Query Response Workflow Functionalities Catalog

IIP Collaborative Multiple Match Query Workgroup

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Background

In February 2020, the [Immunization Integration Program](#) (IIP) Executive Committee identified four areas of focus from over 30 prioritized issues for improving immunization interoperability, information sharing and management. The collaborative selected a workstream to address standardized workflow, messaging and business rules related to multiple patients found in the IIS in response to a query. Queries to an immunization information system (IIS) for a patient may result in a variety of responses. To address these issues a workgroup was formed to discuss challenges and develop potential solutions. Upon the first workgroup meeting, it became apparent that in addition to reviewing multiple match candidates, clinicians have similar challenges when reviewing low confidence matches with single match candidates. Both outcomes are communicated using the same type of HL7 message (profile Z31, return list of candidates), include patient identifiers and demographics but exclude immunization histories and forecasts. Therefore, the workgroup's scope expanded to include "inexact matches"— both those with multiple match candidates and those with a single low confidence match candidate. In addition to inexact matches, a query to an immunization information system (IIS) may return a single high confidence match, no matches, too many matches or a match to a patient's record that may not be returned due to a protection status.

The handling of query responses indicating inexact matches remains inconsistent and can result in the inability of clinicians to provide accurate immunization recommendations. Inexact matches also add burden to provider workflow as re-query is required to obtain a patient's immunization history and forecast. This ultimately impacts the effectiveness of patient care. For both responding systems (typically IIS) and querying systems (typically electronic health record (EHR) systems), failure to efficiently manage inexact match candidates and correctly match patients can result in gaps and, in certain situations, errors in a patient's immunization history. For example, if the provider initiates a query that results in a single or inexact match, the provider may not be able to re-query with additional match information. Either the data is not available or obtaining more data may cause unintended burden. As a result, the accurate history or history and forecast may not be available at the time of the visit. In other cases, if inexact patient matches are returned and the EHR lacks the ability to manage them, the EHR responds as if no patient was found, slowing down the provider workflow.

Approach to Solution Development

The recommended approach for investigating this issue includes convening a workgroup of volunteers with various technical expertise representing EHR developers and vendors, IIS, public health organizations, and other key partners and experts to identify possible solutions. The IIP Multiple Match Query Workgroup was guided by the IIP Executive Committee with additional support from the IIP Technical Council. The primary goal of this workgroup was to assess the current state and gain agreement on recommendations to improve the way in which inexact patient matches from a query to an IIS are handled among clinicians and clinical software systems (e.g., EHRs, pharmacies, etc.). This document will not specifically cover IIS to IIS query-response as it does not involve a provider-initiated query.

The following document identifies the potential query outcomes a provider may be faced with and the actions they may need to take for each situation. The IIP Multiple Match Query Workgroup in collaboration with the American Immunization Registry Association (AIRA), Healthcare Information and Management Systems Society (HIMSS), Centers for Disease Control and Prevention (CDC) and Drummond Group developed a catalog of functionalities that both EHRs and IIS could support to guide healthcare organizations to actions that lead to the best possible patient care. For the purposes of this catalog "healthcare staff" will be used to represent team members with specific roles and responsibilities within the various scenarios presented. These roles include but are not limited to front desk/registration, HIM administrator, operations/product manager, MA, RN, MD, NP, PA, etc.).

The Multiple Match Query Workgroup represents individuals from EHR vendors/developers, IIS and IIS vendors. Due to the makeup of the workgroup, certain perspectives (e.g., health information exchange, school health, etc.) were not captured within this document; however these perspectives are important and will be discussed further in the "Future Work and Considerations" section of the catalog.

Queries for immunization information may be triggered when an EHR user presses a button to search for a patient's immunization information or may be triggered automatically by an event (e.g., a patient makes an appointment). In some cases, multiple events may trigger a query, for example, each time a patient checks in, is transferred to another facility or a procedure is ordered. Multiple trigger events that initiate excessive queries are not discussed in detail within this document. This solution addresses methods to improve available information to support such automated queries resulting in exact matches. This project scope does not address workflow steps to limit potentially excessive queries sent to an IIS for the same patient.

It is recognized that different EHR systems react to multiple/inexact match responses in various ways and that not all EHRs provide support for re-querying of the IIS when a single high confidence patient is not returned. This guidance catalog aims to provide critical functionality that vendors can work towards developing and implementing to address this issue. The Multiple Match Query Workgroup product also includes a [Query Response Aggregate Measurements document](#) for assessing query responses. The aggregate measures document includes ways for determining how best EHRs and IIS can identify areas of concern when analyzing their query response data and also the ability for organizations to know and understand their current status and optimize any changes based on the findings. The workgroup focus was not to eliminate multiple/inexact matches, but rather for both documents to improve awareness and provide guidance to healthcare organizations for handling these occurrences in hopes of reducing burden, streamlining workflows and positively impacting patient care.

Workflows and Functionalities

A typical clinical workflow may include sending a request to a jurisdiction's IIS to obtain past immunization data and information for a patient. The following workflows represent possible scenarios a provider may be presented with and the intended actions when presented with multiple matches. The actions presented are manual processes (e.g., provider triggers

immunization history reconciliation, adds information to the patient's demographics). Based on this, the following EHR/IIS functionalities could be considered to support these actions.

Potential Scenarios

This list references scenarios associated with the suggested functionalities in the preceding section. See the appendix for visuals (linked) for reference.

S1: No patient is returned in the query response

The healthcare staff member may assume that the IIS has no history available for clinical care based on the information submitted with the query. Either the patient is new to the IIS, the query content is insufficient, there is an error present in the query that prevents it from being processed by the IIS or the patient's records are not accessible within the IIS. Possible healthcare staff member actions include:

- Proceed with patient care without patient immunization data (history/history & forecast) from the IIS
- Override specific areas of the query parameters in the response and re-query the IIS
    - This override would occur where an update in the EHR would not be appropriate. The healthcare staff member assumes that a re-query containing the additional and/or updated demographics present in the return candidate will result in the IIS sending the patient immunization history. For example, if a clinic has a woman's married name on file but wants to query the IIS with her maiden name, without replacing her name in the EHR with her old one.

S2: Single patient returned in the query response

The IIS returns either a single high confidence match with the immunization history or a low confidence match Z31 (return candidate clients) without immunization history, which could be due to insufficient information in the original query. The possible healthcare staff actions include:

- Single High Confidence
    - Confirm that the returned patient is correct
    - Reconcile patient's immunization history from each query to the single patient record in the EHR and proceed with clinical care
        - Healthcare staff agrees that high confidence match is correct and reconciles the data
    - Add the IIS patient identifier to the patient demographic data to ensure validity of future queries
- Single Low Confidence
    - Proceed with patient care without patient immunization data (history/history & forecast) from the IIS
    - Notify the IIS that match presented is incorrect
    - Re-query IIS using some/all of patient information from the initial query response
        - The provider assumes that a re-query containing the additional and/or updated demographics present in the return candidate will result in the IIS sending the patient immunization history

- ○ Override specific areas of the query parameters in the response and re-query the IIS
  - This override would occur where an update in the EHR would not be appropriate. The provider assumes that a re-query containing the additional and/or updated demographics present in the return candidate will result in the IIS sending the patient immunization history. For example, if a clinic has a woman's married name on file but wants to query the IIS with her maiden name without replacing her name in the EHR with her old one.

*The provider further assumes that a re-query containing the additional and/or updated demographics present in the return candidate will result in the IIS sending the patient immunization history.

S3: More than one patient returned in the query response; single correct patient is present

The possible provider actions include:
- Proceed with patient care without patient immunization data (history/history & forecast) from the IIS
- Re-query IIS using additional patient demographics from the initial query response
- Confirm demographic data with the patient and, if appropriate, add the IIS patient identifier to the patient demographic data or send notification to practice administration system to update demographics within EHR; re-query using updated demographics

S4: More than one patient returned in the query response, however none can be confirmed as the right patient

The possible provider actions include:
- Proceed with patient care without patient immunization data (history/history & forecast) from the IIS
- Notify the IIS that matches presented are believed to be incorrect; notification mechanism should be confirmed with the IIS until a standard is established to address this workflow

S5: More than one patient returned in the query response, and potential duplicates for the correct patient are present

The possible provider actions include:
- Proceed with patient care without patient immunization data (history/history & forecast) from the IIS
- Notify the IIS that duplicates may exist within the returned list of potential matches; notification mechanism should be confirmed with the IIS until a standard is established to address this workflow
- Generate multiple queries based on data from the response message; reconcile immunizations (as appropriate) after receiving responses
  - ○ Alternatively, the provider may contact the IIS to confirm these are the same patient and add the IIS patient identifier data from each match, as appropriate; merging of patients may need to occur

Functionalities

The following functionalities in Table 1 were listed based on workgroup discussion and prioritized based on utility; however, these should be prioritized based on vendor and provider discretion and organizational needs. The preceding section gives an in-depth description for each functionality.

Priority Definitions

High – EHRs should have the capability to perform these functionalities, regardless of cost (minimal viable product)

Medium – These functionalities would offer utility and EHRs may have the capability, but might require additional technology enhancements (Developers should evaluate the cost vs. utility)

Low – These functionalities may be feasible to implement. They are not currently part of the standard or would require additional training and software development from the EHR vendor and offer limited utility (Cost may exceed utility)

Table 1: Functionality Priorities

Functionality	High	Medium	Low
EHR gives end user the ability to proceed with care without immunization data from an IIS	✔		
EHR allows end user to update demographics within patient chart	✔		
EHR allows for manual re-query to IIS based on updated demographics in the EHR	✔		
EHR allows end user to reconcile patient immunization history to patient chart – link to summary	✔		
EHR allows for re-query using demographics from Z31 (what the IIS sent the EHR) rather than only data from EHR	✔		
EHR allows end user in the receiving system to confirm that the returned patient is correct; positive ID (Single high confidence match		✔	
EHR can generate multiple queries based on data in the query response message and associate with the same patient record to re-query the IIS		✔	
EHR allows for reconciliation of demographic data to patient chart			✔
EHR allows for end user to send feedback to IIS if matches presented are incorrect or if duplicates may exist (e.g., ADT feed or direct message application)			✔

Functionality: EHR gives end user the ability to proceed with care without immunization data from an IIS

Currently in place	Associated Scenario(s)	Benefits	Challenges	IIS Functionality
Yes, based on confirmation from 3 EHR vendors	S1 S2 S3 S4 S5	• No delay in patient care • Reduce provider burden for obtaining information	Misses existing immunization history and/or forecast	NA

Functionality: EHR allows end user to update demographics within patient chart

* The provider can manually go to the demographic section and add details seen in the IIS response

Currently in place	Associated Scenario(s)	Benefits	Challenges	IIS Functionality
Yes, based on confirmation from 3 EHR vendors. However most likely to be completed during registration or check-in	S1	Effective component in health information exchange	User viewing response may not have ability to update demographics	NA

Functionality: EHR allows for manual re-query to IIS based on updated demographics in the EHR	

Currently in place	Associated Scenario(s)	Benefits	Challenges	IIS Functionality
Yes, based on confirmation from 3 EHR vendors	S1 S2	• Receiving requested immunization data • Provider is able to update patient's chart as indicated • Provider has ability to trigger a re-query • Effective patient care continues	User data entry errors, such as entering incorrect or misspelled demographic information, or correct information on the wrong patient	IIS accepts the re-query based on updated demographics including the use of the IIS SR ID

Functionality: EHR allows end user to reconcile patient immunization history to patient chart	

*While the scope of this workflow is to reconcile (import) new or updated immunization history from the returned message to the patient's record, some EHRs also send doses that may be missing in the response to the IIS as VXU messages.

Currently in place	Associated Scenario(s)	Benefits	Challenges	IIS Functionality
Confirmed by 3 EHR vendors	S2	• Available during clinical care • Better access during future visits • Ability to verify with patient during appointment	Historical data that is presented may be from an unreliable source (e.g., historical information from parent's recall or written record)	NA

Functionality: EHR allows for re-query using demographics from Z31 (what the IIS sent the EHR) rather than only data from EHR	

Currently in place	Associated Scenario(s)	Benefits	Challenges	IIS Functionality
• I EHR vendor confirms storing the SR ID (IIS/registry identifier) for use for future queries • 1 EHR vendor confirms presenting user with multiple matches and allowing for selection of the correct patient; The requery uses the demographics temporarily to increase the odds of getting a single match; Data is not stored	S2 S3	EHR increases the odds of getting a high threshold match on a re-query without having to update any demographics data in their system	• Manual data entry errors or automated capture that misreads or concatenates (shortens) the IIS identifier resulting in no subsequent match or erroneous match. • Lack of a steady static registry SR ID	IIS may perform matching using alternative means; possible deviation from default algorithm

Functionality: EHR allows end user in the receiving system to confirm that the returned patient is correct; positive ID (Single high confidence match)	

Currently in place	Associated Scenario(s)	Benefits	Challenges	IIS Functionality
• 1 EHR vendor confirms this functionality • 1 EHR vendor confirms that this is automatically done and system does give providers	S2	• Streamlining the workflow • No delay in patient care • Reduce provider burden if EHR performs the match and allows quick verification by the provider;	End user potentially selects the wrong patient from the list of inexact matches.	NA

the opportunity to verify • 1 EHR vendor confirms that this is configured at the system level	avoids the need for the provider to review more than one patient from a list

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Functionality: EHR can generate multiple queries based on data in the query response message and associate with the same patient record to re-query the IIS

Currently in place	Associated Scenario(s)	Benefits	Challenges	IIS Functionality
1 EHR confirms provider can pick from multiple matches however, SR ID is not stored	S5	Immunization history from more than one returned patient can be consolidated in a single patient record within the EHR	• End user selects the wrong patients from the list of multiple patients and includes the resulting responses in the patient's record. • The EHR software fails to update the patient record as the end user requests	IIS may perform matching using alternative means; possible deviation from default algorithm

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Functionality: EHR allows for reconciliation of demographic data to patient chart

* The EHR allows the provider to select the returned patient record and select the item to save in the patient record from the reconciliation screen and then submit. The EHR demographic data would be updated
* Relatively rare outcome as EHRs would most likely have the most up to date demographics. Many organizations have a standard for confirming or updating demographics, which often occurs during the registration process.

Currently in place	Associated Scenario(s)	Benefits	Challenges	IIS Functionality

Currently in place	Associated Scenario(s)	Benefits	Challenges	IIS Functionality
• Not currently in place • 1 EHR compares incoming demographics to what was queried (dependent on product but visible to provider); • 1 EHR displays what was returned to the end user	S2 S3	Easier access and verification for future queries	• The demographics from the IIS may not always be visible to the end user • The demographics from the IIS may not be the most current. • Demographics from query response are updated incorrectly within the EHR • To protect patient privacy, some IIS do not return demographics not originally sent from the initial query response	NA

Functionality: EHR allows for end user to send feedback to IIS if matches presented are incorrect or if duplicates may exist (e.g., ADT feed or direct message application)

*No current standard exists and may require a focus group of both EHR and IIS individuals to come up with a set of proposed mechanisms to address this.

Currently in place	Associated Scenario(s)	Benefits	Challenges	IIS Functionality
• Not currently in place • In some jurisdictions this task is currently being performed manually (i.e., the provider makes a telephone call to the IIS Helpdesk)	S2 S4 S5	• Active communication with IIS about message response results in more exact matches for future queries • Active communication with IIS about message response	• Lack of existing standard • Complications for what the triggering event in the EHR would involve	IIS can receive and follow up on message and feedback

Additional EHR Functionalities

The following functionalities are suggested as potential methods to decrease the prevalence of multiple matches, but due to their complexity would be considered for future work.

- Resolution of multiple matches from different systems; multi-jurisdictional queries
  - The Multiple Match Query Workgroup discussed a scenario in which a provider needs to search more than one IIS for existing data. A typical situation is when an individual arrives at the pharmacy near their new residence (jurisdiction A) to receive an immunization. The pharmacy must now request data from the patient's previous provider from another state (jurisdiction B). The Workgroup noted that providers practicing in adjacent jurisdictions should consider querying the IIS in their current jurisdictions and that the IIS should query the adjacent IIS to capture a full set of immunizations for such individuals. Ultimately, to avoid the need for inter-IIS queries IIS can participate in CDC's [Immunization (IZ) Gateway](#) to support the exchange of vaccine administration data across jurisdictions. Eventually CDC's IZ Gateway Provider-Initiated Multijurisdictional Data Exchange project could enable provider organizations to receive consolidated vaccination records through a single query routed to multiple IIS.
- EHR end user notifies IIS if demographics are out of date and need updating
  - The Multiple Match Query Workgroup agreed that although there is no current standard that exist, this may be considered for future purposes. This action may require a focus group of both EHR and IIS individuals to come up with a set of proposed mechanisms as there are many possible ways of doing this. One potential benefit of implementing this functionality would be to improve communication between EHR and IIS. Some remaining considerations include whether or not this would be a manual process and could this functionality be mediated by Health Level Seven (HL7) Version 2 (V2) messages. To facilitate demographic only updates, some IIS may need to be modified to support receiving VXUs that do not contain Order Group segments (ORC, RXA, RXR). There may also be considerations for using the data in the QPD (query parameter definition) to create an IIS patient.

Future work and Considerations

Although the functionalities described in this catalog typically apply at the point of care, some query-response interfaces are configured to only allow automated or bulk-query prior to a patient appointment. Such configurations may result in unresolved inexact or multiple matches. In this situation, and depending on system functionality, a staff member may be required to review the query-response outcomes for each patient's record individually to determine if an inexact or multiple match occurred. Instead, it may be beneficial for the querying system to flag these unresolved matches on an upcoming patient appointment schedule. A staff member would still be required to resolve inexact matches, but would not have to review patient records where an exact match or no match occurred.

HIE Considerations

This workgroup's effort specifically addressed multiple/inexact matches, query results and respective workflows at the point of care. The scope of this document is limited to immunization query-response using HL7 V2 messages. Future work in this area should also consider queries from

clinical data exchange intermediaries and/or non-clinical data exchange partners. For example, schools may not have the ability to send health-related identifiers and could potentially include other data elements to facilitate accurate student matches. Under the Family Educational Rights and Privacy Act (FERPA), parents and/or students must provide consent and be given the opportunity to opt-out of sending data to the IIS. The workgroup also recognized important perspectives from querying systems other than EHRs (e.g., pharmacy, long term care, etc.) that could be considered in the future. Based on the needs of the organization, these systems may be capable of implementing the functionalities described in this catalog.

While reducing the occurrence of multiple/inexact matches was not within scope for this workgroup, jurisdictions where health information exchanges (HIEs) play a key role in immunization data exchange may also offer services that improve patient matching. HIEs allow healthcare providers to have secure electronic access to vital patient information from multiple provider organizations. One of the main functions of HIEs is to link and match patient identities across disparate systems and use sophisticated deterministic, rules-based and probabilistic methods to match records. An HIE may play the role of the administrator referenced in this document to create and evaluate system approaches for improving responses to multiple/inexact match queries. The HIE may also be able to coordinate patient matching requirements for other public health, state or local interoperability requirements. Although patient matching algorithms were out of scope for the workgroup, there are HIE capabilities currently available that may support and improve patient matching with established master patient index (MPI) capabilities. For example, Maryland's statewide HIE, CRISP, accurately and consistently links identities across multiple facilities to create a single view of a patient. Evaluation of HIE capabilities may represent future work opportunities.

Conclusions/Next Steps

The Multiple Match Query Workgroup approached this effort with the goal of improving and streamlining clinical workflows to limit provider burden and to positively impact patient care to the extent possible by enabling effective queries that result in exact patient matches. The workgroup addressed EHR and IIS functionalities that might improve user workflow to increase the likelihood of exact matches and considered aggregate performance metrics to assist provider administrative staff or vendor implementer teams to identify trends and to optimize matching success. As an added approach, readers may benefit from this functionalities catalog to determine which activities might provide the most effective solution for their respective settings regarding user workflow, vendor product capabilities and IIS interoperability.

Resources

General query-response
Implementation Guide in particular: query diagrams and tables on pages 137-139 (Z34), 232-233 (Z44), page 18-19 of Appendix A

Guidance for HL7 RSP Messages to Support Interoperability

IIS Functional Guide, Vol. 1: Query and Response

Query for protected patients
Frequently Asked Question: Query Responses and Patient Protection

Query Parameter Completeness and Outcomes
Health Level 7 Web Service Search Success Rates in New York City's Citywide Immunization Registry

IIS Measurement and Improvement for Query-Response
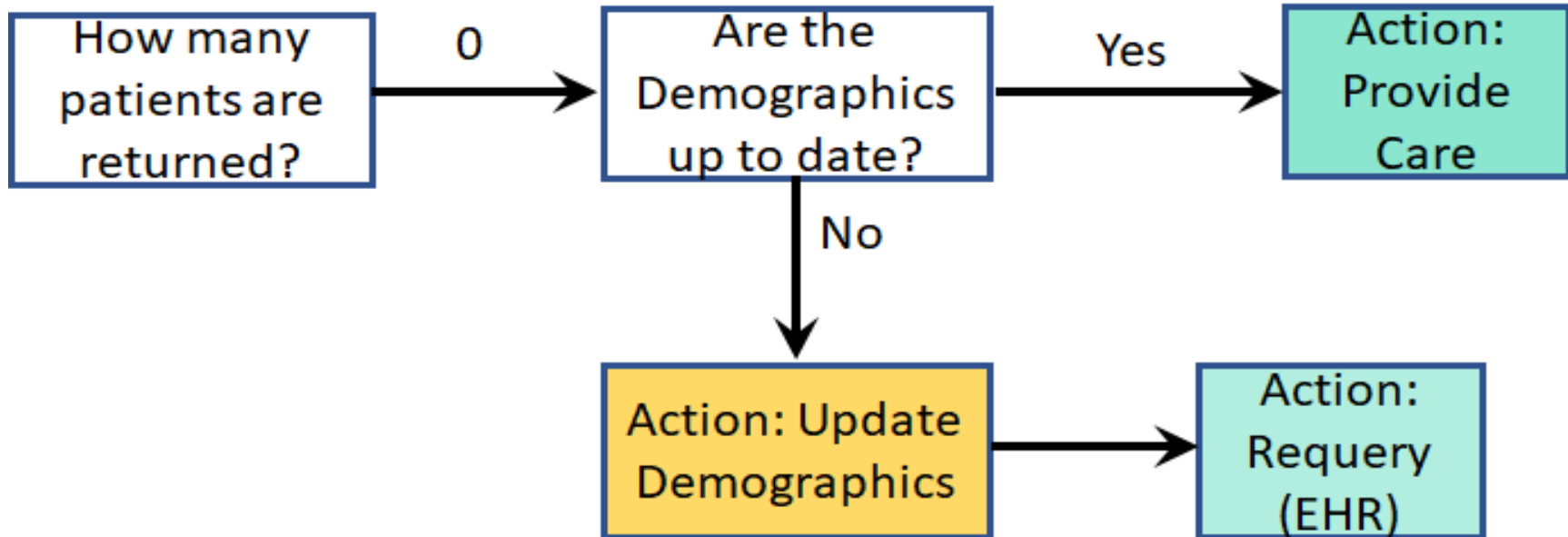
Query and Response Validation: Basic Level

Query and Response Validation: Complete Level

IIS Assessment Aggregate Status Report - Query and Response
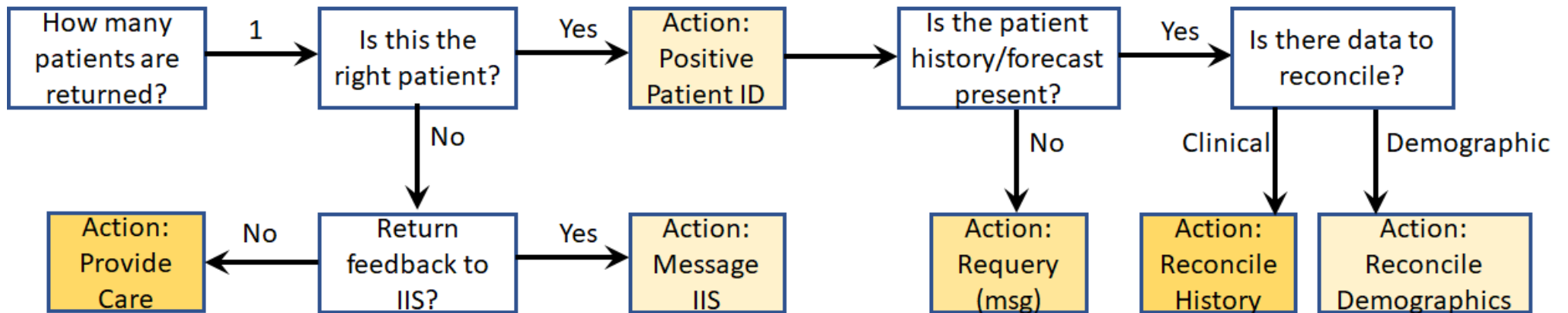
Measures and Tests for Assessment - Query and Response

Visual for S1: No patient is returned in the query response

Link to description
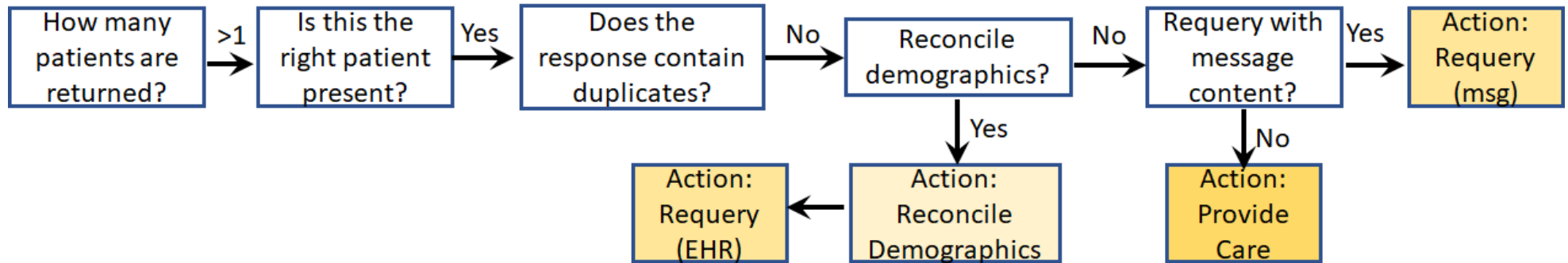
Visual for S2: Exactly one patient returned in the query response

```
How many              1      Is this the         Yes    Action:              Is the patient        Yes    Is there data to
patients are    ────────────▶ right patient? ──────────▶ Positive    ───────▶ history/forecast ──────────▶ reconcile?
returned?                                               Patient ID            present?

                              │ No                                            │ No            Clinical │        │ Demographic
                              ▼                                               ▼                        ▼        ▼
Action:         No     Return         Yes    Action:              Action:              Action:          Action:
Provide   ◀──────────  feedback to ──────────▶ Message             Requery              Reconcile        Reconcile
Care                   IIS?                   IIS                  (msg)                History          Demographics
```
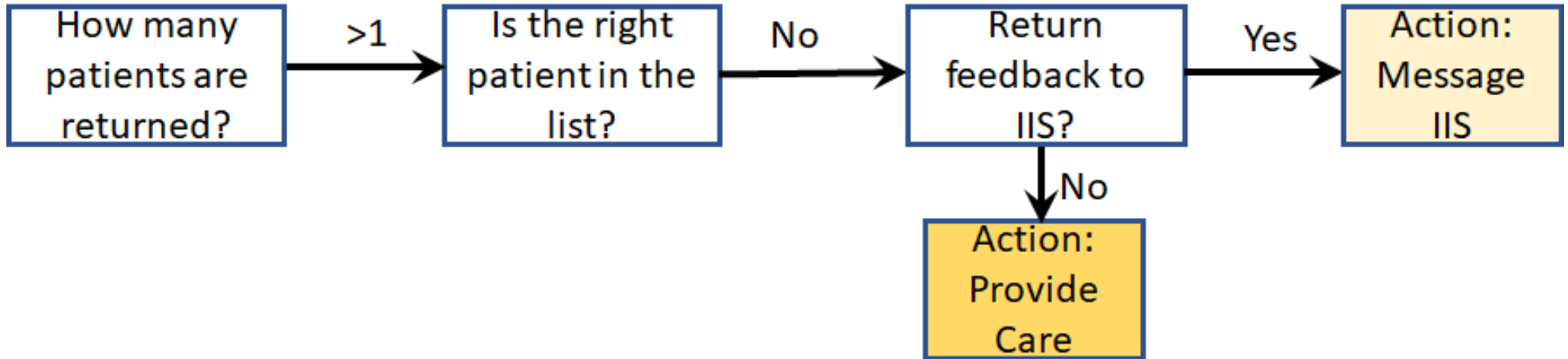
[Link to Description](#)

Visual for S3: More than one patient returned in the query response; single correct patient is present

How many patients are returned? →(>1)→ Is this the right patient present? →(Yes)→ Does the response contain duplicates? →(No)→ Reconcile demographics? →(No)→ Requery with message content? →(Yes)→ Action: Requery (msg)

Reconcile demographics? →(Yes)↓ Action: Reconcile Demographics ← Action: Requery (EHR)
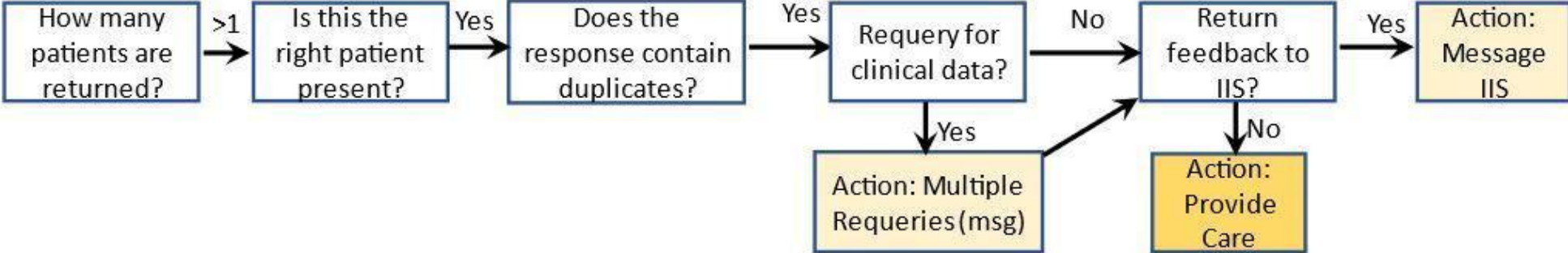
Requery with message content? →(No)↓ Action: Provide Care

Link to Description

Visual for S4: More than one patient returned in the query response; however, none can be confirmed as the right patient

How many patients are returned? →**>1**→ Is the right patient in the list? →**No**→ Return feedback to IIS? →**Yes**→ Action: Message IIS

Return feedback to IIS? →**No**↓ Action: Provide Care

Link to Description

Visual for S5: More than one patient returned in the query response, and potential duplicates for the correct patient are present

Link to Description