Emergency Department Care Technical Report: Clinical Utilization and Outcomes

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Overview:

Hospital Report 2003: Emergency Department Care reports on 8 performance indicators, and introduces two new areas where development work for future indicators is in progress. This *Technical Summary* provides a detailed description of the methods used to select, calculate and compare these indicators across Ontario emergency departments participating in this report.

This year's report builds on the first ED report (2001), and includes indicators of ED utilization across Ontario, and indicators targeted at 4 clinical groups – asthma, chest pain, pneumonia, and ankle injuries. Recent development work has been undertaken to refine the original methodology; this includes new data linkage methods resulting in the inclusion of additional indicators; enhancements to the data analysis process; and new indicators resulting from the work of a Trauma Advisory Panel.

Patient characteristics can have an impact on CUO indicators, and since these can vary across EDs, risk-adjustment techniques have been added this year in the hospital-level reporting. These risk adjustment techniques can help control for, but not eliminate, the impact of case-mix differences among institutions.

Methodology

Data Sources

The National Ambulatory Care Reporting System (NACRS) forms the basis for the information on CUO indicators. NACRS is managed by the Canadian Institute for Health Information (CIHI). Every time a patient is registered at an Ontario ED, a NACRS record is generated for that visit and submitted to CIHI. NACRS data used in this Report are derived from the 2001/2002 fiscal year (April 1st, 2001 to March 31st, 2002) which contains over 4.5 million records. All ED patients who are subsequently admitted to hospital have a second summary abstract created in a separate database – the Discharge Abstract Database (DAD). The DAD is also managed by CIHI and data from the DAD were linked with information from NACRS to provide comprehensive information on the patient's entire stay in hospital including both the ED visit and the inpatient stay. Both the NACRS and DAD data accessed for this Report are protected by privacy and confidentiality policies that ensure that patients and caregivers cannot be individually identified.

Data Quality

The 2001/2002 NACRS dataset was the first full year of data submissions, with an annual volume of emergency charts abstracted ranging from approximately 20,000 to over 100,000 per hospital. Some inconsistencies continue to exist in the way the data elements are interpreted and coded by hospitals. The Hospital Report investigators have worked closely with CIHI to assess the quality of the NACRS data. Based on these analyses, NACRS has been found to be a reliable and important source of information for measuring and reporting ED performance. Using NACRS data to produce comparative performance information will hopefully lead to refinements in the data elements, data coding, and ongoing improvements in data quality.

Data Inclusion/Exclusion Criteria

NACRS records were submitted by 167 of the 175 EDs (at 121 hospital corporations - 166 comprehensive EDs and 9 UCCs), operating in Ontario in 2001/02, giving a NACRS participation rate of 95.4%. Records with invalid Ontario health care numbers, or records that were exact duplicates of an existing record were excluded from further analysis, and individuals with missing values for individual data elements were excluded from specific analyses. In order to focus on care provided to Ontario residents, all records from individuals who resided outside of Ontario were excluded. The inclusion of only Ontario residents means that the analyses will undercount visits by non-residents, especially in EDs located close to Ontario's borders or located in vacation areas where non-residents are more numerous.

The final dataset used for this Report included 4,587,276 ED visits. The inclusion and exclusion criteria are summarized in the following table:

General Inclusions/Exclusions:

	Criteria	Codes/Comments
	Start with full NACRS 2001-2002 dataset.	
Include:	All cases with valid healthcare number	
Include:	All cases with primary functional centre recorded as emergency department	vfc = '71310 '
Include:	All cases with valid Ontario postal codes	Postal Code must begin with K, L, M, N, P
Include:	All cases from valid acute care emergency departments	Do not include cases from mental health facilities, outpatient clinics, or other ambulatory services
Exclude:	All exact duplicate records for a single visit	Duplicate records will be excluded if they match a first occurrence exactly for date/time of registration, encounter number, functional centre code

A Snapshot of Ontario Emergency Departments

Emergency departments provide care to a wide range of patients. The indicators provide a snapshot of care in Ontario EDs, and were selected with input from the ED Advisory Panel. To present the patient characteristics in a more meaningful way, some NACRS data elements were recoded to group information together for presentation – e.g age was recoded into defined age groups, and length of stay was changed to length of stay ranges. These recoded data elements were then used in clinical utilization analysis to measure these indicators that describe patient characteristics and the services used by ED patients .

Indicators describing Patient Characteristics and Services Used:

Patient Characteristics: EDs provide care to a wide range of patients and the following indicators were selected to reflect their clinical characteristics.

- Acuity – urgency rating assigned at the time of patient triage which designate the priority for ED care, based on definitions in the Canadian Triage Acuity Scale (CTAS) ratings. The same CTAS system is used in all Ontario EDs
- Diagnostic Data – type of problem or condition that brought the patient to the ED, defined in the codes contained in the International Classification of Diseases, Ninth Revision (ICD-9). Codes are based on the final ED diagnosis, and are assigned after care is completed in the ED

- **Services Used:** EDs serve as an interface between communities and hospitals, and important aspects of ED care include how patients arrived in the ED, how long they stayed and where they went after the completion of their ED care. Mode of Arrival – whether the patient arrived at the ED by ambulance or some other means of transportation
- ED Length of Stay - the time from when the patient was registered ED staff until the time the patient was discharged from the ED. For ED patients who are admitted to hospital, ED length of stay includes the time from patient registration until the time the patient was assigned inpatient status in the hospital computer system; patients transferred from one ED to another are excluded from the length of stay analysis. The delay until the patient physically leaves the ED for a hospital bed is not included.
- Disposition – Patients were identified as either dying in the ED, being transferred to another ED, being admitted to hospital, or being discharged from the ED.

Data Elements and Summary Variables used to Measure Patient Characteristics and Services Used:

DESCRIPTION	INDICATOR	CATEGORIES
Patient Characteristics	Age Group (Derived variable)	0-5 years 6–12 years 13-18 years 19-44 years 45-64 years 65-84 years 85+ years
	Sex	Male Female Other
	Diagnostic Groups Based on ICD 9 Codes (Derived variable)	Central Nervous System (320-389) Circulatory System (390 – 459) Digestive System (520 – 579) Follow-up (V54, V58, V67) Infectious Disease (001 – 139) Injury (800 – 959) Mental Disorders (290 – 319) Musculoskeletal System (710 – 739) Poisonings (960 – 995) Respiratory System (460 – 519) Symptoms (780 – 799) Other (all other ICD 9 codes)
	Triage Level (Based on CTAS scores)	Resuscitation (CTAS score 1) Emergent (CTAS score 2) Urgent (CTAS score 3) Semi-Urgent (CTAS score 4) Non-Urgent (CTAS score 5)

Services Used	Arrival by Ambulance	Yes No
	Length of Stay Groups (Derived variable)	LOS < 1 hour 1 ≤ LOS < 2 hours 2 ≤ LOS < 4 hours 4 ≤ LOS < 8 hours 8 ≤ LOS < 24 hours LOS ≥ 24 hours
	End of Visit Disposition (Derived variable - See below for definitions)	Admitted to Inpatient Transferred to a different ED for care Dead (death in the ED; or dead on arrival) Discharged (Does not fall into any above category)

Categories for Recoding Patient Disposition:

In some cases, the ED disposition coding may be incorrect. Decision rules were developed to re-code patient disposition from the ED. The decision rules were based on a combination of time differences, NACRS disposition codes and DAD records. These rules included:

- Transfer to inpatient from the ED:
  - This category involves NACRS to DAD linkages;
  - Includes all cases for admits to same institution and admits to different institution;
  - Includes all cases with 0 - 2 hour time difference;
  - Includes all cases with negative time differences from – 24 hr to 0 hrs;
  - Includes all cases with time difference >2 hours to 12 hours, where both NACRS (VD= 4,5,6) and DAD (Entry=E) indicated a transfer to inpatient;
  - No cases with a time difference of 12 hours or greater are included.

- Transfer from one ED (NACRS1) directly to a second (different) ED (NACRS2):
  - This category involves NACRS to NACRS linkages;
  - Includes all cases where the visit disposition category recorded in the first NACRS record was 4 or 5, AND where the time difference between NACRS1 and NACRS2 fell between negative 24 hours to plus 2 hours;
  - Includes all cases where the visit disposition category recorded in the first NACRS record was 6, AND where the time difference between NACRS1 and NACRS2 fell between negative 24 hours to plus 12 hours.

- Repeat visit to the same or different ED:
  - This category involves NACRS to NACRS linkages, excluding ED transfer cases (above);
  - Includes all cases where subsequent ED registration occurs at the same or different institution, and is based on the last NACRS record in the index episode of care;
  - Includes only cases where registration date/time are different for the original ED visit (NACRS 1) and the subsequent ED visit (NACRS 2);

- Includes all cases with a time difference from negative 24 hours to plus 28 days where a second NACRS record is found after an index visit;

- Deaths in the ED:
  - This category involves single NACRS records;
  - Includes all cases where the visit disposition category recorded in the NACRS record was 7 (death in the ED) or 8 (dead on arrival) to the ED.

Selection of Emergency Department Patient Groups and Clinical Indicators

In order to make help make the indicators relevant, information was gathered from the literature search and from a series of consultations with ED physicians and nurse managers to identify clinical conditions (diseases and symptoms) frequently assessed and treated in Ontario EDs for which appropriate care could have important implications for treatment and patient outcomes. This information on potentially relevant indicators was combined with an analysis of the data elements available from NACRS to define a set of feasible indicators.

The CUO indicators used in this year's hospital-level report describe either the process or the outcomes of care for four conditions: asthma, ankle injury, chest pain and pneumonia. These four clinical conditions cover a range of ages and complexity, and represent 8.9% of annual ED visits. Data on system-level indicators for trauma and poisoning are presented this year and with further analysis and consultation they may form the basis for future hospital-level indicators.

Definitions of the Four Clinical Conditions included in this report:

Emergency Department Condition-Specific Patient Groups

Asthma: a disease of the lungs with swelling and narrowing of the airways. It may lead to wheezing, shortness of breath, and other symptoms.

Ankle Injuries: blunt trauma sustained to the ankle or foot area .

Chest Pain: specific type of pain felt in the front of the chest that may result from decreased blood flow to the heart. This does not include chest pain that is a result of a traumatic injury.

Community Acquired Pneumonia (CAP): an infection of the lungs resulting in shortness of breath, fever and an abnormal chest x-ray.

Clinical Condition Definitions and Sample Size

CONDITION	ICD-9 CODES & AGE RESTRICTIONS
Asthma N = 71,917 (1.6% of all records)	Main Problem: 493 OR Main Problem: 786.0, 786.2, 799.1 or 427.5 AND Other Problem: 493 Age Restriction: 0 to 64 years
Ankle Injury N = 138,125 (3.0% of all records)	Main Problem*:824, 825, 827, 837, 838, 845, 924.2 or 959.7 Age Restriction: 6 to 84 years
Chest Pain N = 76,101 TBA (1.7% of all records)	Main Problem*:411 or 413 OR Main Problem: 786.5 AND Main Problem not trauma case (800 – 999), AND no E-codes Age Restriction: 19 to 84 years
Pneumonia N = 33,403 (0.73% of all records)	Main Problem: 481, 482, 485 or 486 OR Main Problem: 786.0, 786.2 or 799.1 AND Other Problem: 481, 482, 485 or 486 Age Restriction: 19 to 84 years
Skull fracture or intracranial injury+ N = 50,143 (1.1% of cases)	Main Problem: 850, 851.1, 851.4, 851.8, 852 - 854 Age Restriction: 0 – 84 years
Hip Fracture+ N = 5,557 (0.1% of cases)	Main Problem: 820 Age Restriction: 0 – 84 years
Self-Inflicted Poisoning+ N = 10,190 (0.2% of cases)	Main Problem: 960-989 AND Ecode: E950 – E952 Age restriction 0 – 84 years

Note: Main Problem refers to the first diagnosis entered into NACRS. Other problem refers to the second diagnosis entered into NACRS .

**Inclusion codes revised in 2003* *+ New Clinical Conditions for 2003*

Clinical Performance Measures for 2003

Clinical Utilization and Outcome Indicators for 2003:

Asthma:

- **The proportion of patients who are discharged from the ED with a diagnosis of asthma who have an urgent or emergent return visit for asthma or a related condition to any ED less than 24 hours after the initial ED discharge.**
- **The proportion of patients who are discharged from the ED with a diagnosis of asthma who have an urgent or emergent return visit for asthma or a related condition to any ED between 24 and 72 hours after the initial ED discharge.**

Chest Pain:

- **The ED length-of-stay of patients discharged from the ED with a diagnosis of chest pain.**
- **The proportion of patients admitted to hospital with an ED diagnosis of chest pain that subsequently have an inpatient diagnosis consistent with severe cardiac disease. (*)**
- **The proportion of patients admitted to hospital with an ED diagnosis of chest pain who have an inpatient length of stay of two days or less. (*)**

Community-Acquired Pneumonia (CAP):

- **The proportion of patients diagnosed with pneumonia in the ED who are admitted to hospital.**
- **The proportion of patients admitted to hospital with an ED diagnosis of pneumonia who have an inpatient length of stay of two days or less. (*)**

Ankle Injuries:

- **The proportion of patients with an ankle or foot injury who receive an x-ray of the ankle or foot in the ED.**

(*) indicates new indicator added for 2003 – the detailed definitions of these clinical outcome indicators follows.

Changes to Clinical Performance Measures for 2003:

As part of the continuing evolution of the CUO measures, three indicators used at the system-level in Hospital Report 2001: Emergency Department Care have not been included in this year's report and three new indicators that link ED care to inpatient care have been added.

Deletions:

- The indicator for AMI mortality was not included because data quality analysis suggested that there are inconsistent coding practices across hospitals regarding the disposition codes used for patient deaths to clearly distinguish between patients who die after arrival and the initiation of treatment in the ED versus those patients who are pronounced dead on arrival to the ED.
- The indicator on the proportion of appropriate AMI patients receiving thrombolytic therapy in the ED has been deferred as a result of changing practices in the immediate treatment of AMI with a number of hospitals have adopted primary percutaneous coronary intervention (PCI) as the initial treatment of choice. Future work with experts in the areas of cardiology and emergency medicine will be undertaken to investigate the development of other measures that could be used to assess care for AMI patients.
- The indicator of return visits to an ED after treatment for chest pain with a diagnosis of AMI or acute coronary syndrome was found to have an incidence of less than 1 per hundred cases and therefore was not included because of the low event rate.

Additions:

- Chest Pain: The proportion of patients admitted from the ED with a diagnosis of chest pain who end up with a diagnosis indicating severe coronary artery disease;
- Chest Pain: The proportion of patients admitted from the ED with a diagnosis of chest pain who remained in hospital 2 days or less;
- Pneumonia: The proportion of patients admitted from the ED with a diagnosis of pneumonia who remained in hospital 2 days or less.

Risk Adjustment:

Clinical utilization and outcome indicator results may be differ between hospitals simply because the patient populations in the two EDs have different characteristics. In order to provide a fair basis for comparison of performance across hospitals, statistical methods are applied to "risk-adjust" the rates of performance for each hospital to account for differences in some of these patient characteristics. In this analysis, we risk-adjusted for the following characteristics: age, sex, and acuity (triage) levels. There are limits to any risk adjustment strategy. These techniques will reduce the effects of the patient population served by different EDs on the results, but will not eliminate all differences. The factors used for risk adjustment in this report are described in the following table along with the detailed indicator definitions.

Definitions of Clinical Utilization and Outcome Performance Indicators

OUTCOME	Definition (NACRS, DAD)	Risk Adjustment
ASTHMA		
Early Recurrent Visit (< 24 hrs)	Second visit meets the following criteria: Main Problem: 493 Triage: CTAS score 1, 2, or 3 Time: within 0 to 24 hours of discharge	Sex (male, female) Triage: 1&2, 3, 4&5 Age: 0-5, 6-12, 13-18, 19-44, 45-64
Later Recurrent Visit (24 – 72 Hrs)	Second visit meets the following criteria: Main Problem: 493 Triage: CTAS score 1, 2, or 3 Time: within 25 to 72 hours of discharge	Sex (male, female) Triage: 1&2, 3, 4&5 Age: 0-5, 6-12, 13-18, 19-44, 45-64
ANKLE INJURY		
X-ray rates	Intervention: 2.67 to 2.68 (CCP) 88.27 to 88.29 (ICD-9)	Sex (male, female) Triage: 1&2, 3, 4&5 Age: 6-12, 13-18, 19-44, 45-64, 65-84
CHEST PAIN		
Length of Stay in ED	Visit Disposition Category : 'Discharged' Calculation: visit disposition date/time – registration date/time	Sex (male, female) Triage: 1&2, 3, 4&5 Age: 19-44, 45-64, 65-74, 75-84
Length of Stay < 2 days as Inpatient	Visit Disposition Category: 'Admitted to Inpatient' DAD: Length of Stay Time Calculation: Inpatient d/c date/time – inpatient admission date/time	Sex (male, female) Triage: 1&2, 3, 4&5 Age: 19-44, 45-64, 65-74, 75-84
Confirmed Diagnosis Of SCD in Hospital	DAD Main Problem: 410 or 411	Sex (male, female) Triage: 1&2, 3, 4&5 Age: 19-44, 45-64, 65-74, 75-84
PNEUMONIA		
Hospital Admission	Visit Disposition Category: 'Admitted to Inpatient'	Sex (male, female) Triage: 1&2, 3, 4&5 Age: 19-44, 45-64, 65-74, 75-84
Length of Stay < 2 days as inpatient	Visit Disposition Category: 'Admitted to Inpatient' DAD: Length of Stay Time Calculation: Inpatient d/c date/time – inpatient admission date/time	Sex (male, female) Triage: 1&2, 3, 4&5 Age: 19-44, 45-64, 65-74, 75-84

Reporting Hospital Level Results:

In this Report performance on these eight indicators is measured at both the corporate level and the individual ED site level. The results are presented as box plots, based on the rate per 100 visits, and include the median values for the indicators as well as the distribution of values for all EDs that submitted data for five or more cases.

Box Plot Interpretation

The indicator data in this section are presented in "box-and-whisker plots", which are graphic displays of the (observed) performance rates across all hospitals that are included in the analysis. The box plots display the variability in the rates per 100 visits across hospitals. The line inside the box reflects the rate for the median hospital, indicating that 50% of the hospitals had higher rates and 50% had lower rates. Similarly, the bottom and top outlines of the box mark the 25th and 75th percentile scores respectively. The "whiskers" extending from both ends of the box display the minimum and maximum hospital rates. The boxes and whiskers do not include the values for hospitals that are considered extreme outliers – that is, those hospitals whose performance rates are considerably higher or lower than the rest of the hospitals. These outliers are represented as circles above and below the whiskers.

It is important to remember that both the indicators and the data source require ongoing refinement and validation. The calculation and release of these indicator rates is an important step in an ongoing process to develop sound, relevant and feasible ED clinical outcome indicators. It is hoped that publication of these indicators will facilitate improved data quality and lead to more in-depth examinations of the delivery of ED clinical care by hospitals.

Calculations for Box Plots and Ratings:

Observed Rate: # observed occurrences / total # cases

Expected Rate: # expected occurrences / total # cases

Calculating Rate per 100 Visits:

Rate per 100 visits = risk adjusted rate per ED multiplied by 100.

95% Confidence Intervals Calculation:

Upper CI = Observed rate + 1.96 SE Lower CI = Observed rate - 1.96 SE