# Can we do it online?
# Validating a clinical prediction rule for chlamydia and gonorrhea infection among internet-based testers in British Columbia

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## BACKGROUND:

- Previously, a clinical prediction rule (CPR) was developed using sexually-transmitted infection (STI) clinic data from Vancouver, Canada, to predict chlamydia and/or gonorrhea (CT/GC) infection among asymptomatic women and heterosexual men[1]
- GetCheckedOnline (GCO)[2], a program of the BC Centre for Disease Control (BCCDC), currently offers universal CT/GC urine screening to all clients

## OBJECTIVE:

- The objective of this study was to evaluate CT/GC case detection online by screening GCO clients under two scenarios:
  1. Using population-based guidelines
  2. Using individualized guidelines, i.e., a CPR

## METHODS:


- **Data sources:**
  - GCO program database and BCCDC's STI Information System
- **Study population:**
  - Women and heterosexual men who completed testing for CT/GC between October 2015 and June 2018
  - Restricted to those who were **asymptomatic** and **not contacts of possible STI cases** at time of testing with **complete data for all CPR variables**
- **Population-based guidelines:**
  - Public Health Agency of Canada (PHAC) STI guidelines[3]
  - A binary variable was created for the presence of the primary risk factor for CT/GC infection**: men aged 20–29 and women aged 15–24**
- **Individualized guidelines:**
  - The previously-developed CPR[1] estimates risk of CT/GC infection based on 5 predictor variables (**Table 1**) : (1) age, (2) ethnicity, (3) number of sexual partners in the past 6 months, (4) previous chlamydia diagnosis, and (5) previous gonorrhea diagnosis
- **Associations with infection:**
  - Associations between predictor variables and CT/GC infection were assessed by calculating unadjusted odds ratios (OR)
- **Model accuracy:**
  - **Calibration** of the CPR was assessed by calculating:
    - Hosmer-Lemeshow (H-L) goodness-of-fit statistic
  - **Discrimination** of the CPR was assessed by calculating:
    - Area under the receiver operating characteristic curve (AUC)
- **Performance measures:**
  - Sensitivity and proportion of GCO clients screened were calculated at different CPR cut-off scores and by application of PHAC guidelines

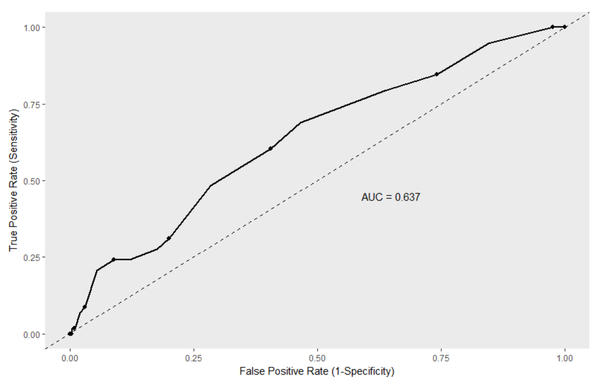
## RESULTS:

- Of completed CT/GC testing episodes among women and heterosexual men on GCO, n=2703 met study inclusion criteria
- Prevalence of CT/GC infection in GCO was 2.2% (**Table 2**)
- Within GCO, CPR variables associated with CT/GC infection were age 14-19 years old (OR=4.99, 95%CI: 1.07-17.92), age 20-24 years old (OR=3.09, 95%CI: 1.37-7.58), and previous CT diagnosis (OR=3.26, 95%CI: 1.53-6.29)
  - Identifying as a woman was associated with CT/GC infection (OR=1.95, 95%CI: 1.15-3.38)
- The H-L statistic p-value was 0.95 ($\chi^2$=2.69, d.f.=8), indicating good model fit within GCO
- The CPR showed reasonable discrimination within GCO (AUC=0.64, 95%CI: 0.57-0.71; **Figure 1**)
- Performance measures (**Figure 2**):
  - If GCO clients were screened according PHAC guidelines, you would avoid screening 70% of the population and would miss 57% of CT/GC cases
  - If only GCO clients with risk scores ≥4 were screened, you would avoid screening 15% of the population and would miss only 5% of CT/GC cases

### Table 1: CPR for predicting CT/GC infection

| Variable | Score |
|---|---|
| Age (years) | |
| 14-19 | 8 |
| 20-24 | 3 |
| 25-29 | 1 |
| 30-39 | -2 |
| ≥40 | 0 |
| Ethnicity | |
| White | 0 |
| Non-white | 5 |
| # of sexual partners, previous 6 months | |
| 0 | 0 |
| 1-2 | 5 |
| ≥3 | 6 |
| Previous chlamydia diagnosis | |
| Yes | 7 |
| No | 0 |
| Previous gonorrhea diagnosis | |
| Yes | 1 |
| No | 0 |

### Figure 1: Receiver operating characteristic (ROC) curve

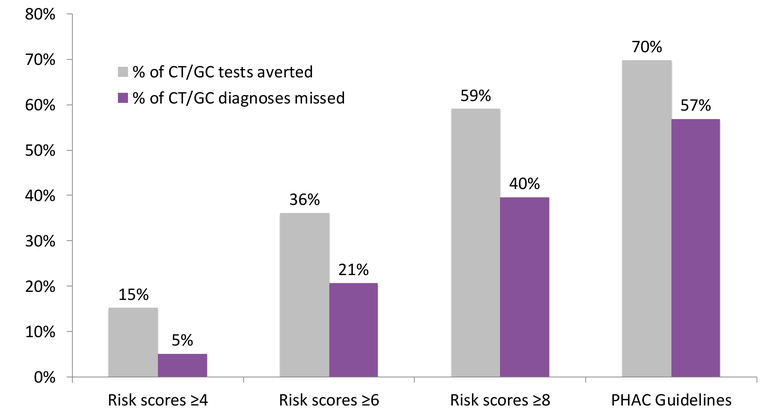



### Table 2: Population characteristics of CT/GC testing episodes

| Variable | | Clinic Derivation Population, 2000-2006, n=10437 | | GCO Validation Population, 2015-2018, n=2703 | |
|---|---|---|---|---|---|
| | | n | % | n | % |
| Chlamydia/gonorrhea case | | 184 | 1.8% | 58 | 2.1% |
| Gender | Women | 3496 | 33.5% | 1243 | 46.0% |
| | Men | 6941 | 66.5% | 1460 | 54.0% |
| Age (years) | 14-19 | 257 | 2.5% | 50 | 1.8% |
| | 20-24 | 1962 | 18.8% | 474 | 17.5% |
| | 25-29 | 2651 | 25.4% | 638 | 23.6% |
| | 30-39 | 3181 | 30.5% | 907 | 33.6% |
| | ≥40 | 2386 | 22.9% | 634 | 23.5% |
| Ethnicity | White | 7732 | 74.1% | 2081 | 77.0% |
| | Non-white | 2705 | 25.9% | 622 | 23.0% |
| # of sexual partners[+] | 0 | 644 | 6.2% | 109 | 4.0% |
| | 1-2 | 6857 | 65.7% | 1456 | 53.9% |
| | ≥3 | 2936 | 28.1% | 1138 | 42.1% |
| Previous chlamydia diagnosis[^] | | 1518 | 14.5% | 169 | 6.3% |
| Previous gonorrhea diagnosis[^] | | 619 | 5.9% | 15 | 0.6% |

[+]STI clinics: previous 6 months; GCO: previous 3 months
[^]STI clinics: assessed for any diagnosis ever by medical chart review; GCO: assessed by self-report within past 12 months

### Figure 2: CT/GC tests averted and diagnoses missed




## CONCLUSIONS:

- CPRs can be applied to an online context with reasonable calibration and discrimination, although population demographics may explain differences in model accuracy between STI clinic and online testing environments
- Compared to population-based guidelines, CPRs perform better at detecting CT/GC infections while reducing the number of tests offered
- By optimizing case detection among asymptomatic internet-based STI testers, overall testing burden and related costs can be reduced

**ACKNLOWLEDGEMENTS:**
The authors would like to thank Janyn Mercado for assistance with data linkage and preparation, Caren Rose for guidance on imputation methods, and Hsiu-Ju Chang for assistance in research administration. This study was funded by the Canadian Institutes of Health Research. Research for this project received approval from the University of British Columbia's Research Ethics Board (# H18-00437).

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