



**BUSINESS RULE SOLUTIONS**  
Enabling Operational Excellence



# Case Study in the Management of Common IIS Rules, Vocabulary, and Operational Decisions

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# What You Will Learn

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- What are business rules
  - How this approach is being used in the Immunization Information Systems Support Branch (IISSB)
  - The benefits of using a business rules approach
  - How a business rule management tool is enabling consistency and reuse of terminology and rules
-

# Agenda

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- Who – the stakeholders
  - Why – vision & benefits
  - What – approach
  - How – the journey
-

# What is a Business Rule?

The adjusted recommend date must be the later of the earliest date and the unadjusted recommended date.

— criterion used in business operations to:

- guide behavior
- make decisions

Number of demographic records created for newborns from vital records must be > 0.

A patient's conflict begin interval date must be calculated as the date administered of the conflicting vaccine dose administered plus the live virus conflict begin interval

|  |     |     |       |     |     |     |
|--|-----|-----|-------|-----|-----|-----|
| Was the Target Dose Satisfied?   |     |     |       |     |     |     |
| Can the Target Dose Be Skipped?  |     |     |       |     |     |     |
| Can the Vaccine Dose Administered Be Evaluated?  |     |     |       |     |     |     |
| Was the Vaccine Dose Administered at a Valid Age?  |     |     |       |     |     |     |
| CONDITIONS   |     |     | RULES |     |     |     |
| Is the date administered < absolute minimum age date?  | Yes | No  | No    | No  | No  | No  |
| Is the absolute minimum age date < date administered < minimum age date?   | No  | Yes | Yes   | Yes | No  | No  |
| Is the minimum age date < date administered < maximum age date?  | No  | No  | No    | No  | Yes | No  |
| Is the date administered < maximum age date?   | No  | No  | No    | No  | No  | Yes |
| Is this the first target dose?   | -   | No  | No    | Yes | -   | -   |
| Is the evaluation status of the previous vaccine dose administered "not valid" due to age or interval recommendations? | -   | Yes | No    | -   | -   | -   |
| OUTCOMES   |     |     | No    | No  | Yes | No  |

The following data elements must have a single value:

- Patient date of birth
- Patient multiple birth indicator
- Patient birth order

PAIS at the geographic jurisdiction level may be assigned only by the immunization program.

# Who – Main Stakeholders

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## **Centers for Disease Control (CDC)**

National Center for Immunization and Respiratory Diseases (NCIRD)  
Immunization Information Systems Support Branch (IISSB)



## **American Immunization Registry Association**

Modeling of Immunization Registry Operations Workgroup (MIROW)

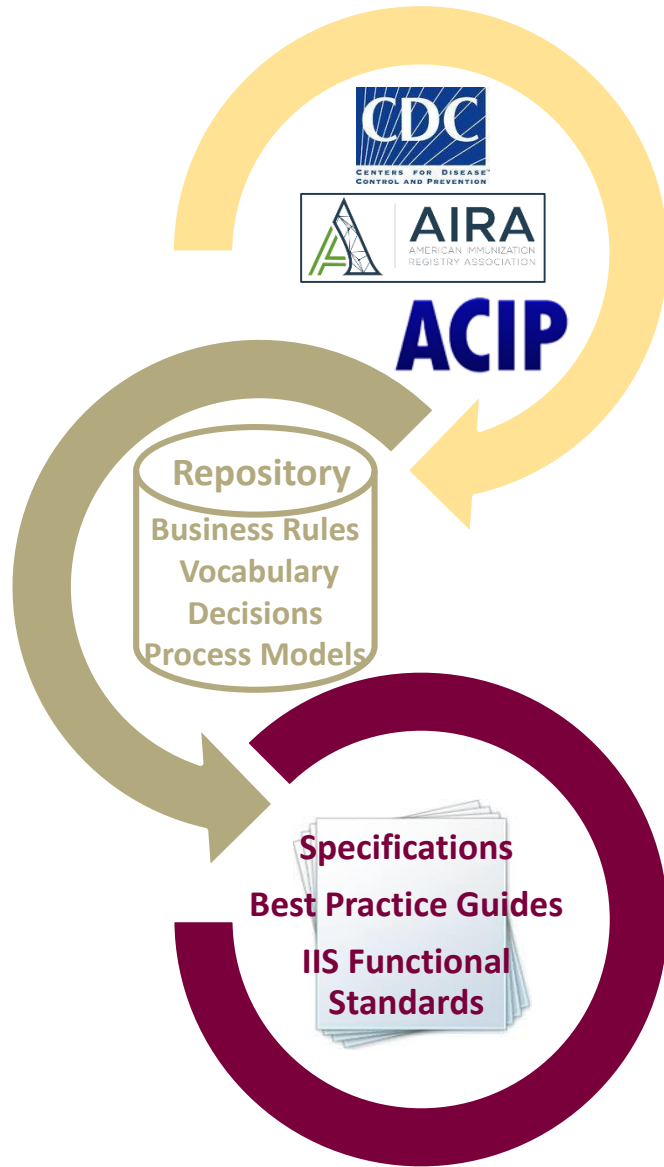
# ACIP

## **Advisory Committee on Immunization Practices (ACIP)**

# Who

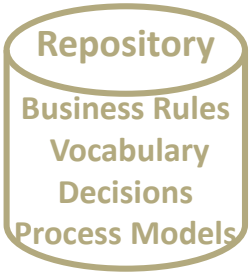
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## Vision

To use industry-recognized business rule methodology and business analysis techniques to capture, analyze, and manage immunization knowledge in a trusted repository for the benefit of the IIS community, immunization programs, and health care providers



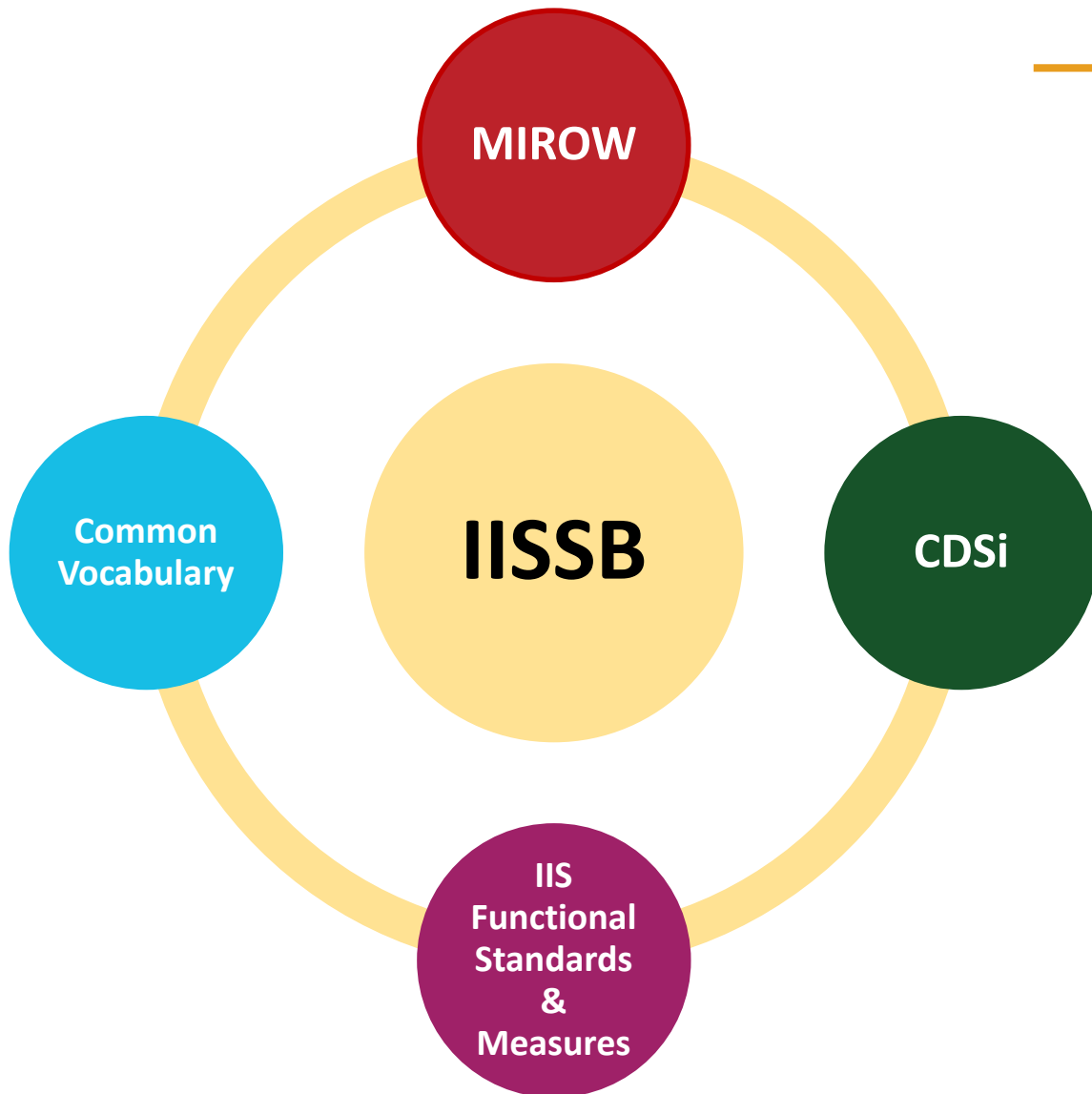
# What

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- Evolutionary approach
  - Introduced methodology and techniques, then tool
  - Adapted techniques and deliverables to need
  - Recognized importance of vocabulary
-

# What

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## *Operational:*

- Modeling of Immunization Registry Operations Workgroup (MIROW)
- Clinical Decision Support for Immunization (CDSi)

## *In Progress:*

- IIS Functional Standards and Measures (IISAR)
- Common Vocabulary



**ACIP**  
Recommendations

are expressed as



provides  
subject matter  
expertise for

## IISSB Analysis Deliverables

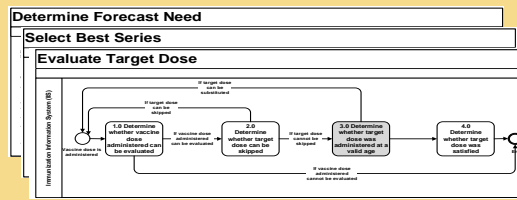
### CDSi Business Rules

| ID | Conditional Skip Rules   |
|----|--|
| ID | Preferable Vaccine Rules   |
| ID | Date Rules   |
| 1  | A patient's maximum age date must be calculated as the patient's date of birth plus the maximum age.   |
| 2  | A patient's minimum age date must be calculated as the patient's date of birth plus the minimum age.   |
| 3  | A patient's absolute minimum age date must be calculated as the patient's date of birth plus the absolute minimum age.   |
| 4  | The earliest date must be the latest of the following dates: <ul style="list-style-type: none"><li>Minimum age date</li><li>Latest minimum interval date</li><li>Latest conflict end interval date</li><li>Seasonal recommendation start date</li><li>Latest inadvertent administration date</li></ul> |

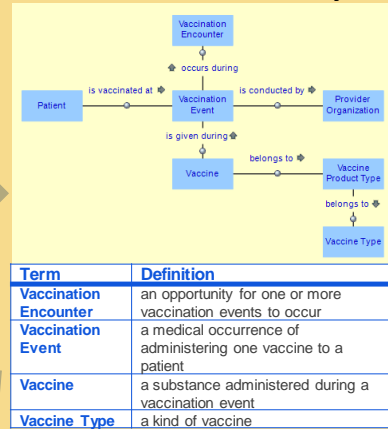
### MIROW Principles & Rules

| CONSOLIDATED RECORD - PRINCIPLES     |  |
|--------------------------------------|--|
| Principle Name                       | Principle Statement  |
| CR - P01. Create consolidated record | The IIS should create a single consolidated demographic record for each patient and a single consolidated vaccination event record for each vaccination event.   |
| CONSOLIDATED RECORD - RULES          |  |
| Rule ID                              | Rule Statement   |
| CR-BR04                              | The following information must be known for each data element and data group to make consolidation decisions: <ul style="list-style-type: none"><li>Type of data source</li><li>Specific data source</li><li>Submission date (recency?)</li><li>Confidence level</li></ul> |
| CR-BR19                              | Use an existing demographic record (and IIS ID) as the base record for merging additional data from an incoming record.  |
| CR-BR06                              | Consolidation of two existing demographic records (i.e., with two IIS IDs) should result in one of the following options: <ul style="list-style-type: none"><li>A new demographic record (i.e. with a new IIS ID).</li></ul>   |

### CDSi Process Models



### Common Vocabulary



| Term                  | Definition   |
|-----------------------|--|
| Vaccination Encounter | an opportunity for one or more vaccination events to occur     |
| Vaccination Event     | a medical occurrence of administering one vaccine to a patient |
| Vaccine               | a substance administered during a vaccination event            |
| Vaccine Type          | a kind of vaccine  |

### IIS Functional Standards & Measures

| Essential Infrastructure Standards  |   |
|---|---|
| 1.0 The IIS contains complete and timely demographic and immunization data for children, adolescents, and adults residing or immunized within its jurisdiction.                         |   |
| 1.1 The IIS establishes a record in a timely manner from sources such as vital records or birthing hospitals for each child born and residing in its jurisdiction at the date of birth. |   |
| Rule  | Measure Text  |
| 1.1.1   | Percentage of children born and residing in the IIS's jurisdiction in the last year that had a record established in the IIS within 60 days of birth. |
| 1.1.2   | Percentage of children born and residing in the IIS's jurisdiction in the last year that had a record established in the IIS within 45 days of birth. |
| 1.1.3   | Percentage of children born and residing in the IIS's jurisdiction in the last year that had a record established in the IIS within 30 days of birth. |
| 1.1.4   | Percentage of children that were born in the calendar year that reside in the IIS's jurisdiction that have a demographic record in the IIS.           |

These analysis models can be used as a basis for generating high-quality, comprehensive business requirements.



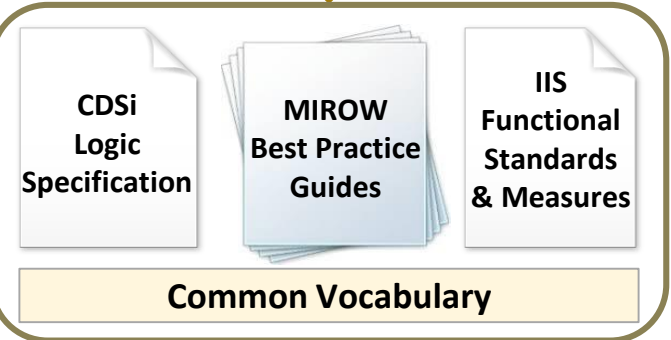
manages

provides content  
and analysis

Content stored  
as the trusted  
source of truth

## Immunization Repository of Knowledge

provides  
content for

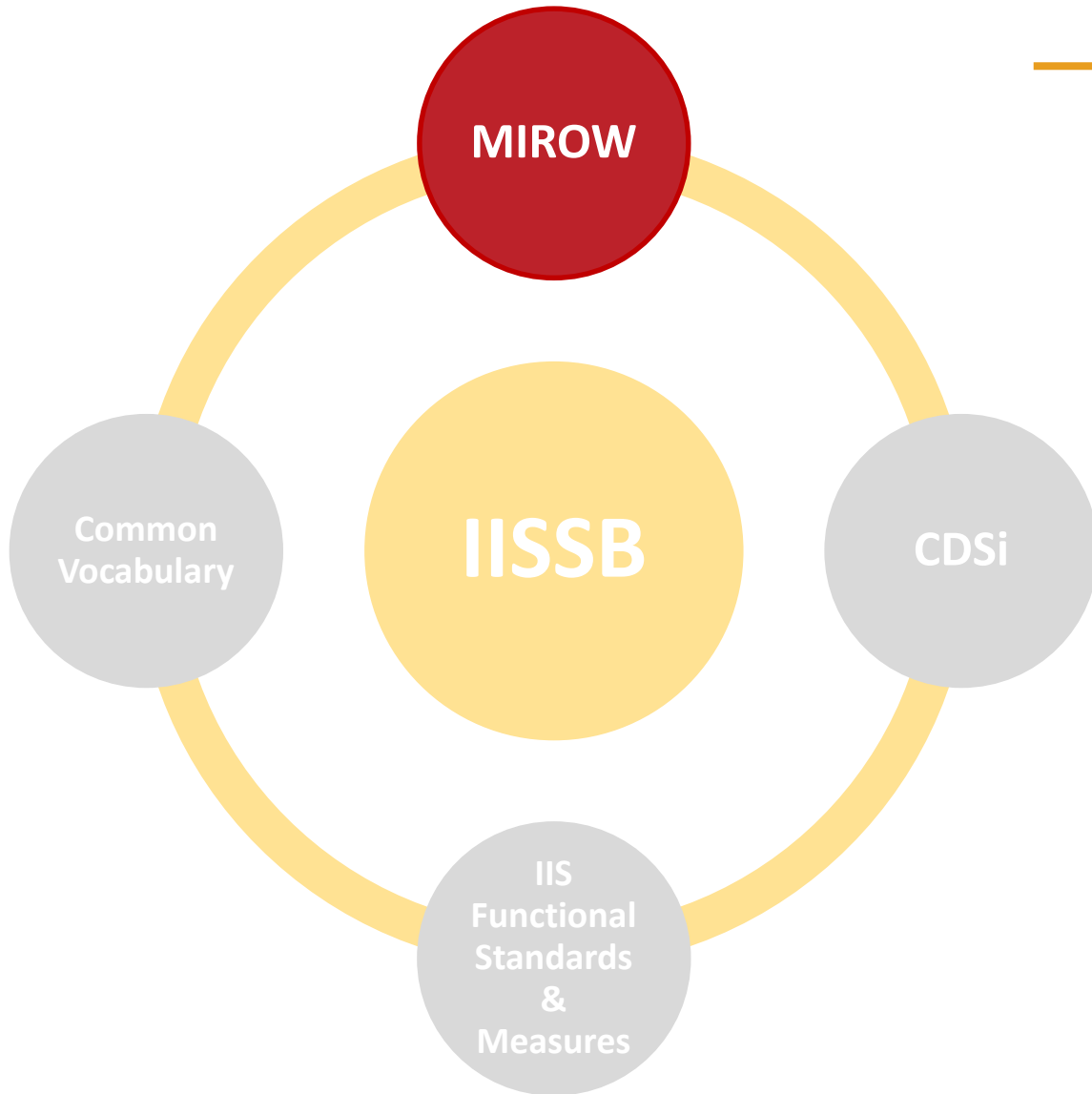


is referenced  
by



# Benefits

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- Better communication amongst stakeholders
- Improved clarity and accuracy of operational decision-making
- Consistency and uniformity of IIS operations



# How – Approach



## Discovery

- As-Is Model
- Documents understanding of how the current program operations work

## Assessment

- What is working well and what isn't
- Improvement options

## Specification

- To-Be Model
- Documents agreed-upon program requirements that should be implemented

## Principles

A principle (P) is a high-level business rule. It provides a high-level direction that helps capture institutional knowledge and guides the development of more specific business rules that represent specific requirements and decision-making logic for IIS processes and operations. The following are some of the identified principles.

| P#  | DESCRIPTION  |
|-----|--|
| P01 | The IIS should create a single consolidated demographic record for each patient and a single consolidated vaccination event record for each vaccination event. |
| P02 | A consolidated record should be used for all IIS functions.  |
| P03 | Original information should be accessible by an IIS.   |
| P04 | Consolidation should result in either a new record or an updated base record.  |
| P05 | The best value for each data element from all available data sources should be used for a consolidated record.   |
| P08 | A confidence ranking for data sources should be established and used by the IIS.   |

*Source:* Consolidating Demographic Records and  
Vaccination Event Records, August 21, 2017

# Sample Techniques

## Principles & Business Rules



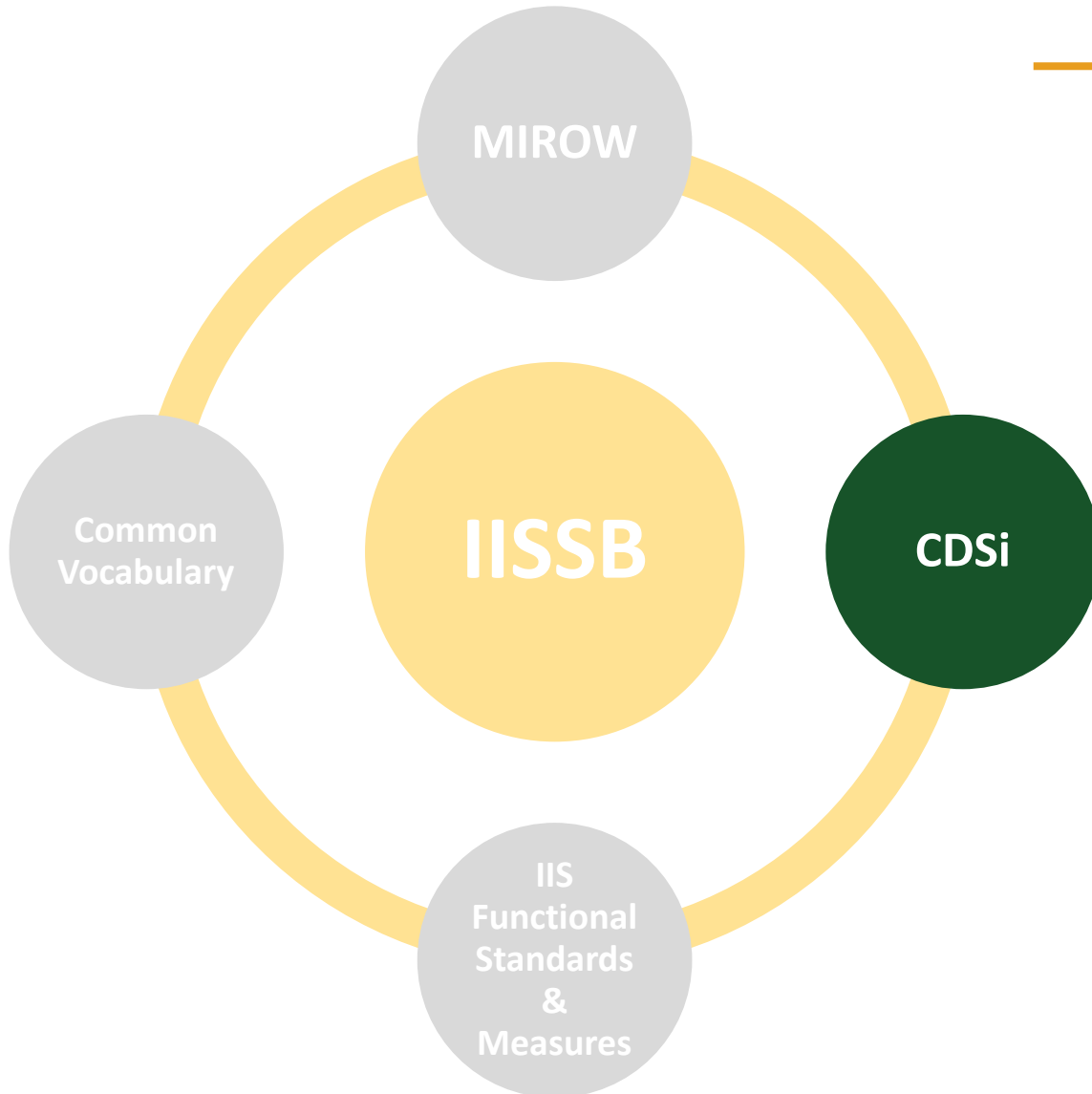
## Business Rules

In contrast to principles, business rules (BR) represent specific requirements and decision-making logic for IIS processes and operations. The following are summaries of some key business rules.

| BR#                        | DESCRIPTION  |
|----------------------------|--|
| <b>Demographic records</b> |  |
| BR201, BR202, BR203, BR204 | The IIS should make accessible information needed to make consolidation decisions.   |
| BR501                      | Valid values should be used over invalid values.   |
| BR601                      | Vital statistics is a definitive source for certain demographic data elements.   |
| BR702                      | If a data element allows for multiple values, then both values should be selected for the consolidated record.   |
| BR801, BR802               | The most complete/specific data element should be selected.  |
| BR901, BR902, BR903        | If the best value cannot be selected based on data-element-level business rules, then record-level characteristics (i.e., confidence level and recency) should be used to select the best value for each data element. |

# Benefits

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- Easier to develop and maintain immunization evaluation and forecasting engines
- Increased accuracy and consistency of immunization evaluation and forecasting
- Improved timeliness of accommodating new and updated ACIP recommendations
- Greater assurance that a patient's immunization status is current, accurate, and consistent



# How – Approach

## Review

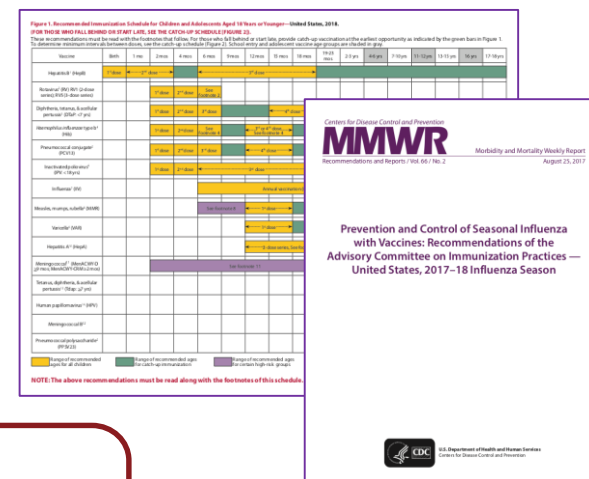
- Review ACIP recommendations/publications
- Determine impact of changes

## Analysis

- Add/change/retire business rules & terminology
- Conduct quality analysis

## Publication

- Update and publish CDSi Logic Specification and/or Supporting Data





# Sample Techniques

## Decision Tables

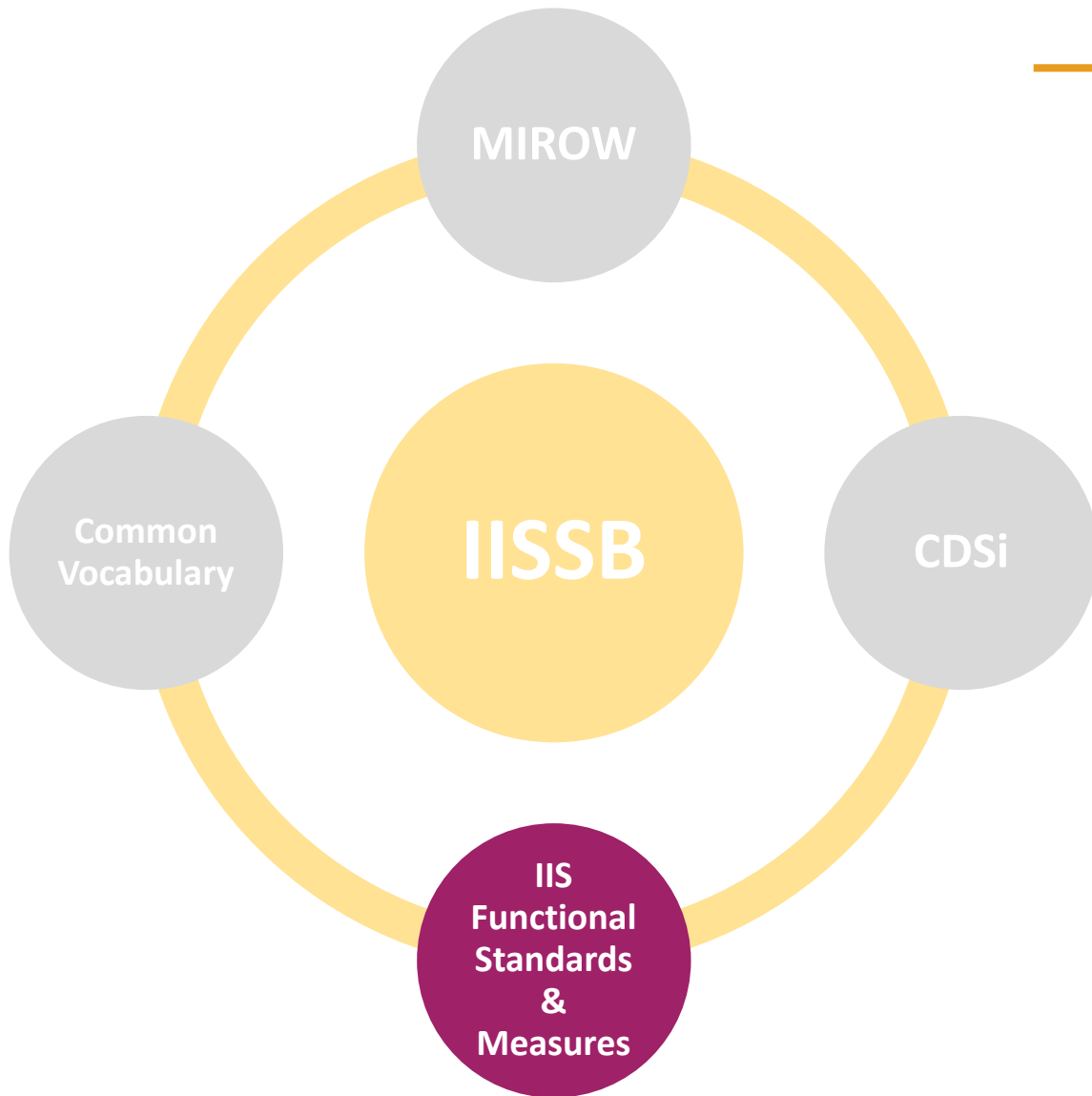
| CONDITIONS   | RULES  |  |  |  |  |    |
|--|--|--|--|--|--|----|
| Is the date administered < absolute minimum age date?  | Yes  | No   | No   | No   | No   | No |
| Is the absolute minimum age date ≤ date administered < minimum age date?   | No   | Yes  | Yes  | Yes  | No   | No |
| Is the minimum age date ≤ date administered < maximum age date?  | No   | No   | No   | No   | Yes  | No |
| Is the date administered ≥ maximum age date?   | No   | No   | No   | No   | No   |    |
| Is this the first target dose?   | -  | No   | No   | Yes  | -  |    |
| Is the evaluation status of the previous vaccine dose administered "not valid" due to age or interval recommendations? | -  | Yes  | No   | -  | -  |    |
| OUTCOMES   | No. The vaccine dose administered was not administered at a valid age. Evaluation reason is "too young." | No. The vaccine dose administered was not administered at a valid age. Evaluation reason is "too young." | Yes. The vaccine dose administered was administered at a valid age. Evaluation reason is "grace period." | Yes. The vaccine dose administered was administered at a valid age. Evaluation reason is "grace period." | Yes. The vaccine dose administered was administered at a valid age. Evaluation reason is "grace period." |    |

| Number of conditional doses administered (BR: CONDSKIP-1) / Dose Count Logic | Greater than Conditional Skip Dose Count | Equal to Conditional Skip Dose Count | Less than Conditional Skip Dose Count |
|--|--|--------------------------------------|---------------------------------------|
| Greater Than   | Yes. The condition is met.               | No. The condition is not met.        | No. The condition is not met.         |
| Equal  | No. The condition is not met.            | Yes. The condition is met.           | No. The condition is not met.         |
| Less Than  | No. The condition is not met.            | No. The condition is not met.        | Yes. The condition is met.            |

| Conditions   | If this condition is true for the scorable patient series | If this condition is true for two or more scorable patient series | If this condition is not true for the scorable patient series |
|--|---|---|---|
| A scorable patient series has the most valid doses.                            | +1  | 0   | -1  |
| A scorable patient series is a product patient series and has all valid doses. | +1  | n/a   | -1  |
| A scorable patient series is the earliest completing.                          | +2  | +1  | -1  |

# Expected Benefits

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- Increased visibility of linking IIS Annual Report responses to measurements of the IIS Functional Standards
- Foundation to build on immunization repository of knowledge such as business rules and decision tables
- Increased flexibility to adjust rules within an ever-changing IT environment



# How – Approach

## Review

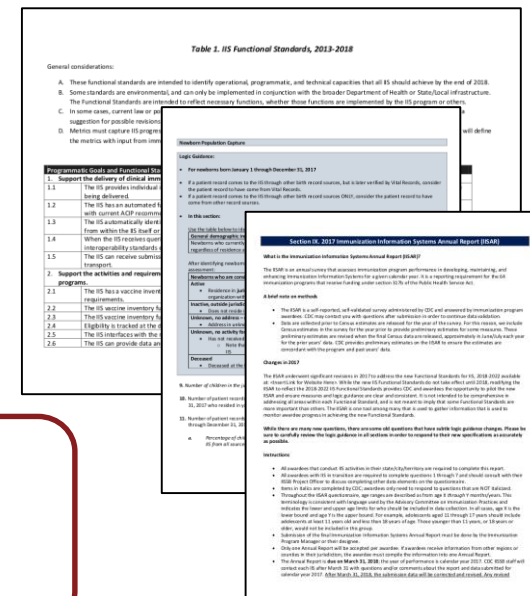
- Review IIS Functional Standards
- Review IIS Annual Report
- Determine impact of changes

## Analysis

- Add/change/retire business rules & terminology
- Conduct quality analysis

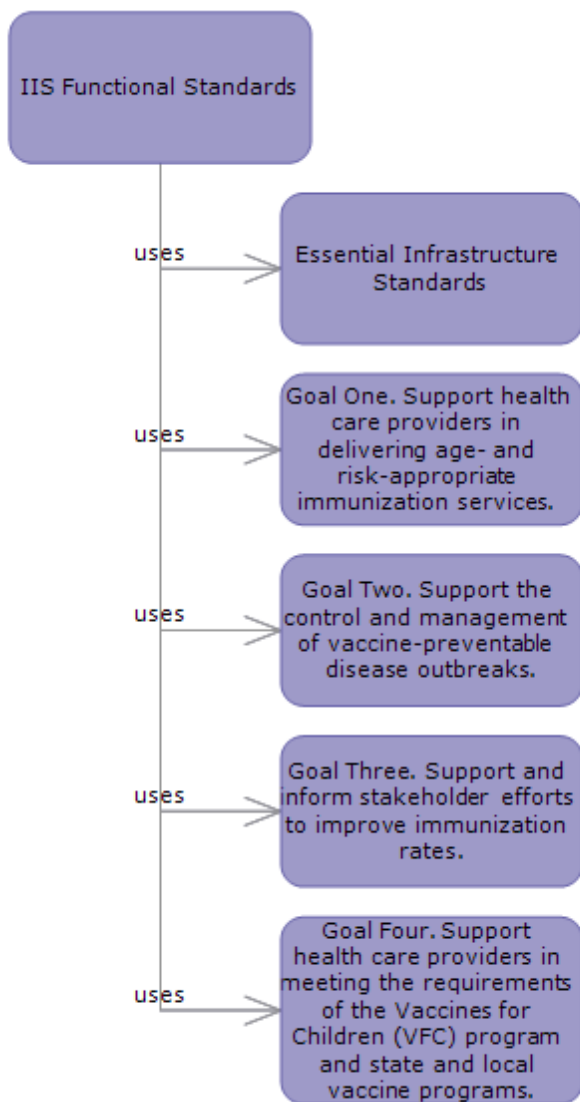
## Reporting

- Produce reports



# Sample Techniques

## Rule Groups

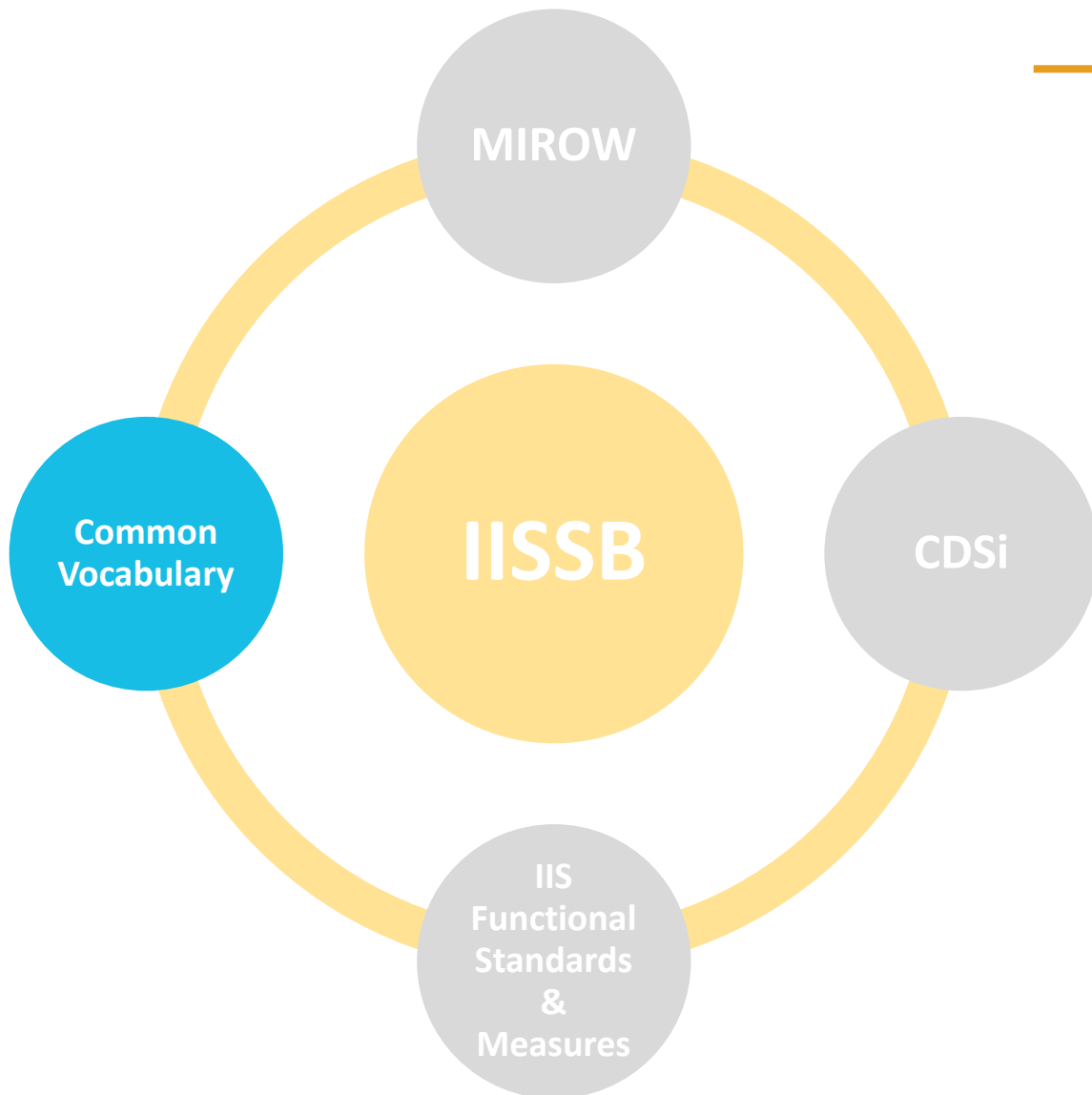


Source: 2017 IISAR

| Name: IIS Functional Standards |   |  |
|--------------------------------|---|--|
|                                | Name  | Rule Statement   |
| 1                              | Essential Infrastructure Standards            |  |
| 2                              | 1.0 The IIS contains complete and timely d... |  |
| 3                              | 1.1 The IIS establishes a record in a tim...  |  |
| 4                              | 1.1.1   | Percentage of demographic records for newborns first established in <= 60 days =...                  |
| 5                              | 1.1.2   | Percentage of demographic records for newborns first established in <= 45 days =...                  |
| 6                              | 1.1.3   | Percentage of demographic records for newborns first established in <= 30 days =...                  |
| 7                              | 1.1.4   | Percentage of demographic records for newborns created from all record sources =...                  |
| 8                              | 1.2 The IIS identifies records created fro... |  |
| 9                              | 1.2.1   | Number of demographic records created for newborns from vital records must be > 0.                   |
| 10                             | 1.3 The IIS contains a complete demogr...     |  |
| 11                             | 1.3.1   | NIS Child-IIS Point Estimate Difference = Number of individuals >= 19 months to <= 35 months         |
| 12                             | 1.3.3   | NIS-IIS Point Estimate Difference  |
| 13                             | 1.3.4   | Percentage of individuals aged 0 to <= 6 years residing in the jurisdiction and enrolled in the IIS  |
| 14                             | 1.3.5   | Percentage of individuals aged 0 to <= 18 years residing in the jurisdiction and enrolled in the IIS |
| 15                             | 1.3.6   | Percentage of individuals of all ages residing in the jurisdiction and enrolled in the IIS =...      |
| 16                             | 1.3.7   | Percentage of individuals aged >= 4 months to <= 5 years enrolled in the IIS with 2+ immunizati      |
| 17                             | 1.3.8   | Percentage of individuals aged >= 11 to <=17 years enrolled in the IIS with 2+ adolescent immu       |
| 18                             | 1.3.2   | NIS Teen-IIS Point Estimate Difference   |
| 19                             | 1.4 The IIS assures that all participating... |  |
| 20                             | 1.4.1 and 1.5.1                               | Percentage of administered vaccination event records for individuals aged 0 to <= 6 years repo       |
| 21                             | 1.4.2 and 1.5.2                               | Percentage of administered vaccination event records for individuals aged 0 to <= 18 years rep       |
| 22                             | 1.4.3 and 1.5.3                               | Percentage of administered vaccination event records for individuals of all ages reported to the     |

# Expected Benefits

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- Better communication across tracks
- Improved consistency of communication products
- Easier impact analysis for changes to products
- Foundation to build on immunization repository of knowledge such as business rules and decision tables



# How – Approach

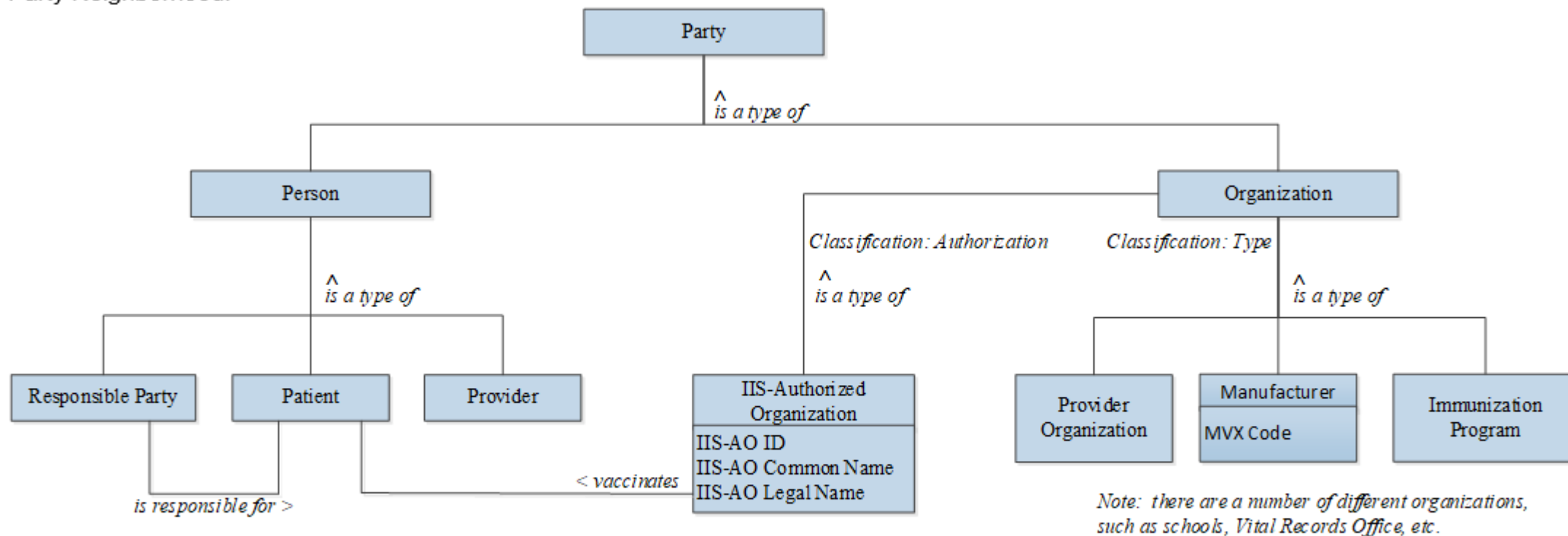
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- MIROW Common Vocabulary Workgroup
    - MIROW best practice guides only
  - CDSi reviewing and incorporating terms if appropriate
-

## Domain Diagram

## Sample Techniques

Party Neighborhood:



Facts:

Responsible Party *is responsible for* Patient

IIS-Authorized Organization *vaccinates* Patient

## Term Definitions

## Sample Techniques



### PATIENT

**Patient:** an individual who is the actual or potential recipient of a vaccine dose administered

|                           |  |
|---------------------------|--|
| Source of Term Definition | CR-2017  |
| Analysis Note             |  |
| Term Alias                |  |
| Comment                   |  |
| Example                   |  |
| Status                    | Proposed   |
| MIROW Guide               | CR-2017  |
| Guide Definition          | An Individual who is the actual or potential recipient of a Vaccine dose administered.   |
| Guide Comment             | Information about a Patient is reflected in a Demographic Record. All data elements listed in Table A-4 are part of the Demographic Record. Data elements listed in Table A-6 may be part of the Demographic Record. |
| MIROW Guide               | DINV-2016  |
| Guide Definition          | An Individual who is the actual or potential recipient of an administered Vaccine from a Provider Organization.  |
| Guide Comment             | For purposes of this guide (DiVEDE), Patients are assumed deduplicated. Refer to the guidelines on patient-level deduplication [3.5].  |

|                  |  |
|------------------|--|
| MIROW Guide      | PAIS-2015  |
| Guide Definition | An Individual who is the actual or potential recipient of a dose of Vaccine from a Provider Organization.  |
| Guide Comment    | Every Patient is an Individual, but not every Individual is a Patient. „ For purposes of Data Quality, Patients are assumed to be deduplicated. Refer to the guidelines on patient-level deduplication ( <a href="http://www.immregistries.org/resources/ijs-meetings/Fred_Grant_AIRA_De-Duplication_Presentation.pdf">http://www.immregistries.org/resources/ijs-meetings/Fred_Grant_AIRA_De-Duplication_Presentation.pdf</a> ). Provider Organizations may report Patient demographic information without Vaccination Event information. |
| MIROW Guide      | DQA-2013   |
| Guide Definition | An Individual who is the actual or potential recipient of an administered dose of Vaccine from a Vaccinator (IIS-AO).  |

## Term Definitions

## Sample Techniques



| Term           | Definition   | Comment | Example | Term Alias | CDC-EDE x-walk  | MIROW Guide  |
|----------------|--|---------|---------|------------|---|--|
| <b>Patient</b> | a <a href="#">person</a> who is the actual or potential recipient of a <a href="#">vaccine</a> | None    | None    | None       | <p>No matching term to Patient is defined. There are some related terms. For example:</p> <p>Patient Alias Name: First: the first name of a patient's alternate or also-known-as name</p> <p>Patient Alias Name: Last: the last name of a patient's alternate or also-known-as name</p> <p>Patient Alias Name: Middle: The middle name of a patient's alternate or also-known-as name.</p> <p>Patient Name: First: the patient's first name</p> <p>Patient Name: Last: the patient's last name</p> <p>Patient Name: Middle: the patient's middle name</p> | <p>CR-2017</p> <p>DINV-2016</p> <p>PAIS-2015</p> <p>DQA-2013</p> <p>INV-2012</p> <p>DLE-2011</p> <p>RR-2009</p> <p>DQA-2008</p> <p>VD-2006</p> |



**ACIP**  
Recommendations

are expressed as



**MIROW**  
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## IISSB Analysis Deliverables

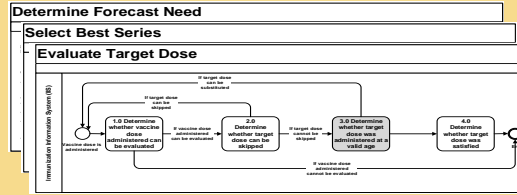
### CDSi Business Rules

| ID | Conditional Skip Rules  |
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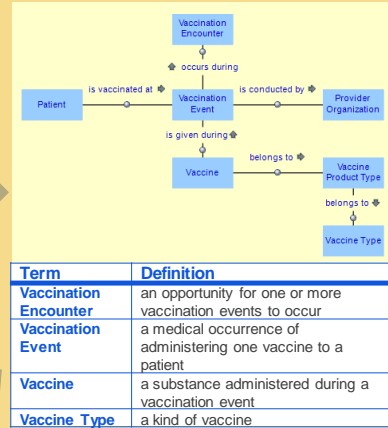
### MIROW Principles & Rules

| CONSOLIDATED RECORD - PRINCIPLES     |  |
|--------------------------------------|--|
| Principle Name                       | Principle Statement  |
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| CONSOLIDATED RECORD - RULES          |  |
| Rule ID                              | Rule Statement   |
| CR-BR04                              | The following information must be known for each data element and data group to make consolidation decisions:<br>• Type of data source<br>• Specific data source<br>• Submission date (recency?)<br>• Confidence level |
| CR-BR19                              | Use an existing demographic record (and IIS ID) as the base record for merging additional data from an incoming record.  |
| CR-BR06                              | Consolidation of two existing demographic records (i.e., with two IIS IDs) should result in one of the following options:<br>• A new demographic record (i.e. with a new IIS ID).                                      |

## CDSi Process Models



## Common Vocabulary



## IIS Functional Standards & Measures

| Essential Infrastructure Standards  |   |
|---|---|
| 1.0 The IIS contains complete and timely demographic and immunization data for children, adolescents, and adults residing or immunized within its jurisdiction.                         |   |
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These analysis models can be used as a basis for generating high-quality, comprehensive business requirements.



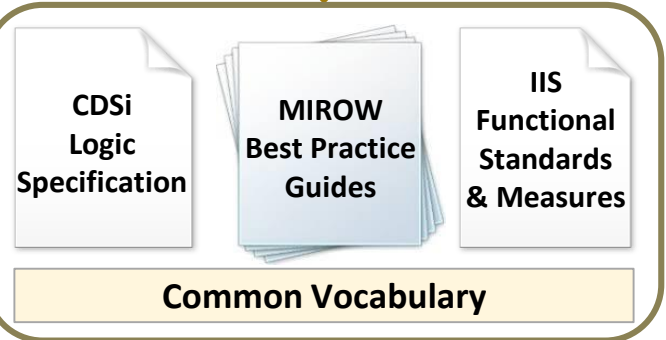
manages

provides content and analysis

Content stored as the trusted source of truth

## Immunization Repository of Knowledge

provides content for



is referenced by



# Recap

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- Evolutionary approach
  - Introduced methodology and techniques, then tool
  - Adapted techniques and deliverables to need
  - Recognized importance of vocabulary
-



# References

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- ***Business Rules Approach***
    - A Brief History of the Business Rules Approach, 3<sup>rd</sup> Edition  
[http://www.brcommunity.com/articles.php?id=b448&zoom\\_highlight=basic+business+rules](http://www.brcommunity.com/articles.php?id=b448&zoom_highlight=basic+business+rules)
    - <http://www.brsolutions.com>
  - ***MIROW***
    - <http://repository.immregistries.org/resources/filtered/by/AIRA-products-and-activities/best-practices/MIROW-guides/>
    - **David Lyalin and Warren Williams** , " Business Rules Hierarchy: The World of Business Rules Is Not Flat" *Business Rules Journal* Vol. 17, No. 2, (Feb. 2016) URL:  
<http://www.brcommunity.com/a2016/b850.html>
  - ***CDSi***
    - <https://www.cdc.gov/vaccines/programs/iis/cdsi.html>
  - ***IIS Functional Standards***
    - <https://www.cdc.gov/vaccines/programs/iis/func-stds.html>
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# Acknowledgements

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- ***CDC***
    - Stuart Myerburg
    - David Lyalin
    - Loren Rodgers
  - ***Business Rule Solutions, LLC***
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    - Ronald G. Ross
    - Cindy Scullion
-