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# Architectures and Transport Mechanisms for Health Information Interchange of Clinical EHR Data for Syndromic Surveillance

A Report from the International Society for Disease Surveillance



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### Disclaimer

This work is supported by contract number 200-2011-41831 to ISDS from the Division of Informatics Solutions and Operations, U.S. Centers for Disease Control and Prevention (DISO/CDC). Its contents are solely the responsibility of the authors and do not necessarily represent the official views of DISO/CDC or ISDS.

## 1. Introduction

A health information interchange architecture (HIIA) defines the attributes of a data sharing relationship between two parties. In the context of electronic syndromic surveillance (ESS), this refers to the standards, tools, and means to securely transport an ESS message from a sender (typically an Electronic Health Record, or EHR, system from a healthcare provider) to a recipient (typically a public health agency). The HIIA must support the set of business processes defined for ESS in the 2011 ISDS *Final Recommendation: Core Processes and EHR Requirements for Public Health Syndromic Surveillance Report*<sup>1</sup> and function with the available infrastructures both within public health and the larger healthcare system.

In support of national efforts to modernize and enhance health information system interoperability for public health purposes, this report seeks to clarify electronic health information interchange requirements for public health syndromic surveillance by providing:

- An assessment of various health information interchange architectures for their ability to meet syndromic surveillance business requirements (See Appendix);
- A comparison of potential data transport mechanisms; and
- Recommendations for data transport to support Meaningful Use implementation

Historically, data sharing for electronic syndromic surveillance (ESS) has been accomplished by a variety of direct network connections between a provider system and a public health agency, typically over the Internet. This report considers existing strategies for data sharing and others given the evolution of the broader health data interoperability environment. With the advent of Meaningful Use and the continuing development of the Nationwide Health Information Network (NwHIN), additional requirements have been placed on data interoperability that affect feasible options for its implementation.

## 2. Background

HIIA is just one component of a larger ESS system architecture that encompasses a number of components, from data extraction (typically from the source system), to transport and security (the subject of this document), data transformation and normalization (typically performed at the destination system), and data analysis (typically performed by the public health agency), as illustrated in Figure 1.<sup>2</sup>

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<sup>1</sup> International Society for Disease Surveillance. (2011, January). *Final Recommendation: Core Processes and EHR Requirements for Public Health Syndromic Surveillance*. Available online: [www.syndromic.org/projects/meaningful-use](http://www.syndromic.org/projects/meaningful-use)

<sup>2</sup> For a more thorough review of PHSS system architectures see Lober WB, Karras B, Trigg L. Information System Architectures for Syndromic Surveillance. MMWR. 2004;53 (Supplement):203-208. Available at: <http://www.cdc.gov/mmwr/preview/mmwrhtml/su5301a37.htm>.

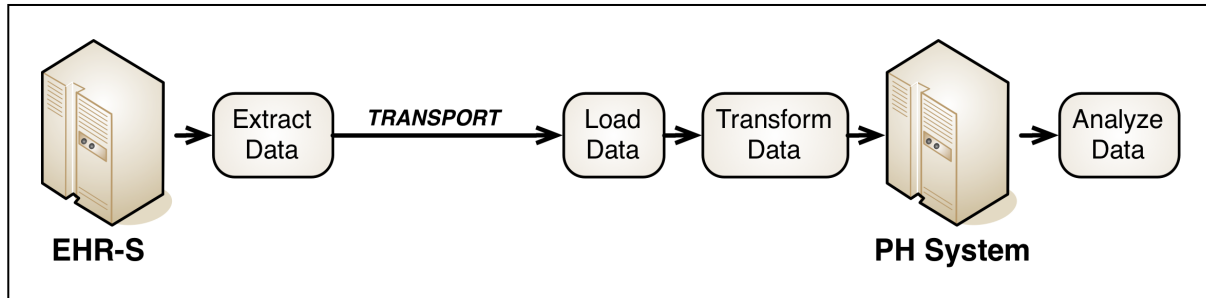


Figure 1: Basic ESS Process Flow

An HIIA and its associated transport and security methods are largely independent of the data being transported, as well as the method used to extract the data from the source system or analyze it once received. An HIIA may encompass data transformation/normalization in some cases.

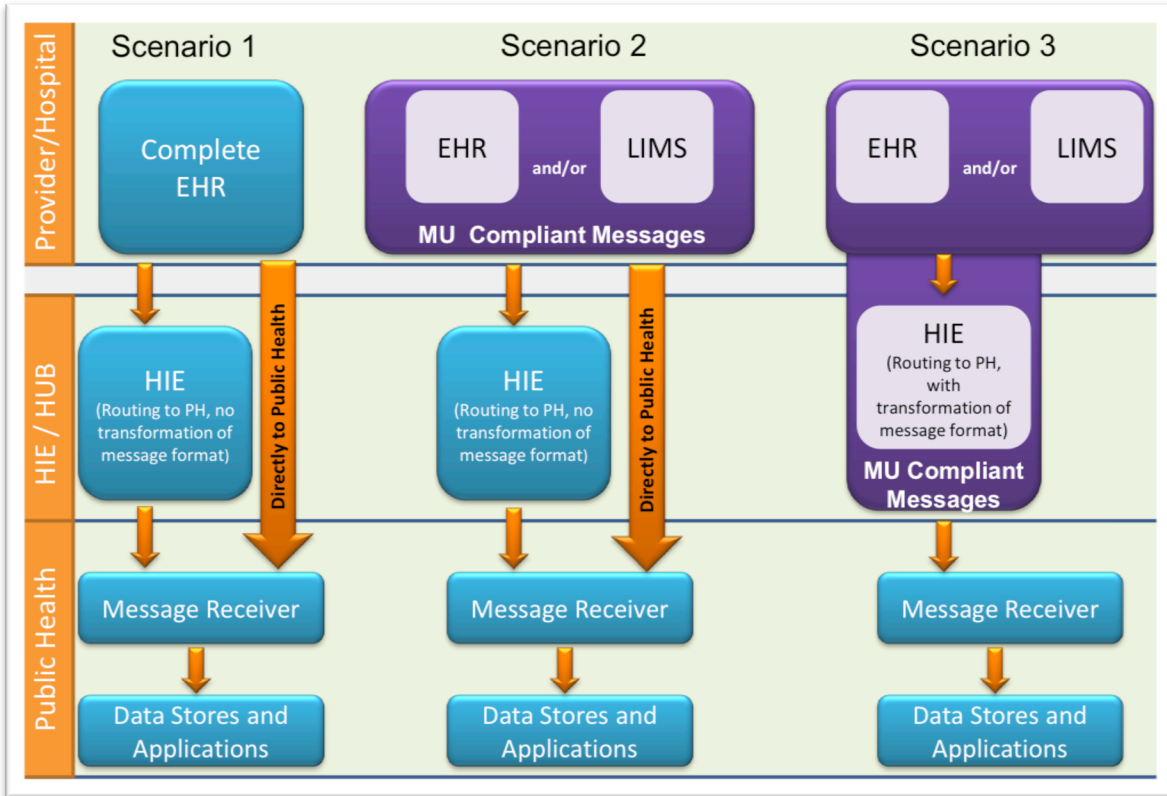
New capabilities in the health information technology marketplace affect the choices providers have for sending ESS data. Most notably, Health Information Exchanges (HIEs) provide various capabilities that support activities that are relevant to syndromic surveillance data submission. An HIE can be as simple as a pass-through for data; it can transform data that passes through it; or it can even aggregate data and prepare it for one or more purposes. Three primary scenarios are currently being used for data submission to satisfy Meaningful Use:

1. Certified EHR systems<sup>3</sup> send required information (immunization, reportable lab results, and/or syndromic surveillance data) directly to public health agencies (the historical approach) or to a public health agency through an HIE (Figure 2, Scenario 1). If an HIE is involved, the data is merely passing through the HIE with no transformation or alteration. The HIE provides the opportunity for the provider to support a single data exchange connection and the HIE routes data to other destinations (including public health) on behalf of the provider.
2. In some circumstances, the necessary information is not contained in the EHR system but rather in an ancillary system; for instance, hospital lab results are often stored in a Laboratory Information Management System (LIMS). In this case, the ancillary system must also become a certified EHR module since a submission of data made directly from such a system will *not* meet Meaningful Use requirements without this certification (Figure 2, Scenario 2).
3. A provider site also may not be able to extract the data in the format required for Meaningful Use. This can occur if the EHR system does not support the proper HL7 format or prefers to extract clinical documents (like Continuity of Care Documents, or CCDs), which are not appropriate for public health Meaningful Use measures. In this case, an HIE could provide services, such as data format translation and message generation, and transport the data to public health on behalf of the clinical site. As before, the HIE would need its

<sup>3</sup> <http://healthit.hhs.gov/portal/server.pt?open=512&mode=2&objID=3120>

software certified in order for these facilitated transactions to meet Meaningful Use (Figure 2, Scenario 3).

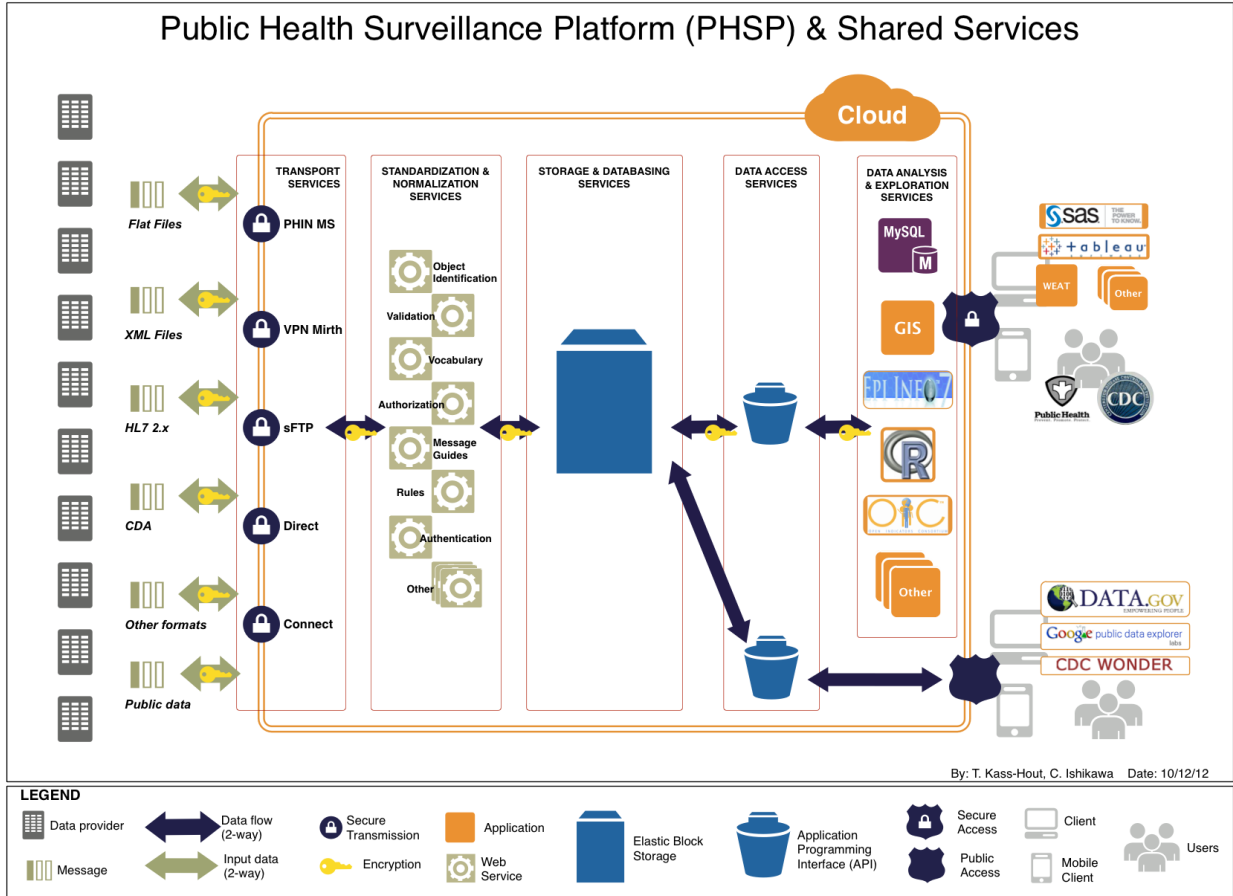
The scenarios are illustrated in Figure 2. Note that any of the provider/hospital-based systems can be deployed locally or remotely in a cloud-based solution (Software as a Service; SaaS, or Platform as a Services, or PaaS).



**Figure 2:** Models of Data Transport Under Stages 1 and 2 Meaningful Use

For this Architecture Assessment, it is expected that one or more of the scenarios in Figure 2 will be relevant. Scenario 1 will likely apply more to smaller practices and ambulatory clinics, and Scenarios 2 or 3 are possible for larger clinics or hospitals, depending on the data selected for submission. The more that data comes solely from EHR systems, the more likely it is that Scenario 1 will apply to larger sites as well. If data comes from ancillary systems, then the other scenarios will become more relevant. In cases where the HIE aggregates data, ESS submissions may come from this aggregated source of data (rather than the provider systems that feed it) either by query from public health or by submission of data by the HIE.

Similarly, public health systems can also be deployed remotely in a cloud-based solution, as well (Figure 3). When deployed in a cloud, interoperability issues are not substantially different than deployment in local systems since the organizational responsibility is identical even though the physical deployments are different.

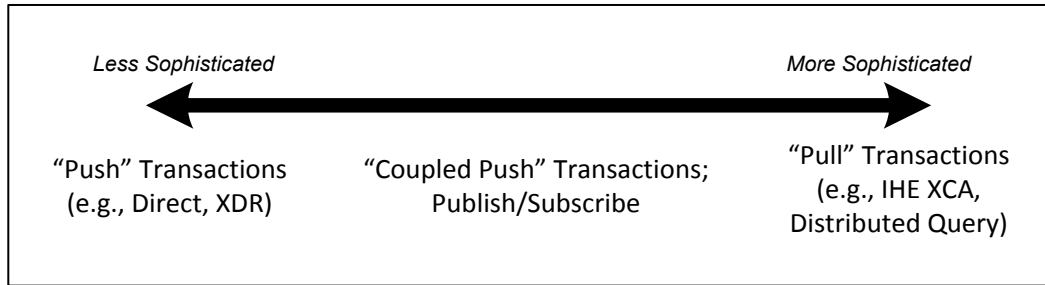


**Figure 3:** Graphic representation of a public health surveillance system deployed in a cloud-based technical environment where infrastructure, platform, and software are available as services

In August 2012, CMS released a Final Rule for Stage 2 Meaningful Use, and ONC released a corresponding Final Rule for the related standards and implementation specifications.<sup>4</sup> While no specific transport methods are prescribed for public health measures, the rule states that eligible professionals and eligible hospitals will be expected to use the transport means stipulated by the public health agency to which they report. Public health agencies should be prepared to offer appropriate reasoning to support a particular transport strategy that may be perceived as a barrier to system interoperability if it does not use one of the technologies identified in the Stage 2 Final Rule (namely Direct or SOAP-based Web Services).

There is a tension between the desire to choose the correct architecture and transport for a particular need, versus the risk that an organization will end up with too many different architectures to support. Different use cases require different architectures and different styles of data transport from “push” transactions where the data provider is responsible for pushing the data out to “pull” transactions whereby the burden of getting the data is on the receiver (Figure 4).

<sup>4</sup> <http://www.healthit.gov/policy-researchers-implementers/meaningful-use-stage-2-0>



**Figure 4:** HIE Transaction Continuum

This may force some necessary compromises simply to reduce the number of protocols and strategies being used, such as a decision to use a more sophisticated technology for a relatively simple task (e.g., using SOAP-based web services merely to carry a uni-directional immunization report to public health), or trying to use a simpler technology for a more sophisticated task (e.g., using a pair of asynchronous Direct messages to simulate a query/response).

### 3. Assessment Objectives

The objectives for this Health Information Interchange Architecture Assessment are to:

- Identify and assess major HIAs currently used for Syndromic Surveillance reporting in the United States;
- Identify and assess existing health information interchange models and architectures currently supporting (or planning to support) similar types of transactions, including other public health reporting (e.g., immunization data submission and electronic laboratory reporting) and other electronic data exchanges (e.g., laboratory results delivery, referral from primary care physicians to specialists); and
- Determine the capability of each architecture model to support the defined business processes and critical tasks of electronic syndromic surveillance as detailed in the 2011 ISDS *Recommendations*<sup>5</sup> and expanded upon in the 2012 *Recommendations*<sup>6</sup> documents; including the data elements defined for electronic syndromic surveillance using clinical data.

### 4. Methods

To describe a variety of technical architecture models for both electronic syndromic surveillance using clinical data and other similar transactions, personnel working with systems representing the range of different HIA architectures were selected for interviews from the following sources:

<sup>5</sup> International Society for Disease Surveillance. (Jan 2011). *Final Recommendation: Core Processes and EHR Requirements for Public Health Syndromic Surveillance*. <http://www.syndromic.org/projects/meaningful-use>.

<sup>6</sup> International Society for Disease Surveillance. *Electronic Syndromic Surveillance Using Hospital Inpatient and Ambulatory Clinical Care Electronic Health Record Data: Recommendations* from the ISDS Meaningful Use Workgroup. 2012. Available online: <http://www.syndromic.org/meaningfuluse/IADData/Recommendations>.

- States identified through ONC's State-level Health Information Exchange (HIE) Cooperative Agreement Program;<sup>7</sup>
- States identified by CDC (including the BioSense team), ISDS, and HLN that can demonstrate a useful approach to public health reporting or health information interchange; and
- States recommended by ISDS Meaningful Use Workgroup Members and community stakeholders.

Once the sample set was identified, telephone interviews were conducted with states/projects to collect descriptive information about the health information interchange strategy used for syndromic surveillance or other similar transactions. In some cases, national webinars had been scheduled that covered the required material, so those events were used to collect data.<sup>8</sup>

## 5. Results and Conclusions

The following observations and conclusions can be made with respect to the data that was collected:

1. Public health reporting for electronic lab reporting (ELR) and syndromic surveillance (ESS) is currently conducted primarily by hospitals and other large organizations whose technical infrastructure and organizational capabilities are generally robust. Immunization reporting is more characteristic of smaller sites with far less developed technical and organizational infrastructures. These are represented by scenarios 1 and 2 in Figure 2. The appropriate strategies for ESS for outpatient settings will likely draw from the experience of *both* of these methods (*i.e.*, ELR and Immunization reporting practices).
2. Existing hospital connections to public health have often been in place for many years and are typified by virtual private network (VPN) connections that support a number of protocols, including SFTP, MLLP, HTTPS POST. PHINMS is established, but few, if any, new installations are being planned. SOAP-based web services (especially for bi-directional exchange) and Direct (for uni-directional exchange) are not yet widely used but are on the rise (scenarios 1 and 2 in Figure 2). These strategies are plotted in Figure 5 on subjective scales of technical maturity (completeness of development and length of time deployed in general production), and practical adoptability (ease of adoption based on solid documentation, reference implementations, and stability of the product).

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<sup>7</sup> [http://healthit.hhs.gov/portal/server.pt/community/state\\_health\\_information\\_exchange\\_cooperative\\_agreement\\_program/1336/home/16375](http://healthit.hhs.gov/portal/server.pt/community/state_health_information_exchange_cooperative_agreement_program/1336/home/16375)

<sup>8</sup> <http://www.syndromic.org/webinars/meaningfuluse>



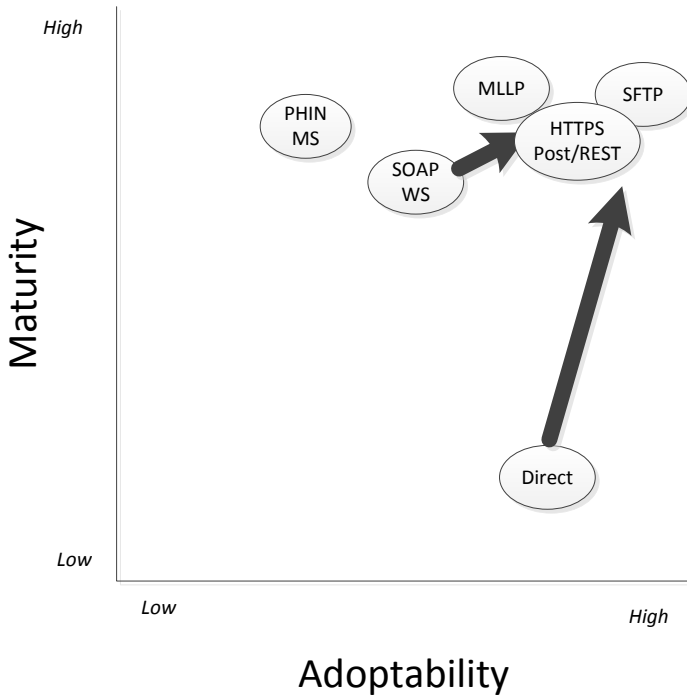


Figure 5: Technology Spectrum

Method	Description
Direct	Simple, secure, scalable, standards-based way for participants to “push” encrypted health information directly to known, trusted recipients over the Internet
HTTPS POST/REST	Common form of transport used by web browsers to send data to web services
MLLP	Relatively simple form of message transport over TCP/IP
PHINMS	CDC-created strategy for public health data exchange
SFTP	Internet standard for point-to-point interactive or “batched” secure file transfer
Web Services	SOA-based strategy for enabling two systems to interoperate securely

- While most public health reporting relationships exist directly between public health agencies and the reporting provider or hospital, HIEs have begun to intermediate in public health reporting services (scenario 3 in Figure 2). HIEs usually support these relationships by relying on existing means of connectivity. Many HIEs rely on proprietary vendor protocols delivered over VPN connections. Some HIEs provide value-added services (such as semantic coding or message filtering), while others simply transport the data from source to destination.
- The various transport options represent different levels of *administrative* scalability. MLLP over a VPN, for instance, requires deployment of a secure, point-to-point connection. SFTP and web services require credentials to be assigned--but not much more. Direct requires knowledge of the recipient’s Direct address (and perhaps digital certificate), while PHINMS allows communication with *any* PHINMS user once a CDC-assigned certificate is received. This is another consideration aside from any *technical* differences between these approaches.

Since different use cases require different strategies, no particular transport strategies should be mandated at the Federal level for public health data submission at this time. The history and character of the organizations involved in an HIE project also need to drive the choices that are made. While compatibility with *de facto* or emerging standards is important, HIEs are in a good position to provide the necessary gateways and translations for their members. It may be instructive to review the deliberations and conclusions of the CDC-convened Immunization Information Systems (IIS) Transport Layer Expert Panel (referenced

above), which struggled with many of these issues. The primary drivers for their selection were the suitability of the transport for bi-directional interoperability, the ability of IIS to implement the protocol, *and* the expectation that EHR system vendors could implement the protocol, as well.

A variety of mature, simple transport strategies are available for *pushing* data to public health agencies. Many of them, however, require configuration by a software vendor to embed the transport in the workflow of the EHR system. As an example, Direct is a relatively simple protocol that can often be implemented “out of the box” by an EHR system vendor and/or Health Information Services Provider (HISP).

As local, regional, and state Health Information Organizations (HIO) continue to develop their infrastructure, there will be increasing opportunities to leverage this infrastructure particularly for small health data providers. Many states are also concentrating their connectivity options to the provider community through a single state gateway or portal. This trend will likely increase, providing even more opportunities to leverage connections for simpler, less costly, and less redundant data exchange to public health agencies.

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**ISDS Mission**

*ISDS works to improve population health by advancing the science and practice of surveillance to support timely and effective prevention and response. We facilitate interdisciplinary collaboration, and promote and conduct research, education, and advocacy.*

## 6. Appendix

**Table:** Summary of mechanisms<sup>9</sup> used to transport public health surveillance data examined for this report

Name of Strategy	Brief Description of Interchange Attributes	Data Transformation/ Normalization Attributes	Role of HIEs	Advantages	Disadvantages	Standards in Use
Direct	Simple, secure, scalable, standards-based way for participants to “push” encrypted health information directly to known, trusted recipients over the Internet.	None	Can vary. HIEs can serve as Health Information Service Provider (HISP) to enable/facilitate communications or providers can subscribe to market-based services. Some states provide these services as well. Important thing is to participate in a trust domain with intended data exchange partners.	<ul style="list-style-type: none"> <li>• “Push” model supports SS paradigm well</li> <li>• Strong ONC support leading to broad adoption</li> <li>• Can support many different payloads</li> <li>• Supports integration into EHR systems or standalone interfaces (e.g., web portal or e-mail client)</li> <li>• Explicitly mentioned in Stage 2 NPRM</li> </ul>	<ul style="list-style-type: none"> <li>• Actual adoption not yet widespread</li> <li>• States require HISP infrastructure, via contracted services or internal IT support</li> <li>• Does not readily support message acknowledgment</li> </ul>	<ul style="list-style-type: none"> <li>• SMTP/MIME</li> <li>• IHE XDR (optionally)</li> <li>• PKI</li> </ul>
HTTPS POST/ REST	Common form of transport used by web browsers to send data to web services	None	None	<ul style="list-style-type: none"> <li>• Fairly simple to implement</li> </ul>	<ul style="list-style-type: none"> <li>• Sender and receiver need to agree on payload structure which is likely to be non-standard</li> </ul>	<ul style="list-style-type: none"> <li>• HTTP</li> <li>• SSL/TLS</li> </ul>
MLLP	Relatively simple form of message transport over TCP/IP	None	None	<ul style="list-style-type: none"> <li>• Simple, easy to implement</li> </ul>	<ul style="list-style-type: none"> <li>• No security features – requires VPN for security</li> </ul>	<ul style="list-style-type: none"> <li>• TCP/IP</li> <li>• SSL/TLS</li> </ul>

Name of Strategy	Brief Description of Interchange Attributes	Data Transformation/ Normalization Attributes	Role of HIEs	Advantages	Disadvantages	Standards in Use
PHINMS	CDC-created strategy for public health data exchange	None	May be an intermediary or connection maybe directly between the source and ultimate destination of the data	<ul style="list-style-type: none"> <li>• Implemented and supported by PHAs in a number of states, especially with hospital partners</li> </ul>	<ul style="list-style-type: none"> <li>• Complex to implement, especially for small organizations</li> <li>• Future of product uncertain</li> <li>• Few EHR-S vendors have experience with it</li> </ul>	<ul style="list-style-type: none"> <li>• ebXML</li> <li>• SSL/TLS</li> </ul>
SFTP	Internet standard for point-to-point interactive or “batched” secure file transfer	None	None	<ul style="list-style-type: none"> <li>• Simple to use; no firewall or network transmission issues</li> <li>• Secure and encrypted</li> </ul>	<ul style="list-style-type: none"> <li>• Most implementations use Interactive clients while goal is for a more user-transparent experience</li> </ul>	<ul style="list-style-type: none"> <li>• SFTP</li> </ul>
Vendor-defined Protocol over VPN	Software or hardware based method for securing a channel between two organizations	None	Common strategy for HIE connectivity to larger organizations especially	<ul style="list-style-type: none"> <li>• Engineered for reliability, security, and high-volume</li> <li>• Can support any type of payload</li> <li>• Well accepted by provider organizations, especially larger ones</li> <li>• If used, edge servers improve performance and allow participating organizations to retain autonomy and control</li> </ul>	<ul style="list-style-type: none"> <li>• Requires careful coordination to set up</li> <li>• May require digital certificate for authentication</li> <li>• May be difficult for smaller organizations to implement</li> </ul>	<ul style="list-style-type: none"> <li>• IPSec</li> <li>• SSL</li> <li>• PKI or dynamic certs</li> </ul>

Name of Strategy	Brief Description of Interchange Attributes	Data Transformation/ Normalization Attributes	Role of HIEs	Advantages	Disadvantages	Standards in Use
Web Services	SOA-based strategy for enabling two systems to interoperate securely	May be included as a companion service	May be an intermediary or connection maybe directly between the source and ultimate destination of the data	<ul style="list-style-type: none"> <li>• Becoming more favored by EHR system vendors</li> <li>• Secure, flexible, and powerful; supports same security features as HTTPS POST plus additional features of WS-Security and SAML assertions</li> <li>• Basis of both IHE and NwHIN implementations</li> <li>• Explicitly mentioned in Stage 2 NPRM</li> </ul>	<ul style="list-style-type: none"> <li>• Data payload defined by a WSDL document which may or may not be standard</li> <li>• May be somewhat complex to implement</li> </ul>	<ul style="list-style-type: none"> <li>• SOAP</li> <li>• SSL/TLS</li> <li>• XML</li> <li>• NwHIN CONNECT</li> </ul>