Background

In 2015, AIRA launched an Interoperability Testing Project to determine the level of alignment between current Immunization Information Systems (IIS) and the community's interoperability standards. The project is heavily informed by IIS Functional Standards[1] and Operational Guidance Statements. The testing process connects with IIS pre-production systems directly where possible, and submits sample messages to these IIS development platforms. Transport Assessment is the first official measurement area for IIS Assessment, a measurement and quality improvement process designed to assist IIS in more closely aligning with standards. The baseline measure was taken in Quarter 3 of 2016. This is the first remeasurement – for all phases of assessment, re-measurements are planned every quarter.

When any two systems connect to exchange data, they must use an agreed upon transport layer to connect. To this end, a CDC-led expert panel was tasked with selecting a transport layer and defining a technical specification. In 2011, the panel selected SOAP and defined a formal specification commonly referred to as the "CDC WSDL."[2]

This report contains the testing conformance results of the community's CDC WSDL implementation where it was installed and where AIRA was able to connect with test systems. The conformance testing utilized the National Institute of Standards and Technology (NIST) Immunization Test Suite Validation Tool. This tooling provides consistent conformance based results for all participants.

This report provides information for IIS jurisdictional use for improvements and internal distribution as needed. AIRA will not redistribute any individual IIS results outside of their respective jurisdiction and self-selected sharing settings within the Aggregate Analysis Reporting Tool, or AART.[3]

Conformance Tests

An Advisory Workgroup of IIS community members and partners crafts the measures and tests for IIS Assessment.[4] Message transport[5] is assessed with three measures:

Measure 1: The IIS supports the Connectivity Test Operation as defined in the SOAP Standard Interface 1.2 specification, Web Services Definition Language (WSDL), as endorsed by CDC.

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[1] http://www.cdc.gov/vaccines/programs/iis/func-stds.html
[2] http://www.cdc.gov/vaccines/programs/iis/technical-guidance/soap/services.html
[3] http://ois-pt.org/dqacm/home
[4] http://www.immregistries.org/resources/aira-initiatives/assessment/measures
[5] http://www.immregistries.org/events/IIS_Assessment_Measures_and_Tests_-_Transport_-_final.pdf

Measure 2: The IIS supports the Submit Single Message Operation as defined in the SOAP Standard Interface 1.2 specification, Web Services Definition Language (WSDL), as endorsed by CDC.

Measure 3: The IIS supports the Security Fault as defined in the SOAP Standard Interface 1.2 specification, Web Services Definition Language (WSDL), as endorsed by CDC.

The *Connectivity Test* operation is a "ping-like" feature that allows EHRs and other sending systems to perform a simple test with an IIS to verify the two systems can at least "see" each other without having to worry about the semantics of HL7 and/or authentication.

The *Submit Single Message* operation is the primary function of the CDC WSDL designed to carry an HL7 V2.x message, along with the authentication (username, password, facility ID) parameters to make data exchange possible.

The *Security Fault* shall be thrown by the IIS if the initiating system fails to authenticate. (e.g., when a bad username password combination occurs).
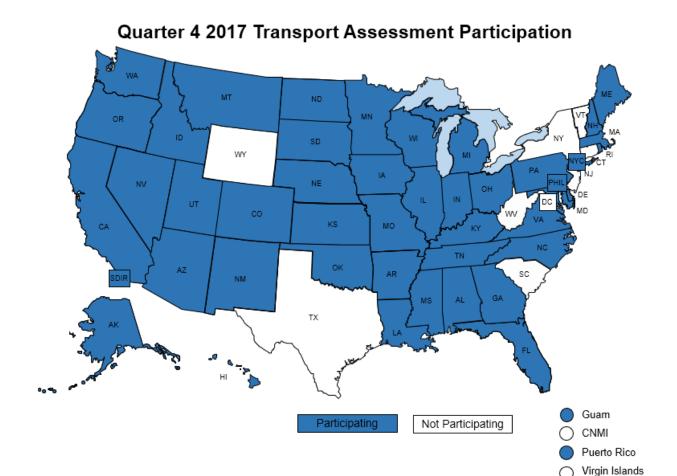
Conformance Results

The following table highlights the possible results of each of the conformance tests in the above descriptions. If any of the conformance tests failed, then further details were outlined in individual reports with individual site results. If an IIS conforms with the standard specified above, it is reported as "Fully Meets" for a specific test. "Deviates from Standard" occurs when an IIS was close to meeting the standard, but has work to do to fully meet the standard. An IIS that "Does Not Meet" the standard may have substantially changed the CDC WSDL or chose not to implement the entire CDC WSDL.

Connectivity Test	Submit Single Message	Security Fault
Fully Meets	Fully Meets	Fully Meets
Deviates from Standard	Deviates from Standard	Deviates from Standard
Does Not Meet	Does Not Meet	Does Not Meet

Summary Results

58 IIS (which includes all 50 states, plus CNMI, D.C., Guam, New York City, Philadelphia, Puerto Rico, San Diego, and the Virgin Islands[6]) were encouraged to voluntarily participate in the IIS Transport Assessment. Of the 58, 47 IIS opted to participate in the IIS Transport Assessment for the snapshot measure in quarter 4 of 2017. This is an increase of 7 IIS over the initial baseline measurement in quarter 3 of 2016.

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[6] Note that the six Pacific Islands were not initially targeted for measurement due to limited transport technology. As capabilities and participation expands, Pacific Islands will be included in this report.

Quarter 4 2017 Transport Assessment Participation

[Map of the United States showing Transport Assessment Participation. Most states shaded as "Participating" (blue). States shown as "Not Participating" (white): WY, TX, WV, SC, VT, NY. Legend: Participating (blue), Not Participating (white). Territories: Guam (filled), CNMI (empty), Puerto Rico (filled), Virgin Islands (empty).]

Of those 47 IIS participating in the transport baseline measure, 37 had a SOAP Web Services/CDC WSDL end point available for testing. This is an increase of 16 IIS since the baseline measurement in quarter 3 of 2016. Specific results for each test were as follows:

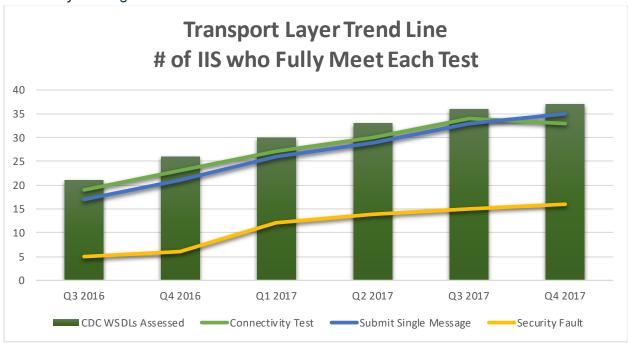| Connectivity Test	Submit Single Message	Security Fault
33	35	16
1	1	13
3	1	8

Of the 37 IIS with a CDC WSDL end point available for testing:
- 16 IIS met all three tests, and thus met the measure overall.
- 16 IIS met two out of three tests, with all 16 cases missing the security fault test. It is important to note that the 16 IIS that passed all measures except the Security Fault are interoperable with the CDC WSDL standard as long as the correct authentication parameters are sent. For this reason, these sites are functionally compatible for production use when authentication succeeds, but improperly indicate authentication failure through the use of the Security Fault.
- Four IIS met one out of three tests.
- One IIS met zero out of three tests.

Finer details on the testing results where IIS deviated or did not meet the standard can be seen in Appendix A.

The next snapshot will take place in Quarter 1 of 2018, and we hope to show increases in both participation and in IIS who fully meet measures and tests for transport. Participation settings can be updated in AART at any time.

Summary of Progress

Since the initial baseline measurement in quarter 3 of 2016, the following progress has been seen:

- **Aligned with CDC WSDL specification:** 16 IIS have a fully compliant WSDL. This is 11 more than the baseline.
- **Nearing Alignment:** 16 additional IIS meet two of the three tests and are likely interoperable in production. This is 4 more than the baseline.
- **Known CDC WSDL implementations:** 37 IIS have a CDC WSDL implementation. This is 16 more CDC WSDL implementations since the baseline.
- **Assessment participation:** 47 IIS are participating in Transport Assessment. This is 7 more IIS since the baseline.
- **Updated resources:** AIRA and CDC have refreshed their CDC WSDL content to be easier for EHR and IIS to use and align with.

Limitations of Report

One limitation is noted in this report. This report is based on conformance requirements that align fully with the standard, but it is not meant to suggest IIS can't achieve interoperability outside of this standard. For example, many IIS do not meet conformance on the Security Fault test, but this does not imply the IIS is unable to interoperate using the Submit Single Message operation when authentication passes. It specifically means the IIS does not conform to the CDC WSDL when throwing a Security Fault during authentication failure. However, full conformance to standards

across the IIS and EHR community will smooth interoperability and speed onboarding going forward.

General Recommendations for All IIS

1) Review conformance test results and work to improve areas of non-conformance. In doing so, it is important to consider if the changes to conform will break existing connections. If the changes will break existing connections, it may be better to leave the existing non-conformant connection operational and provide a new endpoint which conforms with the CDC WSDL. This will provide an easy and natural transition strategy to the conformant CDC WSDL as new and existing providers/EHRs develop or upgrade their interfaces.
2) Utilize conformance tooling provided by NIST when developing and/or improving implementation of the CDC WSDL. The tooling can aid the software development process. The tool is located at https://hl7v2-iz-r1.5-testing.nist.gov/iztool/#/home and is free to use without installation or registration.
3) Publish and make available all transport layer requirements for use by potential trading partners. Almost all IIS publish their HL7 guide, but only a limited number publish their transport layer requirements for use by trading partners prior to beginning the on-boarding process. Waiting until on-boarding may delay or unnecessarily burden the on-boarding process. The earlier a trading partner can access the requirements; the better chance they have at developing to the requirements.
4) Consider sharing your Assessment results in AART with others including EHRs. This can be helpful for as they prepare to exchange with your IIS. Sharing settings can be set in AART.

Questions and/or Comments

Please direct questions and/or comments on this aggregate report to the AIRA Technical Assistance Team.

Appendix A

The following appendix provides the specific details on the reasons why assessment participants either deviated from or Did Not Meet the CDC WSDL standard across the three tests. In some cases, an IIS may have more than one reason they deviated or didn't meet the test.

Connectivity Test

Deviates from Standard	Does Not Meet
(One IIS) Required Authentication: One implementer modified the CDC WSDL by adding WS-Security[7] to their Connectivity Test requirements. The Connectivity Test defined by the CDC WSDL does not require authentication as it is designed to be a "ping-like" test to verify to systems can "see" each other. While using WS-Security is based on standards, it is different than the definition of the CDC WSDL. Sending systems would be required to adhere to WS-Security requirements to successfully exchange data.	**(Three IIS) Changed Request and Response Construct:** This IIS modified the request and/or response construct of the connectivity Test operation. This varied from changing the operation name to adding parameters to changing the return construct to be different than the CDC-defined connectivity test. The functional requirements are the same, but are implemented technically different.

Submit Single Message

Deviates from Standard	Does Not Meet
(One IIS) Authentication Differences: One implementer modified the CDC WSDL by adding WS-Security to their WSDL requirements. The authentication parameters defined by the CDC WSDL were ignored in favor of a different way to perform security. While using WS-Security is based on standards, it is different than the definition of the CDC WSDL. Sending systems would be required to adhere to WS-Security requirements to successfully exchange data.	**(One IIS) Changed Response Construct:** One implementer modified the response (e.g.: information being returned) construct of the XML ever so slightly, but not based on any understood business requirements. The CDC WSDL returns information (e.g.: the ACK or the RSP) in an XML element called *<return>*. This implementer renamed this from *<return>* to something like *<submitSingleMessageResponse>* or *<hl7Response>* with the same technical requirements. This change results in non-conformant XML with unexpected XML tags for the initiating system.
(One IIS) Base64 Encoding/Decoding: One implementer requires the HL7 message (VXU or QBP) be base64 encoded. Further, the response (ACK or RSP) will be returned base64 encoded and will need to be base64 decoded. While base64 encoding/decoding is based on standards, it is different than the definition of the CDC WSDL.	

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[7] https://en.wikipedia.org/wiki/WS-Security

Sending systems would be required to base64 encode submissions (VXU or QBP) and base64 decode return messages (ACK or RSP) to have meaningful communication between two systems.	

Security Fault

Deviates from Standard	Does Not Meet
(13 IIS) Non-Conformant Fault: The IIS throws a fault as required by the standard, but the fault thrown by the IIS does not conform to the fault defined by the CDC WSDL.	**(Eight IIS) Does Not Throw a Fault:** The IIS properly catches an authentication failure, but returns the authentication failure where only HL7 responses are supposed to be returned rather than throwing a SOAP fault dedicated to authentication failures.