Evidence Guiding Health Care

ICES Institute for Clinical Evaluative Sciences

Development of a Consensus on Evidence-Based Quality of Care Indicators for Canadian Emergency Departments

ICES Investigative Report

March 2010

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About ICES

Ontario's resource for informed health care decision-making

The Institute for Clinical Evaluative Sciences (ICES) is an independent, non-profit organization that produces knowledge to enhance the effectiveness of health care for Ontarians. Internationally recognized for its innovative use of population-based health information, ICES' evidence supports health policy development and guides changes to the organization and delivery of health care services.

Key to our work is our ability to link population-based health information, at the patient-level, in a way that ensures the privacy and confidentiality of personal health information. Linked databases reflecting 12 million of 30 million Canadians allow us to follow patient populations through diagnosis and treatment, and to evaluate outcomes.

ICES brings together the best and the brightest talent under one roof. Many of our scientists are not only internationally recognized leaders in their fields, but are also practicing clinicians who understand the grassroots of health care delivery, making the knowledge produced at ICES clinically-focused and useful in changing practice. Other team members have statistical training, epidemiological backgrounds, project management or communications expertise. The variety of skill sets and educational backgrounds ensures a multi-disciplinary approach to issues and creates a real-world mosaic of perspectives that is vital to shaping Ontario's future health care system.

ICES receives core funding from the Ontario Ministry of Health and Long-Term Care. In addition, our faculty and staff compete for peer-reviewed grants from federal funding agencies, such as the Canadian Institutes of Health Research, and project-specific funds are received from provincial and national organizations. These combined sources enable ICES to have a large number of projects underway, covering a broad range of topics. The knowledge that arises from these efforts is always produced independent of our funding bodies, which is critical to our success as Ontario's objective, credible source of *Evidence Guiding Health Care.*

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Background

There is good evidence to support quality of care monitoring and reporting as a means of improving accountability and quality in health care delivery. The evaluation of emergency department (ED) care in Canada, however, is hampered by the absence of a common agreement on what constitutes appropriate measures of quality of ED care.

Study

We present the results of a national process to establish a parsimonious set of evidence-based indicators of quality of care in Canadian EDs. A comprehensive review of the scientific literature was first conducted to identify candidate indicators. A nationally representative steering committee (n=24) consisting of experts from hospital administration, emergency medicine, health information, government and provincial quality councils led the process. A panel of nationally representative clinical and administrative experts (n=21) from emergency medicine and health administration was established to systematically review candidate indicators and related evidence in a modified Delphi panel process.

Findings

A total of 170 candidate indicators were generated from the literature; these were assessed based on scientific soundness and their relevance/importance. Using pre-defined scoring criteria in two rounds of surveys, indicators were coded as: `retain' (53), `discard' (78), or 'borderline' (39). The steering committee considered these rankings in a guided nominal group process and facilitated discussion and made final decisions on indicators. A final set of 48 indicators were retained that were relevant to many patients and across numerous specific clinical conditions, grouped in nine clinical and operational categories. Expert panelists then prioritized the retained indicators within respective categories.

The highest priority indicators, that were relevant to many patients and across multiple specific clinical conditions, were:

- **ED Operations**—ED length of stay (LOS): Time from first documented contact in the ED to the time of physical departure from the ED (overall and by Canadian Emergency Department Triage and Acuity Scale (CTAS));
- **Patient Safety**—Percentage of patients with an unplanned return visit to the ED *resulting* in admission within 48 hours (or 72 hours) of being seen and discharged from the ED, stratified by adult/pediatric patients; and percentage of patients with headache discharged home from the ED who were admitted to hospital with a subarachnoid hemorrhage in the subsequent 14 days;
- **Pain Management**—Time to first dose of analgesic in all painful conditions requiring analgesia;
- **Pediatrics**—Percentage of pediatric patients (aged 0-28 days) with fever who received a full septic workup; and percentage of pediatric patients (aged 0-28 days) who received broad-spectrum IV antibiotics; and percentage of pediatric patients (aged 3 months–3 years) with croup who were treated with steroids;
- **Cardiac**—Percentage of eligible patients with acute myocardial infarction (AMI) who received thrombolytic therapy or percutaneous coronary intervention (PCI);
- **Respiratory**—Percentage of patients with asthma who received corticosteroids in the ED and at discharge (if discharged) stratified by age;
- **Stroke—**Percentage of eligible patients with acute stroke who received tissue plasminogen activator (tPA); and
- **Sepsis/Infection**—Time to antibiotics in patients with bacterial meningitis; and percentage of patients with severe sepsis or septic shock who were given broad-spectrum antibiotics within four hours of ED arrival.

Additional steps included the assessment of the feasibility of measuring the retained indicators using existing administrative databases. Only 13 indicators (27%) can currently be captured using existing administrative databases; and a further nine (19%) would be feasible with enhanced data capture in existing data elements.

Finally, the steering committee conducted a gap analysis to identify important areas for future indicator development. The highest priority gaps where current indicators are weak included patient satisfaction, healthy workplace, mental health and addiction, elder care and community-hospital integration.

Recommendations

Careful evaluation of ED care is becoming increasingly important in Canada, particularly as many jurisdictions are undertaking large scale; complex and system-level efforts to improve ED care. Mandatory collection of consistent and comprehensive ED quality of care information is strongly recommended. Future work is required to generate technical definitions, develop valid data sources for longitudinal and cross-jurisdiction measurement, and establish processes to re-evaluate and update the indicators to ensure continued relevance and accuracy.

Introduction

Access to high quality health care is a major concern for Canadians, with much of the attention focused on access to selective surgical procedures, diagnostic tests and primary care. Yet, every year in Canada more than 12 million emergency department (ED) visits are made[1] and about a quarter of Canadians visit an ED for themselves or a close family member.[2] In Canada, concerns about access to, and quality of, ED care have been the subject of much debate. In a 2001 community survey of 1,400 adults from five countries (Canada, Australia, United Kingdom, New Zealand, United States), Canadians ranked their EDs lowest at providing "good or excellent" care, and were the most likely to say they waited more than two hours in the ED.[3]

While the concern over ED crowding has been articulated in emergency medicine literature for decades,[4] little has been done to improve the situation, especially in large urban EDs where wait times can be dangerously long.[1,5] Some Canadian health authorities have recently responded:

- In 2007, several jurisdictions including the Vancouver Coastal Health (VCH)/Providence Health Care (PHC),[6] and Capital Health: Edmonton (now part of Alberta Health Services)[7] launched major new initiatives to improve ED care and reduce ED wait times.

- In 2008, the Ontario MOHLTC launched its *Emergency Room Wait Times Strategy* to improve ED wait times and overcrowding across the province. This strategy includes system-level solutions encompassing both hospital- and community-based initiatives.[6]

There is good evidence to support quality of care monitoring and reporting as a means of improving accountability and quality in health care delivery[9,10] for both adults[11–15] and children.[16] The evaluation of ED care in Canada, however, is hampered by the absence of a common agreement on what constitutes appropriate measures of quality of ED care. While there has been some work performed in Canada to develop indicators of quality of care in hospital EDs,[17,18] these processes resulted in a large number of indicators with a focus on those that could be feasibly measured using administrative databases. At present, in Canada and elsewhere, there are no standard or widely accepted ED quality of care and patient safety measures. Moreover, the validity of some indicators in wide use has been recently questioned; where concerns rest with unintended consequences such as the overall appropriateness of targets that may result in wasted resources and adversely affect care. Finally, the absence of common indicators hampers efforts for cross-jurisdiction comparisons and broad interventions for improvement.

The process of developing a consensus began in January 2008, when the Calgary Health Region hosted a National Emergency Department Performance Measurement Summit. Clinical, research, administrative, and decision-maker experts were invited from Ontario, Quebec, Atlantic (Nova Scotia, New Brunswick, Newfoundland) and Western Canada (British Columbia, Alberta, Saskatchewan, Manitoba). The purpose of the Summit was to agree on a process for the development of indicators to measure quality and safety in Canadian EDs. Participants agreed to use a modified version of the Alberta Quality Matrix for Health (Exhibit 1) to define the domains of quality of care for indicator selection. Two summit participants (and authors of this report MJS and CH) were selected to co-lead the process (MS, CH).

The objective was to **develop and prioritize an evidence-based and parsimonious set of quality of care indicators for EDs through a nationally representative and scientifically rigorous process**. Given the plethora of existing indicators, there was consensus that the indicators would be identified from among existing ones as opposed to developing new ones, and that gaps would be identified for future indicator development.

Exhibit 1 Domains of quality of care and safety for indicator selection

Domain	Definition
Acceptability	Health services are respectful and responsive to user needs, preferences and expectations.
Accessibility	Health services are obtained in the most suitable setting in a reasonable time and distance.
Appropriateness	Health services are relevant to user needs and are based on accepted or evidence-based practice.
Effectiveness	Health services are provided based on scientific knowledge to achieve desired outcomes.
Efficiency	Resources are optimally used in achieving desired outcomes.
Safety	Mitigate risks to avoid unintended or harmful results.
Healthy Workplace	Provision of health services does not lead to an unhealthy work environment for health care staff.

*Modified from the Alberta Quality Matrix for Health[14]

Methods

Study design

Phase 1: National Steering Committee and Expert Panel Selection

A national steering committee (n=24) was established to develop and approve the methodology for the selection of ED indicators, oversee membership of an Expert Panel (n=21), and advise on dissemination of results. The role of the Expert Panel was to review existing indicators and related evidence and rate each indicator on specific dimensions. Steering committee members and expert panelists were selected from participants at the Calgary Health Region National Emergency Department Performance Measurement Summit or through nomination by research team members. We sought Canada-wide representation from clinicians (doctors and nurses), hospital and ED administrators, health information experts, as well as representatives from regional health authorities, Ministries of Health and provincial health quality councils.

Phase 2: Literature Review

We conducted a rigorous and extensive review of the grey and peer-reviewed international literature to identify existing quality of care and patient safety indicators relevant to care in the ED. We sought indicators applicable to clinical conditions (diseases or presenting complaints) or operational processes with associated best practice evidence. The medical databases MEDLINE, CINAHL, and HealthSTAR were searched from inception to 2008 using specific terms, such as: emergency department, emergency care and emergency pediatric care, emergency health services, performance indicators, quality indicators, performance measures, quality measures, report card, registry, benchmarks, standards, as well as a variety of terms to capture clinical care quality process indicators for specific conditions.

In addition, we performed a thorough review of indicators currently recommended or monitored by health quality and accreditation organizations and/or by governing associations/societies for relevant clinical specialties in Canada and elsewhere (e.g., Canadian Association of Emergency Physicians, Joint Commission on Accreditation of Healthcare Organizations, National Quality Forum, Agency for Healthcare Research and Quality, Institute for Healthcare Improvement, Hospital Quality Alliance, Centers for Medicare & Medicaid Services, Evidence-Based Medicine Resource Centre, National Institute for Health and Clinical Excellence).

Additional searches were conducted using evidence-based medicine databases such as the Cochrane Collaboration and Evidence-Based Emergency Medicine, as well as clinical practice guidelines, consensus reports, and best practice reports.

Indicators were included for further consideration based on the following criteria:

1. Provision of sufficient descriptive information for its practical use; and
2. Evidence of its relevance or importance to ED patient outcomes and/or processes of care.

In order to cast as wide a net as possible, the *quality* of the specific evidence behind a given indicator—with respect to study design, bias, confounding, or outcome measurement—was not a determinant of candidate indicator selection at this stage. Moreover, a formal analysis of the psychometric properties of each indicator variable was beyond the scope of this project. Professional organization clinical guidelines, standards of care or ED decision rules were, as a general rule, not considered unless they had been operationalized as indicators. In cases of two or more indicators worded similarly and/or measuring the same outcome and/or process of care, only the one judged by the research team (MJS and AG) to be most clearly expressed was retained for further consideration. Time-dependent indicators measuring the same process or outcome, but using different time thresholds, were combined into a single indicator with all time thresholds listed (e.g., percentage of patients with an unplanned return visit to the ED *resulting* in admission within 48 hours [or 72 hours] of being seen and discharged from the ED, stratified by adult/pediatric patients). Panelists were asked to consider the indicator without reference to a specific time threshold. Candidate indicators resulting from this review were then organized according to clinical and operational categories.

Phase 3: Expert Panel Modified Delphi Process (Rounds 1 and 2)

Candidate indicators were evaluated by the Expert Panel in two rounds of electronic surveys. Supporting evidence from the grey and/or peer-reviewed literature associated with each indicator was provided to the panelists as embedded online-links to article abstracts or online documents.

In the Round 1 survey, panelists evaluated each indicator for: **1) scientific soundness** (the strength of the evidence demonstrating a link between the indicator and either patient outcomes or an important process(es) of care), and **2) relevance/importance** of the indicator to patients (users) and health care providers (Exhibit 2).

A five-point Likert rating scale was used to rate each indicator from 1 ("not at all") to 5 ("very—with respect to sufficiency of scientific evidence, importance or relevance"). Ratings of indicators were summed and classified into one of three categories:

- **'Retain'**: median score ≥4 on soundness and at least one of the relevance measures
- **'Borderline'**: median score 3.0–3.9 on soundness and at least one of the relevance measures
- **'Discard'**: median score <3.0 on soundness

In the Round 2 survey, panelists were provided median scores for each 'borderline' indicator from Round 1, and were asked to vote 'yes' or 'no' with respect to whether it should warrant further consideration. This step provided the panelists with an opportunity to reconsider indicators which are widely perceived to be important measures of quality and safety despite limited empiric evidence. Borderline indicators which received a vote of 'yes' by at least 50 percent of panelists remained 'borderline,' the balance were classified as 'discard.'

Exhibit 2 Indicator assessment criteria

Criteria	Description
1. Soundness*	
Outcome measure	Sufficient scientific evidence exists to support a link between performance on this patient outcome indicator and processes of care.
Process measure	Sufficient scientific evidence exists to support a link between performance on this process indicator and patient outcomes.
2. Relevance/Importance—User	This indicator is important because it reflects a potentially serious or common gap in the quality of care for patients.
3. Relevance/Importance—Provider	This indicator is important because hospitals or health care providers are able to act in specific ways to respond to quality of care gaps it measures.

* Only one criterion for **soundness** was assessed depending on whether the indicator was a process or outcome measure.

Phase 4: Steering Committee Review and Gap Analysis

The final phase of indicator selection occurred at an in-person meeting of the steering committee, where a comprehensive review and final selection of ED quality of care indicators was completed. A summary of the Expert Panel survey results was provided to participants in advance of the meeting. The steering committee anonymously voted on all 'borderline' indicators using a five-point Likert rating scale that ranged from 1 (must not retain) to 5 (must retain). Borderline indicators with a median score of ≥4 were re-classified as 'retain,' those <4 were re-classified as 'discard.' Next, in a facilitated nominal group process, all retained and discarded indicators were reviewed to either affirm or overturn the 'retain' or 'discard' status of each indicator; this last step produced the final set of indicators. Lastly, a gap analysis was carried out by mapping each of the final indicators to the domains in the Alberta Quality Matrix for Health in order to determine priority areas for future indicator development (Exhibit 1).

Phase 5: Indicator Prioritization

The Expert Panel then prioritized each indicator within the final set of selected indicators in a final Delphi survey. Each indicator was ranked in a head-to-head comparison with each of the other indicators within the same clinical or operational category, based on which of the two indicators they considered to be of "higher priority for measuring quality of care in Canadian emergency departments." The prioritization score was calculated as the number of times an indicator was selected as the `higher priority'.

Phase 6: Feasibility Review with National Administrative Databases

As a final exercise, we conducted a feasibility review of the final set of indicators to determine the capacity for current routinely available administrative databases to capture each respective indicator.

This study was approved by the Sunnybrook Health Sciences Centre Research Ethics Board.

Results

Indicator selection

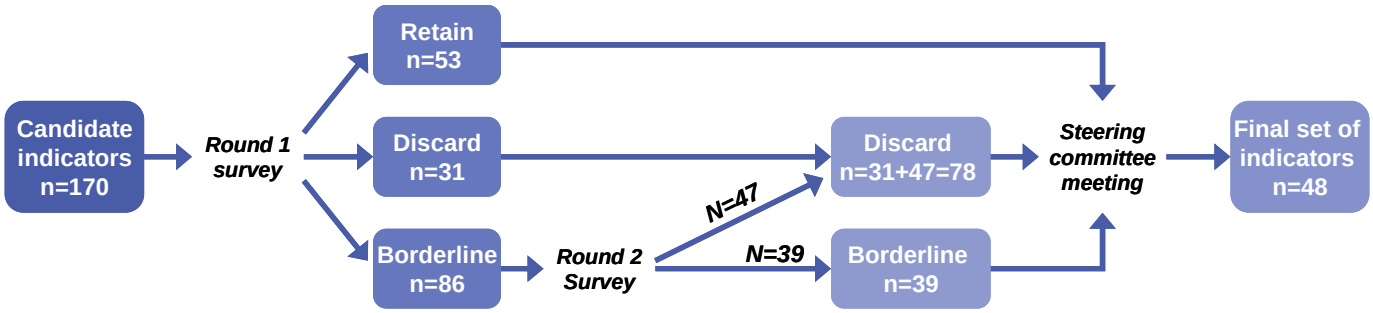
A flow diagram of the indicator selection process is shown in Exhibit 3. A total of 170 evidence-based candidate indicators were generated from the detailed literature review. In the Round 1 survey phase, given the large number of candidate indicators, each were organized according to clinical and operational categories. Expert Panelists ranked 53 indicators as 'retain,' 31 as 'discard,' and 86 as 'borderline' (See Appendix 1 for a listing of all candidate indicators by operational/clinical category and Round 1 survey results). Response rates ranged from 47.6%–100% for the Round 1 surveys, depending on clinical or operational category. In the Round 2 survey phase, 47 of the 86 'borderline' indicators from Round 1 were discarded, 39 remained 'borderline.' The response rate for the Round 2 survey was 52.4%.

At the national steering committee meeting, 15 members were in attendance. All `retain,' 'borderline' and `discard' indicators were reviewed. Committee rankings and facilitated discussion resulted in 46 of the 92 `retain' (53) and `borderline' (39) indicators being included in the final set. The steering committee also made substantive terminology changes to six indicators to improve clarity and clinical relevance at this stage. In addition, two of the 78 'discarded' indicators were considered important by the steering committee and so were included in the final set, for a total of 48 indicators (Exhibit 4).

The **48 final indicators** were categorized as follows:

- Patient satisfaction (1)
- ED operations (8)
- Patient safety (6)
- Respiratory (8)
- Cardiac (8)
- Sepsis/Infection (4)
- Pediatrics (6)
- Stroke (5)
- Pain management (2)

Exhibit 3 Flow diagram of indicator selection process



Indicator Prioritization

In the final survey, Expert Panel members prioritized the 48 retained indicators within each clinical and operational category. The response rate for the indicator prioritization survey was 90.5%. The complete set of 48 indicators and their priority rankings are presented in Exhibit 4.

Exhibit 4 Description and prioritization of the final set of 48 emergency department (ED) quality of care indicators selected, by clinical/operational category

ED quality of care indicators	Priority within category	Prioritization Score*
Patient Satisfaction		
Overall patient assessment of how well information was communicated to them or their family during their ED stay.	1	n/a
ED Operations		
ED length of stay (LOS)— Time from first documented contact in the ED to the time of physical departure from the ED (overall and by Canadian Emergency Department Triage and Acuity Scale (CTAS)).	1	85
Time from arrival in the ED to first physician assessment, by CTAS.	2	81
Time from decision to admit to departure to floor, for admitted patients.	3	69
Ambulance Offload Time (AOT)—Time from patient/ambulance arrival to transfer of care to ED staff.	4	52
Percentage of patients who left the ED without being seen.	5	50
Time from ED physician consult request to decision to admit (if admitted) or to physical departure (if discharged).	6	49
Percentage of ED stretcher hours/day occupied by in-patients.	7	45
Time from first documented contact in the ED to consult request or physical departure (if discharged).	8	45
Patient Safety		
Percentage of patients with an unplanned return visit to the ED *resulting in* admission within 48 hours (or 72 hours) of being seen and discharged from the ED, stratified by adult/pediatric patients.**	1	58
Percentage of patients with headache discharged home from the ED who were admitted to hospital with a subarachnoid hemorrhage in the subsequent 14 days.	2	57
Percentage of ectopic pregnancy patients with a missed diagnosis.	3	55
Percentage of central lines inserted in the ED which developed catheter-related blood stream infections.	4	37
Percentage of patients with an unplanned return visit to the ED *without* admission within 48 hours (or 72 hours) of being seen and discharged from the ED, stratified by adult/pediatric patients.**	5	24
Percentage of intubated patients for whom end-tidal carbon dioxide was monitored.	6	24
Pain Management		
Time to first dose of analgesic in all painful conditions requiring analgesia.	1	12
Percentage of patients with documented pain assessment.**	2	5
Pediatric		
Percentage of pediatric patients (aged 0–28 days) with fever who received a full septic workup.	1	69
Percentage of pediatric patients (aged 0–28 days) with fever who received broad-spectrum IV antibiotics.	2	55
Percentage of pediatric patients (aged 3 months–3 years) with croup who were treated with steroids.	3	53
Percentage of pediatric patients (aged 3 months–3 years) with urinary tract infection who had urine cultures obtained by catheter, suprapubic, or midstream methods.	4	28
Percentage of pediatric patients (aged 3 months–3 years) with bronchiolitis who received a chest x-ray.	5	25
Percentage of pediatric patients (aged 3 months–3 years) with bronchiolitis who were treated with antibiotics.	6	25

ED quality of care indicators	Priority within category	Prioritization Score*
Cardiac		
Percentage of eligible patients with acute myocardial infarction (AMI) who received thrombolytic therapy or percutaneous coronary intervention (PCI).	1	80
Percentage of patients with AMI who received an electrocardiogram (ECG) within 10 minutes of hospital arrival.	2	73
Percentage of patients with primary percutaneous coronary intervention (PCI) who received their primary PCI within 90 minutes of arrival.	3	73
Percentage of patients with AMI who were given acetylsalicylic acid (ASA): a) in the 24 hours before hospital arrival or b) within three hours of hospital arrival (or 24 hours of hospital arrival or during their ED stay.**	4	61
Percentage of patients with chest pain who returned to an ED within 72 hours to seven days of an index visit with a confirmed diagnosis of acute myocardial infarction/acute coronary syndrome (AMI/ACS).	5	61
Percentage of patients with ST-segment myocardial infarction (STEMI) on first ECG who received fibrinolytic therapy within 30 minutes of ED arrival.**	6	57
Percentage of patients with atrial fibrillation who were treated with or received anti-coagulation drug therapy or an anti-platelet therapy, if indicated.	7	36
Percentage of patients with PCI transported to hospital by ambulance who received primary PCI within 120 minutes after call for ambulance.	8	35
Respiratory		
Percentage of patients with asthma who received corticosteroids in the ED and at discharge (if discharged) stratified by age.	1	81
Time from arrival in the ED to first documented beta-agonist-type bronchodilator therapy for an acute exacerbation of asthma.	2	77
Percentage of patients with asthma who had an unplanned return visit to the ED for the same or a related asthma exacerbation within 24 hours (or within 24-72 hours, or within 72 hours) of ED discharge.	3	68
Percentage of patients with asthma who had an objective measurement of lung function during primary ED assessment (one or more of peak flow, oxygen saturation, FEV_1, spirometry).	4	66
Percentage of patients with community-acquired pneumonia who received initial antibiotic therapy within four hours (or six, or eight, or 24 hours) of arrival.**	5	60
Percentage of patients with chronic obstructive pulmonary disease (COPD) who received corticosteroid therapy in the ED and at discharge (if discharged).	6	55
Percentage of patients with community-acquired pneumonia who had vital signs (including O_2 assessment) recorded in the ED.	7	53
Percentage of patients with community-acquired pneumonia who had an inpatient LOS ≤ 2 days.	8	16
Stroke		
Percentage of eligible patients with acute stroke who received tissue plasminogen activator (tPA).	1	48
Percentage of potentially eligible patients with acute stroke who had a computed tomography (CT) scan of the brain within 25 minutes of arrival at ED.	2	43
Percentage of patients with acute stroke given tPA for whom tPA best-practice treatment protocol was followed for tPA administration.	3	43
Percentage of patients with acute stroke who had their blood glucose level checked on arrival at ED or by EMS prior to arrival and regularly for the first 24 hours.	4	25
Percentage of patients with acute stroke who had an ECG.	5	11

ED quality of care indicators	Priority within category	Prioritization Score*
Sepsis/Infection		
Time to antibiotics in patients with bacterial meningitis.	1	39
Percentage of patients with severe sepsis or septic shock who were given broad-spectrum antibiotics within four hours of ED arrival.	2	38
Percentage of patients with severe sepsis or septic shock who survived to hospital discharge (or to 28 days following discharge, or 60 days).**	3	14
Percentage of patients with severe sepsis or septic shock who were monitored for lactate clearance.	4	11

**Prioritization was calculated by taking the sum for each indicator ranked as the highest priority (coded as 1) to each indicator within the same clinical/operational category (coded as 0) in the paired comparison exercise.*

*** These indicators were presented with multiple time thresholds existing in the literature; panelists were not asked to select a preferred time threshold.*

Feasibility of Data Collection Based on Existing Administrative Databases

A feasibility review determined that 13 (27%) out of 48 indicators could be measured using current data elements in the Canadian Institute for Health Information's National Ambulatory Care Reporting System (CIHI-NACRS) or via NACRS plus linkage with other existing administrative databases such as CIHI's Discharge Abstract Database (CIHI-DAD) or death records. These 13 include some high priority indicators (i.e., those ranked as 1, 2 or 3 within a category) for ED operations, patient safety and sepsis/infection. Nine (19%) additional indicators, including five of the six pediatric indicators, *could* be feasibly measured with enhanced data quality in existing NACRS data elements such as, improved reliability of intervention coding and inclusion of a time stamp for interventions performed in the ED. Using provincial or national administrative databases, capture of the remaining 26 indicators would not be feasible; however, they could be obtained either through the integration of new data elements in the NACRS abstract (occasionally in conjunction with improved data quality in existing data elements) or through other data sources (e.g., chart review).

Gap Analysis

Using the Alberta Health Quality Matrix for Health (Exhibit 1) the steering committee mapped indicators to one or more of their relevant quality domains. Overall the candidate indicators covered the seven domains reasonably well. A large number of indicators mapped to safety, effectiveness, appropriateness, and efficiency, while relatively few indicators mapped to acceptability, accessibility or a healthy workplace. Specific gaps included a lack of trauma and pain management indicators. The steering committee identified the **highest priority** for new evidence-based indicator development in the areas of **patient satisfaction, healthy workplace, mental health and addiction, elder care and community-hospital integration**.

Discussion

In a nationally representative modified Delphi panel process, we developed a set of 48 evidence-based indicators to measure and compare quality of care in Canadian EDs. Indicators were prioritized within each of eight clinical/operational categories: patient satisfaction, ED operations, patient safety, pain management, pediatrics, cardiac conditions, respiratory conditions, stroke and sepsis-infection. While this number represents a substantial reduction from the 170 ED quality of care indicators identified from our systematic review, it is likely this parsimonious list is still too large for routine quality measurement and reporting at either the health jurisdiction or hospital level.

Our prioritization of indicators should, however, provide further guidance with respect to the selection of routine quality measures by health policy and decision makers. Our results suggest that the following indicators would be the highest priority for measurement and reporting: For pediatric indicators, the top three are listed to ensure a priority indicator for newborns and infants is included. For patient safety and sepsis/infection indicators, the top 2 indicators are listed since their prioritization scores were separated by only one point.

1. **ED operations:** ED length of stay (LOS): Time from first documented contact in the ED to the time of physical departure from the ED (overall and by Canadian Emergency Department Triage and Acuity Scale (CTAS)).
2. **Patient Safety:** Percentage of patients with an unplanned return visit to the ED *resulting in* admission within 48 hours (or 72 hours) of being seen and discharged from the ED, stratified by adult/pediatric patients; and percentage of patients with headache discharged home from the ED who were admitted to hospital with a subarachnoid hemorrhage in the subsequent 14 days.
3. **Pain Management:** Time to first dose of analgesic in all painful conditions requiring analgesia.
4. **Pediatric (0–28 days): a)** Percentage of pediatric patients (aged 0–28 days) with fever who received a full septic workup; **b)** Percentage of pediatric patients (aged 0–28 days) with fever who received broad-spectrum IV antibiotics.
5. **Pediatric (3 months–3 years):** Percentage of pediatric patients (aged 3 months–3 years) with croup who were treated with steroids.
6. **Cardiac:** Percentage of eligible patients with acute myocardial infarction (AMI) who received thrombolytic therapy or percutaneous coronary intervention (PCI).
7. **Respiratory:** Percentage of patients with asthma who received corticosteroids in the ED and at discharge (if discharged) stratified by age.
8. **Stroke:** Percentage of eligible patients with acute stroke who received tissue plasminogen activator (tPA).
9. **Sepsis/Infection:** Time to antibiotics in patients with bacterial meningitis; and percentage of patients with severe sepsis or septic shock who were given broad-spectrum antibiotics within four hours of ED arrival.

These indicators have face validity in that they cover many of the most serious health care emergencies seen in EDs, such as AMI, stroke, sepsis, and asthma. Moreover, these are conditions for which therapies administered in the ED exist that are known to reduce mortality and/or morbidity. In addition, other indicators such as those associated with appropriate pain management represent common concerns among ED patients. Finally, the ED operations indicators such as ED length of stay represent important indicators of ED efficiency and overcrowding, which are of particular concern to health administrators, clinicians and patients alike.

Limitations

While our steering committee included clinicians, administrative experts and health system decision-makers, it may have been under-represented in certain respects. For example, small and rural EDs, members of trauma programs and non-ED specialists were not well represented. Further, other panelists and jurisdictions may have had different priorities with regard to ED quality of care. It is likely that different indicators will be more or less relevant to different audiences; for example, priority ED indicators for an ED manager may be very different from those of a quality and safety officer in a health ministry.

Our indicators reflect some of the most important illnesses seen in EDs and resulting in hospital admissions (e.g., AMI, asthma, stroke and infection); however, they did not identify quality markers in several other important conditions such as heart failure or major trauma.

Future Directions

The approach taken in this exercise was to develop an evidence-based set of indicators, selected from the wide array that have already been developed and used in hospitals and health system jurisdictions. However, our process identified several important gaps in existing indicators. A major gap identified was in the area of patient satisfaction, a critical ED quality indicator. The expert panel and steering committee reviewed many existing patient satisfaction indicators, but all were discarded since they were either not deemed to be appropriate for ED care, or were overly specific with respect to clinical care processes and non-representative of the ED patient experience (Appendix 1). There was unanimous agreement about the urgency to develop improved measures and means of collecting ED patient satisfaction data. Composite indicators—incorporating critical elements such as communication and courtesy—were endorsed as being the most useful and actionable indicators of patient satisfaction. It was also recommended that patient satisfaction indicators should differentiate between the care provided by different ED healthcare practitioners (physicians, nurses, and other ED staff). In addition, the committee strongly recommended the development of a common and improved methodology for collecting patient satisfaction data in order to ensure that valid comparisons can be generated. Additional gaps included measures of: healthy workplace (e.g., absenteeism, sick time, occupational safety nosocomial infections); patient mental health and addiction (given the significance of this patient issue in Canadian EDs); elder care (e.g., adverse events, such as falls and development of delirium); and community-hospital integration (e.g., preventable ED visits by nursing home/LTC home residents; linkage with community services such as home care at discharge from the ED; and avoidable ED visits).

Monitoring and reporting quality of care measures for accountability and quality improvement can have a significant impact on improving health care delivery.[11,16] The impact, importance and challenges to the broad implementation and use of quality of care and patient safety indicators have been well noted in Canada[19,20] and elsewhere.[13,21–23] Nevertheless, the first step toward developing processes to routinely measure quality of care is to develop a consensus on what constitutes quality of care in EDs. Subsequent necessary steps include developing technical definitions of the indicators, developing appropriate and valid data sources for longitudinal and cross-jurisdiction measurement, and regularly reviewing and revising the indicators to ensure they remain relevant and accurately reflect current knowledge and practice.

The next phase of this project involves the development and publication of a Technical Manual for the prioritized indicator set. The Technical Manual is a national collaborative process led by members from the steering committee and the Canadian Emergency Department Information System (CEDIS), which aims to establish standard measurement criteria for each indicator to enable valid cross-jurisdictional comparisons. Such comparisons are increasingly feasible given that the Canadian Institute of Health Information's National Ambulatory Care Reporting System (CIHI-NACRS) will soon be expanded to Alberta, British Columbia and Quebec. In addition, CIHI has expressed an interest in facilitating measurement of some of the indicators developed in this process through enhancement of respective data elements as a means to facilitate quality of care reporting across Canada.

Careful evaluation of ED care is becoming increasingly important in the Canadian context, particularly as many jurisdictions are undertaking large scale, complex and system-level efforts to improve ED quality of care. In order to measure the impact of such improvement efforts on patient safety and quality of care, quality indicators must go beyond purely operational measures, such as ED length of stay. Rowe and colleagues stated that “there is an urgent need to place the collection of ED information on the provincial and national agenda and to make collecting the information consistent, comprehensive and mandatory.”[19]

Conclusions

From an initial list of 170 candidate indicators of ED quality and safety, 48 indicators were selected and prioritized through a modified Delphi process using experts with broad content and regional representation. These indicators represent several domains of quality of care and safety in the emergency department and cover many of the most serious conditions that present there. Future work is required to generate technical definitions, develop valid and reliable data sources for longitudinal and cross-jurisdiction measurement, and establish processes to re-evaluate and update the indicators to ensure continued relevance and accuracy.

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Appendix 1—Candidate Indicators: Round 1 Expert Panel Survey Results

Table 1 Candidate Indicators following Round 1 Expert Panel survey, by operational/clinical category and indicator status (retained, discarded, borderline)

Operational/ Clinical Category	Candidate Indicators, after Round 1 Expert Panel Survey, by indicator status	Source/ reference for each indicator*
Patient Satisfaction	**Retained**	
	No indicators were retained.	
	Discarded	
	Percentage of patients who stated that they would recommend this ED to friends or family.	(1)
	Overall patient rating of emotional support.	(1)
	Overall patient rating of waiting time to see a physician.	(1)
	Overall patient satisfaction with care received.	(1)
	Borderline	
	Overall patient assessment of how well information was communicated to them or their family during their ED stay.	(1)
	Percentage of patients prescribed a new medication who received instructions on how to take it.	(1)
	Percentage of patients prescribed a new medication who were warned about side effects.	(1)
	Overall rate of patient complaints to the emergency department (per 1,000 visits).	(1)
Patient Safety	**Retained**	
	Percentage of central lines inserted in the ED which developed catheter-related blood stream infections.	(2)
	Percentage of ectopic pregnancy patients with a missed diagnosis.	(3)
	Percentage of intubated patients for whom end-tidal carbon dioxide was monitored.	(4)
	Percentage of patients with headache discharged home from the ED who were admitted to hospital with a subarachnoid hemorrhage in the subsequent 14 days.	(5)
	Percentage of missed diagnosis of acute myocardial infarction in the ED.	(6)
	Borderline	
	Percentage of endotracheal intubation attempts which are successful.	(7; 8)
	Percentage of patients with appendicitis with a missed diagnosis.	(3)
	Percentage of missed diagnostic imaging abnormalities resulting in the patient being recalled to the ED or treatment changed.	(4)

Operational/ Clinical Category	Candidate Indicators, after Round 1 Expert Panel Survey, by indicator status	Source/ reference for each indicator*
ED Operations	**Retained**	
	Percentage of ED stretcher hours/day occupied by in-patients.	(9)
	Percentage of time the ED is at or above stated capacity.	(9)
	Discarded	
	Percentage of patients who left before treatment complete (LBTC).	(10)
	Percentage of Canadian Emergency Department Triage and Acuity Scale (CTAS) level 4 and 5 patients who have ED length of stay less than four hours.	(11-14)
	Time from arrival in ED to triage.	(12)
	Percentage of patients with pain assessed at triage.	(15)
	Percentage of deaths in the ED in which the GP was notified.	(4)
	Percentage of ED visits for conditions that could be treated in alternative primary care settings.	(16)
	Percentage of ED patients admitted to the hospital—overall and by CTAS.	(3; 10; 17-19)
	ED mortality rate—overall and within 48 hours of ED visit.	(20-22)
	Percentage of patients seen in a fast-track area.	(23)
	Percentage of patients whose regular doctor was informed and updated about the plan for follow-up after the hospitalization.	(24)
	Percentage of ED patients where a GP follow-up letter was sent within five working days.	(24)
	Percentage of patients who left against medical advice.	(25)
	Borderline	
	Time from decision to admit to departure to floor, for admitted patients.	(4;16)
	Percentage of CTAS level 2 and 3 patients with initial placement to waiting room.	(16)
	Percentage of patients who left the ED without being seen.	(3; 10; 17-19)
	ED length of stay (LOS): Time from first documented contact in the ED to the time of physical departure from the ED (overall and by Canadian Emergency Department Triage and Acuity Scale (CTAS)).	(3; 10; 17-19)
	Time from physician assessment to discharge.	(26-29)
	Time from triage to full nursing assessment.	(29)
	Time from placing an order for a radiographic test until the results are returned.	(25)
	Time from placing an order for laboratory testing until the results are returned.	(22;25)
	Time from ED physician consult request to decision to admit (if admitted) or to physical departure (if discharged).	(25;29)
	Ambulance Offload Time (AOT)—Time from patient/ambulance arrival to transfer of care to ED staff.	(22; 25; 30)
	Percentage of CTAS level 1, 2 and 3 patients who have ED length of stay less than six hours.	(11-14)
	Percentage of ED patients seen by a physician within target CTAS wait time.	(11-14)
	ED (LOS) for critically ill patients.	(11-14)
	Percentage of patients with eye problems who had their visual acuity recorded.	(4)
	Percentage of patients who returned and were admitted to the hospital within 48–<72 hours of being seen and discharged from ED.	(19)

Operational/ Clinical Category	Candidate Indicators, after Round 1 Expert Panel Survey, by indicator status	Source/ reference for each indicator*
Chronic Obstructive Pulmonary Disease (COPD)/ Asthma	**Retained**	
	Percentage of patients with asthma discharged home from the ED with a prescription/supply for oral steroids (corticosteroids).	(17; 18)
	Percentage of patients with atrial fibrillation who were treated with or received anti-coagulation drug therapy or an anti-platelet therapy, if indicated.	(17)
	Percentage of patients with asthma who had an objective measurement of lung function during primary ED assessment (one or more of peak flow, oxygen saturation, FEV_1, spirometry).	(17; 31)
	Percentage of patients with asthma admitted to hospital with steroid administration in the ED (IV or oral).	(17)
	Percentage of patients with chronic obstructive pulmonary disease (COPD) who received corticosteroid therapy in the ED and at discharge (if discharged).	(31-33)
	Time from arrival in the ED to first documented beta-agonist-type bronchodilator therapy for an acute exacerbation of asthma.	(18; 31)
	Percentage of patients with asthma treated with a beta-agonist-type bronchodilator in the ED.	(17)
	Discarded	
	ED LOS for patients with asthma.	*none
	Percentage of patients with asthma who have provision of discharge instructions documented on ED record.	(18; 31)
	Percentage of patients with asthma who receive a chest x-ray during the ED visit.	(17)
	Percentage of patients with COPD who have arterial blood gas testing in the ED.	(32)
	Percentage of asthma-related patient deaths in the ED.	(31)
	Percentage of patients with asthma discharged home from the ED with a short-term medication management written care plan.	(17)
	Rate of admission for patients with asthma.	(34)
	Percentage of patients with COPD who received anticholinergic-type bronchodilators in the ED and at discharge (if discharged).	(32)
	Percentage of patients with COPD who had a chest x-ray in the ED.	(32)
	Borderline	
	Percentage of patients with COPD who received antibiotics in the ED and at discharge (if discharged).	(32)
	Percentage of patients with COPD who received beta-agonist-type broncho-dilators in the ED and at discharge (if discharged).	(32)

Operational/ Clinical Category	Candidate Indicators, after Round 1 Expert Panel Survey, by indicator status	Source/ reference for each indicator*
Pneumonia	**Retained**	
	Percentage of patients with community-acquired pneumonia with delay (>4 hours from arrival) or nonreceipt of antibiotics in the ED.	(35; 36)
	Percentage of patients with community-acquired pneumonia with an appropriate antibiotic prescribed in the ED.	(37)
	Percentage of patients with community-acquired pneumonia who received initial antibiotic therapy within four hours (or six, or eight, or 24 hours) of arrival.	(17; 31; 38-40)
	Percentage of patients with community-acquired pneumonia who had vital signs (including O_2 assessment) recorded in the ED.	(38; 41)
	Percentage of patients with community-acquired pneumonia with chest x-ray performed to confirm diagnosis.	(38; 42)
	Percentage of high-risk patients (Pneumonia Severity Index [PSI] Class 4 or 5) with community-acquired pneumonia patients who were admitted.	(7)
	Discarded	
	Percentage of patients with community-acquired pneumonia admitted from the ED.	(31)
	Percentage of patients with pneumonia who had blood culture performed (in the ED prior to initial antibiotic received in hospital; within 24 hours).	(39; 43)
	Percentage of patients with community-acquired pneumonia who had a mental status assessment in the ED.	(44)
	Percentage of patients with community-acquired pneumonia who had a PSI completed in the ED.	(45)
	Percentage of patients with community-acquired pneumonia who had a chest x-ray.	(46)
	Mortality rate (30-day) for patients with community-acquired pneumonia.	(39)
	Percentage of patients with community-acquired pneumonia who had an inpatient LOS ≤ 2 days.	(18)
	Borderline	
	Percentage of patients with pneumonia who underwent oxygenation assessment during their ED visit.	(7; 31; 39; 47)
Acute Myocardial Infarction (AMI)	**Retained**	
	Percentage of fibrinolytic therapy patients who received fibrinolysis within 30 minutes of hospital arrival.	(48)
	Percentage of patients with primary percutaneous coronary intervention (PCI) who received their primary PCI within 90 minutes of arrival.	(31; 48; 49)
	Percentage of fibrinolytic therapy patients transported to hospital by ambulance who received fibrinolytic therapy within 60 minutes after call for emergency medical services.	(48)
	Percentage of eligible patients with acute myocardial infarction (AMI) who receive thrombolytic therapy or percutaneous coronary intervention (PCI).	(7; 48; 50)
	Percentage of PCI patients transported to hospital by ambulance who received primary PCI within 120 minutes after call for ambulance.	(48)
	Time from hospital arrival to initial electrocardiogram (ECG) for AMI patients.	(31; 48)
	Percentage of patients with AMI who received an electrocardiogram (ECG) within 10 minutes of hospital arrival.	(48)
	Percentage of patients with AMI given ASA within 24 hours before hospital arrival or within three hours of hospital arrival, 24 hours of hospital arrival, during ED stay.	(48; 51)

Operational/ Clinical Category	Candidate Indicators, after Round 1 Expert Panel Survey, by indicator status	Source/ reference for each indicator*
Acute Myocardial Infarction (AMI) *(continued)*	**Discarded**	
	Risk-standardized mortality rate (30-day; in-hospital) for patients with AMI.	(48; 52; 53)
	AMI in-hospital mortality rate (unadjusted).	(31; 48; 52; 53)
	Borderline	
	Percentage of patients with AMI transported by ambulance who received a pre-hospital 12-lead ECG.	(48)
Other Cardiovascular	**Retained**	
	Percentage of patients with atrial fibrillation who are currently treated with anti-coagulation drug therapy or an anti-platelet therapy.	(54)
	Time of arrival in the ED to first ECG for patients with chest pain.	(4)
	Percentage of patients with chest pain who returned to an ED within 72 hours to seven days of an index visit with a confirmed diagnosis of acute myocardial infarction/acute coronary syndrome (AMI/ACS).	(55)
	Percentage of patients with deep vein thrombosis/pulmonary embolism (DVT/PE) who received anticoagulation in the ED.	(55)
	Percentage of patients with chest pain (aged 40 years+) with an ED discharge diagnosis of non-traumatic chest pain who had an ECG performed.	(56)
	Discarded	
	LOS in hospital for DVT patients admitted from the ED.	(55)
	Percentage of patients with chest pain who were admitted to hospital from the ED and received a confirmed diagnosis of AMI/ACS during hospital admission.	(55)
	Percentage of patients with DVT admitted to hospital from the ED.	(55)
	Percentage of patients with DVT/PE who received venous imaging within 36 hours of an index visit to the ED.	(55)
	Percentage of patients with chest pain symptoms in ED who received early therapy including IV, oxygen, nitroglycerin, morphine, and a chewable aspirin on arrival.	(57)
	Percentage of patients with DVT given low-molecular-weight heparin in the ED.	(55)
	Percentage of patients with congestive heart failure who had left ventricular function assessment.	(58)
	Borderline	
	Percentage of patients (aged >18 years) with an emergency department discharge diagnosis of syncope who had an ECG.	(59)

Operational/ Clinical Category	Candidate Indicators, after Round 1 Expert Panel Survey, by indicator status	Source/ reference for each indicator*
Sepsis/Infection	**Retained**	
	Time to antibiotics in patients with bacterial meningitis.	(4)
	Percentage of patients with severe sepsis/septic shock for whom a resuscitation bundle incorporating early goal-directed therapy (MMS) was started immediately and completed within six hours of recognition of severe sepsis/septic shock.	(24)
	Percentage of patients with severe sepsis or septic shock who were monitored for lactate clearance.	(60)
	Percentage of patients with severe sepsis or septic shock who were given broad-spectrum antibiotics within four hours of ED arrival.	(60)
	Percentage of severe sepsis/septic shock patients who survived (in-hospital; 28 day; 60 day).	(60; 61)
	Discarded	
	Percentage of patients who received antibiotics in 30 minutes or less.	(60)
	Percentage of patients admitted to hospital for urinary tract infection (UTI).	(17)
	Percentage of patients with severe sepsis/septic shock whose central venus pressure/central venus oxygen saturation monitoring was initiated within two hours.	(60)
	Percentage of patients with severe sepsis/septic shock who were on vasopressor or suspected to have adrenal insufficiency who are given corticosteroid.	(60)
	Borderline	
	Time from first documented contact in the ED to antibiotic administration for febrile neutropenia.	(3)
Pediatric	**Retained**	
	Percentage of pediatric patients (aged 3 months–3 years) with urinary tract infection who had urine cultures obtained by catheter, suprapubic, or midstream methods.	(17)
	Percentage of pediatric patients (aged 0–1 months) with jaundice who had a bilirubin drawn.	(17)
	Percentage of pediatric patients (aged 3 months–3 years) with croup who were treated with steroids.	(17)
	Percentage of pediatric patients (aged 0–28 days) with fever who received broad-spectrum IV antibiotics.	(17)
	Percentage of pediatric patients (aged 0-28 days) with fever who received a full septic workup.	(17)

Operational/ Clinical Category	Candidate Indicators, after Round 1 Expert Panel Survey, by indicator status	Source/ reference for each indicator*
Pediatric *(continued)*	**Discarded**	
	Percentage of pediatric patients (0–19 years) with Type I diabetes with ketoacidosis treated initially with IV normal saline.	(17)
	Percentage of pediatric patients discharged from the ED with a written care plan.	(17)
	Percentage of pediatric patients (aged 28 days–24 months) with a fever whose blood and urine was cultured.	(17)
	Percentage of pediatric patients with croup (aged 3 months–3 years) who received a chest or lateral neck x-ray during the ED visit.	(17)
	Time from triage to initiation of phototherapy for pediatric patients with jaundice.	(17)
	Percentage of pediatric patients (aged <18 years) with a current weight in kilograms documented in the ED record.	(7; 24)
	Percentage of pediatric patients with seizures who require ventilatory support.	(17)
	Percentage of pediatric patients (aged 28 days–24 months) with a fever who had a complete blood count drawn.	(17)
	Percentage of pediatric patients treated with IV therapy who initially received isotonic solutions.	(17)
	Percentage of pediatric patients (aged 2–19 years) with an unplanned return visits to any ED within 72 hours of index visit for same/related condition.	(17)
	Percentage of pediatric patients with croup (aged 3 months–3 years) with an unplanned return visit to any ED within 24 hours of index visit for same/related condition.	(17)
	Percentage of pediatric patients (aged 3 months–3 years) with bronchiolitis who received a chest x-ray.	(17)
	Percentage of pediatric patients (aged 3 months–3 years) with bronchiolitis who were treated with antibiotics.	(17)
	Percentage of pediatric patients (aged 0–28 days) with fever who were admitted to hospital.	(17)
	Time to antipyretic for pediatric patients (aged 3–24 months) with temperature 38.5 ^{o}C if not given in preceding six hours.	(17)
	Percentage of pediatric patients (aged 3–24 months) with a fever admitted to hospital and with an inpatient LOS<24 hours.	(17)
	Percentage of pediatric patients with UTI whose blood is cultured.	(17)
	Percentage of pediatric patients (aged 3–24 months) with a fever who received a chest x-ray during the ED visit.	(17)
	Percentage of pediatric patients with minor head injury (aged 0–19 years) who received a skull x-ray.	(17)

Operational/ Clinical Category	Candidate Indicators, after Round 1 Expert Panel Survey, by indicator status	Source/ reference for each indicator*
Pediatric *(continued)*	**Borderline**	
	Percentage of pediatric patients (aged 0–3 months) with a urinary tract infection whose urine is cultured.	(17)
	Time from triage to administration of antibiotics for pediatric patients (aged 0–28 days) with fever.	(17)
	Percentage of patients (aged 28–90 days) who presented with a fever and were classified CTAS level 2 who were seen by a physician within 15 minutes.	(17)
	Percentage of pediatric patients who returned to the ED within 72 hours, with critical diagnosis.	(19)
	Percentage of pediatric patients (aged 28–90 days/3–24 months) with a fever who made an unplanned return visits to any ED within 48/72 hours of index visit for same/related condition.	(17)
	Percentage of pediatric patients with minor head injury (aged 0–19 years) who received a computed tomography (CT) scan of the head.	(17)
Stroke	**Retained**	
	Percentage of potentially eligible patients with acute stroke who had a computed tomography (CT) scan of the brain within 25 minutes of arrival at ED.	(55)
	Percentage of eligible patients with acute stroke who received tissue plasminogen activator (tPA).	(55)
	Percentage of patients with acute stroke who were managed on a designated stroke unit.	(55)
	Percentage of patients with acute stroke who had their blood glucose level checked on arrival at ED or by EMS prior to arrival and regularly for the first 24 hours.	(55)
	Percentage of patients with acute stroke evaluated for tPA eligibility.	(55)
	Percentage of patients with acute stroke for whom National Institute of Neurological Disorders and Stroke (NINDS) inclusion/exclusion criteria were applied to determine eligibility for thrombolysis.	(55)
	Percentage of patients with acute stroke given tPA for whom tPA best-practice treatment protocol was followed for tPA administration.	(55)
	Percentage of patients with acute stroke ineligible for tPA who received a CT/MRI (magnetic resonance imaging) within 24 hours.	(55)
	Percentage of patients with acute stroke who had an ECG.	(55)
	Discarded	
	Percentage of patients with acute stroke who received treatment for elevated blood glucose level.	(55)
	Percentage of patients with acute stroke ineligible for tPA who received a CT/MRI before hospital discharge.	(55)
	Percentage of patients with acute stroke who are mobilized within 24 hours.	(55)
	Percentage of patients with acute stroke whose fever was treated with antipyretics.	(55)
	Percentage of patients with acute stroke treated with indwelling urethral catheter.	(55)
	Percentage of patients with acute stroke treated with sublingual nifedipine.	(62)
	Borderline	
	Percentage of patients with acute stroke for whom acute ASA therapy was initiated as soon as possible.	(55)

Operational/ Clinical Category	Candidate Indicators, after Round 1 Expert Panel Survey, by indicator status	Source/ reference for each indicator*
Trauma	**Retained**	
	No indicators were retained.	
	Discarded	
	Percentage of patients who did not receive an x-ray at the initial visit and who return to any ED within seven days with the same condition, and subsequently received an x-ray on the return visit.	(18)
	Total time spent in ED by patients with minor injury.	(4)
	Percentage of trauma teams led by advanced trauma life support (ATLS) provider.	(4)
	Percentage of patients with ankle trauma where ankle x-rays that are negative.	(18)
	Percentage of ankle or foot injury patients who received an X-ray.	(17)
	Borderline	
	Percentage of patients with wounds who had tetanus status ascertained and received appropriate antitetanus treatment.	(4)
	Percentage of patients with fractures or dislocations who received analgesics in less than one hour from triage.	(63)
	Time to analgesia in all fractures/femoral fractures.	(15)
Mental Health / Neurological	**Retained**	
	Percentage of psychiatric patients who returned to the ED within 72 hours of an ED visit.	(64)
	Discarded	
	Percentage of patients not seen by a crisis team in the ED with an outpatient follow-up arranged within seven days.	(17)
	Percentage of patients assessed by a crisis team in the ED.	(17)
	Percentage of patients with seizure who had a CT scan of the head (excluding febrile seizure).	(17)
	Borderline	
	Time from ED referral to psychiatric opinion.	(4)

**Sources/reference for candidate indicators presented in Table 1.*

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