The NYC Macroscope: Harnessing Data from Electronic Health Records for Population Health Surveillance in NYC

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EHRs Transform Medical Records into Actionable Information
Actionable Information in NYC: Primary Care Information Project (PCIP)

A bureau of NYC Department of Health, PCIP was founded by Mayor Bloomberg in 2005

Mission
• Improve the quality of care in medically underserved areas through health information technology

Success
• On multiple vendor platforms, over 9,000 providers joined PCIP’s Regional Health Extension Center for Health IT (NYC REACH)
  • 1095 independent practices
  • 63 community health centers
  • 54 hospitals & outpatient clinics
<table>
<thead>
<tr>
<th>PCIP Overview</th>
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<tr>
<td><strong>EHR Adoption &amp; Meaningful Use</strong></td>
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<tr>
<td>- Regional Extension Center</td>
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<td>- Behavioral Health</td>
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<tr>
<td>- Medicaid Specialists</td>
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<tr>
<td><strong>Quality Improvement</strong></td>
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<tr>
<td>- PCMH</td>
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<td>- Pay for Performance</td>
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<tr>
<td>- Pay for Quality</td>
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<td>- Patient engagement</td>
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<td>- Community Projects</td>
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<td><strong>Interoperability</strong></td>
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<td>- Health Information Exchange</td>
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<td>- Interfaces</td>
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<td>- Accountable Care</td>
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<td><strong>Public Health Monitoring</strong></td>
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<td>- Disease Surveillance and Management</td>
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<td>- Diabetes Registry</td>
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<td>- Query Health</td>
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<td>- Data Hub</td>
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Providers offered many services

Contemplation
- Provider outreach & education
- Vendor selection
- Group purchasing discounts
- Readiness assessments
- IT consultation
- Partners for financing & workforce development

Implementation
- Contract accountability
- Project management
- Workflow redesign (large practices)
- Social networking
- Communication outreach
- 16 CME credits for training

Go live
- Revenue cycle optimization
- EMR consulting
- QI consulting
- PCMH preparation
- Privacy & security consulting
- Work flow redesign (small practices)
- Patient portal training
- Interfaces (e.g., labs, registries)
- Pilots

Post go live
- Quality measures
- Interoperability
- Patient engagement
- Biosurveillance
- Pay-for-Quality programs

Population Health
Feedback to providers gets buy-in

Monthly dashboards sent to PCIP providers
- 10 EHR Use Measures
  - ePrescribing
  - Reviewing current meds
- 10 Quality-of-care measures
  - Diabetes control
  - Blood pressure control
  - Smoking status
  - Mammography
- Recommendations
- Flu-like illness

Legend (Sample Graph)
- EHR Use Measures
  - Office Visits
  - % Locked Visits
  - % Current Meds Reviewed
  - % Allergy Structured (or N/A)
  - % Electronic Prescribing
  - % Order Sets Used
  - % Complete CPT Coding
  - % Labs Completed
  - % Payment Type Matched

Quality Measures
- % A1C Testing
- % BP Controlled in Hypertensives
- % Cholesterol Screening among non DM/IVD
- % BMI Entered
- % Smoking Status Taken

Syndromic Surveillance, Last 6 Months
- PCIP Weekly % of Visits with vomiting or diarrhea
- PCIP Weekly % of Visits with cough & fever

CPT Codes, Last Month
- 5921X New Patients
- 5921X Established Patients

Payment Type, Last Month
- Medicaid FFS
- Comm. / Medicaid HMO
- Medicaid
- Medicare
Infrastructure to Retrieve EHR Data: The Hub Population Health Network

“The Hub” allows secure exchange of aggregate data with PCIP practices through a distributed model:

- Send out queries
- Receive patient counts overnight

The Hub currently covers:

- 700 practices
- 1.9 M patients in 2013
- 4 M patients since 2009
Mechanics of the Hub

Using a secured HTTPS connection, SQL queries are pushed from the vendor server, run as a scheduled job at each practice, and returned to an internal data warehouse.

*Distributed model - no patient-level data shared*
Hub Strengths: Sample Size, Coverage

3,000+ Patients Per Neighborhood in 2012
Hub Limitations: Documentation Changes Over Time

Per Practice, percent of patients that received \( \geq 1 \) lab result electronically

<table>
<thead>
<tr>
<th>Year</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
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Providers are getting better at using their EHRs.
EHRs are getting better at connecting to electronic resources like labs.
Incentives are changing provider behavior.
Critical question:

How can EHR data be meaningfully harnessed for population surveillance, taking into account representativeness, bias and data quality issues, in New York City and across the country?
THE NYC MACROSCOPE
Goals of the NYC Macroscope

• To develop and validate a system to use data from primary care electronic health records (EHRs) for population health surveillance

• To disseminate the knowledge generated from our work to other jurisdictions
  – Develop a network of people working on this topic
    ▪ “Community of practice”
Challenges

• Reliability/data quality
• Construct and diagnostic validity
• Generalizability
  – From practices to NYC overall
  – From NYC to other jurisdictions
• Questions about how to analyze trends
  – Qualitative changes in denominators over time
    ▪ Case mix within practices
    ▪ Practices within the Health Information Exchange
  – Limitations of confidence intervals
    ▪ Very large sample sizes create very small confidence intervals
    ▪ Need to develop ways to incorporate uncertainty
Strategic Plan

- Governance Issues
- Methodological Considerations
- Plan to Operationalize the NYC Macroscope
- Indicators to be Evaluated
- Evaluation Studies

NYC Macroscope Indicators

Outcomes

- Prevalence, Treatment and Control
  - Diabetes
  - Hypertension
  - Cholesterol

- Prevalence
  - Obesity
  - Smoking
  - Depression

- Use of Preventive Services
  - Vaccination against Influenza

Population Subgroups

- Sex
  - Male
  - Female

- Age Group
  - 20-39
  - 40-59
  - 60-100

- Neighborhood Poverty Rate*
  - <10%
  - 10-19%
  - 20-29%
  - ≥30%

*Derived from American Community Survey data on the percent of individuals in a neighborhood living below 100% of the Federal Poverty Line
Reference Surveys

• **NYC Health and Nutrition Examination Survey (NYC HANES 2013)**
  – Gold-standard examination survey with household-based sampling
  – Includes clinical and laboratory measures
  – Estimated N = 1,550
  – Carried out by CUNY School of Public Health in collaboration with NYC Department of Health
  – Previous NYC HANES conducted in 2004

• **NYC Community Health Survey (CHS)**
  – Annual random-digit-dialed telephone survey
  – N = 8,698 (6,905 in care)
  – Carried out by NYC Department of Health
Evaluation Studies

• Population Level Estimate Comparison
  – Convergent validity: NYC Macroscope vs. CHS, NYC HANES
  – Discriminant validity: NYC Macroscope vs. data expected to correlate poorly (e.g. ownership of outdoor cats)

• Individual Level Outcome Comparison
  – Reliability (NYC Macroscope algorithm vs. entire EHR)
  – Diagnostic validity (NYC Macroscope algorithm vs. NYC HANES 2013)
  – Generalizability across EHR platforms (reliability and validity stratified by EHR platform)

• Temporal Comparison
  – Cohort definitions/sampling
  – Methods to incorporate uncertainty
    ▪ Bootstrapping
    ▪ Adjustment based on sensitivity/specificity
Population-Level Evaluation of Obesity and Hypertension Indicators

PILOT STUDY – 2012 DATA
Research Question

• How do NYC Macroscope 2012 estimates compare to estimates from CHS 2012 and NYC HANES 2004 (most recent NYC HANES)?

  – Obesity (BMI≥30)
    • Prevalence

  – Hypertension
    • Prevalence (diagnosed)
    • Treatment among diagnosed
Methods

• NYC Macrooscope estimates were stratified by sex, age group and neighborhood poverty rate (n=24 strata) and were compared to reference survey estimates
  – Restricted to sub-population who had seen a doctor in the past year

• Metrics of goodness-of-fit
  – Correlation (rho)
  – Mean standardized deviation = \( \text{avg} \left( \frac{|NYC \ Macroscope \ estimate - reference \ estimate|}{\text{standard \ error \ for \ reference \ estimate}} \right) \)
    ▪ \( \geq 1.96 \) means significantly different
  – Mean prevalence ratio = \( \text{avg} \left( \frac{NYC \ Macroscope \ estimate}{reference \ estimate} \right) \)
# Comparison of Prevalence Estimates among the Population in Care

<table>
<thead>
<tr>
<th></th>
<th>2012 NYC Macroscope</th>
<th>2012 CHS</th>
<th>2004 NYC HANES</th>
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<tbody>
<tr>
<td><strong>N</strong></td>
<td>N=640,860</td>
<td>N=7,004*</td>
<td>N=1,261*</td>
</tr>
<tr>
<td>Obesity**</td>
<td>29.5</td>
<td>25.4</td>
<td>28.2</td>
</tr>
<tr>
<td>Hypertension Diagnosis</td>
<td>30.7</td>
<td>30.9</td>
<td>30.9</td>
</tr>
<tr>
<td>Hypertension Treatment</td>
<td>76.4</td>
<td>70.4</td>
<td>70.2</td>
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* Subpopulation that has seen a doctor in the past year.

**CHS obesity is based on self-reported height and weight. NYC Macroscope and NYC HANES obesity is based on measured height and weight.
Comparison of NYC Macroscope 2012 Estimates of Obesity Prevalence with Reference Estimates for 24 Strata Defined by Sex, Age Group and Neighborhood Poverty Rate

**CHS 2012**

- Correlation: 0.84
- Mean Standardized Deviation: 1.37
- Mean Prevalence Ratio: 1.21

**NYC HANES 2004**

- Correlation: 0.72
- Mean Standardized Deviation: 0.84
- Mean Prevalence Ratio: 1.15
Comparison of NYC Macroscope 2012, CHS 2012 and NYC HANES 2004 Estimates of Obesity Prevalence by Sex and Age Group

* Significantly different from NYC Macroscope estimate

Among the Population of New Yorkers in Care
Comparison of NYC MacroScope 2012 Estimates of Hypertension Diagnosis Prevalence with Reference Estimates for 24 Strata Defined by Sex, Age Group and Neighborhood Poverty Rate

**CHS 2012**

- Correlation (Rho): 0.98
- Mean Standardized Deviation: 1.3
- Mean Prevalence Ratio: 0.97

**NYC HANES 2004**

- Correlation (Rho): 0.92
- Mean Standardized Deviation: 1.4
- Mean Prevalence Ratio: 0.86
Comparison of NYC Macroscope 2012, CHS 2012 and NYC HANES 2004 Estimates of Hypertension Diagnosis Prevalence, by Sex and Age Group

* Significantly different from NYC Macroscope estimate

Among the Population of New Yorkers in Care
Comparison of NYC Macroscope 2012, CHS 2012 and NYC HANES 2004 Estimates of Hypertension Treatment Rates among Adults Diagnosed with Hypertension

*Significantly different from the NYC Macroscope estimate (p<.05)

Among the Population of New Yorkers in Care
Pilot Study Conclusions: Prevalence

- NYC Macroscope estimates of obesity and hypertension diagnosis prevalence tracked very well with CHS 2012 and NYC HANES 2004 estimates, however
  - NYC Macroscope estimates of obesity were higher than reference survey estimates for men ages 20-59
  - NYC Macroscope estimates of hypertension diagnosis prevalence were lower than reference survey estimates for the 20-39 age group, especially among women
Pilot Study Conclusions: Hypertension Treatment

• NYC Macroscope estimates of hypertension treatment are much higher than survey estimates for the 20-39 age group and somewhat lower for people ages 40 and older

  – However, population estimates of the number of treated New Yorkers is similar between NYC Macroscope and the reference surveys
NYC Macroscope Work Plan

• Generate and compare 2013 estimates from NYC Macroscope, CHS and NYC HANES to assess construct validity

• Obtain funding and carry out a chart review validation study to assess reliability, diagnostic validity and generalizability across EHR platforms

• Develop and evaluate methods to incorporate uncertainty and assess trends

• Support the development of a community of practice
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To join our community of practice, please contact us at:

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