

Leveraging Clinical Data for Public Health and Hypertension Surveillance

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Background

Chronic diseases are consistently ranked as the leading causes of mortality in the US and the world.

In US, heart disease is the leading cause of death (>600,000 deaths, 2015).

Despite increased adoption of EHRs by clinicians, surveys (e.g. BRFSS) are the primary source of public health surveillance data for chronic disease and hypertension.

Objectives:

- Provide guidance to public health agencies seeking to implement chronic disease surveillance using electronic health record (EHR) data.
- Address reliability and validity of EHR-based surveillance indicators.
- Illustrate concepts with a hypertension surveillance use case.

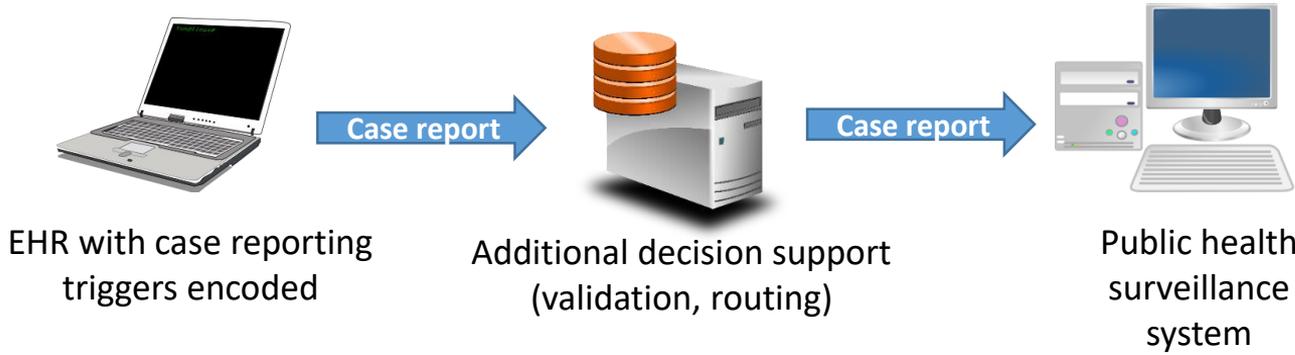
Sources:

WHO. "Chronic diseases and health promotion." <http://www.who.int/chp/en/>
CDC. "Deaths and Mortality". <https://www.cdc.gov/nchs/fastats/deaths.htm>

Overview of Clinical Systems

System Type	Description
Electronic health records (EHR)	Digital version of a patient's medical chart: medical history, vital signs, immunizations, allergies, laboratory results, radiology images, and other records related to the patient's health.
Laboratory information management systems (LIMS)	LIMS are software used by laboratories to manage clinical specimens, laboratory orders sent from EHRs, and related test result data. Many LIMS support data exchange with EHR systems.
Health information exchanges (HIE)	HIEs are organizations that facilitate the sharing of clinical information among various health care provider networks. Some HIEs host data repositories that contain patient data from different providers and EHRs.
Clinical data repositories	Can provide a fuller picture of a patient's medical information and are composed of consolidated data from various clinical sources. Information in repository can be limited to a specific health care provider, HIE, or EHR (particularly vendor-hosted EHR).
Population health management systems	Used to analyze patient populations and facilitate a health care provider's efforts to improve care quality, health outcomes, and lower costs. They facilitate the integration of clinical data with data such as payer claims and emergency medical services information.

Electronic Case Reporting (data “push”)



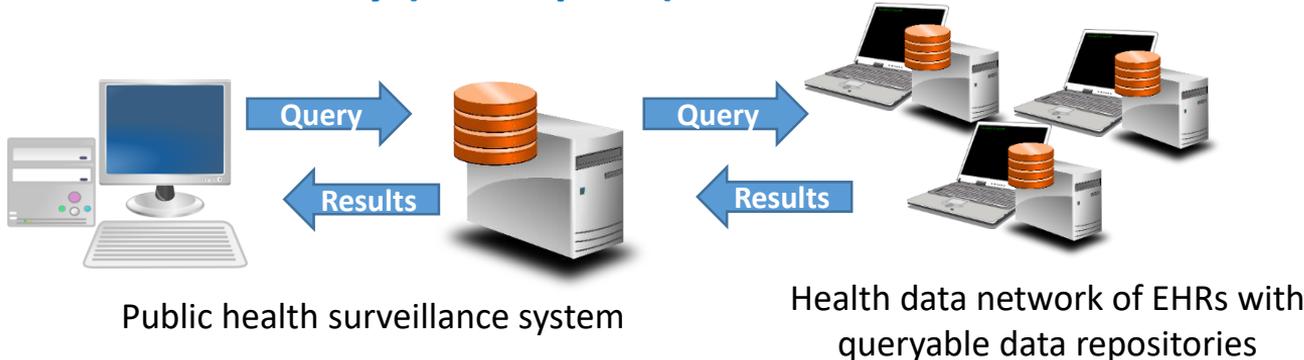
Examples

Digital Bridge eCR
(AIMS, RCKMS)

Notifiable
Conditions
Detector
(Regenstief)

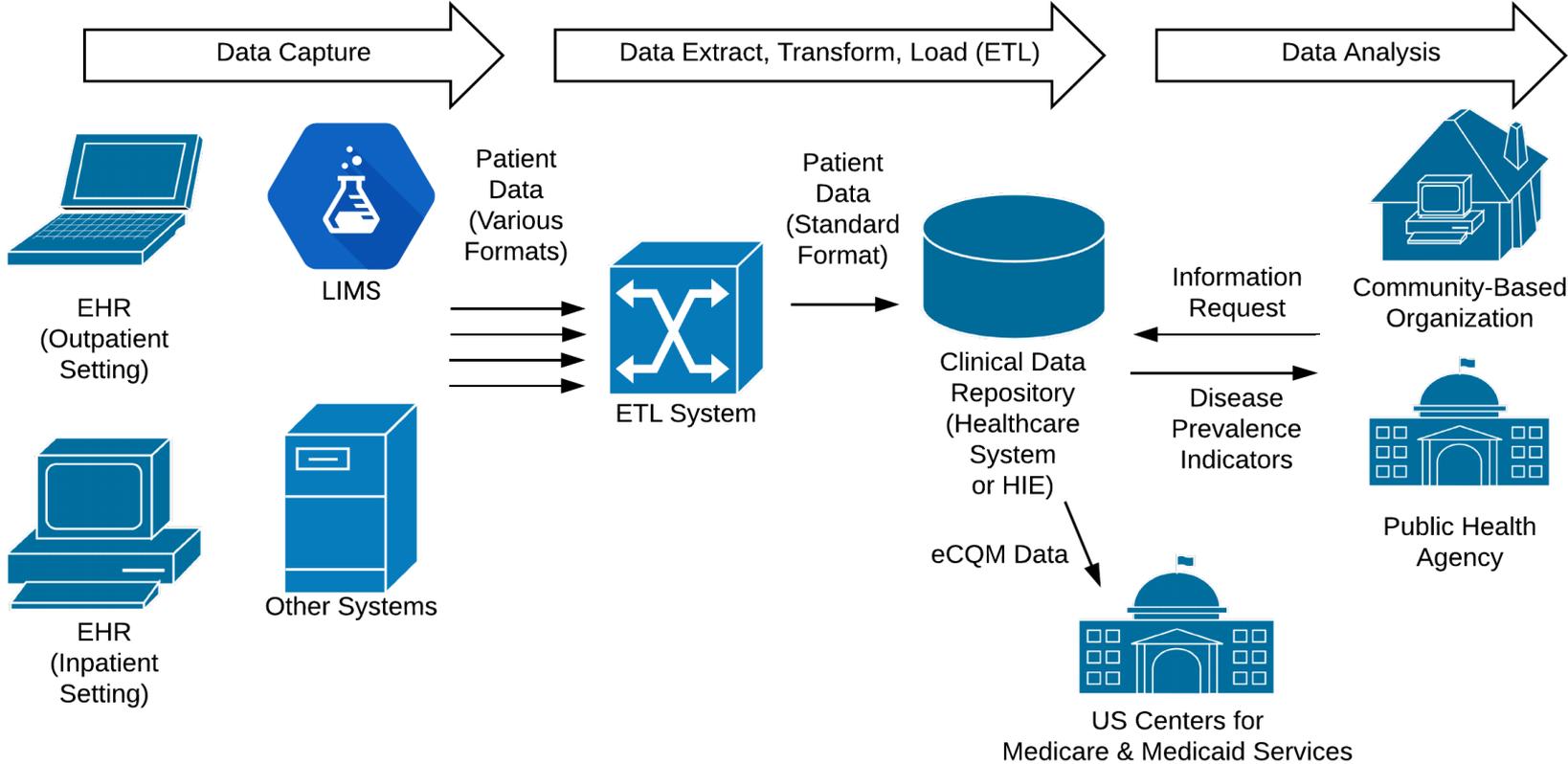
eCR of STIs

Distributed Query (data “pull”)

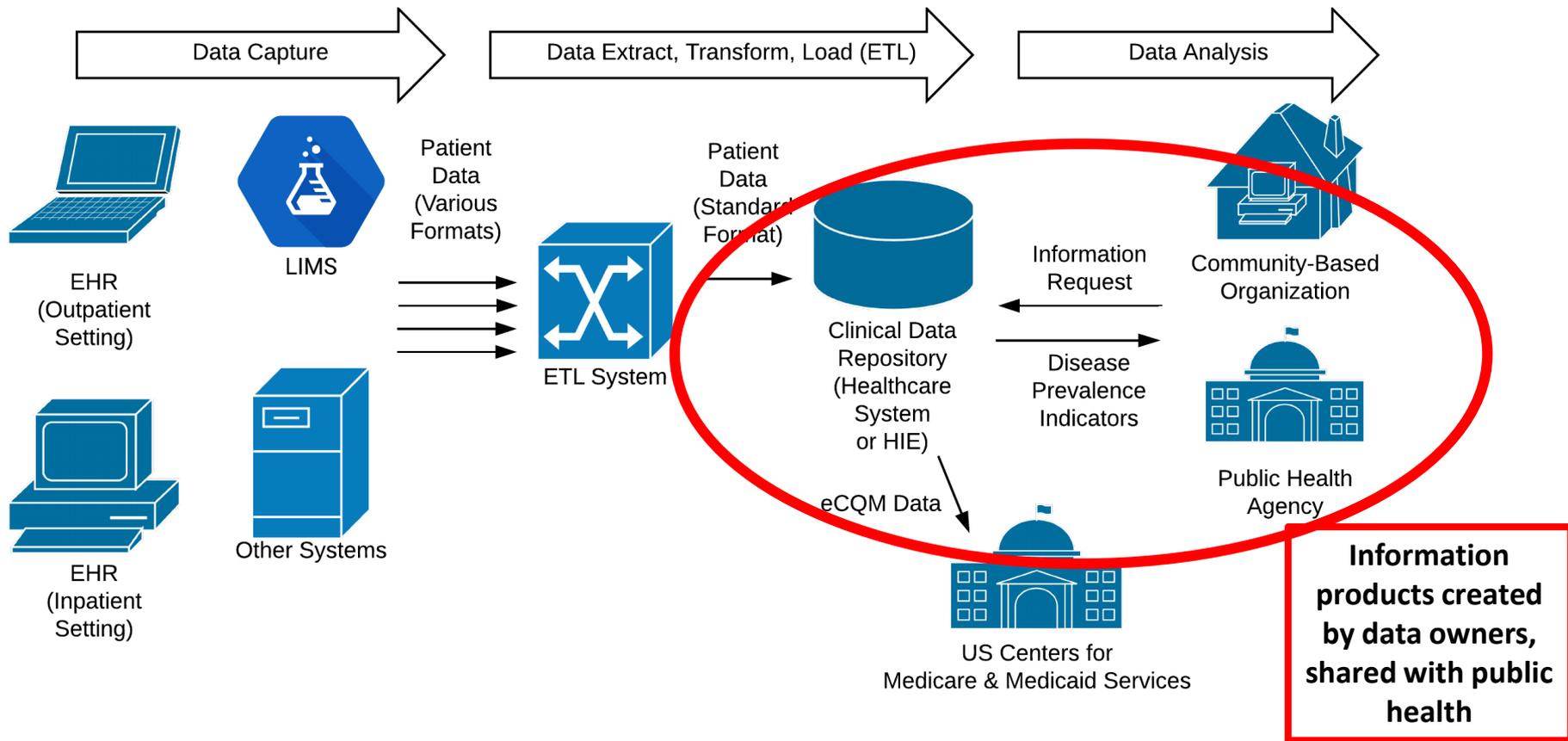


PopMedNet:
PCORnet
ESP - MDPHNet
CHORDs

Collaborative Model



Collaborative Model



Electronic Clinical Quality Measures (eCQM)

Clinical quality measures (CQMs) were created to measure the quality of care provided by health care professionals.

Electronic clinical quality measures, or eCQMs, are the standard data formats extracted from EHRs and used to represent population-level health indicators and satisfy quality reporting requirements.

eCQMs and their technical specifications are endorsed by the National Quality Forum (NQF).

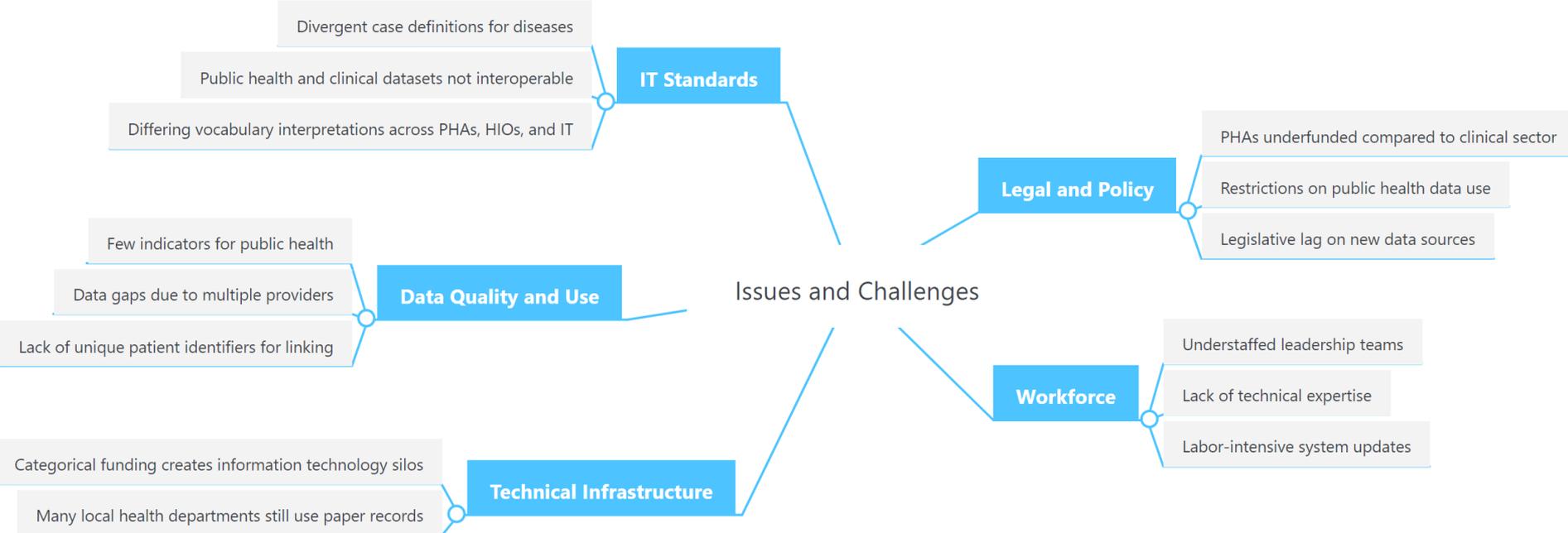
NQF #0018, Hypertension: Controlling High Pressure will be used to illustrate EHR-based surveillance issues. NQF #0018 supports Million Hearts “ABCS”

Sources:

ONC. “Glossary of eCQI Terms.” eCQI Resource Center. <https://ecqi.healthit.gov/content/glossary-ecqi-terms>

DHHS. “Million Hearts Clinical Quality Measures,” <https://millionhearts.hhs.gov/data-reports/cqm.html>

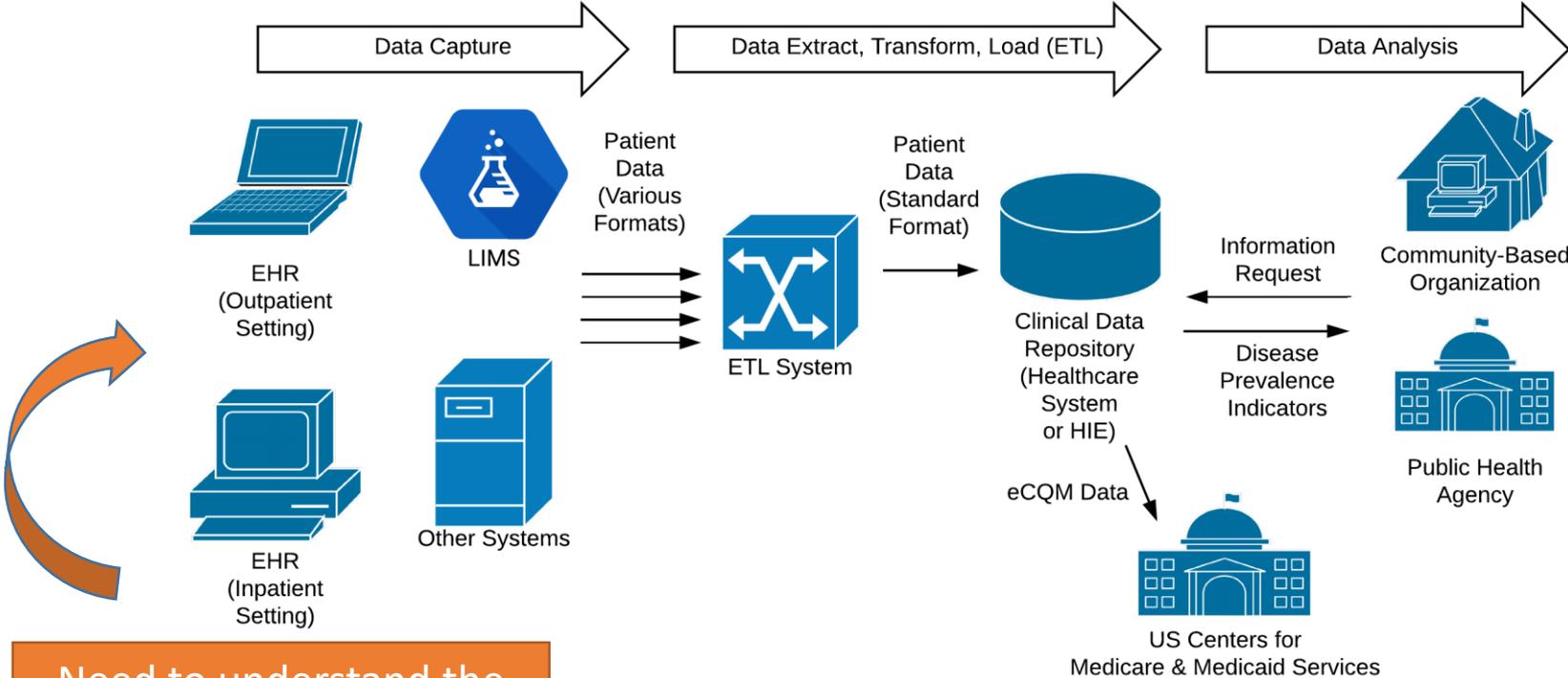
Landscape Analysis: Issues and Challenges For EHR-based Public Health Surveillance



Analysis conducted by Wendy Wen, MPH

References provided at end of presentation.

Key Issues Related to Data Reliability and Validity: Data Capture



Need to understand the context of data collection (who, what, why).

Data Capture: Key Issues Related to Data Reliability and Validity

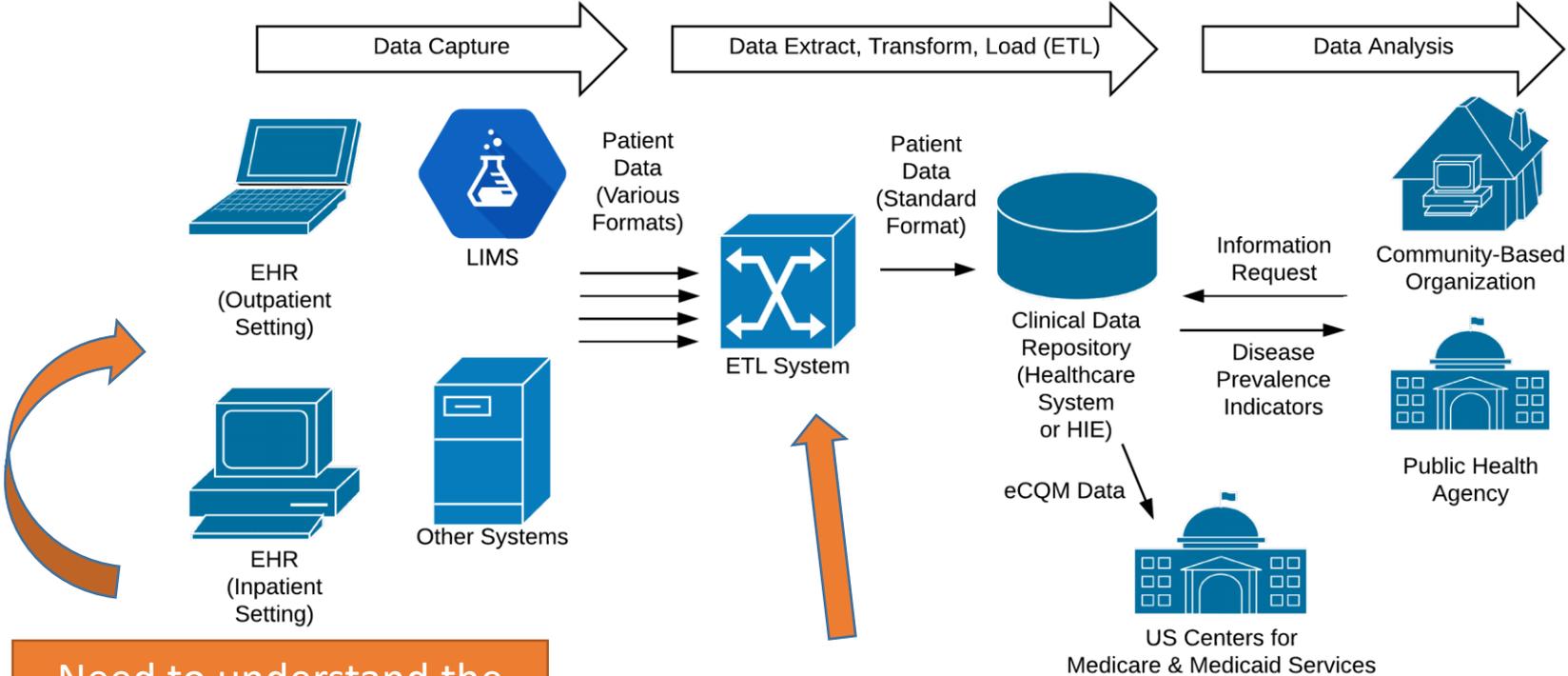
What type of clinical encounters are the data originating from?

How often are the data captured during a clinical encounter?

What data quality safeguards are used as data are entered?

Are the data structured or unstructured?

Key Issues Related to Data Reliability and Validity: Data ETL



Need to understand the context of data collection (who, what, why).

Need to understand how data might be transformed.

Data ETL: Key Issues Related to Data Reliability and Validity

What are the data sources contributing clinical data to the repository, and how heterogeneous are they?

Are patient data de-duplicated as they are loaded into a clinical data repository?

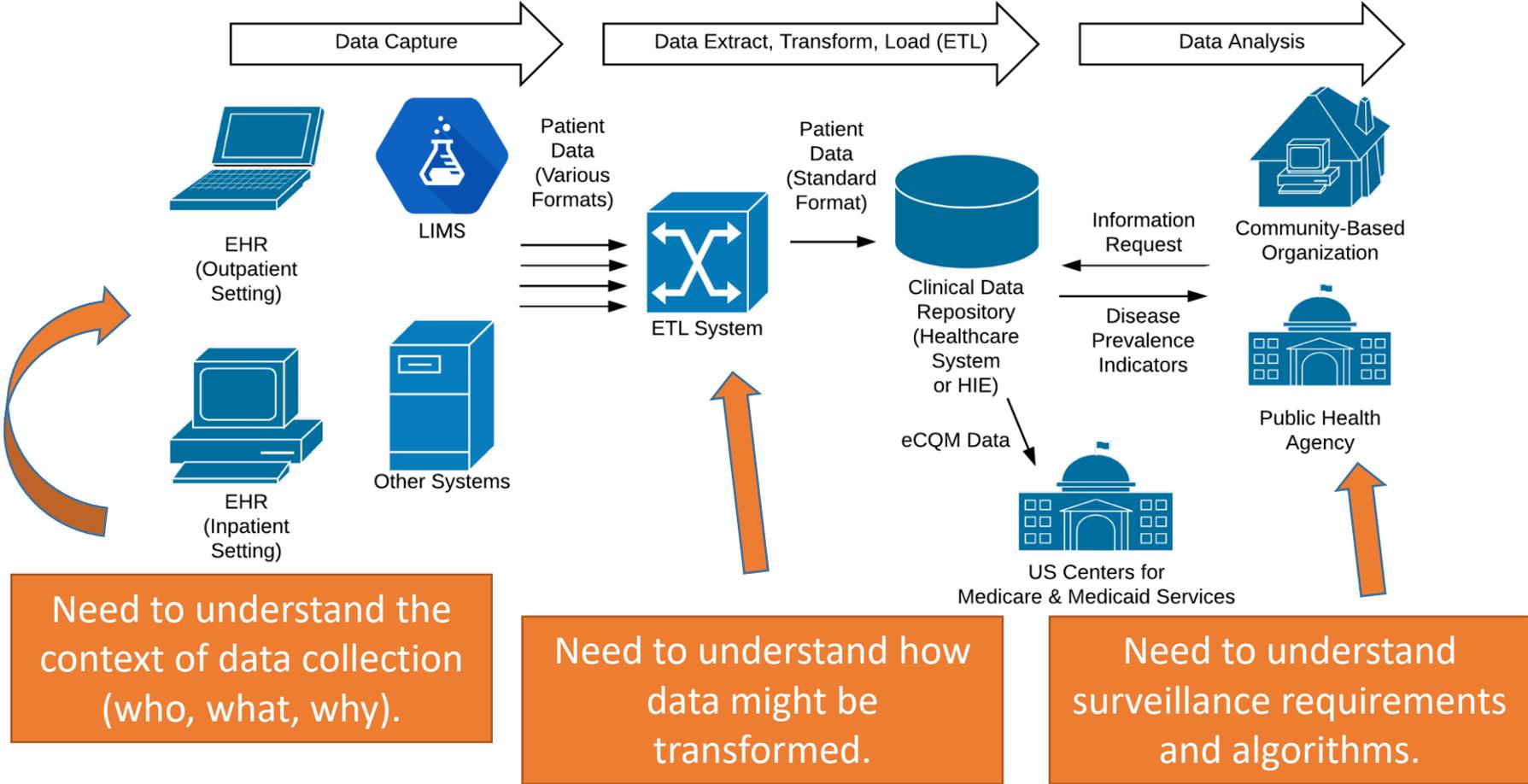
Are the data transformed by the clinical data repository? If so, how does the transformation affect data quality?

Is there a routine patient-level validation process for data contained in the clinical data repository?

How frequently are data extracted from the sources?

What are the most common errors (e.g., missing data) identified during the ETL process?

Key Issues Related to Data Reliability and Validity



Data Analysis: Key Issues Related to Data Reliability and Validity

How is the population under analysis being defined?

How is patient duplication addressed?

How is a case definition algorithm defined?

How should patient privacy be observed during data analysis?

How can neighborhood-level or sub-county disease prevalence measures be calculated?

Hypertension Example (Data Capture, Data ETL)

Issue	Questions & Considerations
Data Capture, ETL: Vital Signs	<p>In a clinical setting, who typically takes blood pressure measurement? What clinical training do they have? What incentive do they have to ensure accurate measurement?</p> <p>Are blood pressure measurements recorded directly into the EHR at the time of measurement, or are they entered later from handwritten notes?</p> <p>If multiple measures are taken, are they all recorded? If so, which would you consider to be the most accurate value? If not, which measure is recorded (highest, lowest, or an average?)</p>
Data Capture, ETL: Diagnosis	<p>Is the hypertension diagnosis typically captured in a structured field or in unstructured free text?</p> <p>Does an elevated blood pressure measurement trigger a diagnosis recommendation, or does the diagnosis have to be manually entered?</p> <p>If the diagnosis code is manually entered, does the clinician select a diagnosis from a list of pre-determined values (structured data), or do they manually type values intended to represent hypertension (unstructured data)?</p>

Hypertension Example (Data Analysis)

Use of Hypertension Control Quality Measure Data for Hypertension Prevalence

NQF 0018 Measure:

of hypertensive patients (18 – 85 years old) whose blood pressure was adequately controlled during measurement period (numerator)

of hypertensive patients (18 – 85 years old) during measurement period (denominator)

Hypertension Prevalence Measure:

of hypertensive patients (18 – 85 years old) during measurement period (numerator)

total population (18 – 85 years old) during measurement period (denominator)



NQF 0018: Based on ICD diagnosis codes

For public health surveillance purposes, how should hypertensive status be defined?

Hypertension Prevalence Measure Considerations (Data Analysis)

Data	Hypertension Case Criteria	Considerations
Total Population (Denominator)	n/a	<p>All patients age 18 years or older and with a home address in the county during the defined time period.</p> <p>A two year period allows more time for county residents to experience a clinical encounter that will be represented in the clinical data repository.</p>
Diagnosis (Numerator)	<p>ICD-9: 401, 401.1, 401.0, 401.9, 405, 405.0, 405.9, 405.91, 405.99</p> <p>ICD-10: I10, I15</p>	<p>Basis of NQF #0018 eCQM (ICD-9 and ICD-10 codes).</p> <p>However, some hypertensive patients are not diagnosed (diagnosis not made or diagnosis not recorded as structured ICD data).</p> <p>Vital sign and medication indicators can be used in conjunction with diagnosis: find undiagnosed patients or increase specificity.</p>
Vital Signs (Numerator)	Systolic BP \geq 140 mm Hg or diastolic BP \geq 90 mm Hg	<p>Consider in conjunction with diagnosis or medication data.</p> <p>Requiring >1 high BP measurement may improve specificity.</p>
Medication (Numerator)	≥ 1 filled prescription(s)	<p>Prescriptions for any medications associated with hypertension.</p> <p>Case definition based on medication alone may misclassify patients as hypertensive.</p>

Regenstrief Analysis of Various Hypertension Phenotypes

#	Phenotype Definition	Notes, Observations
1	≥1 Clinical Diagnosis	Potential utility for comparisons across jurisdictions; some health depts. may only have access to diagnosis data.
2a	≥1 Vitals Indicated	Prevalence estimates relatively close to BRFSS*.
2b	≥2 Vitals Indicated	Prevalence estimates relatively close to BRFSS*.
3a	≥1 Clinical Diagnosis and ≥1 Vitals Indicated	Produced lowest total population prevalence estimate*.
3b	≥1 Clinical Diagnosis or ≥1 Vitals Indicated	Good balance of sensitivity and specificity; useful when true prevalence ~30%. Prevalence estimates relatively close to BRFSS*.
4	≥1 Clinical Diagnosis or ≥1 Vitals Indicated or ≥1 Medications Indicated	Performed best with respect to sensitivity (most inclusive phenotype definition) but may overestimate prevalence.

* Relative to other phenotypes listed in table.

Source: unpublished report from B. Dixon (IUPUI, Regenstrief Institute) and P.J. Gibson (Marion Co. IN Public Health Dept); used with permission.

Discussion, Next Steps

Health IT used by clinicians has potential for improving public health surveillance of hypertension and other chronic conditions.

However, these chronic conditions can reflect complicated medical histories, multiple encounters and providers, variation in how patient data is recorded in EHR.

Different phenotypes/case definitions can each have pros and cons. EHR-based prevalence measures can differ from survey-based measures.

Future Work

Encourage data stewards' (e.g., HIEs) sharing of chronic disease information with public health agencies.

Develop condition-specific guidance on phenotype definitions for prevalence estimates.

References for Landscape Analysis on Issues and Barriers to

EHR Data Access and Use

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Friedman, D. J., Parrish, R. G., & Ross, D. A. (2013). Electronic health records and US public health: current realities and future promise. *American journal of public health*, 103(9), 1560-1567.

Klompas, M., Cocoros, N. M., Menchaca, J. T., Erani, D., Hafer, E., Herrick, B., ... & Eberhardt, K. R. (2017). State and Local Chronic Disease Surveillance Using Electronic Health Record Systems. *American journal of public health*, 107(9), 1406-1412.

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Perlman, S. E., McVeigh, K. H., Thorpe, L. E., Jacobson, L., Greene, C. M., & Gwynn, R. C. (2017). Innovations in population health surveillance: using electronic health records for chronic disease surveillance. *American journal of public health*, 107(6), 853-857.

The Office of the National Coordinator for Health Information Technology (2017). *Connecting Public Health Information Systems and Health Information Exchange Organizations*

Tomines, A., Readhead, H., Readhead, A., & Teutsch, S. (2013). Applications of electronic health information in public health: uses, opportunities & barriers. *eGEMs*, 1(2).

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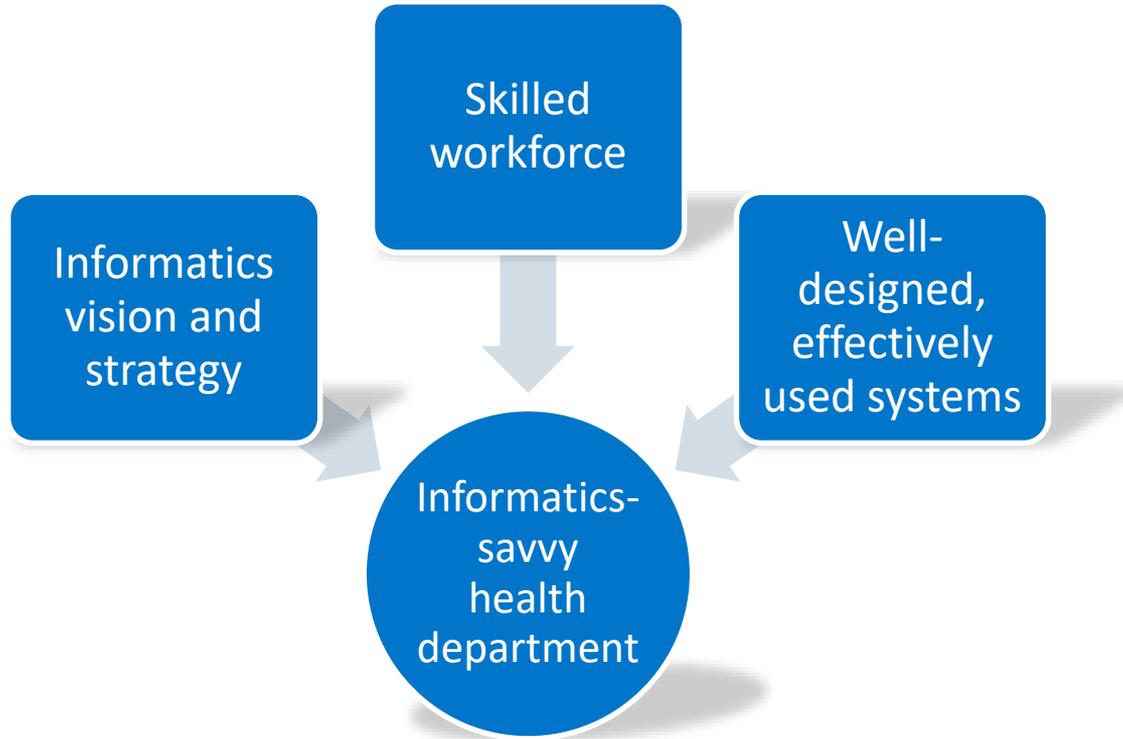
Regenstrief Institute

Indiana Network for Patient Care

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For More Information

<https://www.phii.org/resources>

“Leveraging Clinical Data for Public Health and Hypertension Surveillance”

www.phii.org/infosavvy

www.phii.org/ehrtoolkit

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