ESRD | 14.2 | -16.8 | 82.8 | -3.9 | -2.0 | 35.2 | 19.6 | 9.3 | 39.2 | 39.8 | -25.8 |
| Aged with ESRD | 11.2 | -30.1 | 51.9 | 20.7 | -0.4 | 13.2 | 8.4 | -14.8 | 12.3 | 113.7 | -21.1 |
| Urban/Rural | | | | | | | | | | | |
| Urban | 11.6 | -28.7 | 47.0 | 19.1 | 0.1 | 15.5 | 10.0 | -14.1 | 12.9 | 49.2 | -24.4 |
| Rural | 13.7 | -33.2 | 62.5 | 24.9 | 2.6 | 9.0 | 15.4 | -14.5 | 12.8 | 29.8 | -19.8 |
| Health Status (based upon PIP DCG)[3] | | | | | | | | | | | |
| 1-20% Quintile | 1.5 | -32.1 | 11.7 | 12.1 | -9.4 | -2.7 | -16.5 | -15.1 | -3.8 | -12.9 | -19.3 |
| 21-40% Quintile | 2.0 | -29.7 | 11.2 | 9.7 | -13.5 | -6.0 | -16.2 | -15.6 | -7.5 | -28.9 | -15.3 |
| 41-60% Quintile | -60.0 | -72.3 | 208.3 | 136.7 | -15.4 | -34.7 | -73.5 | -32.8 | 128.0 | -10.9 | -39.5 |
| 61-80% Quintile | -0.9 | -14.0 | 29.3 | 8.1 | 3.1 | 1.4 | -8.5 | -11.9 | 3.0 | -12.8 | -18.8 |
| 81-100% Quintile | 12.5 | -32.4 | 23.4 | 15.6 | -0.1 | 7.4 | 2.2 | -11.8 | 10.4 | 9.6 | -11.0 |

Notes:
1. Due to volatility in the rates between 1992 and 1994, the percentage change is calculated between 1994 and 2000.
2. Rate is calculated using only Medicare FFS beneficiaries with diabetes in the denominator.
3. Higher PIP-DCG scores indicate poorer health status. The change in health status is calculated from 1994 to 2000.

Source: RTI Analysis of 1992 through 2000 Medicare claims and Enrollment Data.

**Exhibit 3-4**
**Percent Change in the Proportion of Hospitalizations by Source of Admission for Medicare Fee-for-Service Beneficiaries for Eleven Ambulatory Care Sensitive Conditions Between 1992 and 2000**

| | Home | | Acute Care Hospital | | Skilled Nursing Facility | | Long-term or sub-acute facility | | Emergency Room | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Baseline (1992) | Percent Change (1992-2000) | Baseline (1992) | Percent Change (1992-2000) | Baseline (1992) | Percent Change (1992-2000) | Baseline (1992) | Percent Change (1992-2000) | Baseline (1992) | Percent Change (1992-2000) |
| | (%) | | (%) | | (%) | | (%) | | (%) | |
| Cellulitis | 53.7 | -8.8 | 0.3 | 70.0 | 1.95 | -37.7 | 1.0 | -49.2 | 43.1 | 13.3 |
| Asthma | 36.5 | -8.4 | 0.3 | 27.3 | 0.85 | -29.9 | 0.5 | -35.8 | 61.9 | 5.5 |
| COPD | 36.0 | -12.2 | 0.4 | 25.4 | 1.26 | -31.4 | 0.6 | -36.3 | 61.7 | 7.9 |
| Dehydration | 43.3 | -12.4 | 0.4 | 44.5 | 2.43 | -37.4 | 1.1 | -36.7 | 52.8 | 12.3 |
| CHF | 33.7 | -8.2 | 0.6 | 71.0 | 1.14 | -11.6 | 0.7 | -20.6 | 63.9 | 4.1 |
| Acute Diabetic Events[1] | 43.6 | -26.5 | 0.5 | 31.4 | 3.26 | -67.1 | 1.0 | -44.9 | 51.6 | 27.2 |
| Lower Limb PVD[1] | 61.9 | -11.1 | 0.3 | 162.2 | 2.43 | -12.1 | 0.8 | -8.0 | 34.6 | 19.5 |
| Pneumonia | 34.9 | -16.5 | 0.5 | 37.2 | 2.93 | -36.6 | 1.2 | -38.5 | 60.5 | 11.7 |
| Septicemia | 28.7 | -20.2 | 0.7 | 48.3 | 4.23 | -12.6 | 1.4 | -19.3 | 65.1 | 9.6 |
| Stroke | 27.3 | -21.6 | 1.0 | 42.8 | 1.28 | -19.8 | 0.8 | -23.0 | 69.7 | 8.5 |
| UTI | 28.9 | -17.2 | 0.5 | 26.4 | 4.71 | -42.9 | 1.4 | -37.7 | 64.4 | 11.5 |

Notes:
1. Proportion is calculated using claims for only Medicare FFS beneficiaries with diabetes.

Source: RTI Analysis of 1992 through 2000 Medicare claims Data.

**Exhibit 3-5**
**Trend in the Number of Medicare Fee-for-Service Beneficiaries Admitted for an Ambulatory Care Sensitive Condition (ACSC) versus Average Number of Admissions for Beneficiaries Admitted with an ACSC, 1992 - 2000**

| | Year | | | | | % Change |
|---|---|---|---|---|---|---|
| | 1992 | 1994 | 1996 | 1998 | 2000 | 1992-2000[1] |
| Cellulitis | | | | | | |
| Number Beneficiaries Admitted/All Beneficiaries | 0.0030 | 0.0031 | 0.0030 | 0.0032 | 0.0035 | 15.5% |
| Average Number Admits/Beneficiary Admitted | 1.07 | 1.07 | 1.073 | 1.08 | 1.08 | 1.2% |
| Asthma | | | | | | |
| Number Beneficiaries Admitted/All Beneficiaries | 0.0021 | 0.0019 | 0.0016 | 0.0015 | 0.0015 | -26.3% |
| Average Number Admits/Beneficiary Admitted | 1.17 | 1.16 | 1.15 | 1.13 | 1.12 | -4.3% |
| Chronic Obstructive Pulmonary Disease | | | | | | |
| Number Beneficiaries Admitted/All Beneficiaries | 0.0060 | 0.0075 | 0.0082 | 0.0091 | 0.0092 | 52.0% |
| Average Number Admits/Beneficiary Admitted | 1.25 | 1.26 | 1.27 | 1.28 | 1.28 | 2.5% |
| Congestive Heart Failure | | | | | | |
| Number Beneficiaries Admitted/All Beneficiaries | 0.0172 | 0.0175 | 0.0180 | 0.0186 | 0.0184 | 6.8% |
| Average Number Admits/Beneficiary Admitted | 1.31 | 1.31 | 1.31 | 1.32 | 1.31 | 0.4% |
| Dehydration | | | | | | |
| Number Beneficiaries Admitted/All Beneficiaries | 0.0048 | 0.0050 | 0.0054 | 0.0057 | 0.0062 | 30.3% |
| Average Number Admits/Beneficiary Admitted | 1.06 | 1.06 | 1.06 | 1.06 | 1.06 | 0.1% |
| Acute Diabetic Events among Beneficiaries with Diabetes | | | | | | |
| Number Beneficiaries Admitted/All Beneficiaries[2] | 0.008 | 0.01233 | 0.01195 | 0.0118 | 0.01184 | -4.0% |
| Average Number Admits/Beneficiary Admitted[2] | 1.06 | 1.07 | 1.06 | 1.08 | 1.07 | 0.0% |

(continued)

**Exhibit 3-5 (continued)**
**Trend in the Number of Medicare Fee-for-Service Beneficiaries Admitted for an Ambulatory Care Sensitive Condition (ACSC) versus Average Number of Admissions for Beneficiaries Admitted with an ACSC, 1992 - 2000**

| | Year | | | | | % Change |
|---|---|---|---|---|---|---|
| | 1992 | 1994 | 1996 | 1998 | 2000 | 1992-2000[1] |
| Lower Limb Peripheral Vascular Disease Among Beneficiaries with Diabetes | | | | | | |
| Number Beneficiaries Admitted/All Beneficiaries[2] | 0.0147 | 0.0143 | 0.0133 | 0.0129 | 0.0114 | -22.4% |
| Average Number Admits/Beneficiary Admitted[2] | 1.15 | 1.15 | 1.16 | 1.14 | 1.16 | 0.5% |
| Pneumonia | | | | | | |
| Number Beneficiaries Admitted/All Beneficiaries | 0.0160 | 0.0177 | 0.0183 | 0.0197 | 0.0194 | 21.2% |
| Average Number Admits/Beneficiary Admitted | 1.10 | 1.10 | 1.11 | 1.11 | 1.11 | 1.3% |
| Septicemia | | | | | | |
| Number Beneficiaries Admitted/All Beneficiaries | 0.0049 | 0.0057 | 0.0069 | 0.0066 | 0.0058 | 17.8% |
| Average Number Admits/Beneficiary Admitted | 1.06 | 1.07 | 1.08 | 1.08 | 1.07 | 0.9% |
| Stroke | | | | | | |
| Number Beneficiaries Admitted/All Beneficiaries | 0.0098 | 0.0095 | 0.0098 | 0.0094 | 0.0090 | -8.6% |
| Average Number Admits/Beneficiary Admitted | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 0.0% |
| Urinary Tract Infection | | | | | | |
| Number Beneficiaries Admitted/All Beneficiaries | 0.0048 | 0.0050 | 0.0051 | 0.0057 | 0.0060 | 23.7% |
| Average Number Admits/Beneficiary Admitted | 1.08 | 1.08 | 1.07 | 1.07 | 1.07 | -0.3% |

Notes:
1. Due to volatility in the rates between 1992 and 1994, the percentage change is calculated between 1994 and 2000 for acute diabetic events
2. Calculations are based on Medicare FFS beneficiaries with diabetes in both the numerator and denominator. Rate is calculated using only Medicare FFS beneficiaries with diabetes in the denominator.

Source: RTI Analysis of 1992 through 2000 Medicare claims Data.

**Exhibit 3-6**
**Trend in Total Inpatient Days and Average Length of Stay for Medicare Fee-for-Service Beneficiaries Hospitalized with Selected Ambulatory Care Sensitive Conditions Between 1992 and 2000**

| | Year | | | | | Percent Change |
|---|---|---|---|---|---|---|
| | 1992 | 1994 | 1996 | 1998 | 2000 | 2000 -1992 |
| Cellulitis | | | | | | |
| Total Inpatient Days | 73,545 | 66,615 | 52,409 | 48,790 | 50,512 | -31.3 |
| Average Length of Stay | 8.8 | 7.8 | 6.5 | 6.0 | 5.9 | -33.8 |
| Asthma | | | | | | |
| Total Inpatient Days | 53,166 | 44,358 | 29,430 | 24,198 | 22,665 | -57.4 |
| Average Length of Stay | 7.3 | 6.5 | 5.6 | 5.2 | 5.0 | -31.9 |
| Chronic Obstructive Pulmonary Disease | | | | | | |
| Total Inpatient Days | 178,130 | 197,080 | 177,054 | 173,855 | 167,212 | -6.1 |
| Average Length of Stay | 8.2 | 7.3 | 6.2 | 5.8 | 5.6 | -31.7 |
| Congestive Heart Failure | | | | | | |
| Total Inpatient Days | 453,429 | 408,703 | 346,381 | 315,341 | 299,302 | -34.0 |
| Average Length of Stay | 8.3 | 7.3 | 6.3 | 6.0 | 5.8 | -29.6 |
| Dehydration | | | | | | |
| Total Inpatient Days | 96,349 | 88,634 | 73,368 | 67,444 | 68,834 | -28.6 |
| Average Length of Stay | 8.3 | 7.1 | 5.7 | 5.3 | 5.1 | -38.4 |
| Acute Diabetic Events[1] | | | | | | |
| Total Inpatient Days | 29,532 | 35,458 | 29,768 | 25,986 | 27,860 | -5.70 |
| Average Length of Stay | 11.6 | 8.2 | 6.8 | 5.8 | 5.9 | -49.50 |

(continued)

**Exhibit 3-6 (continued)**
**Trend in Total Inpatient Days and Average Length of Stay for Medicare Fee-for-Service Beneficiaries Hospitalized with Selected Ambulatory Care Sensitive Conditions**

| | Year | | | | | Percent Change |
|---|---|---|---|---|---|---|
| | 1992 | 1994 | 1996 | 1998 | 2000 | 2000 -1992 |
| Lower Limb Peripheral Vascular Disease[1] | | | | | | |
| Total Inpatient Days | 66,450 | 59,667 | 47,977 | 43,918 | 42,860 | -35.5 |
| Average Length of Stay | 13.4 | 11.0 | 9.1 | 8.3 | 8.5 | -36.1 |
| Pneumonia | | | | | | |
| Total Inpatient Days | 392,951 | 393,369 | 338,567 | 316,993 | 299,257 | -23.8 |
| Average Length of Stay | 9.6 | 8.6 | 7.4 | 6.9 | 6.7 | -30.0 |
| Septicemia | | | | | | |
| Total Inpatient Days | 145,573 | 146,381 | 149,290 | 127,519 | 111,532 | -23.4 |
| Average Length of Stay | 11.7 | 10. | 8.8 | 8.5 | 8.7 | -25.7 |
| Stroke | | | | | | |
| Total Inpatient Days | 258,730 | 208,584 | 169,740 | 137,471 | 124,794 | -51.8 |
| Average Length of Stay | 10.1 | 8.5 | 7.0 | 6.3 | 6.1 | -40.0 |
| Urinary Tract Infection | | | | | | |
| Total Inpatient Days | 97,497 | 87,958 | 70,748 | 67,132 | 68,171 | -30.1 |
| Average Length of Stay | 8.2 | 7.1 | 5.9 | 5.4 | 5.3 | -35.3 |

Notes:
1. Rate is calculated using only Medicare FFS beneficiaries with diabetes in the denominator.

Source: RTI Analysis of 1992 through 2000 Medicare claims Data.

**Exhibit 3-7**
**Percent Change in Medicare Fee-for-Service Beneficiary Observation Stay and Emergency Room (ER) Usage Rates for Eleven Ambulatory Care Sensitive Conditions Between 1992 and 2000**

| | Rate of Observation Bed Stay and Emergency Room Use per 1,000 Medicare FFS Beneficiaries | | |
|---|---|---|---|
| | 1992 (per 1,000) | 2000 (per 1,000) | 1992-2000 (% change) |
| **ACSCs** | | | |
| Cellulitis | 2.1 | 3.0 | 47.0 |
| Asthma | 1.3 | 1.5 | 14.1 |
| COPD | 3.1 | 4.1 | 33.6 |
| Dehydration | 1.0 | 1.9 | 92.7 |
| CHF | 3.0 | 3.5 | 19.8 |
| Acute Diabetic Events[1] | 7.1 | 12.8 | 80.7 |
| Lower Limb PVD[1] | 2.9 | 3.9 | 38.0 |
| Pneumonia | 2.1 | 3.1 | 46.8 |
| Septicemia | 0.4 | 0.6 | 51.4 |
| Stroke | 0.7 | 0.8 | 0.2 |
| UTI | 4.9 | 6.1 | 25.3 |

Notes:
1. Rate is calculated using only Medicare FFS beneficiaries with diabetes in the denominator.

Source: RTI Analysis of 1992 through 2000 Medicare claims Data.

**Exhibit 3-8**
**Percent Change in Medicare Fee-for-Service Beneficiary Observation Stay and Emergency Room (ER) Usage Rates for Eleven Ambulatory Care Sensitive Conditions by Sociodemographic Characteristics and Health Status, 1992 to 2000**

| | Percent Change in ER and Observation Bed Stay Rates | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cellulitis (%) | Asthma (%) | COPD (%) | Dehydration (%) | CHF (%) | Pneumonia (%) | Septicemia (%) | Stroke (%) | UTI (%) | Acute Diabetic Events[1,2] (%) | Lower Limb PVD[1,2] (%) |
| Sex | | | | | | | | | | | |
| Male | 45 | 0 | 16 | 78 | 16 | 44 | 23 | -5 | 13 | 57 | 34 |
| Female | 48 | 22 | 55 | 101 | 23 | 50 | 34 | 4 | 31 | 94 | 37 |
| Race | | | | | | | | | | | |
| White | 47 | 10 | 34 | 98 | 20 | 45 | 24 | 3 | 25 | 79 | 44 |
| Black | 30 | 11 | 25 | 50 | 7 | 51 | 41 | -23 | 12 | 92 | 10 |
| Other | 46 | 37 | 9 | 92 | 20 | 30 | 17 | -12 | 39 | 53 | 4 |
| Age Group | | | | | | | | | | | |
| 65-69 | 41 | 13 | 37 | 134 | 32 | 52 | 45 | 12 | 25 | 55 | 25 |
| 70-74 | 45 | 10 | 35 | 112 | 26 | 53 | 40 | 4 | 27 | 94 | 13 |
| 75-79 | 52 | 16 | 30 | 102 | 21 | 48 | 21 | 0 | 27 | 80 | 79 |
| 80-84 | 51 | 16 | 27 | 90 | 12 | 42 | 32 | -8 | 22 | 82 | 42 |
| 85-89 | 52 | 23 | 36 | 70 | 16 | 39 | 23 | -2 | 22 | 107 | 63 |
| 90-94 | 45 | 34 | 38 | 51 | 13 | 37 | 15 | -5 | 21 | 60 | -1 |
| 95+ | 35 | 30 | 43 | 50 | 10 | 26 | 13 | -8 | 27 | 49 | -5 |
| Medicaid Enrollment Status | | | | | | | | | | | |
| Enrolled in Medicaid | 20 | 1 | 15 | 52 | 7 | 22 | 17 | -21 | 3 | 50 | 5 |
| Not Enrolled in Medicaid | 50 | 11 | 30 | 102 | 19 | 49 | 25 | 3 | 28 | 85 | 41 |

(continued)

**Exhibit 3-8 (continued)**
**Percent Change in Medicare Fee-for-Service Beneficiary Observation Stay and Emergency Room (ER) Usage Rates for Eleven Ambulatory Care Sensitive Conditions by Sociodemographic Characteristics and Health Status, 1992 to 2000**

| | Percent Change in ER and Observation Bed Stay Rates | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cellulitis (%) | Asthma (%) | COPD (%) | Dehydration (%) | CHF (%) | Pneumonia (%) | Septicemia (%) | Stroke (%) | UTI (%) | Acute Diabetic Events* (%) | Lower Limb PVD (%) |
| Medicare Eligibility Status | | | | | | | | | | | |
| Aged without ESRD | 47 | 14 | 33 | 93 | 19 | 46 | 21 | 0 | 25 | 75 | 39 |
| Aged with ESRD | 37 | 15 | 51 | 12 | 0 | 94 | 52 | 7 | 25 | 294 | 3 |
| Urban/Rural | | | | | | | | | | | |
| Urban | 48 | 16 | 30 | 84 | 17 | 49 | 16 | -5 | 26 | 76 | 54 |
| Rural | 45 | 8 | 37 | 111 | 22 | 39 | 54 | 4 | 22 | 93 | 8 |
| Health Status (based upon PIP DCG) | | | | | | | | | | | |
| 1-20% Quintile | 33 | 11 | 26 | 78 | 16 | 33 | 0 | 0 | 16 | 137 | 7 |
| 21-40% Quintile | 31 | 6 | 12 | 55 | 13 | 20 | 0 | 0 | 16 | 75 | -11 |
| 41-60% Quintile | 20 | 8 | 22 | 62 | 12 | -3 | 20 | -2 | 85 | 75 | 29 |
| 61-80% Quintile | 19 | 3 | 17 | 52 | 13 | 20 | 14 | -18 | 5 | 80 | 17 |
| 81-100% Quintile | 29 | -7 | 16 | 48 | 8 | 25 | 21 | -14 | 10 | 80 | 30 |

Notes:
1. Due to volatility in the rates between 1992 and 1994, the percentage change is calculated between 1994 and 2000.
2. Rate is calculated using only Medicare FFS beneficiaries with diabetes in the denominator.

Source: RTI Analysis of 1992 through 2000 Medicare claims and Enrollment Data.

**Exhibit 3-9**
**Percent Change in the Average Number of Observation Bed Stays or the Emergency Room Visits for Medicare Fee-for-Service Beneficiaries Treated for an Ambulatory Care Sensitive Condition (ACSC), 1992 - 2000**

| | 1992 | 2000 | 1992-2000[1] (% change) |
|---|---|---|---|
| **ACSCs** | | | |
| Cellulitis | 1.12 | 1.14 | 1.9 |
| Asthma | 1.29 | 1.26 | 1.2 |
| COPD | 1.30 | 1.27 | 1.3 |
| Dehydration | 1.03 | 1.03 | 0.3 |
| CHF | 1.17 | 1.18 | 1.3 |
| Acute Diabetic Events[2] | 1.08 | 1.13 | 4.5 |
| Lower Limb PVD[2] | 1.12 | 1.12 | -0.4 |
| Pneumonia | 1.05 | 1.05 | -0.7 |
| Septicemia | 1.09 | 1.12 | 2.4 |
| Stroke | 1.03 | 1.02 | -0.6 |
| UTI | 1.08 | 1.08 | -0.1 |

Notes:
1. Due to volatility in the rates between 1992 and 1994, the percentage change is calculated between 1994 and 2000.
2. Rate is calculated using only Medicare FFS beneficiaries with diabetes in the denominator.

Source: RTI Analysis of 1992 through 2000 Medicare claims Data.

**Exhibit 3-10**
**Definitions of Independent and Dependent Variables included in the Multivariate Analysis of Factors Related to the Rate of Ambulatory Care Sensitive Condition (ACSC) Hospitalizations among Medicare Fee-for-Service Beneficiaries from 1993 to 2000**

| Variable Name | Definition of Variable |
|---|---|
| **Dependent Variables** | |
| PVD, COPD, CHF | Annual inpatient hospitalization rate for lower limb peripheral vascular disease (PVD), chronic obstructive pulmonary disease (COPD) and congestive heart failure (CHF) |
| **Independent Variables** | |
| TIME | Continuous variable reflecting time period (1993-2000) |
| **Demographics** | |
| Proportion Died | Percent of beneficiaries who died during the study year |
| Proportion Dual | Percent of beneficiaries who are enrolled in Medicaid |
| Proportion Men | Percent of beneficiaries who are men |
| Proportion Black | Percent of beneficiaries who are Black |
| Proportion ESRD | Percent of beneficiaries originally eligible for Medicare due to end-stage renal disease, obtained from the Medicare Enrollment Database (EDB) file |
| **Health Status** | |
| Median PIP-DCG Score | Median PIP-DCG score |
| Lag Number of Diabetics | Number of beneficiaries with diabetes in the previous time period (included only for PVD regression modeling) |
| **Time Varying Parameters** | |
| T93, T94, T95…T00 | Time dummies to interact with median age and ER/Observation Bed Stay rates |
| T##*ER Rate | Time dummy interacted with annual ER and observation bed stay rates, where # indicates a changing year value |
| T##*Median Age | Median age of the beneficiary population on July 1st of each study year, interacted with time dummy for the year |
| **Geography** | |
| Population Change | Change in size of Medicare FFS beneficiary population from current year to previous year |
| Census Divisions | Set of dummy variables representing the nine Census divisions (Census Division 1, New England, is the reference region) |

**Exhibit 3-11**
**Multivariate OLS Regression of Changes in Inpatient Hospital Admission Rates for Three Ambulatory Care Sensitive Conditions: Lower Limb Peripheral Vascular Disease (PVD), Chronic Obstructive Pulmonary Disease (COPD), and Congestive Heart Failure (CHF), 1993 to 2000**

| | Inpatient PVD Rate[1] | | Inpatient COPD Rate[1] | | Inpatient CHF Rate[1] | |
|---|---|---|---|---|---|---|
| **Variable** | **MSA** | **Non-MSA** | **MSA** | **Non-MSA** | **MSA** | **Non-MSA** |
| **Continuous Time Variable** | | - | | | | |
| **Demographics** | | | | | | |
| Proportion Died | | | | + | + | - |
| Proportion Dual Enrolled in Medicaid | - | + | | | | + |
| Proportion Men | | | + | | + | |
| Proportion Black | | | - | - | + | |
| Proportion with ESRD | + | - | + | | + | |
| **Median Age of Medicare FFS Population of each study year interacted with Time Dummy for the year** | | | | | | |
| 1993 Median Age *1993 | | | - | - | | |
| 1994 Median Age *1994 | | | - | - | | + |
| 1995 Median Age *1995 | | + | - | - | - | + |
| 1996 Median Age *1996 | | + | - | - | - | + |
| 1997 Median Age *1997 | | + | - | | - | + |
| 1998 Median Age *1998 | | + | - | | - | + |
| 1999 Median Age *1999 | | + | - | | - | + |
| 2000 Median Age *2000 | | + | - | | - | + |
| **Health Status** | | | | | | |
| Median PIP-DCG Risk Score | + | | + | | + | |
| Lag Number of Diabetics[2] | | - | **NI**[2] | **NI**[2] | **NI**[2] | **NI**[2] |
| **Year Interacted with ER Visit Rate** | | | | | | |
| 1993 ER Visit Rate *1993 | | | + | + | | |
| 1994 ER Visit Rate *1994 | | | + | + | | |
| 1995 ER Visit Rate *1995 | | | + | | | |
| 1996 ER Visit Rate *1996 | | | + | + | | + |
| 1997 ER Visit Rate *1997 | | - | + | + | | |
| 1998 ER Visit Rate *1998 | | - | + | + | | + |
| 1999 ER Visit Rate *1999 | | + | + | + | | + |
| 2000 ER Visit Rate *2000 | | - | + | + | | + |
| **Population Migration Patterns** | | | | | | |
| Change in Size of Medicare FFS Beneficiary Population from Current Year to Prior Year | | | | - | | - |
| **Set of Dummy Variables for Each Census Division** (*New England is Reference Division*) | | | | | | |
| Middle Atlantic | | + | + | + | + | + |
| East North Central | | | + | + | + | + |
| West North Central | - | | + | + | - | + |
| South Atlantic | | | + | + | | + |
| East South Central | | | + | + | + | + |
| West South Central | | | | + | | + |
| Mountain | - | | - | | - | |
| Pacific | - | | - | | - | |
| Adjusted $R^2$ | 40% | 38% | 66% | 75% | 82% | 71% |
| N | 408 | 400 | 408 | 400 | 408 | 400 |

NOTES:

[1] The unit of analysis is the proportion of Medicare FFS beneficiaries age 65 and older with a hospitalization for each ACSC under consideration, PVD, COPD, and CHF. Only effects of factors significant at the $p<0.05$ level are represented by + and – signs in the table.

[2] NI = Not included in the model.

SOURCE: RTI analysis of 1992-2000 Medicare MedPAR and Denominator File data.

# CHAPTER 4
# MEDICARE CURRENT BENEFICIARY SURVEY (MCBS) DESCRIPTIVE AND MULTIVARIATE ANALYSES OF LIKELIHOOD OF HOSPITALIZATION FOR AN AMBULATORY CARE SENSITIVE CONDITION

## 4.1 Overview

Although claims data provide valuable information on socio-demographic characteristics and the health status of Medicare beneficiaries, they do not contain patient-reported information that may be critical in explaining factors related to ACSC hospitalizations. Therefore, we performed beneficiary-level descriptive and multivariate analyses to combine key self-reported assessments with the claims-based ACSC hospitalization information to allow for a more in-depth analysis of the factors that influence hospitalizations for ACSCs. Specifically, we studied the influence of selected beneficiary characteristics including sociodemographic and geographic factors, health status, place of usual source of care, insurance status, propensity to seek care, and beneficiary assessment of unmet need on the likelihood of hospitalization for congestive heart failure (CHF), chronic lung disease (CLD), and dehydration. Chronic lung disease presents both chronic obstructive pulmonary disease and asthma.

## 4.2 Data Sources

Information on patient characteristics were obtained from the 1999 Medicare Current Beneficiary Survey (MCBS) Access to Care file and hospitalizations related to ACSCs were derived from 1999 and 2000 Medicare FFS claims. The MCBS is a continuous survey of a representative sample of the Medicare population. The survey collects data on demographics, use of health services, sources of payments, health status and functioning, satisfaction with care, health-seeking behavior, and access to medical care. In this study, we analyzed individuals 65 years or older interviewed in the community and facility setting. Only those continuously enrolled in Fee-for-Service Medicare in both 1999 and 2000 were included.

Based on a detailed literature review and expert clinical consultation, three ACSC conditions were selected for study. The ACSC conditions were selected based on whether the clinical condition was appropriate for an aged population, resulted in a sufficient number of hospitalizations among the elderly to allow for stable estimates and the condition was well-captured in Medicare claims data. Admissions related to the three conditions selected for analysis, CHF, chronic lung disease, and dehydration, were identified by the presence of a principle diagnosis for the condition on the inpatient claim.

## 4.3 Analytic File Construction

Guided by a systematic literature review, variables corresponding to the factors that are hypothesized to affect admission for ACSCs were created from the survey responses. Beneficiary income, marital status, education and geographic location were obtained along with the more common demographic information (age, gender, and race). Information on Medicaid enrollment (duals), supplemental insurance, and prescription drug coverage were also obtained from the survey for all enrollees. We classified all individuals with continuous Medicaid enrollment as dual enrollees based on information available in the Medicare enrollment file.

Several patient-reported health status measures are available from the survey responses including self-rated health status, limitations in activities of daily living (ADLs), and count of reported medical conditions. We employed the model-building strategy recommended by Hosmer and Lemeshow (1989) to select among the different specifications available for health status. Our analysis indicated that self-rated health status and count of medical conditions were the health status measures that explained the greatest amount of variation in ACSC hospitalizations and, therefore we chose to include these variables in the multivariate analysis.

Patient reported measures of access and indicators of individuals' propensity to seek care were also derived. The MCBS collects data on two sets of measures, one focusing on medical care and the other on prescription medication, which may be used to identify unmet need. The MCBS also contains four questions on propensity to seek care which were used to develop a composite measure. Again we employed the model-building strategy recommended by Hosmer and Lemeshow (1989) to select among different specifications. ***Exhibit 4-1*** contains details on the specification of these variables.

In addition to the variables described above, several others were derived from Medicare enrollment and claims files. Beneficiaries enrolled in Medicare managed care plans were excluded from this analysis as we did not have hospitalization information for them. The total number of months enrolled in Medicare FFS was calculated from the Medicare eligibility files for all Medicare beneficiaries in the analytic sample. This variable was created to compensate for the truncated data for beneficiaries who died during the 12-months in 2000. Using claims data from 1999 and 2000, we identified hospitalizations with a primary diagnosis of CHF, chronic lung disease, or dehydration for each year. Hospitalization for an ACSC was specified as a dichotomous variable (0 = no ACSC hospitalization; 1= ACSC hospitalization).

Both univariate and multivariate analyses were performed. Logistic regressions were estimated separately for CHF, chronic lung disease, and dehydration. As indicated above, we used patient characteristics and access to care information from the MCBS collected between September and December 1999 to explain ACSC hospitalizations in 2000 for the three conditions selected. For the logistic regression models, we first estimated the models without a variable representing a prior hospitalization for the same condition in 1999 and then we stepped in this variable to study any changes in the other independent variables. Odds ratios were generated and reported for each of the independent variables. All analyses were performed in SUDAAN to take into account the complex sample design of the MCBS and all estimates provided are weighted to reflect the Medicare FFS population.

## 4.4 Summary of Descriptive and Multivariate Findings

The following sets of univariate and multivariate statistics were produced:

*Univariate Analyses*: ***Exhibit 4-2*** through ***Exhibit 4-6*** provide the number and percentage of MCBS respondents included in our analyses stratified by sociodemographics, self-reported health status measures, supplemental insurance status, access to care measures, and ambulatory care sensitive conditions. Statistics are provided for all respondents and stratified by community- and facility-based residency.

*Correlations*: ***Exhibit 4-7*** displays selected correlations among alternative health status, insurance coverage, and access to care measures. These correlations were produced during our multivariate model building exercise and provide us with empirical evidence as to the appropriateness of including variables that may be collinear.

*Multivariate Analyses*: ***Exhibits 4-8*** and ***4-9*** present weighted logistic regression models for the entire sample and for community residents only. Separate logistic regression models were estimated for Congestive Heart Failure (CHF), Chronic Lung Disease (CLD) and Dehydration (DHYD). We have only included self-reported health status in the regression estimation of the entire sample out of concern that the count of medical conditions are not collected in the same manner for community and facility residents. For the regression model for community residents only, we include both self-reported health status and count of medical conditions. In addition, we only present the results of the fully specified model (including the 1999 hospitalization) in the tables. In the findings discussed below, we assess the effect of including or excluding this variable in the regression models.

**Descriptive Findings:**

***Exhibit 4-2*** displays the estimated number and percentage of Medicare beneficiaries who were included in our analyses, in total, and stratified by community and facility residence. The demographics of the study population may summarized as follows:

- half of the respondents are age 65 to 74;
- 90 percent White;
- about 40 percent have some college education;
- approximately 70 percent have annual incomes between $10,000 to $50,000;
- 60 percent are married; and
- 71 percent live in an urban area.

There are significant differences in demographics between community-based and facility-based residents. Facility-based residents are:

- considerably older,
- more likely to be women,
- less likely to have some college education,
- more likely to have lower incomes, and
- far more likely to not be married.

***Exhibit 4-3*** displays the estimated number and percentage of Medicare beneficiaries by alternative measures of self-reported health status. Across all beneficiaries, we observe the following:

- 8 percent of respondents had 3 or more limitations of activities of daily living (ADLs) and 12 percent had 2 or more limitations of ADLs;

- 15 percent of the population self-reported health status as excellent, while 60 percent self-reported health status as good or very good and 24 percent self-reported health status as fair or poor; and

- the vast majority self-reported one or more chronic medical conditions and over 50 percent of respondents reported two to four chronic medical conditions.

There are significant differences in self-reported health status between community-based and facility-based residents. Facility-based residents are frailer and self-report greater activity limitations than community-based residents:

- 50 percent of facility-based residents self-report three or more ADL limitations and 70 percent two or more ADL limitations as compared to less than 10 percent of the community-based residents;

- greater than 50 percent of facility-based residents self-reported fair or poor health status in contrast to 22 percent of community-based residents; and

- there is some shifting of the distribution of number of chronic medical conditions to the presence of more conditions among the facility-based residents but not to the degree one might expect given the significant differences in self-reported health status and number of ADL limitations.

***Exhibit 4-4*** displays the estimated number and percentage of Medicare beneficiaries by presence of supplemental insurance. Across all beneficiaries, we observe the following:

- 8 percent of respondents were dually enrolled in Medicare and Medicaid,

- 79 percent reported having supplemental insurance, and

- 53 percent reported some form of prescription drug coverage.

There are significant differences in supplemental insurance coverage between community-based and facility-based residents. Facility-based residents are:

- far more likely to be dually enrolled in Medicaid, 40 percent versus 6 percent, and

- significantly less likely to have supplemental insurance or prescription drug coverage, which most likely reflects the presence of Medicaid coverage.

***Exhibit 4-5*** displays the estimated number and percentage of community-based Medicare beneficiaries that report the likelihood of seeking care, reluctance to seek care, usual sources of care, and unmet need. Across all community-based beneficiaries, we observe the following:

- Almost three-quarters report they are likely to seek preventive care and one-third report some reluctance to seek care;
- The vast majority report having a usual source of care and the length of association has been greater than 1 year, with one-third reporting length of association being greater than 10 years; and
- Only a small percentage of respondents reported a delay in seeking care due to cost (5%) or that they did not fill a prescription (2.5%).

***Exhibit 4-6*** displays the estimated number and percentage of Medicare beneficiaries that were hospitalized for each of the three selected ACSCs in 1999 or 2000. Across all beneficiaries, we observe the following:

- Relatively few beneficiaries were hospitalized for any of the three ACSCs in 2000:
  - Approximately 2 percent were hospitalized for CHF,
  - Approximately 1 percent were hospitalized for CLD, and
  - Approximately one-half of one percent were hospitalized for dehydration.
- Fewer admissions were observed in 1999 as compared to 2000:
  - Approximately 1 percent were hospitalized for CHF,
  - Less than 1 percent were hospitalized for CLD, and
  - The same one-half of one percent were hospitalized for dehydration.

There are significant differences in the percentage hospitalized for an ACSC between community-based and facility-based residents. In 2000, facility-based residents are more likely to be hospitalized than are community-based residents.

- 3.4 percent of facility-based residents were hospitalized for CHF as compared to 1.8 percent for community-based residents;
- 1.9 percent of facility-based residents were hospitalized for CLD as compared to 1 percent for community-based residents; and
- 1.6 percent of facility-based residents were hospitalized for dehydration as compared to 0.5 percent for community-based residents;
- Similar but less pronounced differences appeared in 1999.

***Exhibit 4-7*** displays correlations among alternative sets of self-reported heath status measures, supplemental insurance coverage, and access to care measures. We observe the following:

- relatively low positive correlation among self-reported health status, number of ADL limitations, and count of chronic medical conditions;
- negative and moderate correlation between Medicaid enrollment and supplemental insurance;
- low positive correlation between supplemental insurance and prescription drug coverage;
- no statistically significant correlation between prescription drug coverage and Medicaid coverage; and
- virtually no correlation among any of the access to care variables.

**Multivariate Findings: Factors Associated with Increased Risk of Hospitalization for an Ambulatory Care Sensitive Condition**

Across all sets of models we observe a relatively low level of power to predict an ACSC hospitalization as reflected in low pseudo-$R^2$ values. Many of the regression covariates are not strong predictors of a hospitalization in 2000; however, the addition of a prior hospitalization in 1999 is a very strong predictor of a hospitalization in 2000. The CHF regression model displayed the largest number of significant covariates but this may reflect the larger percentage of beneficiaries hospitalized with this clinical condition and, thus, more statistical power.

We now present a summary of findings with respect to the individual covariates across the two sets of regression models, which differ by population included in the model, identifying significance at the 5% level. ***Exhibit 4-8*** contains regression results for the sample that includes both community and facility-based respondents. ***Exhibit 4-9*** contains regression results for the sample that includes only community respondents.

- Age was a significant predictor of hospitalization in the Congestive Heart Failure (CHF) regression models; the older the Medicare beneficiary, the higher the probability of having a CHF hospitalization. Beneficiaries 85 years and older were about three times more likely to have a CHF hospitalization than those younger than 75 years (odds ratio depends on regression specification). Age was not a significant predictor in either the chronic lung disease (CLD) or dehydration (DHYD) regression models.
- Other demographic variables (sex, race, education, income and marital status) were generally not significant predictors in the regressions for CHF, CLD and DHYD. The one exception is marital status, which tended toward significance in selected models, where being married reduced the likelihood of a hospitalization.

- Those with good or fair/poor health status versus excellent health were more likely than those with excellent heath status to have had a hospitalization for CHF or CLD. Health status was not a significant predictor in the DHYD regression models.

- Count of medical conditions was consistently a significant predictor across all three conditions (included only in the community-based residency regression). Each additional medical condition increased the odds of a hospitalization for CHF, chronic lung disease, and dehydration by 34 percent, 24 percent and 26 percent, respectively.

- Being dually enrolled in Medicare and Medicaid or having supplemental insurance did not influence hospitalization for CHF or DHYD. Those with supplemental insurance had a lower probability of having a CLD hospitalization in the model with both facility-based and community-based residents.

- Prescription drug coverage was not a significant predictor in any of the regression models. This could potentially be because the variable captures prescription coverage but not the type of coverage provided (i.e. co-payment level).

- Urban residence increased the probability of having a hospitalization for CLD only among the community-based residents and became an insignificant predictor when a 1999 prior admission was stepped into the model. This can be expected since asthma and other lung conditions are more prevalent in urban areas. Urban residents were about 1.5 times more likely to have a CLD hospitalization.

- The indicator for an ACSC hospitalization in 1999 was by far the strongest predictor of hospitalization for all three conditions in 2000. Hospitalization in 1999 increased the likelihood of another hospitalization in 2000 by about 11-fold, 37-fold, and 27-fold for CHF, chronic lung disease, and dehydration, respectively. Clearly those with past hospitalizations are most likely to have future ones. Targeting individuals with prior hospitalization for close monitoring such as through disease management programs may help reduce the rate of repeat hospitalizations.

- Usual source of care and length of association with usual source were only significant predictors in the CHF model when the 1999 hospitalization variable was not included. The relationship was not what we would have expected theoretically. Having a usual source of care increased the probability of a hospitalization although there was some evidence that the greater the length of association the lower the probability of hospitalization. Adding the indicator of hospitalization in 1999 made the usual source of care/length of association variables insignificant.

- Reluctance to seek care was only a significant predictor in the CHF regression model when the 1999 hospitalization variable was not included.

- Estimate of unmet need was not a significant predictor in any of the regression models.

Overall, the two models, one with facility residents and one without, produce the same results. That is, the models generate very similar odds ratios where the variables exist for both models. The additional variables in the community only regression increase the R-square but they don't have a large impact on the odds ratios.

**Exhibit 4-1**
**Specification of Independent Variables from the Medicare Current Beneficiary Survey Used in the Multivariate Modeling of the Likelihood of an Ambulatory Care Sensitive Condition Admission**

Sociodemographic Characteristics

- **Age** (65-74, 75-84, ≥85)
- **Sex** (male versus female)
- **Race** (White versus non-white)
- **Income** (<$10,000; $10,000-$25,000; $25,001-$50,000, >$50,000)
- **Education** (High school & below versus higher education)

Geographic Location

- **MSA versus non-MSA** (MSA – metropolitan statistical area)
- **Health status**
- **Self-rated health status** (excellent, very good, good, fair/poor)
- **Count of medical conditions** (total number of conditions reported)

Access to Care

- **Length of association with usual source of care** (none, 0-1 years, 1-2 years, 3-10 years, >10 years)

Insurance Status

- **Supplemental insurance** (=1, with private health coverage)
- **Prescription drug coverage** (=1, with coverage including Medicaid)
- **Dual Medicare and Medicaid enrollee** (=1, continuously enrolled in Medicaid during year)

Propensity to Seek Care[1]

- **Reluctance to seek care** (=1 if respondent responded positively on two or more of four variables related to attitude towards seeking care)

Unmet Need (Community residents only)

- **Unmet Need** (= 1, if delayed care due to cost or did not fill prescription)

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Notes:

[1] This variable is created by combining responses to four variables on attitude toward seeking care and include items such as worrying about health, delaying, avoiding obtaining care, or going to the doctor. If more than two of the responses were positive, then the reluctance to seek care variable is coded as 1.

**Exhibit 4-2**
**Sociodemographic Characteristics of Respondents to the 1999 Medicare Current Beneficiary Survey**

| | All beneficiaries | | Community Only | | Facility Only | |
|---|---|---|---|---|---|---|
| | Number | Percentage | Number | Percentage | Number | Percentage |
| Age | | | | | | |
| 65-74 | 10,086,186 | 50.19 | 9,923,972 | 52.03 | 162,246 | 15.89 |
| 75-84 | 7,677,303 | 38.20 | 7,315,465 | 38.35 | 361,838 | 35.43 |
| 85+ | 2,331,848 | 11.60 | 1,834,599 | 9.62 | 497,249 | 48.69 |
| Race (white) | 18,117,573 | 90.26 | 17,189,168 | 90.22 | 928,405 | 91.00 |
| Sex (male) | 9,421,513 | 46.88 | 9,086,148 | 47.64 | 335,365 | 32.84 |
| Education (Some college or higher) | 7,747,115 | 39.48 | 7,598,399 | 40.04 | 148,716 | 22.99 |
| Income | | | | | | |
| Under $10,000 | 3,207,094 | 17.70 | 2,953,080 | 16.77 | 254,014 | 50.44 |
| $10,000-$25,000 | 7,098,199 | 39.18 | 6,941,320 | 39.41 | 156,879 | 31.15 |
| $25,001-$50,000 | 6,062,207 | 33.46 | 5,991,692 | 34.02 | 70,515 | 14.00 |
| >$50,000 | 1,747,790 | 9.65 | 1,725,554 | 9.80 | 22,236 | 4.42 |
| Marital Status (Married) | 12,210,949 | 60.84 | 12,034,735 | 63.12 | 176,214 | 17.53 |
| Geographic Location (MSA) | 14,226,865 | 70.80 | 13,502,555 | 70.79 | 724,310 | 70.92 |

SOURCE: RTI analysis of 1999 Medicare Current Beneficiary Survey

**Exhibit 4-3**
**Health Status of Respondents to the 1999 Medicare Current Beneficiary Survey**

| | All beneficiaries | | Community Only | | Facility Only | |
|---|---|---|---|---|---|---|
| | Number | Percentage | Number | Percentage | Number | Percentage |
| ADL (3 or more limitations)[1] | 1,534,800 | 7.71 | 1,091,027 | 5.72 | 443,773 | 52.90 |
| ADL ( 2 or more limitations)[2] | 2,378,279 | 11.95 | 1,792,073 | 9.40 | 586,206 | 69.87 |
| Self-rated Health Status | | | | | | |
| Excellent | 3,034,034 | 15.10 | 3,003,898 | 15.75 | 30,136 | 2.95 |
| Very Good | 5,684,049 | 28.29 | 5,582,580 | 29.27 | 101,469 | 9.94 |
| Good | 6,565,412 | 32.67 | 6,277,393 | 32.91 | 288,019 | 28.20 |
| Fair/Poor | 4,756,149 | 23.67 | 4,171,885 | 21.87 | 584,264 | 57.21 |
| Count of Medical Conditions | | | | | | |
| '0 | 1,694,559 | 8.43 | 1,626,102 | 8.53 | 68,457 | 6.70 |
| 1 | 3,318,918 | 16.52 | 3,166,464 | 16.60 | 152,454 | 14.93 |
| 2 | 4,240,408 | 21.10 | 4,062,341 | 21.30 | 178,067 | 17.44 |
| 3 | 3,883,096 | 19.32 | 3,689,817 | 19.34 | 193,279 | 18.92 |
| 4 | 2,911,622 | 14.49 | 2,769,106 | 14.52 | 142,516 | 13.95 |
| 5 | 1,787,885 | 8.90 | 1,665,370 | 8.73 | 122,515 | 12.00 |
| 6 | 1,145,816 | 5.70 | 1,061,674 | 5.57 | 84,142 | 8.24 |
| 7 | 604,700 | 3.01 | 563,005 | 2.95 | 41,695 | 4.08 |
| 8 | 328,806 | 1.64 | 305,783 | 1.60 | 23,023 | 2.25 |
| 9 | 123,200 | 0.61 | 111,128 | 0.58 | 12,072 | 1.18 |
| 10 | 37,110 | 0.18 | 37,110 | 0.19 | . | . |
| 11 | 4,779 | 0.02 | 4,779 | 0.03 | . | . |
| 12 | 10,845 | 0.05 | 9,439 | 0.05 | 1,406 | 0.14 |
| 13 | 3,602 | 0.02 | 1,897 | 0.01 | 1,705 | 0.17 |

[1] Difficulty performing 3 or more Acitivities of Daily Living (ADL)
[2] Difficulty performing 2 or more Acitivities of Daily Living (ADL)

SOURCE: RTI analysis of 1999 Medicare Current Beneficiary Survey.

**Exhibit 4-4**
**Insurance Status of Respondents to the 1999 Medicare Current Beneficiary Survey**

| | All beneficiaries | | Community only | | Facility only | |
|---|---|---|---|---|---|---|
| | Number | Percentage | Number | Percentage | Number | Percentage |
| Medicaid Enrollee | 1,583,646 | 7.88 | 1,202,777 | 6.31 | 380,869 | 37.29 |
| Supplement Insurance | 15,934,377 | 79.29 | 15,549,310 | 81.52 | 385,067 | 37.70 |
| Prescription Drug Coverage | 11,327,185 | 52.74 | 10,920,000 | 57.27 | 407,128 | 39.86 |

SOURCE: RTI analysis of 1999 Medicare Current Beneficiary Survey.

**Exhibit 4-5**
**Propensity to Seek Care, Access to Care and Unmet Need of Respondents to the 1999 Medicare Current Beneficiary Survey**

| | Community Only | |
|---|---|---|
| | Number | Percentage |
| PROPENSITY TO SEEK CARE | | |
| Attitude concerning preventive care (likely to seek care)[1] | 10,445,074 | 71.05 |
| Reluctance to seek care[2] | 6,332,433 | 33.20 |
| USUAL SOURCE OF CARE | | |
| Usual source of care and length of association | | |
| No usual source | 1,112,920 | 5.83 |
| Less than 1 year | 1,549,937 | 8.13 |
| 1 year or more but less than 3 years | 3,128,401 | 16.40 |
| 3 year or more but less than 10 years | 6,680,424 | 35.02 |
| More than 10 years | 6,535,763 | 34.27 |
| UNMET NEED | | |
| Delayed Care due to Cost | 986,811 | 5.17 |
| Did not fill prescription | 498,775 | 2.62 |
| Unmet need (combination of the above) | 1,400,819 | 7.34 |

[1]This variable is equal to 1 if beneficiary either receives flu or pneumonia shots.

[2]This variable is created by combining responses to four variables on attitude towards seeking care. These include worrying about health, delaying or avoiding obtaining care or going to the doctor. If more than two of the responses were positive then the reluctance to seek care is coded as 1.

SOURCE: RTI analysis of 1999 Medicare Current Beneficiary Survey.

**Exhibit 4-6**
**1999 and 2000 Ambulatory Care Sensitive Condition Hospitalizations for Respondents to the 1999 Medicare Current Beneficiary Survey**

| | All beneficiaries | | Community Only | | Facility Only | |
|---|---|---|---|---|---|---|
| | Number | Percentage | Number | Percentage | Number | Percentage |
| **2000 Hospitalizations** | | | | | | |
| Congestive Heart Failure (CHF) | 383,866 | 1.91 | 348,741 | 1.83 | 35,125 | 3.44 |
| Chronic Lung Disease (CLD) | 222,755 | 1.11 | 203,826 | 1.07 | 18,929 | 1.85 |
| Dehydration (DHYD) | 110,901 | 0.55 | 94,351 | 0.49 | 16,550 | 1.62 |
| **1999 Hospitalizations** | | | | | | |
| Congestive Heart Failure (CHF) | 238,188 | 1.19 | 225,185 | 1.18 | 13,003 | 1.27 |
| Chronic Lung Disease (CLD) | 181,238 | 0.90 | 161,335 | 0.85 | 19,903 | 1.95 |
| Dehydration (DHYD) | 90,238 | 0.45 | 77,177 | 0.40 | 13,061 | 1.28 |

SOURCE: RTI analysis of 1999 MCBS and 1999/2000 Medicare hospital claims data.

**Exhibit 4-7**
**Selected Correlations among Potential Independent Variables for Regression Modeling of Likelihood of Admission for an Ambulatory Care Sensitive Condition for Respondents to the 1999 Medicare Current Beneficiary Survey**

**Health Status**

| | Self-rated health status | ADL ( 2 or more limitations) | Count of medical conditions |
|---|---|---|---|
| Self-rated health status | 1 | 0.30 | 0.36 |
| ADL ( 2 or more limitations) | 0.30 | 1 | 0.21 |
| Count of medical conditions | 0.36 | 0.21 | 1 |

**Insurance Coverage**

| | DUAL enrollee | Supplement insurance | Prescription drug coverage |
|---|---|---|---|
| Medicaid Enrollee | 1 | -0.52 | 0.29 |
| Supplement insurance | -0.52 | 1 | 0.09 |
| Prescription drug coverage | 0.29 | 0.09 | 1 |

**Access to Care**

| | Reluctance to seek care | Regular source of care | Unmet need |
|---|---|---|---|
| Reluctance to seek care | 1 | -0.05 | 0.10 |
| Regular source of care | -0.05 | 1 | -0.03 |
| Unmet need | 0.10 | -0.03 | 1 |

NOTES:
All correlations were significant at the 1% level except for Prescription Drug Coverage and Medicaid enrollee. ADL and Count of Conditions are not estimated in the same manner for facility and community residents.

SOURCE: RTI analysis of 1999 MCBS and 1999/2000 claims data.

## Exhibit 4-8
## Multivariate Analysis of Likelihood of Hospitalization in 2000 for Respondents to the 1999 Medicare Current Beneficiary Survey for Three Ambulatory Care Sensitive Conditions

| | Probability having a CHF Hospitalization | | Probability having a CLD Hospitalization | | Probability having a DHYD Hospitalization | |
|---|---|---|---|---|---|---|
| | Odds Ratio | P value | Odds Ratio | P value | Odds Ratio | P value |
| Age (vs age 65-74) | | | | | | |
| 75-84 | 1.63 | 0.02 | 1.17 | 0.51 | 1.85 | 0.17 |
| 85+ | 3.18 | 0.00 | 0.59 | 0.23 | 2.44 | 0.09 |
| Race (White=1) | 1.21 | 0.48 | 0.85 | 0.60 | 0.70 | 0.44 |
| Sex (Male =1) | 1.04 | 0.86 | 0.81 | 0.55 | 1.33 | 0.44 |
| Education (Some college or higher=1) | 0.78 | 0.22 | 1.10 | 0.72 | 0.58 | 0.17 |
| Income (vs under $10,000) | | | | | | |
| $10,000-$25,000 | 1.36 | 0.25 | 0.87 | 0.74 | 1.75 | 0.31 |
| $25,001-$50,000 | 1.50 | 0.10 | 1.46 | 0.24 | 1.03 | 0.96 |
| >$50,000 | 0.93 | 0.82 | 0.76 | 0.47 | 0.96 | 0.95 |
| Marital Status (Married=1) | 0.72 | 0.19 | 0.68 | 0.29 | 0.37 | 0.08 |
| Marital Status*Sex | 1.02 | 0.95 | 1.75 | 0.25 | 0.75 | 0.67 |
| Self-rated Health Status (vs Excellent) | | | | | | |
| Very Good | 2.34 | 0.08 | 1.65 | 0.43 | 1.28 | 0.70 |
| Good | 4.37 | 0.00 | 4.39 | 0.01 | 0.62 | 0.40 |
| Fair/Poor | 5.55 | 0.00 | 6.80 | 0.00 | 1.08 | 0.88 |
| Dual enrollee | 1.68 | 0.14 | 1.81 | 0.13 | 0.58 | 0.26 |
| Have supplemental insurance | 1.26 | 0.44 | 0.56 | 0.03 | 0.54 | 0.20 |
| Have prescription drug coverage | 0.97 | 0.85 | 1.11 | 0.69 | 1.33 | 0.39 |
| Have regular source of care | 2.73 | 0.11 | 3.07 | 0.13 | 0.61 | 0.53 |
| Urban residence | 1.05 | 0.83 | 1.35 | 0.22 | 1.65 | 0.33 |
| Months of enrollment in FFS 2000 | 0.96 | 0.19 | 1.04 | 0.51 | 0.83 | 0.00 |
| 1999 admission for ACSC | 15.41 | 0.00 | 38.22 | 0.00 | 24.02 | 0.00 |
| Number of observations (unweighted) | 8,600 | | 8,600 | | 8,600 | |
| Pseudo R-Square | 0.14 | | 0.20 | | 0.15 | |

SOURCE: RTI analysis of 1999 MCBS and 1999/2000 claims data.

## Exhibit 4-9
## Multivariate Analysis of Likelihood of Hospitalization in 2000 for Respondents to the 1999 Medicare Current Beneficiary Survey residing in the Community for Three Ambulatory Care Sensitive Conditions

| | Probability having a CHF Hospitalization | | Probability having a CLD Hospitalization | | Probability having a DHYD Hospitalization | |
|---|---|---|---|---|---|---|
| | Odds Ratio | P value | Odds Ratio | P value | Odds Ratio | P value |
| Age (vs age 65-74) | | | | | | |
| 75-84 | 1.53 | 0.04 | 1.17 | 0.51 | 1.30 | 0.53 |
| 85+ | 3.03 | 0.00 | 0.62 | 0.31 | 1.98 | 0.18 |
| Race (White=1) | 1.05 | 0.86 | 0.78 | 0.46 | 0.80 | 0.65 |
| Sex (Male =1) | 1.06 | 0.83 | 0.81 | 0.59 | 1.08 | 0.86 |
| Education (Some college or higher=1) | 0.78 | 0.29 | 1.04 | 0.89 | 0.52 | 0.12 |
| Income (vs under $10,000) | | | | | | |
| $10,000-$25,000 | 1.19 | 0.54 | 0.87 | 0.80 | 1.43 | 0.61 |
| $25,001-$50,000 | 1.25 | 0.32 | 1.55 | 0.23 | 0.71 | 0.52 |
| >$50,000 | 0.74 | 0.33 | 0.80 | 0.60 | 0.60 | 0.44 |
| Marital Status (Married=1) | 0.77 | 0.33 | 0.81 | 0.60 | 0.34 | 0.05 |
| Marital Status*Sex | 0.90 | 0.80 | 1.47 | 0.47 | 0.83 | 0.78 |
| Self-rated Health Status (vs Excellent) | | | | | | |
| Very Good | 1.97 | 0.16 | 1.52 | 0.51 | 0.91 | 0.89 |
| Good | 3.07 | 0.01 | 3.47 | 0.04 | 0.49 | 0.20 |
| Fair/Poor | 2.87 | 0.02 | 4.00 | 0.03 | 0.90 | 0.86 |
| Count of Medical Conditions | 1.34 | 0.00 | 1.24 | 0.00 | 1.26 | 0.00 |
| Dual enrollee | 1.62 | 0.22 | 2.09 | 0.10 | 0.40 | 0.07 |
| Have supplemental insurance | 1.30 | 0.42 | 0.58 | 0.06 | 0.58 | 0.32 |
| Have prescription drug coverage | 1.09 | 0.66 | 0.92 | 0.76 | 0.77 | 0.45 |
| Urban residence | 1.05 | 0.84 | 1.53 | 0.11 | 1.49 | 0.43 |
| Months of enrollment in FFS 2000 | 0.94 | 0.09 | 1.02 | 0.74 | 0.88 | 0.01 |
| Reluctance to seek care[1] | 1.37 | 0.07 | 0.89 | 0.67 | 1.02 | 0.95 |
| Length of association with usual source of care (vs no usual source) | | | | | | |
| Less than 1 year | 1.92 | 0.22 | 1.43 | 0.65 | 0.39 | 0.34 |
| More than 1 year but less than 3 years | 1.93 | 0.18 | 0.71 | 0.67 | 0.56 | 0.52 |
| More than 3 year but less than 9 years | 1.90 | 0.15 | 0.91 | 0.90 | 0.62 | 0.54 |
| More than 10 years | 1.79 | 0.20 | 0.65 | 0.57 | 0.42 | 0.30 |
| Unmet Need[2] | 1.29 | 0.39 | 1.07 | 0.88 | 0.55 | 0.42 |
| 1999 admission for ACSC | 11.32 | 0.00 | 36.87 | 0.00 | 26.69 | 0.00 |
| Number of observations (unweighted) | 8,240 | | 8,240 | | 8,240 | |
| Pseudo R-Square | 0.18 | | 0.21 | | 0.16 | |

[1]This variable is created by combining responses to four variables on attitude towards seeking care. These include worring about health, delaying or avoiding obtaining care or going to the doctor. If more than two of the reponses was positive then the reluctance to seek care is coded as 1.

[2] Unmet Need is coded as 1 if either beneficiary delayed care due to cost or did not fill a prescription medication

SOURCE: RTI analysis of 1999 MCBS and 1999/2000 claims data.

# CHAPTER 5
# MULTIVARIATE ANALYSIS OF MARKET CHARACTERISTICS ON RATES OF HOSPITALIZATION FOR THREE AMBULATORY CARE SENSITIVE CONDITIONS

## 5.1 Overview

This chapter examines the association between geographic or market-level supply and demand factors and market-level rates of three ambulatory care sensitive conditions (ACSCs). Chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), and lower limb peripheral vascular diseases (PVD) among Medicare FFS beneficiaries are examined for two time periods: mid nineties and latter nineties. Markets are defined using the 306 Hospital Referral Regions from the Dartmouth Atlas Project.[2] A spatial regression model allows us to control statistically for unmeasurable quality, practice style, or health seeking behavior within markets, reducing potential omitted variables bias. We estimate the ecological model on data from two separate cross sections to assess whether the effects of factors changed over time. We can, thus, indirectly examine the influence of two recent policy initiatives (implementation of home health and SNF payment reform) on the market rate of ACSC hospitalizations, by examining whether the association between SNF or home health care availability in the market (with ACSC hospitalization rates) changed from the period before to the period after policy reforms were implemented.

*Policy Reforms*

Within the timeframe covered by our market-level variables (1995-2000), we can identify two important policy changes resulting from the Balanced Budget Act (BBA) that could impact ACSC hospitalization rates. In 1998, the Skilled Nursing Facility (SNF) payment policy was changed from a limited cost basis per diem system to a case mix adjusted per diem prospective payment system. If SNF providers view the payment rates for selected ACSCs, such as CHF or COPD, as being too low relative to the costs of care, then one might observe a decline in the number of SNF admissions for this type of patient and a shift to alternate providers, like home health care. Given that home health providers are not able to provide the same level of care as their counterparts in a SNF setting, one might subsequently observe a decline in health status leading to higher rates of hospital readmissions than otherwise would have occurred if the patient had been received in a SNF.

The second policy change in 1998 that could impact ACSC hospitalization rates was the change in the home health interim payment system. This system establishes agency-specific limits on the per-case payment amount based on an agency's historical average per patient expenditure. If agencies historically had low total episode costs, limits on per-case payments might be quite restrictive. Thus, these agencies might face strong disincentives to accept cases

[2] Hospital Referral Regions (HRRs) were constructed by the Dartmouth Atlas researchers in order to establish the geographic boundaries of naturally occurring health care markets in the United States for use in small area spatial analysis. These areas were defined using patient ZIP Codes from 1995 and 1996 Medicare claims data. 306 hospital referral regions (HRRs) were defined on the basis of where Medicare patients were hospitalized for major cardiovascular surgical procedures and neurosurgery, markers for regionalization. See explanation of methods at the Dartmouth Atlas Project website: http://www.dartmouthatlas.org/faq.php

that are predicted to have high total expenditures given their expected payment rate. Access to home health may subsequently be restricted for treatment of some ACSCs, leading to a higher rate of hospitalization for these conditions.

*Previous Literature and Conceptual Model*

Studies have identified several factors that may impact the rates of hospital admissions for ACSCs. Factors such as the aging of society, growth in out-of-pocket spending, an increasing level of frailty in the elderly, and enrollment in or disenrollment from managed care can impact rate of hospitalizations for ACSCs (Culler et al, 1998; Kozak et al, 2001; Call et al, 2001). Having a regular source of care and continuity of care has been shown to significantly reduce the likelihood of hospitalizations and ER visits for ACSCs (Falik *et al.*, 2001; Gill and Mainous, 1998). Limited access to care, such as living in an area with a shortage of health professionals or being uninsured can lead to higher ACSC hospitalization rates. In particular, studies have found that local primary care provider availability is inversely associated with rates of hospitalization for ACSCs in children and non-elderly populations (Basu, Friedman, and Burstin, 2002; Parchmand and Culler, 1994). We have found no studies besides this one that examine whether physician availability is associated with ACSC hospitalization rates among the elderly.

Socioeconomic status and race have been found to influence ACSC hospitalization rates (Shi *et al.*, 1999; Cable, 2002; 1993; Blustein *et al.*, 1998; Weissman *et al.*, 1992; Asch *et al.*, 2000; Djojonegoro *et al.*, 2000; Schreiber and Zielinski, 1997; Culler *et al.*, 1998; Call *et al.*, 2001). Also, among non-elderly populations, ACS hospitalizations (aggregated over 23 medical conditions) have been found to be greater and to exhibit more variability among low-income zipcodes in New York State, with considerable persistence over time (DeLia, 2003). In New York, higher hospitalization rates were found in more populous zipcodes and those with greater proportions of Black or Hispanic populations. DeLia's findings suggest that there is a chronic public health problem in New York among the non-aged population, with deficiency in primary ambulatory care geographically-focused in the most underserved neighborhoods.

Several other studies have examined the associations between ACSC hospitalization rates and demographics at the small area of analysis (typically zipcode), finding that ACSC hospitalization rates are higher in low-income areas and areas with higher concentrations of racial/ethnic minorities (Billings et al., 1993; Billings, Anderson, and Newman, 1996; Pappas et al, 1997). The elderly population has not been studied much in this context, because they are thought to be relatively well-insured. However, Billings, Anderson, and Newman (1996) found that socioeconomic class is important even among the insured populations. Billings, Anderson, and Newman concluded that barriers to access to ambulatory care may extend beyond affordability to other factors, such as transportation or knowledge about how to engage the healthcare system. In this context, recent concern about shortages of primary care physicians for Medicare beneficiaries, high turnover rates among the elderly in Medicare managed care plans, and rising rates of Medicare ACSC hospitalizations has sharpened focus on the Medicare population.

*ACSC Hospitalizations as Markers of Healthcare Access*

The use of hospitalization rates for ambulatory care sensitive conditions (ACSCs) has become an established tool for analyzing access to care (Weissman, Gatsonis, and Epstein, 1992; Perrin, Homer, Berwick, et al., 1989; Bindman, Grumbach, Osmond, et al., 1995; Millman, 1993). If treated in a timely fashion with adequate primary care and managed properly on an outpatient basis, medical practitioners broadly concur that in most instances commonly defined hospital admissions for ACSCs should not advance to the point where hospitalization is required. A key implication emerges from this literature:

- Because lack of primary care for ACSCs does, in fact, often result in hospitalizations, the rate of ACSC inpatient admissions provides a practical way of evaluating primary care delivery and thereby identifying and targeting places where it may be possible to improve access and quality in the health care delivery system.

In the work we present here, we assess whether targeted interventions might be possible, after consideration of the spatial distribution of ACSC hospitalization rates. Targeting interventions to certain regions would be an efficient mechanism for improving outcomes while conserving resources.

The conceptual model (***Exhibit 5-1***) that guides our thinking about ACSC hospitalizations defines access as a spatial problem. This is the Khan and Bhardwaj model (Khan and Bhardwaj, 1994), which builds on the classic Aday-Anderson model (1974), and has been adopted by the World Health Organization as a valid model of accessibility and healthcare utilization (WHO, 2000). The Khan and Bhardwaj model employs a distinctly spatial view of human interaction with the environment and other structural and social aspects of the health care system, along the more and less accessible paths to healthcare utilization.

The spatial model considers characteristics of the person (demand/propulsion factors), characteristics of the chosen facility or provider (supply/attraction factors), and intervening environmental factors that can impact travel to or utilization of health facilities (transportation systems and traffic congestion, climate, safety, distance to facilities ). These intervening environmental variables reflect transaction costs for consumers, adding time and travel cost to distance as a measure of impedance. These impedance factors are often the most difficult to measure and include as factors in empirical studies. In the literature reviewed above, several important variables (such as income and socioeconomic status, frailty) may serve as proxies for travel cost impedance factors.

Another difficult-to-measure factor that may impact patterns of utilization is overall efficacy in the healthcare system. Wennberg, Fisher, and Skinner (Wennberg *et al*., 2001) used area-wide HEDIS® scores (defined for Medicare managed care plans) to measure effective practices, and found considerable geographic variation in these scores. They posited that this variation across regions is due to lack of infrastructure to ensure compliance with evidence-based standards of practice. The necessary infrastructure might include readily accessible preventive care services and health promotional services that increase individual compliance with prescribed treatments, health screening, and other healthy behaviors. Better efficacy in a region

is expected to be negatively correlated with ACSC hospitalization rates, as patients participate better in preventive care that enables them to avoid hospitalization.

The biggest challenge in this approach is accounting for difficult to measure factors, such as transportation impedance, quality, efficacy, and severity of disease mix in the market regions. Severity factors are at least partially captured with measures aggregated up from the beneficiary data, such as proportion of the elderly who have diabetes, have end-stage renal disease, or are over 80 years of age. Transportation impedance is expected to be positively correlated with poverty and dual-enrollment status (dual Medicare and Medicaid enrollees are lower income and often disabled), and health markets (HRRs) with a wider geographic spread in terms of land mass and lower population density pose longer commutes but with less harried conditions. Thus, the only variable we cannot capture well is efficacy of the local healthcare system. Following the literature on knowledge externalities, we expect that more efficacious practices would spread to nearby communities, thus an empirical specification that captures these spillovers would be appropriate. We employ the spatial lag econometric model used by Anselin, Varga, and Acs (1997) in their study of knowledge spillovers from universities to the private R&D sector. This model has been used in several published studies where spatial spillovers are present in the data.[3] The empirical methods are described below following a description of the data and analytic file construction.

## 5.2 Data and Analytic File Construction

The study population consists of all Medicare FFS beneficiaries age 65 and older, enrolled in Medicare Parts A and B for a full year at any time during 1995-2000. We identify three ACSCs of particular interest for the elderly population – PVD, CHF, and COPD. Lower limb peripheral vascular disease (PVD) was chosen because these hospital admission rates were relatively high among the diabetic population, and PVD had been targeted for quality improvement efforts by CMS Quality Improvement Organizations. PVD admissions accounted for 16.98 percent of diabetic patient admissions in 1992, falling to 13.21 percent of diabetic patient admissions in 2000. However, numbers of diabetic patients were increasing over time, and PVD is a condition striking both diabetics and other elderly, so when calculating the rates based on all beneficiaries, there was a slight increase in the rates of PVD admissions over time (**Chapter 3**). In this modeling, we define the ACSC rate as lower limb peripheral vascular disease hospitalizations for all Medicare FFS beneficiaries, rather than just for Medicare FFS beneficiaries with diabetes. Congestive Heart Failure (CHF) was the most common cause of admission among the ACSCs studied in 1992 and CHF hospitalization rates remained stable over the nineties (22.7 per 1,000 beneficiaries in 1992, 22.9 per 1,000 beneficiaries in 2000; **Chapter 3**). Chronic Obstructive Pulmonary Disease (COPD) patients presented modest rates of hospitalization in 1992 (7.6 per 1,000 beneficiaries) but rates increased over the period (11.6 per

[3] Examples of published studies using spatial spillovers include models of adoption of innovation among farmers (Case, 1992), knowledge spillovers on R&D from university research (Anselin, Varga, and Acs, 1997), budget spillovers and fiscal policy interdependence (Case, Rosen, and Hines, 1993), strategic interaction among cities in the choice of growth controls (Brueckner, 1998), property tax competition and welfare competition (Brueckner and Saavedra, 2001; Saavedra, 2000), and competitive pricing interactions among neighboring hospitals (Mobley, 2003).

1,000 beneficiaries in 2000), and there were high rates of emergency room and observation bed encounters for COPD, suggesting potential acute access problems (**Chapter 3).**

The analysis in this chapter is a market-level analysis, where we aim to discover characteristics of places that are associated with higher or lower ACSC hospitalization rates. We aggregated the ACSC hospitalizations over relevant markets to construct market-level rates to use as the dependent variable in our analysis. We aggregated over 3-year intervals (1995-1997; 1998-2000) to construct 3-year rates of hospitalizations. Details on the construction of these rates, including their component ICD-9 codes, are found in ***Appendix A-2***.

We define Hospital Referral Regions (HRRs) as the relevant markets because they reflect actual flows of patients within regions (which often cross state boundaries). Defining the units of observation in this way recognizes that the patterns of health care utilization and outcomes have an explicitly geographic configuration which defines the relevant market. The HRRs are composed of several to many counties, and vary widely across the U.S. in terms of geographic span and urban composition of the component counties. For example, some HRRs are entirely composed or urban counties (45), while some others are totally composed of rural counties (15). The largest group of HRRs (246) is composed of a mixture of urban and rural counties. HRRs vary widely in size – the smallest spanning 53 square miles, while the largest spans 342,437 square miles and the average size is 10,733 square miles.

Explanatory variables include both beneficiary demographics and supply and demand conditions in the HRRs. Beneficiary data are available by zipcode of residence, so aggregation to HRRs is straightforward (HRR boundaries are based on zipcode coverages). However, the market supply and demand variables to use as factors in the regression models are from the Area Resource File (ARF), defined as counts of available facilities, services, and personnel, and poverty rates among the elderly, by county. The geographic boundaries of the HRRs do not match up with U.S. county boundaries, and many counties in the U.S. are divided unequally between two or more HRRs. To use the county-level data in the analysis, it was first necessary to create an index file containing a list of the 306 HRRs and the proportion of each county's population contained in the HRR. An example of the index file is presented in ***Exhibit 5-2***. Notice that often a FIPS code shows up more than once, indicating a county that is split between more than one HRR. More details about this geocoding are in ***Appendix A-3***.

The county proportion was then used as a weight to assign the portion of a county's total counts of facilities, etc. to the overlapping HRR. The portion assigned is the portion that would occur if the spatial arrangement of facilities were based on population size or density, which is a reasonable assumption. If a county were wholly inside an HRR, then all facility counts would be attributed to the HRR (the weight would be 1 in this case). Once these adjusted county counts are assembled, they are then summed to produce HRR-level counts of facilities, services, personnel, etc. For variables expressed as proportions (occupancy rates, managed care penetration rates, poverty rates) the numerators and denominators were aggregated separately, then the sums were used in constructing the HRR-level ratios.

**Data and Data Sources**

The primary data source for the supply variables was the Area Resource File (various years) which contains data from the American Hospital Association, the American Medical Association, CMS Provider of Service (OSCAR) files, and others. Geographic boundary files were acquired from ESRI and from the Dartmouth Atlas Website. Medicare beneficiary data were acquired from CMS. ***Exhibit 5-3*** describes the explanatory variables and their sources.

## 5.3 Model Specification and Results

In our multivariate analysis, we include factors found to be associated with ACSCs in the literature (***Section 5.1***), and use a spatial regression model to help control for omitted practice style, quality, or health-seeking behaviors that are characteristic of the HRR regions. In our analysis, we aim to answer two research questions:

1. *What is the direction of linear association between selected market-level supply or demand factors and the market-area rates of ACSC admissions?*

2. *Was there any change in the associations over the mid to latter nineties, a time during which two new Medicare payment policies took effect?*

Supply and demand factors that may be captured with market level variables include: market area supply of health professionals, healthcare services, or hospital beds; managed care penetration; poverty among the elderly; and disease severity and demographic characteristics of the beneficiary population. These factors have been found important in published studies as described in ***Section 5.1***. We are not aware of any studies that attempt to assess the extent of knowledge spillovers in the efficacy of health care practices, which is a unique contribution of this study. Ignoring these spillovers (i.e. estimating the model using ordinary regression) may lead to biased and inefficient parameter estimates (Anselin and Bera, 1998). The spatial lag econometric model described next correctly specifies the empirical model and leads to robust, consistent parameter estimates. With these estimates in hand, we then compare estimates from the early period (before reforms took place) to estimates in the later period and assess whether any observed changes are consistent with expected effects from the reforms.

If rates of ACSC in one region are comparable to those in nearby regions because of underlying constraints, practices, or conditions in the healthcare markets that cannot be measured directly, but nevertheless affect outcomes in adjacent regions due to spillover effects, then the spatial lag model is appropriate. Styles of medical practice as well as health seeking behaviors themselves, may have regional manifestations. When the market units of analysis (here the HRRs) are smaller than the regional manifestations of these behaviors, then spillovers across regions are observed. In this model, rates in region $i$, $R_i$, are in part determined by rates in adjacent regions, $R_j$, $j \neq i$, in a spatial spillover process. Because each region is adjacent to several other regions, these spillovers are simultaneous - so $R_j$ is endogenous, which should be accounted for in estimation. This is accomplished by using a set of spatial weights that

characterize the interdependencies among contiguous HRRs within a spatial lag model (Anselin and Bera, 1998; Mobley, 2003). The model may be written:

(1) $R_i = \rho\sum_{j\neq i} w_{ij}R_j + x_i\beta + u_i$

where the $w_{ij}$, $j\neq i$ represent the set of weights that aggregate the ACSC hospitalization rates in neighboring regions into a single "regional ACSC" variable, which has a scalar coefficient $\rho$, measuring the strength of spatial spillovers. With proper specification of the weights matrix, $\rho$ ranges between -1 and +1, with positive values reflecting copy-cat behavior and negative values representing contrary behavior among adjacent HRRs. For medical practice efficacy spillovers, we would expect $\rho$ to be positive.

The spatial weights matrix $w_{ij}$ can define neighbors in many ways: as a specific set (i.e., as "k nearest neighbors"), or based on contiguity or distance bands, distance decay, or other measures. The appropriate specification will depend upon the particular scope and type of interaction present in the data. In our model, we estimated several specifications of closest neighbors (2 closest, 4, 6, 8, 10) and found that 6 closest is best for CHF and COPD, while PVD exhibits 2 closest spillovers (at most), a much more localized process. The vector $\beta$ contains coefficients of supply, and demand factors, and the error term $u_i$ is assumed to be homoskedastic, normal, and independent across observations/locations. ***Exhibit 5-4*** provides variable names, descriptions, and sample statistics.

### 5.4 Empirical Results

***Exhibit 5-5*** contains the empirical results, including only the statistically significant effect estimates. The single most important finding is that poverty was found to be significantly and positively associated with COPD and CHF hospitalization rates, almost doubling in size of association over the two periods. COPD and CHF hospitalization rates were increasingly higher over time in HRRs with higher rates of elderly in poverty. Moreover, these HRRs are regionally clustered, as illustrated in the map in ***Exhibit 5-6***, where we display COPD and CHF hospitalization rates summed over 1998-2000, plotted against the proportion of the elderly in poverty, in a bivariate display. The black regions along the Southern Appalachias are HRRs where high poverty rates and high ACSC hospitalization rates coincide.

Other key findings in ***Exhibit 5-5*** may be summarized as follows:

- Beneficiary characteristics aggregated to HRR regions had stronger associations with rates of ACSC hospitalizations than did supply factors.
  - Three proxies of health status – the proportion of the Medicare population with diabetes or end-stage renal disease and the proportion that died – were strongly associated with rates of hospitalization for all three clinical conditions.
  - Places with a higher proportion of ESRD patients also had lower rates of COPD (or conversely).

  - The rates of hospitalization for COPD and CHF were negatively associated with the proportion of the elderly greater than age 80 suggesting that places with higher proportions of the oldest-old also had lower COPD and CHF admission rates. This finding most likely reflects the enclaves of healthier elderly who have settled in retirement communities (Florida, California, and Arizona).

  - Places with higher proportions of elderly Blacks showed negative associations with PVD and COPD hospitalization rates.

  - Gender composition and dual enrollment in Medicare and Medicaid were not associated with ACSC hospitalization rates.

- Availability and use of post-acute services were found to be correlated with hospitalization rates.

  - Availability of SNF facilities was positively associated with high rates of COPD and CHF hospitalization, before and after policy reforms.

  - Availability of hospital-based rehabilitation programs was lower in places with higher rates of COPD and CHF hospitalizations, before and after policy reforms for CHF and after reforms for COPD.

  - Supply of home health agencies was not associated with hospitalization for any of the three conditions; however rates of hospitalization for PVD were positively associated with number of home health visits.

- Occupancy rate in inpatient hospitals was positively associated with PVD hospitalization rates in the early period, and negatively associated with CHF hospitalization rates in the later period, with no other significant associations found.

- Places with high COPD and CHF hospitalization rates were regionally clustered, while places with high PVD hospitalization rates were not clustered.

- HRRs with greater Medicare managed care penetration also had lower COPD hospitalization rates in the later period, but no significant associations were found for other periods or conditions. This is interesting because Medicare managed care payment rates were reduced in many areas in 1998, which might have affected the Medicare managed care sector, with secondary effects on the FFS sector resulting from disenrollment of sicker beneficiaries from managed care. Our results suggest no negative impacts from Medicare managed care payment reform on the FFS ACSC rates.

- State-level variables did not exhibit strong associations with ACSC rates, but there were some interesting observations. Places with higher HMO penetration in the private market show lower PVD and COPD hospitalization rates in the early period. Places where higher proportions of the population ‘didn’t visit a doctor because of cost’ showed positive association with COPD hospitalization rates in the later period,

where places with higher proportions of the elderly holding supplemental insurances (held in addition to traditional Medicare) show lower COPD hospitalization rates in the early period.

- The numbers of physicians and registered nurses, and the statewide measure of physician shortage, were surprisingly insignificant in these models. Other supply variables such as hospital services and other post-acute care services were also surprisingly silent. Other variants of the empirical model with providers per capita, with and without controls for state-level utilization and HRR size, did not improve the explanatory power of these variables.

In our empirical analysis, we assessed whether the estimated association between availability of supply factors and ACSC hospitalization rates changed in the latter nineties, comparing periods before and after policy reforms. Our evidence found that the association between market factors and admission rates do vary over time, but that demographic factors are also important. We also found that ACSC hospitalization rates for CHF and COPD exhibit a significant degree of spatial autocorrelation, with similar rates exhibited in health markets (HRRs) and their contiguous neighbors. For PVD hospitalizations, there was little evidence of spatial autocorrelation across HRRs.

In comparison with the OLS results presented in **Chapter 3**, we found no changes in the sign of estimated relationships, but the OLS estimates were generally biased upward in magnitude, a consequence of spatial multiplier bias (Anselin, 2003). The fit of the model improved with the lag specification for two ACSCs (COPD and CHF) where the spatial lag parameter was highly significant. The spatial lag effect was positive for CHF and COPD hospitalization rates, suggesting that there are spillover effects among HRRs in unmeasured variables such as medical practice styles and/or health behaviors, such that these ACSC hospitalization rates are similar in adjacent HRRs. For COPD and CHF, the six-closest neighbor specification of spatial weights was the most significant among others estimated (2, 4, 8, 10, and 12 closest). For PVD, the two-closest neighbors specification was significant in the early period, but no spillovers were present in the later period. These findings suggest that spillovers in COPD and CHF hospitalization rates are regional in scope, spanning several adjacent HRRs, while PVD hospitalization rate spillovers are (at most) quite localized. These findings further suggest that policy interventions to reduce CHF and COPD hospitalization rates could be targeted to specific regions, while PVD hospitalizations are more randomly dispersed and less easily targeted.

**Exhibit 5-1**
**"Spatial Model of the Utilization of Healthcare Services" adapted from Khan and Bhardwaj (1994)**

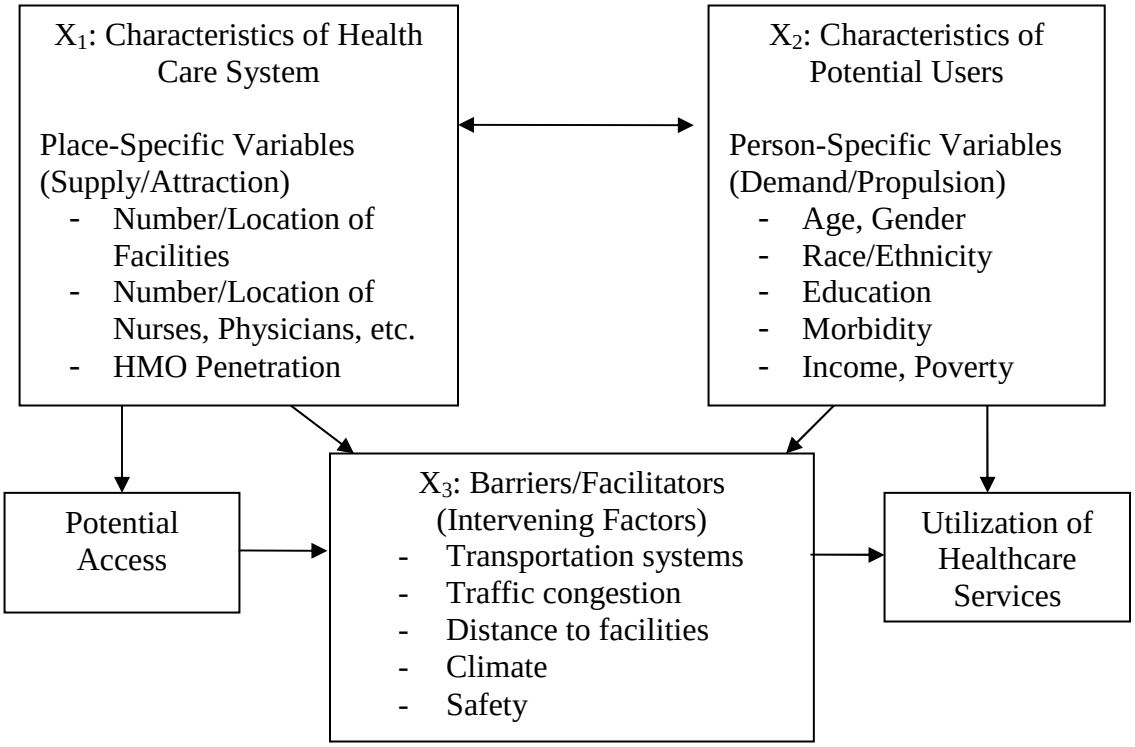


**Exhibit 5-2**
**Illustrative Example of HRR Code, FIPS Code and Proportion of each FIPS Counts Contained in Relevant Hospital Referral Regions (HRRs)**

| Dartmouth Atlas Project HRR | FIPS county code | Proportion of county's population in this HRR |
|---|---|---|
| 001 | 01001 | 0.043278148 |
| 007 | 01001 | 0.956721852 |
| 006 | 01003 | 0.959441655 |
| 134 | 01003 | 0.040558345 |
| 002 | 01005 | 1 |
| 001 | 01007 | 0.487179487 |
| 009 | 01007 | 0.512820513 |
| 001 | 01009 | 0.987398087 |
| 005 | 01009 | 0.012601913 |

**Exhibit 5-3**
**Data Used in the Analysis of Factors Associated with ACSC hospitalization Rates in Hospital Referral Region Markets**

| Original Source and description | Variables from source | Secondary Source/date |
|---|---|---|
| CMS' FFS Medicare Beneficiary Data | Proportion of elderly in the HRR who are: male, black, diabetic, have ESRD, dually eligible, who died, who are >80 years in age | CMS/RTI 1995-2000 |
| CMS Provider of Service (OSCAR) Database | Number of Skilled Nursing Facilities<br>Number of Skilled Nursing Facility Certified Beds<br>Number of Home Health Agencies<br>Number of Rural Health Clinics<br>Number of Hospices | ARF 1994, 1999 |
| CMS Medicare Managed Care Market Penetration File | M+C Penetration: Proportion of Medicare beneficiaries in Medicare managed care plans | ARF 1997, 2000 |
| AMA Physician Master File | Number of active, non-Federal MDs, in patient care | ARF 1995, 2000 |
| AHA County Hospital File | Number of FTE RNs, LPNs, and LVNs in short-term general hospitals and nursing homes | ARF 1996, 2000 |
| AHA County Hospital File | Number of short-term general hospitals with particular services including: rehabilitation care, assisted living, community outreach, home health services, meals on wheels, transportation to hospital | ARF 1996, 2000 |
| U.S. Census of Populations | Population size, population density, proportion of the population who are elderly (1997, 2000);<br>proportion of the elderly population in poverty (1989, 1999) | ARF 1997, 2000<br>1989, 1999 |
| AHA County Hospital File | Hospital occupancy rate, calculated as average number of annual inpatients per staffed bed | ARF 1996, 2000 |
| HRR boundary files, and the land mass spanned by each HRR | HRR files were built from analysis of Medicare patient flows to hospital using 1996 claims data; these are the most recent files available. | Dartmouth Atlas Project website |
| AARP data | State-level data on home health visits per beneficiary, SNF admissions, proportion of the population who didn't see a doctor because of cost, private HMO penetration, proportion of population who reported difficulty accessing a primary care provider, proportion of the elderly with supplemental insurance coverage(s). | AARP annual publication: *Reforming the Healthcare System: State Profiles* (1999, 2000, 2001) |

## Exhibit 5-4
## Variable Definitions and Sample Statistics for Market-Level Analysis

| Variable | Description | Mean | |
|---|---|---|---|
| | | Early | Late |
| **Dependent Variable: Three-year ACSC Hospitalization Rates, expressed per thousand Medicare FFS Beneficiaries**. | | | |
| CHF | Congestive heart failure | 26.92 | 27.9 |
| COPD | Chronic obstructive pulmonary disease | 15.34 | 17.3 |
| PVD | Lower Limb peripheral vascular disease among all Medicare FFS beneficiaries | 2.31 | 2.50 |
| **Supply, Demand, and Transportation Impedance Factors** | | | |
| POVERTY | Proportion of the elderly population in poverty, 1989, 1999 | 0.14 | 0.11 |
| M+C PENE | M+C Penetration of Medicare market, 1997, 2000 | 0.095 | 0.098 |
| OCC RATE | Hospital inpatient occupancy of staffed beds, 1996, 2000 | 0.608 | 0.615 |
| MD | Number of non-Federal, practicing MDs 1995, 2000 | 480 | 546 |
| RN | Number of FTE, hospital-based RNs, 1996, 2000 | 5990 | 6393 |
| SNF | Number of SNFs, 1994, 1999 | 80.8 | 95.3 |
| HHA | Number of HHAs, 1994, 1999 | 47.9 | 47.8 |
| HOSPICE | Number of Hospices, 1994, 1999 | 10.2 | 13.8 |
| RHC | Number of Rural Health Clinics, 1994, 1999 | 10.1 | 17.4 |
| OUTREACH | Number of Hospitals with outreach programs, 1996, 2000 | 15.46 | 16.5 |
| ASSIST | Number of Hospitals with assisted living programs, 1996, 2000 | 1.06 | 1.26 |
| REHAB | Number of Hospitals with rehabilitation programs, 1996, 2000 | 7.04 | 6.84 |
| TRANSPORT | Number of Hospitals with transportation to hospital | 7.30 | 7.41 |
| HOME | Number of Hospitals with home health services, 1996, 2000 | 14.06 | 11.3 |
| %ELDER | Proportion of county population who are elderly, 1997, 2000 | 0.130 | 0.128 |
| %black | Proportion of sample who are black, 1995, 1998 | 0.066 | 0.065 |
| %male | Proportion of sample who are male, 1995, 1998 | 0.40 | 0.40 |
| %aged (>80 ) | Proportion of sample who are > 80 years , 1995, 1998 | 0.27 | 0.29 |
| %diab | Proportion of sample who with diabetes, 1995, 1998 | 0.12 | 0.14 |
| %esrd | Proportion of sample who with End-Stage Renal Disease (ESRD), 1995, 1998 | 0.004 | 0.004 |
| %died | Proportion of sample who died, 1995, 1998 | 0.054 | 0.056 |
| %dual | Proportion of sample who are dually enrolled in Medicare and Medicaid, 1995, 1998 | 0.120 | 0.126 |
| **State-level Variables** | | | |
| XHMO | Proportion of the population in private HMOs (AARP) | 0.22 | 0.25 |
| NOVISIT | Proportion of the population who said they didn't visit a physician due to cost (AARP) | 10.69 | 10.68 |
| PVTINSUR | Proportion of the elderly with supplemental insurance (AARP) | 63.42 | 66.83 |
| MSHORT | Proportion of the population who reported problems accessing a primary care provider (AARP) | 5.61 | 10.53 |
| HHVISIT | Number of Home health visits per Medicare insured (AARP) | 70.34 | 41.08 |
| SNFADMIT | Number of Medicare admissions to SNFs (AARP) | 62.4 | 64.4 |

**Exhibit 5-5**
**Spatial Lag Model: Estimates of Linear Associations Between Market Factors and ACSC Hospitalization Rates in the Early (1995-1997) and Late (1998-2000) Time Intervals. (ACSC Hospitalization rates are expressed per thousand Medicare FFS beneficiaries.)**

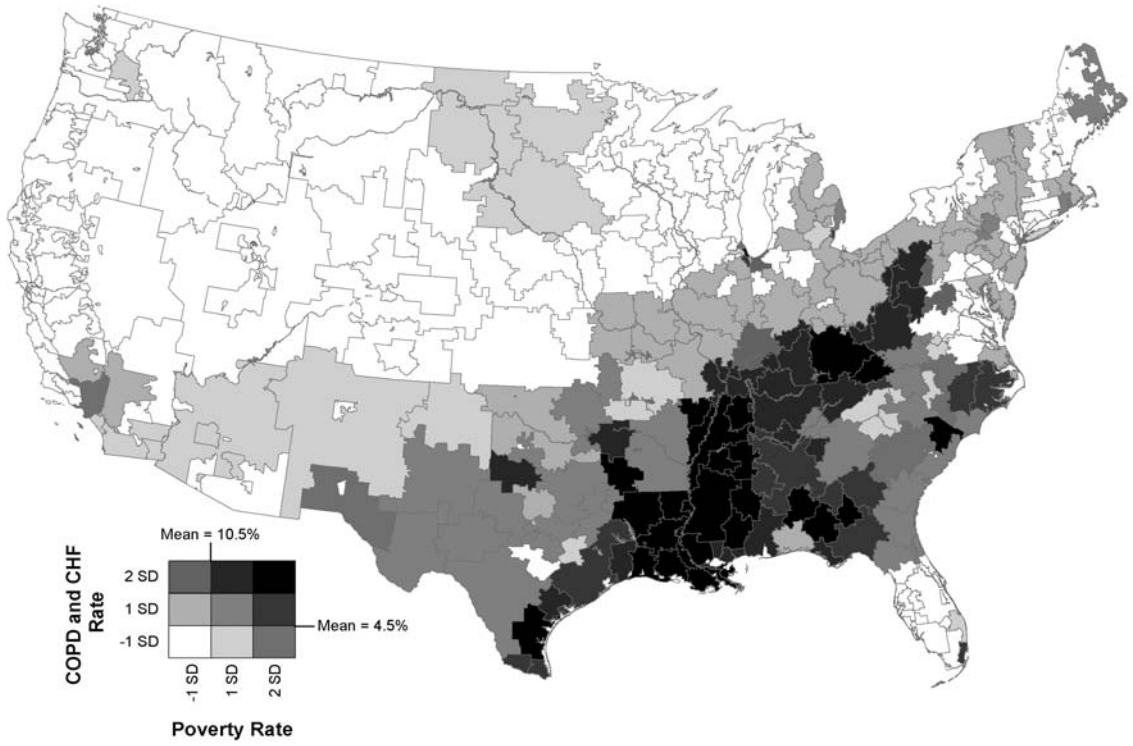
| | PVD | | COPD | | CHF | |
|---|---|---|---|---|---|---|
| Variable | Early | Late | Early | Late | Early | Late |
| Spatial Lag | 0.164 | | 0.515 | 0.527 | 0.421 | 0.449 |
| POVERTY | | | 21.7 | 44.7 | 20.22 | 38.0 |
| M+C PENE | | | | -4.5 | | |
| OCC RATE | 1.20 | | | | | -4.8 |
| MD | | | | | | |
| RN | | | | | | .0002 |
| SNF | | | 0.011 | 0.013 | 0.014 | 0.014 |
| HHA | | | | | | |
| HOSPICE | 0.025 | | | | | |
| RHC | | | | | | |
| OUTREACH | | | | | | |
| ASSIST | | | | | | |
| REHAB | | | | -0.09 | -0.12 | -0.09 |
| TRANSPORT | | | | | 0.12 | 0.081 |
| HOME | | | | | | |
| %ELDER | -0.019 | -3.11 | | 10.8 | | 8.24 |
| %BLACK | -3.10 | -4.30 | -12.9 | -10.8 | | |
| %MALE | | | | | | -14.7 |
| %AGED (>80 ) | | | -42.8 | -56.1 | -30.70 | -19.10 |
| %DIABETES | 19.6 | 23.3 | 24.2 | | 72.76 | 55.3 |
| %ESRD | 129.3 | 120.5 | -557.8 | 472.7 | | 644.9 |
| %DIED | | | 446.1 | 472.7 | 497.3 | 418.6 |
| %DUAL | | | | | | |
| HHVISIT | 0.006 | 0.014 | | | | |
| SNFADMIT | | | | | | |
| NOVISIT | | | | 0.216 | | |
| PVTINSUR | | | -0.05 | | | 0.168 |
| MDSHORT | | | | -0.104 | | |
| XHMO | -1.16 | | -5.0 | | | |
| Adjusted Rsq | 45.5% | 43.8% | 67.3% | 72.4% | 79.7% | 81.8% |
| *Sample size* | 306 | 306 | 306 | 306 | 306 | 306 |

NOTES:

The unit of analysis is the proportion of Medicare FFS beneficiaries with a hospitalization for each ACSC under consideration, aggregated over three years to the HRR market level (306 regions, including Alaska), for two periods: early (1995-1997) and late (1998-2000), expressed in thousands of beneficiaries. Factors significant at the $p<0.10$ level are represented in the table. Other variables included in the regressions but not reported here for brevity: total population, population density, total land area in HRR, and categorical variables reflecting HRRs that are composed entirely of urban, or entirely of rural, counties.

SOURCE: RTI Analysis of 1995-2000 MedPAR Data.

**Exhibit 5-6**
**Three-year Rates (1998-2000) of Combined CHF and COPD Hospitalization Rates and Poverty Rates Among the Elderly (1999)**



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## APPENDIX A-1
## SUMMARY OF AMBULATORY CARE SENSITIVE CONDITION LITERATURE

**Appendix Table A-1**
**Summary of Ambulatory Care Sensitive Condition Literature**

| | ACSC | Source[1] | Population Studied | Sample[2] | Coding[3] |
|---|---|---|---|---|---|
| | **CHRONIC CONDITIONS:** | | | | |
| 1. | Angina | Billings[4] | Under Age 65 | | 411.1, 411.8, 413 and no procedure |
| | | Blustein | Aged Medicare Beneficiaries | 9.4/1000 | 411.1, 411.8, 413 and no procedure |
| | | Culler | Aged Medicare Beneficiaries | 8.1/1000 | 411.1, 411.8, 413 |
| | | DHCFP | Under Age 65 | | 411.1, 411.8, 413 |
| | | IOM[5] | Under Age 65 | 0.47/1000 | 411.1, 411.8, 413 and no procedure |
| | | Krakauer | Medicare Beneficiaries | (0.63-1.71)/1000 | 411.1, 411.8, 413 and no procedure |
| | | Schreiber | Under Age 65 | | 411.1, 411.8, 413 and no procedure |
| | | Epstein | VA 1995-1997<br>a) Low-Income and Elderly (payer source = Medicare (over 65 years only), Medicaid, self-pay, indigent/charity, or government<br>b) All discharges | Share of PH:<br>a) 3.4%<br>b) 4.0% | 411.1, 411.8, 413 |
| | | Gaskin | All inpatient discharges from AZ, CA, FL, MA, MO, NJ, NY, PA, SC, VA (excludes obstetric and mental health discharges) | Share of all d/c = 0.87%<br>Share of PH conditions = 4.82% | No info |
| | | Ricketts | NC 1993-1994 | Share of PH d/c = 8.5% | 411.1, 411.8, 413 (exclude cases with procedure 01-86.99) |
| 2. | Asthma | Billings | Under Age 65 | | 493 |
| | | Bindman | Under Age 65 | | |
| | | Blustein | Aged Medicare Beneficiaries | 1.6/1000 | 493 |
| | | Culler | Aged Medicare Beneficiaries | 0.0/1000 | 493 |

**Appendix Table A-1 (continued)**
**Summary of Ambulatory Care Sensitive Condition Literature**

| ACSC | Source[1] | Population Studied | Sample[2] | Coding[3] |
|---|---|---|---|---|
| Asthma (continued) | DHCFP | Under Age 65 | 1.53/1000 | 493 |
| | IOM | Under Age 65 | (0.94-5.44)/1000 | 493 |
| | Krakauer | Medicare Beneficiaries | | 493 |
| | Pappas | All Age groups | 6.70% | 493 |
| | Schreiber | Under Age 65 | | 493 |
| | Shukla | All Age Groups | | 493.00, 493.01, 493.10, 493.11, 493.20, 493.21, 493.90, 493.91 |
| | Silver | Aged Medicare Beneficiaries | 3.70% | 493 |
| | Solberg | All Age Groups | 20.40% | |
| | Weisman | Under Age 65 | 17.69/1000 | 493 |
| | Wissow | Under Age 19 | | 493 |
| | Epstein | VA 1995-1997<br>a) Low-Income and Elderly (payer source = Medicare (over 65 years only), Medicaid, self-pay, indigent/charity, or government | Share of PH:<br>a) 0.1% of Preventable hospitalizations<br>b) 0.4% | |
| | | b) All discharges | Share of d/c = 0.13% | |
| | Gaskin | All inpatient discharges from AZ, CA, FL, MA, MO, NJ, NY, PA, SC, VA (excludes obstetric and mental health discharges) | Share of PH conditions = 0.70% | No info |
| | Fiore | All inpatient discharges from WI | 1990-1992 = 0.134%<br>1996-1998 = 0.121% | 493 as primary diagnosis |
| | | Age >65 | 1990-1992 = 0.179%<br>1996-1998 = 0.126%<br>Share of PH d/c = 12.3% | |
| | Guo | All inpatient discharges for Cincinnati residents (1994-1996), excludes obstetric and mental health discharges) | Share of PH d/c = 8.9% | 493 |

**Appendix Table A-1 (continued)**
**Summary of Ambulatory Care Sensitive Condition Literature**

| | ACSC | Source[1] | Population Studied | Sample[2] | Coding[3] |
|---|---|---|---|---|---|
| | Asthma (continued) | Ricketts | NC 1993-1994 | | 493 |
| | | Kozak | National Sample over age 65, 1998 | 1.77/1000 | 493 |
| 3. | Chronic Obstructive Pulmonary Disease (COPD) | Billings | Under Age 65 | | 491, 492, 494, 496, or 466.0 with a secondary diagnosis of 491, 492, 494, 496 |
| | | Bindman | Under Age 65 | | |
| | | Blustein | Aged Medicare Beneficiaries | 6.7/1000 | 491, 492, 494, 496 or 466.0 with a secondary diagnosis of 491, 492, 494, 496 |
| | | Culler | Aged Medicare Beneficiaries | 5.7/1000 | 466, 491, 491.1, 491.20, 491.21, 491.8, 492, 492.0, 492.8, 494, or 496 |
| | | DHCFP | Under Age 65 | | 491, 492, 494, 4969, 466.0 |
| | | IOM | Under Age 65 | 0.68/1000 | 491, 492, 494, 496, or 466.0 with a secondary diagnosis of 491, 492, 494, 496 |
| | | Krakauer | Medicare Beneficiaries | (0.20-0.74)/1000 | 491, 492, 494, 496, or 466 with a secondary diagnosis of 491, 492, 494, 496 |
| | | Schreiber | Under Age 65 | | 491, 492, 494, 496, 466.0 with a secondary diagnosis of 491, 492, 494, 496 |
| | | Epstein | VA 1995-1997 | Share of PH: | 466, 491, 491.1, 491.20, 491.21, 491.8, 492, 492.0, 494, 496 |
| | | | a) Low-Income and Elderly (payer source = Medicare (over 65 years only), Medicaid, self-pay, indigent/charity, or government | a) 14.3% | |
| | | | b) All discharges | b) 13.6% | |
| | | Gaskin | All inpatient discharges from AZ, CA, FL, MA, MO, NJ, NY, PA, SC, VA (excludes obstetric and mental health discharges) | share of d/c = 2.05%<br>share of PH conditions = 11.35% | No info |
| | | Ricketts | NC 1993-1994 | share of PH d/c = 9.1% | 491, 492, 494, 496, 466.0 (acute bronchitis only with secondary dx of 5491, 492, 494, 496) |

**Appendix Table A-1 (continued)**
**Summary of Ambulatory Care Sensitive Condition Literature**

| | ACSC | Source[1] | Population Studied | Sample[2] | Coding[3] |
|---|---|---|---|---|---|
| 4. | Congestive Heart Failure | Billings | Under Age 65 | | 428, 402.01, 402.11, 402.91, 518.4 |
| | | Bindman | Under Age 65 | | |
| | | Blustein | Aged Medicare Beneficiaries | 18.6/1000 | 428, 402.01, 402.11, 402.91, 518.4 |
| | | Culler | Aged Medicare Beneficiaries | 11.5/1000 | 402.01, 402.11, 402.91, 428, 428.0, 428.1, 428.9, 518.4 |
| | | DHCFP | Under Age 65 | 0.68/1000 | 428, 402.01, 402.11, 402.91, 518.4 |
| | | IOM | Under Age 65 | (0.35-2.13)/1000 | 428, 402.01, 402.11, 402.91, 518.4 |
| | | Krakauer | Medicare Beneficiaries | | 428, 402.01, 402.11, 402.91, 518.4, and no procedure codes: 36.01, 36.02, 36.05, 36.1, 37.5, 37.7 |
| | | Pappas | All Age Groups | 39.80% | 402.01, 402.11, 402.91, 428 |
| | | Schreiber | Under Age 65 | | 428, 402.01, 402.11, 402.91, 518.4 |
| | | Silver | Aged Medicare Beneficiaries | 26.70% | |
| | | Weissman | Under Age 65 | 6.14/1000 | 428, 402.01, 402.11, 402.91 |
| | | Epstein | VA 1995-1997 | Share of PH: | 402.01, 402.11, 402.91, 428, 428.0, 428.1, |
| | | | a) Low-Income and Elderly (payer source = Medicare (over 65 years only), Medicaid, self-pay, indigent/charity, or government | a) 28.7% | 428.9, 518.4 |
| | | | b) All discharges | b) 24.2% | |
| | | Gaskin | All inpatient discharges from AZ, CA, FL, MA, MO, NJ, NY, PA, SC, VA (excludes obstetric and mental health discharges) | Share of d/c = 4.33%<br>Share of PH conditions = 23.97% | No info |
| | | Guo | All inpatient discharges for Cincinnati residents (1994-1996), excludes obstetric and mental health discharges) | Share of PH d/c = 28.8% | 402.01, 402.11, 402.91, 428 |
| | | Ricketts | NC 1993-1994 | Share of PH d/c = 17.6% | 428, 402.01, 402.11, 402.91, 518.4 (exclude with procedure 36.01, 36.02, 36.05, 36.1, 37.5, 37.7) |
| | | Kozak | National Sample over age 65 1998 | 24.65/1000 | 428, 402.01, 402.11, 402.91 |

**Appendix Table A-1 (continued)**
**Summary of Ambulatory Care Sensitive Condition Literature**

| | ACSC | Source[1] | Population Studied | Sample[2] | Coding[3] |
|---|---|---|---|---|---|
| 5. | Convulsions | Billings | Under Age 65 | 0.45/1000 | 780.3 |
| | | DHCFP | Under Age 65 | (0.30-1.17)/1000 | 780.3 |
| | | IOM | Under Age 65 | | 780.3 |
| | | Schreiber | Under Age 65 | | 780.3 |
| 6. | Diabetes | Billings | Under Age 65 | | A: 250.1, 250.2, 250.3<br>B: 250.8, 250.9<br>C: 250.0 |
| | | Bindman | Under Age 65 | | |
| | | Blustein | Aged Medicare Beneficiaries | 0.0/1000<br>2.9/1000<br>0.0/1000 | A: 250.1, 250.2, 250.3<br>B: 250.8, 250.9<br>C: 250.0 |
| | | Culler | Aged Medicare Beneficiaries | 0.9/1000 | 250.0-250.3, 250.8-250.10, 250.12, 250.13, 250.20, 250.22, 250.23, 250.30, 250.32, 250.33, 250.90, 250.92, or 250.93 |
| | | DHCFP | Under Age 65 | 0.58/1000 | 250.1, 250.2, 250.3, 250.8, 250.9, 250.0 |
| | | IOM | Under Age 65 | (0.19-0.78)/1000<br>(0.28-1.34)/1000<br>(0.02-0.08)/1000 | A: 250.1, 250.2, 250.3<br>B: 250.8, 250.9<br>C: 250.0 |
| | | Krakauer | Medicare Beneficiaries | | 250.0, 250.1, 250.2, 250.3, 250.8, 250.9 |
| | | Pappas | All Age Groups | 1.20% | 250.1-250.3, 251.0 |
| | | Schreiber | Under Age 65 | | A: 250.1, 250.2, 250.3<br>B: 250.8, 250.9<br>C: 250.0 |
| | | Solberg | All Age Groups | 6.50% | |
| | | Shukla | All Age Groups | | 250.10, 250.11, 250.20, 250.21, 250.30, 250.31, 250.90, 250.91, 250.70, 785.40 |
| | | Silver | Aged Medicare Beneficiaries | 6.80% | |
| | | Weissman | Under Age 65 | 3.99/1000 | 250.1, 250.2, 250.3, 251.0 |

**Appendix Table A-1 (continued)**
**Summary of Ambulatory Care Sensitive Condition Literature**

| | ACSC | Source[1] | Population Studied | Sample[2] | Coding[3] |
|---|---|---|---|---|---|
| | Diabetes (continued) | Epstein | VA 1995-1997 | Share of PH: | 250.0-250.3, 250.8-250.10, 250.12, 250.13, |
| | | | a) Low-Income and Elderly (payer source = Medicare (over 65 years only), Medicaid, self-pay, indigent/charity, or government | a) 1.7% | 250.20, 250.22, 250.23, 250.30, 250.32, 250.33, 250.90, 250.92, 250.93 |
| | | | b) All discharges | b) 2.3% | |
| | | Gaskin | All inpatient discharges from AZ, CA, FL, MA, MO, NJ, NY, PA, SC, VA (excludes obstetric and mental health discharges) | Share of d/c = 0.38%<br>Share of PH conditions = 2.09% | No info |
| | | Guo | All inpatient discharges for Cincinnati residents (1994-1996), excludes obstetric and mental health discharges) | Share of PH d/c = 3.3% | 250.1-250.3, 251.0 |
| | | Ricketts | NC 1993-1994 | Share of PH d/c = 2.9% | 250.1-3 |
| | | | | Share of PH d/c = 2.1% | 250.8-9 |
| | | | | Share of PH d/c = 1.9% | 250 |
| | Diabetes with ketoacidosis or coma | Kozak | National Sample over age 65, 1998 | 0.48/1000 | 250.1, 250.2, 250.3, 251.0 |
| 7. | Grand Mal Status and Epileptic Convulsions | Billings | Under Age 65 | | 345 |
| | | Blustein | Aged Medicare Beneficiaries | 0.8/1000 | 345, 780.3 |
| | | Culler | Aged Medicare Beneficiaries | 1.0/1000 | 345-345.9, or 780.3 |
| | | DHCFP | Under Age 65 | | 345 |
| | | IOM | Under Age 65 | (0.20-0.74)/1000 | 345 |
| | | Schreiber | Under Age 65 | | 345 |
| | | Epstein | VA 1995-1997 | Share of PH: | 345.0-345.9, 780.3 |
| | | | a) Low-Income and Elderly (payer source = Medicare (over 65 years only), Medicaid, self-pay, indigent/charity, or government | a) 3.6% | |
| | | | b) All discharges | b) 4.5% | |

**Appendix Table A-1 (continued)**
**Summary of Ambulatory Care Sensitive Condition Literature**

| | ACSC | Source[1] | Population Studied | Sample[2] | Coding[3] |
|---|---|---|---|---|---|
| | Grand Mal Status and Epileptic Convulsions (continued) | Gaskin | All inpatient discharges from AZ, CA, FL, MA, MO, NJ, NY, PA, SC, VA (excludes obstetric and mental health discharges) | Share of d/c = 0.78%<br>Share of PH conditions =4.34% | No info |
| | | Ricketts | NC 1993-1994 | Share of PH d/c = 1.1% | 345 |
| | | | | Share of PH d/c = 0.6% | 780.3 (age 0-5) |
| | | | | Share of PH d/c = 2.4% | 780.3 (age > 5) |
| 8. | Hypertension | Billings | Under Age 65 | | 401.0, 401.9, 402.00, 402.10, 402.90 |
| | | Bindman | Under Age 65 | | |
| | | Blustein | Aged Medicare Beneficiaries | 0.2/1000 | 401.0, 401.9, 402.00, 402.10, 402.90 |
| | | Culler | Aged Medicare Beneficiaries | 1.3/1000 | 401.0, 401.9, 402.00, 402.10, or 402.90 |
| | | DHCFP | Under Age 65 | | 401.0, 401.9, 402.00, 402.10, 402.90 |
| | | IOM | Under Age 65 | (0.11-0.84)/1000 | 401.0, 401.9, 402.00, 402.10, 402.90 and no procedure 36.01, 36.02, 36.05, 36.1, 37.5, 37.7 |
| | | Krakauer | Medicare Beneficiaries | | 401.0, 401.9, 402.00, 402.10, 402.90 and no procedure codes: 36.01, 36.02, 36.05, 36.1, 37.5, 37.7 |
| | | Pappas | All Age Groups | 1.70% | 401.0, 402.0, 403.0, 404.0, 405.0, 437.2 |
| | | Schreiber | Under Age 65 | | 401.0, 401.9, 402.00, 402.10, 402.90 |
| | | Shukla | All Age Groups | | 401.00, 401.10, 401.90, 402.00, 402.10, 402.11, 402.90, 402.91, 437.20, 431, 436, |
| | | Silver | Aged Medicare Beneficiaries | 1.40% | |
| | | Weissman | Under Age 65 | 1.64/1000 | 401.0, 402.0, 403.0, 404.0, 405.0, 437.2 |
| | | Epstein | VA 1995-1997<br>a) Low-Income and Elderly (payer source = Medicare (over 65 years only), Medicaid, self-pay, indigent/charity, or government<br>b) All discharges | a) 1.3%<br>b) 1.6% | 401.0, 401.9, 402.00, 402.10, 402.90 |

**Appendix Table A-1 (continued)**
**Summary of Ambulatory Care Sensitive Condition Literature**

| | ACSC | Source[1] | Population Studied | Sample[2] | Coding[3] |
|---|---|---|---|---|---|
| | Hypertension (continued) | Gaskin | All inpatient discharges from AZ, CA, FL, MA, MO, NJ, NY, PA, SC, VA (excludes obstetric and mental health discharges) | Share of d/c=0.30%<br>Share of PH conditions = 1.66% | No info |
| | | Guo | All inpatient discharges for Cincinnati residents (1994-1996), excludes obstetric and mental health discharges) | Share of PH d/c = 1.0% | 401.0, 402.0, 403.0, 404.0, 405.0, 437.2 |
| | | Ricketts | NC 1993-1994 | Share of PH d/c = 1.4% | 401.0, 401.9, 402.00, 402.10, 402.90 (exclude if procedure 36.01, 36.02, 36.05, 36.1, 37.5, 37.7) |
| | | Kozak | National Sample over age 65, 1998 | 0.58/1000 | 401.0, 402.0, 403.0, 404.0, 405.0, 437.2 |
| 9. | Other Respiratory Tuberculosis | Shukla | All Age Groups | | 012.00, 012.10, 012.20, 012.30, 012.80 |
| 10. | Other Tuberculosis | Billings | Under Age 65 | | 012, 013, 014, 015, 016, 017, 018 |
| | | Blustein | Aged Medicare Beneficiaries | 0.0/1000 | 012, 013, 014, 015, 016, 017, 018 |
| | | DHCFP | Under Age 65 | | 012, 013, 014, 015, 016, 017, 018 |
| | | Schreiber | Under Age 65 | | 012, 013, 014, 015, 016, 017, 018 |
| 11. | Pulmonary Tuberculosis | Billings | Under Age 65 | | 11 |
| | | Blustein | Aged Medicare Beneficiaries | 0.0/1000 | 11 |
| | | DHCFP | Under Age 65 | | 11 |
| | | Shukla | All Age Groups | | 011.00, 011.10, 011.20, 011.30, 011.40, 011.50, 011.60, 011.70, 011.80, 011.90 |
| | | Schreiber | Under Age 65 | | 11 |
| | **ACUTE CONDITIONS:** | | | | |
| 12. | Acute Bronchitis (With Asthma or COPD as a Secondary Diagnosis) | Bindman | | | |
| 13. | Bronchiolitis | Gaskin | All inpatient discharges from AZ, CA, FL, MA, MO, NJ, NY, PA, SC, VA (excludes obstetric and mental health discharges) | Share of d/c = 0.34%<br>Share of PH conditions = 1.88% | No info |

**Appendix Table A-1 (continued)**
**Summary of Ambulatory Care Sensitive Condition Literature**

| | ACSC | Source[1] | Population Studied | Sample[2] | Coding[3] |
|---|---|---|---|---|---|
| 14. | Breast Cancer | Shukla | All Age Groups | | 174.00, 174.10, 174.20, 174.30, 174.40, 174.50, 174.50, 174.60, 174.80, 174.90 |
| | | Solberg | All Age Groups | 15.90% | |
| 15. | Cellulitis | Billings | Under Age 65 | | 681, 682, 683, 686 and no procedure except 86.0 |
| | | Blustein | Aged Medicare Beneficiaries | 1.3/1000 | 681, 682, 683, 686 and no procedure except 86.0 |
| | | Culler | Aged Medicare Beneficiaries | 2.4/1000 | 263, 264, 681, 682, 682.0-682.9, 683, or 686 |
| | | DHCFP | Under Age 65 | 0.78/1000 | |
| | | IOM | Under Age 65 | (0.42-2.11)/1000 | 681, 682, 683, 686 and no procedure except 86.0 |
| | | Krakauer | Medicare Beneficiaries | | 681, 682, 683, 686 and no procedure except 86.0 |
| | | Pappas | All Age Groups | 6.00% | 681, 682 |
| | | Schreiber | Under Age 65 | | 681, 682, 683, 686 and no procedure except 86.0 |
| | | Silver | Aged Medicare Beneficiaries | 5.40% | |
| | | Solberg | All Age Groups | 14.90% | |
| | | Weissman | Under Age 65 | 8.68/1000 | 681, 682 |
| | | Epstein | VA 1995-1997 | Share of PH: | 263, 264, 681, 682, 682.0-682.9, 683, 686 |
| | | | a) Low-Income and Elderly (payer source = Medicare (over 65 years only), Medicaid, self-pay, indigent/charity, or government | a) 4.8% | |
| | | | b) All discharges | b) 5.9% | |
| | | Gaskin | All inpatient discharges from AZ, CA, FL, MA, MO, NJ, NY, PA, SC, VA (excludes obstetric and mental health discharges) | Share of d/c=1.27%<br>Share of PH conditions = 7.05% | No info |

**Appendix Table A-1 (continued)**
**Summary of Ambulatory Care Sensitive Condition Literature**

| | ACSC | Source[1] | Population Studied | Sample[2] | Coding[3] |
|---|---|---|---|---|---|
| | Cellulitis (continued) | Guo | All inpatient discharges for Cincinnati residents (1994-1996), excludes obstetric and mental health discharges) | Share of PH d/c = 7.9% | 681, 682 (exclude with procedure 01-86.99 except when 86.0 is only listed procedure) |
| | | Kozak | National Sample over age 65 1998 | 3.91/1000 | 681, 682 |
| 16. | Congenital syphilis | Ricketts | NC 1993-1994 | Share of PH d/c = 0.1% | 090 (secondary dx for newborns only) |
| 17. | Dehydration | Billings | Under Age 65 | | 276.5 |
| | | Blustein | Aged Medicare Beneficiaries | 4.2/1000 | 276.5 |
| | | Culler | Aged Medicare Beneficiaries | 2.4/1000 | 276.5 |
| | | DHCFP | Under Age 65 | 0.71/1000 | 276.5 |
| | | IOM | Under Age 65 | (0.28-0.59)/1000 | 276.5 |
| | | Krakauer | Medicare Beneficiaries | | 276.5 |
| | | Schreiber | Under Age 65 | | 276.5 |
| | | Epstein | VA 1995-1997<br>a) Low-Income and Elderly (payer source = Medicare (over 65 years only), Medicaid, self-pay, indigent/charity, or government<br>b) All discharges | Share of PH:<br>a) 10.5%<br>b) 10.7% | 276.5 |
| | | Gaskin | All inpatient discharges from AZ, CA, FL, MA, MO, NJ, NY, PA, SC, VA (excludes obstetric and mental health discharges) | Share of d/c = 1.48%<br>Share of PH conditions = 8.18% | No info |
| | | Ricketts | NC 1993-1994 | Share of PH d/c = 5.4% | 276.5 (examine principal and secondary diagnoses separately) |
| 18. | Drug Toxicity / Overdose | Solberg | All Age Groups | 2.80% | |
| 19. | Endometrial Cancer | Solberg | All Age Groups | 4.10% | |
| 20. | Gangrene | Pappas | All Age Groups | | 785.4 |
| | | Solberg | All Age Groups | | extremity only |

**Appendix Table A-1 (continued)**
**Summary of Ambulatory Care Sensitive Condition Literature**

| | ACSC | Source[1] | Population Studied | Sample[2] | Coding[3] |
|---|---|---|---|---|---|
| | Gangrene (continued) | Weissman | Under Age 65 | 4.10% | 785.4 |
| | | Gaskin | All inpatient discharges from AZ, CA, FL, MA, MO, NJ, NY, PA, SC, VA (excludes obstetric and mental health discharges) | Share of d/c = 0.04%<br>Share of PH conditions = 0.20% | No info |
| | | Guo | All inpatient discharges for Cincinnati residents (1994-1996), excludes obstetric and mental health discharges) | Share of PH d/c = 0.1% | 785.4 |
| 21. | Gastroenteritis | Billings | Under Age 65 | 0.23/1000 | 558.9 |
| | | Blustein | Aged Medicare Beneficiaries | 1.4/1000 | 558.9 |
| | | Culler | Aged Medicare Beneficiaries | 1.2/1000 | 558.9 |
| | | DHCFP | Under Age 65 | | 558.9 |
| | | IOM | Under Age 65 | (0.68-1.30)/1000 | 558.9 |
| | | Krakauer | Medicare Beneficiaries | | 558.9 |
| | | Schreiber | Under Age 65 | | 558.9 |
| | | Epstein | VA 1995-1997<br>a) Low-Income and Elderly (payer source = Medicare (over 65 years only), Medicaid, self-pay, indigent/charity, or government<br>b) All discharges | Share of PH:<br>a) 3.2%<br>b) 4.4% | 558.9 |
| | | Gaskin | All inpatient discharges from AZ, CA, FL, MA, MO, NJ, NY, PA, SC, VA (excludes obstetric and mental health discharges) | Share of d/c = 0.56%<br>Share of PH conditions = 3.07 | No info |
| | | Ricketts | NC 1993-1994 | Share of PH d/c = 4.6% | 558.9 |
| 22. | Hypoglycemia | Billings | Under Age 65 | | 251.2 |
| | | Blustein | Aged Medicare Beneficiaries | 0.8/1000 | 251.2 |
| | | Culler | Aged Medicare Beneficiaries | 0.6/1000 | 251.2 |

**Appendix Table A-1 (continued)**
**Summary of Ambulatory Care Sensitive Condition Literature**

| | ACSC | Source[1] | Population Studied | Sample[2] | Coding[3] |
|---|---|---|---|---|---|
| | Hypoglycemia (continued) | DHCFP | Under Age 65 | | 251.2 |
| | | IOM | Under Age 65 | (0.03-0.14)/1000 | 251.2 |
| | | Krakauer | Medicare Beneficiaries | | 251.2 |
| | | Schreiber | Under Age 65 | | 251.2 |
| | | Epstein | VA 1995-1997<br>a) Low-Income and Elderly (payer source = Medicare (over 65 years only), Medicaid, self-pay, indigent/charity, or government<br>b) All discharges | Share of PH:<br>a) 0.2%<br>b) 0.2% | 251.2 |
| | | Gaskin | All inpatient discharges from AZ, CA, FL, MA, MO, NJ, NY, PA, SC, VA (excludes obstetric and mental health discharges) | Share of d/c = 0.02%<br>Share of PH conditions =0.13% | No info |
| | | Ricketts | NC 1993-1994 | Share of PH d/c = 0.2% | 251.2 |
| 23. | Hypokalemia | Pappas | All Age Groups | 1.70% | 276.8 |
| | | Solberg | All Age Groups | 2.00% | 276.8 |
| | | Weissman | Under Age 65 | 0.31/1000 | |
| | | Guo | All inpatient discharges for Cincinnati residents (1994-1996), excludes obstetric and mental health discharges) | Share of PH d/c = 0.5% | 276.8 |
| | | Kozak | National Sample over age 65 1998 | 0.48/1000 | |
| 24. | Kidney/urinary Infection | Billings | Under Age 65 | | 590, 599.0, 599.9 |
| | | Blustein | Aged Medicare Beneficiaries | 6.1/1000 | 590, 599.0, 599.9 |
| | | Culler | Aged Medicare Beneficiaries | 4.9/1000 | 590, 590.2, 590.9, 590.10, 590.11, 599.0, or 599.9 |
| | | DHCFP | Under Age 65 | 0.67/1000 | 590, 599.0, 599.9 |
| | | IOM | Under Age 65 | (0.46-1.28)/1000 | 590, 599.0, 599.9 |
| | | Krakauer | Medicare Beneficiaries | | 590, 599.0, 599.9 |

**Appendix Table A-1 (continued)**
**Summary of Ambulatory Care Sensitive Condition Literature**

| | ACSC | Source[1] | Population Studied | Sample[2] | Coding[3] |
|---|---|---|---|---|---|
| | Kidney/urinary Infection | Schreiber | Under Age 65 | | 590, 599.0, 599.9 |
| | | Epstein | VA 1995-1997<br>a) Low-Income and Elderly (payer source = Medicare (over 65 years only), Medicaid, self-pay, indigent/charity, or government<br>b) All discharges | Share of PH:<br>a) 8.1%<br>b) 7.9% | 590,590.2, 590.9, 590.10, 590.11, 599, 599.9 |
| | | Gaskin | All inpatient discharges from AZ, CA, FL, MA, MO, NJ, NY, PA, SC, VA (excludes obstetric and mental health discharges) | Share of d/c = 1.37%<br>Share of PH conditions =7.63% | No info |
| | Kidney/urinary tract infections | Guo | All inpatient discharges for Cincinnati residents (1994-1996), excludes obstetric and mental health discharges) | Share of PH d/c = 3.4% | 590.0, 59.01, 590.8 |
| | | Ricketts | NC 1993-1994 | Share of PH d/c = 8.0% | 590, 599.0, 599.9 |
| | | Pappas | All Age Groups | 1.70% | 590.0, 590.1, 590.8 |
| | | Weissman | Under Age 65 | 4.11/1000 | 590.0, 590.1, 590.8 |
| | | Kozak | National Sample over age 65 1998 | 0.71/1000 | 590.0, 590.1, 590.8 |
| 25. | Pelvic Inflammatory Disease | Billings | Under Age 65 | | 614 exclude procedure 68.3-68.8 |
| | | Blustein | Aged Medicare Beneficiaries | | 614 exclude procedure 68.3-68.8 |
| | | DHCFP | Under Age 65 | 0.0/1000 | 614 |
| | | Schreiber | Under Age 65 | | 614 exclude procedure 68.3-68.8 |
| 26. | Perforated or Bleeding Ulcer | Pappas | All Age Groups | 5.30% | 531.0,531.2, 531.4, 531.6, 532.0, 532.2, 532.4, 532.6, 533.0-533.2, 533.4-533.6 |
| | | Solberg | All Age Groups | 17.90% | |
| | | Silver | Aged Medicare Beneficiaries | 14.10% | |
| | | Weissman | Under Age 65 | 2.47% | 531.0,531.2, 531.4, 531.6, 532.0, 532.2, 532.4, 532.6, 533.0-533.2, 533.4-533.6 |
| | | Guo | All inpatient discharges for Cincinnati residents (1994-1996), excludes obstetric and mental health discharges) | Share of PH d/c = 4.3% | 531.0, 531.2, 531.4, 531.6, 532.0, 532.2, 532.4, 532.6, 533.0-533.2, 533.4-533.6 |
| | | Kozak | National Sample over age 65 1998 | 2.37/1000 | 531.0,531.2, 531.4, 531.6, 532.0, 532.2, 532.4, 532.6, 533.0-533.2, 533.4-533.6 |

**Appendix Table A-1 (continued)**
**Summary of Ambulatory Care Sensitive Condition Literature**

| | ACSC | Source[1] | Population Studied | Sample[2] | Coding[3] |
|---|---|---|---|---|---|
| 27. | Pneumonia | Billings | Under Age 65 | | 481, 482.2, 482.3, 482.9, 483, 485, 486 |
| | | Bindman | Under Age 65 | | |
| | | Culler | Aged Medicare Beneficiaries | 9.7/1000 | 481, 482.2, 482.3, 482.9, 483, 483.0, 485, or 486 |
| | | DHCFP | Under Age 65 | 1.42/1000 | 481, 482.2, 482.3, 482.9, 483, 485, 486.2 |
| | | IOM | Under Age 65 | (0.81-4.39)/1000 | 481, 482.2, 482.3, 482.9, 483, 485, 486 |
| | | Krakauer | Medicare Beneficiaries | | 481, 482.2, 482.3, 482.9, 483, 485, 486 |
| | | Pappas | All Age Groups | 35.30% | 481-483, 485-486 with Asthma or COPD as a secondary diagnosis |
| | | Schreiber | Under Age 65 | | 481, 482.2, 482.3, 482.9, 483, 485, 486 |
| | | Weissman | Under Age 65 | 14.92/1000 | 481, 482, 483, 485, 486 |
| | | Epstein | VA 1995-1997<br>a) Low-Income and Elderly (payer source = Medicare (over 65 years only), Medicaid, self-pay, indigent/charity, or government<br>b) All discharges | Share of PH:<br>a) 19.4%<br>b) 19.6% | 481, 482.2, 482.3, 482.9, 483.0, 485, 486 |
| | | Gaskin | All inpatient discharges from AZ, CA, FL, MA, MO, NJ, NY, PA, SC, VA (excludes obstetric and mental health discharges) | Share of d/c = 3.6%<br>Share of PH conditions = 19.9% | No info |
| | | Guo | All inpatient discharges for Cincinnati residents (1994-1996), excludes obstetric and mental health discharges) | Share of PH d/c = 36.2% | 481-483, 485-486 |
| | | Ricketts | NC 1993-1994 | Share of PH d/c = 18.6% | 481, 482.2, 482.3, 482.9, 483, 485, 486 (exclude if secondary dx of 282.6 and < 2 mths old |
| | | Kozak | National Sample over age 65 1998 | 22.2/1000 | 481, 482, 483, 485, 486 |
| 28. | Pneumonia, Bronchitis, Respiratory Infection | Silver | Aged Medicare Beneficiaries | 39.60% | |
| 29. | Pulmonary Embolism/Infarction | Solberg | All Age Groups | 6.10% | |

**Appendix Table A-1 (continued)**
**Summary of Ambulatory Care Sensitive Condition Literature**

| | ACSC | Source[1] | Population Studied | Sample[2] | Coding[3] |
|---|---|---|---|---|---|
| 30. | Severe Ear, Nose and Throat Infections | Billings | Under Age 65 | | 382, 462, 463, 465, 472.1 exclude cases with proc 20.01 |
| | | Blustein | Aged Medicare Beneficiaries | 0.3/1000 | 382, 462, 463, 465, 472.1 exclude cases with proc 20.01 |
| | | Culler | Aged Medicare Beneficiaries | 0.1/1000 | 382, 382.1-382.9, 382.00-382.02, 462, 463, 464, 465, or 472.1 |
| | | DHCFP | Under Age 65 | | 382, 462, 463, 465, 472.1 |
| | | IOM | Under Age 65 | (0.24-0.82)/1000 | 382, 462, 463, 465, 472.1 exclude cases with proc 20.01 |
| | | Schreiber | Under Age 65 | | 382, 462, 463, 465, 472.1 exclude cases with proc 20.01 |
| | | Epstein | VA 1995-1997<br>a) Low-Income and Elderly (payer source = Medicare (over 65 years only), Medicaid, self-pay, indigent/charity, or government<br>b) All discharges | Share of PH:<br>a) 0.6%<br>b) 0.8% | 382, 382.1-382.9, 382.00-382.02, 462, 463, 464, 465, 472.1 |
| | | Gaskin | All inpatient discharges from AZ, CA, FL, MA, MO, NJ, NY, PA, SC, VA (excludes obstetric and mental health discharges) | Share of d/c=0.14%<br>Share of PH conditions = 0.76% | No info |
| | | Ricketts | NC 1993-1994 | Share of PH d/c = 1.5% | 382, 462, 463, 465, 472.1 (exclude 382 with 20.01) |
| 31. | Skin Grafts with Cellulitis | Billings | Under Age 65 | | DRG 263, 264 |
| | | Blustein | Aged Medicare Beneficiaries | 0.5/1000 | DRG 263, 264 |
| | | IOM | Under Age 65 | (0.08-0.46)/1000 | DRG 263, 264 |
| | | Krakauer | Medicare Beneficiaries | | DRG 263, 264 |

**Appendix Table A-1 (continued)**
**Summary of Ambulatory Care Sensitive Condition Literature**

| | ACSC | Source[1] | Population Studied | Sample[2] | Coding[3] |
|---|---|---|---|---|---|
| | Skin Grafts with Cellulitis (continued) | Schreiber | Aged Medicare Beneficiaries | | DRG 263, 264 |
| | | Ricketts | NC 1993-1994 | Share of PH d/c = 1.1% | 263-4 (exclude admit from SNF/ICF) |
| | **AVOIDABLE CONDITIONS** | | | | |
| 32. | Acute Poliomyelitis | Shukla | All Age Groups | | 045.00, 045.10, 045.20, 045.90 |
| 33. | Dental | Billings | Under Age 65 | | 521, 522, 523, 525, 528 |
| | | Blustein | Aged Medicare Beneficiaries | 0.0/1000 | 521, 522, 523, 525, 528 |
| | | IOM | Under Age 65 | | 521, 522, 523, 525, 528 |
| | | Schreiber | Under Age 65 | | 521, 522, 523, 525, 528 |
| | | Gaskin | All inpatient discharges from AZ, CA, FL, MA, MO, NJ, NY, PA, SC, VA (excludes obstetric and mental health discharges) | Share of d/c = 0.02%<br>Share of PH conditions = 0.11% | No info |
| | | Ricketts | NC 1993-1994 | Share of PH d/c = 0.4% | 521-3, 525, 528 |
| 34. | Immunizable Conditions | Billings | Under Age 65 | | 033, 390, 391, 037, 045 |
| | | Blustein | Aged Medicare Beneficiaries | 0.0/1000 | 033, 390, 391, 037, 045 |
| | | DHCFP | Under Age 65 | | 033, 037, 045, 320.0, 390, 391 |
| | | Pappas | All Age Groups | | 032, 033, 037, 045, 055, 072 |
| | | Schreiber | Under Age 65 | | 033, 390, 391, 037, 045 |
| | | IOM | Under Age 65 | | 033, 037, 045, 320.0, 390, 391 |
| | | Weissman | Under Age 65 | 0.04/1000 | 032, 033, 037, 072, 045, 055 |
| | | Guo | All inpatient discharges for Cincinnati residents (1994-1996), excludes obstetric and mental health discharges) | Share of PH d/c = 0.1% | 032, 033,037, 045,055, 072 |
| | | Ricketts | NC 1993-1994 | Share of PH d/c = 0.2% | 033,037,045,320.0, 390,391, (320.2 –age 1-5 only) |

**Appendix Table A-1 (continued)**
**Summary of Ambulatory Care Sensitive Condition Literature**

| | ACSC | Source[1] | Population Studied | Sample[2] | Coding[3] |
|---|---|---|---|---|---|
| | Ruptured Appendix (continued) | Gaskin | All inpatient discharges from AZ, CA, FL, MA, MO, NJ, NY, PA, SC, VA (excludes obstetric and mental health discharges) | Share of d/c = 0.31%<br>Share of PH conditions = 1.73% | No info |
| | | Guo | All inpatient discharges for Cincinnati residents (1994-1996), excludes obstetric and mental health discharges) | Share of PH d/c = 1.9% | 540.0-540.1 |
| | | Kozak | National Sample over age 65 1998 | .021/1000 | 540.0, 540.1 |
| 42. | Tetanus | Shukla | All Age Groups | | 37 |

**NOTES:**

[1] A full bibliography is attached.

[2] Expressed in rates per thousand eligibles or as a percent of the study hospitalizations

[3] Codes are ICD-9 principal diagnosis codes unless specified otherwise.

[4] Billings *et al.* (1993) and Billings *et al.* (1996) use the same specifications

[5] Many of the IOM conditions are also found in Mitchell *et al.* (1993).

**APPENDIX A-2**
**SPECIFICATIONS FOR SELECTED OF AMBULATORY CARE SENSITIVE CONDITIONS (ACSCs)**

*THE LIST OF ICD-9 DIAGNOSIS CODES FOR EACH ACSC CONTAINS ALL ICD-9 DIAGNOSIS CODES THAT WERE ACTIVE DURING THE PERIOD OCTOBER 1, 1991 THROUGH SEPTEMBER 30, 2001, ALTHOUGH NOT ALL CODES MAY APPLY TO ALL YEARS. THUS, THERE IS ONE COMPREHENSIVE LIST OF ICD-9 DIAGNOSIS CODES THAT ACCOUNTS FOR CHANGES IN CODING DURING THE NINE-YEAR STUDY PERIOD.*

## *CELLULITIS*

**Description**: Annual rate of admissions with a principal diagnosis of cellulitis.

**Denominator:** All Medicare Part A and B FFS beneficiaries for 12 consecutive months.

**Numerator**: All patients with a principal diagnosis of any of the following ICD-9-CM codes:

| | |
|---|---|
| 681 | Cellulitis and Abscess of Finger and Toe |
| 6810 | Cellulitis of Finger |
| 68100 | Cellulitis and Abscess, Unspecified |
| 68101 | Felon |
| 68102 | Onychia and Paronychia of Finger |
| 6811 | Cellulitis and Abscess of Toe |
| 68110 | Cellulitis and Abscess, Unspecified |
| 68111 | Onychia and Paronychia of Toe |
| 6819 | Cellulitis and Abscess of Unspecified Digit |
| 682 | Other Cellulitis and Abscess |
| 6820 | Other Cellulitis and Abscess of Face |
| 6821 | Other Cellulitis and Abscess of Neck |
| 6822 | Other Cellulitis and Abscess of Trunk |
| 6823 | Other Cellulitis and Abscess of Upper Arm and Forearm |
| 6824 | Other Cellulitis and Abscess of Hand |
| 6825 | Other Cellulitis and Abscess of Buttock |
| 6826 | Other Cellulitis and Abscess of Leg, except Foot |
| 6827 | Other Cellulitis and Abscess of Foot, except Toe |
| 6828 | Other Cellulitis and Abscess, Other Specified Sites |
| 6829 | Other Cellulitis and Abscess, Unspecified Site |

## *CHRONIC LUNG DISEASE*

**Description**: Annual rate of admissions with a principal diagnosis of asthma or chronic obstructive pulmonary disease (COPD).

**Denominator:** All Medicare Part A and B FFS beneficiaries for 12 consecutive months.

**Numerator**: All patients with a principal diagnosis of any of the following ICD-9-CM codes:

**ASTHMA**

| | |
|---|---|
| 493 | Asthma |
| 4930 | Extrinsic Asthma |
| 49300 | Extrinsic Asthma w/o mention of status asthmaticus or acute exacerbation |
| 49301 | Extrinsic Asthma w/mention of status asthmaticus |
| 49302 | Extrinsic Asthma w/acute exacerbation |
| 4931 | Intrinsic Asthma |
| 49310 | Intrinsic Asthma w/o mention of status asthmaticus or acute exacerbation |
| 49311 | Intrinsic Asthma w/mention of status asthmaticus |
| 49312 | Intrinsic Asthma w/acute exacerbation |
| 4932 | Chronic Obstructive Asthma |
| 49320 | Chronic Obstructive Asthma w/o mention of status asthmaticus or acute exacerbation |
| 49321 | Chronic Obstructive Asthma w/mention of status asthmaticus |
| 49322 | Chronic Obstructive Asthma w/acute exacerbation |
| 4939 | Asthma, Unspecified |
| 49390 | Asthma, Unspecified w/o mention of status asthmaticus or acute exacerbation |
| 49391 | Asthma, Unspecified w/mention of status asthmaticus |
| 49392 | Asthma, Unspecified w/acute exacerbation |

COPD and **CHRONIC BRONCHITIS**

| | |
|---|---|
| 491 | Chronic Bronchitis |
| 4910 | Simple Chronic Bronchitis |
| 4911 | Mucopurulent Chronic Bronchitis |
| 4912 | Obstructive Chronic Bronchitis |
| 49120 | Obstructive Chronic Bronchitis w/o mention of acute exacerbation |
| 49121 | Obstructive Chronic Bronchitis with acute exacerbation |
| 4918 | Other Chronic Bronchitis |
| 4919 | Unspecified Chronic Bronchitis |

492 Emphysema
4920 Emphysematous Bleb
4928 Other Emphysema
494 Bronchiectasis
4940 Bronchiectasis without acute exacerbation
4941 Bronchiectasis with acute exacerbation
496 Chronic Airway Obstruction, NEC

## *CONGESTIVE HEART FAILURE*

**Description**: Annual rate of admissions with a principal diagnosis of congestive heart failure, including hypertensive heart disease with congestive heart failure.

**Denominator:** All Medicare Part A and B FFS beneficiaries for 12 consecutive months.

**Numerator**: All patients with a principal diagnosis of any of the following ICD-9-CM codes:

| | |
|---|---|
| 40201 | Malignant Hypertensive Heart Disease w/ CHF |
| 40211 | Benign Hypertensive Heart Disease w/ CHF |
| 40291 | Unspecified Hypertensive Heart Disease w/ CHF |
| 40401 | Malignant Hypertensive Heart & Renal Disease w/ CHF |
| 40411 | Benign Hypertensive Heart & Renal Disease w/ CHF |
| 40491 | Unspecified Hypertensive Heart & Renal Disease w/ CHF |
| 428 | Heart Failure |
| 4280 | Congestive Heart Failure |
| 4281 | Left Heart Failure |
| 4289 | Heart Failure, Unspecified |

## *DEHYDRATION*

**Description**: Annual rate of admissions with a principal diagnosis of dehydration.

**Denominator:** All Medicare Part A and B FFS beneficiaries for 12 consecutive months.

**Numerator**: All patients with a principal diagnosis of:

2765 Hypovolemia

## *DIABETES MELLITUS: ACUTE DIABETIC EVENTS*

**Description**: Annual rate of admission for acute diabetic events among Medicare beneficiaries with diabetes mellitus. Acute diabetic events include ketoacidosis, hypoglycemia, and hyperosmolality.

**Denominator:** A 5% sample of Medicare Part A and B FFS beneficiaries for 12 consecutive months with a diagnosis of diabetes mellitus. The following algorithm is used to identify diabetics for CMS's QIOs' 6th Scope of Work related to the Diabetes Clinical Quality Improvement Project and is being used to identify diabetics in this project. Using the claims data, we identify diabetics from the eligible population as those beneficiaries who had (1) at least one acute face-to-face claim with a principal or secondary diagnosis of diabetes, or (2) at least two non-acute face-to-face claims at least seven days apart with a principal or secondary diagnosis of diabetes.

The following ICD-9 codes are used to identify diabetes using either principal or secondary diagnosis codes:

| | |
|---|---|
| 2500 | Diabetes Mellitus |
| 25000 | Diabetes Mellitus, type II or unspecified type, not stated as uncontrolled |
| 25001 | Diabetes Mellitus, type I, not stated as uncontrolled |
| 25002 | Diabetes Mellitus, type II or unspecified type, uncontrolled |
| 25003 | Diabetes Mellitus, type I, uncontrolled |
| 2501 | Diabetes with Ketoacidosis |
| 25010 | Diabetes with Ketoacidosis, type II or unspecified type, not stated as uncontrolled |
| 25011 | Diabetes with Ketoacidosis, type I, not stated as uncontrolled |
| 25012 | Diabetes with Ketoacidosis, type II or unspecified type, uncontrolled |
| 25013 | Diabetes with Ketoacidosis, type I, uncontrolled |
| 2502 | Diabetes with Hyperosmolality Coma |
| 25020 | Diabetes with Hyperosmolality Coma, type II or unspecified type, not stated as uncontrolled |
| 25021 | Diabetes with Hyperosmolality Coma, type I, not stated as uncontrolled |
| 25022 | Diabetes with Hyperosmolality Coma, type II or unspecified type, uncontrolled |
| 25023 | Diabetes with Hyperosmolality Coma, type I, uncontrolled |
| 2503 | Diabetes with Other Coma |
| 25030 | Diabetes with Other Coma, type II or unspecified type, not stated as uncontrolled |
| 25031 | Diabetes with Other Coma, type I, not stated as uncontrolled |
| 25032 | Diabetes with Other Coma, type II or unspecified type, uncontrolled |
| 25033 | Diabetes with Other Coma, type I, uncontrolled |
| 2504 | Diabetes with Renal Manifestations |

25040 Diabetes with Renal Manifestations, type II or unspecified type, not stated as uncontrolled

25041 Diabetes with Renal Manifestations, type I, not stated as uncontrolled

25042 Diabetes with Renal Manifestations, type II or unspecified type, uncontrolled

25043 Diabetes with Renal Manifestations, type I, uncontrolled

2505 Diabetes with Ophthalmic Manifestations

25050 Diabetes with Ophthalmic Manifestations, type II or unspecified type, not stated as uncontrolled

25051 Diabetes with Ophthalmic Manifestations, type I, not stated as uncontrolled

25052 Diabetes with Ophthalmic Manifestations, type II or unspecified type, uncontrolled

25053 Diabetes with Ophthalmic Manifestations, type I, uncontrolled

2506 Diabetes with Neurological Manifestations

25060 Diabetes with Neurological Manifestations, type II or unspecified type, not stated as uncontrolled

25061 Diabetes with Neurological Manifestations, type I, not stated as uncontrolled

25062 Diabetes with Neurological Manifestations, type II or unspecified type, uncontrolled

25063 Diabetes with Neurological Manifestations, type I, uncontrolled

2507 Diabetes with Peripheral Circulatory Disorders

25070 Diabetes with Peripheral Circulatory Disorders, type II or unspecified type, not stated as uncontrolled

25071 Diabetes with Peripheral Circulatory Disorders, type I, not stated as uncontrolled

25072 Diabetes with Peripheral Circulatory Disorders, type II or unspecified type, uncontrolled

25073 Diabetes with Peripheral Circulatory Disorders, type I, uncontrolled

2508 Diabetes with Other Specified Manifestations

25080 Diabetes with Other Specified Manifestations, type II or unspecified type, not stated as uncontrolled

25081 Diabetes with Other Specified Manifestations, type I, not stated as uncontrolled

25082 Diabetes with Other Specified Manifestations, type II or unspecified type, uncontrolled

25083 Diabetes with Other Specified Manifestations, type I, uncontrolled

2509 Diabetes with Unspecified Complications

25090 Diabetes with Unspecified Complications, type II or unspecified type, not stated as uncontrolled

25091 Diabetes with Unspecified Complications, type I, not stated as uncontrolled

25092 Diabetes with Unspecified Complications, type II or unspecified type, uncontrolled

| | |
|---|---|
| 25093 | Diabetes with Unspecified Complications, type I, uncontrolled |
| 3572 | Polyneuropathy in Diabetes |
| 3620 | Diabetic retinopathy |
| 36201 | Background Diabetic retinopathy |
| 36202 | Proliferative Diabetic retinopathy |
| 36641 | Diabetic cataract |
| 6480 | Diabetes mellitus |

Note: Individuals with evidence of diabetes in pregnancy (with a diabetes code of 6480 or 6488) are not included.

Acute and non-acute face-to-face claims are identified based on revenue center and HCPCS codes using either of the following algorithms:

5. One face-to-face acute encounter in either the inpatient hospital or emergency room setting:

| **CPT Code** | **Description** |
|---|---|
| 99221 | Initial Hospital Care |
| 99222 | Initial Hospital Care |
| 99223 | Initial Hospital Care |
| 99231 | Subsequent Hospital Care |
| 99232 | Subsequent Hospital Care |
| 99233 | Subsequent Hospital Care |
| 99238 | Hospital Discharge Day |
| 99239 | Hospital Discharge Day |
| 99251 | Initial Inpatient Consult |
| 99252 | Initial Inpatient Consult |
| 99253 | Initial Inpatient Consult |
| 99254 | Initial Inpatient Consult |
| 99255 | Initial Inpatient Consult |
| 99261 | Follow-Up Inpatient Consult |
| 99262 | Follow-Up Inpatient Consult |
| 99263 | Follow-Up Inpatient Consult |
| 99291 | Critical Care, First Hour |
| 99292 | Critical Care, Addl 30 Min |
| 99281 | Emergency Dept Visit |
| 99282 | Emergency Dept Visit |
| 99283 | Emergency Dept Visit |
| 99284 | Emergency Dept Visit |
| 99285 | Emergency Dept Visit |
| 99288 | Direct Advanced Life Support |
| 99356 | Prolonged Service, Inpatient |
| 99357 | Prolonged Service, Inpatient |

**Revenue Center**

| **Code** | **Description** |
|---|---|
| 010X | All inclusive rate-room and board |
| 011X | private medical or general |
| 012X | semi-private 2 beds |
| 013X | semi-private 3 or 4 beds |
| 014X | private (deluxe) |
| 015X | room and board ward |
| 016X | other room and board |
| 020X | intensive care |
| 021X | coronary care |
| 022X | special charges |
| 045X | ER |
| 072X | labor room /delivery |
| 080X | inpatient renal dialysis |
| 0981 | professional fees-ER |
| 0987 | professional fees-hospital visit |

(2) Two face-to-face non-acute encounters at least seven days apart in non-cute care settings:

**CPT**

| **Code** | **Description** |
|---|---|
| 99201 | Office/Outpatient Visit, New |
| 99202 | Office/Outpatient Visit, New |
| 99203 | Office/Outpatient Visit, New |
| 99204 | Office/Outpatient Visit, New |
| 99205 | Office/Outpatient Visit, New |
| 99211 | Office/Outpatient Visit, Est |
| 99212 | Office/Outpatient Visit, Est |
| 99213 | Office/Outpatient Visit, Est |
| 99214 | Office/Outpatient Visit, Est |
| 99215 | Office/Outpatient Visit, Est |
| 99217 | Observation Care Discharge |
| 99218 | Observation Care |
| 99219 | Observation Care |
| 99220 | Observation Care |
| 99241 | Office Consultation |
| 99242 | Office Consultation |
| 99243 | Office Consultation |
| 99244 | Office Consultation |
| 99245 | Office Consultation |
| 99271 | Confirmatory Consultation |
| 99272 | Confirmatory Consultation |

| CPT Code | Description |
|---|---|
| 99273 | Confirmatory Consultation |
| 99274 | Confirmatory Consultation |
| 99275 | Confirmatory Consultation |
| 99354 | Prolonged Service, Office |
| 99355 | Prolonged Service, Office |
| 99381 | Prev Visit, New, Infant |
| 99382 | Prev Visit, New, Age 1-4 |
| 99383 | Prev Visit, New, Age 5-11 |
| 99384 | Prev Visit, New, Age 12-17 |
| 99385 | Prev Visit, New, Age 18-39 |
| 99386 | Prev Visit, New, Age 40-64 |
| 99387 | Prev Visit, New, 65 & Over |
| 99391 | Prev Visit, Est, Infant |
| 99392 | Prev Visit, Est, Age 1-4 |
| 99393 | Prev Visit, Est, Age 5-11 |
| 99394 | Prev Visit, Est, Age 12-17 |
| 99395 | Prev Visit, Est, Age 18-39 |
| 99396 | Prev Visit, Est, Age 40-64 |
| 99397 | Prev Visit, Est, 65 & Over |
| 99401 | Preventive Counseling, Indiv |
| 99402 | Preventive Counseling, Indiv |
| 99403 | Preventive Counseling, Indiv |
| 99404 | Preventive Counseling, Indiv |
| 99411 | Preventive Counseling, Group |
| 99412 | Preventive Counseling, Group |
| 99420 | Health Risk Assessment Test |
| 99429 | Unlisted Preventive Service |
| 99341 | Home Visit, New Patient |
| 99342 | Home Visit, New Patient |
| 99343 | Home Visit, New Patient |
| 99347 | Home Visit, Est Patient |
| 99348 | Home Visit, Est Patient |
| 99349 | Home Visit, Est Patient |
| 99350 | Home Visit, Est Patient |
| 99351 | Home Visit, Est. Patient |
| 99352 | Home Visit, Est. Patient |
| 99353 | Home Visit, Est. Patient |
| 99499 | Unlisted E&M Service |
| 92002 | Eye Exam, New Patient |
| 92004 | Eye Exam, New Patient |
| 92012 | Eye Exam Established Pat |
| 92014 | Eye Exam & Treatment |
| 99301 | Nursing Facility Care |

| CPT Code | Description |
|---|---|
| 99302 | Nursing Facility Care |
| 99303 | Nursing Facility Care |
| 99311 | Nursing Fac Care, Subseq |
| 99312 | Nursing Fac Care, Subseq |
| 99313 | Nursing Fac Care, Subseq |
| 99321 | Rest Home Visit, New Patient |
| 99322 | Rest Home Visit, New Patient |
| 99323 | Rest Home Visit, New Patient |

| Revenue Center Code | Description |
|---|---|
| 049X | Ambulatory Surgical Care |
| 050x | Outpatient Service-General |
| 051x | Clinic |
| 052x | Free-Standing Clinic |
| 053x | Osteopathic Service |
| 055x | Skill Nursing |
| 056x | Medical Social Services |
| 057x | Home Health Aid |
| 058x | Other Visits (Home Health) |
| 059x | Units Of Service (Home Health) |
| 065x | Hospice Services |
| 066x | Respite Care (Hha) |
| 076x | Treatment Or Observation Room |
| 082x | Hemodialysis Op Or Home Dialysis |
| 083x | Peritoneal Dialysis Op Or Home |
| 084x | Capd Outpatient |
| 085x | Ccpd Outpatient |
| 088x | Miscellaneous Dialysis |
| 092x | Other Diagnostic Services |
| 094x | Other Therapeutic Services |
| 096x | Professional Fee-Psychiatric, Oph., Anesthetist, Etc |
| 0972 | Professional Fee-Radiology Diagnostic |
| 0973 | Professional Fee-Radiology Therapeutic |
| 0974 | Professional Fee-Nuclear Medicine |
| 0975 | Professional Fee-Operating Room |
| 0976 | Professional Fee-Respiratory Therapy |
| 0977 | Professional Fee-Physical Therapy |
| 0978 | Professional Fee-Occupational Therapy |
| 0979 | Professional Fee-Speech Pathology |
| 0982 | Professional Fee-Op Service |
| 0983 | Professional Fee-Clinic |

| Revenue Center Code | Description |
|---|---|
| 0984 | Professional Fee-Medical Social Service |
| 0985 | Professional Fee-Ekg |
| 0986 | Professional Fee-Eeg |
| 0988 | Professional Fee-Consultation |
| 0989 | Professional Fee-Private Duty Nurse |

**Numerator** : All patients with a principal diagnosis of any of the following ICD-9-CM codes:

| | |
|---|---|
| 2501 | Diabetes with Ketoacidosis |
| 25010 | Diabetes with Ketoacidosis, type II or unspecified type, not stated as uncontrolled |
| 25011 | Diabetes with Ketoacidosis, type I, not stated as uncontrolled |
| 25012 | Diabetes with Ketoacidosis, type II or unspecified type, uncontrolled |
| 25013 | Diabetes with Ketoacidosis, type I, uncontrolled |
| 2502 | Diabetes with Hyperosmolality Coma |
| 25020 | Diabetes with Hyperosmolality Coma, type II or unspecified type, not stated as uncontrolled |
| 25021 | Diabetes with Hyperosmolality Coma, type I, not stated as uncontrolled |
| 25022 | Diabetes with Hyperosmolality Coma, type II or unspecified type, uncontrolled |
| 25023 | Diabetes with Hyperosmolality Coma, type I, uncontrolled |
| 2503 | Diabetes with Other Coma |
| 25030 | Diabetes with Other Coma, type II or unspecified type, not stated as uncontrolled |
| 25031 | Diabetes with Other Coma, type I, not stated as uncontrolled |
| 25032 | Diabetes with Other Coma, type II or unspecified type, uncontrolled |
| 25033 | Diabetes with Other Coma, type I, uncontrolled |
| 2508 | Diabetes with Other Specified Manifestations |
| 25080 | Diabetes with Other Specified Manifestations, type II or unspecified type, not stated as uncontrolled |
| 25081 | Diabetes with Other Specified Manifestations, type I, not stated as uncontrolled |
| 25082 | Diabetes with Other Specified Manifestations, type II or unspecified type, uncontrolled |
| 25083 | Diabetes with Other Specified Manifestations, type I, uncontrolled |

## *DIABETES MELLITUS: LOWER LIMB PVD*

**Description**: Annual rate of admission for lower limb peripheral vascular disease (PVD) and PVD-related cellulitis among Medicare beneficiaries with diabetes mellitus.

**Denominator:** A 5% sample of Medicare Part A and B FFS beneficiaries for 12 consecutive months with a diagnosis of diabetes mellitus. Please see Diabetes Mellitus A specifications for detailed discussion of the denominator definition.

**Numerator** : All patients with a principal diagnosis of any of the following ICD-9-CM codes:

| | |
|---|---|
| 6811 | Cellulitis and Abscess of Toe |
| 68110 | Cellulitis and Abscess, Unspecified |
| 68111 | Onychia and Paronychia of Toe |
| 6826 | Other Cellulitis and Abscess of Leg, except Foot |
| 6827 | Other Cellulitis and Abscess of Foot, except Toe |
| 7854 | Diabetic Gangrene |
| 2507 | Diabetes with Peripheral Circulatory Disorders |
| 25070 | Diabetes with Peripheral Circulatory Disorders, type II or unspecified type, not stated as uncontrolled |
| 25071 | Diabetes with Peripheral Circulatory Disorders, type I, not stated as uncontrolled |
| 25072 | Diabetes with Peripheral Circulatory Disorders, type II or unspecified type, uncontrolled |
| 25073 | Diabetes with Peripheral Circulatory Disorders, type I, uncontrolled |

## *BACTERIAL PNEUMONIA*

**Description**: Annual rate of admissions with a principal diagnosis of bacterial pneumonia.

**Denominator**: All Medicare Part A and B FFS beneficiaries for 12 consecutive months.

**Numerator**: All patients with a principal diagnosis of:

| | |
|---|---|
| 481 | Pneumococcal Pneumonia |
| 482 | Other Bacterial Pneumonia |
| 4820 | K. Pneumonia |
| 4821 | Pseudomonal Pneumonia |
| 4822 | H.Influenzae Pneumonia |
| 4823 | Streptococcal Pneumonia |
| 48230 | Striptococcal Pneumonia NOS |
| 48231 | Pneumonia Streptococcus A |
| 48232 | Pneumonia Streptococcus B |
| 48239 | Pneumonia Other Strep |
| 4824 | Staphylococcal Pneumonia |
| 48240 | Staphylococcal Pneumonia |
| 48241 | Staphylococcal Aureus Pneumonia |
| 48249 | Staphylococcal Pneumonia NEC |
| 4828 | Bacterial Pneumonia NEC |
| 48281 | Pneumonia Anaerobes |
| 48282 | Pneumonia E Coli |
| 48283 | Pneumonia Other Gram-Negative Bacterial |
| 48284 | Legionnaires' Disease |
| 48289 | Pneumonia Other Specific Bacteria |
| 4829 | Bacterial Pneumonia NOS |
| 483 | Pneumonia: Organism NEC |
| 4831 | Pneumonia D/T Chlamydia |
| 4830 | Mycoplasm Pneumonia |
| 4838 | Pneumonia Other Specific Organism |
| 485 | Bronchopneumonia Organism NOS |
| 486 | Pneumonia, Organism Unspecified |

## *SEPTICEMIA*

**Description**: Annual rate of admissions with a principal diagnosis of septicemia.

**Denominator**: All Medicare Part A and B FFS beneficiaries for 12 consecutive months.

**Numerator**: All patients with a principal diagnosis of:

| | |
|---|---|
| 038 | Septicemia |
| 038.0 | Streptococcal Septicemia |
| 038.1 | Staphylococcal Septicemia |
| 038.10 | Staphylococcal Septicemia, unspecified |
| 038.11 | Staphylococcal Aureus Septicemia |
| 038.19 | Other Staphylococcal Septicemia |
| 038.2 | Pneumococal Septicemia |
| 038.3 | Septicemia due to anaerobes |
| 038.4 | Septicemia due to other gram-negative organisms |
| 038.40 | Gram-negative organism, unspecified |
| 038.41 | Hemophilus influenzae |
| 038.42 | Escherichia coli |
| 038.43 | Pseudomonas |
| 038.44 | Serratia |
| 038.49 | Other |
| 038.8 | Other specified septicemia |
| 038.9 | Unspecified septicemia |

## *ISCHEMIC STROKE*

**Description**: Annual rate of admissions with a principal diagnosis of ischemic stroke.

**Denominator:** All Medicare Part A and B FFS beneficiaries for 12 consecutive months.

**Numerator**: All patients with a principal diagnosis of:

| | |
|---|---|
| 434.0 | Cerebral thrombosis |
| 434.00 | Occlusion of cerebral arteries: Cerebral thrombosis without mention of cerebral infarction |
| 434.01 | Occlusion of cerebral arteries: Cerebral thrombosis with cerebral infarction |
| 434.1 | Cerebral embolism |
| 434.10 | Occlusion of cerebral arteries: Cerebral embolism without mention of cerebral infarction |
| 434.11 | Occlusion of cerebral arteries: Cerebral embolism with cerebral infarction |
| 434.9 | Cerebral artery occlusion, unspecified |
| 434.90 | Occlusion of cerebral arteries: Cerebral artery occlusion, unspecified and without mention of cerebral infarction |
| 434.91 | Occlusion of cerebral arteries: Cerebral artery occlusion, unspecified with cerebral infarction |
| 436 | Acute, but ill-defined cerebrovascular disease |

## *URINARY TRACT INFECTION*

**Description**: Annual rate of admissions with a principal diagnosis of urinary tract infection.

**Denominator**: All Medicare Part A and B FFS beneficiaries for 12 consecutive months.

**Numerator**: All patients with a principal diagnosis of:

| | |
|---|---|
| 599.0 | Urinary Trace Infection, site not specified |
| 599.9 | Other specified disorders of urinary tract |

## APPENDIX A-3
## GEOCODING DETAILS

The proportions used to weight the county data in the aggregation to HRRs were created using point level data from Environmental Systems Research Institute (ESRI), derived from 2000 Census Block Groups. The points represent the centroids for the smallest geographic entity for which the Census Bureau collects and tabulates decennial census information. This geographic entity is smaller than the Block Group, and may more accurately be referred to as a "neighborhood" as it is bounded on all sides by visible features such as streets, streams, and railroad tracks, and by invisible boundaries such as city, town, and county limits. There are several neighborhood centroids for each block group and each point reflects the number of people living in a specific area of the Census Block. Using such a small geographic unit helps to ensure that we obtain the most accurate count of the number of people in each HRR-county pairing.

Proportions were created by summing the neighborhood centroids' population for those portions of a county inside the HRR, and dividing by the total county population. If the result is the amount '0.10', then about 10 percent of the county's population is inside the HRR. Thus, if the county has 10 hospitals, only 0.1*10, or 1, hospital would be assigned to the portion of the county within the HRR. Summing all of the weighted counts over all counties in the HRR, we aggregated to achieve the total counts in the HRR.