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HEALTH INFORMATION EXCHANGES: AN INTEGRAL COMPONENT FOR OPTIMIZING VALUE-BASED CARE

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ABSTRACT

Health information exchange (HIE) organizations have proven themselves effective and efficient in coping with many of the interoperability challenges faced by the healthcare industry today. However, many HIEs were financed by public programs whose funding limits have now been reached. HIEs will need to quickly become self-sustaining if they are to continue delivering desperately needed services.

The good news is that there are many strong HIEs that are delivering continuous value to their communities. Other HIEs have the opportunity to look to them for guidance and best practices. As they are a linchpin to delivering the interoperability needed for value-based care, it is critical for HIEs to follow best practices, increase capabilities, and expand adoption.

This whitepaper provides HIE definitions and background, describes the components of an HIE, and elaborates on advanced use cases that provide for compelling value proposition and foster sustainability.

> HIEs don't have a right to exist just because we're HIEs. We should only exist if we are indeed adding value, like any other business or organization would have to do. I think what we will continue to see is those that haven't figured out how to do that well will be challenged. There may still be some consolidation, or HIEs that cease to exist, if they haven't put a sustainability model together. That shouldn't mean that the whole concept is wrong, just that, like in any business, some work and some don't. For example, there are some that know how to run a book store and some that don't, and the bad book stores go away and the good ones continue to exist. So, I welcome that scrutiny and what it will mean for what we're doing to enhance care coordination and facilitate cost optimization.
>
> **Doug Dietzman, Executive Director, Great Lakes Health Connect[1]**

HIE DEFINITION

According to HealthIT.gov, HIEs allow doctors, nurses, pharmacists, other health care providers, and patients to appropriately access and securely share a patient's vital medical information electronically. HIEs can greatly improve the speed, quality, safety, and cost of patient care during medical data transfer. There are three distinct types of HIEs in the marketplace now:

- **Directed Exchange** - ability to send and receive secure information electronically between care providers to support coordinated care.
- **Query-Based Exchange** - ability for providers to find and/or request information about a patient from other providers, often used for unplanned care.
- **Consumer-Mediated Exchange** - ability for patients to aggregate and control the use of their health information among providers.

[1] http://blog.galenhealthcare.com/2017/11/13/chime-fall-forum-interview-series-doug-dietzman-executive-director-great-lakes-health-connect/

WHAT IS AN HIE?

Health information exchange can either be a verb or a noun. As a verb, health information exchange is the process of sharing health information electronically. As a noun, a health information exchange is an organization that provides technology and services to allow its stakeholders to safely share health information. HIE organizations work within their communities to facilitate secure health data sharing.

HIEs come in many different varieties: statewide, regional, and community; government-run, for-profit, and non-profit; large and small; and hybrids that involve collaborations among diverse organizations. None of them provide health care services, produce health care data, or compete in the marketplace. Instead, they help disparate health care systems share vital health information to deliver better care, better outcomes and lower costs.

As unbiased data trustees in their communities, HIEs manage and provide secure digital exchange of data by medical, behavioral, and social service professionals to improve the health of the communities they serve.

HOW HIEs SUPPORT PATIENT CARE

Health information exchanges (HIEs) support patient care by:

- Serving as an unbiased community data trustee for health information.
- Connecting health care systems, private HIEs, and independent providers.
- Filling gaps in patient health information for more comprehensive patient records.
- Providing real-time access to patient information for better clinical coordination and decisions.
- Improving the quality, safety, efficiency, and reliability of care.

HIEs are the vanguards of health IT in their respective communities. For example, HIEs integrate electronic health records (EHRs) and pharmacy systems used by organizations that treat behavioral health and substance abuse into broader health IT interoperability networks that include care organizations, ranging from health researchers to nursing homes.

By expanding interoperability services, HIEs support better care for patients because physicians will have access to all relevant information they need to provide the best possible care.

In addition to individual HIEs expanding their coverage in their respective regions, collectively, HIEs have been able to work together on initiatives to improve nationwide interoperability. For example, the Strategic Health Information Exchange Collaborative (SHIEC) recently launched a Patient Centered Data Home™ (PCDH) initiative, a significant nationwide interoperability effort that allows for alerting and record sharing among HIEs when patients require treatment outside their local community.

HIE BACKGROUND

As part of the 2009 American Recovery and Reinvestment Act (ARRA), Congress passed the Health Information Technology for Economic and Clinical Health (HITECH) Act, to promote "the electronic movement and use of health information among organizations using nationally recognized interoperability standards." The HITECH Act provided $564 million to the Office of the National Coordinator for Health Information Technology (ONC) in the U.S. Department of Health and Human Services (HHS) to enable rapid development of health information exchange across the nation. In 2010, the ONC awarded funds to 56 states, territories and qualified State Designated Entities as part of the State Health Information Exchange Cooperative Agreement Program, supporting states in their efforts to rapidly build capacity for exchanging health information across the healthcare system both within and across states.[2, 3]

Some publicly funded State HIEs failed, and many have struggled financially. A 2015 study supported by the Robert Wood Johnson Foundation reported that 44 of the 202 public and private HIEs it had been tracking had to be removed from the list, but of the rest surveyed (with an 80% response rate), 106 were operational and 21 were in the planning phase, and 32 were public statewide HIEs supported by federal money. It is noteworthy that 78% of the leaders of the public HIEs surveyed were optimistic they could make it financially, while just 30% of the private or nonprofit HIEs surveyed thought the public HIEs would survive.[4] Technical complexity, competitive pressure, and lack of business model often prove to be toxic to the sustainability of HIEs. However, the public and population health utility HIEs provide is invaluable and found worthy of the investment.

HIE CURRENT LANDSCAPE

New care and payment models like the Medicare Access and CHIP Reauthorization Act of 2015 (MACRA) will soon be stressing care coordination and quality outcomes across the care continuum. The expanded exchange of health information can transform care delivery by improving access to health information, increasing communication among and between care teams and individuals. Consequently, workflow is improved and healthcare costs are reduced. Access to health information through a secure exchange can achieve better care, smarter spending, and healthier people.[5]

As health information exchange organizations continue to evolve, HIE leaders are focused on expanding services and providing data analytics and business intelligence tools to providers and health plans. Many provider organizations view local, regional, and even national HIEs as important partners for data sharing for population health management and care coordination.[6]

HIE data can be used by provider organizations to improve quality measures, care management, and to address gaps in care. Once an organization decides to invest in HIE to support initiatives, it will need to formulate an approach to define its objectives and scope.

Scope may encompass:

- Enhancing Transitions of Care (ToCs)
  - Which ToCs? - What Data? - What Facilities? Workflow?
  –
- Enabling Patient Engagement and Care Management
  - Which Problems? - Functions? - What Apps? – Workflow?
- Supporting Analytics for Population Health and Value-Based Payment
  - What Contracts? - Which Population? - What Measures? – What Data?[7]

[2] https://www.healthit.gov/sites/default/files/reports/finalsummativereportmarch_2016.pdf

[3] https://www.telequality.com/blog/2017/7/7/health-information-exchanges-one-solution-to-the-interoperability-dilemma

[4] https://www.managedcaremag.com/archives/2016/1/untangling-hie-mess

[5] https://www.healthit.gov/sites/default/files/playbook/pdf/general-provider-value-prop-fact-sheet.pdf

[6] https://www.healthcare-informatics.com/print/article/population-health/health-plan-leaders-detail-value-proposition-hie-data

TYPES OF HIE MODELS

There are a few basic models for HIE in the United States. For the most part, HIE organizations are established at the state or regional level. Typically, the basic conceptual frameworks for these models are government-led, a public utility model, private-sector led, or a hybrid of these (See The State Alliance for e-Health, 2009, "Preparing to Implement HITECH: A State Guide for Electronic Health Information Exchange")[7]

- **Government-led HIE is under direct government supervision, with a public entity having responsibility for governance, financing and operations.** Using funding available through the Federal HITECH Act of 2009, many states (such as North Dakota and South Dakota) chose to establish government-led exchanges. This funding was paired with policies that focused on clinical and hospital care. As such, few of these exchanges include non-acute care providers across the care continuum. Many of the government-led models have faced sustainability problems.

- **HIE as a public utility with strong government oversight.** In this model, the state authorizes a non-government entity to design, own, and operate one or more exchanges. The state regulates industry behavior, but can grant greater operational flexibility than under the government-led model. The independent entities are typically responsible for technical infrastructure and pricing. In addition, the state may provide an entity with exclusive rights to operate within a market. States that have pursued an approach similar to this include New York, Michigan and Texas.

- **Private sector-led HIE with government collaboration.** Private sector HIE efforts have evolved in some states and/or regions among organized groups of stakeholders, with services already in place and agreements on the technical architecture. In this model, the exchange has primary governing responsibility over its operations. State government would support and participate in the exchange and, where appropriate, provide regulation or the threat of regulation, to ensure appropriate industry behavior and to protect consumer interests. States that have pursued an approach similar this include Indiana, Wisconsin and Nebraska.

The choice of a model depends on many factors, including health care market characteristics, policies, funding options, and popular or political sentiment. For example, a state-led model may work well in a state with a consolidated health care market and/or small geography, whereas one of the other models may be more appealing in markets with large geography and little consolidation. Another factor in the choice is the goal(s) of the state officials for what types of health information they want exchanged and for what purposes. At this time, most state health information exchanges are a hybrid of these three types of models.

[7] https://www.nga.org/files/live/sites/NGA/files/pdf/0908EHEALTHHITECH.PDF

CORE HIE ATTRIBUTES

1. **Master Patient Index (MPI):** A core element of any HIE is the ability to correctly match patients with their clinical data. In the absence of a single, standardized patient identifier (e.g., social security number), the MPI can use either deterministic and/or probabilistic algorithms to identify and link patient data from different provider networks or data exchanges.

2. **Record Locator Service (RLS)**: This coordinates with the MPI. Once the patient is identified, the provider can use the RLS to retrieve a copy of the patient's records stored in decentralized provider systems. The RLS facilitates the exchange of secure messages and documents, but does not store information contained in the records.

3. **Clinical Data Repository (CDR):** This is only used in centralized or hybrid data models (in hybrid, CDR is transitory). The CDR provides a central repository for storing clinical data.

4. **Access and Authorization:** This is role-based security that controls how an individual is permitted to access and use the HIE.

5. **Auditing and Logging:** This provides an additional level of security by monitoring activity taking place within an HIE, as well as monitoring overall usage patterns.

6. **Transport and Content Standards:** These are nationally recognized specifications and protocols to enable communication among different health data systems. Common standards today include CCD, DICOM, HL7, ICD-9, NDP, LOINC and SNOMED.

7. **Messaging Services:** These are processes and software necessary to facilitate the exchange of various types of data through the HIE.

8. **User and System Interface:** These are methods to access HIE which can range from basic physician portals on the HIE to data embedded directly into a physician's EHR.

9. **Consent Management:** This is a mechanism through which patient consent is obtained regarding how their personal health information (PHI) may be shared and with whom within an HIE.

CHALLENGES

What kills HIEs? Here are a few common toxicities:

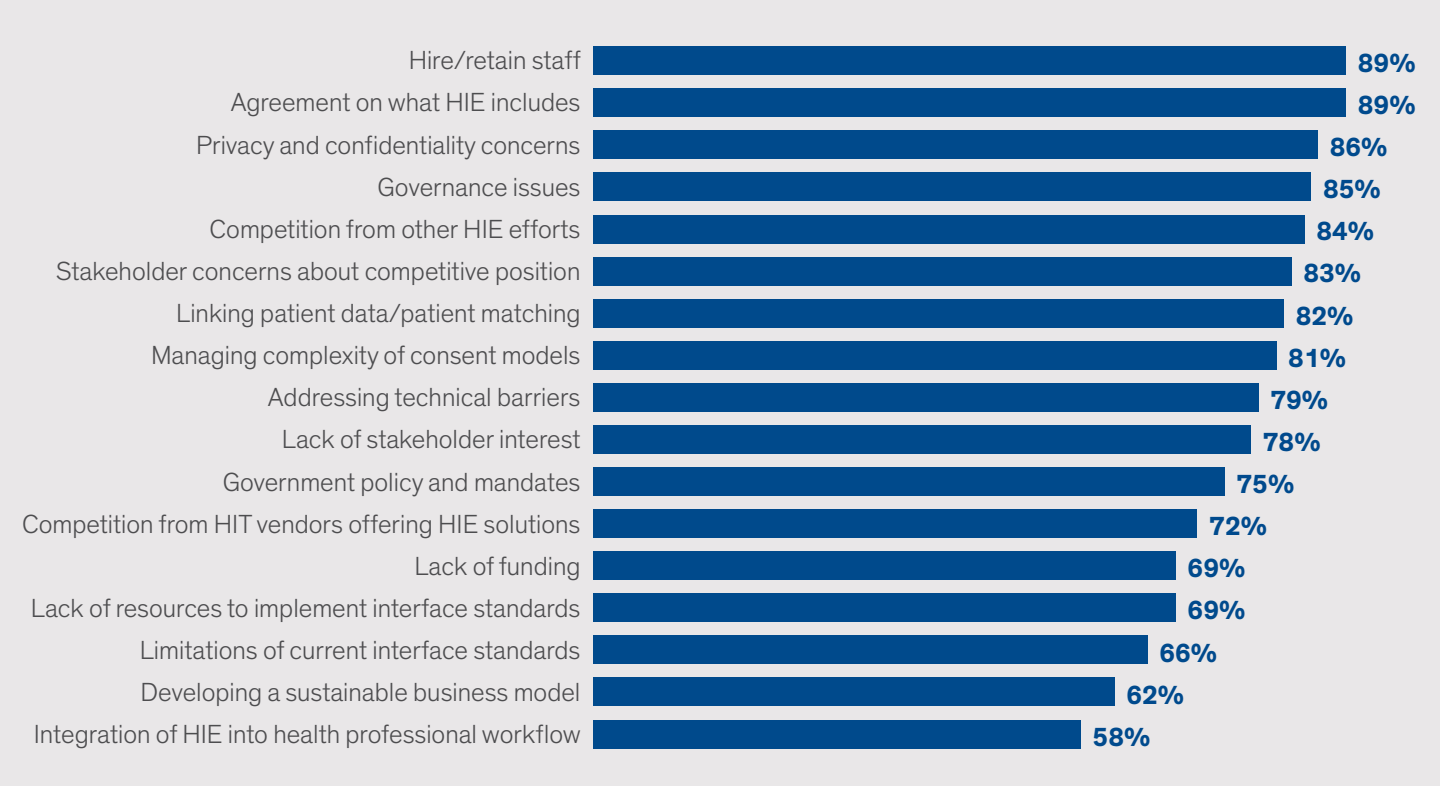
Technical complexity. American hospitals, doctors, and other providers use more than 500 different medical record systems. Those systems often do not use the same technical standards and may not easily communicate with one another.

Competitive pressure. There is wariness about sharing patient records with a competitor. Patient data is also a potential source of revenue that healthcare organizations of all types don't want to just give away.

Lack of a business model. It's one thing to get a government grant and hire some programmers to write interfaces between information systems. It's another thing to keep on paying them. Many HIEs have floundered when they couldn't find a way to pay for the ongoing expense.

What are the stumbling blocks?

The Robert Wood Johnson Foundation asked executives at 106 health information exchanges (HIEs) to identify the barriers to HIE development.



Source: Robert Wood Johnson Foundation "Health Information Technology in the United States, 2015: Transition to a Post-HITECH World," Sept. 18, 2015.[8]

- **Sustainability challenges**
  - From 2010-2014, states received federal grants to establish HIEs with hopes they would be sustainable by 2015. The vision was not realized and most HIEs still depend on public funding.
  - In the meantime, many health systems around the country developed their own internal HIE capabilities, reducing the value of centralized HIE service.
- **Technological and Quality challenges**
  - The wide variety of Electronic Health Record technologies available and the lack of nationwide data sharing standards have resulted in data quality and exchange issues.
- **Workflow challenges**
  - Many HIEs require users to log into a second system to get to the HIE.
  - Many HIEs do not successfully match patient records across providers, which results in multiple separate records (not a consolidated record).
  - Many HIEs only allow users to view data—the data cannot be downloaded into the EHR or shared.

[8] https://www.managedcaremag.com/archives/2016/1/untangling-hie-mess

CHARACTERISTICS OF A SUCCESSFUL HIE MODEL

First and foremost, an HIE can only be successful if both exchange partners and patients are confident in the HIE's privacy and security measures. Further, use of HIE is predicated on the the state and local environments within which they exists. However, some states, specifically those with state-led programs, as opposed to state designated entities, have been more successful with adoption. There are nine states that stand out, as they have developed successful HIEs - Colorado, Delaware, Maine, Maryland, Michigan, Nebraska, Oklahoma, Oregon, and Utah - and share common characteristics:

1. HIE activities are formally structured and governed with clearly defined roles.
2. HIEs have an effective governance model and are performance driven.
    a. Highly integrated with the state's HIT/HIE structure (including Medicaid agency).
    b. Strong strategic plans with clearly defined outcomes and performance measures.
    c. Accountable to all customers including the state.
3. Laser-focused on core HIE functions:
    a. Connects all patient data to the system in a secure manner.
    b. Significant percentage of patients (with their records matched) accessible in HIE.
    c. Produces high quality data: Have complete and accurate data that support high-quality health care and the ability to measure health systems.
    d. The system is secure, yet efficient, and easy to access and exchange health records.
4. Financial decisions are transparent and can be traced back to program goals[9]

By working together, our HIE members are uncovering ways to better serve vulnerable populations and provide valuable support in emergency preparedness and response to natural disasters, for example. We all get stronger through collaboration, and together, our members are playing an important role in addressing and overcoming health disparities across the country.

Kelly Hoover Thompson , CEO, Strategic Health Information Collaborative[10]

[9] https://legislature.vermont.gov/assets/Documents/2018/WorkGroups/House%20Health%20Care/Vermont%20Information%20Technology%20Leaders--VITL/W~Michael%20Costa~Evaluation%20of%20Vermont%20Information%20Technology%20Activities~1-11-2018.pdf

[10] https://ehrintelligence.com/news/what-are-potential-benefits-challenges-of-hie-use

ANATOMY OF AN HIE

HIEs integrate many types of healthcare data produced from a variety of sources. Central to this exchange is patient identity, a component that frequently consume much of an HIE's resources. In addition, HIEs continue to be challenged by connectivity to participants and acquisition of source data that conforms to standards and specifications.

HIEs not only serve to aggregate and distribute healthcare data, but also to provide critical analysis of the data to derive insights that feed care coordination, population health, and public health.

SOURCES OF DATA

TYPES OF DATA

- Demographics (Name, Gender, DOB, Race, Ethnicity, Language)
- Allergies
- Medications
- Medication Allergies
- Smoking Status
- Immunizations
- Encounters
- Observations
- Vital Signs (Hgt, Wgt, BP, BMI)
- Pharmacy Fill Data
- Lab Tests, Values / Results
- Radiology Reports / Images
- Other Diagnostics Results
- Diagnoses
- Problem Lists
- Procedures
- Functional / Cognitive Status
- Care Plans / Team Members
- Discharge Instructions / Clinical Summaries
- Advanced Directives
- Care Plans
- eMOLST
- EMS Run Sheets
- Image Exchange
- Medicaid Claims Data
- Social Determinants of Health

CORE SERVICES

Patient Record Search:
Access to a more comprehensive patient profile Statewide

Direct Messaging:
Secure HIPAA-compliant messaging

Delivery of Clinical Summaries:
Ability to push clinical summaries (CCD, C-CDA) and lab results

Predictive Analytics:
Assessing risk and managing patients to optimize care

Clinical Event Notifications (CENs):
24/7 Custom alerts provide real-time updates for patients in care

PATIENT MATCHING

Patient matching is one of the largest challenges faced by HIEs because they have little control over the quality, completeness, or standardization of the patient data they receive from their participants. Not only do HIEs inevitably receive duplicate patient records from each participant, but the differences in data governance between participants dramatically increases the challenge of identifying and matching common patients. But our cloud-based Referential Matching technology was built to handle the largest and most difficult patient matching scenarios—whether the varied data sources at an HIE, an EHR migration or hospital acquisition at a health system, or matching sparse member data at a payer."

Mark LaRow, CEO, Verato[11]

HIEs face significant challenges with matching and linking patient identities because of the diversity and independence of the institutions they serve. At the very core of an HIE—as documents and records are pulled from organizations—is assembling them for a particular patient. As such, patient matching is foundational to HIE operations. However, the challenge is that HIEs don't control the capturing of the demographic information and don't always get the cleanest information coming back from participating organizations. Consequently, probabilistic or deterministic matching is often deployed, with additional tuning of algorithms a necessity to mitigate false positives. For an end-user of the services—a clinician, for example—some HIEs will present a possible match of duplicates or present multiple records in the case of uncertainty regarding multiple records for a single patient.

[11] https://globenewswire.com/news-release/2018/05/15/1502480/0/en/Health-Information-Exchange-in-Colorado-to-Improve-Patient-Matching-with-Verato.html

When I joined Healthix two and a half years ago, I observed that we were losing ground because we were getting 11K new potential patient matches every day that required manual review. With such a high volume, we couldn't possibly keep up using a manual approach. To automate the process, we contracted with Verato, a company that has a service that does something unique. They realized a while ago that there are a lot of public records for Todd Rogow. For example, I have an electricity bill, so there's a public record of me and my address. There could be a credit agency that also has my name and my address and could include other things like a social security number, home phone number, or my date of birth. All of this is publicly available. They built an application that we reach out to as a service through an API, and we provide two identities for who we think may be the same person. We're not certain, so we reach out to them and we ask them to query their public datasets from credit agencies, public utilities, etc., and come back with a recommendation on identity matching.

Todd Rogow, CHCIO, Senior VP & CIO, Healthix[12]

HIE VALUE PROPOSITION

REASONS TO CONSIDER CONNECTING TO AN HIE

1. Missing information when an individual arrives at a care facility.
2. Care team suspects incomplete medication list.
3. Before administering medicine, care team members can use the HIE to understand an individual's medical history.
4. An individual forgets or doesn't remember a part of their history.
5. An individual's care team needs the most recent EKG tracing or imaging report.
6. The care team doesn't have time to wait for anther care facility to share labs, etc.
7. Care team members need to see the trend in lab value over time.
8. An individual shares information with the care team not in their record.
9. The care team and individual are having trouble communicating about the individual's medical history.
10. The care team can use the HIE to capture outcomes data needed to improve quality measure reporting.[13]

[12] http://blog.galenhealthcare.com/2017/09/11/chime-cio-interview-series-todd-rogow-chcio-senior-vp-cio-healthix/

[13] https://www.healthit.gov/sites/default/files/playbook/pdf/general-provider-value-prop-fact-sheet.pdf

THE BENEFIT AND IMPACT OF HIE

PATIENT IMPACT

More complete history
- Patient information is imported directly to the EHR

Transition of care simplified
- Less "re-telling" of history, data at the provider's fingertips

Higher patient satisfaction scores

HDO IMPACT

Increased Continuity of Care
- Medication reconciliation
- Immunization records
- Problem list
- Lab data

OVERALL BENEFITS

- Reduce medical records requests
- Improve quality scores (HEDIS/STARS)
- More accurate member health profile
- Analytic capabilities – value-based, population health, predictive analytics
- Improve patient safety by reducing medication and medical errors
- Increase efficiency by eliminating unnecessary paperwork and handling
- Provide caregivers with clinical decision support tools for more effective care and treatment
- Eliminate redundant or unnecessary testing
- Improve public health reporting and monitoring
- Engage healthcare consumers regarding their own personal health information
- Reduce health related costs
- (A recent study actually found widespread use of HIE's could save an estimated $63 million annually to Medicare in outpatient therapeutic procedure costs.)[14]

USE CASES

- Quality measures and care gaps
- Risk adjustment programs
- Care management – notification, care coordination, re-admission risk, medication reconciliation
- Pay for performance

EMERGENCY

- Allows care team to respond quickly to individuals in emergency
- Protects individuals' information in event of disaster

IMPROVES HEALTH

- Tailors care decisions to individual needs and promotes person-centered care through greater patient engagement
- Provides information when verbal communication is difficult (e.g., language barrier, dementia or lack of consciousness)

CARE COORDINATION

- Allows care team to access and share an individual's medical history, no matter where care occurs
- Improves accuracy of medication reconciliation to ensure an individual's medications are based on the most up-to-date information available

EFFICIENCY

- Improves efficiency and savings in process flow because information is available when needed
- Reduces duplicate diagnostic tests, streamlining care and increasing efficiency
- Avoids readmissions and associated penalties by improved monitoring of at-home needs and notifying care team members of hospital and ED admissions/discharges through alerts
- Allows the care team to qualify for financial incentives for care coordination and the exchange of health information from the Centers for Medicare and Medicaid Services (CMS) and other health plans

[14] https://www.telequality.com/blog/2017/7/7/health-information-exchanges-one-solution-to-the-interoperability-dilemma

HIE USE CASES

Health information exchange is comprised of many use cases which facilitate care coordination. This is achieved through providing a complete view of the patient, enabling real-time intervention at the point of care, determining risk, and providing actionable data. These use cases serve to enable patient engagement and care management.

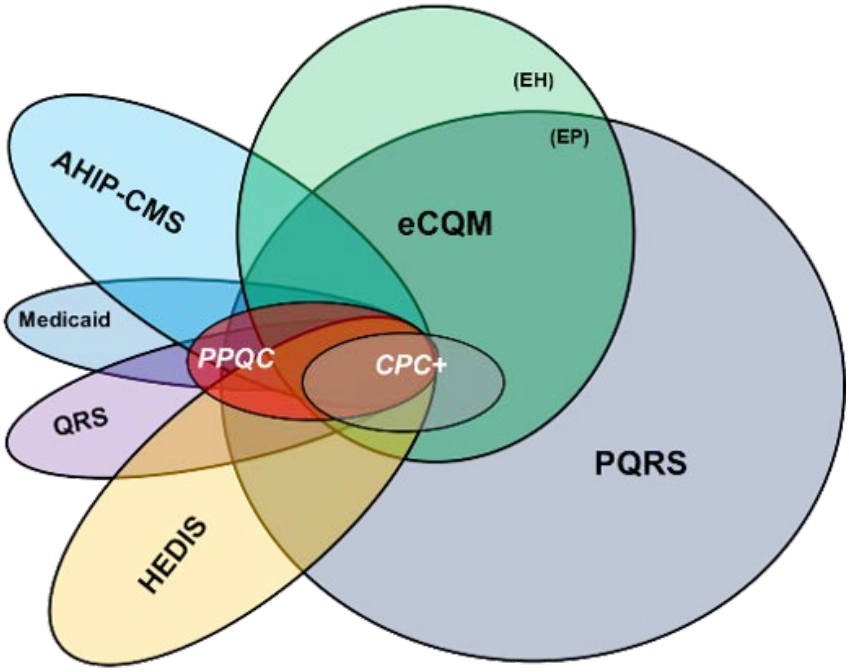
1. Clinical results delivery (lab, radiology, etc.)
2. Medication history, summaries, alerts, etc.
3. Notification of clinical events for patients in a defined population
4. Immunizations, syndromic surveillance and public health data
5. Electronic prescribing and refilling information
6. PHRs, patient-reported data
7. Claims transaction
8. Data quality and research support
9. Connectivity to electronic health records
10. Alerts to providers
11. Enrollment or eligibility checking
12. Electronic referral processing
13. Clinical decision support
14. Disease or chronic care management
15. Quality improvement reporting for clinicians
16. Disease registries
17. CCR/CCD summary record exchange
18. Quality performance for purchasers or payers
19. Public health surveillance
20. Electronic prescribing and refill information
21. Query for documents
22. ADT notification
23. Claims processing
24. Population health management
25. Research support
26. Ambulatory order entry
27. Connectivity to EHRs

LEVERAGING HIE FOR QUALITY REPORTING

Hundreds of clinical quality measures are used by multiple quality reporting programs to evaluate care practices. Unfortunately, many of these quality measures overlap, causing considerable reporting burdens for healthcare providers and health plans (payers). Quite often, providers and payers must report the same quality measure multiple times to numerous different reporting programs.

Some HIEs are Qualified Clinical Data Registries (QCDRs), a CMS-approved entity that collects clinical data on behalf of clinicians for data submission, and can submit data for thirty-five Electronic Clinical Quality Measures (eCQMs). These measures, certified by the National Committee for Quality Assurance and ONC, are standardized and intended to provide reliable indicators of high quality patient care. The metrics cover management of chronic diseases, preventive care screening, use of appropriate medications, and overall cost of care reductions.[15] This facilitates "reporting once," satisfying multiple quality reporting program needs.

Measure Set	# of Unique Measures
PQRS	281
eCQM	93
HEDIS®	93
AHIP - CMS	88
Medicaid	51
QRS	43
CPC+	22
PPQC	27
Overlap	***3***

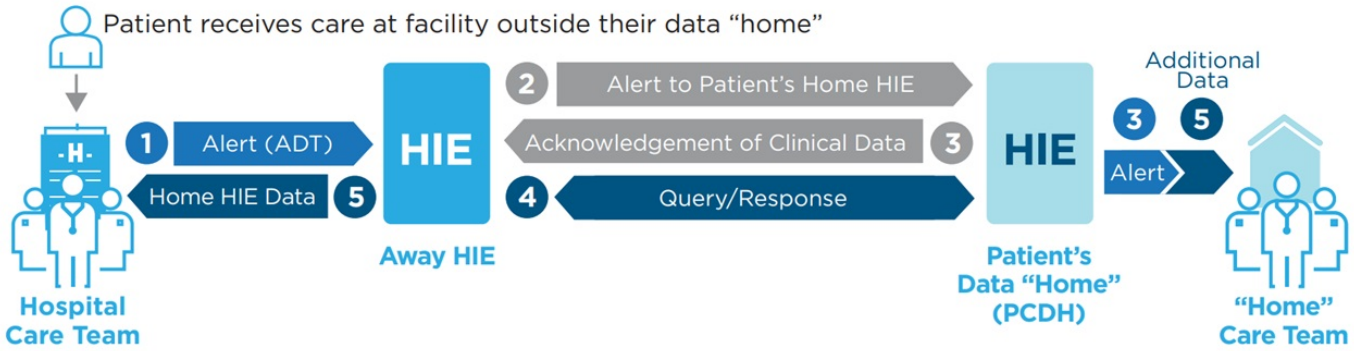


[15] https://mihin.org/clinical-quality-measure-reporting-and-repository/

PATIENT CENTERED DATA HOME

The Patient Centered Data Home (PCDH) is a cost-effective, scalable method of exchanging patient data among health information exchanges (HIEs). It's based on triggering episode alerts, which notify providers a care event has occurred outside of the patient's "home" HIE, and confirms the availability and the specific location of the clinical data, enabling providers to initiate a simple query to access real-time information across state and regional lines and the care continuum.

PCDH is an initiative of the Strategic Health Information Exchange Collaborative (SHIEC) that makes it possible for clinical data to be available whenever and wherever care occurs. All clinical data becomes part of the comprehensive longitudinal patient record in the HIE where the patient resides (the Patient Centered Data Home).



1	Share patient encounter "alert" (from "away HIE" to "home HIE") based on ZIP code look up tables
2	Away HIE queries home HIE for clinical data to aid provider at the time of treatment
3	Home HIE alerts treating away HIE if there are records. Simultaneously, the home HIE alerts patient's usual "home" doctors
4	If records exist at home HIE, away HIE issues a query for records for the home HIE to respond to
5	Away HIE delivers records to treating care team and shares post-encounter summary to "home HIE"

PRINCIPLE BEHIND PCDH:

Regardless of where patient care is received, data should "wrap around" the patient

- Simple and cost-effective based upon existing standards and technologies
- Scalable
- HIEs query and push data to one another based on patients' ZIP codes listed in ADT messages
- Through the cHIE, providers can query/pull information from other HIEs – based upon a "trigger" event or notification of hospital admission
- Data is available when and where it's needed
- Data becomes part of record in patients' PCDH (home) HIE

Benefits of PCDH

- Allows information to follow patients who cross state lines for care
- Provides a cost-effective technology for accessing patient data from another state or regional HIE
- Builds a more comprehensive, longitudinal patient record in the patient's home HIE or PCDH

Importance of HIE to HIE Sharing

- Puts patient in the center of his/her care
- Care provider teams in divergent geographies can coordinate care
- Better results
- Lower costs
- Simple and comprehensive data collection
- Reduces need for unnecessary duplication (e.g., labs and radiology studies)
- Better medication management
- Builds more comprehensive longitudinal patient record

We are a member of the Strategic Health Information Exchange Collaborative (SHIEC), whose members are 50 of the sustainable HIEs in the country. Many of the members have different business models than we do. For instance, some are state entities, like Kentucky Health Information Exchange (KHIE), and others don't preserve data, they just transact, as with the Kansas Health Information Network (KHIN) model. Our first annual meeting was in 2015, when about a dozen of us got together to share ideas and have conversations about how we can work together, share services, and lower operational costs. Our country does not have an operational HIE that covers all of the market. SHIEC is the closest we have, and that covers about half of the population.

Charles Christian, VP, Technology and Engagement, Indiana Health Information Exchange[16]

[16] http://blog.galenhealthcare.com/2017/03/07/chime-fall-forum-interview-series-charles-christian-vp-technology-engagement-indiana-health-information-exchange/

PREDICTIVE ANALYTICS FUELED BY HIE

Use of real-time clinical data to determine and identify the potential costly patients who are in the middle range. They're not yet the high-cost, frequent users of the system, but they very well could be. Care managers find more potential at-risk patients than before, lowering readmissions rates in the process.[17]

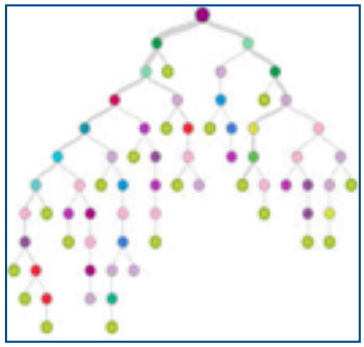
Patient History

Risk Model Development

1000s of Patient Features

- Age
- Gender
- Geography
- Income
- Education
- Race
- Diagnoses
- Procedures
- Chronic conditions
- Visit and admission history
- Outpatient medications
- Vital signs
- Lab orders and results
- Radiology orders
- Social characteristics
- Behavioral characteristics

Multivariate Statistical Modeling - Decision Tree Analysis Machine



Patient Risk of Event or Outcome

Population Risk Model

Predicts future 12 months

- Predicted future cost
- Risk of inpatient admission
- Risk of emergency department (ED visit)
- Risk of acute myocardial infraction (AMI)
- Risk of asthma
- Risk of cerebrovascular accident (CVA)
- Risk of congestive heart failure (CHF)
- Risk of COPD
- Risk of diabetes
- Risk of hypertension
- Risk of morality

Events Based Risk Models (predicts future 30 days

- Risk of 30 day readmission
- Risk of 30 day ED re-visit

For example, HealthInfoNet, Maine's statewide health information exchange, has contracts for its predictive analytics package from five hospitals and the state's Pioneer accountable care organization. This HIE is the first in the country to adopt this type of model. And, based on a review of the the trials that took place before the contracts were signed and the work the predictive analytics made possible afterwards, the model shows great promise.

Customers can use the analytics and predictive tools to study market share, clinical performance, population health, and patient risk, all in real-time.[18-19]

Real-time alerts are extremely helpful, but healthcare organizations don't have to stop there. Predictive analytics give providers the tools they need to prevent problems before they arise. This is particularly critical for Medicaid patients, who often face a complex web of socioeconomic challenges, behavioral health issues, and barriers to care access.

[17] https://www.healthcare-informatics.com/print/article/patients-motion-maine-hie-rolls-out-real-time-predictive-analytics
[18] http://www.healthcareitnews.com/news/maines-hie-launches-analytics-business
[19] https://hbisolutions.com/healthinfonet-brings-hie-members-real-time-predictive-analytics-tool/

By merging clinical data from EHRs and claims data from payers, "we have created predictive analytics models that we're running for the Medicaid program as part of a CMMI initiative to show the value of merging clinical and claims data to monitor risk," said Shaun Alfreds, HealthInfoNet's CEO.

"Those risk scores can then repopulate into the HIE environment, so that a provider accessing the portal can take advantage of those analytics. They can better understand the risk of that patient having an adverse event or developing a chronic illness," he added.

Adding claims data into the picture can help connect the dots for patients who may skip around the care continuum, visit multiple providers, or receive care from organizations that do not have the capability to connect to the main stream of information flowing across the state.[20]

> We've introduced new services, such as predictive analytics, focusing on the top 5-10% of the population that could be, or are the highest cost patients. We aim to get in front of the cost curve, and be proactively impactful, giving the care management teams of healthcare organizations indications as to who the individuals are that we believe are likely to present in the ER or another inpatient setting, or have the potential of having a chronic condition. We highlight these patients so clinicians can effectively reach out to highest need patients.
>
> **Todd Rogow, CHCIO, Senior VP & CIO, Healthix[21]**

LEVERAGING SOCIAL DETERMINANTS OF HEALTH FOR HIE

According to the Centers for Disease Control and Prevention (CDC), social determinants of health include the conditions of the places where people live, learn, work, and play. These conditions can affect a variety of health risks and outcomes. Unstable housing, low income, unsafe neighborhoods, and substandard education are some of the major factors that can influence patient health. Incorporating social determinants of health data into patient EHRs may improve individual and population health management.[22]

Patients facing the challenges of low health literacy and social determinants are more likely to fall through the cracks for transitions in care. Using risk stratification to target the most-needy members, high-quality data delivered by the HIE, and automated matching of the CCD data with other medication sources, health plans are able to identify patients needing immediate follow-up.[23]

The healthcare industry is increasingly aware that complex geographic, socioeconomic, and behavioral factors are a key component to making population health management work. For example, Michigan health information exchange Great Lakes Health Connect (GLHC) is making some of that data available for some of the 9 million patients at the 129 hospitals and 4,000-plus ambulatory sites that connect to it. GLHC has enlisted Alpharetta, Georgia-based startup Holon Solutions, which develops patent-pending data exchange and decision support technology.

[20] https://healthitanalytics.com/news/how-did-maines-state-hie-become-a-big-data-analytics-beacon
[21] http://blog.galenhealthcare.com/2017/09/11/chime-cio-interview-series-todd-rogow-chcio-senior-vp-cio-healthix/
[22] https://ehrintelligence.com/news/texas-hie-to-link-social-determinants-of-health-to-patient-ehrs
[23] https://www.healthcare-informatics.com/print/article/population-health/health-plan-leaders-detail-value-proposition-hie-data

The aim is to provide more effective care while also meeting the goals set by Michigan's State Innovation Model, which has established a series of standards for providers managing Medicaid patients.

Holon says its CollaborNet technology will help integrate clinical and social determinant data, and present information via intelligent alerts within clinicians' existing EHR the workflow. The tool will also allow care providers more easily refer patients to community groups that could help them address social health issues such as transportation or housing.

When a patient's electronic health record is opened, the Holon tool senses it and begins searching other data sources for supplementary data associated with that patient, company officials say. The analytics tools examine the records and relay pertinent data with an appropriate alert in the top right corner of the clinician's workflow.

The alert can be clicked away or opened for further information and potential intervention. The tool can show coding or risk-adjustment opportunities, reveal gaps in care, and identify members of specially-managed populations.

HIE FOR BEHAVIORAL HEALTH

"We know that the biggest burden for people with severe mental illnesses isn't always their mental health, but their physical health," said Chris Copeland, Chief Operating Officer of The Institute of Community Living (ICL).

"That means we have to do a better job of understanding the impact that the two issues have on one another, especially when it comes to people with chronic physical health conditions that have been undiagnosed or have unrecognized psychological underpinnings to them."

Because many behavioral health organizations have not been integrated into data exchange systems on the clinical side, much of the physical health data they collect is provided by their patients, who may not be able to accurately recall every diagnosis, treatment, or medication that may be relevant to their care.

"Much of our data is generated internally, and a lot of it is self-reported by patients," said Copeland.

"Over the last few years, we've been able to look at data around emergency department use and hospitalizations, as well as physical health indicators like BMI and metrics related to diabetes. We also look at connections to primary care, medication adherence, and additional indicators that function as proxies for how well patients are doing with their healthcare in general, and if they are improving with us."[24]

One HIE, Colorado Regional Health Information Organization (CORHIO), has a focus on behavioral health and substance use data integration. They are working with stakeholders to address integration of care and are working on rapidly incorporating social determinants and environmental care factors into the longitudinal record.

[24] https://healthitanalytics.com/features/why-hie-data-analytics-are-critical-for-behavioral-healthcare

This type of integration, of course, is challenging as providers are not traditionally accustomed to thinking about these data points. "One of our staff members describes HIE challenges in two paths: documents and data," says Morgan Honea, CEO, CORHIO. "In the provider workflow, it is focused around documents describing the clinical encounter that happened at the primary care practice, or the discharge that came from the hospital. This is very much a document-based exchange. And then as you think about population health, environments of care and public health use cases, it's much more about data. Crossing those chasms and making them interweave and mesh together, and using the healthcare standards and the things we leverage to make that magic happen, is challenging. But in Colorado we are fortunate to have smart folks in different segments doing great work," Honea attests.[25]

We've been working with a community mental health organization here in Michigan, over towards Ann Arbor, and their use of our Virtual Integrated Patient Record (VIPR). We've been challenged with the consent laws and other legal frameworks to accept behavioral health data into our virtual health record. What we did in this case was to make sure their behavioral health care workers were provided with physical health information on their patients. There is no regulatory restriction there, and having access to that information informed their ability to care for the folks they were seeing in the CMH. The Director, Mike Harding, talked about one particular lab test that they would order on a regular basis for their patients. Once they gained access to the community health record, they could see the results of past testing, eliminating the need to run an additional panel. He estimated that their organization was able to eliminate about 200 tests a month because the necessary results were already in the record. This translated to a savings of $72,000 a year for them!

Doug Dietzman, Executive Director, Great Lakes Health Connect[26]

INTELLIGENT SEARCH CAPABILITIES

With an overwhelming amount of clinical information presented to the clinician, HIEs like Indiana Health Information Exchange (IHIE) are introducing advanced search capabilities to bubble up contextually relevant and critical clinical information for an encounter. IHIE's CareWeb Search function embeds capability within the EHR, finding discrete data (i.e. test results and radiology reports) and specific words in free text and PDFs.

One of the innovative capabilities we have is a smart search within our repository – likened to a google search. Take one of our ER physicians at Eskenazi, for example. He's got a search protocol called "chest pain," which pulls any recent admissions with chest pain as the chief complaint. It also pulls troponin levels, any echocardiograms, or cast studies, and delivers to him instead of the physician having to hunt for them. We are working with an EMR vendor to embed this capability within the system of record. In this way, we can embed a search bar and the physician can access saved searches that retrieve information based upon criteria and filters they setup.

Charles Christian, VP, Technology & Engagement, Indiana Health Information Exchange[27]

[25] https://www.healthcare-informatics.com/print/article/hie/muddy-hie-landscape-corhio-delivers-goods

[26] http://blog.galenhealthcare.com/2018/01/15/chime-fall-forum-interview-series-doug-dietzman-executive-director-great-lakes-health-connect-part-2/

[27] http://blog.galenhealthcare.com/2017/03/07/chime-fall-forum-interview-series-charles-christian-vp-technology-engagement-indiana-health-information-exchange/

One search

- CareWeb search bar within your EMR (aka Smart Pass)
- Query results for the patient you are viewing by keyword or phrase
- Save and name searches to use on other patients
- Tailor search results using filters and operators, e.g. "leg AND fracture", or "chest NOT pain"

> The CareWeb search function is like Google for CareWeb - it's easy to find specific reports and labs.
>
> **Dr. Donald Trainor**
> Chief Medical Officer, HealthNet

HIE CRITICAL TO COMBATTING OPIOID EPIDEMIC

Michigan health information exchange (HIE) Great Lakes Health Connect (GLHC) will assist in a University of Michigan project centered on researching the scope and impact of the opioid crisis. GLHC will contribute clinical data from acute care emergency departments to the research project.

The project is funded by a partnership between the UM Injury Prevention Center and the High Intensity Drug Trafficking Areas (HIDTA) program — a coalition of local, state, and federal law enforcement. The project will take a system-based approach to reducing opioid overuse by collecting clinical data from multiple sources.

The project will also help to increase the timelines and quality of reporting for the development of improved regional response strategies.

As part of the project, GLHC will sort admissions, discharge, and transfer (ADT) notifications from all participating hospital emergency departments for opioid-related diagnosis codes. The S.O.S project will combine this data with information aggregated from other sources.[28]

[28] https://ehrintelligence.com/news/mi-health-information-exchange-joins-opioid-research-project

ENABLING HIE CONNECTIVITY AND INCORPORATING CAPABILITIES INTO EHR WORKFLOWS

HIE Participant Onboarding Best Practices

Onboarding participants quickly and ensuring data quality are essential to deploying a successful HIE solution. A critical component of participant onboarding is determining readiness. Namely, evaluating source system type (EMR, Lab, Transcription) and data accessibility (source vendor involvement), types of clinical data, volume estimates, historical load, and clinical data formats. Successful HIEs lower subscription costs for expedited onboarding.

Below is a list of top considerations for HIE Participant onboarding.

1. Understand the technical capabilities of participants
2. Plan ahead for increasing volume
3. Understand throughput requirements for mission critical applications
4. Define a process to prune received data so it is clean and relevant
5. Establish data filtering; define sensitive data and patient consent[29]

Download the HIE Participant Onboarding toolkit, which provides templates, best practices, and lessons learned to successfully on-board participants/connections and acquire data from source EHR and EMR systems.

- Templates for onboarding a readiness questionnaire, technical design document, use case and user acceptance criteria
- Proven methodology, best practices and lessons learned for successful and efficient participant onboarding

Source Organization	Specific Source System	Type of Clinical Data	Date first live in production	Volume Estimates (e.g., # of unique patients)	Clinical Data Format (include terminology used, if any)	Location or region
XYZ Health System (hospital)	ADT (GE)	Admissions data, discharge summaries	Since Jan 2009	2,000,000	HL7 v2.5.1.	Tallahassee
ABC Hospital	Lab (Cerner)	Lab results	Since Feb 2010	1,000,000	HL7 v2.5.1, LOINC coded	Jacksonville
St. Sam's Hospital	Transcript on (XYZ vendor)	Transcribed reports: surgical notes, radiology reports	Since June 2010	1,000,000	HL7 v2.6	Lakeland

[29] http://blog.galenhealthcare.com/2016/09/01/hie-participant-onboarding-considerations/

Required data for children:

Total Patients <19 years (denominator): 17

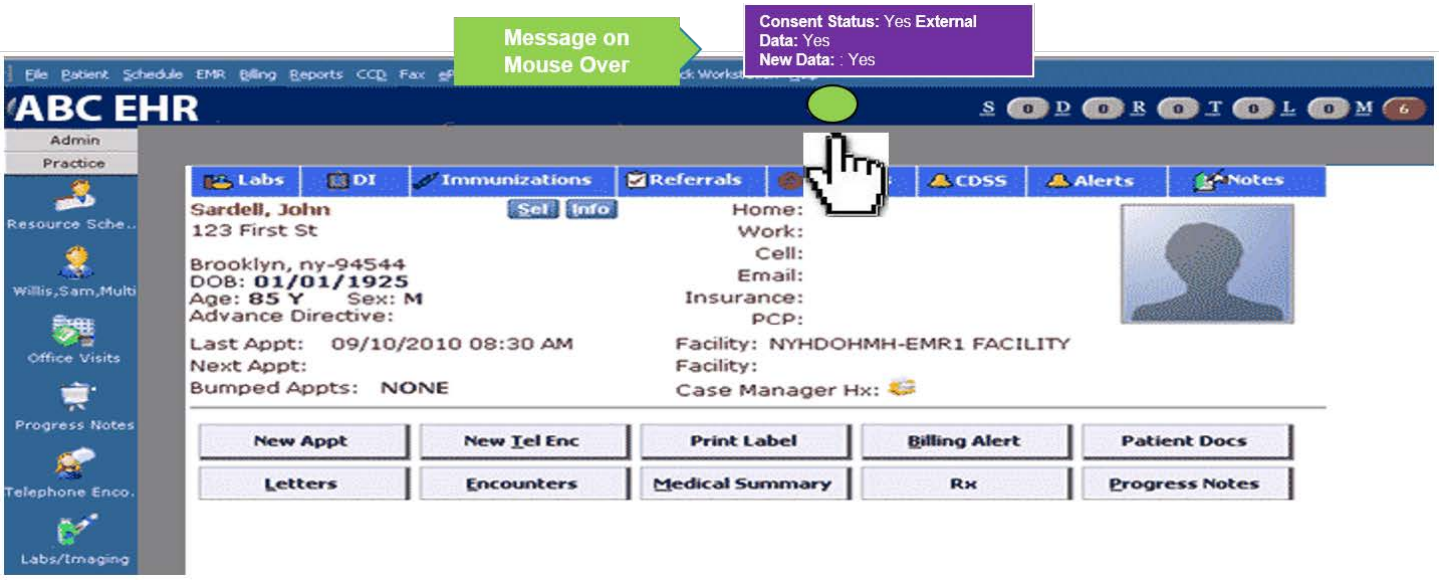
Data	Children (<19 years)		Comments
	Count (Percent)	Pass/Fail	
Mother's Maiden Name	0	Fail	No required if guardian information is supplied
Guardian First Name	100	Pass	
Guardian Last Name	100	Pass	
VFC Eligibility Status	0	Fail	VFC codes backwards. Not recognized

Comments:

- Race is not present for 6 records (2 patients).
- Medicaid numbers are not present for Medicaid patients.
- NK1-3 (guardian relationship) is hard coded to "GRD".
- PV1-20 (VFC eligibility) is backwards.
- Lot numbers are missing ().
- Unknown substance manufacturers ().
- VIS date is hard coded to 01/01/1900 ().

INTEGRATING HIE CAPABILITIES TO THE POINT OF CARE

To facilitate seamlessness of integration, HIEs offer capabilities for contextual single-sign-on from EMR to HIE. Many EMRs have extensibility frameworks to expose information from the HIE. Tasking and alerting can be leveraged to facilitate critical notifications or interventions. HIEs can also compute analytics and package insights into outbound ADT messages for the target EHR to consume and manifest at the point of care to enhance clinical decision support. Longitudinal or community records across care settings and healthcare organizations can be aggregated, producing a consolidated CCD for man-readable view or delivery to the source EMR for import and reconciliation.



GALEN HEALTHCARE SOLUTIONS

Other areas we've been exploring are customized real-time clinical event notifications. We offer a lot of the basic trigger events. For instance, if a patient presents in the ER, that will trigger an alert. However, if we're able to provide a chief complaint, and other key data within that alert, that provides greater value to the provider or care manager. Increasingly, we're able to identify services that our customers' value and are willing to pay for.

Todd Rogow, CHCIO, Senior VP and CIO, Healthix[30]

HIE IS ESSENTIAL AND IS THE BACKBONE OF HEALTH DATA

There's been a lot of press about HIEs and how so many providers still are not participating in them. A couple of years ago, a Black Book Ranking's study of HIEs found providers and payers shifting away from community, public HIEs and moving toward private ones.[31]

This is nothing new; health information exchanges have for years been plagued by the looming question: Is an HIE business model actually sustainable? From politics and competition to privacy and security, HIE organizations are fighting a battle on many fronts. Adding to this challenge, many HIEs were formed with public money and many of those programs have now run their course. While few argue that they have faced challenges to basic survival, many HIEs have grown strong roots, and as previously discussed, some are thriving.

"HIEs are alive and well and we're moving forward to support our communities," said Dick Thompson, chairman of the Strategic Health Information Exchange Collaborative, which counts 60+ HIEs as members. "The exchanges have begun to readily identify value and they are monetizing that value to sustain themselves."[32]

The good news is that there are many strong self-sustaining HIEs that have created a way to deliver continuous value to their communities. These HIEs have demonstrated enhancement of administrative efficiencies, as well as cost containment, and healthcare providers rely on them to:

- Improve safety of patient care
- Provide clinical decision support tools for more effective care and treatment
- Eliminate redundant or unnecessary testing
- Improve public health reporting and monitoring
- Allow community-based providers to coordinate care with other caregivers[33]

In summary, robust and optimal HIE is critical to individual & community health, and it's imperative for healthcare delivery organizations to take advantage of the capabilities offered today in the marketplace.

[30] http://blog.galenhealthcare.com/2017/09/11/chime-cio-interview-series-todd-rogow-chcio-senior-vp-cio-healthix/
[31] https://www.fiercehealthcare.com/ehr/are-we-witnessing-death-public-hies
[32] http://www.healthcareitnews.com/news/whats-next-health-information-exchanges
[33] https://legislature.vermont.gov/assets/Documents/2018/WorkGroups/House%20Health%20Care/Vermont%20Information%20Technology%20Leaders--VITL/W~Michael%20Costa~Evaluation%20of%20Vermont%20Information%20Technology%20Activities~1-11-2018.pdf