Query Response Aggregate Measures for Multiple Matches

IIP Collaborative Multiple Match Query Workgroup

Contents

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(Z31 profile) and 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 an 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 several patients 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 towards solution development included convening a workgroup of volunteers with various technical expertise representing EHR vendors, IIS vendors, public health organizations and other key stakeholders and experts. The IIP Multiple Match Query Workgroup members were selected and guided by the IIP Executive Committee with additional guidance from the IIP Technical Council. The primary goal of this workgroup was to assess the current state and gain agreement on possible solutions to improve the way in which inexact patient matches from a query to an IIS are handled among clinicians, clinical software systems (e.g., EHRs, pharmacies, etc.), IIS and health information exchanges (HIEs).

The IIP Multiple Match Query Workgroup in collaboration with AIRA, Healthcare Information and Management Systems Society, Centers for Disease Control and Prevention and Drummond

Group developed this aggregate measurement document for assessing query responses. Benefits to using this document include ways for determining how best EHRs and IIS can identify areas of concern when analyzing their query response data, and the ability for organizations to know and understand their current status and optimize any changes based on the findings.

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.

The Multiple Match Query Workgroup also produced a Query Response Workflow Functionalities Catalog aimed at identifying the potential query outcomes a provider may be faced with and the actions they may need to take for each situation. A list of functionalities was suggested that both EHRs and IIS could support in order to guide providers to actions which lead to the best possible patient care. The workgroup focus was not to eliminate inexact matches, but rather improve awareness and guidance for handling these occurrences.

Issue Prevalence and Impact

Obtaining estimates for inexact match rates is difficult as many health information technology systems do not retain query-response message data in a manner conducive to the type of analysis described within this guidance. Limited query-response data provided to the IIP Multiple Match Query Workgroup indicates the prevalence of inexact matches within immunization query-response interfaces vary widely. The Tennessee Immunization Information System reported that 2.34% (40,796) of query-responses for July 2021 were inexact matches. Due to policy, the New York Citywide Immunization Registry (CIR) does not return inexact matches in response to queries. Instead, it returns query-responses indicating "too many matches." In July 2021, CIR indicated that 0.8% (25,212) of its responses were "too many matches." An EHR vendor participating in the IIP Multiple Match Query Workgroup provided information across 12 different IIS jurisdictions, which varied greatly. It was reported that inexact match responses varied from 0.13% to 26.41% with a median of 1.30%. While the prevalence of inexact matches is estimated to be low, due to the large volume of queries received by IIS, this could impact millions of patients. In the most recent IIS Functionality-Volume Survey conducted by the American Immunization Registry Association ([AIRA](#)), 21 (out of 58) IIS reported receiving more than 246 million query messages in 2019.

Interfaces that support inexact match resolution require a human to evaluate if the patient's data submitted represents the same person as the match returned. This can represent a sizable investment of healthcare personnel time. Clinicians using querying system interfaces that do not support inexact matches receive 'no match' responses and they are unaware of the inexact matches identified by the responding system. Clinicians who receive inexact matches yet do not re-query after resolving a positive match do not obtain the patient's immunization history or

forecast from the responding system. Receiving a 'no match' response or failing to re-query can impact patient safety leading to patient being under or over vaccinated and contribute to a waste of resources.

Purpose of Measurement

Interfaces that have a sizable portion of inexact matches require users to spend additional time reviewing and resolving matches. Better understanding the prevalence of inexact matches and the factors that lead to them can enable activities to mitigate system issues and thus reduce the burden upon end users. While improvement in workflow functionality may reduce the number of inexact matches, lack of success is sometimes a result of a technical configuration, out-of-date or missing patient demographic data, in either the querying or responding system, which may be outside the control of end users rather than a single user error. These issues require aggregate data analysis to evaluate trends and to establish thresholds above which an organization may wish to drill down and perform root cause analysis to improve overall performance.

The ability to generate query-response metrics should be considered for inclusion within data systems which initiate (frequently EHRs), respond to (most often IIS) or pass through (frequently HIEs) queries for immunization histories and forecasts. Each of these systems and their users share responsibility for monitoring query-response performance and outcomes.

The Multiple Match Query Workgroup noted that provider organizations might not be demanding aggregate query report functionality because they do not recognize the additional workflow burden as something that might be reduced, or because they are bypassing an attempt to match and proceeding with workflow with less-than-optimal patient information. The workgroup also suggested that a report of performance analytics may also benefit clinical software vendors and implementers to evaluate the extent to which new software implementations or updates impact query response success. Such a report could also allow periodic performance monitoring to maintain expected functionality, identifying evolving challenges. Such capabilities could help with customer satisfaction and retention by enabling optimization of the query process during implementation and at periodic intervals or after product upgrades.

Performance Metrics

Below, readers will find three sets of metrics termed: "basic," "query parameter completeness" and "advanced." All include a narrative description of the metrics along with example reports. Additionally, Table 1 summarizes the basic measures, including the technical definitions. Some readers may find it helpful to begin reviewing these tables before reading the narrative below.

After further discussion, the IIP Executive Committee recognized limitations of the proposed metrics, such as the impact of duplicate queries. Therefore, additional context can be found within the "Limitations and Considerations Regarding Duplicate Queries" section. This information should be considered when developing reports featuring query-response performance metrics.

Basic

The following metrics, classified as "basic," represent the minimal functionality recommended to assess the performance of a query-response interface. This category represents a starting point and may require further analysis to identify potential root causes of match issues.

Performance metrics should, ideally, include data points captured as a result of the operational workflow processes and not require additional work on the part of software end users. However, such process data may not be readily accessible and report generators will need to ensure such data are available for analysis and provide aggregation and summary analyses. When reporting performance metrics, report developers can provide important contextual information by including the time period of analysis (e.g., May 9, 2020 – May 15, 2020) and a description of the organization or practice site evaluated (e.g., Quality Care Health Clinic). Aggregate report generators may wish to consider functionality beyond that described below that allows end-users to perform next-level analysis that identifies root causes of non-exact match outcomes (low confidence matches, multiple matches or errors) using drill-down functions.

Aggregate report developers should total the number of queries a submitting system initiated as the most basic query-response metric. Additional metrics, calculated as proportions, can be derived using queries submitted as the denominator. These proportion metrics and technical definitions are summarized in Table 1, which appears below the outlined list of metrics.

- Queries Sent
  - Number: total number of queries a submitting system (often an EHR) sent to a receiving system (often an IIS) for a specified period of time

- Query Responses Received
  - Number: total number of responses a receiving system (often an IIS) generated and sent to the querying system for the same period of time as defined in "Queries Initiated"
  - Proportion: 2a (query responses received) divided by 1a (queries sent)

    i. **Exact Matches Found –** the proportion of total responses (2a) that result in "return complete immunization history" (Z32) or "return evaluated history and forecast" messages (Z42).

Formula:

$$\frac{\text{Number of "exact patient" responses}}{\text{Number of query responses received (2a)}}$$

Technical implementation note:
- Some, especially those developing reports for responding systems, may find it helpful to examine each query type (complete immunization history and evaluated history and forecast) separately. If a system only supports one type of query, there is no need to include the unsupported query type in a report.

ii. **Inexact Matches Found -** the proportion of total responses (2a) that include a listing inexact match candidate (Z31).

Formula:

Number of "inexact patients" responses
————————————————————————————————
Number of query responses received (2a)

Technical implementation notes:

- Some responding systems do not permit sharing patient data when more than one potential match is identified. In these cases, this metric would always yield a 0% outcome; however measures for too many patients found and no patients found (defined below) should have a correspondingly higher values that seen within the responding system that do permit sharing patient data when identifying more than one potential match.
- Some responding systems respond to queries for immunization history and forecast (Z42) with candidate listings (Z31). This behavior may be purposely "beyond standard" to provide maximum flexibility to querying systems.
- It may be helpful to identify a sub-proportion of inexact match responses that only contain a single patient in the candidate listing (number of PIDs = 1)—if a sizable number of responses are single inexact matches this may warrant further investigation.
- It may be helpful to determine the average number of inexact matches presented to an end user at the provider site (i.e., PID segments for Z31 responses).

iii. Too Many Patients Found – the proportion of total responses (2a) that indicate too many patient matches were found. This situation can occur due to the patient matching limit set by the querying system (e.g., an EHR) as the "Response Control Parameter's Quantity Limited Request (RCP-2), or when the responding system (e.g., an IIS) limits the number of matches returned and responds with no matches (Z33) with response status (QAK-2): TM (too many).

Formula:

Number of "too many patients" responses
————————————————————————————————
Number of query responses received (2a)

iv. No Patients Found (NF) – the proportion of total responses (2a) that indicate the query was processed successfully but no person(s) matching the submitted query parameters appears in the responding system. (Message profile: Z33 – return response with no matches combined with query response status (QAK-2): NF (no data found))

Formula:

Number of "no patients" responses

Number of query responses received (2a)

Technical implementation note:
- Some responding systems may identify a protected patient and may choose to respond as if no patient was found. For more detail please see: https://repository.immregistries.org/resource/frequently-asked-question-query-responses-and-patient-protection/ .
    - v. Protected Patient Found -

For querying systems: the proportion of total query responses received (2a) by the querying system from responding system indicating protected patients were identified but immunization data was not provided. Please see the technical implementation notes on the next page for additional guidance.

Formula for querying systems:

Number of "protected patient found" query responses received

Number of query responses generated (2a)

Or

For responding systems: the proportion of total queries for which the responding system identifies protected patients and prevents sharing immunization data with querying system to protect patient privacy. These results may not be shared with querying systems to protect patient privacy.

Formula for responding systems:

Number of queries that matched to a protected patient

Number of queries sent (1a)

Technical implementation notes:

- This metric for responding systems uses a different denominator than other metrics (queries sent instead of responses generated) as a protected patient response may not be generated by the responding system.
- As responding systems have a variety of choices in the way they respond to queries which match protected patients, this metric may not be available to querying systems but may be available to responding systems. Please see: https://repository.immregistries.org/resource/frequently-asked-question-query-responses-and-patient-protection/ .
- Reports which disclose the number or percent of protected patients found may need to be suppressed/censored to avoid potentially identify protected patients matched by responding systems. For example, a querying system may know 99 of 100 patients queried return exact matches and the remaining patient's query returned "no patient found". If the responding system produces a corresponding report that discloses 99 of 100 queries generated an exact match and the remaining query identified a protected patient it is possible to ascertain the patient's data exists and is protect patient exists within the responding system.
- Responding systems may find this measure helpful at identifying facilities that send protected patients that are also of interest to querying systems.

vi. Structural/Technical/Content errors (i.e., those with problem outcomes) – The proportion of responses received that indicate either message rejection errors or message content/processing errors severe enough that the querying system must resubmit the query message. Structural/technical errors are communicated using message acknowledgment code of Application Acknowledgement Reject (AR). Fatal content errors are communicated using message acknowledgment code of Application Acknowledgement Error (AE) and contain an error severity (ERR-4) of error. Both types of issues are so severe enough of an error they prevent the search from successfully executing.

Formula:

$$\frac{\text{Number of query responses indicating query syntax or content errors}}{\text{Number of query responses received (2a)}}$$

Technical implementation notes:
- These types of responses may need to be examined in detail by technical users.
- It may be helpful to separate structural/technical errors from fatal content errors.

Table 1. Summary of Query-Response Proportion Metrics Technical Definitions

This table provides technical definitions of the metrics described above. When calculating a numerator, readers should use the inclusion criteria listed to the right of the "Metric Denominator" column. For example, when calculating the proportion of inexact matches, developers should only include responses using the Z31 profile with a QAK-2 value of "OK." Further, messages which communicate no errors or errors that are "informational" or "warnings" are to be included. Therefore, messages that do not match the listed criteria should be excluded.

#	Metric Numerator	Metric Denominator	Response Profile	Outcome of Query	Query Acknowledgment Field 2 (QAK-2)	Message Acknowledgment Segment Field 1 (MSA-1)	Error Segment Field 4 (ERR -4)
1 a	Queries sent	NA	NA				
2 a	Query Responses received	NA	NA				
2 b (i)	Exact Matches Found	Query responses received (2a)	Return IZ history (Z32) or IZ history and forecast (Z42)	One exact match found	Data found, no errors (OK)	Application Acceptance (AA)	No error (No ERR segment)
							Informational error (I)
						Application Error (AE)	Warning error (W)
2 b (ii)	Inexact Matches Found	Query responses received (2a)	Return a list of candidates (Z31)	Inexact matches found (but less than the maximum allowed)	Data found, no errors (OK)	Application Acceptance (AA)	No error (No ERR segment)
							Informational error (I)
						Application Error (AE)	Warning error (W)
2 b (iii)	Too Many Patients Found	Query responses received (2a)	Return an acknowledgment with no person records (Z33)	More than the maximum number of allowed matches found	Too many candidates found (TM)	Application Acceptance (AA)	No error (No ERR segment)
							Informational error (I)
						Application Error (AE)	Warning error (W)

Continuation of Table 1. Summary of Query-Response Proportion Metrics Technical Definitions

#	Metric Numerator	Metric Denominator	Response Profile	Outcome of Query	Query Acknowledgment Field 2 (QAK-2)	Message Acknowledgment Segment Field 1 (MSA-1)	Error Segment Field 4 (ERR -4)
2 b (iv)	No Patients Found	Query responses received (2a)	Return an acknowledgment with no person records (Z33)	No match found	No data found (NF)	Application Acceptance (AA)	No error (No ERR segment)
							Informational error (I)
						Application Error (AE)	Warning error (W)
2 b (v)	Protect Patient Found[3]	Querying systems: Query responses received (2a)	NA	Protected patient found	Protected Data (PD)[4]	Application Acceptance (AA)	No error (No ERR segment)
		Responding systems: Number of queries sent (1a)			No data found (NF)		Informational error (I)
2 b (vi)	Structural/ Technical or Content Errors	Query responses received (2a)	Return an Acknowledgement (Z23)	Message processing error	No QAK segment	Application Rejection (AR)	Error (E)
			Return an acknowledgement with no person records (Z33)		AE (Application error)	Application Error (AE)	

Table 1. Notes

1. Querying systems are limited to only using response data from the responding system to generate reports
2. Responding systems may use response data returned to the querying system OR actual outcome (generally for internal reports)
3. Responding systems may choose to respond to matches to protected patients in a variety of ways, see [Query Responses and Patient Protection Discussed with SISC on August 10, 2016](#)
4. Few IIS use this code, see [Query Responses and Patient Protection Discussed with SISC on August 10, 2016](#)

Query Parameter Completeness/Response Type Received Crosstabs

Data completeness is one of four characteristics the CDC lists in its [IIS Data Quality Blueprint](#) as a way to improve data quality. In the case of immunization query-response, the metrics proposed below require aggregate report developers to join a query to its corresponding response. For each query with complete (non-missing/null/blank) parameter data elements determine the proportion that resulted in each query response type group. After joining the data, one can associate an outcome (exact match, inexact match, too many) with a query parameter (e.g., patient's phone number). The aggregate report developer will need to determine the relative value anticipated with respect to the effort required to parse the data and join queries to their responses. Developing reports that examine data completeness may help identify strategies to improve the likelihood of achieving exact matches. The current Immunization Implementation Guide for HL7 version 2.5.1 supports many parameters:

- Patient identifiers
  (repetitions are allowed)
- Patient name
- Patient mother's maiden name
- Patient date of birth
- Patient sex
- Patient address
- Patient home phone
- Patient multiple birth indicator
- Patient birth order
- Client last updated date (optional)
- Client last updated facility (optional)

For each cell (e.g., patient phone number x exact match) within the cross tabs, divide the number of queries that contain the data element by the number of responses within a response group. For example, perhaps 20 of 100 exact match query responses came from queries that contained a patient's mother's maiden name. Therefore, 20% of queries resulting in exact matches contained the patient's mother's maiden name as a query parameter.

Technical implementation notes:
- It may be beneficial to look at each type of identifier (e.g., State Registry, Medicaid Number) separately. To improve matching in future queries, some receiving systems may retain the patient's local medical record number and some querying systems may retain the patient's state registry ID.
- To obtain the greatest benefit report developers should separate parts of a patient's name (last, first, middle), address (address, city, state, zip code) and phone number (area code, local number).
- Report developers may wish to exclude fields that are optional or rarely submitted for example: Patient Multiple Birth Indicator (QPD-10) and Patient Birth Order (QPD-11), Client Last Updated Date (QPD-12) and Client Last Updated Facility (QPD-13).

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Advanced

Several advanced performance metrics were considered when developing this guidance. These are referenced as advanced because they evaluate the actions that a provider organization or user might perform after receiving inexact matches. Clinical software implementation may limit user abilities to perform some or all these actions; hence, the measures are only potentially useful if the software allows the actions specified. Clinical software developers need to determine the value of enabling these potential actions with respect to development effort and clinical utility and burden. Such evaluation requires careful attention to user design principles. These advanced metrics have the potential for demonstrating a return on investment of user time for reviewing and reconciling data from the query-response interface. These metrics may also have high utility if querying system users accept and/or reconcile a sizable amount of returned data. If, however, querying system users spend a considerable amount of time reviewing but reject a large amount of data utility will be low and provider organizations should investigate reasons for such rejections. In combination with the potential query response outcomes, the following action outcomes could be considered for performance metrics (counts and/or proportions) within future efforts:

1. Acceptance/Reconciliation – all the immunization data returned from the responding system applies to the queried patient (i.e., accept as a one-to-one match and reconcile by importing all immunization data not yet present in querying system).
   a. Count number of Immunization doses accepted
   b. Count number of unique, unduplicated patients with one or more accepted immunization doses

2. Partial Acceptance – querying system user determines <u>some but not all,</u> of the immunization history data returned from a responding system applies to the queried patient (this capability may be managed as an automated process).
   a. Count number of immunization doses accepted (i.e., reconciled into the existing querying system)
   b. Count number of unduplicated patients with one or more accepted immunization doses

3. Re-query – After evaluating the results (exact match, inexact match(es), too many matches, no match) from a responding system the querying system user generates a subsequent query for the original patient (this capability may be managed as an automated process). The related performance metrics may be:
   a. Count number of re-queries that are Identical to the initial query (assuming the user expects a new outcome without changing the query parameters)
   b. Count number of revised queries containing new or updated patient demographic data
   c. Count number of re-queries containing supplemented or substituted patient demographic data that was present in the patient identifier (PID) segment of an inexact match candidate listing (Z31 profile)

4. Rejection – Querying system end user or automated process determines <u>none</u> of the data returned from a responding system applies to the queried patient.
   a. Count number of unduplicated returned patients with zero accepted immunization doses

Note: only patients should be reported here, not immunization doses. When a querying system user accepts at least one immunization dose this should be categorized as "partial acceptance."

5. Potential duplicate notification – Querying system end user wishes to notify the responding system that two or more patient identifier (PID) segments within an inexact match candidate listing (Z31 profile) are believed to be the same patient (i.e., duplicates exist within the responding system).
   a. Count number of notifications sent to the responding systems indicating that a duplicate patient has been identified in the response

Note: the count for this action should not exceed the number of responses (i.e., when duplicates exist a single notification will be submitted to the responding system for patients needing to be merged. This capability represents new functionality for querying and responding systems that do not currently exist.

6. Potential bad match notification – Querying system end user or automated process generates a notification to the responding system indicating a concern that the patient does not match the demographics sent with the query
   a. Count the number of unduplicated patients with zero accepted immunization doses resulting in a notification from the querying system to the responding system indicating poor match quality.

Note: this would require new functionality within querying and responding systems that do not currently exist.

7. Proceed with care (i.e., stop looking) – After receiving a match response without a patient identifier (PID) segment (i.e., too many matches, no matches, errors) the querying user or automated processes chooses not to initiate a subsequent query (re-query). Note: This differs from the rejection action described above as the provider is not presented with any potential patient matches.

Example Report

Metadata

Facility	Quality Care Health Clinic
Time Period Start	05/09/2021
Time Period End	05/15/2020
First Query	05/09/21 07:04 AM
Last Query	05/13/21 08:46 PM

Basic Measures

1.a. Queries Initiated (QBP)		2,500
2.a.	Responses Received (RSP)	2,500
2.b.i.	Exact Matches Found	68.00% (1,700)
2.b.ii.	Inexact Matches Found	16.00% (400)
	Inexact Responses with single PID	62.50% (250)
	Average Number of PID segments	1.635
2.b.iii.	Too Many Patients Found	2.80% (70)
2.b.iv.	No Patients Found	9.88% (247)
2.b.v.	Protected Patients Found	0.12% (3)
2.b.vi.	Query Errors	3.32% (83)

Basic Measure Interpretation (not included inside the report) –
● The number of queries and responses received are equal; (i.e., each query sent has a corresponding response. This outcome is desirable.
● If queries and responses were not equal data loss may have occurred and should be investigated if time permits.
● Most queries returned exact matches and a sizable portion of responses indicated inexact or multiple matches:
● A majority (62.50%) of the inexact match responses only include a single patient identifier (PID) segment indicating a single inexact match
● A smaller portion of inexact matches indicate multiple potential patient matches (37.5%=100%-62.50%)
● A very small portion of query-responses indicate too many patients were identified in the responding system; this type of response indicates:
● The responding system located a greater number of potential matches than requested by the querying system (RCP-2)
● The responding system exceeded the number of match candidates permitted by the responding system, or
● The responding system matched the query parameters provided by the querying system to a patient within the responding system that is protected. Patients with protected indicator status may not be shared by the responding system to the querying system. This response type is believed to be rare, instead most responding systems return a no patients found response.
● A very small portion of queries resulted in an error due to their structure or content; for example, a patient's date of birth (or other required fields) may not have been provided or the query may have been malformed.

Query Parameter Completeness by Response Outcomes

Populated Field	All Responses	Exact Match	Inexact Match	Too many	Not Found	Protected Patients	Query Errors
Any	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Immunization Registry Identifier (QPD-3.1 where QPD-3.5=SR)	40.00%	57.14%	0.00%	0.00%	0.00%	0.00%	0.00%
Last Name (QPD-4.1)	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
First Name (QPD-4.2)	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Middle Name or Initials (QPD-4.3)	60.00%	78.57%	50.00%	0.00%	0.00%	0.00%	0.00%
Mothers' Maiden Name (QPD-5.1)	20.00%	28.57%	0.00%	0.00%	0.00%	0.00%	0.00%
Date of Birth (QPD-6)	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Sex (QPD-7)	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Street (QPD-8.1)	44.00%	62.86%	0.00%	0.00%	0.00%	0.00%	0.00%
City (QPD-8.3)	66.00%	84.29%	70.00%	0.00%	0.00%	0.00%	0.00%
State (QPD-8.4)	66.00%	84.29%	60.00%	0.00%	0.00%	50.00%	0.00%
Zip (QPD-8.5)	44.00%	62.86%	0.00%	0.00%	0.00%	0.00%	0.00%
Area Code (QPD-9.6)	56.00%	74.29%	40.00%	0.00%	0.00%	0.00%	0.00%
Seven Digit Local Phone # (QPD-9.7)	58.00	82.86%	0.00%	0.00%	0.00%	0.00%	0.00%

Populated Field	All Responses	Exact Match	Inexact Match	Too many	Not Found	Protected Patients	Query Errors
Any	100	70	10	5	10	2	3
Immunization Registry Identifier (QPD-3.1 where QPD-3.5=SR)	40	40	0	0	0	0	0
Last Name (QPD-4.1)	100	70	10	5	10	2	3
First Name (QPD-4.2)	100	70	10	5	10	2	3
Middle Name or Initials (QPD-4.3)	60	55	5	0	0	0	0
Mothers' Maiden Name (QPD-5.1)	20	20	0	0	0	0	0
Date of Birth (QPD-6)	100	70	10	5	10	2	3
Sex (QPD-7)	10	70	10	5	10	2	3
Street (QPD-8.1)	44	44	0	0	0	1	0
City (QPD-8.3)	66	59	7	0	0	0	0
State (QPD-8.4)	66	59	7	0	0	0	0
Zip (QPD-8.5)	44	44	0	0	0	0	0
Area Code (QPD-9.6)	56	52	4	0	0	0	0
Seven Digit Local Phone # (QPD-9.7)	58	58	0	0	0	0	0

Query Parameter Completeness by Response Outcomes Measure Interpretation (not included inside the report) – In the example provided above, the reader may notice that compared to all responses, exact responses were associated with more data completeness (more query parameters were included within the query). Readers may also notice that patient first name, last name and date of birth were always included in queries that did not result in errors. In the example, the responding system requires these parameters or an error response will be generated. Data incompleteness was associated with errors. Readers may also notice that when query parameters included State Registry ID, mother's maiden name, address and phone number; exact matches were more likely than other outcomes. This may prompt the querying system user to attempt to collect these data elements in the future or understand the relative importance of each piece of data in achieving desirable outcomes.

Advanced Measures - Raw Numbers

	Responses	Acceptance/ Reconciliation		Partial Acceptance		Re-query	Proceed with Care Delivery Process	Rejection	Possible Duplicate	Possible Bad Match
		Patients	Doses	Patients	Doses					
Exact Matches Found	49	30	150	10	20			5		4
Inexact Matches	20					10		7	2	1
Multiple: PID segments > 1	7					2		3	2	
Inexact: PID segments = 1	13					8		4		1
Too Many Patients Found	18					9	9			
No Patients Found	10					8	2			
Structural/Technical/Cont ent errors	3					2	1			
Total	100	30	150	10	20	29	12	12	2	5

Notes: Acceptance is defined as when the user accepted a patient as a match and incorporated all retrieved immunization data, that does not also exist in the querying system, into the local immunization record. Partial acceptance is defined as user accepted a patient as a match and incorporates some (but not all) of the immunization data retrieved. Summing cells exceeds 100 as inexact matches are evaluated twice—one as a whole and one by number of PID segments. Cells with gray background indicate combinations that are not possible.

Advanced Measures - Proportions

	Responses	Acceptance/ Reconciliation		Partial Acceptance		Re-query	Proceed with Care	Rejection	Possible Duplicate	Possible Bad Match
		Patients	Doses	Patients	Doses					
Exact Matches Found	49	30.00%		10.00%				5.00%		4.00%
Inexact Matches	20					10.00%		7.00%	2.00%	1.00%
Multiple: PID segments > 1	7					2.00%		3.00%	2.00%	
Inexact: PID segments = 1	13					8.00%		4.00%		1.00%
Too Many Patients Found	18					9.00%	9.00%			
No Patients Found	10					8.00%	2.00%			
Structural/Technical/Content errors	3					2.00%	1.00%			

Notes: Acceptance is defined as user accepted a patient as a match and incorporated all retrieved immunization data, that does not also exist in the querying system, into the local immunization record. Partial acceptance is defined as user accepted a patient as a match and incorporates some (but not all) of the immunization data retrieved. Summing cells exceeds 100 as Inexact Matches are evaluated twice - one as a whole and one by number of PID segments. Cells with gray background indicate combinations that are not possible.

Limitations and Considerations Regarding Duplicate Queries

Duplicate patient queries may have an impact on the metrics listed in this guidance. For example, repeated queries for the same patient may inflate the total number of queries. Defining a duplicate query can be challenging, but may be defined as a query for the same individual by the same querying system within a short period of time with identical query parameters. This definition excludes secondary queries that attempt to resolve inexact/multiple matches. Some EHRs may have built-in query triggers associated with appointments or transfers that may result in duplicate queries. For example, if an oncology patient has a visit that also includes a physical examination, laboratory tests and imaging, the EHR may be configured to generate three queries as each event may be considered a separate encounter. Over time, if this same trigger mechanism is repeated, it could quickly inflate the proportion of query-response outcomes (e.g., inexact match). Additionally, this type of query trigger configuration could result in reduced query interface performance. It may be beneficial to develop an organization-specific duplicate query definition, related metrics and strategies to account for these queries when assessing inexact/multiple matches.

Resources

The following materials were consulted during development of query-response measurement and may assist readers further.

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