NYC MACROSCOPE
ELECTRONIC HEALTH RECORD SURVEILLANCE INDICATOR FACT SHEET

PURPOSE

- Provide an overview of select indicator classifications used in the NYC Macroscope
- Share lessons learned with those interested in adopting electronic health record (EHR) surveillance systems to expedite selection and standardization of health indicator classifications

Background Information

Description of the NYC Macroscope

NYC Macroscope is a population health surveillance system that makes use of EHR data from primary care practices throughout New York City to track the prevalence of chronic conditions and risk factors among the adult population that is actively in care. NYC Macroscope uses data from approximately 700,000 New York City residents 20 years of age and older who, in the past year, visited a primary care provider that shares EHR data with the NYC Department of Health and Mental Hygiene (DOHMH) through participation in the Hub Population Health System (the "Hub").[1] Specific practice inclusion and exclusion criteria have been implemented for data quality assurance. More information can be found at http://www1.nyc.gov/site/doh/data/health-tools/nycmacroscope.page and in NYC Macroscope publications.[2-8]

Representativeness of the NYC Macroscope sample

In our analysis of the 2013-14 NYC Health and Nutrition Examination Survey (HANES) and 2013 Community Health Survey (CHS), approximately three-quarters of the New York City population was in care during 2013.[2] Approximately 17% of this in-care population visited a provider contributing data to NYC Macroscope in 2013. Geographically, NYC Macroscope had highest penetration rates in select low-income neighborhoods (up to 47.9%), but covered at least 10% of the in-care population in most neighborhoods throughout the city.

Validation of the NYC Macroscope

The NYC Macroscope was validated at both the population and individual levels:

- Population level: Prevalence estimates from the 2013 NYC Macroscope were compared with data from the 2013-14 NYC HANES and the 2013 CHS.
- Individual level: A sample of 2013-14 NYC HANES participants consented to share their medical records. NYC Macroscope indicator classifications were applied to their EHR data. EHR and survey data were compared for each patient and concordance was then summarized across patients, stratified by whether or not the patient contributed data to the NYC Macroscope.

Data presented in fact sheets

- Prevalence and measures of agreement are presented for each indicator, along with the correlation of NYC Macroscope and NYC HANES/CHS estimates when stratified by age group and sex.
- Data describing criterion-related validity and generalizability to practices outside the NYC Macroscope are also presented.

DATA SOURCES

2013 NYC Macroscope

The population was restricted to in-care adults 20 years of age and older with a valid New York City zip code and known sex (male or female) who were seen by a provider that contributed data to the Hub in 2013. The Hub is a distributed query network of outpatient practices participating in the DOHMH's Primary Care Information Project (PCIP).[1] Participating practices share aggregated, de-identified

data with PCIP using a distributed model. SQL language queries are sent to practices and aggregate counts are returned automatically.

- **Provider inclusion and exclusion criteria:**
  - **Primary care:** Data were restricted to primary care providers, defined as internal medicine without a subspecialty, pediatrics, geriatrics, or family medicine. If a primary care practice included specialists, data from the specialists were excluded. Obstetrics/gynecology providers were also excluded.
  - **Documentation:** Providers who had more than 10 patients 20 years of age or older during 2013 and whose practice documented ICD-9 codes for at least 80% of patients, recorded body mass index (BMI) or blood pressure for at least 50% of patients, and documented medications in structured fields of the EHR for at least 20% of patients were included. These criteria closely align with Stage 1 Meaningful Use requirements.[9]
- **EHR Vendor:** All NYC Macroscope records were from providers who use the eClinicalWorks EHR platform.
- **Sample size:** 716,076
- **Weighting and adjustment:** Estimates were weighted to the age, sex, and neighborhood poverty distribution of the 2013-14 NYC HANES population in care and age adjusted to the 2000 US Standard Population.[10]
  - **Neighborhood poverty:** Neighborhood poverty was the percent of population in an individual's zip-code area living below 100% of the federal poverty level.[11] It was categorized as low (<10%), medium (10-19%), high (20-29%) and very high (≥30%) poverty.
- **Data completeness:**
  - **Practice level:** Percent of NYC Macroscope practices that reported data for the indicator of interest. Some practices failed to report data on some or all measures due to technical problems.
  - **Patient level:** Percent of patients with data reported as missing in the structured field for the indicator of interest.

2013-14 NYC Health and Nutrition Examination Survey (HANES)

The 2013-14 NYC HANES was a population-based in-person survey with a standardized brief physical exam and biospecimen collection among New York City residents 20 years of age and older.[12] The survey was conducted by the City University of New York School of Public Health and the NYC DOHMH. The analytic sample for this validation was restricted to the in-care population.

- **In-care population:** In-care population was defined as having visited a healthcare provider in the past year for a check-up, advice about a health problem, or basic care.
- **Sample size:** 1,135
- **Weighting and adjustment:** Data were weighted to adjust for complex survey design, nonresponse, and post-stratification, and were age adjusted to the 2000 US Standard Population.[10]

2013 Community Health Survey (CHS)

The CHS is a telephone survey of New York City adults conducted annually by the NYC DOHMH. Self-reported data are collected from landline and cellphone users 18 years of age and older.[13] We restricted the sample to the in-care population 20 years of age and older.

- **In-care population:** The in-care population was defined as having visited a doctor or healthcare provider who participants considered their personal doctor or provider in the past year.
- **Sample size:** 6,166
- **Weighting and adjustment:** Data were weighted to adjust for probability of selection and post-stratification, and were age adjusted to the 2000 US Standard Population.[9]

2013 NYC Macroscope Chart Review Study

Chart review participants were recruited from the NYC HANES 2013-14 study sample. Participants were included if they saw a healthcare provider within 12 months before their NYC HANES interview and signed a Health Insurance Portability and Accountability Act (HIPAA) waiver. Retrospective chart abstraction was conducted and the abstracted EHR data were then linked to the individual's NYC HANES data for analysis.

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- **Sample size:** 190 medical records, 48 (25%) of which were obtained from providers contributing data to the 2013 NYC Macroscope. The remaining 142 records were from other providers located throughout New York City.
- **EHR vendors:** More than 20 different EHR vendors were represented across the 142 non-NYC Macroscope records. All 48 NYC Macroscope records were from providers who use the eClinicalWorks EHR platform.
- **Analytic inclusion/exclusion criteria:**
  - **NYC Macroscope Practices:** 48 records were received from primary care providers who contributed data to the 2013 NYC Macroscope.
  - **Non-NYC Macroscope Records**: 142 records were received from providers who did NOT contribute data to the 2013 NYC Macroscope.
    - **Primary care:** Records from providers who practice internal medicine without a subspecialty, pediatrics, geriatrics, and family medicine among the non-Macroscope charts (n=142).
    - **Primary care and Stage 1 Meaningful Use:** A restricted sample of providers who practice internal medicine without a subspecialty, pediatrics, geriatrics, and family medicine and attested to Stage 1 Meaningful Use among the non-Macroscope charts (n=86). As Stage 1 Meaningful Use was the highest level of attestation possible in 2013, this indicated better data quality.[9]

STATISTICAL METHODS AND DEFINITIONS

Prevalence and fit statistics

We compared the 2013 NYC Macroscope prevalence estimates with the reference survey estimates. The following panel of statistics and a priori criteria were used to assess the similarity between estimates:

1. **Prevalence ratio:** A prevalence ratio less than 0.85 or greater than 1.15 was considered a meaningful difference.
2. **Test of difference:** A two-sided t-test was used to statistically assess difference. A $p<0.05$ was considered statistically significant (i.e., different).
3. **Test of equivalence**: Two one-sided test (TOST) of equivalence combines two one-sided t-tests to evaluate if two estimates are equivalent, i.e., if two estimates are similar enough to fall within a pre-specified margin of equivalence. An equivalence margin of ±5 percentage points was used,[8] and a $p<0.05$ was considered statistically significant (i.e., equivalent).
4. **Spearman correlation**: Prevalence estimates were stratified by age group (20–39, 40–59, ≥60) and sex (female or male), and Spearman correlation was used to assess correlation of stratified estimates between NYC Macroscope and the reference surveys. A Spearman correlation of 0.8 or greater was considered to reflect high internal consistency.

Chart review analyses and generalizability to non-NYC Macroscope practices

In the chart review study, we assessed the validity of NYC Macroscope indicator classifications relative to NYC HANES classifications for NYC HANES participants seen by both NYC Macroscope and non-Macroscope outpatient medical practices. We also assessed how the provider inclusion/exclusion criteria of NYC Macroscope impacted the validity of NYC Macroscope indicator classifications in the non-Macroscope sample. The following measures of validity were reported:

1. **Kappa**: (Observed proportional agreement - expected agreement) / (1 - expected agreement). Kappa was classified as slight (0.0-0.20), fair (0.21-0.40), moderate (0.41-0.60), substantial (0.61-0.80), and near perfect (0.81-1.0) agreement.[14]
2. **Sensitivity**: True positives / (true positives + false negatives). Sensitivity is the probability a true positive is classified as positive. A sensitivity ≥0.9 was considered high, 0.70-0.89 was considered moderate, and <0.7 was low.
3. **Specificity**: True negatives / (true negatives + false positives). Specificity is the probability a true negative is classified as negative. A specificity of ≥0.9 was considered high, 0.80-0.89 was considered moderate, and <0.8 was considered low.
4. **Positive predictive value (PPV)**: True positives / (true positives + false positives). PPV is the probability a classified positive is a true positive.
5. **Negative predictive value (NPV)**: True positives / (true positives + false positives). NPV is the probability a classified negative is a true negative.

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TECHNICAL CONSIDERATIONS

Technical elements to consider when replicating measures include:

- Office visit: Appropriate billing codes or the capture of vital signs such as BMI and blood pressure are effective ways to limit measurement to patients receiving primary care services. EHR test patients and patients with visit types such as phone visit or blood draw should be excluded.
- Valid measurement ranges: Excluding physically implausible values for measurements such as BMI and blood pressure reduces the capture of data entry errors.
- Dates: Relevant time periods should be defined for each element of the measure (e.g., diagnosis added, medication prescribed, vital signs documented). Patient age must be calculated from date of birth; it can simplify measures if all ages are calculated from the beginning of the reporting period.

For more information about this project, please visit http://www1.nyc.gov/site/doh/data/health-tools/nycmacroscope.page or email nycmacroscope@health.nyc.gov.

REFERENCES

1. Buck MD, Anane S, Taverna J, et al. The Hub Population Health System: distributed ad hoc queries and alerts. J Am Med Inform Assoc. 2012;19(e1):e46-50.

2. Romo ML, Chan PY, Lurie-Moroni E, et al. Characterizing adults receiving primary medical care in New York City: implications for using electronic health records for chronic disease surveillance. Prev Chron Dis. 2016;13:E56.

3. McVeigh KH, Newton-Dame R, Chan PY, et al. Can electronic health records be used for population health surveillance? Validating population health metrics against established survey data. eGEMS. 2016;4(1):27.

4. Thorpe LE, McVeigh KH, Perlman SE, et al. Monitoring prevalence, treatment, and control of metabolic conditions in New York City adults using 2013 primary care electronic health records: a surveillance validation study. eGEMS. 2016;4(1):28.

5. Newton-Dame R, McVeigh KH, Schreibstein L, et al. Design of the New York City Macroscope: innovations in population health surveillance using electronic health records. eGEMs. 2016;4(1):26.

6. McVeigh KH, Lurie-Moroni E, Chan PY, et al. Generalizability of indicators from the New York City Macroscope Electronic Health Record Surveillance System to systems based on other EHR Platforms. eGEMs. 2017;5(1):25.

7. Perlman SE, McVeigh KH, Thorpe LE, Jacobson L, Greene CM, Gwynn RC. Innovations in Population Health Surveillance: Using Electronic Health Records for Chronic Disease Surveillance. Am J Public Health. 2017; 107(6):853-857. DOI: 10.2105/AJPH.2017.303813.

8. Tatem KS, Romo ML, McVeigh KH, et al. Comparing prevalence estimates in population-based surveys to inform surveillance using electronic health records. Prev Chronic Dis. 2017; 14:160516. DOI: https://doi.org./10.5888/ped14.160516.

9. Centers for Medicare and Medicaid Services. EHR incentive programs: requirements for previous years. Available at: https://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/RequirementsforPreviousYears.html. Accessed August 22, 2016.

10. United States Census Bureau. ACS Summary File Technical Documentation. Available at: https://www2.census.gov/programs-surveys/acs/summary_file/2014/documentation/tech_docs/2014_SummaryFile_Tech_Doc.pdf. Accessed August 22, 2016.

11. Toprani A, Hadler JL. Selecting and applying a standard area-based socioeconomic status measure for public health data: analysis for New York City. New York City Department of Health and Mental Hygiene: Epi Res Rep. May 2013; 1-11. (available by emailing query@health.nyc.gov).

12. Thorpe LE, Greene C, Freeman A, et al. Rationale, design and respondent characteristics of the 2013–2014 New York City Health and Nutrition Examination Survey (NYC HANES 2013–2014). Prev Med Rep. 2015;2:580-585.

13. New York City Department of Health and Mental Hygiene. NYC Community Health Survey Public Use Data. Available at: http://www.nyc.gov/html/doh/html/data/chs-data.shtml. Accessed August 22, 2016.

14. Landis J, Koch G. An application of hierarchical kappa-type statistics in the assessment of majority agreement among multiple observers. Biometrics. 1977;33(2):363-374.

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