



Institute for Clinical Evaluative Sciences
G1 06, 2075 Bayview Avenue
Toronto, Ontario M4N 3M5
www.ices.on.ca

Data Impact Challenge

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

Team Avengers: Tony Antoniou, Simon Hollands, Ryan Ng, Jagadish Rangrej, Deva Thiruchelvam, Marian Vermeulen

Data and Analysis

The data custodian organization used to answer the repeated diagnostic imaging test question was the Institute for Clinical Evaluative Sciences (ICES). In brief, ICES is an independent, non-profit organization that uses population-based information to produce knowledge on a broad range of health care issues. ICES has the ability to link population-based health information at the patient level in the province of Ontario for 13 million individuals. This linkage allows researchers to follow patient populations through diagnosis and treatment, and to evaluate outcomes.

To answer the question of repeated diagnostic imaging tests within a ninety day period, the team used two databases: the *Ontario Health Insurance Plan (OHIP) Claims Database* and the *Registered Persons Database*. The OHIP Claims Database contains billing information for all physician services reimbursed by the Ontario government. The Registered Persons Database contains demographic and residential information of all individuals who have ever held an OHIP health card.

We examined repeated diagnostic imaging tests in the province of Ontario for six major modalities – *computed tomography (CT)*, *echocardiogram (ECHO)*, *magnetic resonance imaging (MRI)*, *nuclear medicine*, *ultrasound* and *x-ray* – over a four year period starting from July 1, 2010 to June 30, 2014. All diagnostic tests were identified from the OHIP claims database using fee code billing information, which is billed by the physician for performing and/or interpreting the diagnostic test. The unit of analysis was the modality, body region or system, and type of test. **We categorized these tests using fee code information provided in the Government of Ontario's Schedule of Benefits.** For example, an x-ray of the lower extremities where the specific type was the foot would be considered a single test. Each diagnostic test was followed forward for a ninety-day period to look for a repeat diagnostic test in the same patient. A repeated test was defined as any test within ninety days with the same modality, body region or system, and type of test. To be an eligible test in our analysis, the test needed to belong to a patient who was:

- (1) a resident of Ontario on the date of the diagnostic test – defined as having an Ontario postal code, and
- (2) an adult between the ages of 18 and 105 years on the date of the diagnostic test.

For each modality, we calculated an overall rate of repeated diagnostic imaging tests for the study period defined as the number of diagnostic imaging tests with a repeat test within ninety-days (numerator) divided by the total number of diagnostic imaging tests (denominator). By modality, we calculated the same ninety day repeated test rate by year – from July 1 to June 30 – to examine temporal trends. All rates are reported with 95% confidence intervals. To understand who underwent diagnostic testing, we examined demographic characteristics, specifically age, sex and socioeconomic status as measured by their residential neighbourhood income quintile at the time of the initial test. To better understand the nature of repeated tests, we also determined the median and interquartile range (IQR) for the time elapsed between repeated tests.

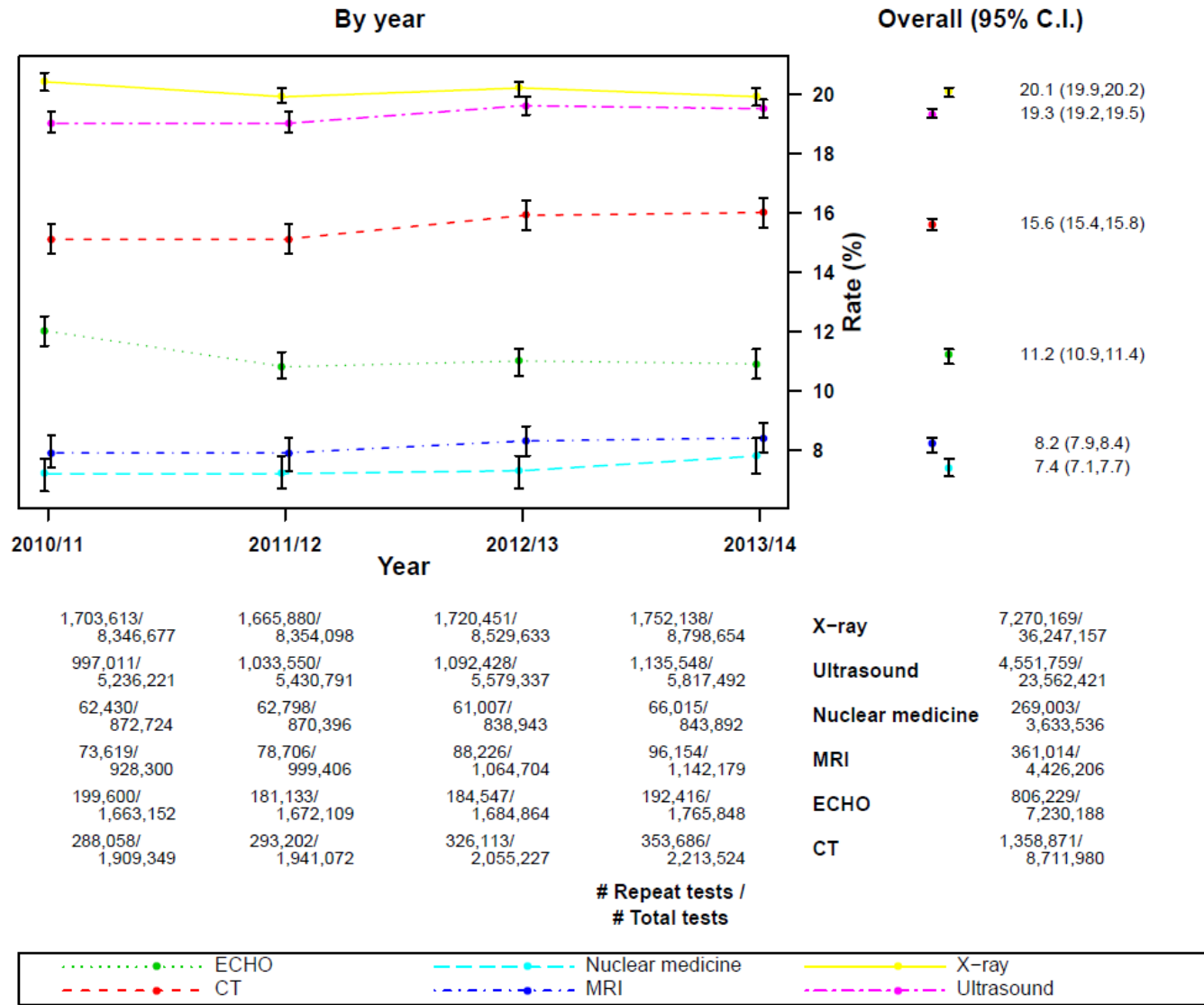
Findings

The total number of diagnostic imaging tests during the study period was 91,495,036. Among these, there were 15,001,277 repeated tests within 90 days or an overall rate of 16.4% (95% confidence intervals (CI): 16.4 to 16.4%). The number of tests varied by modality with x-rays the most common diagnostic test (n=34,029,062) and nuclear medicine the least common (n=3,425,955). The overall rate of repeated tests varied from 7.4% (95% CI: 7.1 to 7.6%) for nuclear medicine to 20.1% for x-ray (95% CI: 20.0 to 20.2%) – **Figure 1**. The temporal trends for repeated test rates varied by diagnostic test. The repeated diagnostic test rate of CT, MRI, nuclear medicine and ultrasound increased over time while the rate decreased for ECHO and x-rays.

A total of 8,511,929 individuals received a diagnostic imaging test at least once during the study period, 2,998,163 of whom had at least one repeated test (35.5%). The mean age of a person with a repeated test was 52.9 years (standard deviation (SD): 19.5 years) compared to 47.1 years (SD: 17.2 years) for a person with no repeated tests. Most individuals undergoing repeat testing were women (62.7%) compared to 53.2% of individuals with no repeated tests. The proportion of individuals with a repeated test in the lowest and highest income quintiles were 20.3% and 19.2%, respectively. Similarly, the proportion of individuals with no repeated tests in the lowest and highest income quintile were 18.5% and 20.5%.

The length of time between repeated tests varied by test modality. The median (IQR) time between repeated tests for CT, ECHO, MRI, nuclear medicine, ultrasound and x-ray were 36 (9-64), 27 (8-55), 26 (6-57), 3 (1-29), 21 (7-48) and 13 (2-35) days, respectively.

Figure 1: The rate of repeated diagnostic imaging tests, by modality, in Ontario, 2010/11 to 2013/14



Interpretations and limitations

An important consideration when examining the results is the unit of analysis used to define a repeated test. Our unit of analysis was modality, body region or system, and type of test, which is extremely specific. For example, diagnostic tests with the same modality examining the same body region but not the same test type were not considered repeated tests. In this sense, our estimates are conservative.

The rate of repeated tests for each modality should be considered individually and not directly compared with one another. There are different clinical reasons that explain why some modalities are more common than others. In some instances, a repeated diagnostic test may be necessary. For example, the rate of repeated ultrasounds was 19.3%. Many ultrasounds are repeated as part of prenatal care. When ultrasounds for prenatal care and ultrasounds in the pelvic region are excluded, the rate of repeated ultrasounds decreased to 10.0%.

One limitation of the data was the inability to determine the laterality of certain body parts (e.g. arms, legs). Thus, we may have misclassified a repeated test; for example, if the first test examined the left arm but the second test examined the right arm, our methods would define the second test as repeated. Because our datasets lack clinical information, we could also not comment on the clinical appropriateness of repeat tests.

Strategies to reduce the cost of repeated tests based on the presented findings should be done with caution. Additional research which distinguishes between necessary and unnecessary repeated tests is required so that the quality of patient care is not compromised for cost cutting measures.