# Using Electronic Medical Records to Better Understand the Relationship Between Testing, Diagnosis and Treatment of Gonorrhea in Ontario

**Allan F. Gillman, PhD** – IMS Brogan, Toronto, Canada

## ABSTRACT

Anonymized longitudinal EMR patient data (IMS Evidence 360, Canada) were examined to better understand the relationship between the testing, diagnosis, and treatment of gonorrhea.

A 42% increase in the volume of gonorrhea cases has been observed by Public Health Ontario (2012-14), with treatment resistant cases at just over 10%. This study leverages EMR data to validate these trends and provide additional insights related to patient treatment. Testing, diagnosis and treatment information by age, gender, and year were examined for cross-sectional cohorts from 2008 to 2014. A longitudinal cohort was also used to control for socio-demographic changes in the EMR patient panel.

In recent years testing rates for women have been declining, while testing for men has been increasing. In spite of this, test rates for women are 2-5 times the level for men, even though men are twice as likely to be diagnosed with gonorrhea. The drop in testing for women appears to align with changes to cervical cancer screening guidelines (and funding for Pap tests) in Ontario. Young women (<=28) represent the largest (67.6% of women) and fastest growing segment for gonorrhea, while older men (>=29) represent the largest segment (59.2%) of men. Treatment using Cefixime and Azithromycin is the most common, even though this is no longer recommended as first line treatment for gonorrhea.

This analysis generally aligns with information from Public Health Ontario, and provides insights beyond those currently available. It also demonstrates the value that EMR insights can bring to a challenging area such as STIs.

## INTRODUCTION

Gonorrhea is second only to clamydia in the volume of sexually transmitted infections in Ontario[1]. A recent rise in the rates of gonorrhea coupled with its increasing resistance to antibiotics has public health officials in Ontario trying to understand why, and the media is proclaiming that "Gonorrhea's making a comeback"[2].

In mid-2012, Cancer Care Ontario released new cervical cancer screening guidelines which increased the age and dropped the frequency of Pap testing for women in Ontario[3] (and provincial funding was realigned to these guidelines in 2013). Although this should arguably have had little impact on testing for STIs, doctors in the US (where similar guidelines were put in place in 2009) feared that it would reduce the need for pelvic exams which "are commonly used to screen for sexually transmitted diseases...and some doctors wonder if patients will come without it"[4]. An unintended consequence of the updated screening guidelines may have been an inadvertent drop in random STI testing. This hypothesized reduction in STI testing was recently confirmed using audit data in Ontario5.

In mid-2013, Public Health Ontario[6] and the Public Health Agency of Canada[7] updated their guidelines for the testing and treatment of gonorrhea. As a result, confirmed or suspected cases of gonorrhea should be treated with a combination of ceftriaxone and azithromycin. With the increasing treatment resistance of gonorrhea, it is unclear how well these guidelines are being followed.

The ability to effectively examine the inter-relationship between patient testing, diagnosis, and treatment is challenging, and the ability to do it with small patient populations is even more so. Anonymized longitudinal EMR patient data in Ontario (IMS Evidence 360, Canada) were examined to better understand this relationship for gonorrhea, and cross validate the insights against what is available from Public Health.

## METHODS

Patient testing, diagnoses, treatment, and outcomes data is rarely available for analysis, and where it is available, it is usually found in unlinked silos of information. As a result, understanding the inter-relationship between these areas is difficult to understand.

IMS Evidence 360, provides access to longitudinal multidimensional patient centric information from over 900,000 deidentified patients across Ontario. A cohort builder was used to extract insights based on calendar year, number of visits, diagnosis of gonococcus infections, lab tests for STIs, Pap test billings, treatment regimens, age, and gender. Cross-sectional comparisons over a seven year window (2008-14) were used for trending and analysis.

KEYWORDS: SEXUALLY TRANSMITTED INFECTIONS, ELECTRONIC MEDICAL RECORDS, TESTING DIAGNOSIS AND TREATMENT

1 Ontario Agency for Health Protection and Promotion (Public Health Ontario). Reportable disease trends in Ontario, 2013. Toronto, ON: Queen's Printer for Ontario; 2015.
2 Armstrong and Cain (2015), "Toronto at centre of dramatic rise of gonorrhea in Ontario", http://globalnews.ca/news/1874609/toronto-at-centre-of-dramatic-rise-in-gonorrhea-in-ontario/?sc_ref=twitter
3 Cancer Care Ontario, "New Cervical Cancer Screening Guidelines For Ontario Women", https://www.cancercare.on.ca/cms/One.aspx?portalId=1377&pageId=154934
4 Beck (2011), "Questioning the Need for Routine Pelvic Exam", http://www.wsj.com/articles/SB10001424052748703584804576144161119909004
5 Ubelacker (2015), "Fewer Pap smear tests due to rewritten guidelines led to less STI testing: study", http://www.ctvnews.ca/health/fewer-pap-smear-tests-due-to-rewritten-guidelines-led-to-less-sti-testing-study-1.2611924
6 Ontario Agency for Health Protection and Promotion (Public Health Ontario). Guidelines for testing and treatment of gonorrhea in Ontario. Toronto, ON: Queen's Printer for Ontario; 2013.
7 Public Health Agency of Canada (2013), "Canadian Guidelines on Sexually Transmitted Infections", http://www.phac-aspc.gc.ca/std-mts/sti-its/cgsti-ldcits/section-5-6-eng.php

## RESULTS

In recent years, STI testing rates have dropped from a high in 2011 to current levels. This is driven largely by a significant drop in testing of women despite a fourfold increase in the testing of men (Figure 1). The relative rate of testing for women has dropped from 11.4:1 in 2008 to 2.4:1 in 2014. Over this time frame, relative gonorrhea infection rates for men have been fairly stable at over twice that observed for women (Figure 2).

Concurrent with this drop in STI testing was the release of new Cancer Care Ontario guidelines in 2012 which generated the intended drop in Pap testing (Figure 3) as seen in the EMR data. This data aligns with recent audit data published in Ontario, and further suggests that an unintended consequence of the guideline change was a reduction in/reduced opportunity for random STI testing by physicians.

A major increase in the volume of gonorrhea cases has been observed by Public Health in Ontario over the last number of years. EMR data mirrors this with an increase in the volume of cases observed per 100,000 by year since 2008 (Figure 2), and in particular since 2011. To control for socio-demographic changes due to organic growth in the panel over time, a cohort based only on patients in the data in 2013 was similarly analysed for comparative purposes. Figure 4 shows that while the rates of infection are lower than that found across all patients, it still compares favourably with and is in line with the increases observed by Public Health. While moderating the size of the trends observed, the impact on the results and conclusions were otherwise not material.

Table 1 shows that gonorrhea growth rates are higher amongst those under 29, and that men represent the largest segment of gonorrhea patients (although most are >28). Growth rates for both men and women are similar at just over 37%. Interestingly, growth rates across all age ranges appear fairly balanced for men, however growth rates for women under 29 are the highest of all at over 66%, almost twice average of the entire group.

Lastly, treatment of gonorrhea appears to be lagging current guidelines, with most physicians (51.5%) using a combination of azithromycin and cefixime as their treatment of choice for gonorrhea. PHO, PHAC, and CDC guidelines recommend treatment with a combination of azithromycin and ceftriaxone (only 3.0% are treated this way). The remaining treatment choices include even older mono or combination therapies.

## CONCLUSIONS

Understanding the relationship between disease testing, diagnosis, and treatment, is challenging at the best of times, and is particularly so with diseases where patient volumes are low. In the case of gonorrhea, even mandatory reporting and pooled information collected for such patients by Public Health cannot answer key questions of interest. As a result, other methods of filling the knowledge gaps should be used where appropriate.

The insights from this study reveal a direct correlation between Pap testing and STI testing, which is likely an unintended consequence of the 2012 CCO Pap testing guidelines. Since the implementation of these guidelines, there has been a disconcerting rise in gonorrhea infection rates. This suggests that Pap tests should no longer be used as the sole opportunity for random STI testing, and that testing of young women in particular should be pursued more actively (decoupled from Pap testing) to help moderate infection rates in this impacted group. Secondly, this research suggests that more aggressive communication of current treatment guidelines may be needed to ensure the climb in drug resistance rates is minimized.

Anonymised longitudinal EMR patient data (IMS Evidence 360, Canada) mirrored Public Health trends for infection, and was able to provide a deeper and complimentary understanding of this disease state. Some of the results reported above cannot be investigated by looking at just the subset of patients reported to Public Health and some cannot be replicated as easily as in the EMR patient data.

Furthermore, the power of longitudinal EMR patient data is that it permits a greater understanding of the relationship between testing, diagnosis, treatment and outcomes, in the investigation of many disease states beyond gonorrhea.

**Table 1:** Demographic differences and 6 year annual growth rates for Gonorrhea

| | All Cases | Share | 6 Yr A Growth* | Males | Share | 6 Yr A Growth* | Females | Share | 6 Yr A Growth* |
|---|---|---|---|---|---|---|---|---|---|
| **Total** | **201** | **100.0%** | **37.4%** | **130** | **100.0%** | **37.4%** | **71** | **100.0%** | **37.5%** |
| 1-23 | 46 | 22.9% | 48.6% | 23 | 17.7% | 39.4% | 23 | 32.4% | 66.1% |
| 24-28 | 55 | 27.4% | | 30 | 23.1% | | 25 | 35.2% | |
| 29-35 | 49 | 24.4% | 28.1% | 35 | 26.9% | 35.7% | 14 | 19.7% | 12.2% |
| 36+ | 51 | 25.4% | | 42 | 32.3% | | 9 | 12.7% | |

* too small to be broken out by age groups

Source: IMS Evidence 360, Canada

**Figure 1:** Absolute and relative STI testing rates per 100,000

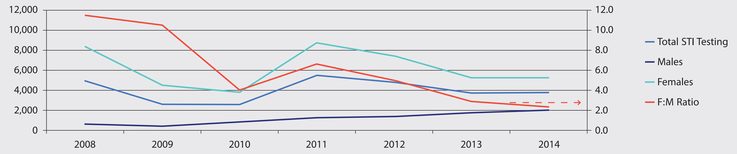



**Figure 2:** Absolute and relative infection rates per 100,000

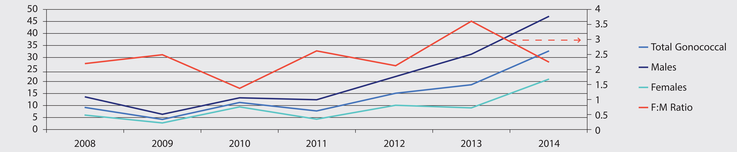



**Figure 3:** Proportion of women by age given Pap tests after CCO guideline change

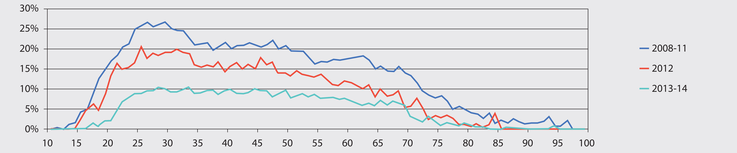
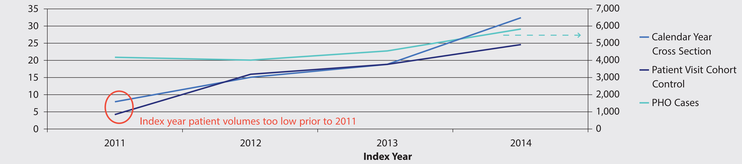



**Figure 4:** EMR and Public Health infection rates align




Source: IMS Evidence 360, Canada

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