

Data Impact Challenge

Challenge Question: **What is the rate of repeated diagnostic imaging tests within a ninety (90) day period?**

Team: Ottawa Hospital Performance Measurement
Team members: Yiran (Erin) Liu, Deanna Rothwell, Nadine Lawrence, Jocelyn Tufts, Kristy Zhou, Amal Al Zayadi, Ata Torabi, Jo Ann Colas, Pedram Noghani, Saskia Vanderloo, Alison Jennings

DATA

Data custodian:	The Ottawa Hospital (TOH)
Data sources:	The data were extracted from The Ottawa Hospital Data Warehouse (TOHDW). The Ottawa Hospital is a 1,117-bed tertiary-care teaching hospital in Ottawa, Ontario with five campuses. TOHDW pulls together information from many different operational databases into a single repository with a clearly defined structure.
List of Datasets:	<ul style="list-style-type: none">• SMS – Patient registration system• OACIS – Clinical Information System that captures all lab, pharmacy and diagnostic imaging orders and reports
Data Quality:	The TOHDW contains high quality data. TOHDW incorporates administrative, clinical, and patient information from various source systems, thus capturing complete information for each hospital encounter. The diagnostic and procedural coding is consistent with international classifications. The datasets have a normalized data structure, with standard naming conventions and formats across systems. Each record is time-stamped and updated on a nightly basis. The data is highly accurate and has been used extensively to support decision-making, report to the Ministry of Health, and in several high-impact research publications.
Inclusions:	All Computed Tomography (CT) scans and Magnetic Resonance Imaging (MRI) scans performed between June 1, 2010 and June 30, 2015 at The Ottawa Hospital.
Exclusions:	Duplicate tests (i.e., multiple codes associated with a single test, body location and date/time).
Nature of cohort:	Any CT or MRI associated with a selected body location (abdomen, chest, head, or extremities) for all patients of the following TOH campuses: Civic, General, Riverside Campuses, University of Ottawa Heart Institute and The Rehabilitation Centre.
Size of cohort:	<ul style="list-style-type: none">• Number of patients: 276,899• Number of DI tests: 476,652
Data timeframe:	<ul style="list-style-type: none">• Index tests: date performed between June 1, 2010 and March 31, 2015.• Repeated tests: date performed between June 1, 2010 and June 30, 2015.
Representativeness:	<p>TOH is one of the largest academic health sciences centres in Canada and serves a population of 1.2 million residents. The hospital and its associated institutes provide a number of acute care services, including cardiovascular, surgical and trauma programs. The hospital is the main referral centre for those requiring complex care in the region, and therefore the patient population is representative of other tertiary care centres.</p> <p>The Ottawa Hospital serves Ottawa and sees most of the patients living in the Champlain Local Health Integration Network (LHIN). MRIs and CTs can only be done in-hospital unless a patient seeks private care, so we are confident that we are capturing the vast majority of the tests for the Ottawa region.</p>

Data Impact Challenge

ANALYSIS

Diagnostic Imaging (DI) test – All CT and MRI tests during the selected timeframe were counted for all encounter types at any of TOH’s five campuses (i.e. in-patient, out-patient, day surgery, medical daycare or emergency visits). Codes for DI were classified by modality (i.e., CT or MRI) and body location (i.e., abdomen, chest, head, or extremities). This was accomplished through a chart review carried out by a physician for a prior study in 2012/2013 (unpublished).

Index test – First DI test observed per patient/modality/body location during data timeframe.

Repeat test – Repeated tests were flagged and counted if they occurred within 1, 7 and 90 days (d) from the index encounter, by scan type and body location.

Time (T) = 1 day, 7 days, or 90 days

DI Test Repeat Rate (per 100 patients):

$$\text{Repeat rate}_T = \left[\frac{\text{Number of patients with } \geq 1 \text{ repeat DI test}_T}{\text{Total number of DI tests}_{(T=90)}} \right] \times 100$$

Numerator: Number of patients having at least one repeated DI test at time = ‘T’

Denominator: Total number of DI tests (all index tests + repeat tests ≤90d of index)

Proportion of Tests Repeated:

$$\% \text{ Repeated DI Tests}_T = \left[\frac{\text{Number of repeated tests}_T}{\text{Total number of repeated tests}_{(T=90)}} \right] \times 100\%$$

Numerator: Number of repeated DI tests at time = ‘T’

Denominator: Total number of repeated DI tests within T = 90d of index

Proportion of Patients with Repeat DI Tests, at Time = ‘T’:

$$\% \text{ Patients with Repeat DI Tests}_T = \left[\frac{\text{Number of patients with } \geq 1 \text{ repeat DI test}_T}{\text{Total number of patients with any DI test}} \right] \times 100\%$$

Numerator: Number of patients with at least one repeat DI test at time = ‘T’

Denominator: Total number of patients with any DI test

Innovation: In addition to repeated testing within 90 days, we looked at the frequency of repeated testing within 1 and 7 days. We also looked at DI tests by body location.

Data Impact Challenge

FINDINGS

Table 1: It is interesting to see that for some modality/body locations most repeats occurs within 1 day (e.g., abdominal or chest MRI). We also noticed that there are generally more CT scans (see 'Total DI Tests') than MRIs although the repeat rates of MRIs is higher than those of CT scans. Furthermore, as shown in **Figure 1**, repeat CTs of the chest and abdomen peak every 7 days after about 42 days from the index test.

Limitations: There are 2 smaller community hospitals in the region but we believe that if a patient had their index DI test done at TOH, they will get subsequent test here as well.

Table 1: Rates of Repeated CT and MRI Tests Performed at TOH within 1, 7 and 90 Days

Modality	Body Location	Patients with any DI Test	Patients with ≥ 1 Repeat DI Test ($\leq 90d$ of Index)	Total DI Tests (Index & Repeats $\leq 90d$ of Index)	Repeat Intervals								
					1 day			7 days			90 days		
					Repeat Rate ^a	% of Repeat DI Tests ^b	% of Patients With Repeat DI Tests ^c	Repeat Rate	% of Repeat DI Tests	% of Patients With Repeat DI Tests	Repeat Rate	% of Repeat DI Tests	% of Patients With Repeat DI Tests
CT	Abdomen	73,457	13,948	139,728	2	7.8%	2.9%	4	24.6%	7.6%	10	100.0%	19.0%
	Chest	59,570	12,120	117,450	2	8.6%	3.3%	4	21.2%	7.0%	10	100.0%	20.3%
	Extremities	5,180	396	5,969	2	26.7%	2.5%	4	58.4%	4.9%	7	100.0%	7.6%
	Head	90,827	18,942	155,355	4	20.9%	7.7%	9	60.7%	14.7%	12	100.0%	20.9%
MRI	Abdomen	20,827	5,242	34,067	12	67.0%	19.9%	13	74.6%	21.6%	15	100.0%	25.2%
	Chest	8,571	2,348	15,656	10	55.2%	17.7%	10	59.6%	18.9%	15	100.0%	27.4%
	Extremities	19,753	2,576	24,541	6	53.6%	7.5%	8	74.6%	10.1%	10	100.0%	13.0%
	Head	57,724	12,334	100,062	7	37.4%	11.9%	9	53.9%	15.3%	12	100.0%	21.4%
All CT and MRI		335,909	67,906	592,828	4	22.6%	7.5%	7	45.1%	12.0%	11	100.0%	20.2%

a - Rates are expressed as the number of tests per 100 patients per 90d

b - Number of repeated tests within 1, 7 or 90d divided by the total number of repeated tests within 90d (expressed as a percentage)

c - Number of patients with at least one repeated test within 1, 7 or 90d divided by the total number of patients with any test (expressed as a percentage)

Data Impact Challenge

Figure 1: Frequency of Repeat Tests, by Number of Days after Index Test [Index Date: June 1, 2010 – March 31, 2015]

