

## Chapter 25: CCORT/CCS quality indicators for acute myocardial infarction care

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**BACKGROUND:** Although quality indicators for the care of acute myocardial infarction (AMI) patients have been described for other countries, there are none specifically designed for the Canadian health care system. The authors' goal was to develop a set of Canadian quality indicators for AMI care.

**METHODS:** A literature review identified existing quality indicators for AMI care. A list of potential indicators was assessed by a nine-member panel of clinicians from a variety of disciplines using a modified-Delphi panel process. After an initial round of rating the potential indicators, a series of indicators was identified for a second round of discussion at a national meeting. Further refinement of indicators occurred following a teleconference and review by external reviewers.

**RESULTS:** To identify an AMI cohort, case definition criteria were developed, using a hospital discharge diagnosis for AMI of *International Classification of Diseases-Ninth revision* (ICD-9) code 410.x. Thirty-seven indicators for AMI care were established. Pharmacological process of care indicators included administration of acetylsalicylic acid, beta-blockers, angiotensin-converting enzyme inhibitors, thrombolytics and statins. Mortality and readmissions for AMI, unstable angina and congestive heart failure were recommended as outcome indicators. Nonpharmacological indicators included median length of stay in the emergency department, and median waiting times for cardiac catheterization, percutaneous coronary intervention and/or coronary artery bypass graft surgery.

**INTERPRETATION:** A set of Canadian quality indicators for the care of AMI patients has been established. It is anticipated that these indicators will be useful to clinicians and researchers who want to measure and improve the quality of AMI patient care in Canada.

**Key Words:** *Canadian health system; Myocardial infarction; Quality indicators; Quality of care*

In the era of accountability in medicine, the measurement of the structures, processes and outcomes of patient care is becoming increasingly important in Canada. To measure the quality of care, it is first necessary to establish practice standards called 'quality indicators' or 'performance measures' (1,2). These measures may be defined on the basis of scientific evidence or by clinical experts in the field and

**Indicateurs de la qualité des soins après un infarctus aigu du myocarde selon l'Équipe canadienne de recherche sur les résultats des interventions en santé cardio-vasculaire et la Société canadienne de cardiologie**

**CONTEXTE :** Même s'il existe des indicateurs de la qualité des soins après un infarctus aigu du myocarde (IAM) dans différents pays, aucun ensemble n'a été spécialement conçu pour le système de soins au Canada. Les auteurs visent donc à élaborer un faisceau d'indicateurs de la qualité des soins post-infarctus, qui soit propre au Canada.

**MÉTHODE :** Un examen de la documentation scientifique nous a permis de relever les indicateurs actuels de la qualité des soins après un IAM. Neuf cliniciens travaillant dans diverses disciplines ont procédé à une évaluation d'une liste d'indicateurs possibles à l'aide d'une version modifiée de la méthode Delphi. Après un premier tour d'évaluation, un certain nombre d'indicateurs possibles ont été retenus pour un deuxième tour de discussion dans le cadre d'une réunion nationale. Nous avons peaufiné les derniers indicateurs à la suite d'une téléconférence et d'un examen effectué par des spécialistes externes.

**RÉSULTATS :** Pour pouvoir constituer une cohorte appropriée, nous avons défini des critères de sélection des patients à l'aide d'un des codes 410 de la *Classification internationale des maladies*, 9<sup>e</sup> édition, indiquant un diagnostic d'IAM dans le registre des sorties de l'hôpital. Trente-sept critères de soins post-infarctus ont été retenus. Sur le plan pharmacologique figurait l'administration d'acide acétylsalicylique, de bêta-bloquants, d'inhibiteurs de l'enzyme de conversion de l'angiotensine, de thrombolytiques et de statines. Sur le plan non pharmacologique, mentionnons la durée médiane du séjour au service d'urgence et les délais d'attente médians en vue d'un cathétérisme cardiaque, d'une intervention coronarienne percutanée ou d'un pontage coronarien. La mortalité et les réadmissions pour un IAM, de l'angine instable et de l'insuffisance cardiaque congestive ont été recommandées comme indicateurs de résultats.

**INTERPRÉTATION :** Nous sommes parvenus à élaborer un faisceau d'indicateurs de la qualité des soins après un IAM, qui soit propre au Canada. Nous croyons que ces indicateurs aideront les cliniciens et les chercheurs à mesurer et à améliorer la qualité des soins post-infarctus au pays.

should ultimately be linked to improved patient outcomes. Although quality indicators for the care of patients having acute myocardial infarction (AMI) have been described for other countries, there are none specifically tailored to the Canadian health care system. Our goal was to identify and develop a set of quality indicators for the care of AMI patients in Canada.

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The Canadian Cardiovascular Outcomes Research Team (CCORT) was established in 2001 as a Canadian Institutes of Health Research (CIHR)-Heart and Stroke Foundation (HSF) Interdisciplinary Health Research Team (IHRT). The team includes researchers from five Canadian provinces (British Columbia, Alberta, Ontario, Quebec and Nova Scotia). One of the major goals is to conduct research to improve the quality of care of AMI and congestive heart failure patients in Canada, in collaboration with other organizations including the Canadian Cardiovascular Society (CCS). The CCORT investigators will conduct studies comparing the quality of AMI care in different regions and hospitals in Canada. To facilitate this and other quality improvement projects, the development of Canadian quality indicators for AMI care was imperative.

## METHODS

A flowchart of the AMI indicator selection process is displayed in Figure 1.

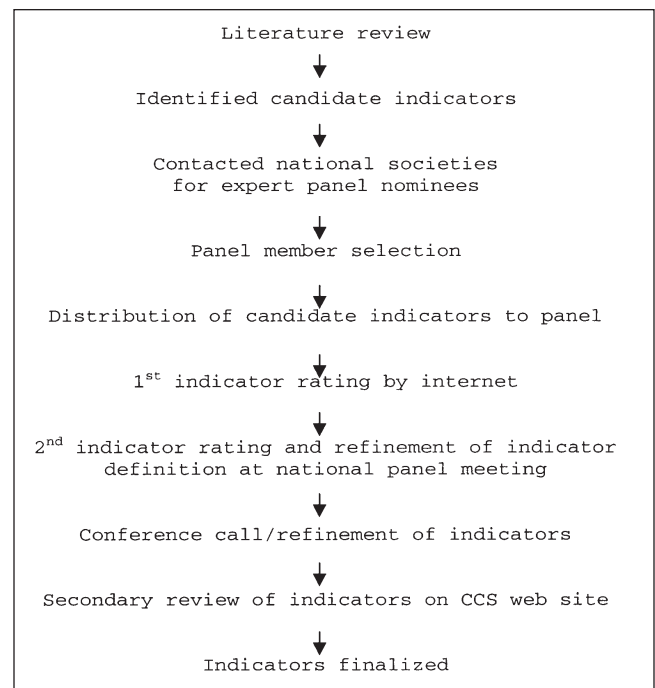
### Assembly of Delphi panel

The Delphi methodology was employed to assemble expert panelists who would subsequently develop consensus regarding the content of the indicators (3,4-6). Panelists were selected from a variety of disciplines to reflect the multidisciplinary nature of AMI care. Nominations to the AMI panel were solicited from the HSF, the Canadian Society of Internal Medicine, the College of Family Physicians of Canada, the CCS and the Canadian Society of Hospital Pharmacists. Nine members from British Columbia, Alberta, Saskatchewan, Ontario, Quebec and Nova Scotia agreed to participate in the Delphi panel. The panel consisted of six cardiologists, one internist, one family practitioner and one clinical pharmacist. There was one Delphi panel chair and one co-chair representing clinical and methodological expertise, respectively.

### Review of existing indicators

A literature search was conducted using the OVID technologies interface to search the MEDLINE (1966 to 2000), PREMEDLINE (March 16, 2001), EMBASE and HealthSTAR (1975 to 2000) databases. To identify articles pertaining to quality indicators for AMI care, a search of the English language literature was performed using the following MEDLINE subject heading terms: 'quality of care', 'quality assurance', 'health care', 'health care reform', 'United States', 'Medicare', 'consumer satisfaction', 'risk adjustment' and 'myocardial infarction'. The names of professional, quality improvement and government or nonprofit organizations involved in developing quality indicators were included as key words. Bibliographies of relevant articles were also searched.

All indicators identified from the literature review were included in the list of potential indicators sent out for the initial rating by panelists. These indicators were divided into inpatient process of care (pharmacological and nonpharmacological) indicators, outpatient process of care (pharmacological and nonpharmacological) indicators and outcome indicators, to permit easier identification of the stage of medical management. Process of care indicators were defined as the steps by which clinicians treat patients. Outcome indicators were defined as changes in patients' health status. All process and outcome indicators had to be measurable via chart abstraction and/or linkage of existing administrative databases. Structural indicators were defined as static or technical aspects



**Figure 1** Flow diagram of the Canadian acute myocardial infarction quality indicator development process. CCS Canadian Cardiovascular Society

of patient care (eg, characteristics of organizations) and are measurable via hospital survey.

For all indicators, 'eligible' patients were defined as those having a diagnosis of AMI based on defined criteria. Patients were further deemed as 'ideal candidates', if they had none of the exclusion criteria (eg, clinical contraindications) for a particular intervention or measured outcome. It was recognized that many nonideal patients (eg, those with relative contraindications) may receive an intervention and that this should not necessarily be considered substandard care.

### Initial rating of potential quality indicators

Using a modified Delphi process, the indicators were rated electronically on the CCORT Web site by each panel member in May 2001. The panel was asked to rate each potential indicator, on a five point scale, according to the following six criteria as adapted from the methodology for eliciting expert opinion using the Delphi technique as outlined by Normand et al (7): meaningfulness, usefulness, potential for improvement in clinical practices, impact on patient outcomes, feasibility of collecting the data and overall value of inclusion. A score of one indicated the lowest rating and a score of five indicated the highest possible rating.

For the criterion of "overall value of inclusion of an indicator", the dimensions of the scale were:

- I. do not include (rating=1)
- II. little reason to include (rating=2)
- III. could include (rating=3)
- IV. should include (rating=4) or
- V. must include (rating=5).

**TABLE 1**  
**Summary table of process of care and outcome indicators for acute myocardial infarction (AMI) and their data sources**

| Inpatient process of care (pharmacological) indicators                                      | Administrative data (ADM) | Chart abstracted data (CHT) |
|---|---------------------------|-----------------------------|
| 1. Acetylsalicylic acid (ASA) prescribed within 6 h of hospital arrival                     |                           | X                           |
| 2. ASA prescribed at hospital discharge   |                           | X                           |
| 3. Reperfusion with thrombolytics during hospitalization                                    |                           | X                           |
| 4. Median 'door to needle' time for thrombolysis  |                           | X                           |
| 5. Beta-blockers within 12 h of admission   |                           | X                           |
| 6. Beta-blockers at hospital discharge  |                           | X                           |
| 7. Angiotensin-converting enzyme (ACE) inhibitors prescribed at hospital discharge          |                           | X                           |
| 8. Lipid sample obtained within 24 h of admission   |                           | X                           |
| 9. Statins prescribed at hospital discharge   |                           | X                           |
| Inpatient process of care (nonpharmacological) indicators                                   | ADM                       | CHT                         |
| 1. Reperfusion using primary percutaneous coronary intervention (PCI)                       | X                         | X                           |
| 2. Median time from door to first balloon inflation in primary PCI                          |                           | X                           |
| 3. Coronary angiography in-hospital or referral for angiography (test indicator*)           |                           | X                           |
| 4. Median length of stay in emergency department  | X                         | X                           |
| 5. Median length of coronary care unit/intensive care unit stay                             |                           | X                           |
| 6. Median length of in-hospital stay  | X                         | X                           |
| Outpatient process of care (pharmacological) indicators                                     | ADM                       | CHT                         |
| 1. Beta-blocker prescription filled within 30 days postdischarge                            | X                         |                             |
| 2. Beta-blocker prescription filled within 90 days postdischarge                            | X                         |                             |
| 3. Beta-blocker one-year adherence postdischarge  | X                         |                             |
| 4. ACE inhibitor prescription filled within 30 days postdischarge                           | X                         |                             |
| 5. ACE inhibitor prescription filled within 90 days postdischarge                           | X                         |                             |
| 6. ACE inhibitor one-year adherence postdischarge   | X                         |                             |
| 7. Statin prescription filled within 30 days postdischarge                                  | X                         |                             |
| 8. Statin prescription filled within 90 days postdischarge                                  | X                         |                             |
| 9. Statin one-year adherence postdischarge  | X                         |                             |
| Outpatient process of care (nonpharmacological) indicators                                  | ADM                       | CHT                         |
| 1. Physician visit within four weeks postdischarge  | X                         |                             |
| 2. Median waiting time (in days) for catheterization postmyocardial infarction              | X                         |                             |
| 3. Median waiting time (in days) for PCI postmyocardial infarction                          | X                         |                             |
| 4. Median waiting time (in days) for coronary artery bypass graft postmyocardial infarction | X                         |                             |
| Outcome indicators  | ADM                       | CHT                         |
| 1. In-hospital mortality  | X                         | X                           |
| 2. 30 day mortality   | X                         |                             |
| 3. One year mortality   | X                         |                             |
| 4. AMI readmission rate at 30 days postdischarge  | X                         |                             |
| 5. AMI readmission rate at one year postdischarge   | X                         |                             |
| 6. Congestive heart failure (CHF) readmission rate at 30 days postdischarge                 | X                         |                             |
| 7. CHF readmission rate at one year postdischarge   | X                         |                             |
| 8. Unstable angina readmission rate at 30 days postdischarge                                | X                         |                             |
| 9. Unstable angina readmission rate at one year post discharge                              | X                         |                             |

\*Coronary angiography was classified as a test indicator due to panel uncertainty whether the data required for this indicator could be reliably abstracted from patient hospital charts

**TABLE 2**  
Potential test structural (organizational) indicators for acute myocardial infarction

|  |
|--|
| 1.0 General  |
| 1) Secondary prevention clinic and/or access to cardiac rehabilitation |
| 2) Standard admitting orders for CCU/ICU                               |
| 3) Presence of dedicated clinical pharmacist in CCU/ICU                |
| 4) Presence of coronary CCU or medical ICU                             |
| 5) Step down unit  |
| 6) Catheterization laboratory onsite                                   |
| 7) Percutaneous coronary intervention capability                       |
| 2.0 Thrombolysis   |
| 1) Protocol for thrombolysis in emergency department                   |
| 2) Availability of thrombolytics in emergency department               |
| 3) Specialist consult not required for thrombolytic administration     |

These indicators may be measured by hospital survey. CCU/ICU Coronary care unit/intensive care unit

After this round of rating, the top-rated indicators, (ie, those with a mean score of greater than 4 for the 'overall value of inclusion' criterion) were considered for the second round of discussion by the panelists. A list of indicators that were included and excluded can be found in the appendixes to this report at [www.ccort.ca](http://www.ccort.ca). Additional supplemental information about the indicators is also available on the Web site.

### Secondary rating of potential quality indicators

On June 27, 2001, the panelists convened for a face-to-face meeting for the second round of the Delphi panel process at the CCORT/CCS AMI Canadian Quality Indicator Panel meeting held in Toronto, Ontario. At this meeting, the results from the first round of rating were presented. This was followed by an open discussion surrounding the potential indicators. Panelists reviewed each indicator and associated eligibility and exclusion criteria focusing on the relevance to the Canadian environment and evidence (eg, guidelines, randomized, controlled trials), or lack thereof, to support the inclusion of the indicator. As well, the methodology for reporting the indicator, ie, the indicator statistic, was discussed with consideration given to Canadian regional practice variation.

Indicators were excluded if they were deemed not to be applicable or suitable for measurement in the Canadian health care environment. Final approval of the indicator occurred by consensus.

In addition to the discussion of the process of care and outcome indicators, the following items were discussed by the panelists at this face-to-face meeting: diagnostic, exclusion and validation criteria for identifying AMI patients from hospital discharge databases; structural or organizational hospital quality indicators for AMI care; important risk factors for AMI mortality; and benchmarks (ie, target levels for appropriate care) for various process of care indicators. Consideration was given to the data source for an indicator (chart abstraction versus administrative data), benchmarks published in the literature (8,9) or performance measure results previously obtained for other quality indicators for AMI care (1).

The indicators were compiled and a follow-up conference call was held to refine the indicators such that they could be

**TABLE 3**  
Diagnostic criteria for identifying acute myocardial infarction (AMI) patients from hospital discharge administrative data

#### A) AMI patient identification criteria

##### 1.0 Inclusion criteria

Most responsible diagnosis of acute myocardial infarction  
(*International Classification of Diseases-Ninth revision code 410.x*)

##### 2.0 Exclusion criteria\*

1. Not admitted to an acute care hospital
2. Age <20 or >105 years
3. Invalid health card number
4. Admitted to noncardiac surgical service
5. Transferred from another acute care facility
6. AMI coded as an in-hospital complication
7. AMI within the past year

#### B) AMI diagnosis clinical validation criteria

##### 1.0 Joint European Society of Cardiology/American College of Cardiology criteria

1. Typical rise of troponin (above upper limit of normal at that hospital) or typical rise (2× upper limit of normal at that hospital) and fall of creatinine kinase isoform-MB with at least one of the following: ischemic symptoms; development of pathological Q waves on the ECG; ECG changes indicative of ischemia
2. Pathological findings of AMI

\*The rationale for the exclusion criteria are described in Tu et al (1999) in reference 15. Exclusion criteria obtained from health administrative data should be applied to the identified acute myocardial infarction cohort where possible ECG Electrocardiogram

'operationalized' for the purpose of data collection from charts or administrative databases. The indicators were also made available on the CCS Web site for review and comments by CCS members across Canada. Both the CCORT Steering Committee and the CCS Executive Committee formally approved the final version of the indicators.

## RESULTS

Sixty-four potential process of care and outcome indicators were assembled for the initial round of rating. Thirty-four indicators satisfied the "overall value of inclusion" criterion and underwent a second round of discussion by the panel at a national meeting. Revisions to the indicators were made at this meeting and at the teleconference, which led to the inclusion of additional indicators to cover relevant topics in AMI care in Canada. This resulted in 37 indicators for AMI care (Table 1). With regard to structural indicators, 10 potential test indicators were identified by the panel (Table 2).

### Case definition criteria

Diagnostic criteria for retrospective identification of AMI patients from administrative databases, consisted of inclusion, exclusion and validation criteria (Table 3). Inclusion criteria were defined as a most responsible diagnosis of AMI according to the *International Classification of Diseases-Ninth revision* (ICD-9) code 410.x. Exclusion criteria (eg, transfers from another institution) were established to avoid double counting patients and identification of a cohort of new AMI patients. Validation of the identified AMI cohort as true AMI patients may occur with application of the suggested European Society of Cardiology

**TABLE 4**  
**Specific summary definitions for acute myocardial infarction (AMI) inpatient process of care indicators**

**Pharmacological indicators**

|  |   |
|--|---|
| 1.0 Acetylsalicylic acid (ASA) prescribed within 6 h of hospital arrival |   |
| Eligible   | 1) Confirmed AMI  |
| Exclusions   | 1) Active bleeding on admission<br>2) History of coagulopathy<br>3) First platelet count $<100 \times 10^9/L$ drawn within 24 h of admission<br>4) Allergy to ASA<br>5) Documentation of ASA administration before hospital arrival<br>6) Physician documented reason for nonuse of ASA (eg, patient refusal)   |
| 2.0 ASA prescribed at discharge  |   |
| Eligible   | 1) Confirmed AMI and alive at discharge   |
| Exclusions   | 1) Evidence of i. Active bleeding on admission or<br>ii. Active bleeding during hospitalization<br>2) History of i. Coagulopathy or<br>ii. Platelet count $<100 \times 10^9/L$<br>3) Allergy to ASA<br>4) Prescribed other antiplatelet agent at discharge (eg, clopidogrel, ticlopidine)<br>5) Physician documented reason for nonuse of ASA (eg, patient refusal)   |
| 3.0 Reperfusion using thrombolytics during hospitalization               |   |
| Eligible   | 1) AMI as proposed by European/ACC criteria: i. ST segment elevation on initial electrocardiogram (ECG); or ii. LBBB on initial ECG   |
| Exclusions   | 1) Did not have chest pain or other AMI symptoms $<12$ h before hospital arrival<br>2) Active (any) bleeding on admission<br>3) Recent surgery in the past month<br>4) Recent trauma in the past month<br>5) Recent cardiopulmonary resuscitation<br>6) History of coagulopathy<br>7) History of stroke<br>8) Physician documented reason for nonuse of thrombolytics (eg, patient refusal, cancer, severe uncontrolled hypertension)   |
| 4.0 Median 'door to needle' time for thrombolysis                        |   |
| Eligible   | 1) Received thrombolytics within 12 h of admission  |
| Exclusions   | 1) None   |
| 5.0 Beta-blockers within 12 h of admission                               |   |
| Eligible   | 1) All AMI patients   |
| Exclusions   | 1) Allergy or intolerance to beta-blocker<br>2) Bradycardia (heart rate $<60$ beats/min) on admission and not on beta-blocker<br>3) Symptomatic heart failure on admission<br>4) Systolic blood pressure $<100$ mmHg at admission<br>5) PR interval $>0.24$ s on admission ECG<br>6) Second or third degree heart block on admission ECG<br>7) Bifascicular block on admission ECG<br>8) Severe chronic obstructive pulmonary disease<br>9) Asthma<br>10) Taking beta-blocker preadmission<br>11) Physician documented reason for nonuse of beta-blocker (eg, patient refusal, symptomatic hypotension)                                       |
| 6.0 Beta-blockers at discharge   |   |
| Eligible   | All patients with AMI alive at discharge  |
| Exclusions   | 1) Congestive heart failure and on diuretic (unless measured left ventricular ejection fraction $>50\%$ )<br>2) Systolic blood pressure $<100$ mmHg at discharge<br>3) Severe COPD<br>4) Asthma<br>5) Bradycardia (heart rate $<60$ beats/min) at discharge<br>6) Conduction disorder defined as:<br>i. first degree atrioventricular block (PR interval $>0.24$ s on last ECG);<br>ii. Second or third degree heart block on last ECG;<br>iii. bifascicular block on last ECG<br>7) Allergy or intolerance to beta-blocker<br>8) Physician documentation of reason for nonuse of beta-blocker (eg, symptomatic hypotension, patient refusal) |

*continued on next page*

**TABLE 4 (CONTINUED)**  
**Specific summary definitions for acute myocardial infarction (AMI) inpatient process of care indicators**

| Pharmacological indicators   |   |
|--|---|
| 7.0 Angiotensin-converting enzyme (ACE) inhibitors prescribed at discharge   |   |
| Eligible   | 1) All AMI patients discharged alive<br>2) Past or current clinical features of heart failure<br>3) Anterior infarction<br>4) Ejection fraction <40% or left ventricular grade ≥III out of IV   |
| Exclusions   | 1) Moderate or severe aortic stenosis<br>2) Allergy or intolerance to ACE inhibitors<br>3) Severe renal dysfunction (ie, peak or last prehospital discharge serum creatinine level >200 µmol/L)<br>4) Systolic blood pressure <100 mmHg at discharge<br>5) Bilateral renal artery stenosis<br>6) Hyperkalemia (ie, peak or last prehospital discharge K <sup>+</sup> >5.5 mmol/L)<br>7) Physician documented reason for nonuse of ACE inhibitor at discharge (eg, patient refusal, symptomatic hypotension) |
| 8.0 Lipid sample obtained within 24 h of admission   |   |
| Eligible   | 1) All AMI patients   |
| Exclusions   | 1) Patients already on lipid-lowering agents preadmission   |
| 9.0 Statins at discharge   |   |
| Eligible   | 1) AMI patients discharged alive<br>2) Total serum cholesterol level on admission >5.2 mmol/L or LDL > 3.4 mmol/L   |
| Exclusions   | 1) Liver disease<br>2) Patients with cholestasis<br>3) Patients on fibrates at risk of rhabdomyolysis<br>4) Physician documented reason for nonuse of statin (eg, patient refusal)  |
| Nonpharmacological indicators  |   |
| 1.0 Reperfusion using primary percutaneous coronary intervention (PCI) (to be measured in hospitals with the capabilities) |   |
| Eligible   | 1) AMI as proposed by European/ACC criteria: i) ST segment elevation on initial electrocardiogram (ECG) or ii) LBBB on initial ECG  |
| Exclusions   | 1) Did not have chest pain or other AMI symptoms <12 h before hospital arrival<br>2) Primary PCI considered but patient refused<br>3) Physician documented reason for nonuse of PCI procedure (eg, renal failure)<br>4) Suspected aortic dissection<br>5) Use of thrombolytics  |
| 2.0 Median time from door to first balloon inflation in primary PCI  |   |
| Eligible   | Received primary PCI within 12 h of admission   |
| Exclusions   | 1) None   |
| 3.0 Coronary angiography in-hospital or referral for angiography (test indicator)  |   |
| Eligible   | 1) All AMI patients postinfarction with<br>i. recurrent ischemia (chest pain at rest ≥20 min);<br>ii. high-risk positive stress test (<7 METS) or positive within first 3 min of Bruce protocol;<br>iii. shock;<br>iv. mechanical complications (eg, acute mitral regurgitation, ventricular septal defect)   |
| Exclusions   | 1) Hepatic failure<br>2) Metastatic cancer<br>3) Terminal illness<br>4) Do not resuscitate order<br>5) Severe neurological deficit (eg, decorticate or decerebrate posturing or lack of motor response)<br>6) Physician documented reason for nonuse of angiography (eg, patient refusal)   |
| 4.0 Median length of stay in emergency department  |   |
| Eligible   | All AMI patients admitted to hospital emergency department  |
| Exclusions   | None  |
| 5.0 Median length of coronary care unit stay   |   |
| Eligible   | All AMI patients admitted to coronary care unit   |
| Exclusions   | None  |
| 6.0 Median length of in-hospital stay  |   |
| Eligible   | All AMI patients admitted   |
| Exclusions   | None  |

**TABLE 5**  
**Proposed benchmarks for various process indicators.**  
**Target level refers to the proposed minimum target level, among ideal candidates for an intervention (ie, patients who meet both eligibility and exclusion criteria for each quality indicator)**

| Process of care quality indicators                             | Minimum target level in ideal candidates |
|--|--|
| 1) Acetylsalicylic acid (ASA) within 6 h of hospital admission | ≥90%                                     |
| 2) ASA prescribed at hospital discharge                        | ≥90%                                     |
| 3) Reperfusion with thrombolytics during hospitalization       | ≥85%                                     |
| 4) Median 'door to needle' time for thrombolysis               | ≤30 min                                  |
| 5) Beta-blocker within 12 h of hospital admission              | ≥85%                                     |
| 6) Beta-blocker at hospital discharge                          | ≥85%                                     |
| 7) ACE inhibitor at hospital discharge                         | ≥85%                                     |
| 8) Lipid sample obtained within 24 h of admission              | ≥85%                                     |
| 9) Statin at discharge   | ≥70%                                     |

ACE Angiotensin-converting enzyme

and American College of Cardiology criteria (10) obtainable from chart abstraction.

#### Process of care indicators

**Inpatient process of care indicators:** Inpatient process of care indicators were selected on the basis of routine AMI patient management consistent with the 1999 American College of Cardiology/American Heart Association guidelines (9) and the 1994 CCS Consensus Conference on Coronary Thrombolysis (11,12) as much as possible (Table 4). These indicators were further categorized as pharmacological and nonpharmacological indicators. The greater number of pharmacological indicators reflects the importance of drug therapy in AMI management and the strong scientific basis for these therapies. The panel did not include measurement of acetylsalicylic acid (ASA) prescriptions and adherence postdischarge with existing administrative databases because this could lead to underestimations of ASA use due to the nonprescription availability of ASA. Notably, for nonpharmacological indicators, median length of stay in the emergency department was added as an important Canadian process of care indicator, given emergency department overcrowding occurring, in many parts of the country. As well, to capture infrequent but important reasons why a physician may not prescribe a therapeutic intervention, any physician-documented reason was included as an exclusion criterion.

**Outpatient process of care indicators:** These indicators were also categorized as pharmacological or nonpharmacological indicators (Table 1). As observed for the inpatient process of care indicators, there was an emphasis on secondary prevention with drug therapy. With regard to nonpharmacological indicators, median waiting times for cardiac catheterization, and rates of percutaneous coronary intervention and coronary artery bypass graft surgery were included as indicators particularly relevant to the Canadian environment. Linked

administrative databases will be required to measure these indicators.

#### Outcome indicators

Mortality rates, length of stay and readmission rates were chosen as outcome indicators because of their clinical importance and their potential responsiveness to evidence-based care (Table 1). This information will primarily be available from linked administrative databases.

#### Benchmarks

Benchmarks for all inpatient process of care pharmacological indicators were established (Table 5) (13). These proposed benchmarks reflect the minimum proportion of AMI patients who are 'ideal candidates' (do not have any exclusion criteria) who the panelists believed should receive a particular intervention. For example, a minimum of 90% of ideal ASA candidates should receive ASA within 6 h of hospital admission. Statins at discharge had a lower target level than the other indicators because some patients may appropriately receive statin prescriptions postdischarge rather than at the time of hospital discharge.

#### Structural indicators

Structural indicators for institutions providing care to AMI patients are presented in Table 2. These indicators reflect other important aspects of AMI care related to the functioning of institutional facilities, or presence of standardized protocols and patient education. It is intended that these indicators will be measured via hospital surveys, because complete information is not likely to be available from chart abstraction or administrative databases. The panelists believed that the presence of many of these structural attributes at a hospital may lead to better patient outcomes and recommended that these attributes be 'test indicators' at this time because uncertainty exists whether many of these indicators definitively lead to better patient outcomes. They also recognized that further study of these indicators would be required.

## DISCUSSION

The selection of AMI quality indicators tailored to the Canadian environment is a critical first step toward the goal of improving the quality of AMI care in Canada. These indicators are distinct from previously published indicators in the United States (1) and Australia (8,14), which have focused primarily on processes of care as opposed to outcome indicators. These indicators also reflect the unique population-based, administrative data available in Canada that permits more detailed quality measurements. Other notable differences can be seen with the eligibility and exclusion criteria for each individual indicator (data not shown). In particular, physician-documented reason for nonuse of a therapy was adopted for many of these indicators to capture other reasons why a particular therapy may not be given.

Realizing that there are a large number of Canadian indicators, an attempt was made to strike a balance between the comprehensive eligibility and exclusion criteria established by the Cooperative Cardiovascular Project (CCP) (1) in the United States and the less comprehensive West Moreton Coronary Outcomes Program (WESTCOP) indicators developed in Australia (8). This will lead to more

efficient data abstraction processes for clinicians and hospitals who wish to use these indicators for quality improvement initiatives.

Users of these indicators will likely want to apply a subset of the indicators depending on their particular interests. For example, for local hospitals, clinicians may want to focus on measuring thrombolytic or beta-blocker use in ideal patients. In contrast, researchers comparing AMI care across regions may want to use the administrative data-based indicators if the data are available.

A few caveats about these indicators should be noted. Although the indicators were intended to reflect care provided in the community setting, the panelists recognized that all possible valid reasons for not performing an intervention as identified in the exclusion criteria may not be documented in the charts. Thus, target benchmarks were set for less than 100% among 'ideal candidates' for an intervention. There is still uncertainty regarding the optimal achievable level for many of these outcomes; therefore, outcome benchmark targets are not defined.

It is also recognized that suggested 'target' levels may not be achievable at all hospitals in the country. For example, barriers such as lack of access to echocardiography, cardiac catheterization facilities or reimbursement, may limit the performance of some hospitals for some indicators. Thus, the application of the indicators and the benchmarks can be tailored to local or regional conditions.

Nevertheless, the panel believed that the indicator targets should reflect 'optimal' care for patients as opposed to setting lower standards that may encourage suboptimal care. It is anticipated that once these indicators are employed and benchmarks are measured, a review of the target levels will take place to determine whether they are feasible. As well, ongoing revisions to indicator definitions will need to take place with the publication of new scientific data or practice guidelines.

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## CONCLUSIONS

We have identified a unique Canadian set of quality indicators for the care of AMI patients. We hope these indicators will prove to be useful in highlighting opportunities for improving the treatment and outcomes of AMI patients throughout Canada.

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## CONTRIBUTORS

All investigators contributed to the design and execution of this project. Ms Tran was primarily responsible for selecting, reviewing and collating the background material in preparation for the expert panel meeting and manuscript writing. Dr Lee assisted in reviewing the background papers and manuscript revision. Dr Grant provided assistance with project planning, oversight and interpretation. Ms Flintoft coordinated the panel process and was primarily responsible for its day-to-day operations. She contributed to instrument design and manuscript revision. Drs Higginson and Tu co-chaired the expert panel, guided discussion leading to consensus, and provided logistical support. Dr Tu conceived the idea, supervised the panel project and obtained funding for the project. All authors contributed to revising multiple drafts of the manuscript.

