The Office of the National Coordinator for
Health Information Technology

Regional ADT Exchange Network Infrastructure Models

Prepared for the Office of the National Coordinator for Health IT by Audacious Inquiry, LLC

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CONTENTS

When a patient checks in to a hospital, or some other health care facility, and is later discharged, news of the medical encounter may take time to reach the patient's physician, if it ever does. This is because care coordination, while improving, still isn't as universal and seamless as it needs to be. The Office of the National Coordinator for Health Information Technology (ONC) is making important strides to get there. In August, 2016, ONC awarded a total of $2.5 million to four HIEs to participate in the Advance Interoperable Health Information Technology Program Supplemental Award focusing on Admission, Discharge and Transfer (ADT) notifications, commonly referred to as HIE-ADT. This program builds on the efforts and lessons learned from the Advance Interoperable Health Information Technology Services to Support HIE (2015-2017) program to support the expansion of nationwide routing of ADT messages as a means of improving care coordination and nationwide interoperability. The four awardees are current recipients of the Advance Interoperable HIE award and have demonstrated unique capability to expand ADT notification and provider directory services across the United States. The ultimate goal is to have a learning health system where accurate and evidence-based information helps ensure the right individual receives the right care at the right time to improve the quality of health care and population health while lowering health care costs. This issue brief was created by Audacious Inquiry under contract GS35F0147V to provide technical assistance to the four awardees.

Background

The 2016, 21st Century Cures Act[1] defines interoperability as "health information technology that enables the secure exchange of electronic health information with, and use of electronic health information from, other health information technology without special effort on the part of the user…" Specifically, it calls for ONC to ensure "full network-to-network exchange of health information" among health information networks nationally.[2] Over the past few years, Admit, Discharge, Transfer (ADT) messages have reemerged as one of the more valuable, effective, and financially and technically feasible means to support the goal of nationwide interoperability. ADT messages can support notification services, which in comparison to other value-add services, can be implemented broadly and quickly based on the basic infrastructure components and basic HL7 ADT feeds necessary to power the solution. There has also been a movement by health information organizations (HIOs)[3] to use ADT messages to notify providers when their patient has an interaction with a hospital in their region.[4] Though ADTs can be used for many purposes, including quality measurement and closing referral loops, the use of ADT messages for notification services to alert providers when a patient has an interaction with a hospital or other care provider has gained momentum and is being used by a number of HIOs across the country.

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[1] 21st Century Cures Act, Section 4003, https://www.congress.gov/114/bills/hr34/BILLS-114hr34enr.xml

[2] Ibid.

[3] HIOs are organizations who facilitate the exchange and potentially aggregation of electronic health information.

[4] CollectiveMedical Technologies' EDIE has more than 150 hospitals participating, Ai's ENS has almost 700 hospitals participating, PatientPing has more than 15,000 providers receiving notifications. Additionally, the majority of HIE vendors and EHR vendors now offer ADT-based notification services as part of their products and the amount of venture capital funding being invested in notification services has increased in recent years.

Inter-HIO alerting is a low-barrier and high-value use case that begins to lay the foundation for nationwide interoperability, while improving care coordination and health outcomes. ADT alerts are designed to improve the timely flow of information so providers and case managers can quickly and effectively address the health care needs of their patients transitioning in and out of care settings. These alerts support coordination across a number of disparate care providers and other stakeholders, including payers, and public health. In addition to improved care coordination, these alerts and notifications are expected to facilitate a reduction in hospital readmissions, improved patient health status, and decreased health care costs.[5]

Previous and on-going investments in HIOs by federal agencies such as HHS have assisted HIOs in the development of an ADT infrastructure upon which to build nationwide interoperability, allowing many HIOs to adopt ADT alerting services in their state.[6] Future and on-going efforts should seek to expand on this functionality by deploying automated inter-HIO alerting across states and regions. Inter-HIO altering is enabled by the HIOs in each region connecting to one another for the purposes of routing ADT visit alerts, which allows providers to monitor their patients, even when they seek care outside of their local region. Such inter-state connectivity is critical, as many HIOs have found that a portion of the providers and patients they serve also receive care in neighboring geographic territories or communities. Establishing a connection with bordering HIOs can better serve each HIO's respective subscriber base and improve patient health outcomes.

The low technical barriers, manageable policy issues and privacy/security concerns, and the relatively limited financial investment required for broad ADT connectivity, paired with high-value use cases, have accentuated the opportunity to build a network of HIOs on a foundation of ADT connectivity. Establishing an ADT connection is itself a generally lightweight technical lift. Moreover, the clinical content of an ADT is generally limited, mitigating concerns inherent in establishing broader health data exchange. But, highly valuable services can be enabled from these data flows. ADT services have taken the form of reporting services, access to encounter data via query service, and perhaps most broadly, encounter notification services. The HIO community is increasingly confirming that developing ADT connectivity, an exercise that was previously largely viewed as a means to an end, has itself become valuable to enable HIE services. From this expanding national ADT connectivity, many HIOs have coordinated to achieve inter-HIE ADT-sharing as a manageable and incremental method for achieving statewide, regional, and perhaps eventually, nationwide data exchange.

This issue brief focuses on four infrastructure models for Inter-HIO data exchange, including the point-to-point, hub, MPI query, and Patient Centered-Data Home (PCDH) models, as well as other technical aspects of ADT exchange. While there are important legal, policy, and financial considerations that are integral to a successful initiative, they are not detailed in this brief. These considerations will be discussed in subsequent issue briefs.

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[5] Enhancing Patient Care and Care Coordination Using Event Notification Systems. Alice Noblin, Kendall Cortelyou-Ward, Steven Ton, Victor Nunez. Journal of Cases on Information Technology, Volume 18 Issue 1 pp 17-27: January 2016. 10.4018/JCIT.2016010102

[6] HHS investments include the 2010 State HIE Cooperative Agreements, the 2010 Beacon Community Program, and the 2015 Advance Interoperable HIE and Community HIE programs

A MODEL FOR SUPPORTING NATIONAL EXCHANGE

Models for facilitating national exchange are inherently complex. Legal, policy, technical (including data normalization and terminologies), and competitive barriers continue to impede the growth of data exchange among health systems and HIOs serving diverse geographic regions. Moreover, defined medical trading areas[7], where the majority of care is provided, may limit the motivation to pursue inter-HIO exchange, especially when the methods to achieve that exchange are complex or the HIOs are not in adjacent regions.[8] At the most basic level, many HIOs around the country have started developing their networks by establishing ADT connectivity with hospitals in their state or region. This connectivity is the basis for a simplified model of inter-regional data exchange based on routing data in a "push-transaction" to the local network serving the geography of the patient's home address. The recipient HIO can then incorporate that data into any services offered to its community of users.

There are numerous permutations of this model that have emerged over the past few years, each facilitating the core technical approach of patient geography-based routing (note that the MPI Query approach described below is not enabled by geography-based routing). Because ADT messages [as well as other clinical documents such as a consolidated-clinical document architecture (C-CDA)] carry patient level demographic data, including a full home address, the HIO receiving that message or document is able to evaluate the address content to support routing to other HIO entities serving the region associated with the given address. It should be noted that participation in an inter-HIO ADT sharing initiative does not require the deployment of a notification service, it merely requires ADT connectivity flowing through an interface engine. The models explored below offer variations on this basic approach, and in some cases, layer in additional infrastructure or capabilities to extend the value or increase scalability.

[7] Medical trading areas are confined geographic spaces where the majority of a patients' care is provided with established referral patterns between providers.

[8] So far, the majority of HIOs that have connected for ADT sharing have been in neighboring states or regions.

Infrastructure Models Overview

Explored below are a series of models that have surfaced over the last two years. Many of these models are in production among HIOs around the country and are being tested and refined. There are also cross-cutting implementation factors that are not given an in-depth treatment below but are nonetheless important, practical considerations. For example, ADT messages tend to be high volume, especially when triggered from hospital facilities. Implementing filters to only share certain event types, to avoid duplicate message routing, and to manage for inter-facility variation in ADT messages are examples of relevant factors. For example, an HIO may apply a filter to only route emergency room registration, Inpatient Admission, and Inpatient Discharge events in order to reduce the overall "chatter" or message volume of an ADT feed. As another example, ADT events may be triggered in different patterns based on the specific system and hospital implementation. In some cases, a specific workflow could cause two admission ADTs to be sent, or a transfer from an emergency department (ED) setting to an inpatient setting may be represented by an ADT transfer message rather than an ADT Inpatient Admission message.

POINT-TO-POINT MODEL

The point-to-point model is the most basic and simplified approach to enable geography-based ADT-exchange. To illustrate the point-to-point model, consider two state-level HIOs seeking to exchange ADT data when a resident from a state of one HIO ("Home HIO") is hospitalized in the state of the other HIO ("Visiting HIO"). When the Visiting HIO receives an ADT message, it evaluates the state code of the patient address. When the state code of the address equals the state of the Home HIO, the visiting HIO routes the ADT onward to the Home HIO. If an HIO is serving a sub-state region, routing could be based on zip codes assigned to a given HIO. The underlying technical approach relies on the two HIOs establishing VPN connectivity with one another and creating inbound and outbound channels over which to send and receive ADT messages. The routing rules can be simple interface engine level rules to positively identify the state or zip code and route it through the outbound channel when it equals that of an HIO data trading partner. Each of the HIOs must also share facility code cross-walks or normalize to one standard, such as the national provider identifier (NPI), and potentially other coded value tables, to ensure the facility name within the ADT can be accurately represented to an end-user of an HIE service. Importantly, in this model, no centrally operated infrastructure is required to enable the exchange of ADT data due to the fact all routing rules exist within each participating HIO and all connectivity is, as the name suggests, directly between HIO nodes. When an HIO receives an ADT, it would rely on its own local master patient indexing process to manage the identity of the patient just as the HIO would manage a patient identity within the ADT sent from a hospital directly participating in their network. A different iteration of the point-to-point model could be two HIOs where the Home HIO automatically receives all ADT messages from the Visiting HIO, regardless of the zip code. In this scenario, the Home HIO would be responsible for deleting or rejecting ADT messages that are not applicable to the Home HIO.

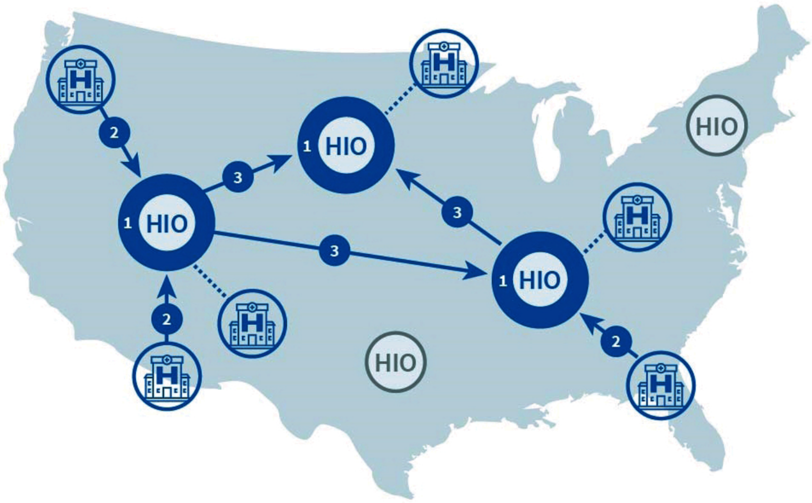

Figure 1 Point-to-Point Model

Transaction Steps

1. Visiting and Home HIOs pre-establish routing rules related to each other's service area definitions (e.g. MD = CRISP)
2. Visiting HIO receives an ADT from a Data Source that has a state or zip code in the patient's home address that matches the Home HIO's service area
3. Visiting HIO routes the ADT to Home HIO

The most significant benefit of this model is its technical simplicity, which lends itself to rapid implementation. The model also has limited governance implications as it is enabled by a two-party agreement rather than a larger multi-party agreement. A potential limitation of this approach is that each new HIO participant that wishes to join requires each existing participant to create new inbound and outbound rule sets to govern routing to and from the new HIO participant. In other words, each HIO must have multiple connections, one to each HIO, instead of a single connection point to all HIOs, which may inhibit scalability of the model.

HUB MODEL

The hub model is intended to address the scalability shortcoming of the point-to-point approach by introducing a lightweight engine to facilitate the processing and routing of ADT messages. Rather than each HIO creating local rules to positively identify a state code or zip code in order to properly route a message (as in the point-to-point model), each HIO would only maintain a single rule, which would effectively say "if the state code (or zip code) does NOT equal my local state code, then send the ADT message to the routing hub." The routing hub is a basic rules engine that maintains a cross-walk of state/zip codes to the HIOs that serve those regions. Using Delaware as an example, the Delaware Health Information Network (DHIN) would maintain a rule that says an ADT with a state code other than "DE" will be sent to the hub. When the hub receives the ADTs, it will evaluate if the state or zip code has a correlated HIO in its routing tables. If yes, the hub will route the message to that entity. Because the HIO is sending outbound ADTs to the hub for any non-local patient, messages will be sent to the hub for patients for whom their "Home HIO" is not participating (or does not exist). In that case, if the hub does not have a destination for the ADT in its routing tables, the message would be terminated. This is a critical principal of this model: *data does not persist in the hub*. However, if a new HIO were to join, the existing HIO participants would not need to modify their rules to route to the new entity because they were already sending all non-local ADT messages to the hub. As in the point-to-point model, all patient identity management functions are managed at the local HIO level.

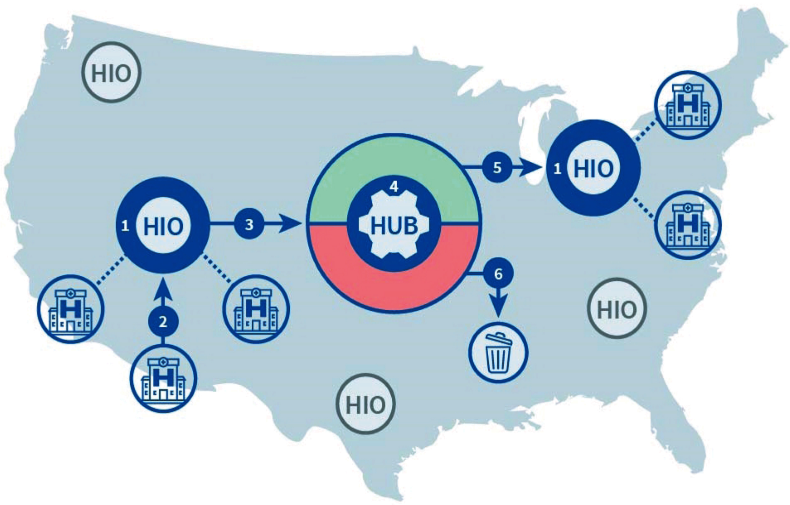

Figure 2 Hub Model

Transaction Steps

1. Visiting and Home HIOs pre-establish routing rules indicating that any ADT received that does not match their own network's service area definition should be sent to the hub (e.g. if ADT State Code ≠ MD, route to hub)
2. Visiting HIO receives an ADT from a Data Source that has a state or zip code other than its own service area
3. Visiting HIO routes the ADT to hub
4. Hub determines if state or zip code is correlated with any HIO registered in the hub
5. If there is a match, the ADT is routed to the Home HIO and no data is stored
6. If there is not a match, the ADT is terminated and no data is stored

This model still requires the coordination of facility codes among participant HIOs to ensure messages can be properly interpreted when received, unless the HIOs have agreed to normalize/standardize to a single code such as the NPI. The hub could have a natural extension to manage facility code mappings centrally so each participant could regularly update their local facility codes to reflect the latest HIO participants (and in turn their provider participants) in the hub. A natural question raised in the context of the hub model is what entity hosts and operates the hub. This topic brief does not seek to offer approaches to answer that question, though in exploring additional technical concepts for the hub model, options will begin to emerge, such as the hosting of a hub by an existing HIO on behalf of a region. Within a given region of the country, a single hub could facilitate exchange among many participating HIOs. However, from both a network resiliency and governance perspective, a multi-hub scenario could develop. In this approach, the hubs operate similarly to the internet DNS infrastructure, routing onward to the next hub when a given ADT cannot be resolved to a participating HIO at the regional hub level.

MPI QUERY MODEL

The MPI query model creates a more targeted method of routing ADTs based on the known existence of a patient identity within a given HIO. Rather than relying on the geographic data within an ADT to support routing, the MPI query model is premised on first evaluating if a patient exists within another HIO infrastructure, and if yes, routing data onward to the HIO. The technical approach relies on a central MPI that is receiving patient identity feeds from each participating HIO. This does not imply that the

HIOs are sharing MPI infrastructure, but rather participating in a cross-HIO MPI by sending a patient identity feed to the central MPI. By sending a patient identity feed to a central MPI, a cross-reference is created indicating within which HIOs a given patient has had an encounter. When an ADT is sent to an HIO, that HIO sends a query to the central MPI to determine if the patient referenced in the ADT exists in any other HIOs participating in the central MPI. If yes, the ADT message is then routed to those HIOs. If not, no further action is taken. This model inherently requires more infrastructure to maintain than the point-to-point and hub models and has the same unanswered question of what entity would run the MPI. Additionally, when patient-matching expands beyond a small geography to a larger area of the country, false positives and false negatives typically increase as well due to the cultural variation in demographics across the country.[9] The MPI model may suffer from these types of matching issues, making the model less effective.

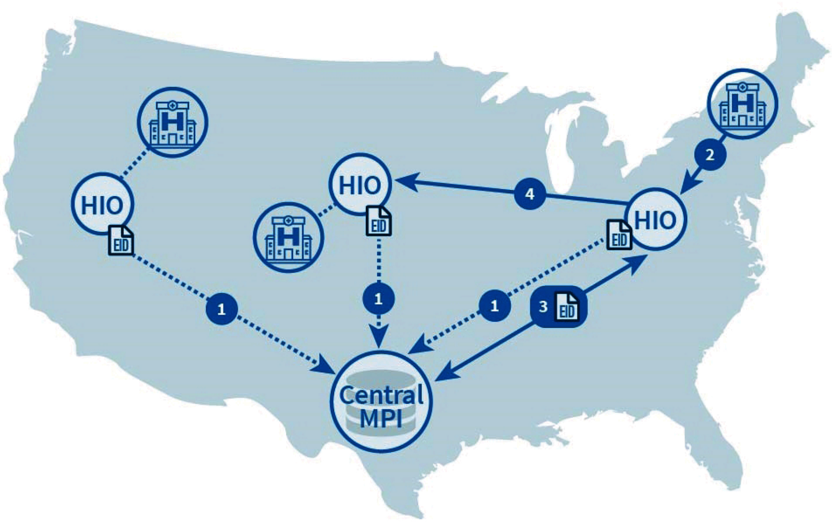

Figure 3 MPI Query Model

Transaction Steps

1. Participating HIOs send a patient identity feed to a central MPI which registers their local HIO EID for a patient
2. Visiting HIO receives an ADT from a Data Source and triggers a query to the MPI
3. Central MPI responds with any other participating HIO that have an ID for that patient
4. If patient has EIDs from other HIOs, Visiting HIO routes ADT to other HIOs
5. If patient does not have an EID within any other HIO, ADT is not routed

SHIEC PATIENT CENTERED DATA HOME (PCDH) APPROACH

The PCDH approach combines aspects of the technical models above to enable inter-HIE data sharing. The SHIEC-supported PCDH transaction flow begins with geography-based routing by evaluating the patient's state or zip code within an ADT message. Similar to both the point-to-point and hub models, the ADT (filtered based on ADT transaction type) is pushed to the destination HIO. However, distinct from those models, the originating HIO unique patient identifier (i.e. the unique ID produced by the local MPI, sometimes also called an Enterprise ID or "EID") associated with the subject patient is

[9] Patient Identification and Matching Report. Genevieve Morris, Greg Farnum, Scott Afzal, Carol Robinson, Jan Greene, and Chris Coughlin. February 2014. https://www.healthit.gov/sites/default/files/patient_identification_matching_final_report.pdf

included in the ADT message. By including the unique/enterprise identifier, the recipient HIO can in turn enable additional transactions beyond the initial ADT data sharing. Specifically, sending the unique ID is designed to support a subsequent query from the recipient HIO back to the originating HIO to pull a summary of care (a C-CDA if available). The initial PCDH ADT transaction could be enabled through either a point-to-point model or hub model. The subsequent query transaction requires pre-arranged configuration of potential HIO sources to be queried and requires a point-to-point connection between the HIOs sending and receiving the query.

Figure 4 PCDH Model

Transaction Steps

1. Visiting HIO receives an ADT from a Data Source that has a state or zip code in the patient's home address that matches the Home HIO's service area
2. Visiting HIO assigned the Visiting HIO's EID to the message
3. Visiting HIO send the ADT to Home HIO
4. Home HIO adds the patient to their MPI with the Visiting HIOs EID assigned as an alias for the Visiting HIE data source
5. Confirmation ADT with Home HIO EID is sent to Visiting HIO
6. Visiting HIO adds patient to their MPI with the Home HIO EID assigned as an alias for the Home HIO data source

Considerations

The descriptions above offer a high-level overview of how these models can support exchange of basic but valuable encounter data among HIOs serving different regions of the country. This overview, however, sidesteps a number of unavoidable complexities and nuances that must be addressed in any practical implementation. Some of these challenges are core building block issues that are true of any health data sharing effort. Other questions are more strategically important if these models are to mature towards a more cohesive nationwide solution for facilitating diverse data exchange services. The questions below are offered as an initial set of discussion points that highlight important topics relevant to an on-going emphasis on inter-HIO ADT data sharing initiatives.

COEXISTENCE AND INTEGRATION OF MULTIPLE MODELS

As each of the above models is deployed, and new models emerge, it is important to consider the myriad ways in which models can converge to create hybrids, which may be more conducive to the unique needs of each state. Such integration of models may be necessary in developing a reliable nationwide model for data exchange. Identifying what would prevent each model from independently thriving while still enabling cross-HIO connectivity among them, reveals that most of the models are quite similar with variation around the edges. Three of the models in particular -- point-to-point, the hub model, and the PCDH approach -- all have a basic set of similarities.

To demonstrate this point, consider a point-to-point and hub model seeking to enable ADT sharing between them. Further assume that each cohort of HIO participants is committed to remaining within their current ADT-exchange models. In order to facilitate this exchange, each HIO participating in the point-to-point model would need to add a rule for each of the HIOs participating in the hub model. Assuming the HIOs are committed to the point-to-point model, this should be feasible (though not necessarily the most efficient). In order to receive data from the hub model participants, the hub would add the state and zip codes and their associated end-points to the hub routing logic, thereby enabling the outbound flow of ADTs directly to each of the point-to-point participants. Additional coordination would be necessary to share facility name /Object Identifier (OID) information to ensure each receiving HIO could properly process inbound ADT messages, but it would follow the same underlying approach as establishing the base connectivity.

Folding in the PCDH model essentially incorporates an incremental step of adding a unique ID to the outbound ADT to enable further services beyond the initial ADT routing. A participant in either the point-to-point or hub model would need to modify their ADT to include such an identifier as an incremental technical step. Rather than simply routing from the interface engine level, a transaction to the "Visiting HIO" MPI to retrieve the HIO-level ID is necessary. This step is ultimately not overly complex, but as stated above, does represent an additional step to achieve integration. To receive an ADT from a PCDH model participant, no additional step is necessary beyond adding the PCDH participants to a hub or locally as a data source for point-to-point model HIOs, assuming the appropriate agreements are in place. Those HIOs could simply ignore the Unique ID provided in the ADT from PCDH participants until such a time they determined it was worth processing / relying on for additional services.

Finally, the MPI query model may be trickiest to integrate with other models because it departs from the geography-based routing method. Because the routing begins by first hitting a central MPI, the other models may have to make significant departures from their models in order to receive data from any of the MPI query model HIOs. Alternatively, routing rules could be created within the MPI that would allow HIOs following the point-to-point or hub model to connect with HIOs using the MPI query model. Generally, because the barriers to participation are considerably low for most of these models, a given HIO could reasonably participate in multiple models if it were in their strategic interest.

IDENTITY MANAGEMENT / VOLATILITY

Models in which an HIO-level master identity is shared externally must account for the concept of identity volatility over time. Generally, an MPI within an HIO links different identity sources (e.g. individual, hospitals) to a master identifier comparing the demographic data from each source system to determine if the local identities should be linked by a master identifier. As described above, this master identifier or link point is sometimes called an enterprise identifier (EID) within the HIO. This EID can be thought of as an umbrella ID linking any local IDs across data sources within the network, but an EID is not always a static value. As the sources contributing to an EID composition change or update over time, occasionally the EID and the local identifiers associated with it can change as well. There are many factors that influence this volatility of an identifier. For example, when an existing record within a given source system in a network is updated (consider, for instance, if a patient has a second encounter and their phone number or address is updated), the closing or widening of the data gap with records from other source systems can incur an EID change. Imagine two records that are not currently linked, each with its own respective EID. One of the records is updated in the source system at a hospital, which triggers a message to the HIO. Because of the update, the records are now similar enough that the scoring allows for them to automatically link. A similar scenario can occur when two entities that are initially linked become unlinked due to a data change. The MPI within an HIO will typically “retire” or remove one of the EIDs and preserve the other. Similar discarding of an EID can occur after manual intervention (i.e. an individual manually reviews the records and determines whether they should match or not), when two records do not meet the automatic threshold for linking or delinking, but are possible candidates. Any inter-HIE data sharing method must consider the identity volatility concept.

POTENTIAL FOR BROADER EXCHANGES AND USE CASES WITHIN MODELS

ADT-based inter-HIE data sharing represents a substantial opportunity to enable increasingly valuable and more sophisticated HIE services. By pursuing a basic set of data exchange capabilities, connectivity, and relationships, these models are better positioned to establish future, value-add services. The PCDH pilot has already created a model for facilitating additional services, such as querying for clinical data from the Visiting HIO. Additionally, a host of further point of care, care management, public health, and other uses could become possible. For example, rather than query for a full clinical document, Fast Healthcare Interoperability Resource (FHIR) protocols could be invoked to pull targeted content back from a given Visiting HIO to satisfy more explicit use cases.[10] From a public health standpoint, routing rules and nodes could be established for disease surveillance or forwarding of content to specialized registries. Like many data exchange initiatives, demonstrating the ability to work collaboratively and successfully is an important foundation on which to achieve on-going progress.

[10] FHIR protocols allow for the query of individual data elements from a patient’s record, rather than querying for a full document. See https://www.hl7.org/fhir/index.html for more information on FHIR.

Additional Core Considerations

PREFERRED NOTIFICATION TYPES FOR EXCHANGE TO MINIMIZE ALERTING FATIGUE

With more than 50 different types of ADT messages in HL7 2.5.1, it is unlikely than an HIO would want to send and receive all 51 types to use for notifications.[11] For example, an A03 message is important to notify providers when a patient is discharged; however, depending on the use case, other message types could also be important. For the basic use case of notifying a PCP that a patient visited the hospital and requires follow-up or will be sent to an outpatient service such as a rehabilitation organization, the A03, A09, and A07 (Change an inpatient to an outpatient) message types are sufficient. A similar use case is notifying a PCP that a patient was admitted to the hospital, so the PCP can provide timely information or even visit their patient at the hospital. For this use case, the A02 and A06 messages may be very useful. If an HIO is pursuing a use case that notifies caregivers that a loved one is in the ED in real-time, an A04 (Register a patient) message would be necessary. Likewise, if a practice provides a service of visiting their patients while admitted to the hospital, an A01 (Admit/visit notification) message would be able to notify the practice that the patient was admitted to the inpatient services so they could schedule a time to visit. Many HIOs have indicated that the A08 message can be useful for multiple purposes, including: an updated and final diagnosis code and making changes to a subscription/panel list. Outside of these message types, most of the remaining ADT messages, while valuable within a health system, could become white noise for providers or caregivers. HIOs should consider focusing on A03, A09, and A07 messages and then moving to additional message types as additional use cases are implemented, and as allowed based on the messages their participants are able or willing to send.

NOTIFICATION CONTENT

Each ADT message type requires the same four segments be included: message header (MSH), event type (EVN), patient identification (PID), and patient visit (PV). All other segments in each message type are optional. Organizations do not always follow the HL7 specification and may eliminate even required fields like PV. In many cases HIOs will still accept the ADTs, though some HIOs are considering not accepting ADTs from other HIOs that do not have specified fields.[12] Alternately, organizations often include additional fields that are optional in the HL7 ADT specification. For example, in the A03 message, organizations often send the diagnosis (DG), and additional demographics (PD1). In the A01, A04, and A07, organizations often send the allergy information (AL) and insurance information (IN). The DG segment would be especially helpful to have for notifications to PCPs and LTPACs, though caregivers may be less interested in the diagnosis, particularly since the diagnosis often changes from when a patient is admitted as compared to discharged. As noted earlier, for inter-HIO alerting, a number of HIOs are considering rejecting ADT messages that do not have a minimum set of required data fields. In such cases, an HIO can either reject the ADT and send an acknowledgement message back to the HIO indicating the ADT was rejected or simply delete the ADT message

[11] See Appendix A for a list of the ADT message types.

[12] Based on conversations with the grantees, a number are considering this requirement.

NOTIFICATION TRANSPORT METHODS

There are multiple methods for delivering notifications to PCPs, LTPACs, and caregivers. The methods chosen will most likely depend on the sophistication level of the receiver's technology, the number of staff members a facility has designated for care management, and whether the receiver will have access to additional clinical data about a hospitalization, above and beyond the ADT notification. For example, if the HIO is notifying caregivers or family members in real-time that a patient is in the hospital, a secure text message with basic information such as which hospital the patient is at would likely make the most sense, so that the caregiver or family member can meet the patient at the hospital.

When sending notifications to a practice, the HIO will need to take into account technology and staffing levels. Some practices are strong users of EHRs and have developed workflows for incorporating Direct messaging into their practice. For these organizations, Direct messages that contain either real-time information or a list of all discharges for a particular day make the most sense. However, some practices have not fully implemented Direct messaging workflows, and depend more heavily on electronic faxes that contain a list of notifications. Some practices may not elect to receive notifications in their system at all or have not implemented an EHR (particularly in the LTPAC space) and prefer to use Secure File Transport Protocol (sFTP) methods or a website to review all notifications. If practices want to receive more detailed clinical data about a visit, i.e. a summary of care, Direct messaging options might make the most sense, since an HIO can include a summary of care in the Direct message or a link to the HIO to query for the summary of care. This method also allows ambulatory providers to meet Meaningful Use and Merit-based Incentive Payment System (MIPS) requirements.[13] All of these transport methods work. It depends on the practice receiving notifications which works best. HIOs should consider providing more than one transport method, so that they can support all practices with notifications.

[13] Meaningful Use and the Advancing Care Information category of MIPS have a measure that requires eligible providers/eligible clinicians to send a summary of care electronically when transitioning or referring a patient to another setting of care.

Conclusion

There is a certain fatigue and skepticism that accompanies new and ambitious data sharing initiatives, especially when those initiatives are nationwide in scale. Most of the industry's skepticism is rooted in the challenges faced by these efforts to date. However, there is reason to have measured optimism. As described above, the simplicity of many of the models suggest that enabling inter-HIO ADT sharing is practically accomplishable. Indeed, many efforts around the country have validated that point to be true. But, while independently valuable, the intent of enabling these basic data flows is to lay the foundation for broader clinical data sharing. These efforts establish the connectivity and relationships (and the associated trust) necessary to take the next step and begin pushing clinical documents over the same framework or leverage query protocols as is described in the PCDH model or a hybrid hub/MPI model. Ultimately, as nationwide scalability of these models becomes ever more pressing, it is likely that multiple models for enabling inter-HIO data exchange will coexist.

Appendix A: ADT Message Types

A01	Admit/visit notification
A02	Transfer a patient
A03	Discharge/end visit
A04	Register a patient
A05	Pre-admit a patient
A06	Change an outpatient to an inpatient
A07	Change an inpatient to an outpatient
A08	Update patient information
A09	Patient departing - tracking
A10	Patient arriving - tracking
A11	Cancel admit/visit notification
A12	Cancel transfer
A13	Cancel discharge/end visit
A14	Pending admit
A15	Pending transfer
A16	Pending discharge
A17	Swap patients
A18	Merge patient information
A19	QRY/ADR - Patient query
A20	Bed status update
A21	Patient goes on a “leave of absence”
A22	Patient returns from a “leave of absence”
A23	Delete a patient record
A24	Link patient information
A25	Cancel pending discharge
A26	Cancel pending transfer
A27	Cancel pending admit
A28	Add person information
A29	Delete person information
A30	Merge person information
A31	Update person information
A32	Cancel patient arriving - tracking
A33	Cancel patient departing - tracking
A34	Merge patient information - patient I
A35	Merge patient information - account only
A36	Merge patient information - patient ID and account number
A37	Unlink patient information
A38	Cancel pre-admit

A39	Merge person - patient ID
A40	Merge patient - patient identifier list
A41	Merge account - patient account number
A42	Merge visit - visit number
A43	Move patient information - patient identifier list
A44	Move account information - patient account number
A45	Move visit information - visit number
A46	Change patient ID
A47	Change patient identifier list
A48	Change alternate patient ID
A49	Change patient account number
A50	Change visit number
A51	Change alternate visit ID

Appendix B: Infrastructure Models Comparison

Complexity	Legal Approach	Governance	Scalability	Cost
1) Low complexity 2) Interface engine routing	1) HIO-to-HIO agreements. 2) Individual agreements could vary based on HIO-to-HIO negotiation.	1) Decisions pertaining to ADT exchange are determined between each HIO in a given 1-to-1 relationship.	1) Local HIO routing rules-management makes national scalability challenging.	1) Generally low cost and basic interface engineering work. 2) Vendor fees could drive cost up. 3) Legal fees may vary based on how many concepts are addressed in the agreements.
1) Low complexity for HIO participants 2) Moderate complexity to develop and manage the Hub	1) HIO to HIO agreements can be relied upon but must include many uniform conditions. 2) Standard multi-HIO agreement could be relied upon to uniformly govern participant relationship.	1) Multi-HIO Governance process is required to make decisions affecting all hub participants.	1) Highly scalable based on single routing rule enabled by each participating HIO.	1) Lowest cost for HIO in that only one routing rule created. 2) Low to Moderate cost for establishing and maintaining a hub. 3) Uniform agreement should reduce legal expense over time.
1) Increased complexity based on the need to route MPI query transactions	1) Uniform Participation Agreement between HIO and entity managing MPI	1) Multi-HIO Governance process is required to make decisions affecting all hub participants.	1) Limited scalability based on the need for a central MPI.	1) Moderate cost for establishing and testing MPI transaction sets. 2) Uniform agreement should reduce expense.
1) Low complexity for the basic approach of geographic routing 2) Increasing complexity as enterprise Identifier (EID) and document query is included	1) PCDH Agreement	1) Multi-HIO Governance process is required to make decisions affecting all hub participants.	1) Scalability s dependent on whether a hub or point-to-point approach is used.	1) Basic approach of routing is low cost. 2) Adding eMPI data and enabling query functions create moderate expense.