Leveraging Business Rules Approach for Advancement of Immunization Information Systems

Warren Williams, Gladys Lam, Ronald G. Ross, David Lyalin, Stuart Myerburg, Eric Larson

Centers for Disease Control and Prevention
Business Rule Solutions, LLC

AIRA 2013 IIS National Meeting
Denver, Colorado

Presentation's Outline

- Introduction and background
- Business rule approach overview
- Business rules at three levels of concern for IIS (policy, operational and functional requirements, technical architecture)
- Wrapping up
- Q&A and discussion

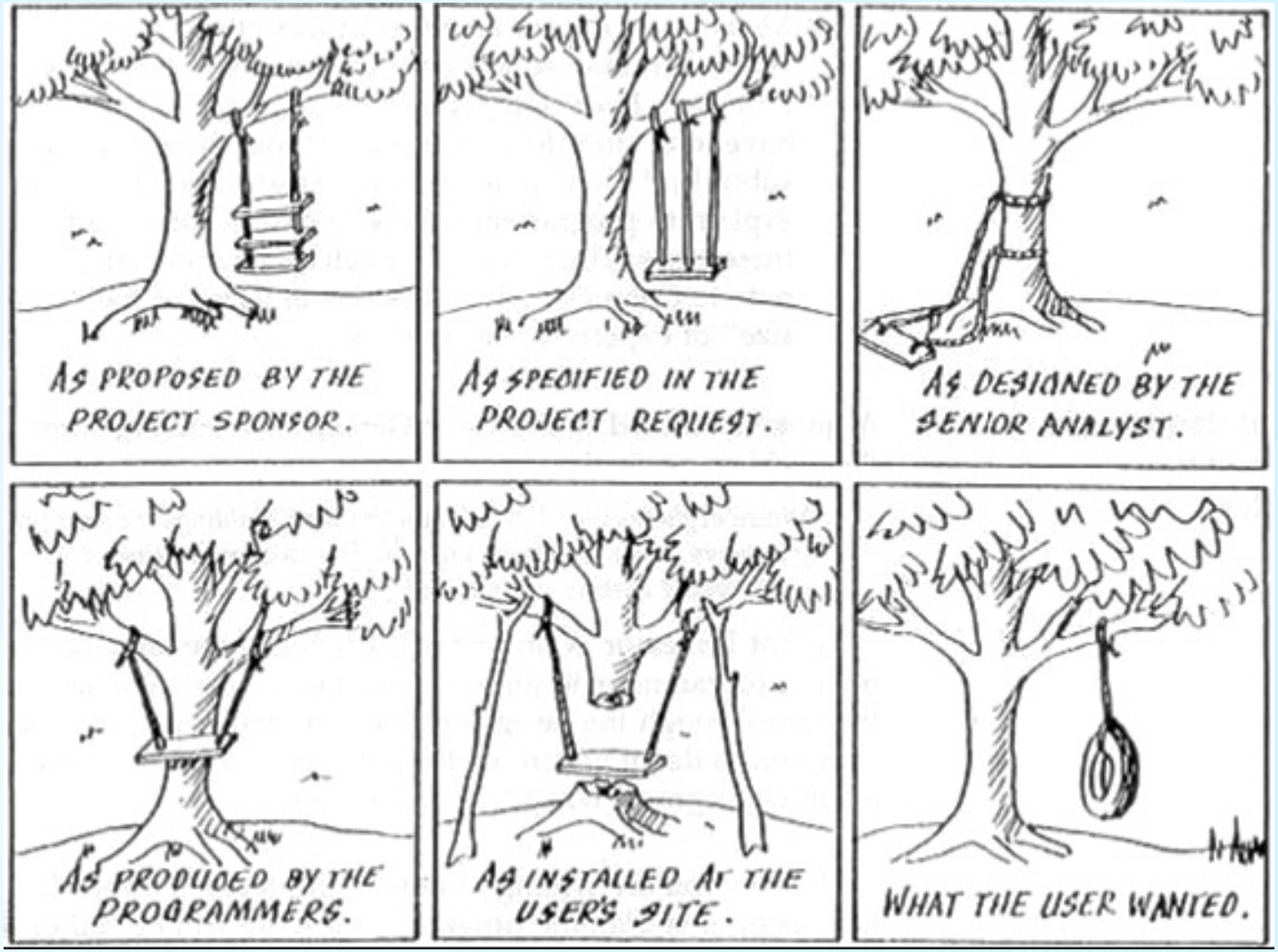
Why this topic is important for IIS?

- The business rules approach provides a set of systematic techniques to document institutional knowledge, analyze and improve operations in a complex 'IT focused' world, as well as to create a robust technical architecture for IIS
- This is a proven approach / methodology that can be followed, benefiting the IIS community across multiple registries
  - Modeling Immunization Registry Operations Workgroup (MIROW) – best practice recommendations for IIS

    http://www.cdc.gov/vaccines/programs/iis/activities/mirow.html
  - Clinical Decision Support for Immunization (CDSi) – vaccination forecasting

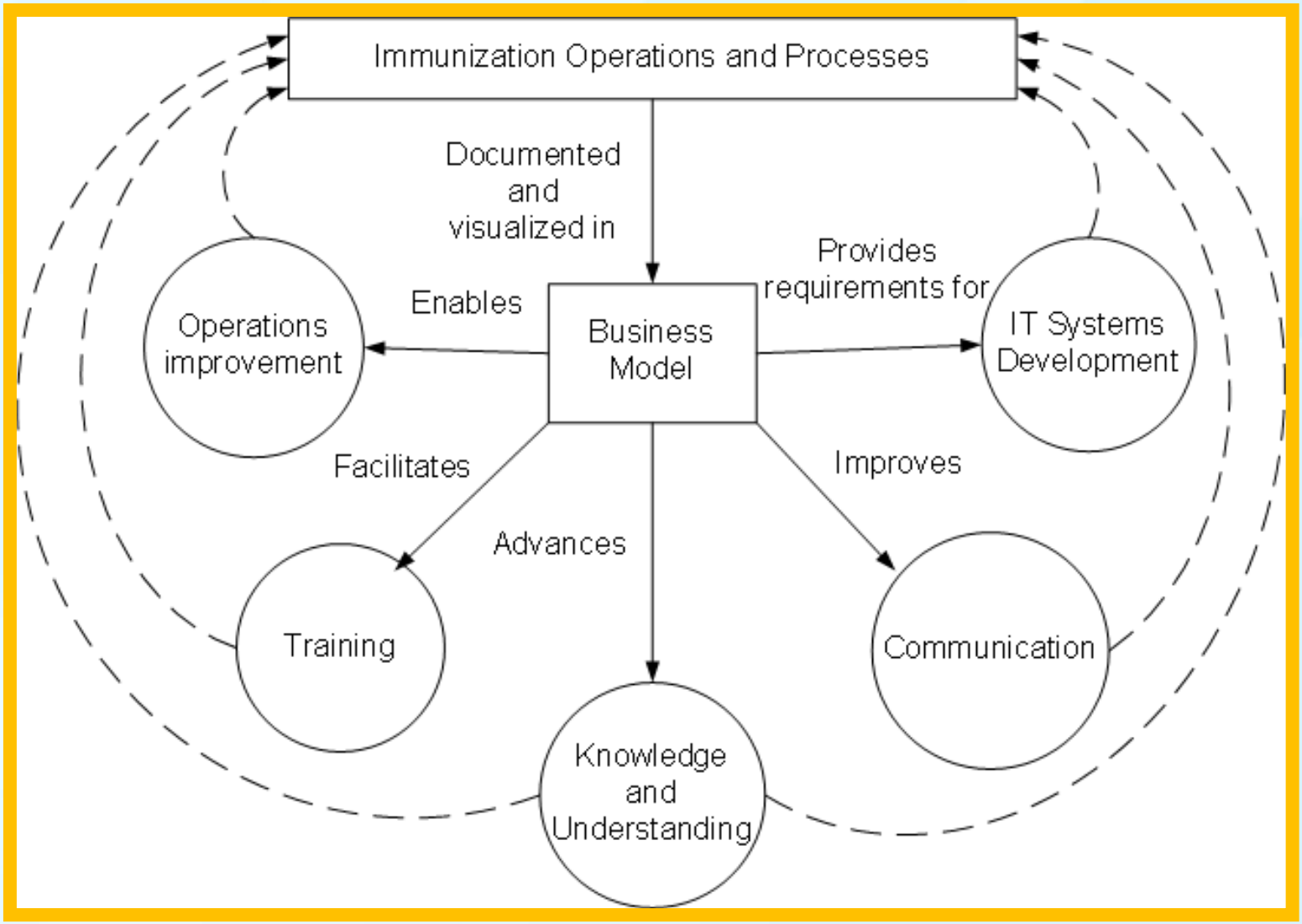
    http://www.cdc.gov/vaccines/programs/iis/interop-proj/cds.html

When business rules are missing



from Alexander, C., et al., The Oregon Experiment. 1975, Oxford: Oxford University Press.

Use and benefits



Implementation examples

- Dutch Ministry of Health, Welfare and Sports
  - uses BRs to make complex legislation accessible to the public (ROI 31% over 5 year period)
- New Zealand Ministry of Health
  - uses business rules (BRs) to determine funding of primary health care based on number of registered individuals
- Norway Financial Supervisory Authority
  - Uses BRs to formulate and remove ambiguity from laws
- International Myeloma Foundation (IMF)
  - Leverages BRs to help interpret clinical data and provide guidance and appropriate references

Questions?

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For more information please contact Centers for Disease Control and Prevention

1600 Clifton Road NE, Atlanta, GA 30333
Telephone: 1-800-CDC-INFO (232-4636)/TTY: 1-888-232-6348
E-mail: cdcinfo@cdc.gov Web: http://www.cdc.gov

Business Rules & Decisions

AIRA Meeting – October 9, 2013

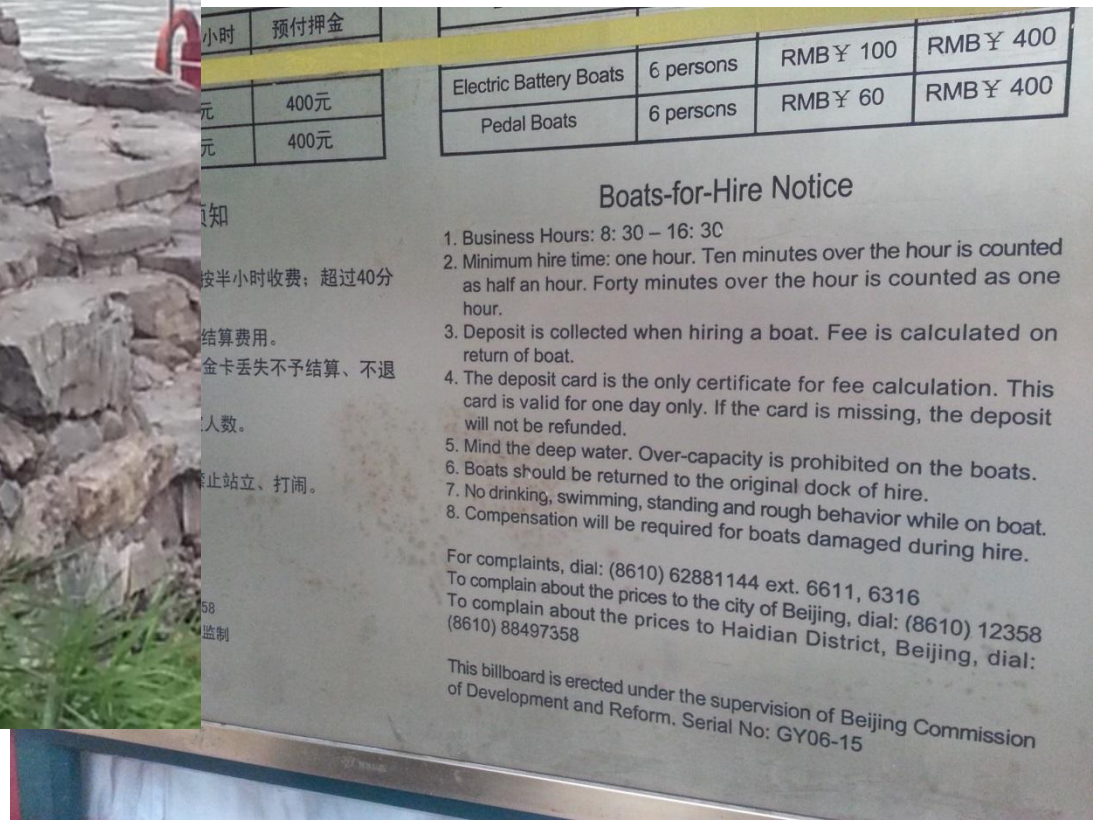
***by* Ronald G. Ross *and* Gladys S.W. Lam**

Co-Founders & Principals, Business Rule Solutions, LLC
BRSolutions.com

Executive Editor & Publisher, Business Rules Journal
BRCommunity.com

Business Rules & Decisions: Quick Introduction

Summer Palace, Beijing



小时	预付押金
元	400元
元	400元

Electric Battery Boats	6 persons	RMB￥100	RMB￥400
Pedal Boats	6 persons	RMB￥60	RMB￥400

知

按半小时收费；超过40分

结算费用。

金卡丢失不予结算、不退

人数。

止站立、打闹。

58

监制

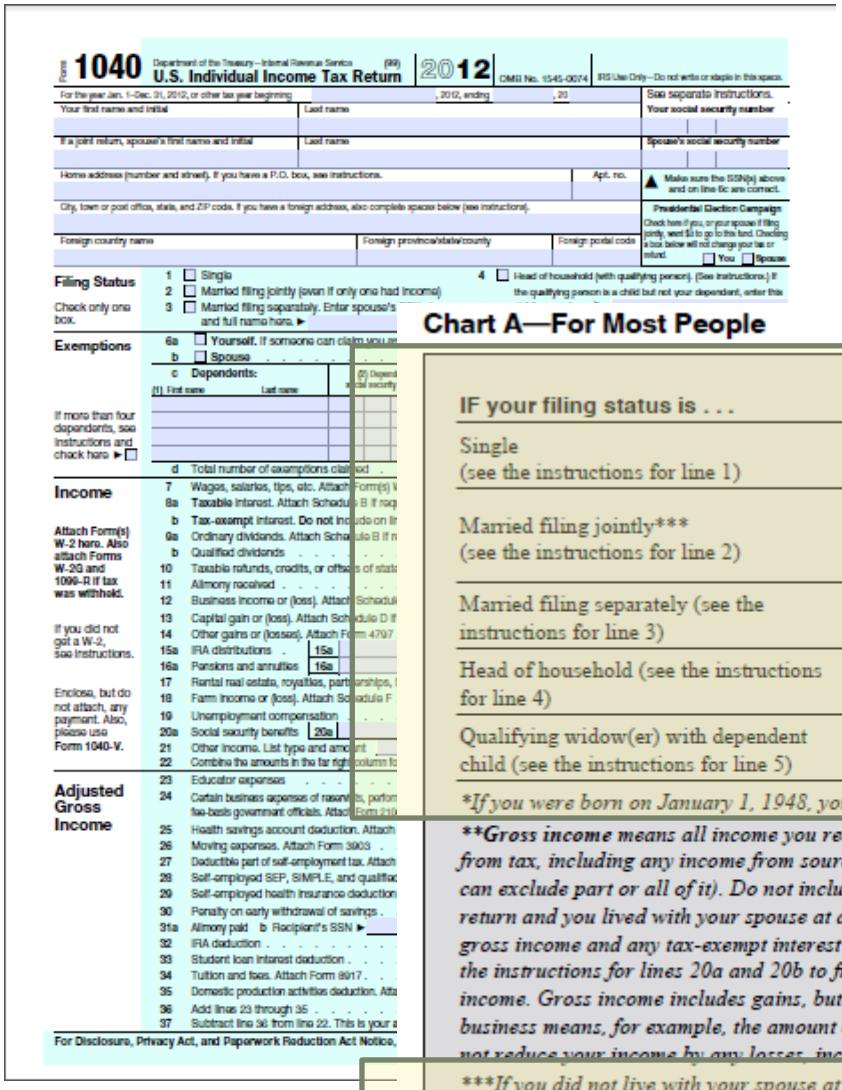
Boats-for-Hire Notice

1. Business Hours: 8: 30 – 16: 30
2. Minimum hire time: one hour. Ten minutes over the hour is counted as half an hour. Forty minutes over the hour is counted as one hour.
3. Deposit is collected when hiring a boat. Fee is calculated on return of boat.
4. The deposit card is the only certificate for fee calculation. This card is valid for one day only. If the card is missing, the deposit will not be refunded.
5. Mind the deep water. Over-capacity is prohibited on the boats.
6. Boats should be returned to the original dock of hire.
7. No drinking, swimming, standing and rough behavior while on boat.
8. Compensation will be required for boats damaged during hire.

For complaints, dial: (8610) 62881144 ext. 6611, 6316
To complain about the prices to the city of Beijing, dial: (8610) 12358
To complain about the prices to Haidian District, Beijing, dial: (8610) 88497358

This billboard is erected under the supervision of Beijing Commission of Development and Reform. Serial No: GY06-15

example: taxes



Form **1040** Department of the Treasury—Internal Revenue Service (99) **U.S. Individual Income Tax Return** **2012** OMB No. 1545-0074 IRS Use Only—Do not write or staple in this space.

For the year Jan. 1–Dec. 31, 2012, or other tax year beginning , 2012, ending , 20 See separate instructions.

Your first name and initial | Last name | Your social security number

If a joint return, spouse's first name and initial | Last name | Spouse's social security number

Home address (number and street). If you have a P.O. box, see instructions. | Apt. no. | Make sure the SSN(s) above and on line 6c are correct.

City, town or post office, state, and ZIP code. If you have a foreign address, also complete spaces below (see instructions). | Presidential Election Campaign

Foreign country name | Foreign province/state/county | Foreign postal code | Check here if you, or your spouse if filing jointly, want $3 to go to this fund. Checking a box below will not change your tax or refund. You Spouse

Filing Status Check only one box.
1 Single
2 Married filing jointly (even if only one had income)
3 Married filing separately. Enter spouse's and full name here. ▶
4 Head of household (with qualifying person). (See instructions.) If the qualifying person is a child but not your dependent, enter this

Exemptions
6a Yourself. If someone can claim you as
b Spouse
c Dependents: (1) First name Last name (2) Dependent's social security
If more than four dependents, see instructions and check here ▶
d Total number of exemptions claimed

Income Attach Form(s) W-2 here. Also attach Forms W-2G and 1099-R if tax was withheld. If you did not get a W-2, see instructions. Enclose, but do not attach, any payment. Also, please use Form 1040-V.
7 Wages, salaries, tips, etc. Attach Form(s)
8a Taxable interest. Attach Schedule B if req
b Tax-exempt interest. Do not include on li
9a Ordinary dividends. Attach Schedule B if r
b Qualified dividends
10 Taxable refunds, credits, or offsets of state
11 Alimony received
12 Business income or (loss). Attach Schedul
13 Capital gain or (loss). Attach Schedule D if
14 Other gains or (losses). Attach Form 4797
15a IRA distributions 15a
16a Pensions and annuities 16a
17 Rental real estate, royalties, partnerships,
18 Farm income or (loss). Attach Schedule F
19 Unemployment compensation
20a Social security benefits 20a
21 Other income. List type and amount
22 Combine the amounts in the far right column fo

Adjusted Gross Income
23 Educator expenses
24 Certain business expenses of reservists, perform fee-basis government officials. Attach Form 2106
25 Health savings account deduction. Attach
26 Moving expenses. Attach Form 3903
27 Deductible part of self-employment tax. Attach
28 Self-employed SEP, SIMPLE, and qualified
29 Self-employed health insurance deduction
30 Penalty on early withdrawal of savings
31a Alimony paid b Recipient's SSN ▶
32 IRA deduction
33 Student loan interest deduction
34 Tuition and fees. Attach Form 8917
35 Domestic production activities deduction. Attach
36 Add lines 23 through 35
37 Subtract line 36 from line 22. This is your

For Disclosure, Privacy Act, and Paperwork Reduction Act Notice,

Chart A—For Most People

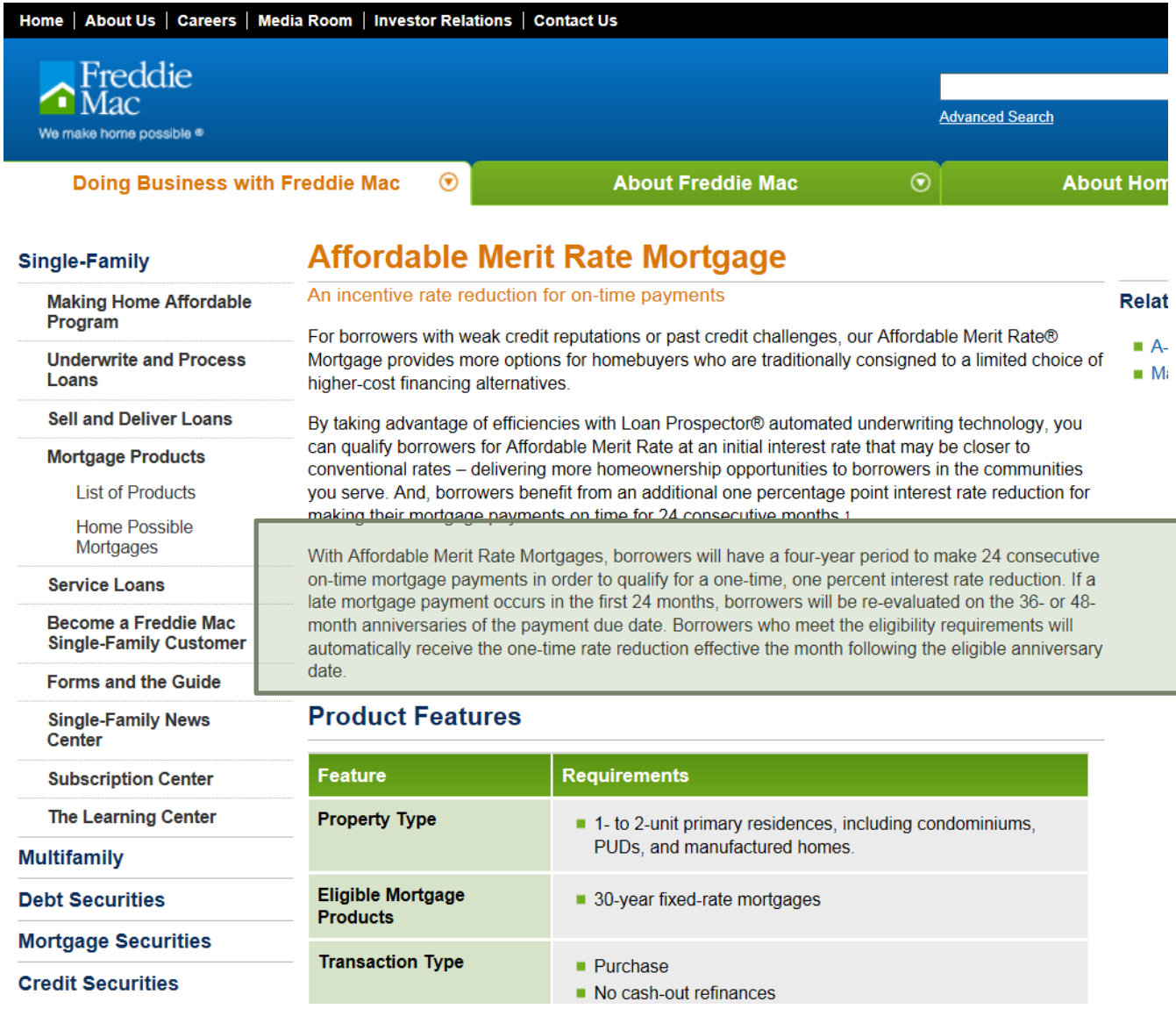
IF your filing status is . . .	AND at the end of 2012 you were* . . .	THEN file a return if your gross income** was at least . . .
Single (see the instructions for line 1)	under 65 65 or older	$9,750 11,200
Married filing jointly*** (see the instructions for line 2)	under 65 (both spouses) 65 or older (one spouse) 65 or older (both spouses)	$19,500 20,650 21,800
Married filing separately (see the instructions for line 3)	any age	$3,800
Head of household (see the instructions for line 4)	under 65 65 or older	$12,500 13,950
Qualifying widow(er) with dependent child (see the instructions for line 5)	under 65 65 or older	$15,700 16,850

**If you were born on January 1, 1948, you are considered to be age 65 at the end of 2012.*

*****Gross income** means all income you received in the form of money, goods, property, and services that is not exempt from tax, including any income from sources outside the United States or from the sale of your main home (even if you can exclude part or all of it). Do not include any social security benefits unless (a) you are married filing a separate return and you lived with your spouse at any time in 2012 or (b) one-half of your social security benefits plus your other gross income and any tax-exempt interest is more than $25,000 ($32,000 if married filing jointly). If (a) or (b) applies, see the instructions for lines 20a and 20b to figure the taxable part of social security benefits you must include in gross income. Gross income includes gains, but not losses, reported on Form 8949 or Schedule D. Gross income from a business means, for example, the amount on Schedule C, line 7, or Schedule F, line 9. But, in figuring gross income, do not reduce your income by any losses, including any loss on Schedule C, line 7, or Schedule F, line 9.*

****If you did not live with your spouse at the end of 2012 (or on the date your spouse died) and your gross income was at least $3,800, you must file a return regardless of your age.*

example: mortgages



example: immunization

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Morbidity and Mortality Weekly Report (*MMWR*)

MMWR

Recommend 34 Tweet 4 Share

General Recommendations on Immunization

Recommendations of the Advisory Committee on Immunization Practices (ACIP)

Please note: An erratum has been published for this article. To view the erratum, please click here.

Recom
January

Spacing of Multiple Doses of the Same Antigen

Vaccination providers should adhere as closely as possible to recommended vaccination schedules (Table 1). Administration at recommended ages and in accordance with recommended intervals between doses of multidose antigens provide optimal protection.

Administration of doses of a multidose vaccine using intervals that are shorter than recommended might be necessary in certain circumstances, such as impending international travel or when a person is behind schedule on vaccinations but needs rapid protection. In these situations, an accelerated schedule can be implemented using intervals between doses that are shorter than intervals recommended for routine vaccination. The accelerated or minimum intervals and ages for scheduling catch-up vaccinations are available at http://www.cdc.gov/vaccines. Vaccine doses should not be administered at intervals less than these minimum intervals or at an age that is younger than the minimum age.*

Before administering a vaccine dose, providers might need to verify that all previous doses were administered after the minimum age and in accordance with minimum intervals (Table 1). In clinical practice, vaccine doses occasionally are administered at intervals less than the minimum interval or at ages younger than the minimum age. Doses administered too close together or at too young an age can lead to a suboptimal immune response. However, administering a dose a few days earlier the minimum interval or age is unlikely to have a substantially negative effect on the immune response to that dose. Vaccine doses administered ≤4 days before the minimum interval or age are considered valid; however, local or state mandates might supersede this 4-day guideline.† (Day 1 is the day before the day that marks the minimum age or minimum interval for a vaccine.) Because of the unique schedule for rabies vaccine, the 4-day guideline does not apply to this vaccine (5). Doses of any vaccine administered ≥5 days earlier than the minimum interval or age should not be counted as valid doses and should be repeated as age appropriate. The repeat dose should be spaced after the invalid dose by the recommended minimum interval (Table 1). For example, if the first and second doses of *Haemophilus influenzae* type b (Hib) were administered only 14 days apart, the second dose would be invalid and need to be repeated because the minimum interval from dose 1 to dose 2 is 4 weeks. The repeat dose should be administered ≥4 weeks after the invalid dose (in this case, the second). The repeat dose is counted as the valid second dose.

If the first dose in a series is given ≥5 days before the recommended minimum age, the dose should be repeated on or after the date when the child reaches at least the minimum age. If the vaccine is a live vaccine, ensuring that a minimum interval of 28 days has elapsed from the invalid dose is recommended. For example, if the first dose of varicella vaccine were inadvertently administered at age 10 months, the repeat dose would be administered no earlier than the child's first birthday (the minimum age for the first dose). If the first dose of varicella vaccine were administered at age 11 months and 2 weeks, the repeat dose should be administered no earlier than 4 weeks thereafter, which would occur after the first birthday.

Certain vaccines (e.g., adult tetanus and diphtheria toxoids [Td], pediatric diphtheria and tetanus toxoids [DT]; and tetanus toxoid) produce increased rates of local or systemic reactions in certain recipients when administered more frequently than recommended (6,7). Careful record keeping, maintenance of patient

No jet-powered cars.

me

No car is allowed if it has a peacock on the top.

No peacock is allowed if it has a car at the bottom.

Gene Weng

A vehicle must not carry a Christmas tree on its roof if it's on fire.

Casper Yeow

No campfires on a car roof.

J John Jones

No car explosions allowed in the area.

Johannes van Schalkwyk

Business rules are about business communication … people communicating with people, often displaced in time, place & function.

Reference: RuleSpeak® 3.0 (free download) http://www.brsolutions.com/b_ipspeakprimers.php

translating ACIP recommendations

Advisory Committee on Immunization Practices (ACIP)

Clinical Immunization Recommendations

CDS Engine

bridging the gap …

governance & research

- strategy & policies
- principles
- science & engineering know-how

operations

- business rules
- decision structures
- decision tables
- subject vocabulary

IT technology

specifications for …

- business rule engines
- programming languages
- application platforms

business rule statement

A vaccine dose administered must be considered an allowable vaccine if all the following are true:

- The vaccine type of the vaccine dose administered is one of the allowable vaccine types.
- The date administered is on or later than the allowable vaccine type begin age date.
- The date administered is earlier than the allowable vaccine type end age date.

business rules

definition

business rule: criterion used in business operations to

- guide behavior
- shape judgments
- make decisions

Can a vaccine dose administered be evaluated and why?

Vaccination Expired?	Dose Condition Indicated? Yes	Dose Condition Indicated? No
Yes	Vaccine dose administered cannot be evaluated	Vaccine dose administered cannot be evaluated
No	Vaccine dose administered cannot be evaluated	Vaccine dose administered can be evaluated

Definition:

Vaccination Expired means Vaccination Date > Lot Expiration Date.

decision tables

business rule

The vaccine lot number must be reported for every vaccination event.

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definitions

Vaccination Event: administration of one Vaccine to a Patient

Vaccination Encounter: an interaction between a Provider and Patient resulting in one or more Vaccination Events

Provider: a medical practitioner (e.g., physician, nurse) who administers an immunization – i.e., conducts a Vaccination Event

Patient:

Vaccine:

Vaccine Lot Number:

subject vocabulary

goal for know-how in a knowledge economy

governance & research

operations

IT technology

- business rules
- decision structures
- decision tables
- subject vocabulary

the same complete, intelligible, unambiguous, deployable meaning for each audience

challenges

- policies and regulations not rigorously captured
- incomplete, inaccurate or absent specifications
- imbalance between business need and supporting technology
- the need to do more with less
- effective, timely communication among all stakeholders
- poor preservation of institutional knowledge

references

- 2007 - OMG Semantics of Business Vocabulary and Business Rules (SBVR) standard
- 2000 - BRG Business Motivation Model (BMM)
  www.businessrulesgroup.org/second_paper/BRG-BMM.pdf
- 2002 - Business Rules Manifesto (16+ languages)
  www.businessrulesgroup.org/brmanifesto.htm
- 1997 – 2013 - Business Rules & Decisions Forum conference, Nov 11 – Nov 15, Las Vegas
- 2000 – 2013 - www.BRCommunity.com

Business Rules & Decisions: from Interpretation to Implementation

to be discussed

- where are the business rules
- how to be rigorous and precise
- how to go from business source to implementation
- how to develop scenarios for testing
- how to ensure true business alignment

immunization rules for children

Morbidity and Mortality Weekly Report (*MMWR*)

MMWR

General Recommendations on Immunization

Recommendations of the Advisory Committee on Immunization Practices (ACIP)

Please note: An erratum has been published for this article. To view the erratum, please click here.

Recommendations and Reports
January 28, 2011 / 60(RR02);1-60

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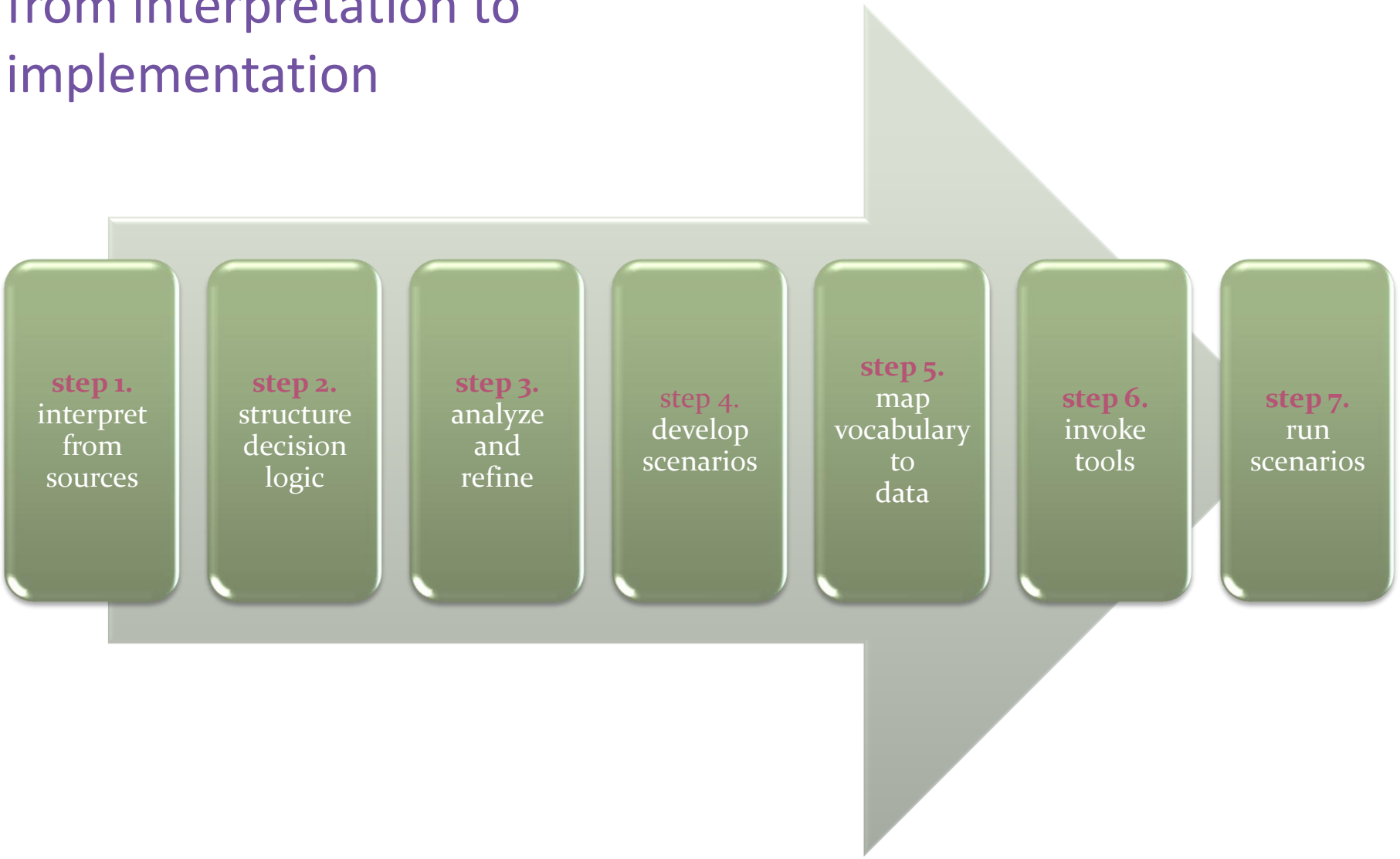
Corresponding preparer: Andrew Kroger, MD, National Center for Immunization and Respiratory Diseases, 1600 Clifton Rd., MS E-52, Atlanta, GA 30333. Telephone: 404-639-1958; Fax: 404-639-8828; E-mail: aok2@cdc.gov.

Summary

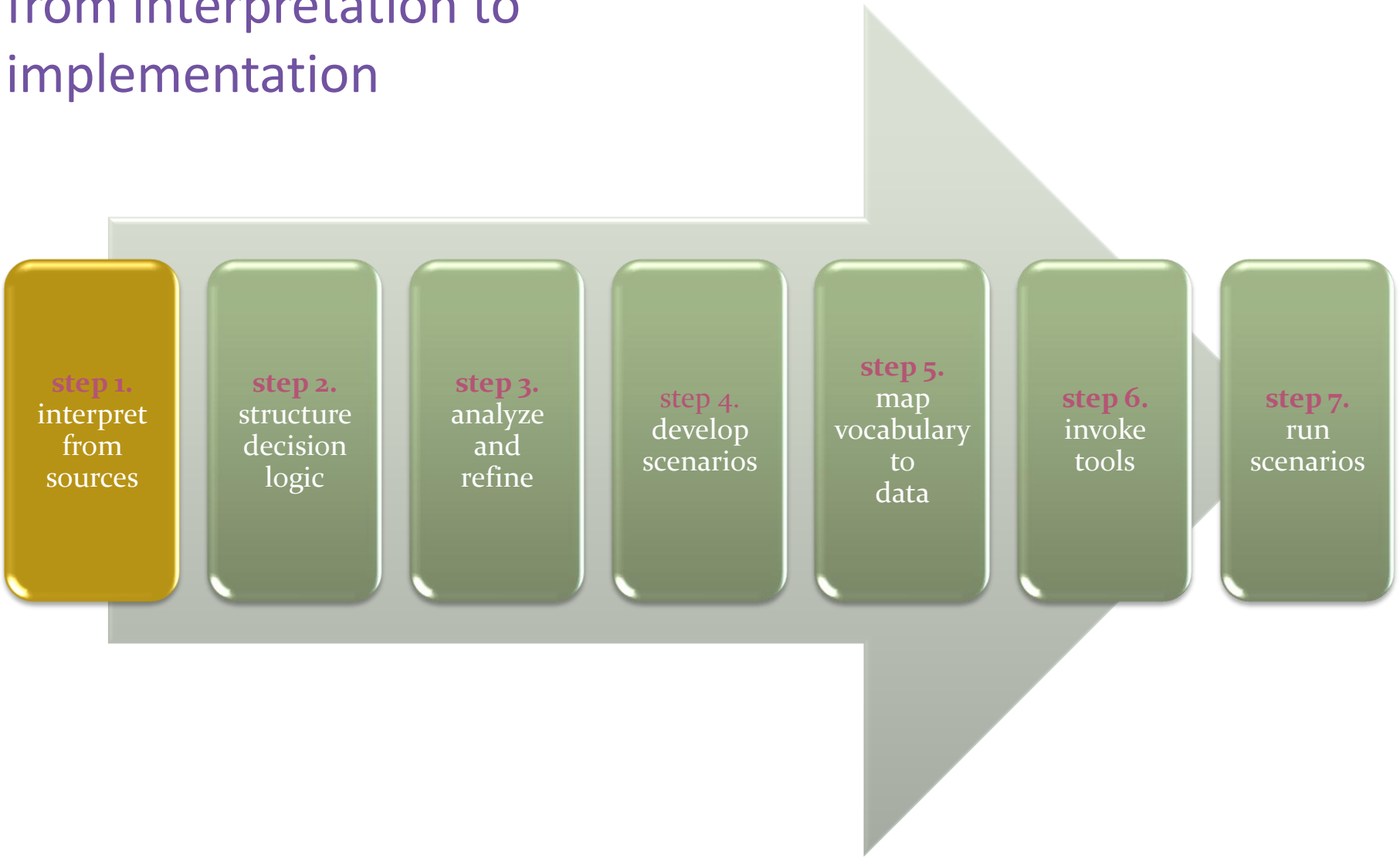
This report is a revision of the General Recommendations on Immunization *and updates the 2006 statement by the Advisory Committee on Immunization Practices (ACIP) (CDC. General recommendations on immunization: recommendations of the Advisory Committee on Immunization Practices [ACIP]. MMWR 2006;55[No. RR-15]). The report also includes revised content from previous ACIP recommendations on the following topics: adult vaccination (CDC. Update on adult immunization recommendations of the immunization practices Advisory Committee [ACIP]. MMWR 1991;40[No. RR-12]); the assessment and feedback strategy to increase vaccination rates (CDC. Recommendations of the Advisory Committee on Immunization Practices: programmatic strategies to increase vaccination rates---assessment and feedback of provider-based vaccination coverage information. MMWR 1996;45:219--20); linkage of vaccination services and those of the Supplemental Nutrition Program for Women, Infants, and Children (WIC program) (CDC. Recommendations of the Advisory Committee on Immunization Practices: programmatic strategies to increase vaccination coverage by age 2 years---linkage of vaccination and WIC services. MMWR 1996;45:217--8); adolescent immunization (CDC. Immunization of adolescents: recommendations of the Advisory Committee on Immunization Practices, the*

business rules & decisions: from interpretation to implementation



step by step

business rules & decisions: from interpretation to implementation



step by step

imprecise

inconsistent

disjointed

nature of sources

Poliomyelitis Prevention in the United States

Updated Recommendations of the Advisory Committee on Immunization Practices (ACIP)

Summary

These recommendations of the Advisory Committee on Immunization Practices (ACIP) for poliomyelitis prevention replace those issued in 1997. As of January 1, 2000, ACIP recommends exclusive use of inactivated poliovirus vaccine (IPV) for routine childhood polio vaccination in the United States. All children should receive four doses of IPV at ages 2, 4, and 6--18 months and 4--6 years. Oral poliovirus vaccine (OPV) should be used only in certain circumstances, which are detailed in these recommendations. Since 1979, the only indigenous cases of polio reported in the United States have been associated with the use of the live OPV. Until recently, the benefits of OPV use (i.e., intestinal immunity, secondary spread) outweighed the risk for vaccine-associated paralytic poliomyelitis (VAPP) (i.e., one case among 2.4 million vaccine doses distributed). In 1997, to decrease the risk for VAPP but maintain the benefits of OPV, ACIP recommended replacing the all-OPV schedule with a sequential schedule of IPV followed by OPV. Since 1997, the global polio eradication initiative has progressed rapidly, and the likelihood of poliovirus importation into the United States has decreased substantially. In addition, the sequential schedule has been well accepted. No declines in childhood immunization coverage were observed, despite the need for additional injections. On the basis of these data, ACIP recommended on June 17, 1999, an all-IPV schedule for routine childhood polio vaccination in the United States to eliminate the risk for VAPP. ACIP reaffirms its support for the global polio eradication initiative and the use of OPV as the only vaccine recommended to eradicate polio from the remaining countries where polio is endemic.

imprecise

nature of sources

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All children should receive four doses of IPV at ages 2, 4, and 6--18 months and 4--6 years. Oral poliovirus vaccine (OPV) should be used only in certain circumstances, which are detailed in these recommendations.

- 2 and 4 – months or years?
- up to, or up to and including (through), 18 months and 6 years
- vaccination at 2 or 4 months? what about +/- 1 day? +/- 5 days? +/- 30 days? what is the threshold?

imprecise

nature of sources

from Proof of Insurance Underwriter Guidelines

Refusal Criteria

Uninsured Driver. Candidate shall be deemed ineligible for Protector.

Note: Candidate's eligibility for Reliance to be based on the Insurance Risk Score and satisfying other criteria.

Exception: A Candidate is eligible for Protector without Proof of Insurance if:

- The Candidate has been insured in Protector for 30 months or more, and
- The current policy has not been out of force for more than two months, and
- There was no prior lapse in coverage, and
- All other eligibility requirements are met.

Note: Candidate to be treated as Re-Admission.

Acceptance Criteria

Uninsured Non-Driver. Candidates who do not have Proof of Insurance but who have not been driving uninsured may be submitted non-binding for Protector or Reliance.

Note: A Candidate's eligibility to be based meeting all other eligibility criteria.

First-Time or Re-Admission Candidate. A First-Time or Re-Admission Candidate may be written in Protector or Reliance if the Candidate is:

- Currently insured, and
- Acceptable evidence of current liability insurance is given, and
- Is otherwise eligible.

First-Vehicle Candidate. A First-Vehicle Candidate may be submitted in Protector or Reliance if the Candidate:

- Is becoming an owner of an automobile for the first time, and
- Provides proof of purchase, and
- Has not been driving a car uninsured, and
- Is otherwise eligible.

need to examine other sources

disjointed

nature of sources

from Proof of Insurance Underwriter Guidelines

synonyms?

applicant?

The preferred form of Proof of Insurance is a current renewal notice.

Other acceptable forms are:

- A letter or FAX from the previous carrier acknowledging cancellation by the policyholder.
- A cancellation notice from the previous insurance company due to non-payment.

A Declaration Page shall not be accepted unless one of these special circumstances applies:

- Multiple Insured Vehicles …
- Newly Purchased Vehicle. An original or facsimile of a current Declaration Page may be accepted as proof of insurance if:
  - ⇔ The Candidate has purchased a vehicle in the past 20 days and seeks coverage, *and*
  - ⇔ A facsimile of the purchase contract or sales invoice is submitted, *and*
  - ⇔ All other household vehicles are currently insured with some other insurer, *and*
- New Resident. An original or facsimile of a current Declaration Page may be accepted as proof of insurance if:
  - ⇔ The Candidate is moving into the state, *and*
  - ⇔ All other vehicles are currently insured with some other provider …

inconsistent

nature of sources

research

interpret

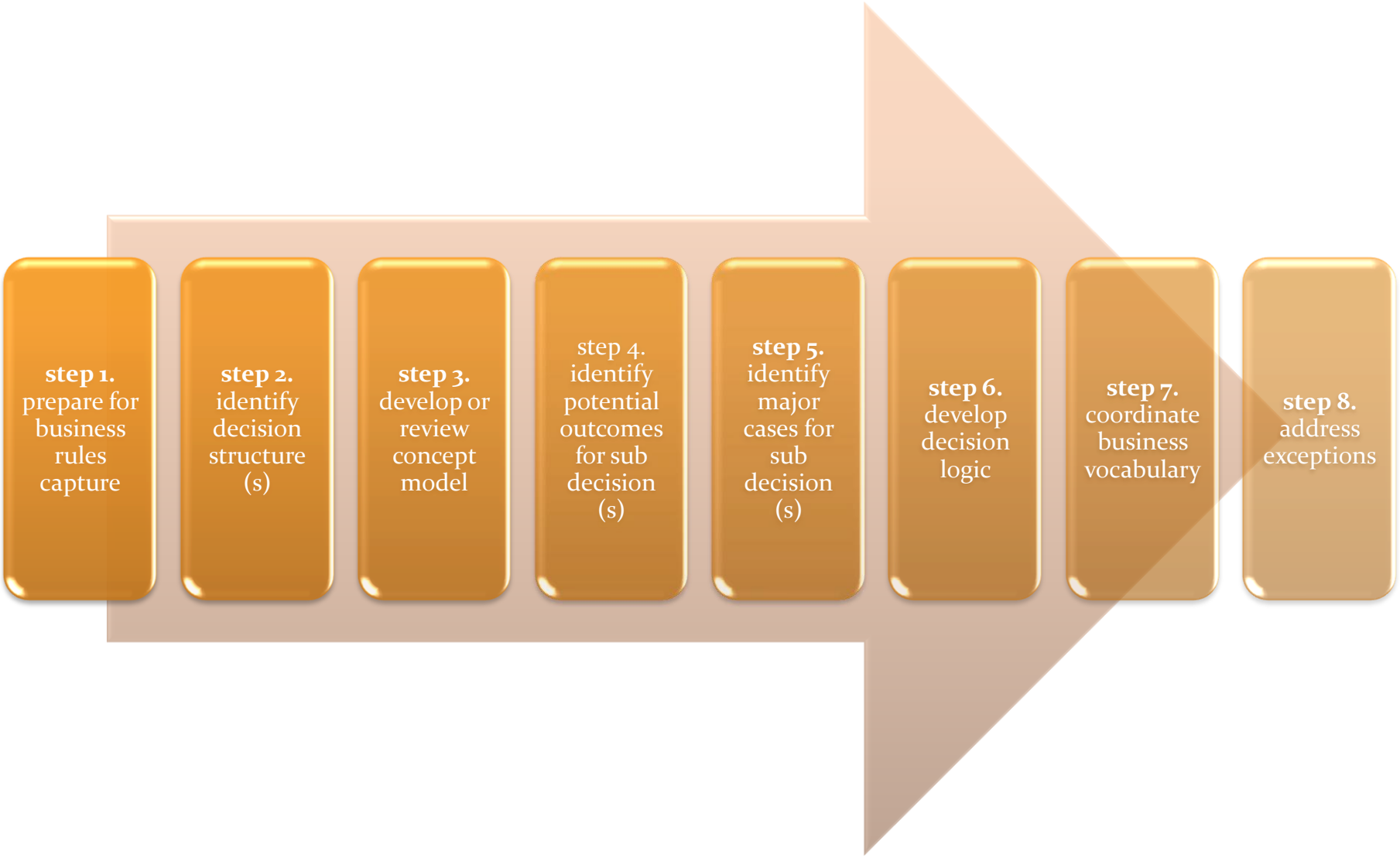
brainstorm, validate & review

facilitated sessions

step 1: the journey

- increase precision
- eliminate inconsistency
- drill down on decision logic
- fill gaps

8 steps in harvesting business rules



step 1: the method

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All children should receive four doses of IPV at ages 2, 4, and 6--18 months and 4--6 years. Oral poliovirus vaccine (OPV) should be used only in certain circumstances, which are detailed in these recommendations.

interpret to

date ranges of

- 0 through 2 months
- 2 months + 1 day through 4 months
- 6 months through 18 months
- 4 years through 6 years

minimum age
maximum age

imprecise

step 1: the destination

Poliomyelitis Prevention in the United States

Updated Recommendations of the Advisory Committee on Immunization Practices (ACIP)

Summary

These recommendations of the Advisory Committee on Immunization Practices (ACIP) for poliomyelitis prevention replace those issued in 1997. As of January 1, 2000, ACIP recommends exclusive use of inactivated poliovirus vaccine (IPV) for routine childhood polio vaccination in the United States. All children should receive four doses of IPV at ages 2, 4, and 6--18 months and 4--6 years. Oral poliovirus vaccine (OPV) should be used only in certain circumstances, which are detailed in these recommendations. Since 1979, the only indigenous cases of polio reported in the United States have been associated with the use of the live OPV. Until recently, the benefits of OPV use (i.e., intestinal immunity, secondary spread) outweighed the risk for vaccine-associated paralytic poliomyelitis (VAPP) (i.e., one case among 2.4 million vaccine doses distributed). In 1997, to decrease the risk for VAPP but maintain the benefits of OPV, ACIP recommended replacing the all-OPV schedule with a sequential schedule of IPV followed by OPV. Since 1997, the global polio eradication initiative has progressed rapidly, and the likelihood of poliovirus importation into the United States has decreased substantially. In addition, the sequential sche... for additional injections. On... vaccination in the United St... use of OPV as the only vacc...

All children should receive four doses of IPV at ages 2, 4, and 6--18 months and 4--6 years. Oral poliovirus vaccine (OPV) should be used only in certain circumstances, which are detailed in these recommendations.

interpret to

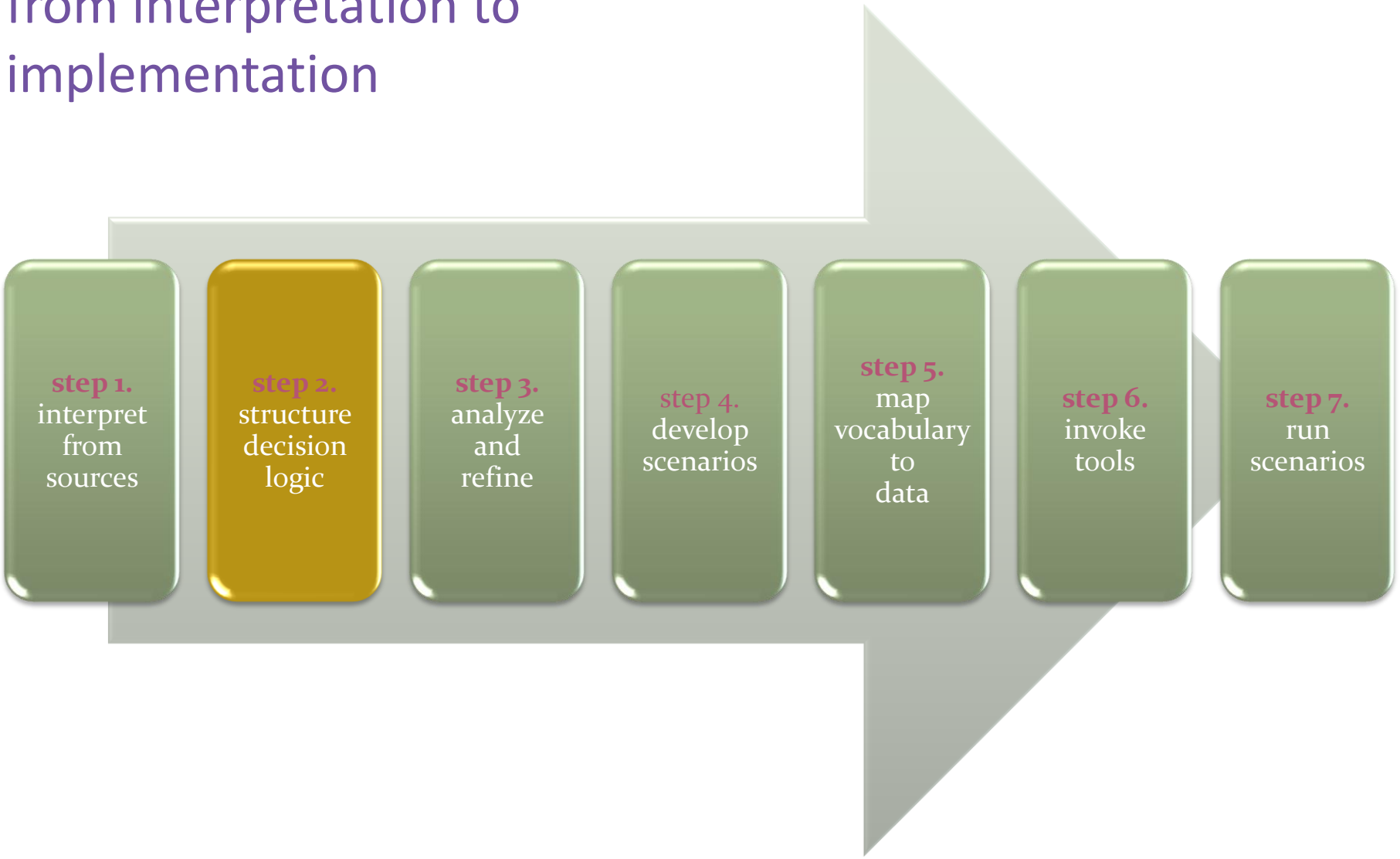
- absolute minimum age is 6 weeks – 4 days
- minimum age is 6 weeks
- earliest recommended age is 2 months
- latest recommended age is 3 months + 4 weeks

imprecise

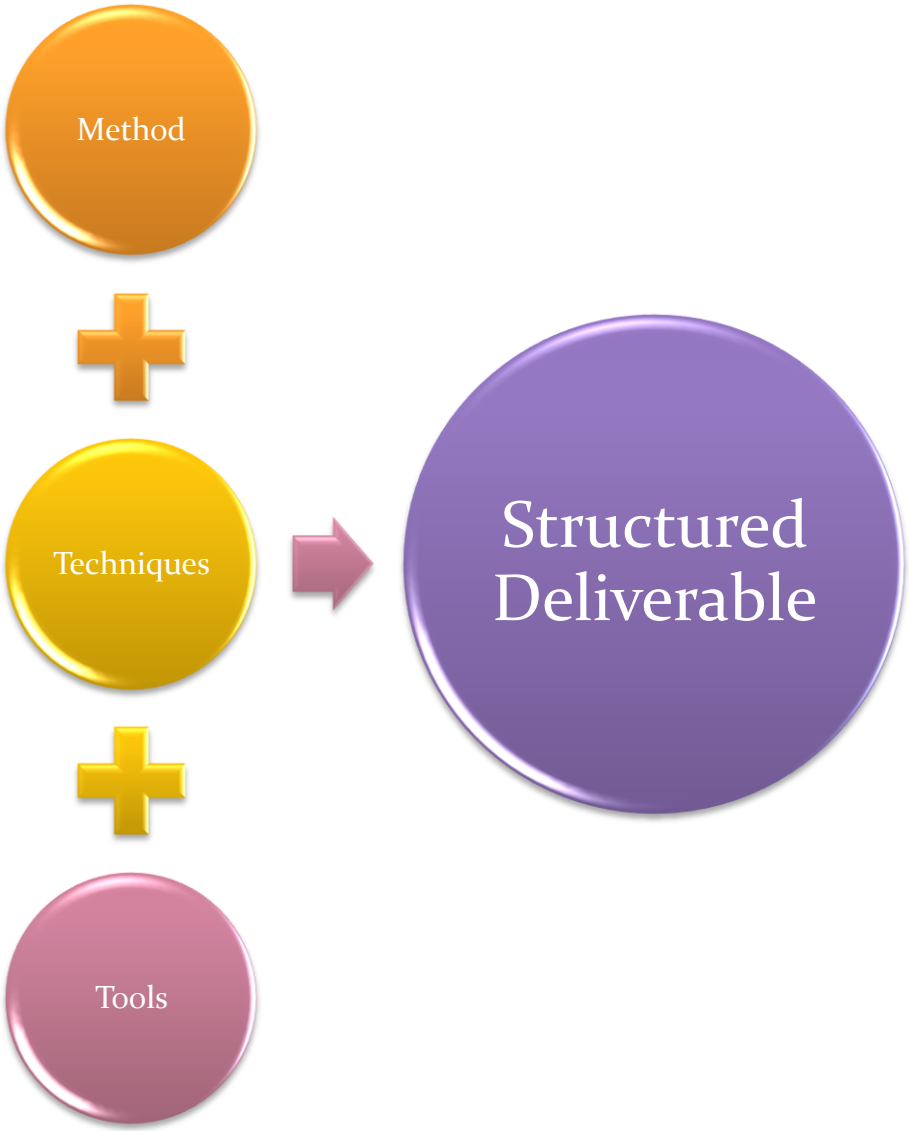
step 1: the destination

- make terminology precise
- identify decisions and business rules
- resolve gaps and inconsistencies
- start to shape decision logic and business rule statements

business rules & decisions: from interpretation to implementation



step by step



structure decision logic

specify, model, organize and analyze

validate

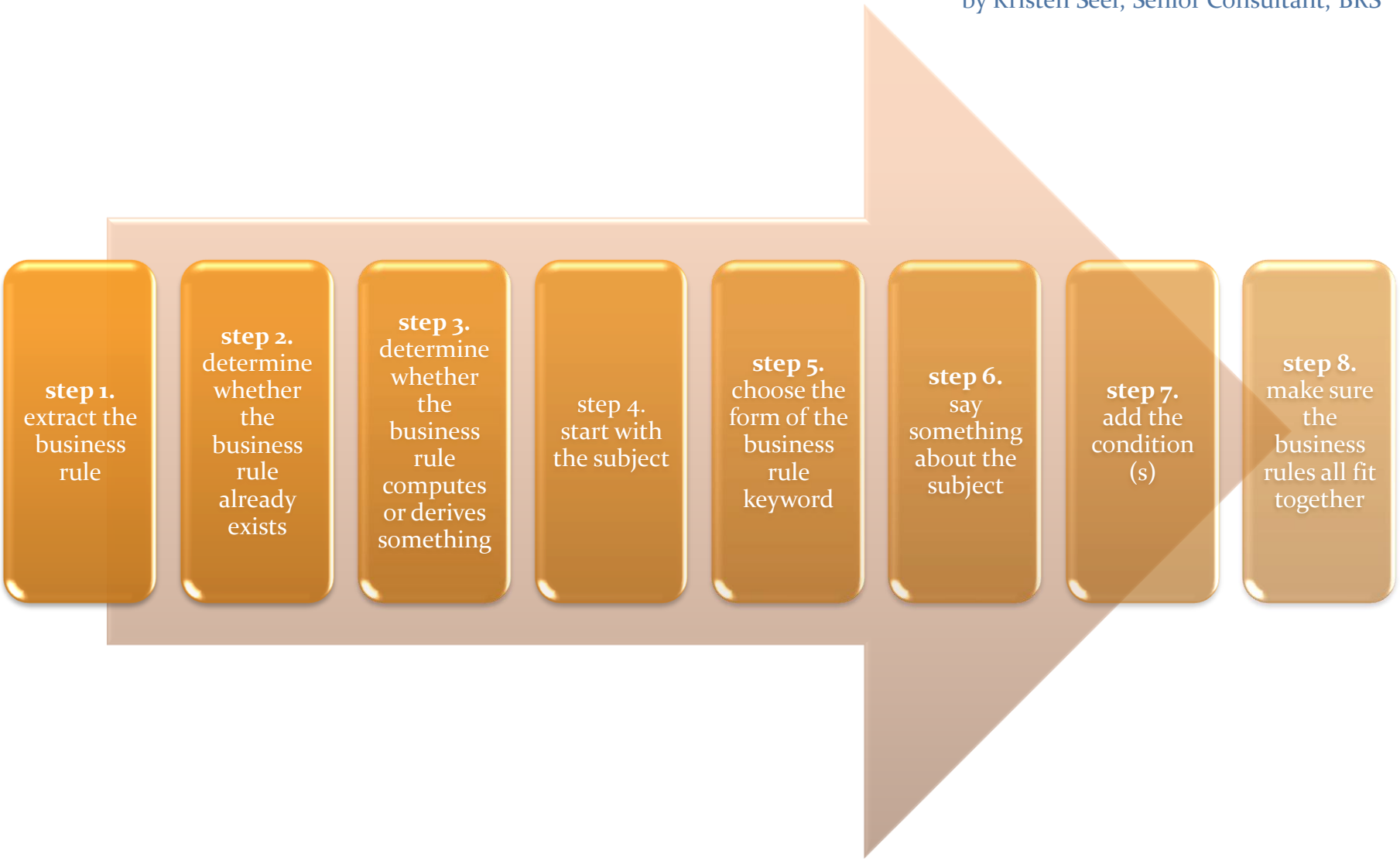
facilitated sessions

step 2: the journey

- apply method and techniques
- structure deliverables
- organize deliverables
- validate deliverables

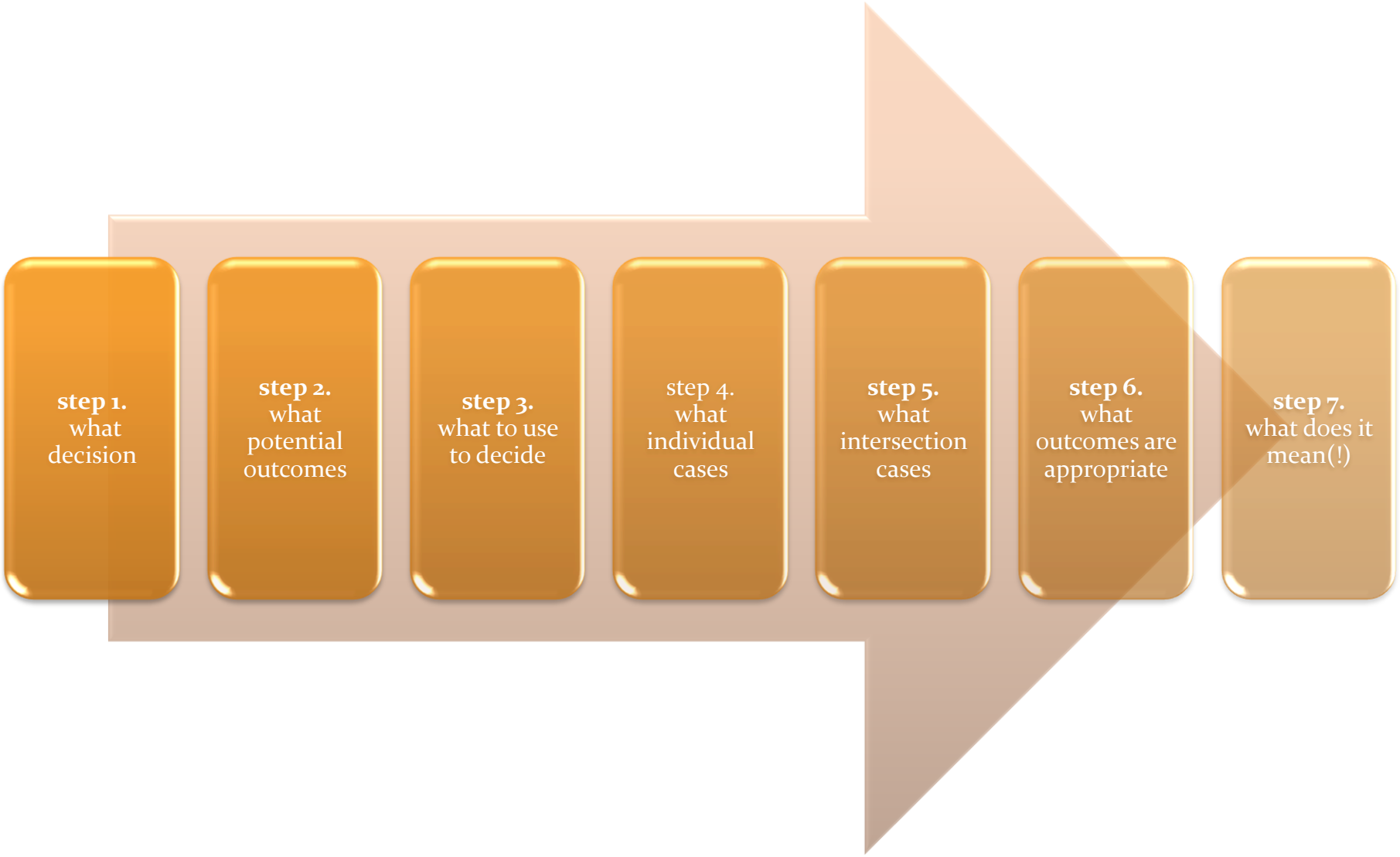
8 steps in specifying a business rule

the original version of this training material created by Kristen Seer, Senior Consultant, BRS



step 2: the method

7 steps in structuring decision tables

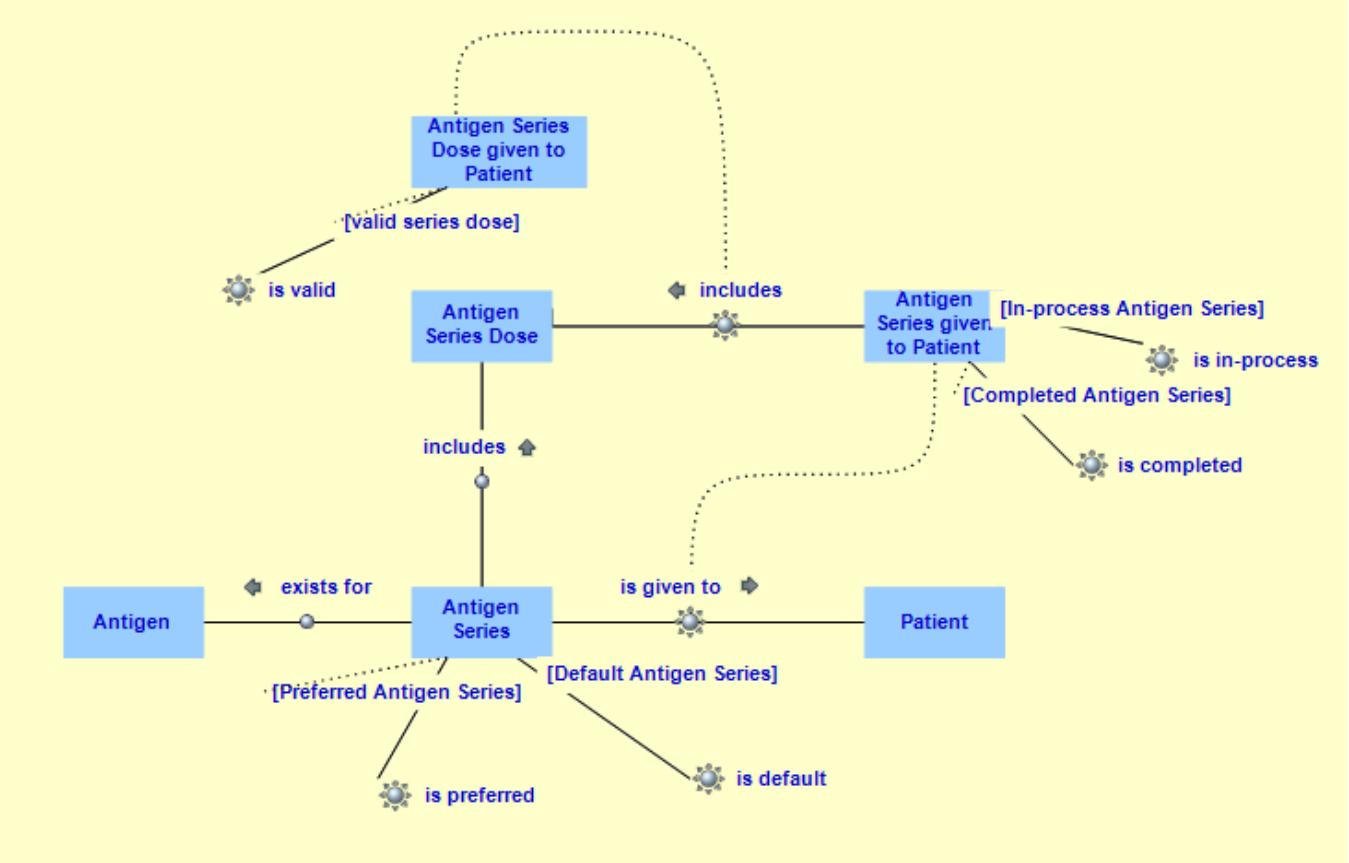


step 2: the method

- IPSpeak™ ...
  - DecisionSpeak™
  - TableSpeak™
  - ConceptSpeak™
  - RuleSpeak®
- drill-down on decision logic
- decision and rule management

step 2: the techniques

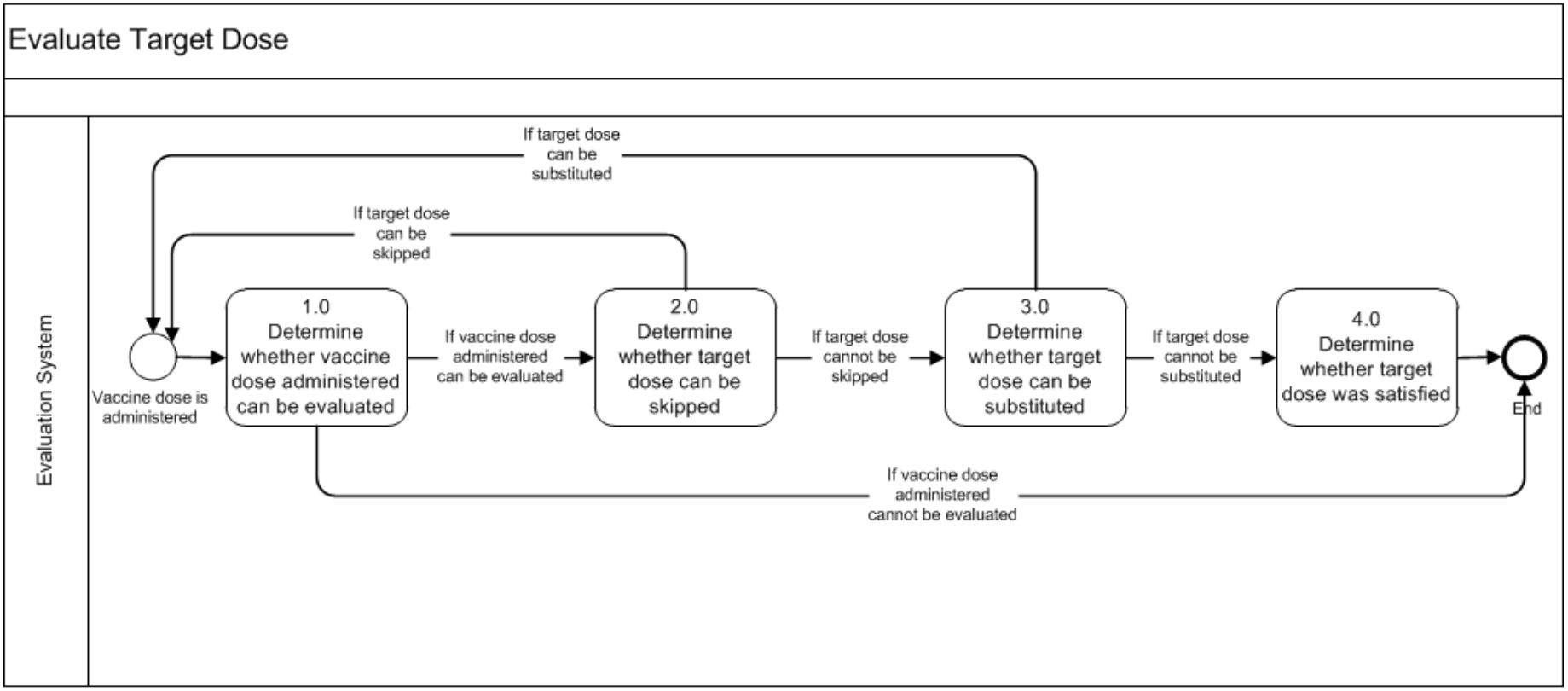
concept model (structured business vocabulary)



Antigen	a foreign (non-self) substance which can cause an immune response
Antigen Series	one possible path to achieve presumed immunity against a disease
Antigen Series Dose	the measured quantity of a medicine or other therapeutic agent to be taken at one time or in a period of time
Antigen Series Dose given to Patient	an Antigen Series Dose given to a patient
Antigen Series given to Patient	an Antigen Series given to a patient

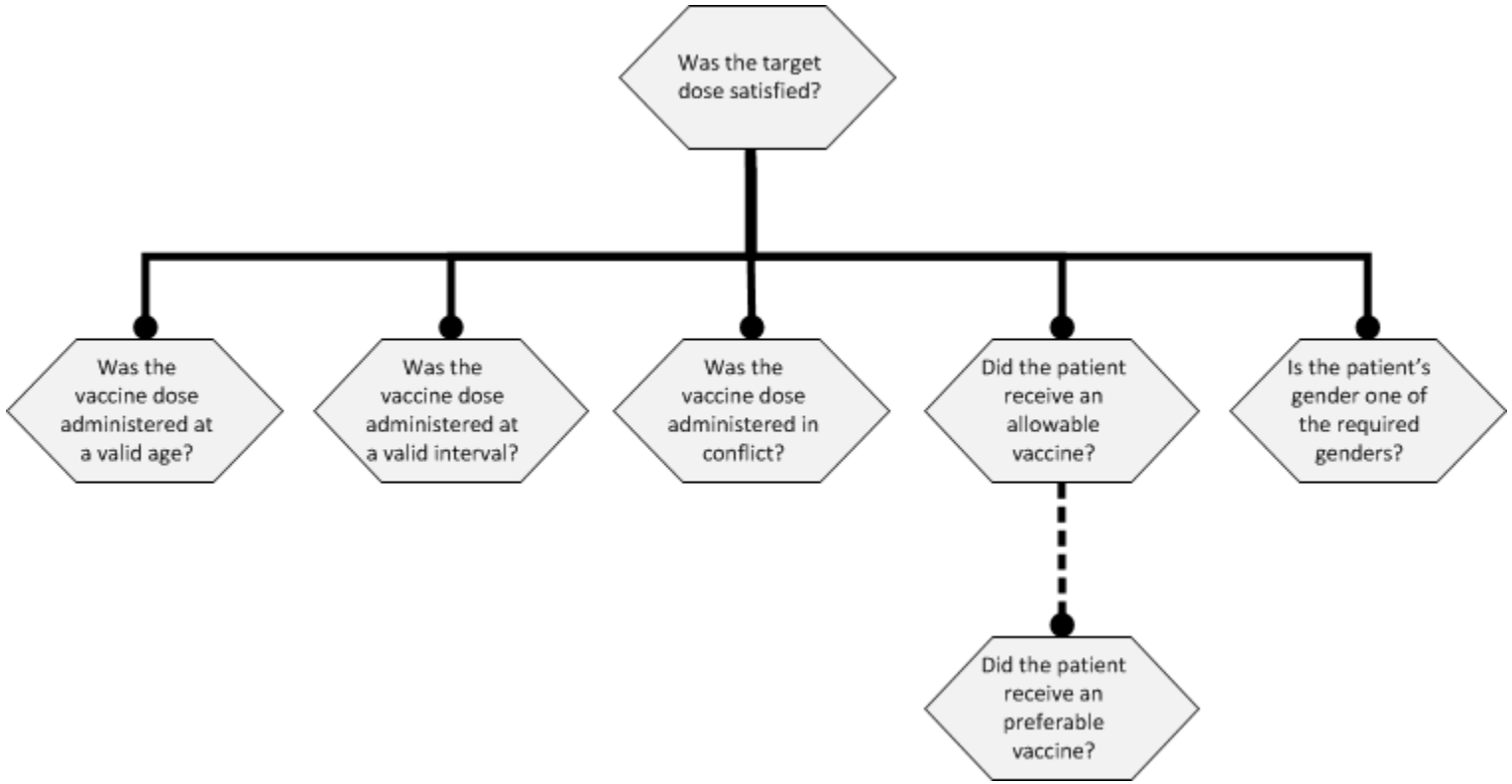
step 2: the destination

process model



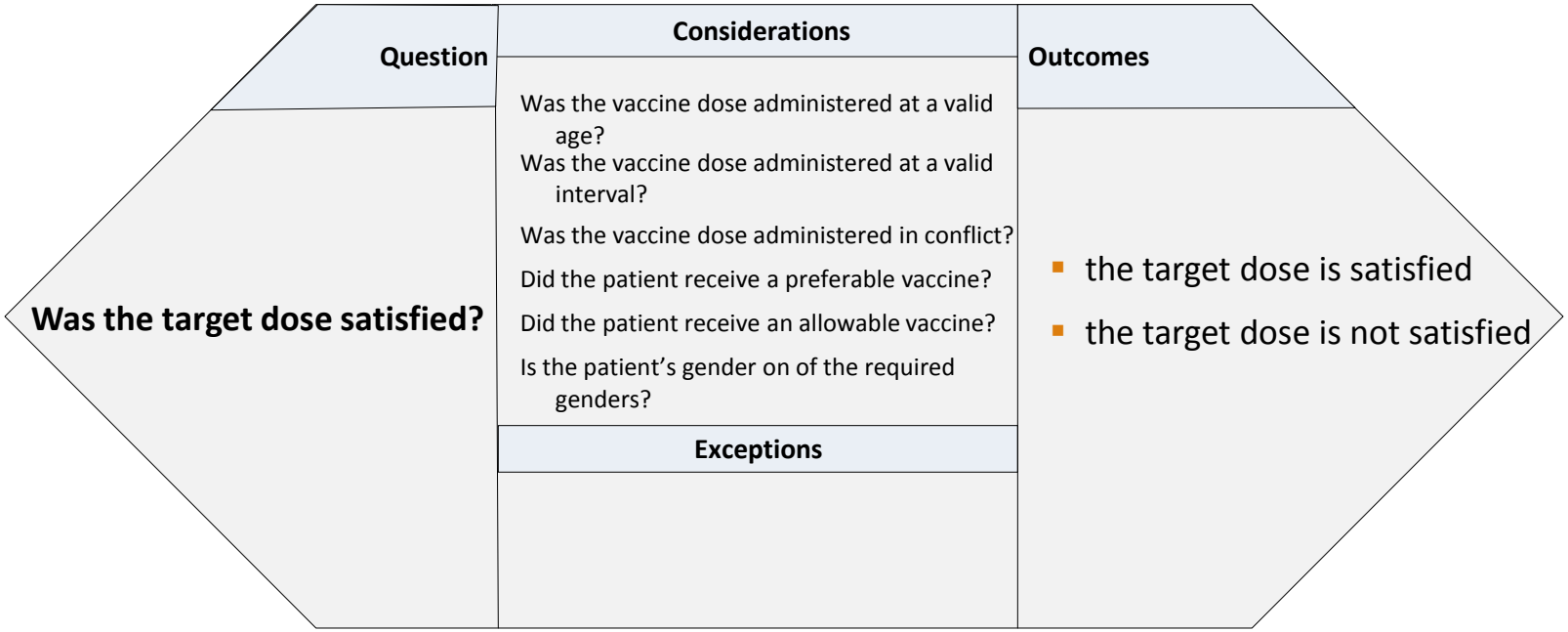
step 2: the destination

Q-Chart



step 2: the destination

Q-COE



step 2: the destination

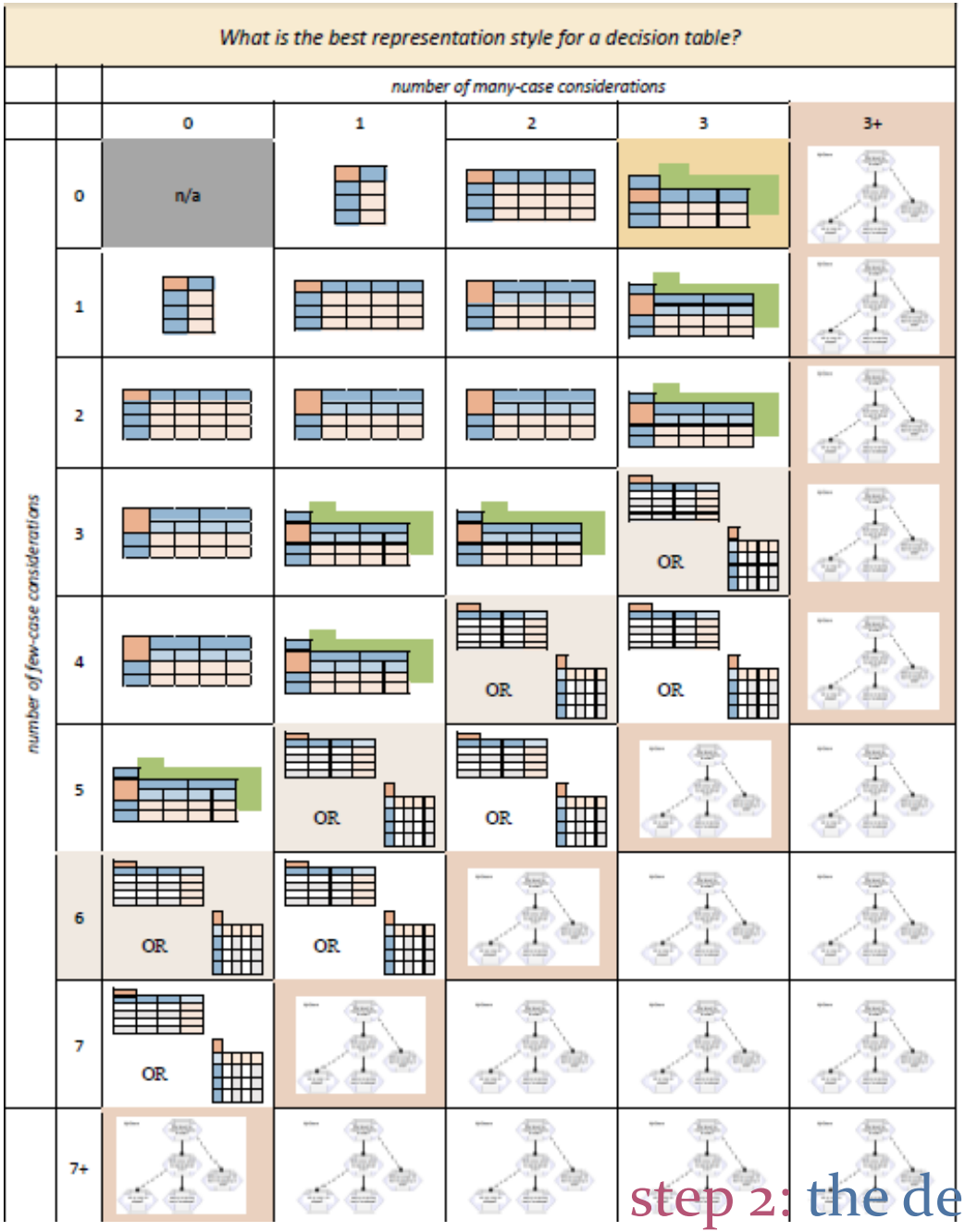
decision table

considerations			
Is the vaccine type of the vaccine dose administered one of the allowable vaccine types?	yes	no	yes
Allowable vaccine type begin age date ≤ date administered < allowable vaccine type end age date?	yes	-	no
outcomes	The patient received an allowable vaccine.	The patient did not receive an allowable vaccine.	The patient did not receive an allowable vaccine.

step 2: the destination

guidelines for decision table formats

www.brsolutions.com



step 2: the destination

business rule statements

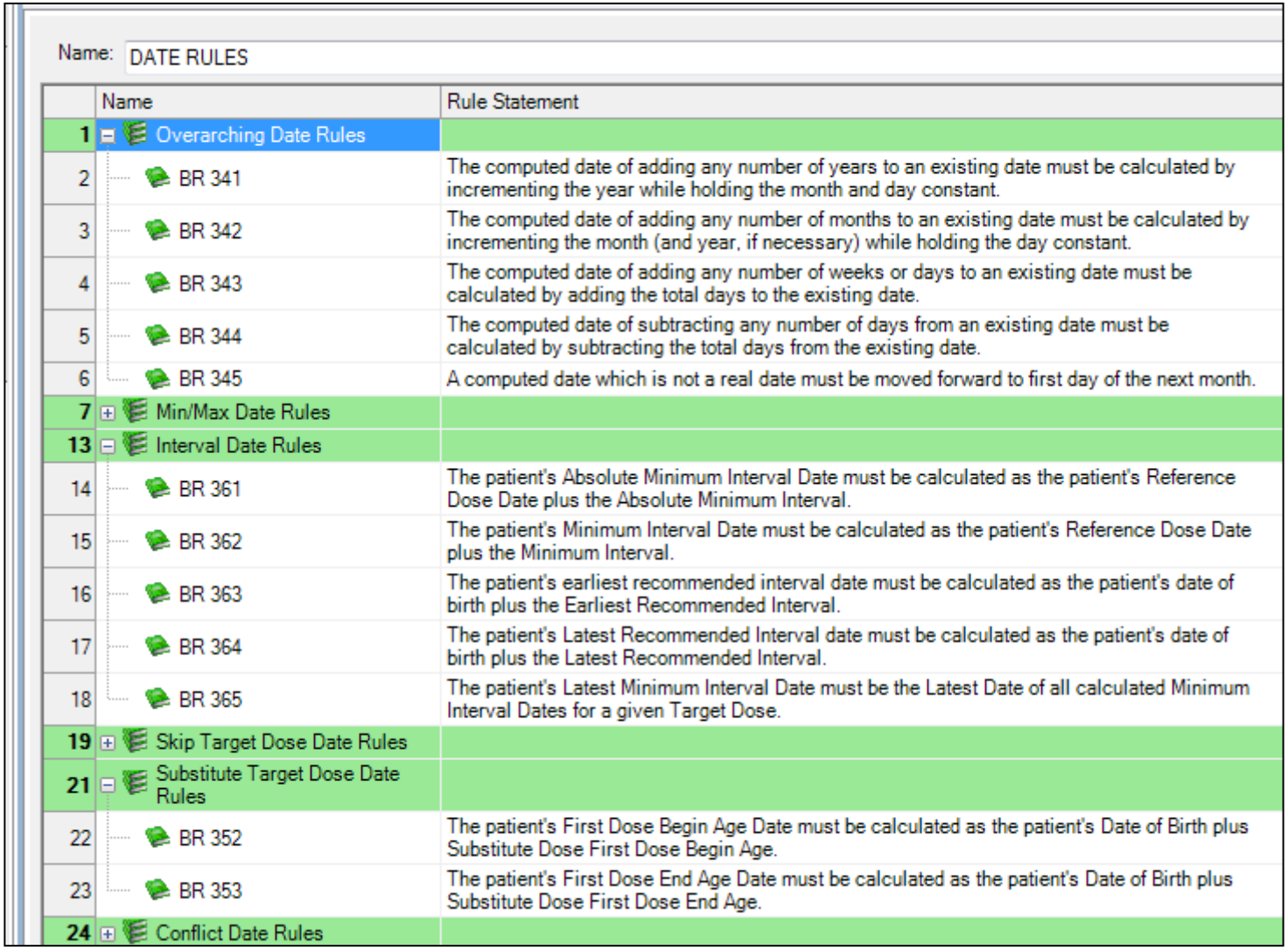
A vaccine dose administered must be considered an allowable vaccine if all the following are true:

- The vaccine type of the vaccine dose administered is one of the allowable vaccine types.
- The date administered is on or later than the allowable vaccine type begin age date.
- The date administered is earlier than the allowable vaccine type end age date.

expressed in *RuleSpeak®*
http://www.rulespeak.com/en/

step 2: the destination

business rule groups

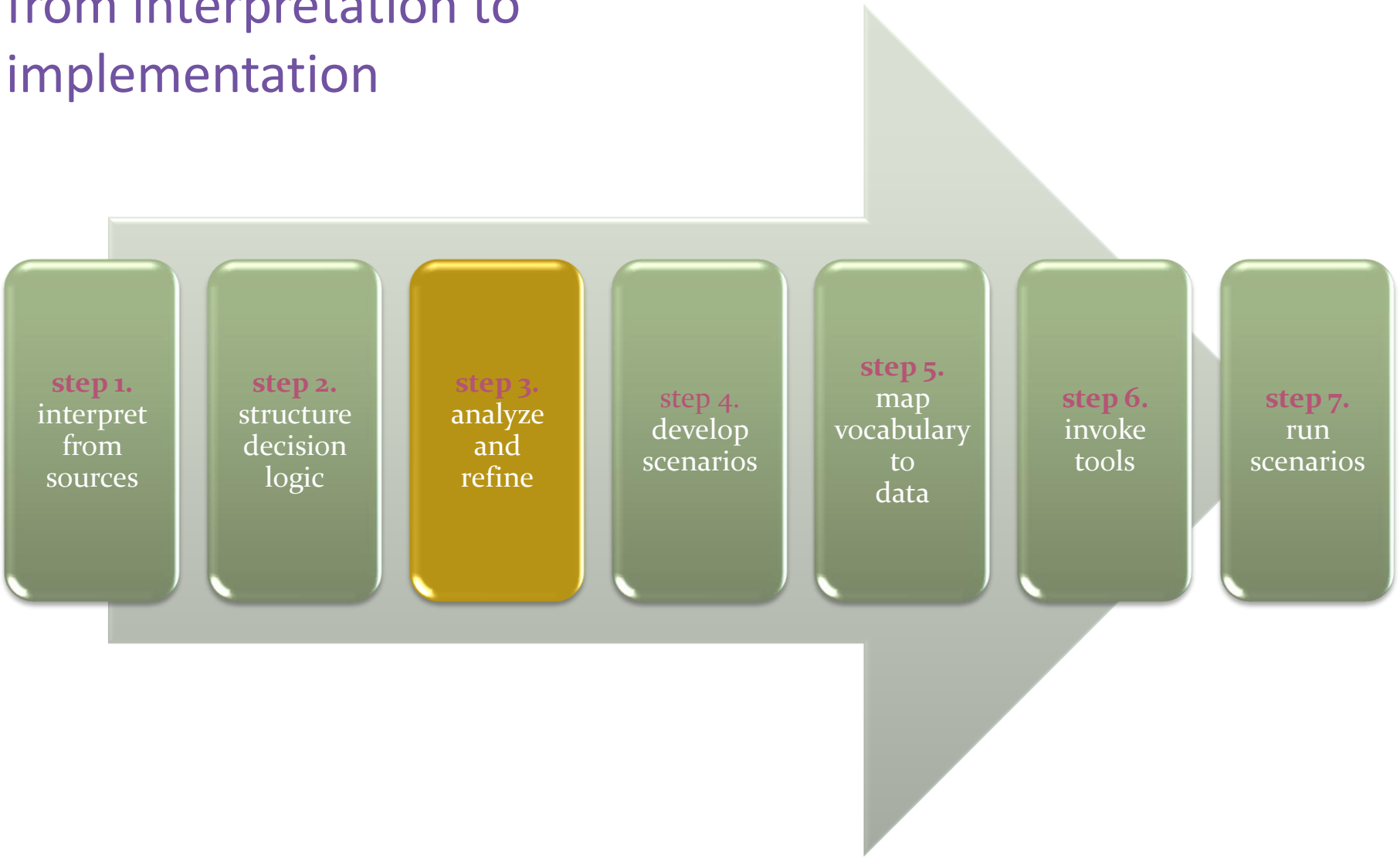


Name: DATE RULES

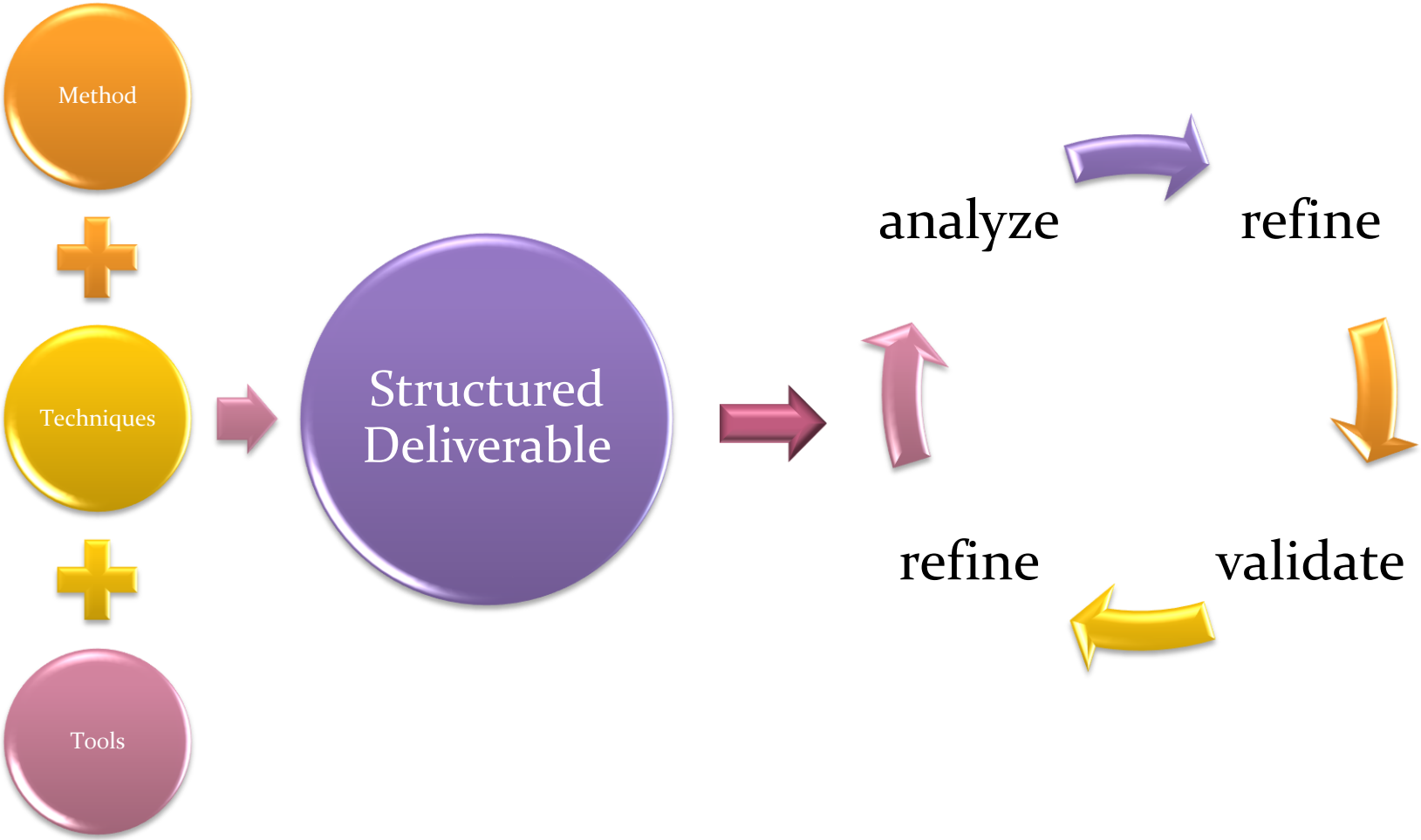
	Name	Rule Statement
1	Overarching Date Rules	
2	BR 341	The computed date of adding any number of years to an existing date must be calculated by incrementing the year while holding the month and day constant.
3	BR 342	The computed date of adding any number of months to an existing date must be calculated by incrementing the month (and year, if necessary) while holding the day constant.
4	BR 343	The computed date of adding any number of weeks or days to an existing date must be calculated by adding the total days to the existing date.
5	BR 344	The computed date of subtracting any number of days from an existing date must be calculated by subtracting the total days from the existing date.
6	BR 345	A computed date which is not a real date must be moved forward to first day of the next month.
7	Min/Max Date Rules	
13	Interval Date Rules	
14	BR 361	The patient's Absolute Minimum Interval Date must be calculated as the patient's Reference Dose Date plus the Absolute Minimum Interval.
15	BR 362	The patient's Minimum Interval Date must be calculated as the patient's Reference Dose Date plus the Minimum Interval.
16	BR 363	The patient's earliest recommended interval date must be calculated as the patient's date of birth plus the Earliest Recommended Interval.
17	BR 364	The patient's Latest Recommended Interval date must be calculated as the patient's date of birth plus the Latest Recommended Interval.
18	BR 365	The patient's Latest Minimum Interval Date must be the Latest Date of all calculated Minimum Interval Dates for a given Target Dose.
19	Skip Target Dose Date Rules	
21	Substitute Target Dose Date Rules	
22	BR 352	The patient's First Dose Begin Age Date must be calculated as the patient's Date of Birth plus Substitute Dose First Dose Begin Age.
23	BR 353	The patient's First Dose End Age Date must be calculated as the patient's Date of Birth plus Substitute Dose First Dose End Age.
24	Conflict Date Rules	

step 2: the destination

business rules & decisions: from interpretation to implementation



step by step



analyze and refine

specify, model, organize and analyze

validate

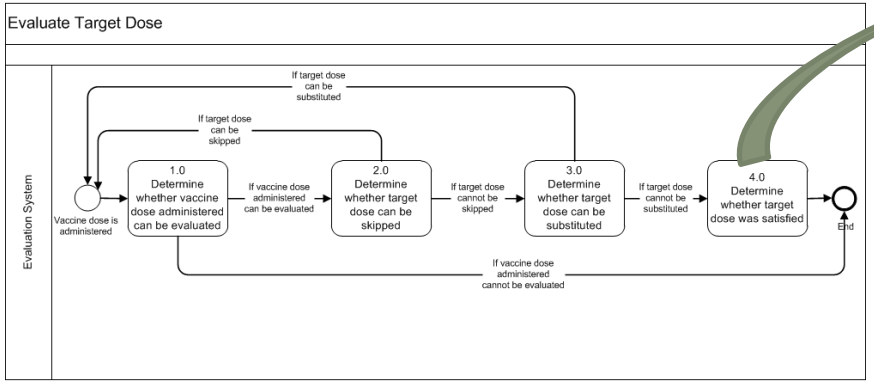
facilitated sessions

step 3: the journey

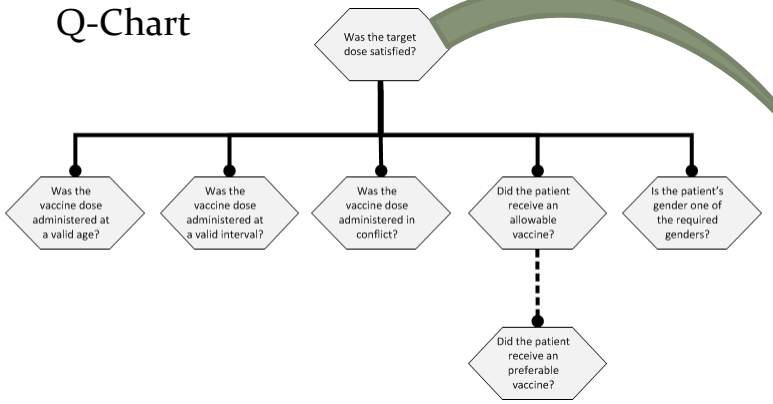
- review deliverables as a whole
- refine terminology
- resolve anomalies
  - conflicts
  - subsumptions
  - redundancies
  - similarities
- simplify whenever possible

step 3: the work

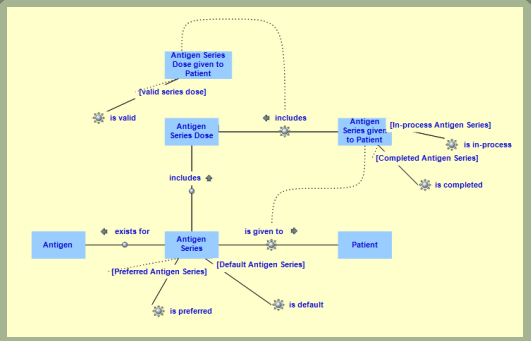
process model



Q-Chart



concept model



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Antigen Series Dose given to Patient	an Antigen Series Dose given to a patient
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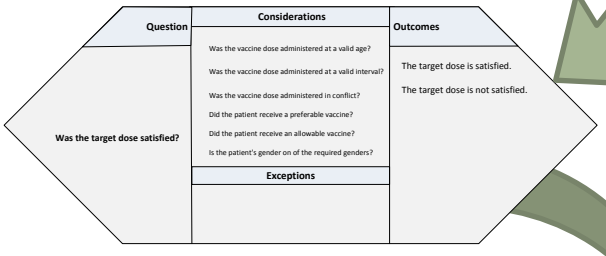
Q-COEs



the deliverables all fit together … the concept model serves as the 'glue'

business rules

Rule	Statement	Status
BR 341	The computed date of adding any number of years to an existing date must be calculated by incrementing the year while holding the month and day constant.	Operational
BR 342	The computed date of adding any number of months to an existing date must be calculated by incrementing the month (and year, if necessary) while holding the day constant.	Operational
BR 343	The computed date of adding any number of weeks or days to an existing date must be calculated by adding the total days to the existing date.	Operational
BR 344	The computed date of subtracting any number of days from an existing date must be calculated by subtracting the total days from the existing date.	Operational
BR 345	A computed date which is not a real date must be moved forward to first day of the next month.	Operational
BR 351	The patient's Skip Target Dose Trigger Age Date must be calculated as the patient's Date of Birth plus the Skip Target Dose Trigger Age.	Proposed
BR 352	The patient's First Dose Begin Age Date must be calculated as the patient's Date of Birth plus Substitute Dose First Dose Begin Age.	Proposed
BR 353	The patient's First Dose End Age Date must be calculated as the patient's Date of Birth plus Substitute Dose First Dose End Age.	Proposed
BR 354	The patient's Maximum Age Date must be calculated as the patient's Date of Birth plus the Maximum Age.	Proposed

decision tables

step 3: review deliverable as a whole

should finish date be actual finish date or forecast finish date?

	Name	Rule Statement	Status
	Show all	contains finish date	Show all
	Series 001	A patient series must be considered completable if the finish date is less than the maximum age date of the last target dose.	Proposed
	Series 002	A complete patient series must be considered to be the earliest completing if the actual finish date is before the actual finish date for all other candidate patient series.	Proposed
	Series 004	The actual finish date of a complete patient series must be the latest date administered of a vaccine dose administered with an evaluation status "valid."	Proposed
	Series 008	A patient series must be considered to finish earliest if the patient series can be completed and the forecast finish date is earlier than the forecast finish date in all other candidate patient series.	Proposed

step 3: refine terminology

derivation rule for complete patient series is missing

	Name	Rule Statement	Status
	Show all	contains finish date	Show all
	Series 001	A patient series must be considered completable if the finish date is less than the maximum age date of the last target dose.	Proposed
	Series 002	A complete patient series must be considered to be the earliest completing if the actual finish date is before the actual finish date for all other candidate patient series.	Proposed
	Series 004	The actual finish date of a complete patient series must be the latest date administered of a vaccine dose administered with an evaluation status "valid."	Proposed
	Series 008	A patient series must be considered to finish earliest if the patient series can be completed and the forecast finish date is earlier than the forecast finish date in all other candidate patient series.	Proposed

Series 003	A patient series must be considered a complete patient series if the patient series status is "complete."	Proposed

step 3: the destination

derivation rule for first target dose is missing

Was the vaccine dose administered at a valid interval?

considerations					
absolute minimum interval date > date administered?	yes	no	no	no	no
absolute minimum interval date ≤ date administered < minimum interval date?	no	yes	yes	yes	no
minimum interval date ≤ date administered?	no	no	no	no	yes
Is this the first target dose?	-	no	no	yes	-
Is the previous vaccine dose administered 'not valid' due to age or interval requirements?	-	yes	no	-	-
outcomes	Interval is not valid.	Interval is not valid.	Interval is valid.	Interval is valid.	Interval is valid.

derivation rule expressed in RuleSpeak®

A target dose for an antigen must be considered the first target dose for a patient if the patient has not satisfied any target doses for the given antigen series.

Did the patient receive a preferable vaccine?

considerations					
Is the vaccine type of the Vaccine Dose Administered one of the Preferable Vaccine Types?	yes	yes	no	yes	yes
Preferable Vaccine Type Begin Age Date ≤ Date Administered < Preferable Vaccine Type End Age Date?	yes	yes	-	no	yes
Is the Vaccine Dose Administered Trade Name the same as the Preferable Vaccine Trade Name?	yes	yes	-	-	no
Vaccine Dose Administered Volume < Preferable Vaccine Volume?	yes	no	-	-	-
outcomes	The patient received a Preferable Vaccine.	The patient received a Preferable Vaccine.	The patient did not receive a Preferable Vaccine.	The patient did not receive a Preferable Vaccine.	The patient did not receive a Preferable Vaccine.

consideration immaterial … does not affect the outcome

considerations				
Is the vaccine type of the Vaccine Dose Administered one of the Preferable Vaccine Types?	yes	no	yes	yes
Preferable Vaccine Type Begin Age Date ≤ Date Administered < Preferable Vaccine Type End Age Date?	yes	-	no	yes
Is the Vaccine Dose Administered Trade Name the same as the Preferable Vaccine Trade Name?	yes	-	-	no
outcomes	The patient received a Preferable Vaccine.	The patient did not receive a Preferable Vaccine.	The patient did not receive a Preferable Vaccine.	The patient did not receive a Preferable Vaccine.

step 3: the destination

can the rules be improved?

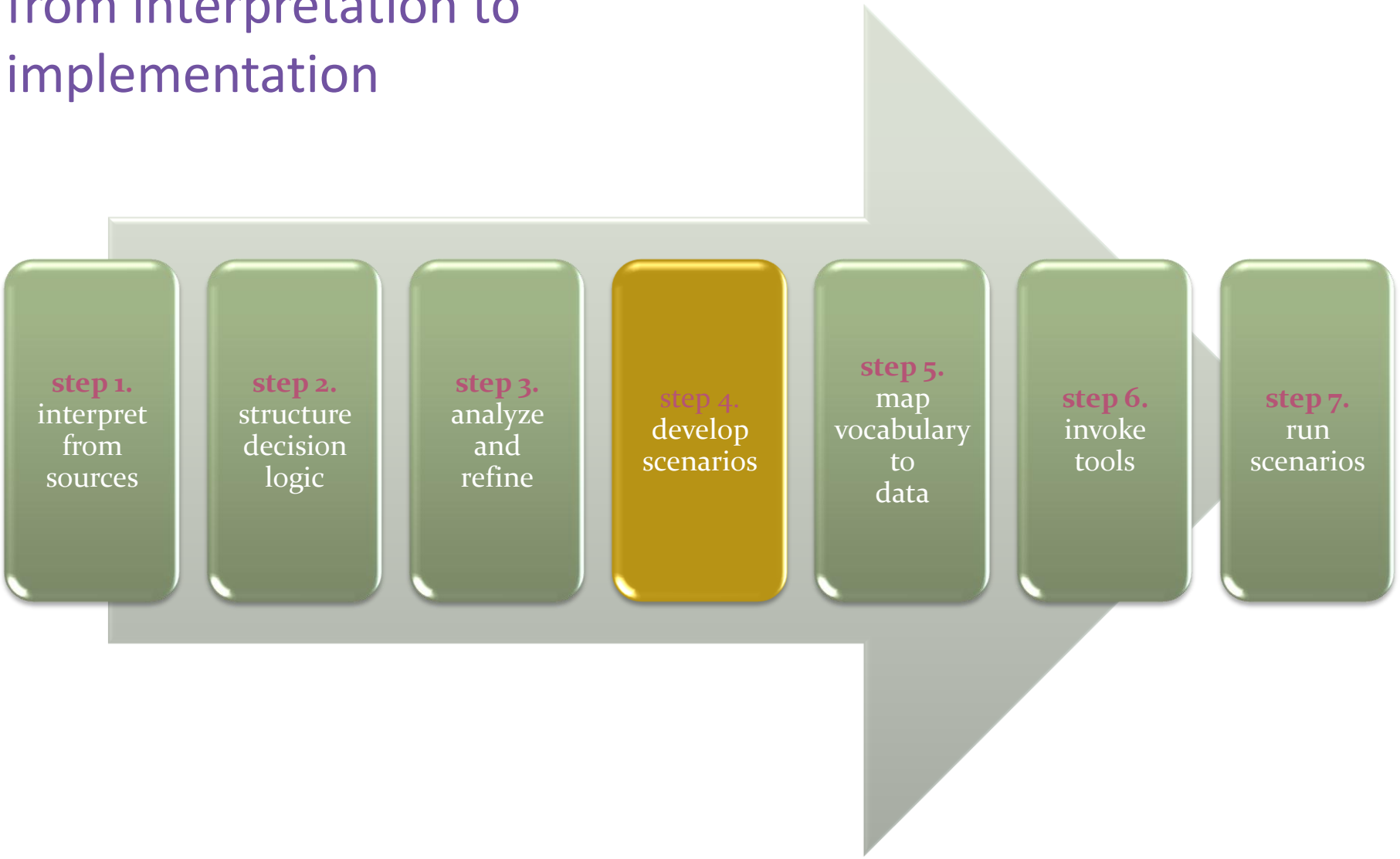
	BR 902	An Antigen Series must be considered the best patient series if only 1 antigen series exists for that antigen.	Prepared
	BR 903	An Antigen Series must be considered the best patient series if exactly 1 antigen series is completed for the patient.	Prepared
	BR 904	An Antigen Series must be considered the best patient series if all the following are true: - exactly 1 antigen series is in-process for the patient - no antigen series is completed.	Prepared
	BR 905	An Antigen Series must be considered the best patient series if all the following are true: - all the antigen series given to the patient do not have any valid dose - the antigen series is the default for the antigen.	Prepared

best practice: single rule to derive or compute anything

	Best Patient Series	An Antigen Series must be considered the best patient series if any of the following are true: - only 1 antigen series exists for that antigen - exactly 1 antigen series is completed for the patient - all the following are true: - exactly 1 antigen series is in-process for the patient - no antigen series is completed - all the following are true: - all the antigen series given to the patient do not have any valid dose - the antigen series is the default for the antigen.	Proposed

step 3: the destination

business rules & decisions: from interpretation to implementation



step by step

decision tables & business rules

concept model

supporting data

test data (mock-ups of real-world cases)

test-drive the decisions

develop scenarios

Series Name	Polio - All IPV - 4 Dose					
Target Disease	Polio					
Vaccine Group	Polio					
Select Best Patient Series	Default Series	Product Path	Series Preference			
	Yes	Yes	1			
Series Dose	Dose 1					
Age	Absolute Minimum Age	Minimum Age	Earliest Recommended Age	Latest Recommended Age (less than)	Maximum Age (less than)	
	6 weeks - 4 days	6 weeks	2 months	3 months + 4 weeks	n/a	
Interval	From Immediate Previous Dose Administered? Y/N	From Target Dose # in Series	Absolute Minimum Interval	Minimum Interval	Earliest Recommended Interval	Latest Recommended Interval (less than)
	n/a	n/a	n/a	n/a	n/a	n/a
Preferable Vaccine	Vaccine Type (CVX)	Vaccine Type Begin Age	Vaccine Type End Age (less than)	Trade Name (MVX)	Volume (in ml)	
	IPV (10)	6 weeks	n/a	n/a	0.5	
	DTaP-HepB-IPV (110)	6 weeks	7 years	n/a	0.5	
	DTaP-Hib-IPV (120)	6 weeks	5 years	n/a	0.5	
Allowable Vaccine	Vaccine Type (CVX)	Vaccine Type Begin Age	Vaccine Type End Age (less than)			
	IPV (10)	6 weeks - 4 days	n/a			
	DTaP-HepB-IPV (110)	6 weeks - 4 days	n/a			
	DTaP-Hib-IPV (120)	6 weeks - 4 days	n/a			
	DTaP-IPV (130)	6 weeks - 4 days	n/a			
	DTaP-IPV-Hib-HepB, Historical (132)	6 weeks - 4 days	n/a			
	DTaP-IPV-Hib-HepB (146)	6 weeks - 4 days	n/a			
Skip Dose	Trigger Age					
	n/a					
Recurring Dose	Recurring Dose (Yes/No)					
	No					
Conditional Need	Condition Set	Start Date	End Date	Dose Count (less than)	CVX List	
	n/a					
Seasonal Recommendatio	Start Date	End Date				
	n/a					
Substitute Dose	total count of valid doses	First Dose Begin Age	First Dose End Age (less than)	number of target doses to substitute		
	n/a					
Gender	Required Gender					
	n/a					

supporting data: polio vaccine

create

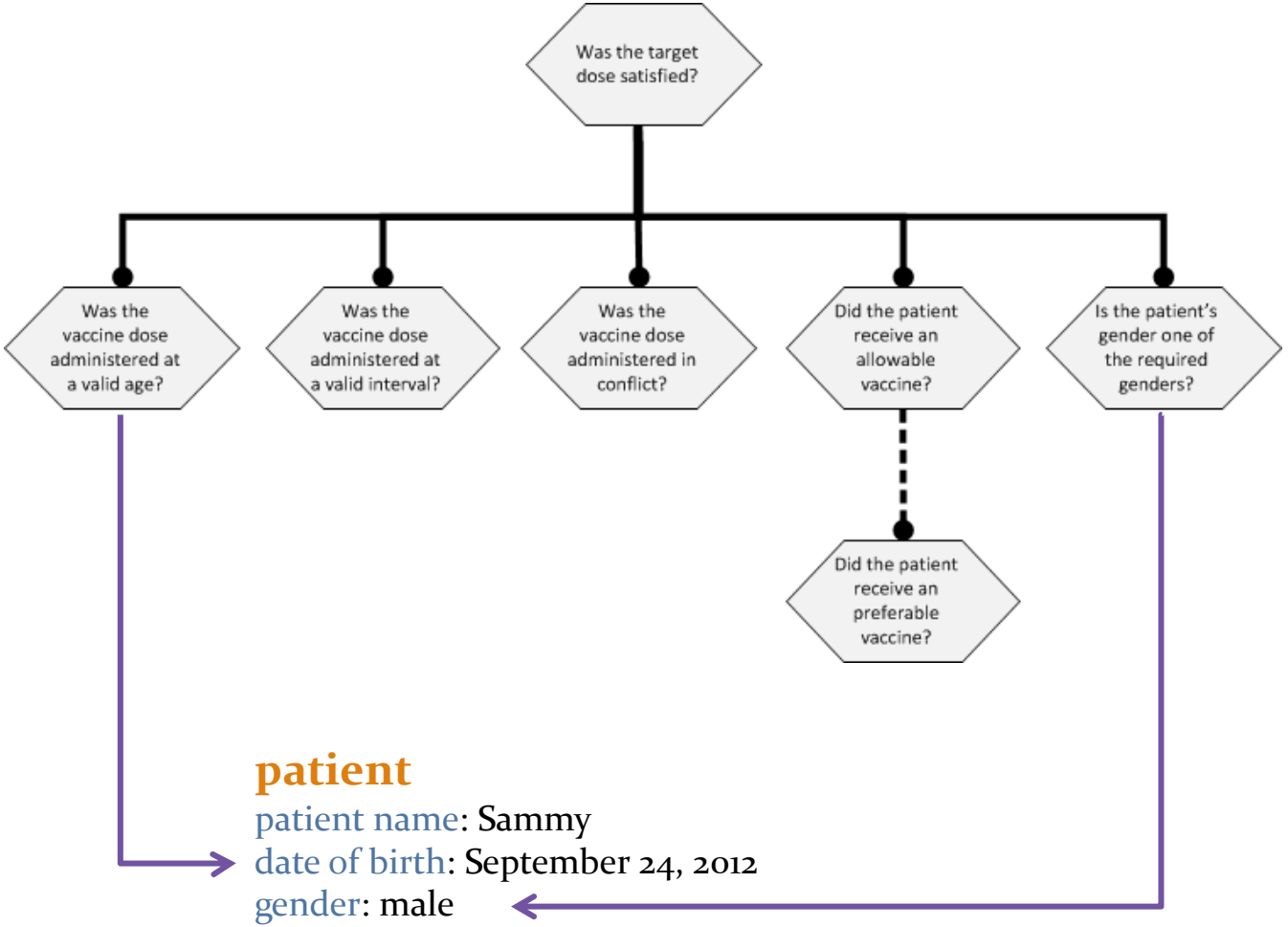
validate

facilitated sessions

step 4: the journey

- identify scenarios
- define expected outcomes
- create test data (mock-up cases)
- create a new scenario variation by altering the test data

identify scenarios based on decisions

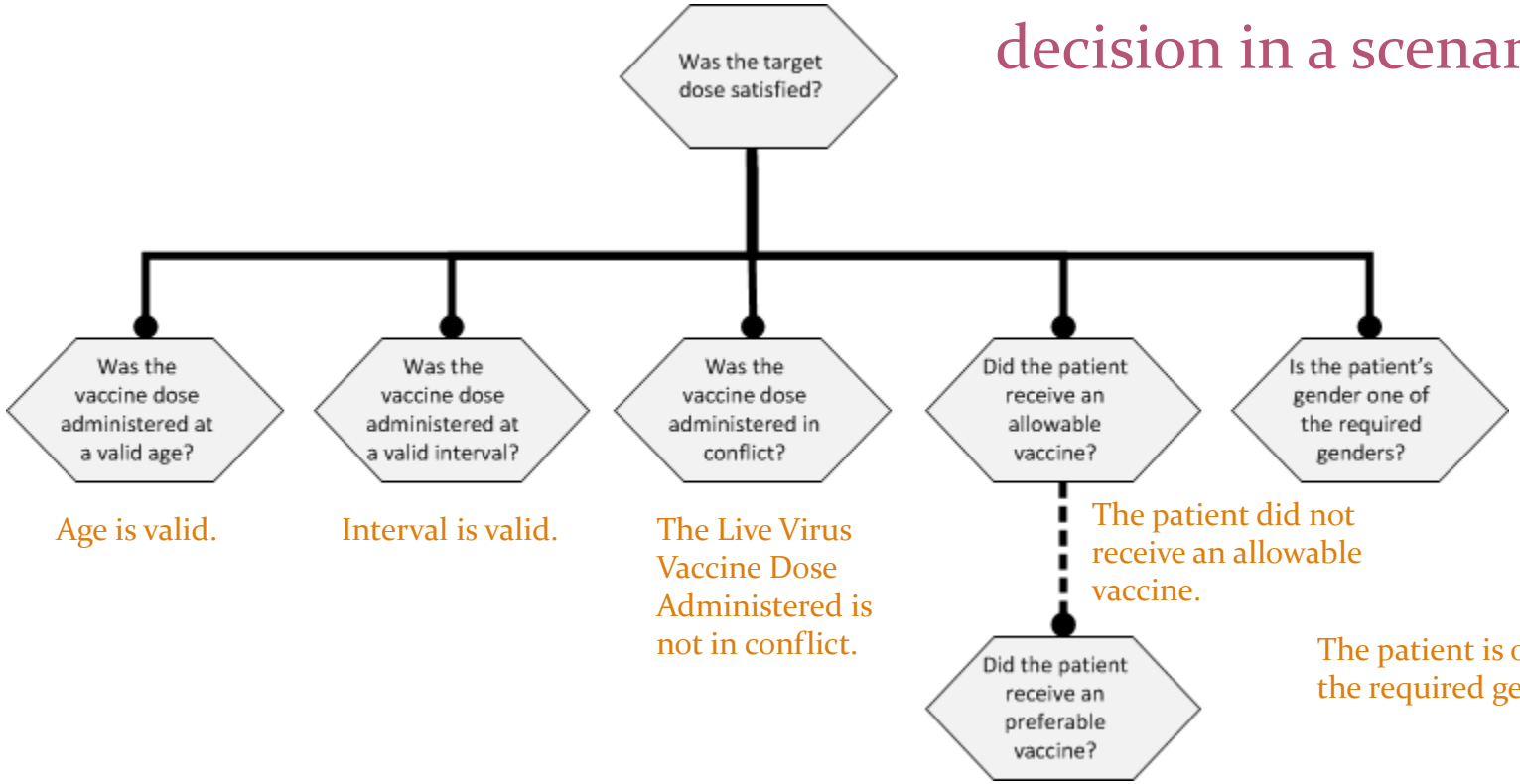


step 4: the technique

scenario 1

male patient received the first dose of IPV(10) vaccine at two months and 6 days old.

define outcome for each individual decision in a scenario

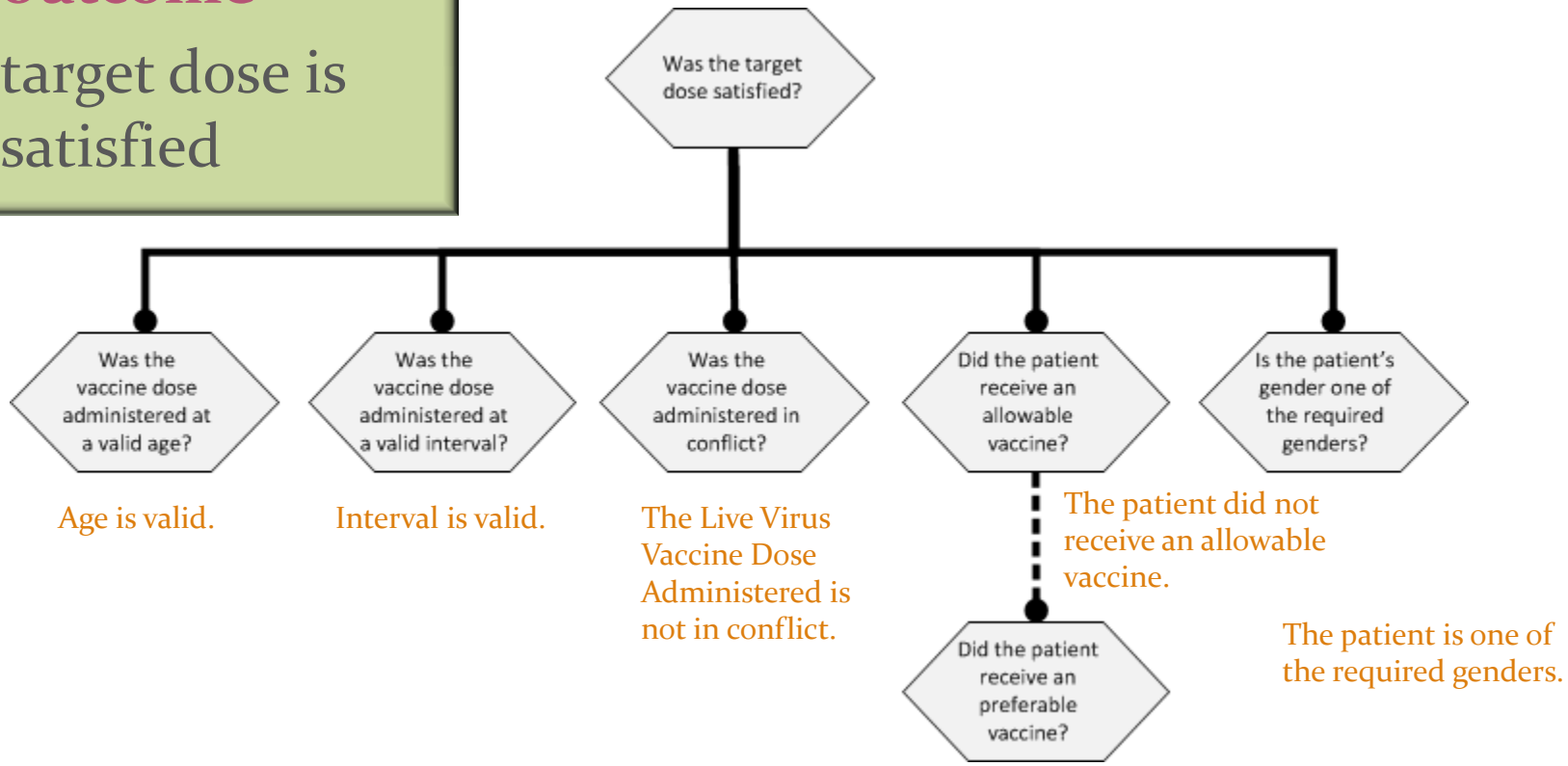


step 4: the technique

define ultimate outcome for scenario

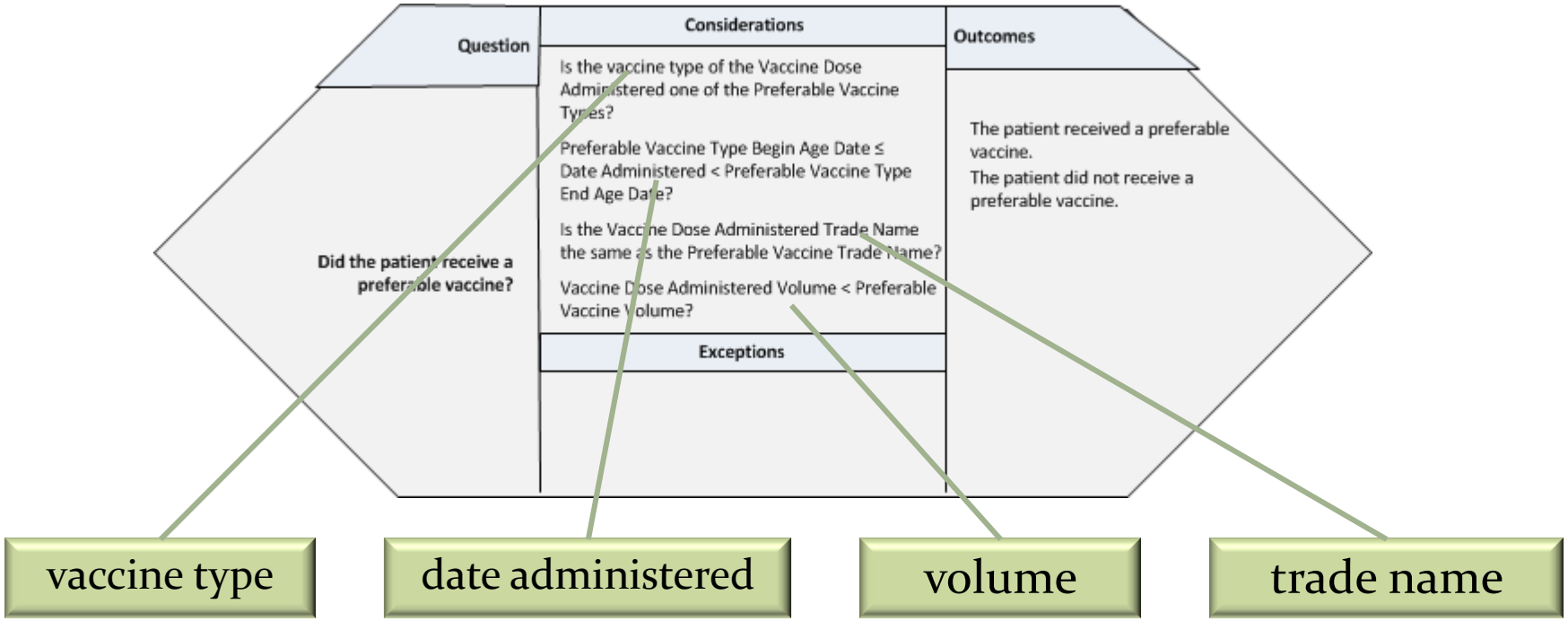
outcome

target dose is satisfied



step 4: the technique

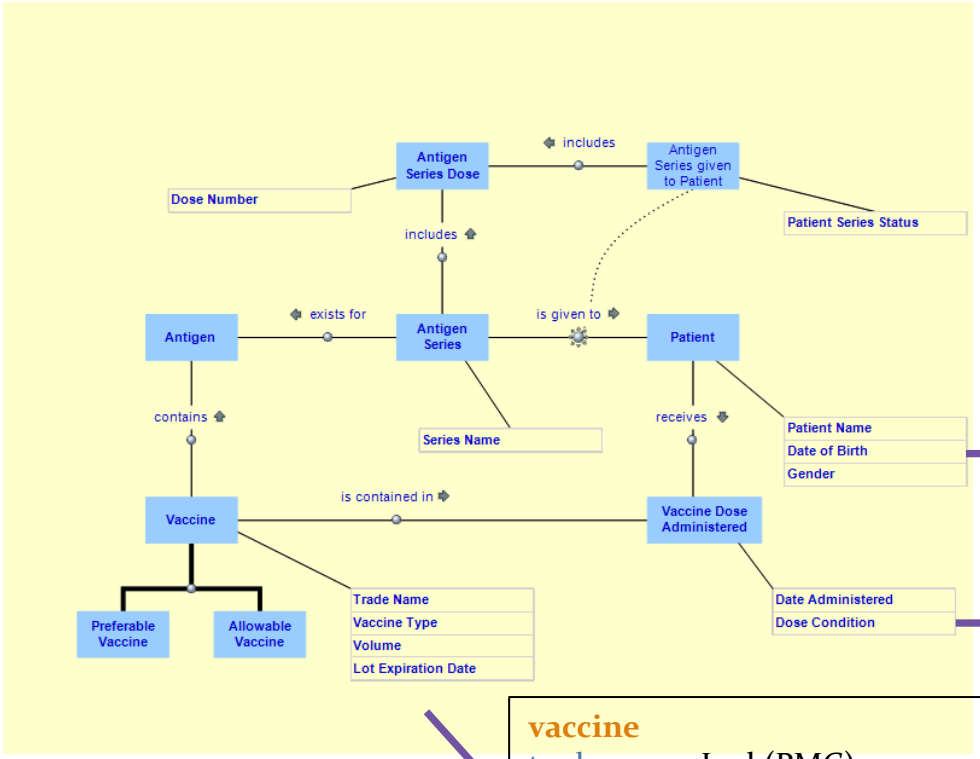
define test data (mock-up case) based on individual decisions



vaccine dose administered
dose number: 1
trade name: Ipol (PMC)
vaccine type: IPV (10)
volume: 0.5
date administered: Nov. 30, 2012

step 4: the technique

refine test data (mock-up case) by following concept model



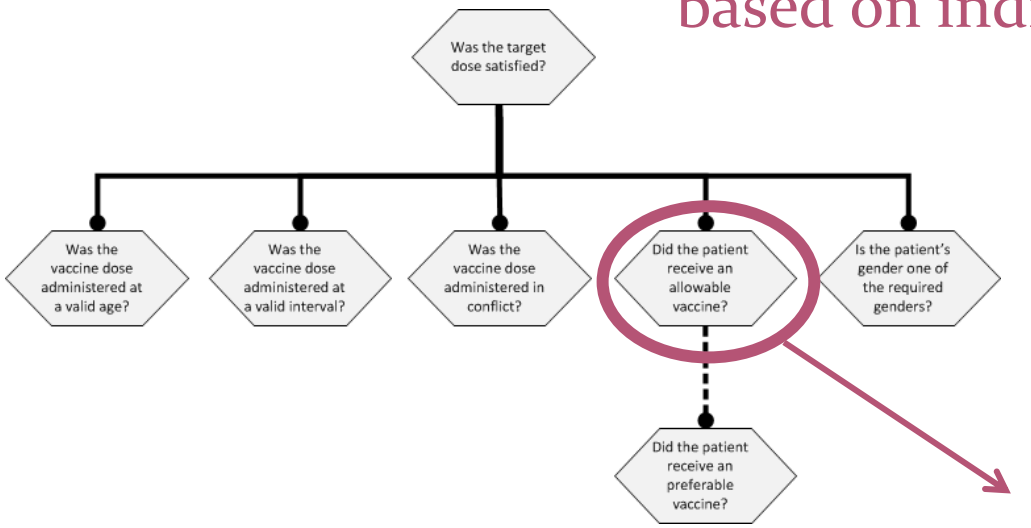
patient
patient name: Sammy
date of birth: Sept. 24, 2012
gender: male

vaccine dose administered
date administered: Nov. 30, 2012
dose condition is not indicated

vaccine
trade name: Ipol (PMC)
vaccine type: IPV (10)
volume: 0.5
lot expiration date: Dec. 31, 2015

step 4: the technique

create test data (mock-up case) based on individual business rules



outcome

the patient did not receive an allowable vaccine

scenario

dose number: 1
trade name: Ipol (PMC)
vaccine type: IPV (10)
lot expiration date: Dec. 31, 2015
volume: 0.5
date administered: Nov. 30, 2012
dose condition is not indicated

decision table

considerations			
Is the vaccine type of the vaccine dose administered one of the allowable vaccine types?	yes	no	yes
Allowable vaccine type begin age date ≤ date administered < allowable vaccine type end age date?	yes	-	no
outcomes	The patient received an allowable vaccine.	The patient did not receive an allowable vaccine.	The patient did not receive an allowable vaccine.

step 4: the technique

polio vaccine supporting data

Series Name	Polio - All IPV - 4 Dose					
Target Disease	Polio					
Vaccine Group	Polio					
Select Best Patient Series	Default Series	Product Path	Series Preference			
	Yes	Yes	1			
Series Dose	Dose 1					
Age	Absolute Minimum Age	Minimum Age	Earliest Recommended Age	Latest Recommended Age (less than)	Maximum Age (less than)	
	6 weeks - 4 days	6 weeks	2 months	3 months + 4 weeks	n/a	
Interval	From Immediate Previous Dose Administered? Y/N	From Target Dose # in Series	Absolute Minimum Interval	Minimum Interval	Earliest Recommended Interval	Latest Recommended Interval (less than)
	n/a	n/a	n/a	n/a	n/a	n/a
Preferable Vaccine	Vaccine Type (CVX)	Vaccine Type Begin Age	Vaccine Type End Age (less than)	Trade Name (MVX)	Volume (in ml)	
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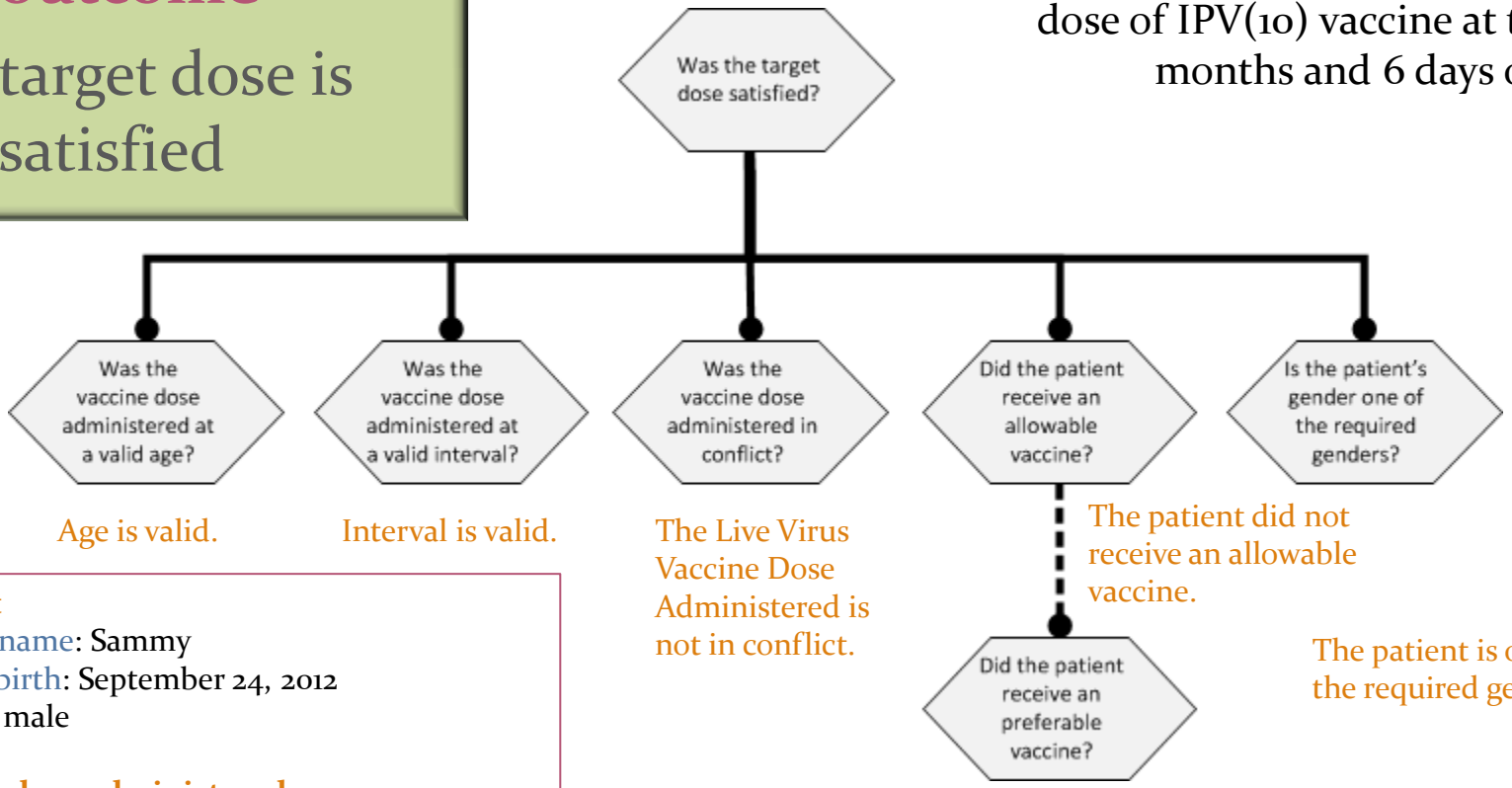
	DTaP-Hib-IPV (120)	6 weeks - 4 days	n/a			
	DTaP-IPV (130)	6 weeks - 4 days	n/a			
	DTaP-IPV-Hib-HepB Historical (132)	6 weeks - 4 days	n/a			
	DTaP-IPV-Hib-HepB (146)	6 weeks - 4 days	n/a			
Skip Dose	Trigger Age					
	n/a					
Recurring Dose	Recurring Dose (Yes/No)					
	No					
Conditional Need	Condition Set	Start Date	End Date	Dose Count (less than)	CVX List	
	n/a					
Seasonal Recommendatio	Start Date	End Date				
	n/a					
Substitute Dose	total count of valid doses	First Dose Begin Age	First Dose End Age (less than)	number of target doses to substitute		
	n/a					
Gender	Required Gender					
	n/a					

scenario 1

male patient received the first dose of IPV(10) vaccine at two months and 6 days old.

outcome

target dose is satisfied

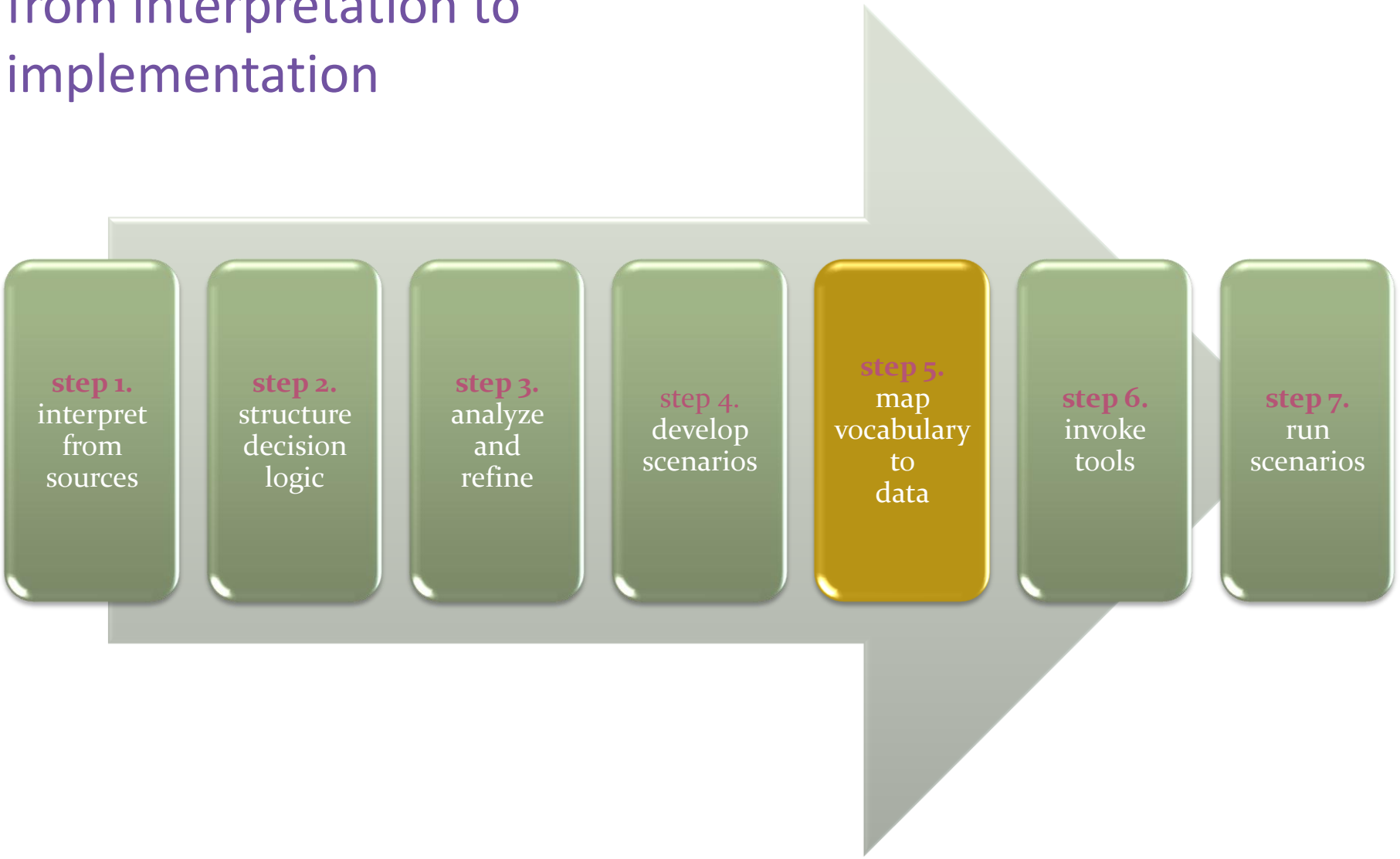


patient
patient name: Sammy
date of birth: September 24, 2012
gender: male

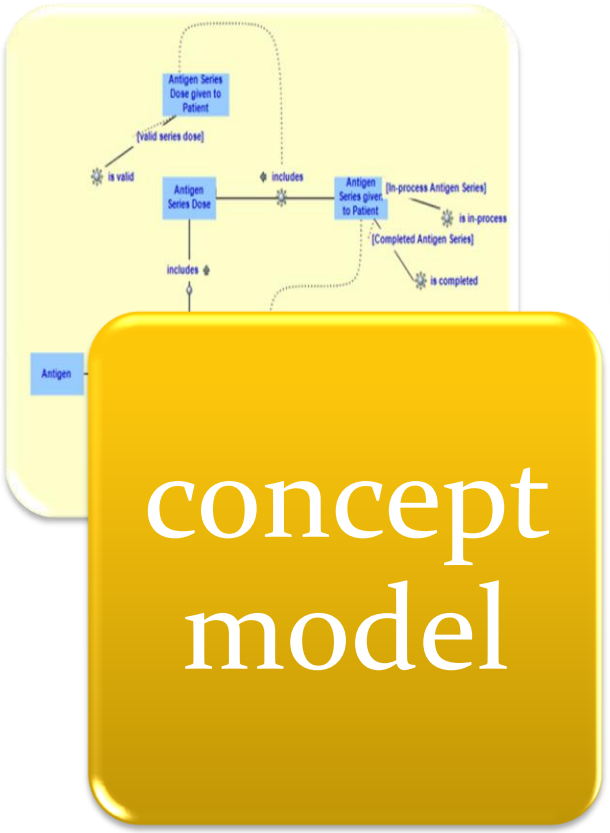
vaccine dose administered
dose number: 1
trade name: Ipol (PMC)
vaccine type: IPV (10)
volume: 0.5
lot expiration date: Dec. 31, 2015
date administered: nov. 30, 2012
dose condition is not indicated

step 4: the destination

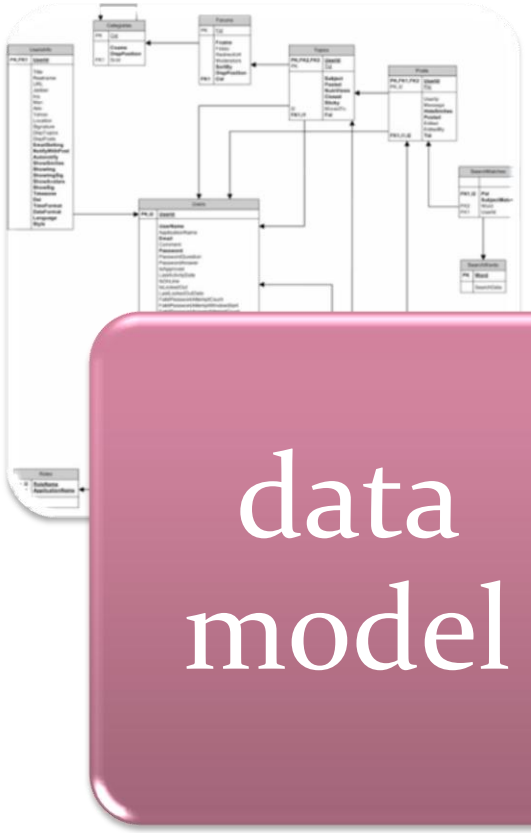
business rules & decisions: from interpretation to implementation



step by step



concept model



data model

map vocabulary to data

business analysts

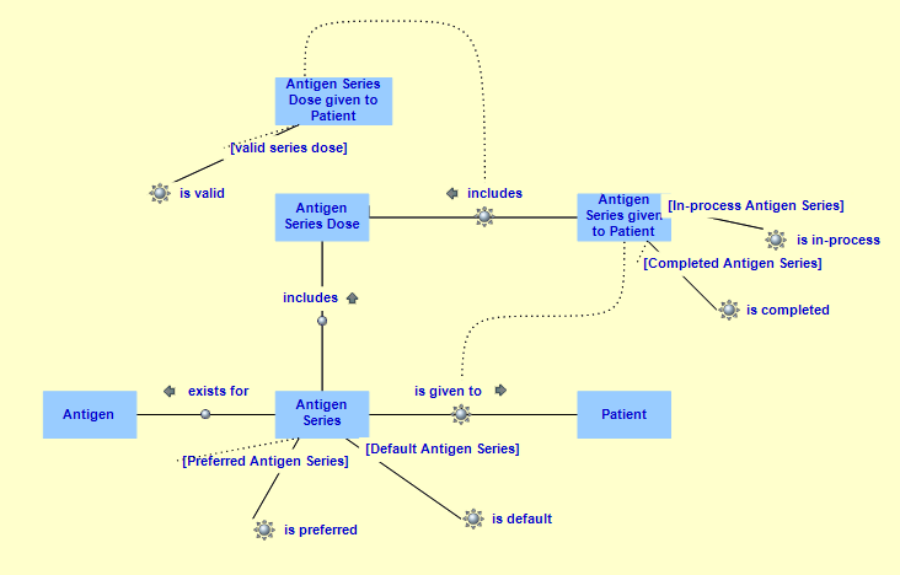
data specialist

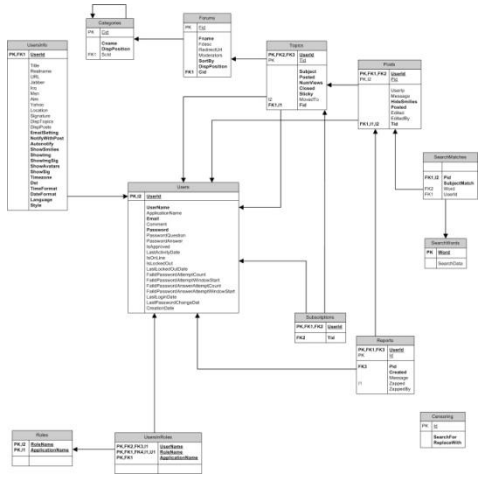
step 5: the drivers

collaborate

- identify data sources
- map terms to attributes
- specify static vs. dynamic data

map concept model to data model





step 5: the destination

map terms to attributes

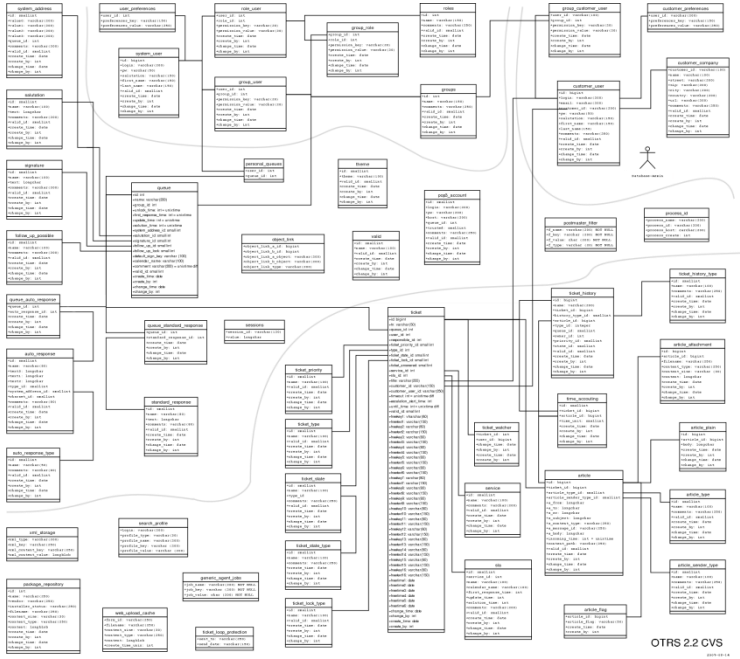
Glossary glossary		
Variable Name	**Business Concept**	**Attribute Name**
ID	**Antigen Series Vaccine Dose**	id
Absolute Minimum Age		absoluteMinimumAge
Minimum Age		minimumAge
Earliest Recommended Age		earliestRecommendedAge
Latest Recommended Age		latestRecommendedAge
Maximum Age		maximumAge
From Immediate Previous Dose Administered		fromImmediatePreviousDoseAdministered
From Target Dose # in Series		fromTargetDoseinSeries
Absolute Minimum Interval		absoluteMinimumInterval
Minimum Interval		minimumInterval
Earliest Recommended Interval		earliestRecommendedInterval
Latest Recommended Interval		latestRecommendedInterval
Skip Target Dose Trigger Age		skipTargetDoseTriggerAge
Recurring Dose		recurringDose
Condition Set		conditionSet
Conditional Need Start Date		conditionalNeedStartDate
Conditional Need End Date		conditionalNeedEndDate
Conditional Need Dose Count		conditionalNeedDoseCountMax
Conditional Need CVX List		conditionalNeedDoseCVXList
Seasonal Recommendation Start date		seasonalRecommendationsStartDate
Seasonal Recommendation End Date		seasonalRecommendationsEndDate
Substitute Dose First Dose Begin Age		substituteFirstDoseBeginAge
Substitute Dose First Dose End Age		substituteFirstDoseEndAge
Substitute Dose Total Count of Valid Doses		substituteTotalCountOfValidDoses
Number of Target Doses to substitute		numberOfValidDosesToSubstitute
Required Gender		requiredGender

step 5: the destination

populate supporting data (static data)

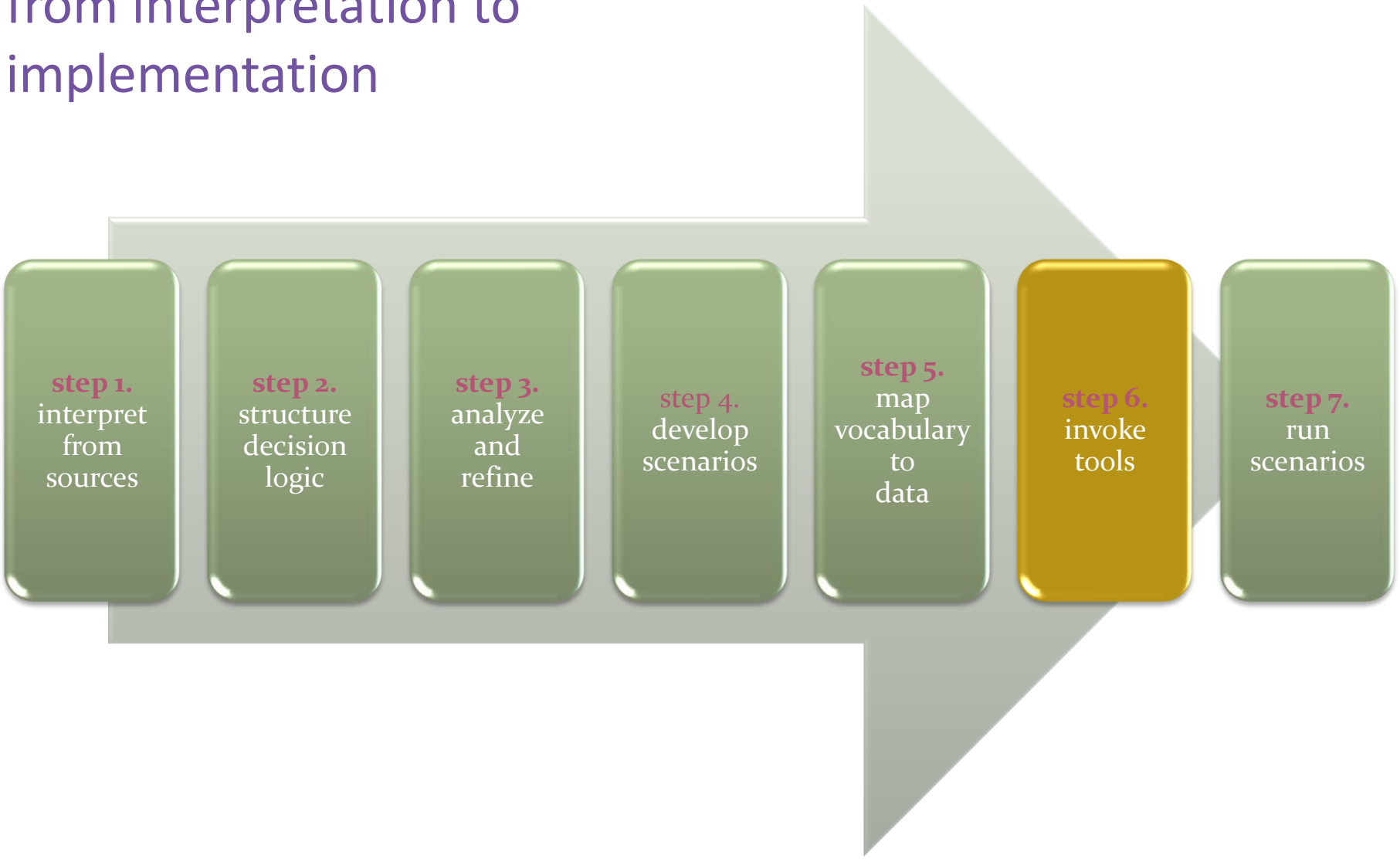
Series Name	Polio - All IPV - 4 Dose					
Target Disease	Polio					
Vaccine Group	Polio					
Select Best Patient Series	Default Series	Product Path	Series Preference			
	Yes	Yes	1			
Series Dose	Dose 1					
Age	Absolute Minimum Age	Minimum Age	Earliest Recommended Age	Latest Recommended Age (less than)	Maximum Age (less than)	
	6 weeks - 4 days	6 weeks	2 months	3 months + 4 weeks	n/a	
Interval	From Immediate Previous Dose Administered? Y/N	From Target Dose # in Series	Absolute Minimum Interval	Minimum Interval	Earliest Recommended Interval	Latest Recommended Interval (less than)
	n/a	n/a	n/a	n/a	n/a	n/a
Preferable Vaccine	Vaccine Type (CVX)	Vaccine Type Begin Age	Vaccine Type End Age (less than)	Trade Name (MVX)	Volume (in ml)	
	IPV (10)	6 weeks	n/a	n/a	0.5	
	DTaP-HepB-IPV (110)	6 weeks	7 years	n/a	0.5	
	DTaP-Hib-IPV (120)	6 weeks	5 years	n/a	0.5	
Allowable Vaccine	Vaccine Type (CVX)	Vaccine Type Begin Age	Vaccine Type End Age (less than)			
	IPV (10)	6 weeks - 4 days	n/a			
	DTaP-HepB-IPV (110)	6 weeks - 4 days	n/a			
	DTaP-Hib-IPV (120)	6 weeks - 4 days	n/a			
	DTaP-IPV (130)	6 weeks - 4 days	n/a			
	DTaP-IPV-Hib-HepB, Historical (132)	6 weeks - 4 days	n/a			
	DTaP-IPV-Hib-HepB (146)	6 weeks - 4 days	n/a			
Skip Dose	Trigger Age					
	n/a					
Recurring Dose	Recurring Dose (Y or No)					
	No					
Conditional Need	Condition Set	Start Date	End Date	Dose Count (less than)	CVX List	
	n/a					
Seasonal Recommendatio	Start Date	End Date				
	n/a					
Substitute Dose	total count of valid dose	First Dose Begin Age	First Dose End Age (less than)	number of target dose to substitute		
	n/a					
Gender	Required Gender					
	n/a					

map



step 5: the destination

business rules & decisions: from interpretation to implementation



step by step

ORACLE

Oracle Policy Automation

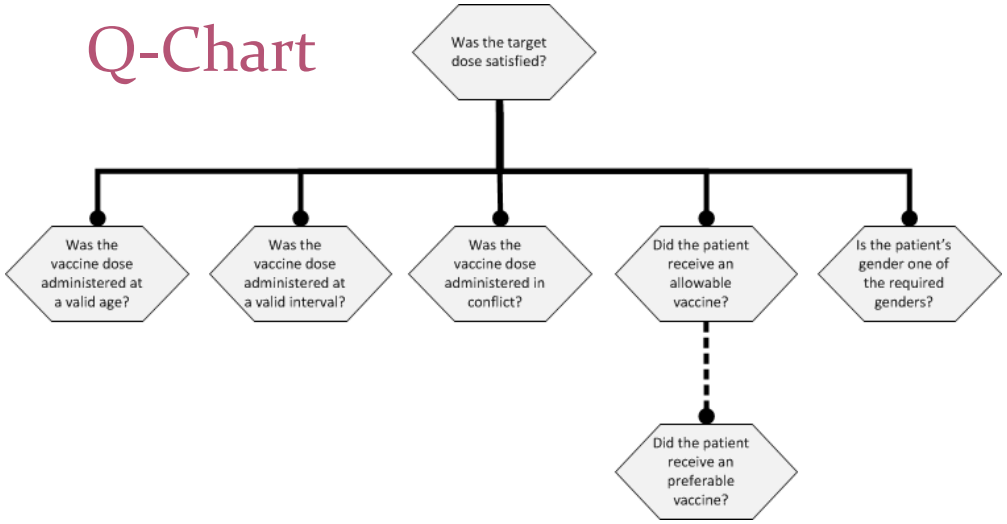
MVC Pro

Independent System Integrator

three development teams

info@openrules.com

Q-Chart



translated to decision table in OpenRules

Decision EvaluateVaccineDoseAdministered

Condition		Condition		Condition		Condition		ActionPrint	ActionExecute
Vaccine Dose Administered Can Be Evaluated		**Target Dose Can Be Skipped**		**Target Dose Can Be Substituted**		**Patient Received Preferable Vaccine**		**Decisions**	**Execute Decision Tables**
								Calculate Patient Immunization Variables	:= CalculatePatientImmunizationVariables()
								Define If Vaccine Dose Administered Can Be Evaluated	:= DefineIfVaccineDoseAdministeredCanBeEvaluated()
Is	No							Decline Evaluation	:= AddExplanation("Vaccine Dose Administered Cannot Be Evaluated")
Is	Yes							Define If Target Dose Can Be Skipped	:= DefineIfTargetDoseCanBeSkipped()
Is	Yes	Is	Yes					Target Dose Can Be Skipped	:= AddExplanation("Target Dose Can Be Skipped")
Is	Yes	Is	No					Define If Target Dose Can Be Substituted	:= DefineIfTargetDoseCanBeSubstituted()
Is	Yes	Is	No	Is	Yes			Target Dose Can Be Substituted	:= AddExplanation("Target Dose Can Be Substituted")
Is	Yes	Is	No	Is	No			Define If Vaccine Dose Administered At a Valid Age	:= DefineIfVaccineDoseAdministeredAtValidAge()
Is	Yes	Is	No	Is	No			Define If Vaccine Dose Administered At a Valid Interval	:= DefineIfVaccineDoseAdministeredAtValidInterval()
Is	Yes	Is	No	Is	No			Define If Live Virus Vaccine Dose Administered Is In Conflict	:= DefineIfLiveVirusVaccineDoseAdministeredIsInConflict()
Is	Yes	Is	No	Is	No			Define If Patient Received Preferable Vaccine	:= DefineIfPatientReceivedPreferableVaccine()
Is	Yes	Is	No	Is	No	Is	No	Define If Patient Received Allowable Vaccine	:= DefineIfPatientReceivedAllowableVaccine()
Is	Yes	Is	No	Is	No			Define If Patient Has a Required Gender	:= DefineIfPatientHasRequiredGender()
Is	Yes	Is	No	Is	No			Define Target Dose Status	:= DefineTargetDoseStatus()

Question: Was the target dose satisfied?

Default: Target Dose is not satisfied.

CONSIDERATIONS								
Was the Vaccine Dose Administered at a Valid Age?	Age is valid.	Age is valid.	Age is extraneous.	Age is not valid.	-	-	-	-
Was the Vaccine Dose Administered at a Valid Interval?	Interval is Valid.	Interval is Valid.	-	-	Interval is Not Valid.	-	-	-
Was the live virus Vaccine Dose Administered in conflict with any previous live virus Vaccine Dose Administered?	The Live Virus Vaccine Dose Administered is not in conflict.	The Live Virus Vaccine Dose Administered is not in conflict.	-	-	-	The Live Virus Vaccine Dose Administered is in conflict.	-	-
Did the patient receive a Preferable Vaccine?	The patient received a Preferable Vaccine.	The patient did not receive a Preferable Vaccine.	-	-	-	-	The patient did not receive a Preferable Vaccine.	-
Did the patient receive an Allowable Vaccine?	-	The patient received an Allowable Vaccine.	-	-	-	-	The patient did not receive an Allowable Vaccine.	-
Is the patient's Gender one of the Required Genders?	The patient's Gender is one of the Required Genders.	The patient's Gender is one of the Required Genders.	-	-	-	-	-	The patient's Gender is not one of the Required Genders.
OUTCOMES	Target Dose status is satisfied.	Target Dose status is satisfied.	Target Dose status is not satisfied.	Target Dose status is not satisfied.	Target Dose status is not satisfied.	Target Dose status is not satisfied.	Target Dose status is not satisfied.	Target Dose status is not satisfied.

business-oriented decision table

translated to decision table in OpenRules

DecisionTable DefineTargetDoseStatus

Condition		Condition		Condition		Condition		Condition		Condition		Conclusion		Message
Vaccine Dose Administered At Valid Age		**Vaccine Dose Administered At Valid Interval**		**Live Virus Vaccine Dose Administered Is In Conflict**		**Patient Has Required Gender**		**Patient Received Preferable Vaccine**		**Patient Received Allowable Vaccine**		**Target Dose Status**		**Reason**
Is	No											Is	Invalid	Invalid Age
Is	Yes	Is	No									Is	Invalid	Invalid Interval
Is	Yes	Is	Yes	Is	Yes							Is	Invalid	Vaccine Dose Administered Is In Conflict
Is	Yes	Is	Yes	Is	No	Is	No					Is	Invalid	Patient does not have required gender
Is	Yes	Is	Yes	Is	No	Is	Yes	Is	No	Is	No	Is	Invalid	Vaccine is neither preferable or allowable
Is	Yes	Is	Yes	Is	No	Is	Yes	Is	No	Is	Yes	Is	Valid	
Is	Yes	Is	Yes	Is	No	Is	Yes	Is	Yes			Is	Valid	

BR 351	The patient's Skip Target Dose Trigger Age Date must be calculated as the patient's Date of Birth plus the Skip Target Dose Trigger Age.	Proposed
BR 352	The patient's First Dose Begin Age Date must be calculated as the patient's Date of Birth plus Substitute Dose First Dose Begin Age.	Proposed
BR 353	The patient's First Dose End Age Date must be calculated as the patient's Date of Birth plus Substitute Dose First Dose End Age.	Proposed
BR 354	The patient's Maximum Age Date must be calculated as the patient's Date of Birth plus the Maximum Age.	Proposed
BR 355	The patient's Latest Recommended Age Date must be calculated as the patient's Date of Birth plus the Latest Recommended Age.	Proposed
BR 356	The patient's Earliest Recommended Age Date must be calculated as the patient's Date of Birth plus the Earliest Recommended Age.	Proposed

business rules translated to implementation format in OpenRules

Method void CalculatePatientImmunizationVariables()

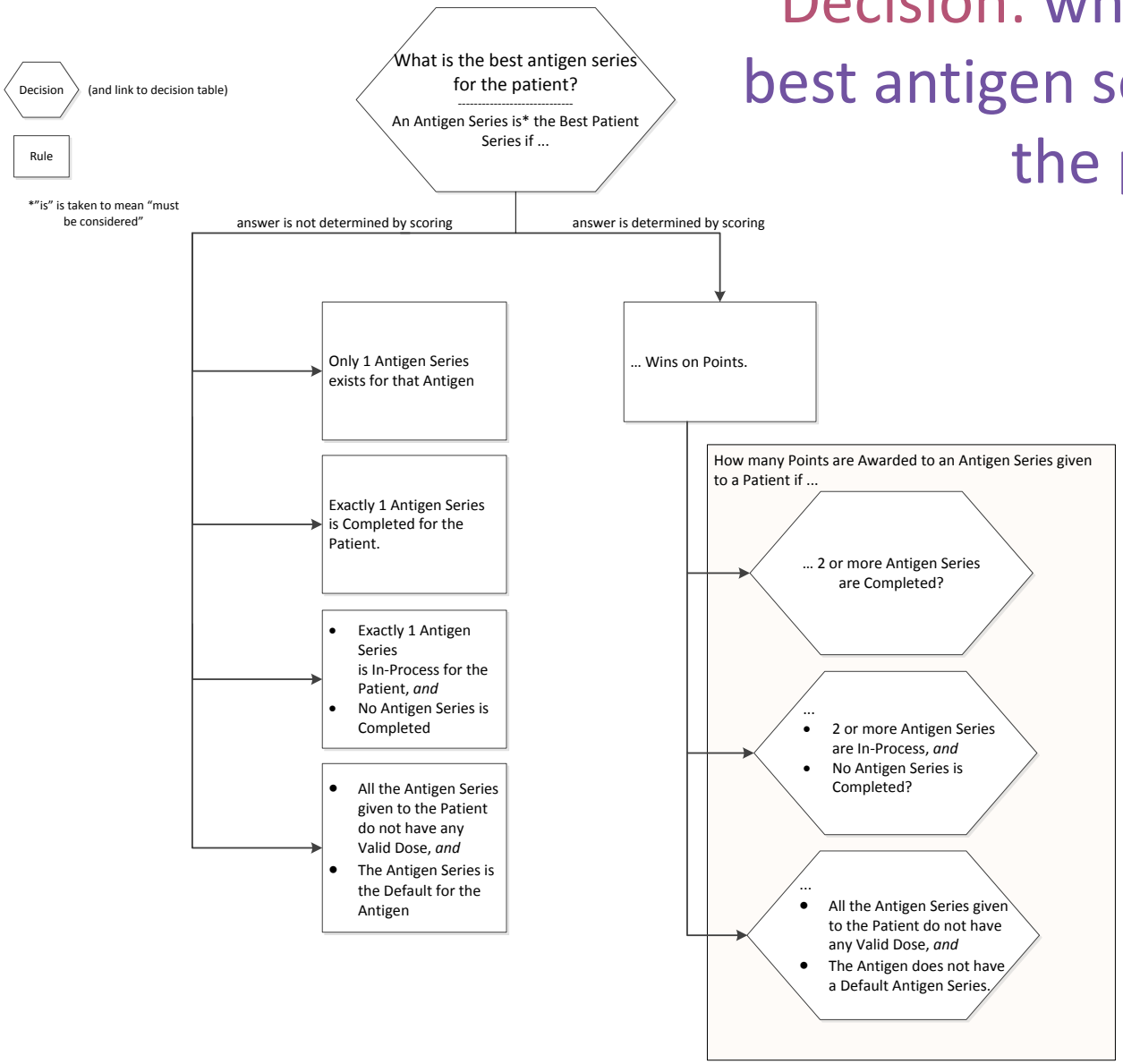
```
CalculatePatientSpecificDates();
defineDateAdministeredOfFirstSatisfiedTargetDose();
setInt("Substitute Dose Total Count of Valid Doses",0); // TBD
defineTotalCountOfSatisfiedTargetDosesInPatientSeries();
definePreviousVaccineDoseAdministeredViolationReason(); // TBD
defineFirstTargetDose();
```

DecisionTableDatesArithmetic **CalculatePatientSpecificDates**

Target Date	=	Source Date	+	Days
Skip Target Dose Trigger Age Date	=	Patient's Date of Birth	+	Skip Target Dose Trigger Age
First Dose Begin Age Date	=	Patient's Date of Birth	+	Substitute Dose First Dose Begin Age
First Dose End Age Date	=	Patient's Date of Birth	+	Substitute Dose First Dose End Age
Absolute Minimum Age Date	=	Patient's Date of Birth	+	Absolute Minimum Age
Minimum Age Date	=	Patient's Date of Birth	+	Minimum Age
Maximum Age Date	=	Patient's Date of Birth	+	Maximum Age
Absolute Minimum Interval Date	=	Patient's Date of Birth	+	Absolute Minimum Interval
Minimum Interval Date	=	Patient's Date of Birth	+	Minimum Interval

Peter.Still@oracle.com

Decision: what is the best antigen series for the patient?



Rule	Statement	Status
Win on Points	An antigen series must be considered to win on points if any of the following are true: - It is the only Antigen Series that scores the highest total of points awarded; - all the following are true: - It scores the highest total of points awarded; - It ties another antigen Series - the series preference of the antigen series is the least of any antigen series it is tied with.	Proposed

business rule translated to implementation format in OPA

The antigen series is the highest ranking on points if

The antigen series scored the highest total of points awarded

The number of points awarded to the antigen series = the highest number of points awarded to any antigen series

and

Either

There is only one antigen series with the highest number of points or

The series preference of the antigen series is the least of all highest scoring antigen series

The series preference of the antigen series = the lowest series preference of all highest scoring antigen series

Decision Table - Completed:

How many Points are Awarded to a Completed Antigen Series given to a Patient if 2 or more Antigen Series are Completed?		Evaluation of Consideration		
		If this Series is the only one for which this is true	If this Series is one of two or more for which this is true	If false for the Series
The Antigen Series Given to a Patient ...	has the Most Valid Doses.	+1	0	-1
	has All Valid Doses.	+1	n/a	-1
	is the Earliest Completing.	+2	+1	-1

business -oriented decision table

translated to implementation format in OPA

Completed Main Rule

the number of points awarded to the antigen series for being completed =
the number of points awarded to the antigen series for being completed and having the most valid doses +
the number of points awarded to the antigen series for being completed and having all valid doses +
the number of points awarded to the antigen series for being completed and being earliest completing

the number of points awarded to the antigen series for being completed and having the most valid doses	
1	the antigen series has the most valid doses and The total number of antigen series which are complete and have the most valid doses = 1
0	the antigen series has the most valid doses and The total number of antigen series which are complete and have the most valid doses > 1
-1	**otherwise**

the number of points awarded to the antigen series for being completed and having all valid doses	
1	the antigen series has all valid doses and The total number of antigen series which are complete and have all valid doses = 1
0	the antigen series has all valid doses and The total number of antigen series which are complete and have all valid doses > 1
-1	**otherwise**

the number of points awarded to the antigen series for being completed and being earliest completing	
2	the antigen series is the earliest completing and The total number of antigen series which are complete and earliest completing = 1
1	the antigen series is the earliest completing and The total number of antigen series which are complete and earliest completing > 1
-1	**otherwise**

MVC Pro

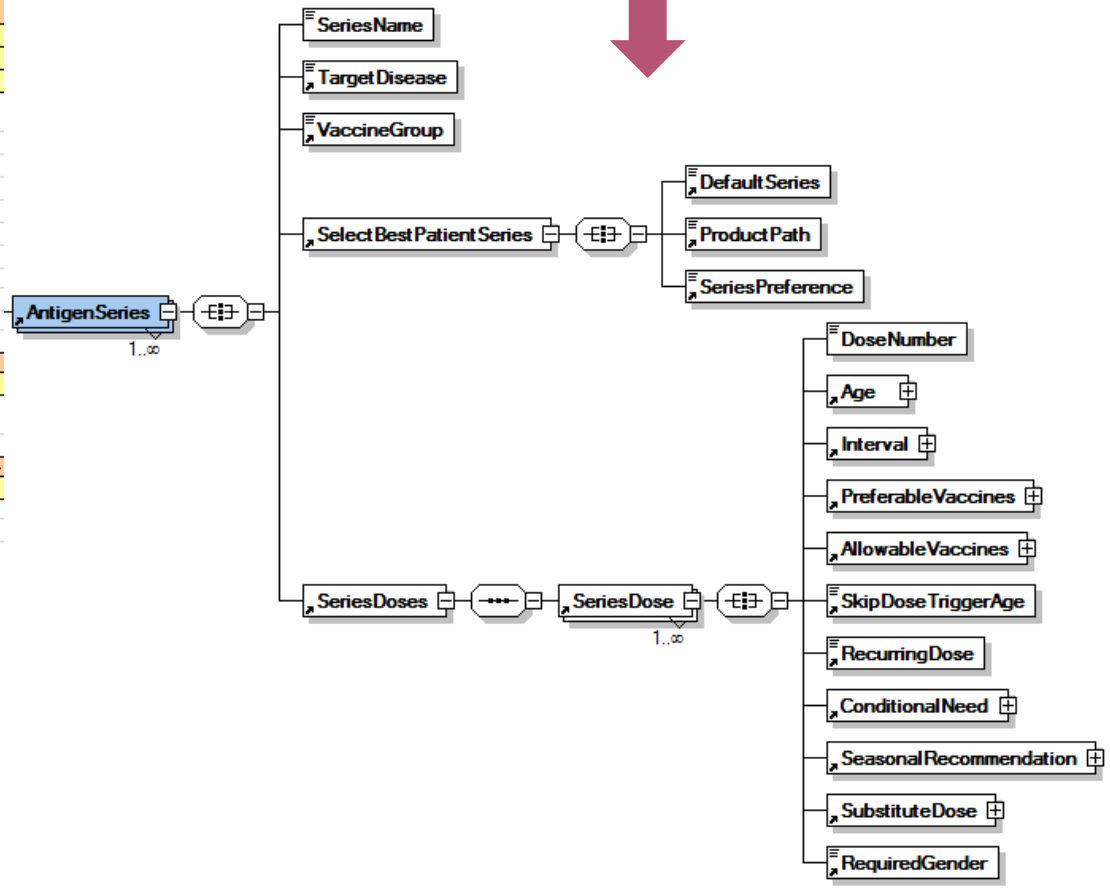
Independent System Integrator

peterwei@mvcpro.com

supporting data

Series Name	Polio - All IPV - 4 Dose					
Target Disease	Polio					
Vaccine Group	Polio					
Select Best Patient Series	Default Series	Product Path	Series Preference			
	Yes	Yes	1			
Series Dose	Dose 1					
Age	Absolute Minimum Age	Minimum Age	Earliest Recommended Age	Latest Recommended Age (less than)	Maximum Age (less than)	
	6 weeks - 4 days	6 weeks	2 months	3 months + 4 weeks	n/a	
Interval	From Immediate Previous Dose Administered? Y/N	From Target Dose # in Series	Absolute Minimum Interval	Minimum Interval	Earliest Recommended Interval	Latest Recommended Interval (less than)
	n/a	n/a	n/a	n/a	n/a	n/a
Preferable Vaccine	Vaccine Type (CVX)	Vaccine Type Begin Age	Vaccine Type End Age (less than)	Trade Name (MVX)		
	IPV (10)	6 weeks	n/a	n/a		
	DTaP-HepB-IPV (110)	6 weeks	7 years	n/a		
	DTaP-Hib-IPV (120)	6 weeks	5 years	n/a		
Allowable Vaccine	Vaccine Type (CVX)	Vaccine Type Begin Age	Vaccine Type End Age (less than)			
	IPV (10)	6 weeks - 4 days	n/a			
	DTaP-HepB-IPV (110)	6 weeks - 4 days	n/a			
	DTaP-Hib-IPV (120)	6 weeks - 4 days	n/a			
	DTaP-IPV (130)	6 weeks - 4 days	n/a			
	DTaP-IPV-Hib-HepB, Historical (132)	6 weeks - 4 days	n/a			
	DTaP-IPV-Hib-HepB (146)	6 weeks - 4 days	n/a			
Skip Dose	Trigger Age					
	n/a					
Recurring Dose	Recurring Dose (Yes/No)					
	No					
Conditional Need	Condition Set	Start Date	End Date	Dose Count (less than)		
	n/a					
Seasonal Recommendatio	Start Date	End Date				
	n/a					
Substitute Dose	total count of valid doses	First Dose Begin Age	First Dose End Age (less than)	number of target doses to substitute		
	n/a					
Gender	Required Gender					
	n/a					

translated to data structure for InRule



supporting data

Series Name	Polio - All IPV - 4 Dose					
Target Disease	Polio					
Vaccine Group	Polio					
Select Best Patient Series	Default Series	Product Path	Series Preference			
	Yes	Yes	1			
Series Dose	Dose 1					
Age	Absolute Minimum Age	Minimum Age	Earliest Recommended Age	Latest Recommended Age (less than)	Maximum Age (less than)	
	6 weeks - 4 days	6 weeks	2 months	3 months + 4 weeks	n/a	
Interval	From Immediate Previous Dose Administered? Y/N	From Target Dose # in Series	Absolute Minimum Interval	Minimum Interval	Earliest Recommended Interval	Latest Recommended Interval (less than)
	n/a	n/a	n/a	n/a	n/a	n/a
Preferable Vaccine	Vaccine Type (CVX)	Vaccine Type Begin Age	Vaccine Type End Age (less than)	Trade Name (MVX)	Volume (in ml)	
	IPV (10)	6 weeks	n/a	n/a	0.5	
	DTaP-HepB-IPV (110)	6 weeks	7 years	n/a	0.5	
	DTaP-Hib-IPV (120)	6 weeks	5 years	n/a	0.5	
Allowable Vaccine	Vaccine Type (CVX)	Vaccine Type Begin Age	Vaccine Type End Age (less than)			
	IPV (10)	6 weeks - 4 days	n/a			
	DTaP-HepB-IPV (110)	6 weeks - 4 days	n/a			
	DTaP-Hib-IPV (120)	6 weeks - 4 days	n/a			
	DTaP-IPV (130)	6 weeks - 4 days	n/a			
	DTaP-IPV-Hib-HepB, Historical (132)	6 weeks - 4 days	n/a			
	DTaP-IPV-Hib-HepB (146)	6 weeks - 4 days	n/a			
Skip Dose	Trigger Age					
	n/a					
Recurring Dose	Recurring Dose (Y or N)					
	No					
Conditional Need	Condition Set	Start Date	End Date	Dose Count (less than)	CVX List	
	n/a					
Seasonal Recommendatio	Start Date	End Date				
	n/a					
Substitute Dose	total count of valid doses	First Dose Begin Age	First Dose End Age (less than)	number of target doses to substitute		
	n/a					
Gender	Required Gender					
	n/a					

populated data structure in InRule

Immunization Process Tool

Summary | Decision Tables | Input Xml | Evaluation Output Xml | Determination Output Xml

```
<?xml version="1.0" encoding="utf-8" ?>
- <Immunization xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation=
  + <PatientData>
  - <Configuration>
    + <Vaccines>
    - <AntigenSeriesCollection>
      - <AntigenSeries>
          <SeriesName>Polio IPV/OPV Mixed 4 Dose</SeriesName>
          <TargetDisease>Polio</TargetDisease>
          <VaccineGroup>Polio</VaccineGroup>
        - <SelectBestPatientSeries>
            <DefaultSeries>No</DefaultSeries>
            <ProductPath>No</ProductPath>
            <SeriesPreference>2</SeriesPreference>
          </SelectBestPatientSeries>
        - <SeriesDoses>
          - <SeriesDose>
              <DoseNumber>1</DoseNumber>
            - <Age>
                <AbsoluteMinimumAge>6 weeks - 4 days</AbsoluteMinimumAge>
                <MinimumAge>6 weeks</MinimumAge>
                <EarliestRecommendedAge>2 months</EarliestRecommendedAge>
                <LatestRecommendedAge>3 months + 4 weeks</LatestRecommendedAge>
                <MaximumAge>n/a</MaximumAge>
              </Age>
            + <Interval>
            + <PreferableVaccines>
            + <AllowableVaccines>
              <SkipDoseTriggerAge>n/a</SkipDoseTriggerAge>
              <RecurringDose>No</RecurringDose>
            + <ConditionalNeed>
            + <SeasonalRecommendation>
              <SubstituteDose>
              <RequiredGender>n/a</RequiredGender>
            </SeriesDose>
          - <SeriesDose>
              <DoseNumber>2</DoseNumber>
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                <MinimumAge>10 weeks</MinimumAge>
```
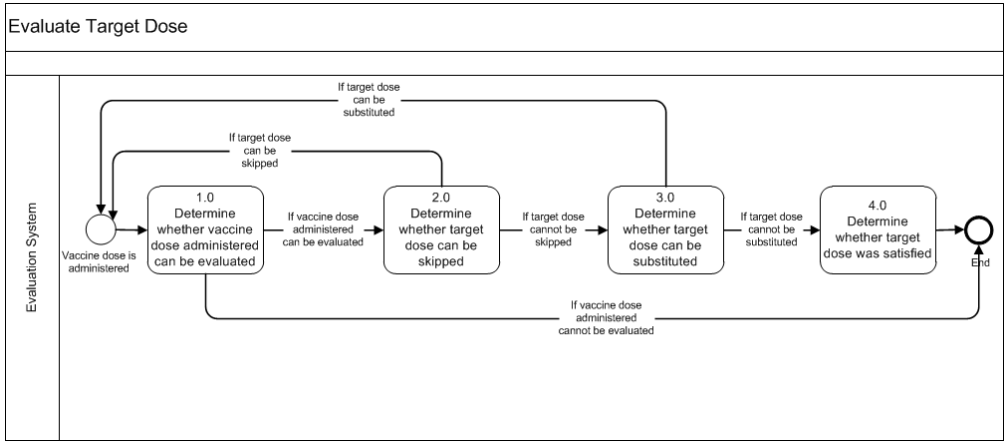
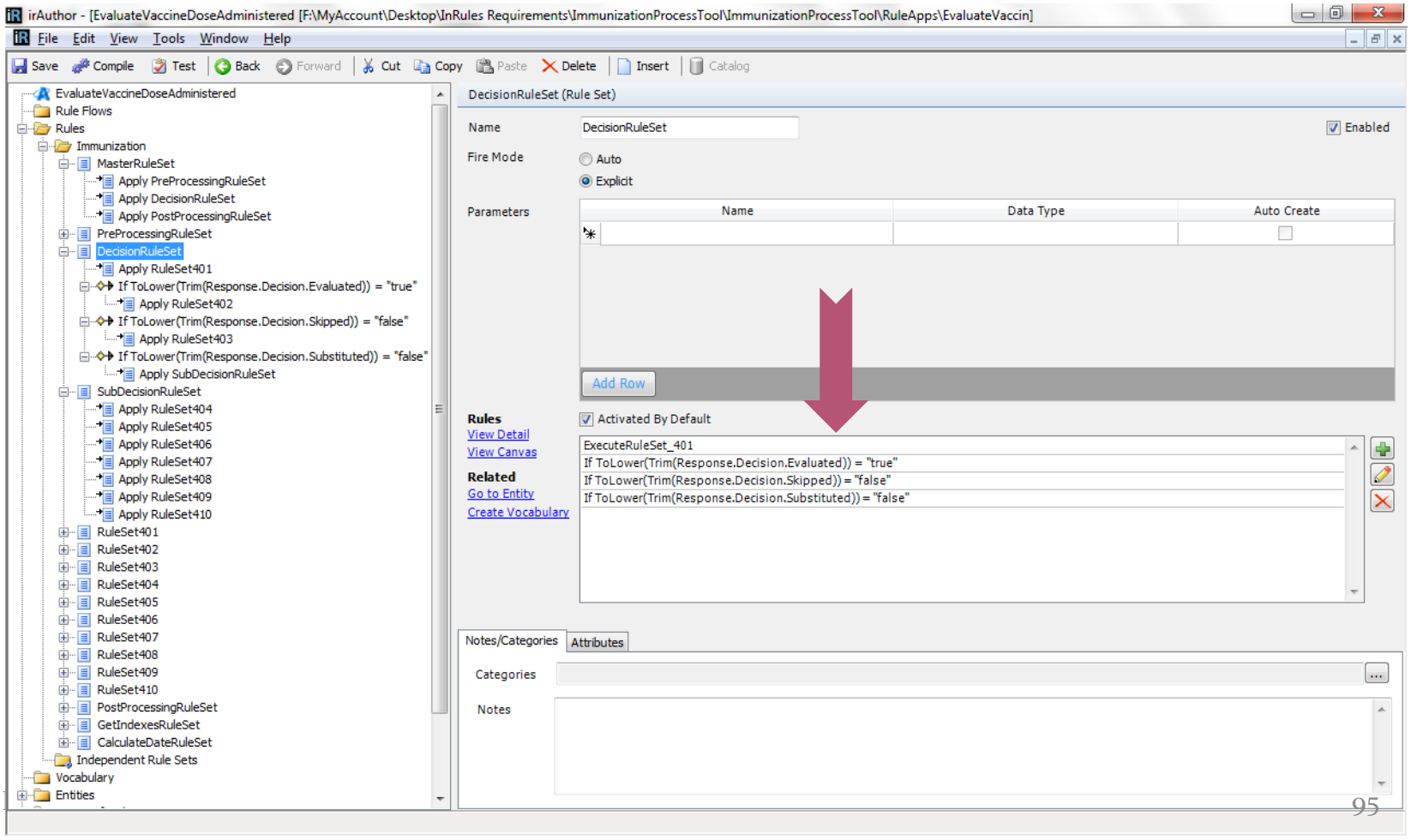



process model

translated to code in InRule



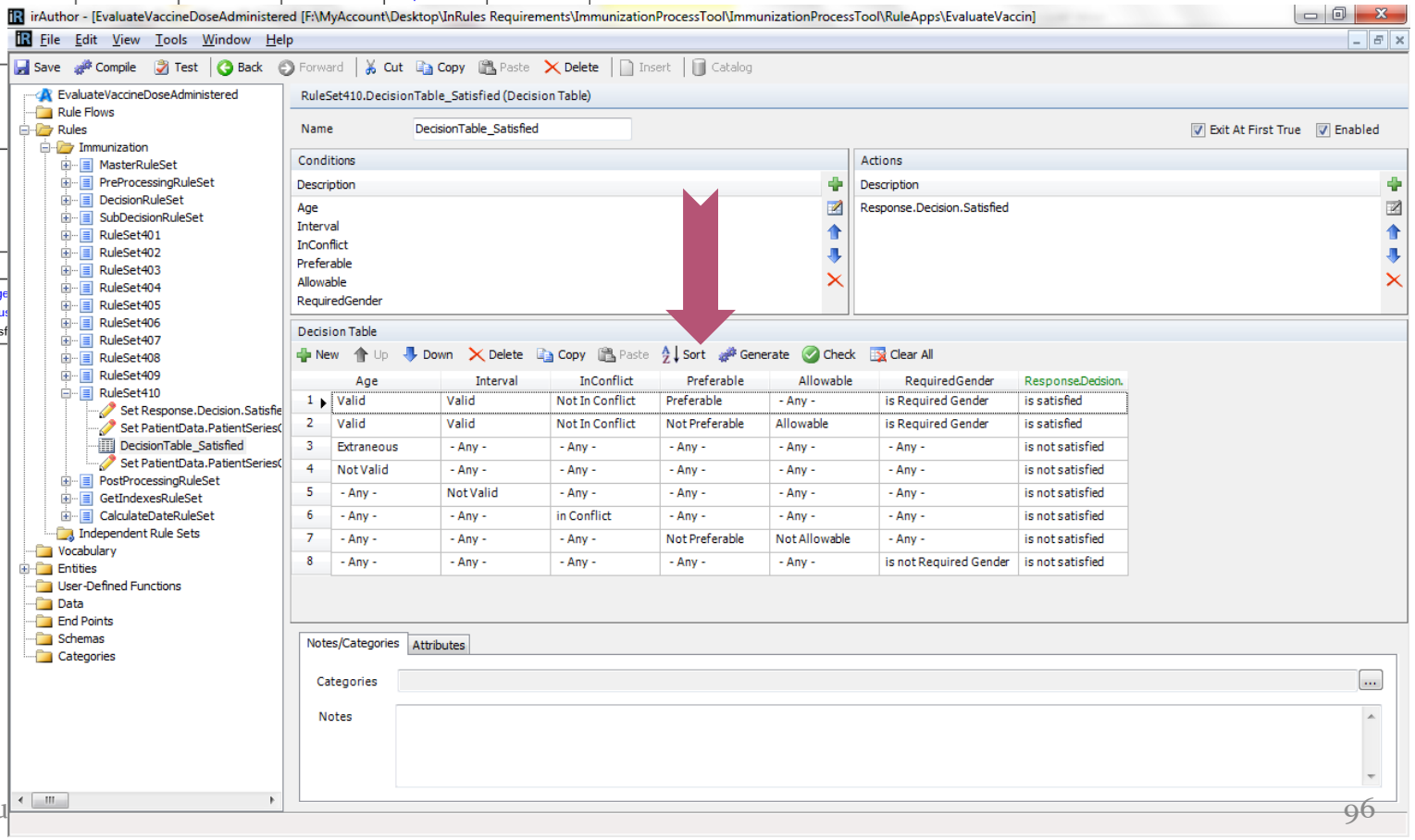
Question: Was the target dose satisfied?

Default: Target Dose is not satisfied.

CONSIDERATIONS								
Was the Vaccine Dose Administered at a Valid Age?	Age is valid.	Age is valid.	Age is extraneous.	Age is not valid.	-	-	-	-
Was the Vaccine Dose Administered at a Valid Interval?	Interval is Valid.	Interval is Valid.	-	-	Interval is Not Valid.	-	-	-
Was the live virus Vaccine Dose Administered in conflict with any previous live virus Vaccine Dose Administered?	The Live Virus Vaccine Dose Administered is not in conflict.	The Live Virus Vaccine Dose Administered is not in conflict.	-	-	-	The Live Virus Vaccine Dose Administered is in conflict.	-	-
Did the patient receive a Preferable Vaccine?	The patient received a Preferable Vaccine.	The patient did not receive a Preferable Vaccine.	-	-	-	-	The patient did	-
Did the patient receive an Allowable Vaccine?	-	The patient received an Allowable Vaccine.	-					
Is the patient's Gender one of the Required Genders?	The patient's Gender is one of the Required Genders.	The patient's Gender is one of the Required Genders.	-					
OUTCOMES	Target Dose status is satisfied.	Target Dose status is satisfied.	Targe status satisf					

business-oriented decision table

translated to decision table in InRule



Question: Was the target dose satisfied?

Default: Target Dose is not satisfied.

CONSIDERATIONS								
Was the Vaccine Dose Administered at a Valid Age?	Age is valid.	Age is valid.	Age is extraneous.	Age is not valid.	-	-	-	-
Was the Vaccine Dose Administered at a Valid Interval?	Interval is Valid.	Interval is Valid.	-	-	Interval is Not Valid.	-	-	-
Was the live virus Vaccine Dose Administered in conflict with any previous live virus Vaccine Dose Administered?	The Live Virus Vaccine Dose Administered is not in conflict.	The Live Virus Vaccine Dose Administered is not in conflict.	-	-	-	The Live Virus Vaccine Dose Administered is	-	-
Did the patient receive a Preferable Vaccine?	The patient received a Preferable Vaccine.	The patient did not receive a Preferable Vaccine.	-					
Did the patient receive an Allowable Vaccine?	-	The patient received an Allowable Vaccine.	-					
Is the patient's Gender one of the Required Genders?	The patient's Gender is one of the Required Genders.	The patient's Gender is one of the Required Genders.	-					
OUTCOMES	Target Dose status is satisfied.	Target Dose status is satisfied.	Tar status satisf					

business-oriented decision table

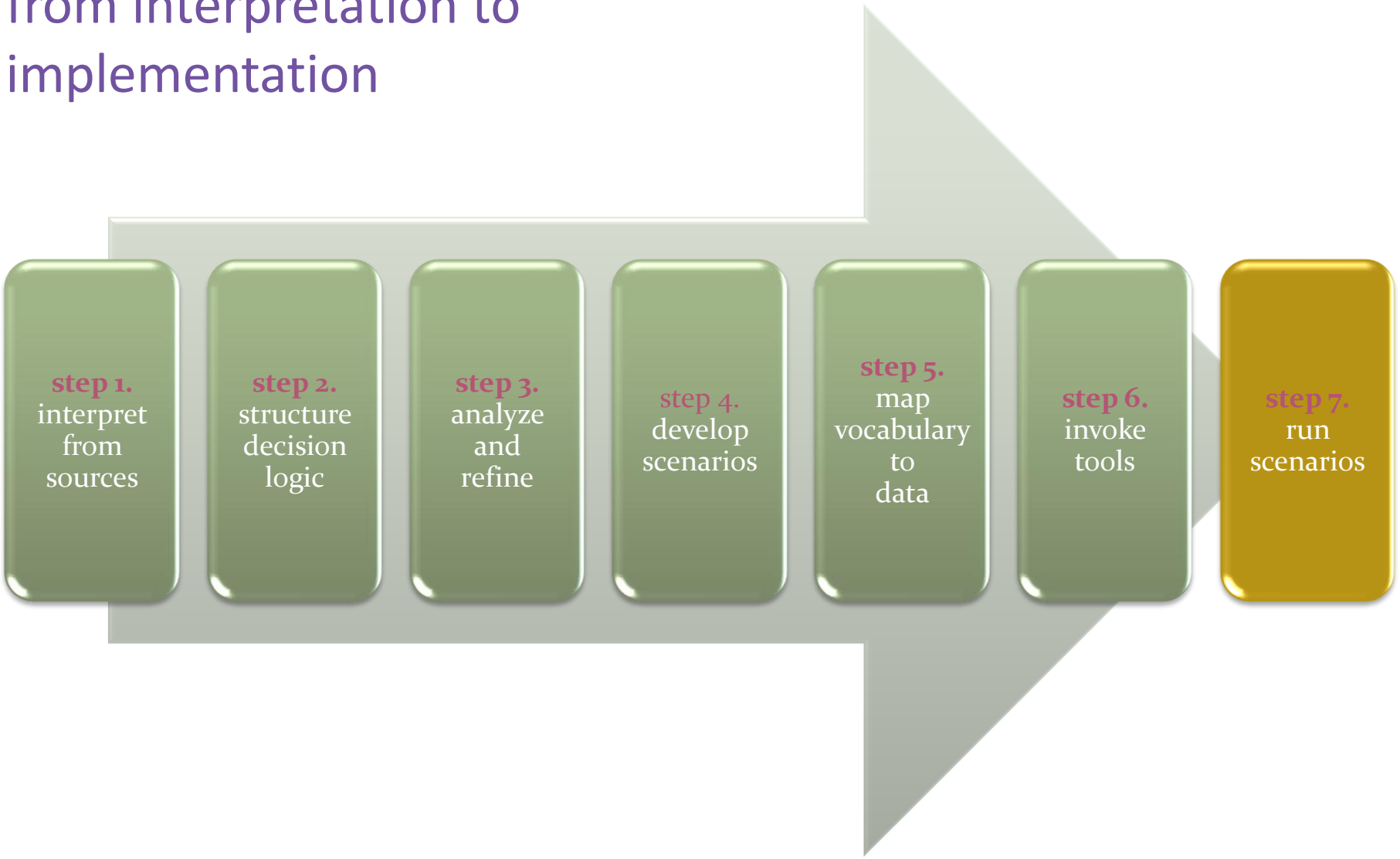
translated to decision table in InRule

Decision Table

New | Up | Down | Delete | Copy | Paste | Sort | Generate | Check | Clear All

	Age	Interval	InConflict	Preferable	Allowable	RequiredGender	ResponseDecision.
1	Valid	Valid	Not In Conflict	Preferable	- Any -	is Required Gender	is satisfied
2	Valid	Valid	Not In Conflict	Not Preferable	Allowable	is Required Gender	is satisfied
3	Extraneous	- Any -	- Any -	- Any -	- Any -	- Any -	is not satisfied
4	Not Valid	- Any -	- Any -	- Any -	- Any -	- Any -	is not satisfied
5	- Any -	Not Valid	- Any -	- Any -	- Any -	- Any -	is not satisfied
6	- Any -	- Any -	in Conflict	- Any -	- Any -	- Any -	is not satisfied
7	- Any -	- Any -	- Any -	Not Preferable	Not Allowable	- Any -	is not satisfied
8	- Any -	- Any -	- Any -	- Any -	- Any -	is not Required Gender	is not satisfied

business rules & decisions: from interpretation to implementation



step by step

scenario 1

male patient received the first dose of IPV(10) vaccine at two months and 6 days old.

mock-up (test data)

patient
patient name: Sammy
date of birth: September 24, 2012
gender: male

vaccine dose administered
dose number: 1
trade name: Ipol (PMC)
vaccine Type: IPV (10)
volume: 0.5
lot expiration date: Dec. 31, 2015
date administered: Nov. 30, 2012
dose condition is not indicated

decision: Was the target dose satisfied?

expected outcome: target dose is satisfied

Age is valid.
Interval is valid.
The Live Virus Vaccine Dose Administered is not in conflict.
The patient received a preferable vaccine.
The patient did not receive an allowable vaccine.
The patient is one of the required genders.
Target dose status is 'satisfied'.

step 7: the destination

scenario 1 expected outcome: target dose is satisfied

Age is valid.
Interval is valid.
The Live Virus Vaccine Dose Administered is not in conflict.
The patient received a preferable vaccine.
The patient did not receive an allowable vaccine.
The patient is one of the required genders.
Target dose status is 'satisfied'.

actual outcome in OpenRules (technical)

```
[java] Decision EvaluateVaccineDoseAdministered: Define If Vaccine Dose Administered Can Be Evaluated
[java] Conclusion: Vaccine Dose Administered Can Be Evaluated Is Yes
[java] Decision EvaluateVaccineDoseAdministered: Define If Target Dose Can Be Skipped
[java] Conclusion: Target Dose Can Be Skipped Is No
[java] Decision EvaluateVaccineDoseAdministered: Define If Target Dose Can Be Substituted
[java] Conclusion: Target Dose Can Be Substituted Is No
[java] Decision EvaluateVaccineDoseAdministered: Define If Vaccine Dose Administered At a Valid Age
[java] Conclusion: Vaccine Dose Administered At Valid Age Is Yes
[java] Decision EvaluateVaccineDoseAdministered: Define If Vaccine Dose Administered At a Valid Interval
[java] Conclusion: Vaccine Dose Administered At Valid Interval Is Yes
[java] Decision EvaluateVaccineDoseAdministered: Define If Live Virus Vaccine Dose Administered Is In Conflict
[java] Conclusion: Live Virus Vaccine Dose Administered Is In Conflict Is No
[java] Decision EvaluateVaccineDoseAdministered: Define If Patient Received Preferable Vaccine
[java] Preferable Vaccine Type Begin Date: Mon Sep 24 15:18:19 PDT 2012
[java] Preferable Vaccine Type End Date: Wed Aug 31 15:18:19 PDT 2112
[java] Conclusion: Patient Received Preferable Vaccine Is Yes
[java] Decision EvaluateVaccineDoseAdministered: Define If Patient Has a Required Gender
[java] Conclusion: Patient Has Required Gender Is Yes
[java] Decision EvaluateVaccineDoseAdministered: Define Target Dose Status
[java] Conclusion: Target Dose Status Is Valid
[java] Decision has been finalized
```

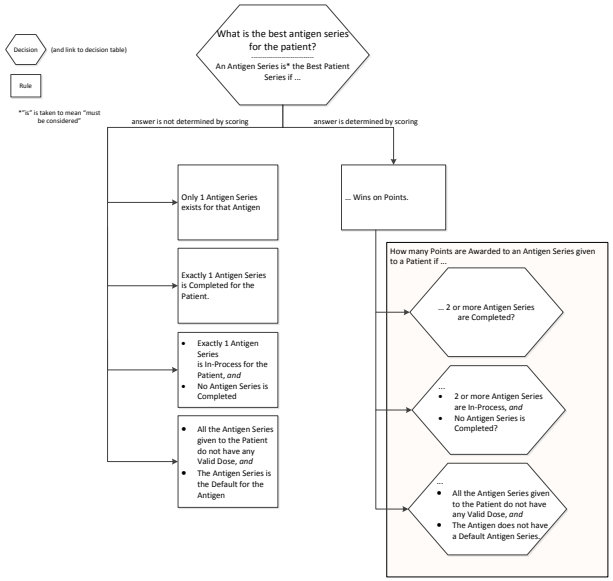
scenario 1 expected result: target dose is satisfied

Age is valid.
Interval is valid.
The Live Virus Vaccine Dose Administered is not in conflict.
The patient received a preferable vaccine.
The patient did not receive an allowable vaccine.
The patient is one of the required genders.
Target dose status is 'satisfied'.

actual result in OpenRules (business-friendly)

Executed Rule	Condition	Condition	Condition	Condition	Condition	Condition	Conclusion	Message
#	Vaccine Dose Administered At Valid Age	Vaccine Dose Administered At Valid Interval	Live Virus Vaccine Dose Administered Is In Conflict	Patient Has Required Gender	Patient Received Preferable Vaccine	Patient Received Allowable Vaccine	Target Dose Status	Reason
7	Is Yes	Is Yes	Is No	Is Yes	Is Yes	-	Is Valid	-

step 7: the destination



Decision: what is the best antigen series for the patient?

actual result in OPA

ORACLE Web Determinations

Data Review

Best Antigen Series Assessment Tool

This interview has been created from the CDC best antigen series rules.

- The best antigen series is Polio IPV/OPV Mixed 4 Dose. [Why?]

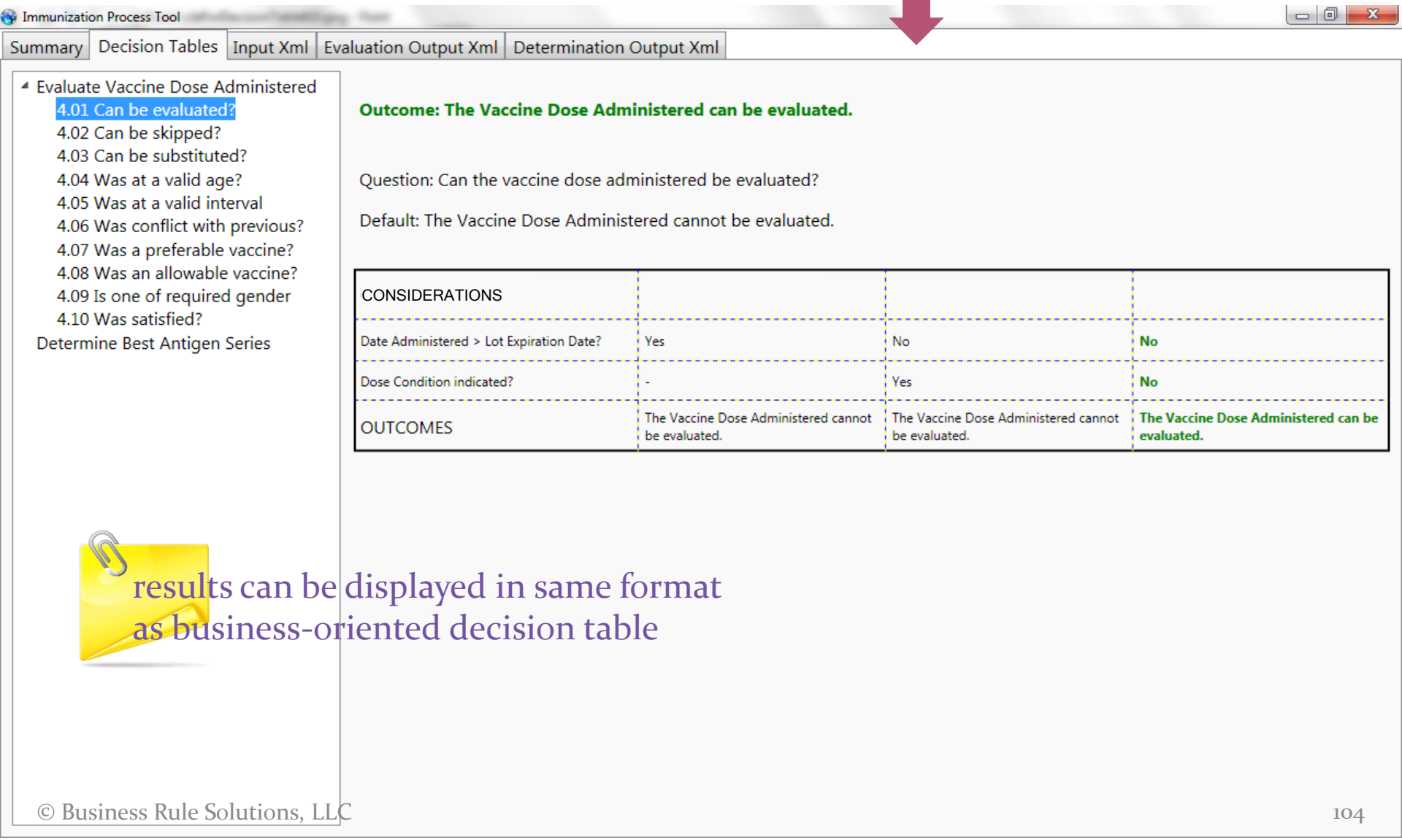
step 7: the destination

actual result (why?) in OPA

Disclaimer:
This example uses an earlier version of the supporting data so the logic is not current.

step 7: the destination

scenario 1 actual result in InRule (MVC Pro)

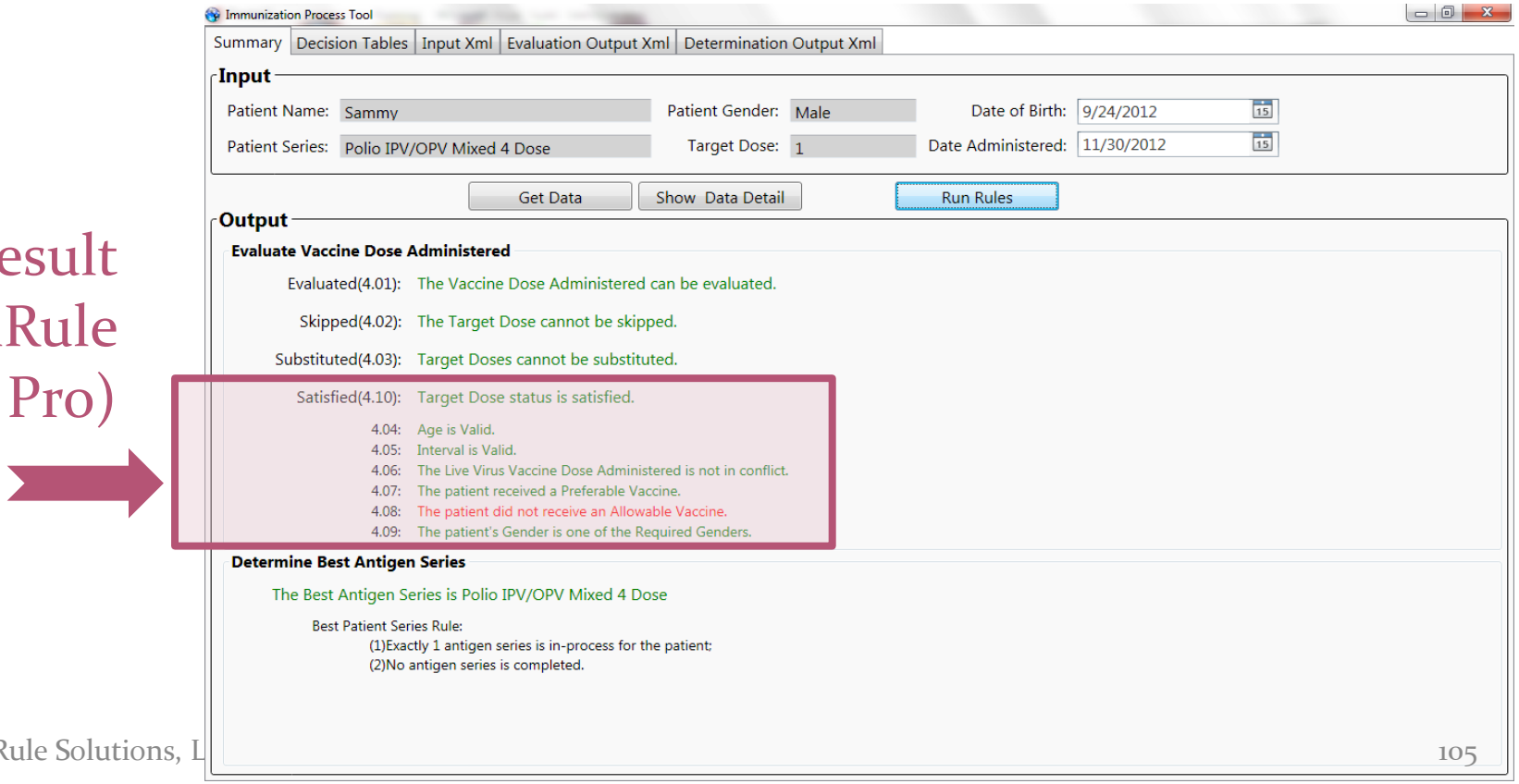


results can be displayed in same format as business-oriented decision table

scenario 1 expected result: target dose is satisfied

Age is valid.
Interval is valid.
The Live Virus Vaccine Dose Administered is not in conflict.
The patient received a preferable vaccine.
The patient did not receive an allowable vaccine.
The patient is one of the required genders.
Target dose status is 'satisfied'.

actual result in InRule (MVC Pro)



size

- 158 terms
- 5 neighborhoods in concept model
- 11 decisions
- 14 decision tables
- 47 business rules
- 10 rule groups

some numbers

analysis effort

- 3 months - initial creation of decisions, decision tables and business rules with business stakeholders
- 5 days - create scenarios and requirements document
- half day – handover meeting per developer
- 3 days – answering questions, coordination, testing, validating results

some numbers

development effort

development	evaluate target dose	best antigen series
OPA	1 day	1 day
OpenRules	~ 1 week	n/a
MVP Pro	~ 1 week	~ 1 week

some statistics

recap

- three different implementations; similar questions for each
- most questions about terminology
- scenarios valuable
- 3-5 hours of our time spent with each of the 3 development teams
- each team able to produce results

heads-up for IT

- work with business analysts specifically to …
  - map concepts to data
  - identify reference data in the concept model
  - distinguish static vs dynamic data

heads-up for business analysts

- be prepared to participate with IT in test - driving the decision logic
- produce detailed …
  - scenarios
  - test data
  - expected outcomes
- remember to identify defaults to ensure your decision logic is complete
- stick to the approach to guide, capture and validate thinking by business stakeholders

heads-up for business stakeholders

insist on …

- a top-down business-driven approach
- business terminology
- business-friendly styles of decision tables
- a clearly structured approach that you can follow all the way to deployment

takeaways

You can do this!
You just need the
right approach.

find out more

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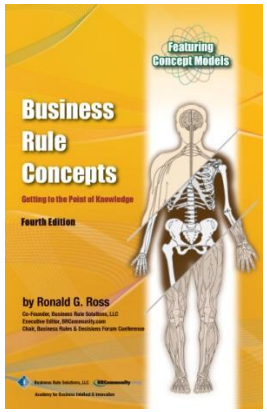

Business Rule Concepts

Getting to the Point of Knowledge

4th edition, 2013

Primer Trio

Decision Analysis
Decision Tables
RuleSpeak® 3.0

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training

- 2013 Instructor-Led Online Training Series …
  - Oct. 1 – 3 … Business Rule Analysis: Practitioner MasterClass Series
  - Oct. 29 – 31 … Business Analysis with Business Rules: From Strategy to Requirements
  - Nov. 20 – 21 … Decision Analysis and Decision Tables: All About Modeling Decisions

request
30 minutes
with us!

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thank you!

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