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The New York City Macroscope: A New Model for Monitoring the Health of Communities

New research, featured in three-paper series in eGEMs, finds NYC Macrosope on par with traditional gold-standard methods for estimating prevalence of obesity, hypertension, smoking, diabetes

Design of the New York City Macroscope: Innovations in Population Health Surveillance Using Electronic Health Records

Dr. Remle Newton-Dame

Introduction: Electronic health records (EHRs) have the potential to offer real-time, inexpensive standardized health data about chronic health conditions. Despite rapid expansion, EHR data evaluations for chronic disease surveillance have been limited. We present design and methods for the New York City (NYC) Macroscope, an EHR-based chronic disease surveillance system.

This methods report is the first in a three-part series describing the development and validation of the NYC Macroscope. This report describes in detail the infrastructure underlying the NYC Macroscope; indicator definitions; design decisions that were made to maximize data quality; characteristics of the population sampled; completeness of data collected; and lessons learned from doing this work. The second report describes the methods used to evaluate the validity and robustness of NYC Macroscope prevalence estimates; presents validation results for estimates of obesity, smoking, depression and influenza vaccination; and discusses the implications of our findings for NYC and for other jurisdictions embarking on similar work. The third report applies the same validation methods to metabolic outcomes, including the prevalence, treatment and control of diabetes, hypertension and hyperlipidemia.

Methods: We designed the NYC Macroscope for comparison to a local "gold standard," the 2013-14 NYC Health and Nutrition Examination Survey, and the telephonic 2013 Community Health Survey. NYC Macroscope indicators covered prevalence, treatment, and control of diabetes, hypertension, and hyperlipidemia; and prevalence of influenza vaccination, obesity, depression and smoking. Indicators were stratified by age, sex, and neighborhood poverty, and weighted to the in-care NYC population and limited to primary care patients. Indicator queries were distributed to a virtual network of primary care practices; 392 practices and 716,076 adult patients were retained in the final sample.

Findings: The NYC Macroscope covered 10% of primary care providers and 15% of all adult patients in NYC in 2013 (8-47% of patients by neighborhood). Data completeness varied by domain from 98% for blood pressure among patients with hypertension to 33% for depression screening.

Discussion: Design and validation efforts undertaken by NYC are described here to provide one potential blueprint for leveraging EHRs for population health monitoring. To replicate a model like NYC Macroscope, jurisdictions should establish buy-in; build informatics capacity; use standard, simple case definitions; establish documentation quality thresholds; restrict to primary care providers; and weight the sample to a target population.

Can Electronic Health Records Be Used for Population Health Surveillance? Validating Population Health Metrics Against Established Survey Data

Dr. Katharine McVeigh

Introduction: Electronic health records (EHRs) offer potential for population health surveillance but EHR-based surveillance measures require validation prior to use. We assessed the validity of obesity, smoking, depression, and influenza vaccination indicators from a new EHR surveillance system, the New York City (NYC) Macroscope. This report is the second in a 3-part series describing the development and validation of the NYC Macroscope. The first report describes in detail the infrastructure underlying the NYC Macroscope; design decisions that were made to maximize data quality; characteristics of the population sampled; completeness of data collected; and lessons learned from doing this work. This second report, which addresses concerns related to sampling bias and data quality, describes the methods used to evaluate the validity and robustness of NYC Macroscope prevalence estimates; presents validation results for estimates of obesity, smoking, depression and influenza vaccination; and discusses the implications of our findings for NYC and for other jurisdictions embarking on similar work. The third report applies the same validation methods described in this report to metabolic outcomes, including the prevalence, treatment and control of diabetes, hypertension and hyperlipidemia.

Methods: NYC Macroscope prevalence estimates, overall and stratified by sex and age group, were compared to reference survey estimates for adult New Yorkers who reported visiting a doctor in the past year. Agreement was evaluated against 5 a priori criteria. Sensitivity and specificity were assessed by examining individual EHR records in a subsample of 48 survey participants.

Results: Among adult New Yorkers in care, the NYC Macroscope prevalence estimate for smoking (15.2%) fell between estimates from NYC HANES (17.7 %) and CHS (14.9%) and met all 5 a priori criteria. The NYC Macroscope obesity prevalence estimate (27.8%) also fell between the NYC HANES (31.3%) and CHS (24.7%) estimates, but met only 3 a priori criteria. Sensitivity and specificity exceeded 0.90 for both the smoking and obesity indicators. The NYC Macroscope estimates of depression and influenza vaccination prevalence were more than 10 percentage points lower than the estimates from either reference survey. While specificity was > 0.90 for both of these indicators, sensitivity was < 0.70.

Discussion: Through this work we have demonstrated that EHR data from a convenience sample of providers can produce acceptable estimates of smoking and obesity prevalence among adult New Yorkers in care; gained a better understanding of the challenges involved in estimating depression prevalence from EHRs; and identified areas for additional research regarding estimation of influenza vaccination prevalence. We have also shared lessons learned about how EHR indicators should be constructed and offer methodologic suggestions for validating them.

Conclusions: This work adds to a rapidly emerging body of literature about how to define, collect and interpret EHR-based surveillance measures and may help guide other jurisdictions.

Monitoring Prevalence, Treatment, and Control of Metabolic Conditions In New York City Adults Using 2013 Primary Care Electronic Health Records: A Surveillance Validation Study

Dr. Lorna Thorpe

Introduction: Electronic health records (EHRs) can potentially extend chronic disease surveillance, but few EHR-based initiatives tracking population-based metrics have been validated for accuracy. We designed a new EHR-based population health surveillance system for New York City (NYC) known as NYC Macroscope. This report is the third in a 3-part series describing the development and validation of that system. The first report describes governance and technical infrastructure underlying the NYC Macroscope. The second report describes validation methods and presents validation results for estimates of obesity, smoking, depression and influenza vaccination. In this third paper we present validation findings for metabolic indicators (hypertension, hyperlipidemia, diabetes).

Methods: We compared EHR-based estimates to those from a gold standard surveillance source – the 2013-2014 NYC Health and Nutrition Examination Survey (NYC HANES) – overall and stratified by sex and age group, using the two one-sided test of equivalence and other validation criteria.

Results: EHR-based hypertension prevalence estimates were highly concordant with NYC HANES estimates. Diabetes prevalence estimates were highly concordant when measuring diagnosed diabetes but less so when incorporating laboratory results. Hypercholesterolemia prevalence estimates were less concordant overall. Measures to assess treatment and control of the 3 metabolic conditions performed poorly.

Discussion: While indicator performance was variable, findings here confirm that a carefully constructed EHR-based surveillance system can generate prevalence estimates comparable to those from gold-standard examination surveys for certain metabolic conditions such as hypertension and diabetes.

Conclusions: Standardized EHR metrics have potential utility for surveillance at lower annual costs than surveys, especially as representativeness of contributing clinical practices to EHR-based surveillance systems increases.