# Acute myocardial infarction

## *Quality of care in rural Alberta*

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**ABSTRACT**

**OBJECTIVE** To assess the quality of care of acute myocardial infarction (AMI) in a rural health region.

**DESIGN** Clinical audit employing multiple explicit criteria of care elements for emergency department and in-hospital AMI management. The audit was conducted using retrospective chart review.

**SETTING** Twelve acute care health centres and hospitals in the East Central Health Region, a rural health region in Alberta, where medical and surgical services are provided almost entirely by family physicians.

**PARTICIPANTS** Hospital inpatients with a confirmed discharge diagnosis of AMI (ICD-9-CM codes 410.xx) during the period April 1, 2001, to March 31, 2002, were included (177 confirmed cases).

**MAIN OUTCOME MEASURES** Quality of AMI care was assessed using guidelines from the American College of Cardiology and the American Heart Association and the Canadian Cardiovascular Outcomes Research Team and Canadian Cardiovascular Society. Quality of care indicators at three stages of patient care were assessed: at initial recognition and AMI management in the emergency department, during in-hospital AMI management, and at preparation for discharge from hospital.

**RESULTS** In the emergency department, the quality of care was high for most procedural and therapeutic audit elements, with the exception of rapid electrocardiography, urinalysis, and provision of nitroglycerin and morphine. Average door-to-needle time for thrombolysis was 102.5 minutes. The quality of in-hospital care was high for most elements, but low for nitroglycerin and angiotensin-converting enzyme (ACE) inhibitors, daily electrocardiography, and counseling regarding smoking cessation and diet. Few patients received counseling for lifestyle changes at hospital discharge. Male and younger patients were treated more aggressively than female and older patients. Sites that used care protocols achieved better results in initial AMI management than sites that did not. Stress testing was not readily available in the rural region studied.

**CONCLUSION** Quality of care for patients with AMI in this rural health region was high for most guideline elements. Standing orders, protocols, and checklists could improve care. Training and resource issues will need to be addressed to improve access to stress testing for rural patients. Clinical audit should be at the core of a system for local monitoring of quality of care.

**EDITOR'S KEY POINTS**

- Some studies have reported that, compared with urban hospitals, the quality of care for patients with AMI in rural hospitals is relatively poor.
- In 2001, the Canadian Institute for Health Information published a report in which the East Central Health Region (ECHR), a rural health region in Alberta, ranked second highest in the country for 30-day AMI in-hospital mortality.
- Criterion standards for assessing the quality of AMI management in the ECHR were the American College of Cardiology and American Heart Association Guidelines for the Management of Patients with Myocardial Infarction and the Canadian Cardiovascular Outcomes Research Team and Canadian Cardiovascular Society Quality Indicators for Acute Myocardial Infarction Care.
- Sites that used a care protocol achieved better results in initial AMI management than sites that did not.

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Many Canadians receive acute myocardial infarction (AMI) care in rural hospitals, but little is known about the quality of AMI management in rural practice. Managing AMI challenges rural hospitals and their staffs because the condition is relatively rare, because round-the-clock medical personnel are needed on site, and because care for widely scattered populations is compromised simply as a function of time and distance from a health facility.[1]

Some American studies have reported that patients with AMI get poorer care in rural hospitals than they do in urban hospitals.[2] Recent Canadian data[3,4] indicate that older Canadians with AMI do not receive the same quality of care as their younger counterparts. Other studies suggest that women receive less effective treatment than men, despite having a higher mortality rate.[5-8]

There are no adequate studies of AMI care in rural Canada. The most relevant literature for Canadians regarding rural AMI management comes from the United States,[2,9] but there is little of it. Established benchmarks are derived from large administrative databases that include outcomes from tertiary hospital coronary care units.[10,11]

In 2001, the Canadian Institute for Health Information published a report[12] in which the East Central Health Region (ECHR), a rural health region in Alberta, ranked second highest in the country for 30-day AMI in-hospital mortality (17% versus the Canadian average of 12.65%). In light of these data, the ECHR set out to examine the quality of care being provided to patients presenting with AMI at its 12 health centres and hospitals. Given the disproportionate number of elderly people residing in the region, the question of whether age bias influenced AMI treatment needed to be addressed. Objectives were to measure quality of care against AMI management criterion standards, to determine whether there was age and sex bias in AMI management, and to propose strategies to improve care.

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## METHODS

This study was a clinical audit, which is "a quality improvement process that seeks to improve patient care and outcomes through systematic review of care against explicit criteria and the implementation of change."[13] The audit was conducted using retrospective chart review.

### Setting

The province of Alberta is divided into nine health regions. The ECHR, located in the east central part of the province, encompasses an area of 176 000 km$^2$ and is a predominantly agricultural area with a population of 110 000 people dispersed in 84 communities. The ECHR is unique in that 15.4% of its residents are older than 65 years (the provincial average is 10%). The 12 acute care hospitals and health centres located in the ECHR range in size from five to 76 beds. There are 256 acute care beds available overall. The region's closest tertiary care hospital is in Edmonton, located between 67 to 290 km away, depending on community. Medical and surgical services within the region are provided almost entirely by family physicians. During the study period, stress testing was not readily available in the ECHR. Access to stress testing was available only in Edmonton or through a cardiologist who visited once monthly.

### Study patients

The health records from the 12 ECHR health centres and hospitals of all inpatients with a confirmed discharge diagnosis of AMI (ICD-9-CM codes 410.xx) during the period April 1, 2001, to March 31, 2002, inclusive, were identified from a 3M inpatient database and reviewed retrospectively. Discharged patients who had arrived in emergency departments with a confirmed diagnosis of AMI during

the study period were also included. Patients who presented with cardiac arrest or who were dead on arrival were excluded. The discharge diagnosis was confirmed using the World Health Organization's definition of AMI, which requires the presence of at least two of the following criteria:

- a clinical history of ischemic-type chest discomfort,
- changes on serially obtained electrocardiograms (ECGs), or
- a rise and fall in serum cardiac markers.[14]

## Quality and standard of care

The criterion standards for assessing the quality of AMI management in the ECHR used in this study were the American College of Cardiology and American Heart Association Guidelines for the Management of Patients with Myocardial Infarction[15] and the Canadian Cardiovascular Outcomes Research Team and Canadian Cardiovascular Society Quality Indicators for Acute Myocardial Infarction Care.[16] The "elements" of the audit were defined as those clinical features (ie, quality of care indicators) desired to be found at three stages of patient care:

- at initial recognition and AMI management in an emergency department,
- during in-hospital AMI management, and
- at preparation for discharge from hospital.

Although stress testing is included in the guidelines, we did not include stress testing due to poor access to it within the ECHR. If patients were sent for stress testing outside the region or saw a visiting cardiologist, results of this encounter would not be recorded in their charts, and access to their medical records outside the hospital record was beyond the scope of this study.

The "standard" for each element was defined as the percentage of eligible patients for whom the respective element was expected to be used. Standards were defined before the audit was done and, depending on the element, ranged from 30% to 100%. We had no rural hospital benchmarks on which to base our standards; therefore, very high standards were set for most elements.

## Data collection and analysis

For each case of AMI, binary data were collected as either performing or not performing each element, mitigated by exclusion criteria when applicable. Only patients eligible to receive the treatment or procedure were included in the denominator for calculating the percentage of times that an element met its standard. Patients were considered ineligible to receive the treatment if they had known contraindications to it or if clinical indicators did not warrant a particular treatment.

Confidentiality was maintained by not recording patient names on the data collection form. Data collection was conducted during June and July 2003 by a medical student (T.D.) who was trained in performing chart reviews. The audit process was not blinded to patients or physicians, although names were not recorded.

Descriptive data analysis was performed using SPSS for Windows. Chi-square and Fisher exact tests were used to test for differences between groups by age and sex. An alpha level of .05 was used to test for statistical significance.

Ethical approval for the study was obtained from the Health Research Ethics Board at the University of Alberta.

# RESULTS

A total of 177 cases with confirmed AMI presented during the study period. Patients ranged in age from 41 to 96 years (average 71 years); 128 patients (72.3%) were between 60 and 89 years. The patient cohort was predominantly male (66.1% versus 33.9% female); mean age of men was younger than mean age of women (67.9 years versus 77 years).

## Emergency department AMI management

Time from onset of AMI symptoms to presentation in the emergency department was 1 hour or less for 24.8% of AMI patients and was 12 hours or more for 22.6%. **Table 1** illustrates the degree to which quality-of-care indicators for initial management were met in the 12 health centres and hospitals in the ECHR. In general, patient history and physical examination were poorly documented, but the quality of care was high for most of the procedural

**Table 1.** Acute myocardial infarction management in emergency departments

| QUALITY OF CARE INDICATORS | STANDARD (%) | OBSERVED (%) |
|---|---|---|
| **PATIENT HISTORY (n = 175*)** | | |
| AMI symptoms (chest pain, dyspnea, vomiting, sweating) (n = 167) | 100 | 87.4 |
| Previous angina, myocardial infarction, hypertension, cardiac problems | 100 | 82.3 |
| Smoking habits | 100 | 47.4 |
| Diabetes | 100 | 38.3 |
| Family history of myocardial infarction, cardiac problems | 100 | 35.4 |
| Peripheral vascular disease | 100 | 4.6 |
| **PHYSICAL EXAMINATION (n = 177)** | | |
| Blood pressure measurement | 100 | 100 |
| Heart rhythm and rate | 100 | 92.7 |
| Adventitious respiratory sounds | 80 | 68.9 |
| Heart sounds | 80 | 65.0 |
| Jugular venous pulse | 100 | 32.2 |
| Murmurs (presence or absence) | 80 | 28.8 |
| Cardiac apex location | 80 | 7.9 |
| Cardiac rubs (presence or absence) | 80 | 5.1 |
| Pleural rubs (presence or absence) | 80 | 5.1 |
| **INITIATION OF AMI PROTOCOL (n = 177†)** | | |
| Cardiac enzymes assessed (n = 175) | 100 | 98.3 |
| Continuous ECG monitoring (n = 174) | 100 | 97.7 |
| Complete blood count assessed | 100 | 96.6 |
| Intravenous access established (n = 156) | 100 | 93.6 |
| Electrolytes assessed | 100 | 91.0 |
| Creatinine assessed | 100 | 83.6 |
| Chest x-ray examination completed within 24 hours | 100 | 78.5 |
| 12-lead ECG obtained within 10 minutes (n = 174) | 80 | 43.1 |
| Urinalysis completed | 100 | 41.8 |
| **INITIAL DRUG THERAPY** | | |
| Oxygen provided (n = 177) | 100 | 98.3 |
| Acetylsalicylic acid (160-325 mg) chewed or clopidogrel given if patient is allergic to ASA (n = 174) | 100 | 86.1 |
| Sublingual nitroglycerin given in three doses 5 minutes apart as needed (n = 172) | 100 | 71.5 |
| Morphine provided (n = 153) | 100 | 67.3 |

*AMI—acute myocardial infarction, ECG—electrocardiogram.*
**Percentages observed for all elements of patient history were based on a denominator of 175 (two patients were unable to provide a history), except where indicated otherwise.*
*†Percentages for initiation of AMI protocol were based on a denominator of 177, except where indicated otherwise.*

and therapeutic audit elements, with the exceptions of rapid ECG, urinalysis, and provision of nitroglycerin and morphine.

Thrombolytic drugs were given to 75.4% of eligible patients. Door-to-needle time ranged from 20 to 384 minutes; the mean was 102.5 minutes. Among patients who received thrombolytic drugs, 7.1% were treated within 30 minutes, 28.6% between 31 and 60 minutes, 38.1% between 61 and 120 minutes, and 26.2% after more than 121 minutes.

A consultation with either a cardiologist or a general internist was arranged for 59.1% of patients. This was done significantly more often ($P = .008$) for men (66.4%) than for women (43.6%). A consultation was obtained for 71.3% of all complicated cases (those with arrhythmias, cardiogenic shock, congestive heart failure, pericarditis, ongoing angina). The consultation was most often conducted using a computerized Critical Care Line, which linked the ECHR facility with a specialist referral centre.

## In-hospital AMI management

The quality of in-hospital AMI care was high for most of the audit elements, but low for provision of nitroglycerin and ACE inhibitors, daily ECG, and counseling regarding smoking cessation and diet (**Table 2**).

**Table 2.** In-hospital AMI management

| QUALITY OF CARE INDICATORS | STANDARD (%) | OBSERVED (%) |
|---|---|---|
| Less than full activity for 12 hours (n = 175) | 100 | 97.1 |
| Activity advanced as tolerated (n = 129) | 100 | 93.8 |
| Heparin provided (n = 161) | 100 | 88.2 |
| Beta-blocker provided (n = 148) | 100 | 86.5 |
| Acetylsalicylic acid provided (n = 140) | 100 | 85.0 |
| 12-lead electrocardiography daily for 2 days and until stable (n = 132) | 100 | 78.0 |
| Nitroglycerin provided for ongoing pain (n = 142) | 100 | 73.2 |
| Angiotensin-converting enzyme inhibitor provided (n = 168) | 100 | 64.3 |
| Dietary counseling documented or ordered (n = 159) | 100 | 23.9 |
| Smoking cessation counseling documented (n = 45) | 100 | 13.3 |

Each of heparin, acetylsalicylic acid, and a beta-blocker were given to 73.7% of eligible patients. For

treatment with beta-blockers specifically, a greater proportion ($P = .002$) of men (93%) than women (72.9%) were treated, and a greater proportion ($P = .02$) of younger (94.2%) than older (79.7%) patients were treated.

## Hospital discharge of AMI patients

The quality of care was generally high for most audit elements related to hospital discharge planning for AMI patients, but low for lifestyle changes: diet and exercise (**Table 3**). The standard for referral to a cardiac rehabilitation program was set relatively low simply because few programs are currently available in the ECHR.

**Table 3. Preparation for hospital discharge of AMI patients**

| QUALITY OF CARE INDICATORS | STANDARD (%) | OBSERVED (%) |
|---|---|---|
| Ambulant on discharge (n = 84) | 100 | 97.6 |
| Free from pain on discharge (n = 90) | 100 | 95.6 |
| Pulse recorded as normal or stable on discharge (n = 80) | 100 | 93.8 |
| Angiotensis-converting enzyme inhibitor prescribed if systolic dysfunction (n = 76) | 75 | 86.8 |
| Beta-blocker prescribed (n = 82) | 75 | 86.6 |
| Acetylsalicylic acid prescribed (n = 90) | 75 | 85.6 |
| Statins prescribed if low-density lipoprotein level > 100 mg/dL (n = 34) | 75 | 85.3 |
| Nitroglycerin prescribed (n = 91) | 75 | 82.4 |
| Heart-healthy diet prescribed (n = 93) | 100 | 44.1 |
| Referred to dietitian (n = 96) | 100 | 25.0 |
| Referred to cardiac rehabilitation program (n = 95) | 30 | 20.0 |
| Regular aerobic exercise prescribed (n = 90) | 100 | 6.6 |

## Outcomes

Of the 177 patients who presented with AMI during the study period, 72 (40.7%) were transferred to tertiary-level care. Most of the transferred patients (63.9%) had complications, mainly arrhythmias or cardiogenic shock. More men (46.2%, $P = .05$) and younger patients (54.5%, $P = .001$) were transferred to tertiary care than women (30%) and older patients (29.6%).

The overall in-hospital mortality rate within the ECHR for AMI patients was 7.9% (14/177). Average age of patients who died was 79.9 years.

## Care protocol checklist

During data collection, it became evident that some sites used standing orders or care protocols for AMI management and other sites did not. We compared the findings in the four sites (n = 71) that employed care protocols and the eight sites (n = 106) that did not. The four sites that used care protocols consistently achieved better results in the initial AMI care quality indicators than did the sites that did not (**Table 4**). Time from hospital arrival to ECG took about half as long (average 13.8 minutes versus 27 minutes), and door-to-needle time was 11 minutes faster in sites employing care protocols.

**Table 4. Comparison of sites with and without care protocol checklists**

| | WITH CHECKLIST | | WITHOUT CHECKLIST | | |
|---|---|---|---|---|---|
| QUALITY OF CARE INDICATORS | N | % | N | % | *P* VALUE* |
| Intravenous access obtained | 56 | 92.9 | 100 | 94.0 | 1.00 |
| 12-lead electrocardiogram obtained within 10 minutes | 71 | 66.2 | 103 | 27.2 | < .001 |
| Acetylsalicylic acid given to chew on arrival | 68 | 89.7 | 105 | 83.8 | .38 |
| Sublingual nitroglycerin given on arrival | 68 | 77.9 | 104 | 67.3 | .18 |
| Oxygen provided | 71 | 100.0 | 106 | 97.2 | .40 |
| Morphine given | 66 | 78.8 | 87 | 58.6 | .01 |
| Thrombolysis | 34 | 88.2 | 23 | 56.5 | .02 |
| Chest x-ray examination completed within 24 hours | 71 | 84.5 | 106 | 74.5 | .16 |
| Complete blood count completed | 71 | 100.0 | 106 | 94.3 | .11 |
| Electrolytes assessed | 71 | 93.0 | 106 | 89.6 | .62 |
| Creatinine assessed | 71 | 91.5 | 106 | 78.3 | .03 |
| Urinalysis completed | 71 | 59.2 | 106 | 30.2 | < .001 |

**Chi-square P value with continuity correction for 2x2 table.*

## DISCUSSION

To our knowledge, this is the first rural, multi-facility audit of quality of care for AMI management in Canada. Hence, there are few benchmark data against which to compare our results.

The ECHR, as a whole, performed comparatively well in the quality-of-care indicators for in-hospital AMI management and for preparation for discharge. The ECHR facilities generally met the standards[16] for six basic quality-of-care measures in these areas. The area of poorest performance was in thrombolytic reperfusion during hospitalization. While 75.4% of eligible patients received thrombolytic drugs, only 7.1% met the standard of being treated within 30 minutes of arriving at the hospital. Average door-to-needle time in the ECHR was 102.5 minutes; the Canadian average is 69 minutes.[17] Many factors conspire to prevent rapid thrombolysis in rural Canadian hospitals, distance and staff availability chief among them.

While few data document the quality of AMI care in rural areas, our findings are consistent with a Quebec study of management of unstable angina in a rural hospital[18] that also reported comparably high quality of care for ASA started on admission (76.7%) and for heparin administration (86%). Provision of beta-blockers and ACE inhibitors was markedly higher in our study than in a study from rural Australia.[19,20]

A key question is to what extent quality of AMI care in rural areas is similar to quality of care in urban centres. While this assessment was beyond the scope of our study, our findings can be compared with those in the published literature. Data from 27 Canadian tertiary care hospitals in the GUSTO trial[21] revealed that 98% of inpatients with myocardial infarction received ASA, 86% beta-blockers, and 32% ACE inhibitors; 69% were prescribed beta-blockers and 22% ACE inhibitors at discharge. Our rural data indicate comparably high results for ASA (85%) and beta-blockers (86.5%), and far better results for ACE inhibitors (64.3%) provided in-hospital; as well as more prescriptions for ACE inhibitors (86.8%) and beta-blockers (86.6%) at discharge. By comparison, Australian data[22] up to 11 years older than ours reveal that, in metropolitan hospitals, 87% of AMI inpatients received ASA, 38% received ACE inhibitors, and 52% received beta-blockers.

In assessing patient age as a factor in AMI care, we found that younger patients (41 to 69 years) received significantly better care for most quality indicators than did older patients (70 to 96 years), despite the fact that the older patients tended to have more complicated AMIs. There were fewer specialist consultations or transfers to tertiary centres and, as a consequence, significantly fewer therapies, such as percutaneous transluminal coronary angioplasty, were offered to older patients, even though Alberta data show elderly patients who undergo revascularization procedures have better outcomes than those who receive only medical therapy.[23] Care for elderly patients can be improved by educating staff physicians and nurses on the benefits of following care protocols and on being willing to consider more aggressive treatments.

Like older patients, women in this study were also disadvantaged. Therapies such as ASA and nitroglycerin on arrival, beta-blockers, and heparin were given to women significantly less often than they were to men. Women had fewer transfers to tertiary centres ($P = .038$) and received percutaneous transluminal coronary angioplasty less often ($P = .017$). It is unclear why a sex bias exists, but it is consistent with findings from elsewhere in Canada.[7]

This audit has identified several areas where improvements in AMI care can be made. One of these areas is documentation. Many important aspects of patients' history and physical examination were unrecorded. While chart abstraction methodology underestimates the quality of care provided, and medical records are neither sensitive nor specific,[24] physicians often do not record negative findings. In rural hospitals, however, physicians frequently rotate in-hospital ward coverage, and having complete information is vital for continuity of care. A simple process change, such as a checklist incorporating the key elements of history and physical examination, could easily be developed. Similarly, standing orders for patients presenting with cardiac-type chest pain would improve the consistency and quality of initial AMI management. Given that most rural physicians see only about

three AMI patients per year,[25] and that AMI survival directly correlates with hospital volume[26] of AMI patients treated, simple tools such as these should contribute to better care.

This study, because of its retrospective nature, has limitations. Quality-of-care indicators were considered to be present only if they were recorded in patients' charts; however, absence of indicators does not necessarily mean they were not done. This is especially true in the areas of history and physical examination and health promotion (eg, advice regarding smoking cessation).[27] We did not have access to the health records of all patients transferred to tertiary centres, and as a result could have underestimated the number of our patients who received the more aggressive therapies of percutaneous transluminal coronary angioplasty or coronary artery bypass grafting. The generalizability of our findings to other rural areas is unknown.

The lack of ready access to stress testing is clearly a weakness in AMI management in the ECHR, as it could be in other rural areas. This is a training and resource issue. If rural cardiac care is to be improved, family physicians need to have training opportunities in stress testing, and rural regions must allocate resources to make stress testing readily available to rural patients.

Clinical audits are useful only insofar as they bring about improvements. As a result of this study, all ECHR health centres and hospitals have implemented a chest pain protocol and a standing order sheet for use in the emergency department. A "care map" to guide in-hospital AMI management is being developed. A Cardiac Care Group has been established to update protocols and care maps. This group is chaired by the Director of Medical Services and consists of a tertiary care cardiologist, two internists from within the region, a rural family physician with an interest and special training in cardiology, a pharmacist, and the program leader from emergency nursing. We plan to repeat the audit cycle after changes have been made.

## CONCLUSION

In the rural health region studied, the quality of AMI care in the emergency department was high for most procedural and therapeutic elements. Men and younger patients were treated more aggressively than women and older patients were. Records of discharge planning for AMI management that requred lifestyle changes were poor. Sites that used care protocols achieved better results in initial AMI management than sites that did not. Poor availability of stress testing in rural practice is a weakness in AMI management. Clinical audit should be at the core of a system of local monitoring. It can indicate rapidly and accurately where improvements can be made.

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**Contributors**

**Dr Domes** *conducted chart reviews, performed data analysis, contributed to interpretation of study findings, and wrote a summary report of study findings.* **Ms Szafran** *was involved in conception and design of the study, ethics application, data analysis and interpretation, and manuscript preparation.* **Ms Bilous** *participated in conception and design of the study, ethics application, and interpretation of study findings. She also supervised the chart review.* **Dr Olson** *contributed to conception and design of the study and interpretation of study findings.* **Dr Spooner** *was involved in conception and design of the study, interpretation of study findings, and manuscript preparation. All authors reviewed and approved the manuscript submitted.*

**Competing interests**

*None declared*

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