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Quality of Care for Acute Myocardial Infarction: Are the Gaps Between Rural and Urban Hospitals Closing?

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WWAMI RURAL HEALTH RESEARCH CENTER

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ABOUT THE CENTER

The WWAMI Rural Health Research Center (RHRC) is one of six centers supported by the Federal Office of Rural Health Policy (FORHP), a component of the Health Resources and Services Administration (HRSA) of the U.S. Public Health Service. The major focus of the RHRC is to perform policy-oriented research on issues related to rural health care and the rural health professional workforce. Specific interests of the RHRC include the adequacy of the supply and education of rural health care professionals, and the availability and quality of health care for rural populations, with particular emphasis on access to high-quality care for vulnerable and minority rural populations.

The WWAMI Rural Health Research Center is based in the Department of Family Medicine at the University of Washington School of Medicine, and has close working relationships with the WWAMI Center for Health Workforce Studies, state offices of rural health, and the other health science schools at the University, as well as with other major universities in the five WWAMI states: Washington, Wyoming, Alaska, Montana, and Idaho. The University of Washington has over 30 years of experience as part of a decentralized educational research and service consortium involving the WWAMI states, and the activities of the RHRC are particularly focused on the needs and challenges in these states.

The Rural Health Final Report Series is a means of distributing prepublication articles and other working papers to colleagues in the field. Your comments on these papers are welcome, and should be addressed directly to the authors. Questions about the WWAMI Rural Health Research Center should be addressed to:

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Quality of Care for Acute Myocardial Infarction: Are the Gaps Between Rural and Urban Hospitals Closing?

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EXECUTIVE SUMMARY

BACKGROUND

In the mid-1990s, quality of care for AMI lagged significantly in rural hospitals, with patients in the smallest and most remote rural hospitals at greatest risk. Overall quality of AMI care has improved in the United States since that time. Whether these improvements have been consistent across rural and urban hospitals is unknown.

METHODS

This study used detailed clinical information gathered by the Medicare Quality Improvement Organizations from the hospital records of 21,616 Medicare patients discharged from short-term, non-federal hospitals in 2000-2001 with a principal diagnosis of acute myocardial infarction. Weighting the data to a nationally representative sample (n = 159,305), we compared the quality of care between admissions to hospitals in or strongly associated with urban and three levels of rural location as defined by Rural-Urban Commuting Area (RUCA) codes—urban (n = 119,011), large rural (n = 23,235), small rural (n = 13,932), and remote small rural (n = 3,127). Quality measures included receipt of aspirin within 24 hours before or after hospital arrival, aspirin prescription at discharge, beta blocker prescription at discharge, and angiotensin converting enzyme (ACE) inhibitor at discharge for those with left ventricular ejection fraction under 40%.

RESULTS

Substantial proportions of 2000-2001 admissions to all four hospital types did not receive the recommended interventions for AMI for which they

were eligible. For three of the four interventions, those admitted to small and/or remote small hospitals were the least likely to receive the recommended interventions. Logistic regression analysis adjusting for patient demographic and clinical characteristics found that those admitted to remote rural hospitals were significantly less likely than those admitted to urban hospitals to be prescribed aspirin and beta blockers at discharge and that those admitted to small rural hospitals were significantly less likely than those admitted to urban hospitals to be prescribed beta blockers at discharge. Importantly, there were no differences between large rural and urban hospitals in the adjusted risk of receiving these four acute myocardial infarction treatments.

CONCLUSIONS

In 2000-2001, admissions to large rural hospitals receive care that is essentially equivalent to that in urban hospitals, while some disparities persist between urban and small and remote small rural hospitals. Comparison to an earlier study of AMI care in rural and urban hospitals[1] suggests overall improvement in quality, yet many simple interventions that improve AMI outcomes are not adequately implemented, regardless of geographic location. Further improving AMI care in both rural and urban hospitals will require identifying hospitals' best practices, then translating these practices to the broadest range of institutions and providers.

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BACKGROUND

Improving the quality of care for acute myocardial infarction (AMI) has garnered considerable attention for over a decade. Quality improvement interventions for AMI have been developed by the American College of Cardiologists (GAP—Guidelines Applied in Practice) and the American Heart Association (GWTG—Get With the Guidelines) and applied by hospitals nationally.[2-5] These efforts are reaping benefits. Across the United States, the quality of AMI care has improved, though substantial gaps remain between actual and recommended optimal care.[6-8]

Whether patients cared for in rural and urban hospitals are reaping similar benefits from these efforts to improve the quality of AMI care is unknown. In the mid-1990s, quality of care for AMI lagged significantly in rural hospitals.[1,9,10] Patients with AMI admitted to rural hospitals were less likely to receive recommended life-saving treatments such as aspirin and reperfusion than those admitted to urban hospitals. Patients in the smallest and most remote rural hospitals were at the greatest risk.

In this study, we use the most recent national data on clinical care for AMI to examine whether differences in the quality of AMI care have persisted between urban hospitals and three types of rural hospitals. Identification of remaining gaps can help organizations tailor their quality improvement efforts to meet the needs of smaller, rural hospitals.

METHODS

DATA SOURCES

The Medicare Quality Improvement Organization systematically randomly sampled up to 750 inpatient records of Medicare patients from each U.S. state discharged from a short-term, non-federal hospital with a principal discharge diagnosis of acute myocardial infarction. Each state's discharge records were sampled over a 6-month period in 2000-2001. These records underwent extensive abstraction to gather patient demographics, measures of case severity, and elements of care during the hospitalization. The abstracted data were used to determine whether patients were eligible for and received 8 recommended quality of care indicators for the treatment of AMI. Hospital ZIP code was also included in these data, allowing classification of geographic location.

STUDY POPULATION

Medical records data were abstracted for 34,776 Medicare beneficiaries who met the above-noted sampling criteria. We then excluded those Medicare beneficiaries who did not meet the following criteria at the time of their hospitalization: (1) ages 65 years and older (excluded n = 2,945), (2) AMI confirmed by a creatine kinase MB fraction above 0.05 units, a lactate dehydrogenase level more than 1.5 times the upper limit of normal with the level of lactate dehydrogenase isoenzyme 1 greater than the level of lactate dehydrogenase isoenzyme 2, or the presence of at least two of the following: chest pain, doubling of the creatine kinase level, or electrocardiographic evidence of a new myocardial infarction (excluded n = 3,567), (3) AMI prior to rather than during their admission (excluded n = 847), and (4) known to be direct admitted for the AMI care rather than transferred from another acute care hospital (excluded n = 9,484). We also excluded 26 patients whose hospital could not be given a geographic designation. A total of 21,616

Medicare beneficiaries comprised our study population after invoking these exclusions.

STUDY VARIABLES

The rural-urban status of each hospital was determined by linking one of the 30 Rural-Urban Commuting Area (RUCA) codes to the hospital's ZIP code, and aggregating these codes to represent hospitals in or strongly associated with urban and three levels of rural locations—large rural (RUCAs 4.0, 5.0, 6.0), small rural (RUCAs 7.0, 7.2, 7.3, 7.4, 8.0, 8.2, 8.3, 8.4, 9.0, 9.1, 9.2), and remote small rural (RUCAs 10.0, 10.2, 10.3, 10.4, 10.5).[11]

Numerous characteristics describing the study patients were available for analysis, including sociodemographic factors, prior or current comorbidities, previous interventions related to coronary artery disease, severity of disease, and other factors that might influence treatment choice or severity of illness.

This study focuses on the four quality of care measures available in both the 2000-2001 database and the Cooperative Cardiovascular Project (CCP) data used in our prior study. All are measured only among those without contraindications to the intervention:

1. Receipt of aspirin within 24 hour before or after hospital arrival.
2. Aspirin prescription at discharge.
3. Beta blocker prescription at discharge.
4. Angiotensin converting enzyme (ACE) inhibitor at discharge for those with left ventricular ejection fraction under 40%.

DATA ANALYSIS

To ensure that our results were nationally representative, we weighted each state's data on the roughly 750 AMI cases up to the expected number of AMIs based on the age and gender distribution using the following method. We used available data on all AMIs nationally in 1994-1995[1] to calculate the AMI rate for each of six age (65-74, 75-84, 85 years and older)/gender categories by state at that time. State-level data were missing for five states. For these, we used the overall U.S. AMI rate for each of the age/gender categories. Assuming a constant AMI rate, we applied the 1994-1995 rates to the 2000-2001 census population data to calculate an expected number of AMIs in each state for each of the six age/gender categories. The ratio of expected to actual numbers of AMIs generated state/age/gender-specific weights. Using this weighting strategy, the 21,616 Medicare beneficiaries in our sample represented a projected 159,305 individuals nationally.

We describe and compare the characteristics of our weighted admissions by the geographic location of the hospital in which they were treated, using chi square and standard Student t-tests to identify statistically significant differences. We then use chi-square tests to compare the unadjusted intervention rates of weighted admissions to the hospitals in the four geographic locations. Last, we conducted multivariate logistic regression analysis using the SUDAAN software package to examine the odds of receipt of the different interventions among admissions in each of the three rural hospital locations compared to those in urban hospitals, controlling for the patient characteristics listed above. Because the study measures are relatively common, the odds ratios and their confidence intervals were converted to relative risks using published methods.[12] We present these findings alongside those of our prior study in the tables.

RESULTS

Those individuals admitted to all four types of hospital in 2000-2001 were in their late 70s, were predominantly non-Hispanic Caucasian, and had a range of comorbidities (Table 1). The majority of all four groups carried a diagnosis of hypertension, though there were significant differences between the hospital types, with the lowest rates of hypertension among those admitted to remote small hospitals. There were significant differences in rates of other characteristics as well. Remote small hospital admissions had the highest rates of chronic obstructive pulmonary disease and admission from a skilled nursing or intermediate care facility. Not unexpectedly, urban hospital admissions had high rates of prior percutaneous transluminal coronary angioplasty (PTCA) and coronary artery bypass graft (CABG).

Substantial proportions of admissions to all four hospital types did not receive the recommended interventions for AMI for which they were eligible (Table 2). Aspirin within 24 hours before and after admission was received by between 76.4% and 83.0% of admissions, aspirin prescription at discharge by 64.7% and 82.0%, beta blocker prescription at discharge by 53.4% and 69.2%, angiotensin converting enzyme (ACE) inhibitor prescription at discharge by 61.2% and 68.8%, all depending on the geographic location of their treating hospital.

Unadjusted rates of three of the four recommended AMI interventions examined in this study were significantly different between those admitted to the four hospital types (Table 2). For all but ACE inhibitor prescription at discharge, those admitted to small and/or remote small hospitals were the least likely to receive the recommended interventions. For

Table 1. Characteristics of Admissions for Acute Myocardial Infarction by Geographic Location of Admitting Hospital (2000)

Admission Characteristics	Urban (n = 119,011)	Large Rural (n = 23,235)	Small Rural (n = 13,932)	Remote Small Rural (n = 3,127)	*P* Value*	All Admissions† (n = 159,305)
Age (SD)	77.3 (21.8)	77.2 (17.6)	77.9 (18.5)	77.6 (17.0)	0.004	77.3 (20.5)
Female (%)	48.8	47.6	51.7	47.2	<0.001	48.8
White non-Hispanic (%)	88.9	94.2	94.7	95.7	<0.001	90.4
Diabetes (%)	35.3	36.6	37.9	40.0	<0.001	35.8
Hypertension (%)	74.4	74.8	71.8	64.7	<0.001	74.0
Congestive heart failure (%)	31.9	31.9	32.7	30.8	0.163	32.0
Cerebrovascular accident (%)	19.9	21.0	20.2	18.4	<0.001	20.0
Previous MI (%)	38.3	40.3	37.3	31.3	<0.001	38.3
Chronic obstructive pulmonary disease (%)	24.7	27.0	28.9	29.5	<0.001	25.5
Prior PTCA (%)	15.2	13.7	11.5	8.9	<0.001	14.5
Prior CABG (%)	19.0	19.2	15.4	17.0	<0.001	18.7
Current smoking (%)	15.8	16.6	16.3	15.4	0.009	15.9
Terminal illness (%)	0.2	0.1	0.1	0.1	<0.001	0.2
Incontinent (%)	15.7	17.8	20.0	17.1	<0.001	16.5
Dementia (%)	10.1	9.4	12.4	8.9	<0.001	10.2
Admitted from SNF or ICF (%)	8.1	8.5	11.5	11.7	<0.001	8.5
Metastatic cancer (%)	1.4	1.3	0.7	2.4	<0.001	1.3
APACHE II (SD)	8.8 (9.1)	8.9 (7.1)	9.0 (7.4)	8.9 (7.4)	0.334	8.9 (8.5)
Limitation of resuscitation (%)	20.1	22.2	24.7	24.7	<0.001	20.9
Chest pain >6 hours (%)	12.7	14.9	12.7	8.2	<0.001	12.9

MI = myocardial infarction; PTCA = percutaneous transluminal coronary angioplasty; CABG = coronary artery bypass graft; SNF = skilled nursing facility; ICF = intermediate care facility; APACHE = acute physiological and chronic health evaluation.
Weighted estimates are based on data from the following numbers of chart abstracts: urban 14,337, large rural 4,244, small rural 2,423, remote small rural 612, total 21,616.

* *P* value for overall chi-square or t-test between admissions in hospitals in different geographic areas.
† Missing values: race 1,792, incontinence 7,640, APACHE II 1,680, chest pain 15,068.

Table 2. Unadjusted Rates of Acute Myocardial Infarction Treatment Use by Hospital Geographic Location

Treatments	Urban	Large Rural	Small Rural	Remote Small Rural	*P* Value
Aspirin within 24 hours* (%)					
2000-2001†	82.2	83.0	79.8	76.4	0.040
1994-1995‡	55.9	55.8	51.4	47.8	≤0.001
Aspirin at discharge (%)					
2000-2001†	82.0	78.0	77.4	64.7	≤0.001
1994-1995‡	76.4	74.4	71.1	67.7	≤0.001
Beta blocker at discharge (%)					
2000-2001†	69.2	68.3	59.9	53.4	≤0.001
1994-1995‡	51.8	49.6	47.2	55.4	0.160
ACE inhibitor§ at discharge (%)					
2000-2001†	61.2	62.7	62.6	68.8	0.806
1994-1995‡	59.4	63.1	56.9	64.0	0.021

* Aspirin within 24 hours before or after hospital arrival.
† AMI treatment use rates for 2000-2001 are based on weighted data.
‡ Data excerpted from prior study: Baldwin LM, MacLehose RF, Hart LG, Beaver SK, Every N, Chan L. Quality of care for acute myocardial infarction in rural and urban U.S. hospitals. *J Rural Health*. Spring 2004;20(2):99-108.
§ ACE inhibitor = angiotensin converting enzyme inhibitor.

example, among those ideally eligible, 69.2% of urban hospital admissions and 68.3% of large rural hospital admissions were prescribed a beta blocker at the time of discharge, compared to 59.9% of small rural and 53.4% of remote small rural hospital admissions.

Logistic regression analysis adjusting for patient demographic and clinical characteristics found that those admitted to remote small rural hospitals were significantly less likely than those admitted to urban hospitals to receive two myocardial infarction treatments—prescription of aspirin and beta blockers at discharge (Table 3). Those admitted to small rural and urban hospitals had roughly equivalent likelihood of all myocardial infarction treatments except prescription of beta blocker at discharge, which was significantly lower in small rural hospitals. There were no differences between large rural and urban hospitals in the adjusted risk of any acute myocardial infarction treatments. There also were no significant differences in aspirin receipt within 24 hours before or after hospital arrival or in ACE inhibitor prescription between urban and any of the rural hospitals.

Table 3. Adjusted Relative Risk of Acute Myocardial Infarction Treatment Use by Hospital Geographic Location

Treatments	Urban	Large Rural	Small Rural	Remote Small Rural
Aspirin within 24 hours*				
2000-2001	Reference	1.01 (0.99-1.03)	0.98 (0.95-1.01)	0.94 (0.86-1.01)
1994-1995	Reference	0.99 (0.97-1.02)	0.93 (0.90-0.96)	0.87 (0.82-0.93)
Aspirin at discharge				
2000-2001	Reference	0.97 (0.93-1.00)	1.00 (0.95-1.04)	0.83 (0.72-0.93)
1994-1995	Reference	0.99 (0.96-1.01)	0.95 (0.92-0.98)	0.90 (0.86-0.96)
Beta blocker at discharge				
2000-2001	Reference	1.00 (0.96-1.05)	0.94 (0.87-1.00)	0.81 (0.67-0.94)
1994-1995	Reference	0.97 (0.89-1.05)	0.93 (0.83-1.05)	1.07 (0.83-1.38)
ACE inhibitor† at discharge				
2000-2001	Reference	1.04 (0.95-1.13)	1.06 (0.91-1.19)	1.16 (0.84-1.38)
1994-1995	Reference	1.06 (1.01-1.11)	0.94 (0.87-1.02)	1.08 (0.93-1.24)

* Aspirin within 24 hours before or after hospital arrival.
† ACE inhibitor = angiotensin converting enzyme inhibitor.

DISCUSSION

In the mid-1990s, several studies demonstrated clear disparities in receipt of recommended AMI interventions between rural and urban Medicare beneficiaries, with remote rural hospitals the least likely to offer recommended care.[1,9,10] Most notably at that time, however, there were deficits in receipt of the most basic recommended AMI interventions among patients at both urban and rural hospitals. This study's reexamination of rural-urban differences in AMI care six years later suggests overall improvement in the three of the four quality measures common to these two studies. Additional good news is that admissions to large rural hospitals receive care that is essentially equivalent to that in urban hospitals. Disparities persist, however, in prescription of two of the three recommended discharge medications among AMI admissions to remote small rural hospitals, and one of the three recommended discharge medications among AMI admissions to small rural hospitals.

The most notable improvement in recommended AMI treatment over time was in the use of aspirin within 24 hours. With only about half of AMI patients having received early aspirin in the mid-1990s, receipt rates between 76.4% and 82.2% in 2000-2001 represent an overall increase in early aspirin use of 1.5 times that only six years before. This is a significant success story for the many quality improvement programs working with patients, emergency personnel, physicians, and hospitals to disseminate the guidelines for simple interventions such as aspirin.

Another intervention that appears to have improved in most geographic locations over time is the prescription of beta blockers at discharge from the hospital. In the mid-1990s, only about half of AMI patients received beta blockers at discharge, whereas in 2000-2001 in urban, large rural, and small rural areas, between 59.9% and 69.3% of eligible AMI patients received this treatment. There is room for substantial improvement in receipt of this recommended treatment, especially in remote rural areas, which did not demonstrate improvement in prescription of discharge beta blockers over time.

Those interventions with higher use rates in the mid-1990s, ACE inhibitor and aspirin prescription at discharge, overall demonstrated only minor improvements over time. There is substantial room for improvement in the prescription of both of these interventions at discharge, especially ACE inhibitors.

Our adjusted analyses comparing care between admissions to rural and urban hospitals found that it is in prescription of the discharge medications that the greatest disparities between small and remote small rural and urban hospitals persist. AMI admissions to remote small rural hospitals are significantly less likely than those admitted to urban hospitals to receive an aspirin and a beta blocker prescription at discharge. AMI admissions to small rural hospitals are significantly less likely than those admitted to urban hospitals to receive a beta blocker prescription at discharge. Discharge medications may be at the discretion of the physician to a greater degree than many of the other interventions studied, which may be directed by emergency response, emergency room, or hospital protocols. Emergency response and hospital systems may be more easily influenced than individual physician practice.

This project is limited by the age of its data. It has used the richest national population-based data source available on AMI care in rural hospitals. However, several quality improvement projects, such as the American Hospital Association's "Get With The Guidelines" program, became more widely available shortly before this study's data were gathered. There have undoubtedly been ongoing changes in adherence to the AMI care guidelines in both rural and urban hospitals that are not reflected in these findings. We were able to find one study using more recent data to examine differences in AMI quality between a limited set of rural critical access hospitals and urban hospitals, and its findings were consistent with those of this study.[13] Our comparison of 1995-1996 and 2000-2001 data must be interpreted with caution, as there were some differences in ascertainment of AMI cases in the two time periods. The consistency of our data with other published AMI treatment rates is reassuring, however.

IMPLICATIONS

This study supports the need for continued monitoring of adherence to guidelines in caring for AMI patients. Many simple, evidence-based guidelines that can improve outcomes in AMI care are not adequately implemented in patient care. In small and remote small rural locations, special attention should be paid to educating individual physicians about beneficial discharge medications that have life-saving benefits for their patients. Further improving care for AMI patients will likely require understanding more about the strategies employed by those institutions demonstrating the greatest improvements, especially in the area of prescription of discharge medications. If best practices in quality improvement can be identified, additional efforts to translate these practices to the broadest range of institutions and providers can be mounted to ensure that individuals with AMI are receiving the highest quality care regardless of their geographic location.

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