Child Health Evaluation and Research Unit

University of Michigan

University of Michigan
C.S. Mott Children's Hospital

EHR / MCIR Interoperability Evaluation

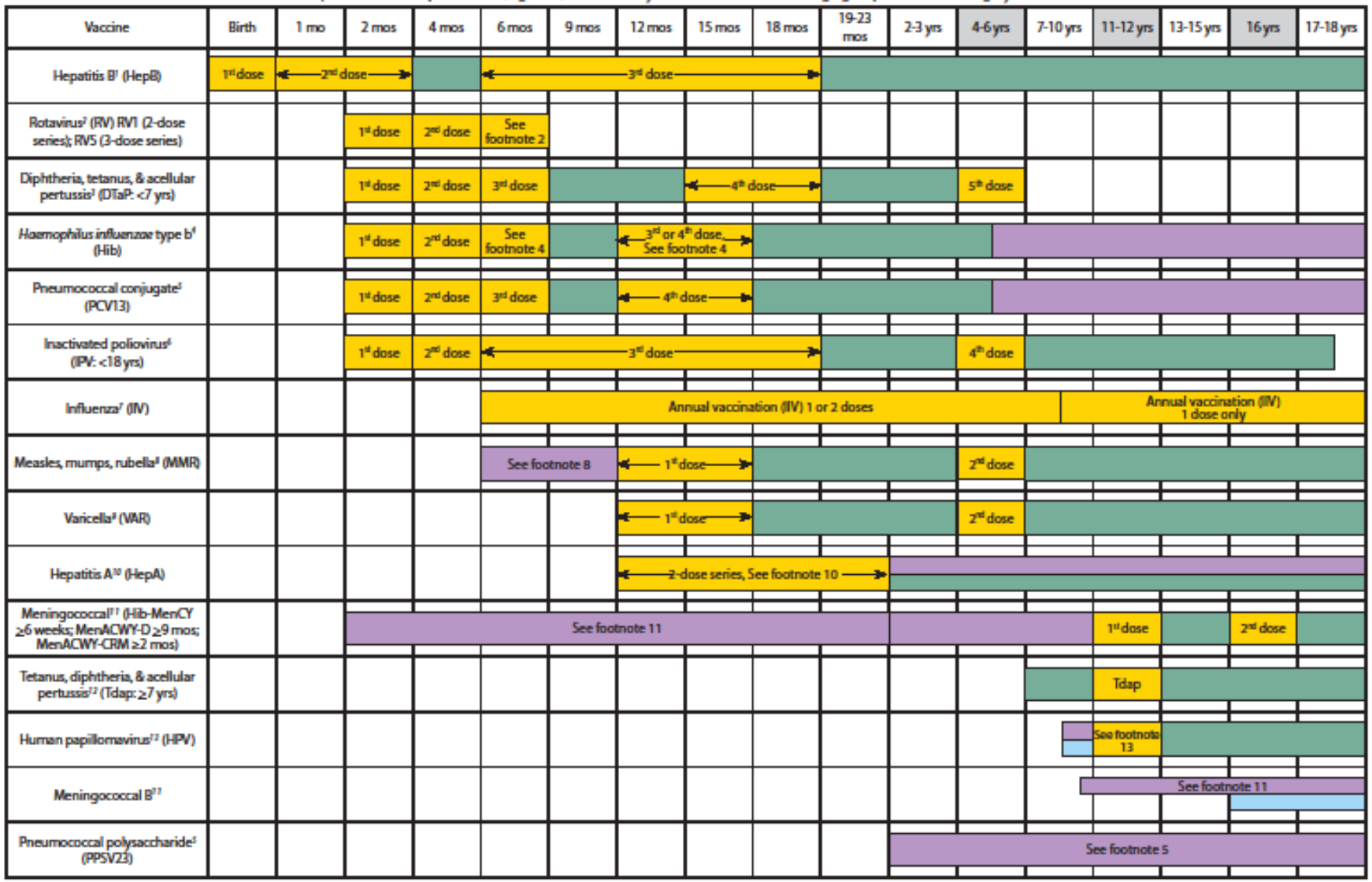
Clinical Decision Support for Immunizations (CDSi): Forecaster Comparison

April 13, 2017

Figure 1. Recommended Immunization Schedule for Children and Adolescents Aged 18 Years or Younger—United States, 2017.

(FOR THOSE WHO FALL BEHIND OR START LATE, SEE THE CATCH-UP SCHEDULE [FIGURE 2]).

These recommendations must be read with the footnotes that follow. For those who fall behind or start late, provide catch-up vaccination at the earliest opportunity as indicated by the green bars in Figure 1. To determine minimum intervals between doses, see the catch-up schedule (Figure 2). School entry and adolescent vaccine age groups are shaded in gray.



NOTE: The above recommendations must be read along with the footnotes of this schedule.

Background

- The Michigan Care Improvement Registry (MCIR) has historically maintained its own forecasting capabilities
- Alternative forecasting approaches exist
- How might adoption of an alternative forecasting method affect MCIR?
  - statewide / jurisdiction assessments
  - reminder / recall interventions
  - forecasts returned via QBP / RSP

Objective

- Evaluate potential differences in vaccination assessment and forecasting using alternative CDSi approaches
- Not aimed at:
  - understanding differences in specific test cases
  - evaluating whether an assessment is ‘correct’
- Consider a population-based perspective

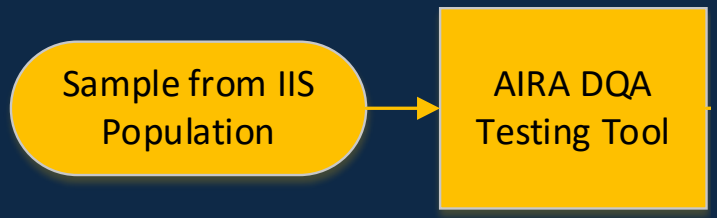
Approach

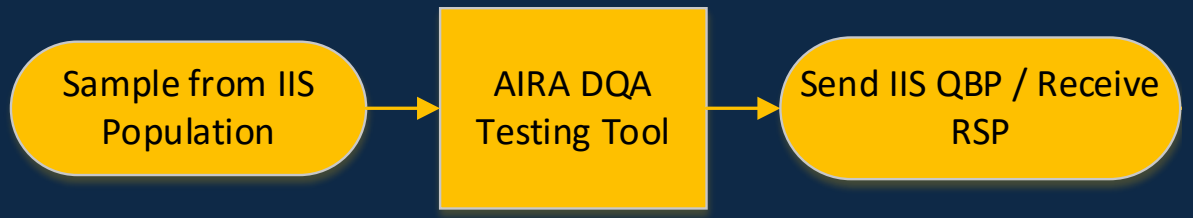
- Compare MCIR forecast with select forecasters available via Texas Children's Hospital (TCH) Forecast Tester:
  - Texas Children's Hospital (TCH)
  - TCH Forecast for Indian Health Service (IHS)
  - Massachusetts Immunization Information System (MIIS)
  - Immunization Calculation Engine (ICE)
  - Scientific Technologies Corporation (STC) Forecaster
- Challenge: acquiring MCIR forecasts for a random sample of children that could be imported into TCH Forecast Tester

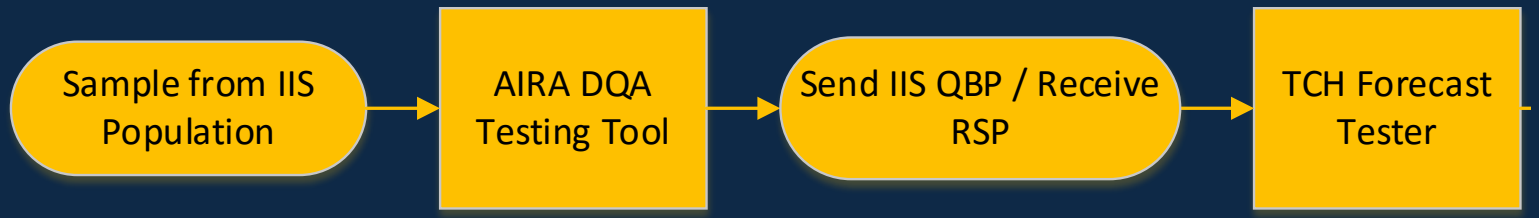
Sample from IIS Population

Sample

- Random samples of kids 19-35 months from 5 cities:
  - Detroit
  - Flint
  - Grand Rapids
  - Benton Harbor
  - Marquette
- Target: 1,000 kids from each jurisdiction
- Actual: n=4,154


Sample from IIS Population
AIRA DQA Testing Tool


Sample from IIS Population
AIRA DQA Testing Tool
Send IIS QBP / Receive RSP

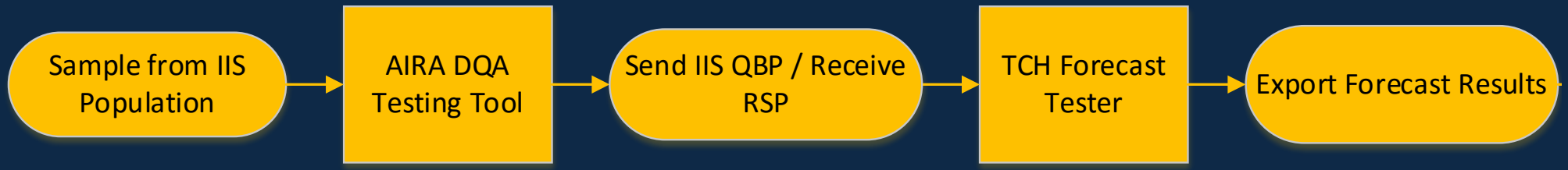

Sample from IIS Population
AIRA DQA Testing Tool
Send IIS QBP / Receive RSP
TCH Forecast Tester

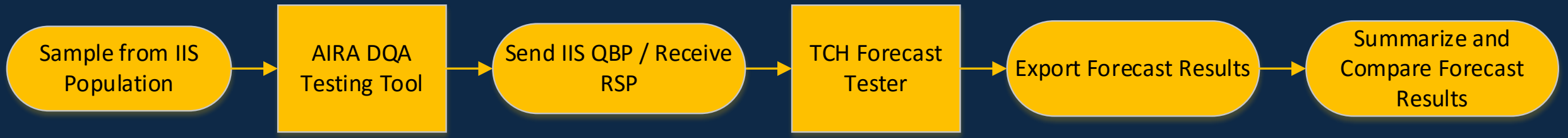
TCH Forecast Tester

- Forecast results included:
  - DTaP, Polio, MMR, Hib, Hep B, Varicella, PCV, Hep A, Flu
- For each child, vaccine series, and forecaster :
  - Status of vaccine series (e.g. Complete, Overdue, etc.)
  - Earliest date for next dose due
  - Recommended date for next dose due
  - Overdue date for next dose due

TCH Forecast Tester

- Forecasters by vaccine series were compared to MCIR for:
  - Percent agreement on status designations
  - Number of days' difference for forecasted dates


Sample from IIS Population
AIRA DQA Testing Tool
Send IIS QBP / Receive RSP
TCH Forecast Tester
Export Forecast Results


Sample from IIS Population
AIRA DQA Testing Tool
Send IIS QBP / Receive RSP
TCH Forecast Tester
Export Forecast Results
Summarize and Compare Forecast Results

Status Designations - MCIR

MCIR Status	Definition
Complete	Immunization requirement completed for a given series. No further doses are required.
Up-To-Date	The evaluation date is prior to the earliest recommended date. A dose cannot be given.
Incomplete / Eligible	The evaluation date is between the earliest and overdue dates. A dose can be given today.
Overdue	The evaluation date is greater than the overdue date (usually 30 days after recommended).
Consider	This is a “soft” recommendation, for certain high risk situations conditions.
Recommended	The recommended date typically used to administer the dose.
Immune	A “titer” or immunity has been documented. No vaccinations required for this series.
Waived	A parent/patient waiver of the vaccine requirement was received (used only in school records).

Status Designations – TCH Forecast Tester

	Complete*	Due Later	Due	Overdue	Not Complete	Complete for Season*	Immune*	No Results*	Unknown	Error*
MCIR	X	X		X	X		X			
TCH	X	X	X	X		X				
MIIS	X	X	X	X						
IHS	X	X	X	X						
STC								X	X	
ICE	X	X	X					X		X

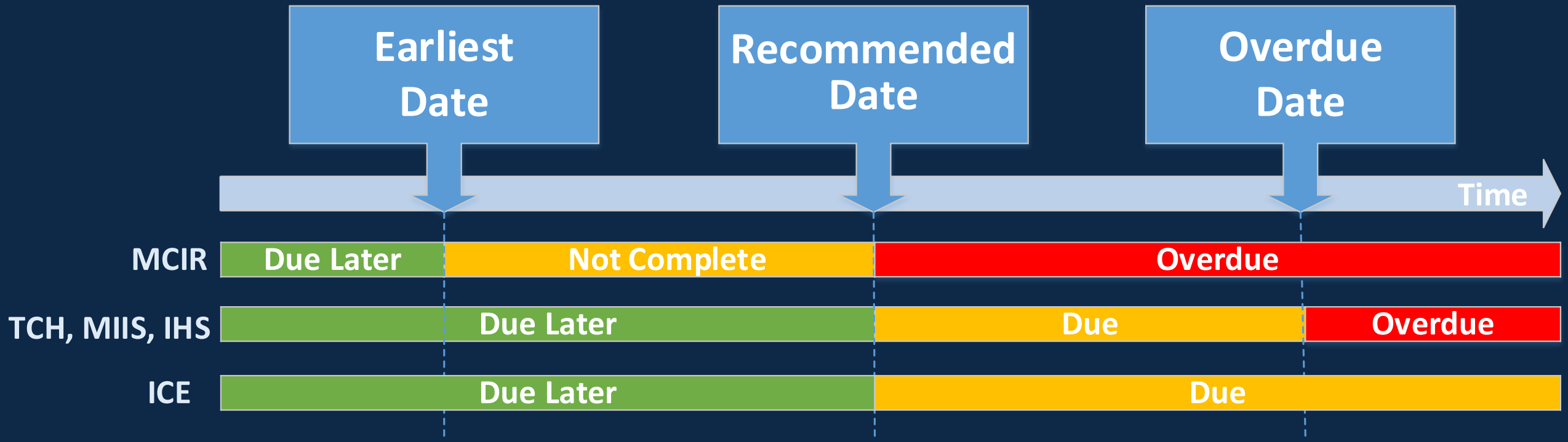
***Statuses that do not come with any dates**

Status Designations – TCH Forecast Tester

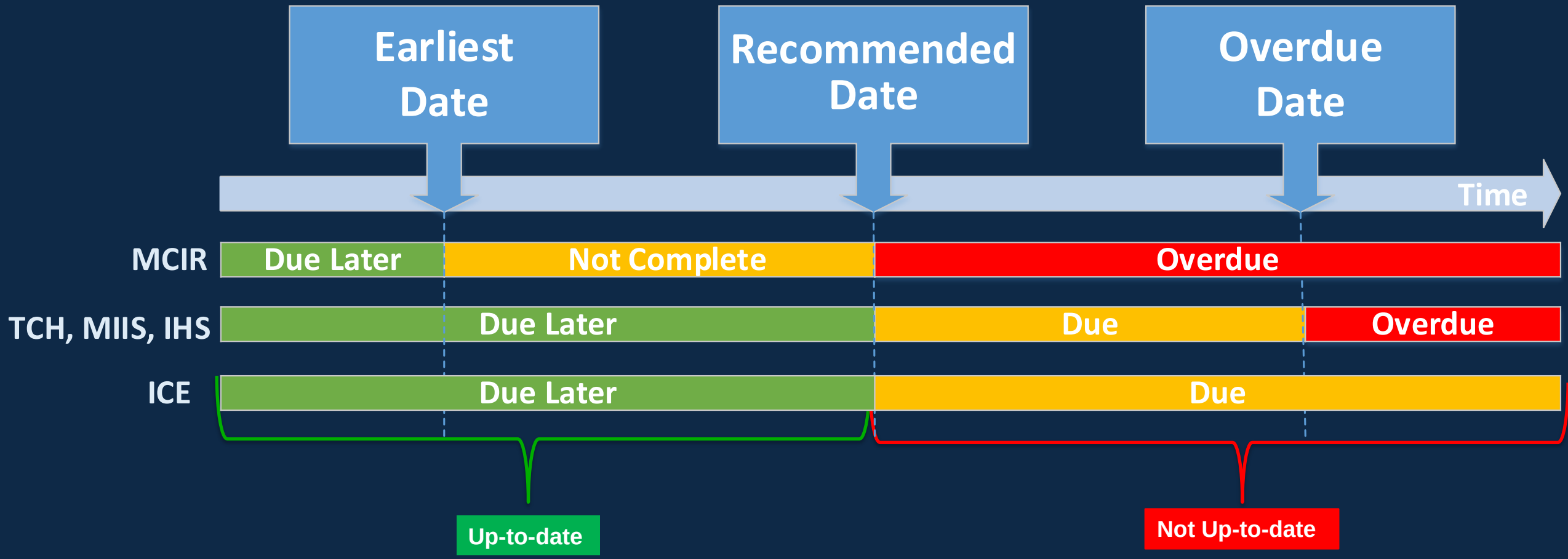
	Complete*	Due Later	Due	Overdue	Not Complete	Complete for Season*	Immune*	No Results*	Unknown	Error*
MCIR	X	X		X	X		X			
TCH	X	X	X	X		X				
MIIS	X	X	X	X						
IHS	X	X	X	X						
STC								X	X	
ICE	X	X	X					X		X

***Statuses that do not come with any dates**

Status Classification by Date



Status Classification by Date



TCH Forecast Tester: Case Info

Auto-generated

Auto-generated

Fabricated name

Test Case COPY EDIT

Category	Toddler
Label	20160831-1
Description	Test case built from forecast results from external source.
Vaccine Group	Influenza
Include Status	Included
Result Status	Accept
Number	20160831-1
Patient	Altman Allen (M)
Birth Date	10/14/2014
Assessment Date	09/13/2016

Used to forecast

TCH Forecast Tester: Vaccination History

Actual vaccination history from MCIR is loaded into the Tester

Vaccination History

Edit

#	Vaccination	CVX	MVX	Date	Age
1	Hep B, adolescent or pediatric	08		10/15/2014	newborn
2	DTaP-Hep B-IPV	110		12/15/2014	2 Months
3	Hib (PRP-OMP)	49		12/15/2014	2 Months
4	Pneumococcal conjugate PCV 13	133		12/15/2014	2 Months
5	rotavirus, pentavalent	116		12/15/2014	2 Months
6	Pneumococcal conjugate PCV 13	133		02/17/2015	4 Months
7	rotavirus, pentavalent	116		02/17/2015	4 Months
8	Hib (PRP-OMP)	49		02/17/2015	4 Months
9	DTaP-Hep B-IPV	110		02/17/2015	4 Months
10	Pneumococcal conjugate PCV 13	133		04/28/2015	6 Months

TCH Forecast Tester: Flu

Actual vs Expected for Influenza

PREVIEW EDIT

Forecast

	Entity	Status	Dose	Earliest	Recommend	Past Due
	Expected by Josh Hull at MCIR	Overdue		08/01/2016	08/01/2016	-
IHS	Actual from TCH Forecast for IHS	Due	1	07/01/2016	08/01/2016	11/01/2016
ICE	Actual from ICE Forecaster	Due	*	07/31/2016	07/31/2016	07/31/2016
STC	Actual from STC Forecaster	Unknown	2	10/24/2015	10/24/2015	10/24/2015
MIIS	Actual from MIIS Forecaster	Overdue	1	08/01/2016	08/01/2016	09/01/2016
TCH	Actual from TCH Forecaster for Testing	Due	1	07/01/2016	08/01/2016	12/01/2016
MCIR	Actual from AART 57A	Overdue		08/01/2016	08/01/2016	-

STATE OF MICHIGAN DEPARTMENT OF HEALTH AND HUMAN SERVICES

As of: November 02, 2016

Official State of Michigan Immunization Record

MCIR ID#: [redacted] **Name:** [redacted] **DOB:** 10/14/2014 **Age:** 2 Years **Gender:** Male

History of Immunizations Given by Series										Status	Accelera-ted Date	Recomme-nded	Shots Given
DTP/DTaP/DT/Td/Tdap	12/15/14 DTaP-Hep B-IPV	02/17/15 DTaP-Hep B-IPV	04/28/15 DTaP-Hep B-IPV	02/04/16 DTaP (pediatric)						Up-To-Date	10/14/2018	10/14/2018	
Hib	12/15/14 Hib (PedvaxHIB)	02/17/15 Hib (PedvaxHIB)	10/15/15 Hib (PedvaxHIB)							Complete			
Polio	12/15/14 DTaP-Hep B-IPV	02/17/15 DTaP-Hep B-IPV	04/28/15 DTaP-Hep B-IPV							Up-To-Date	10/14/2018	10/14/2018	
MMR	10/15/15 MMR									Eligible	03/03/2016	10/14/2018	
Hepatitis B	10/15/14 Hep B (ped/adol)	12/15/14 DTaP-Hep B-IPV	02/17/15 * DTaP-Hep B-IPV	04/28/15 DTaP-Hep B-IPV						Complete			
Varicella	02/04/16 Varicella (Varivax)									Eligible	04/28/2016	10/14/2018	
Rotavirus	12/15/14 RV5 (Rotateq)	02/17/15 RV5 (Rotateq)	04/28/15 RV5 (Rotateq)										
Hepatitis A	02/04/16 Hep A (ped/adol)	10/17/16 Hep A (ped/adol)								Complete			
Seasonal Influenza	10/15/15 IIV4 Ped(P-free,inj)	10/17/16 IIV4 Ped(P-free,inj)								Up-To-Date	11/14/2016	11/17/2016	
Pneumococcal Conjugate	12/15/14 PCV13 (Prevnar13)	02/17/15 PCV13 (Prevnar13)	04/28/15 PCV13 (Prevnar13)	10/15/15 PCV13 (Prevnar13)						Complete			

Example of Status Definition Differences

Varicella	MCIR	TCH	MIIS	IHS	ICE
Status	Not Complete	Due Later	Due Later	Due Later	Due Later
Earliest Date	4/28/16	4/28/16	4/28/16	4/28/16	10/14/18
Recommended Date	10/14/18	10/14/18	10/14/18	10/14/18	10/14/18
Overdue Date	NA	10/14/21	10/14/19	10/14/21	10/14/18

Up-to-Date Agreement with MCIR

Percent (%) of vaccine series that are concordant with MCIR on an up-to-date vs. not up-to-date basis (n=4154)

Forecaster	Overall*	DTaP	Polio	MMR	Hib	Hep B	Varicella	PCV	Hep A	Flu
TCH	96.4	99.3	99.4	99.9	99.9	99.6	99.9	99.8	94.3	96.1
IHS	96.4	99.3	99.4	99.9	99.9	99.6	99.9	99.8	94.3	96.1
MIIS	92.5	99.4	99.4	99.9	99.8	99.2	99.9	99.6	94.2	92.0
ICE	96.0	99.4	99.4	99.9	99.9	99.7	99.9	99.2	94.2	96.1

*Child-level up-to-date vs. not up-to-date agreement

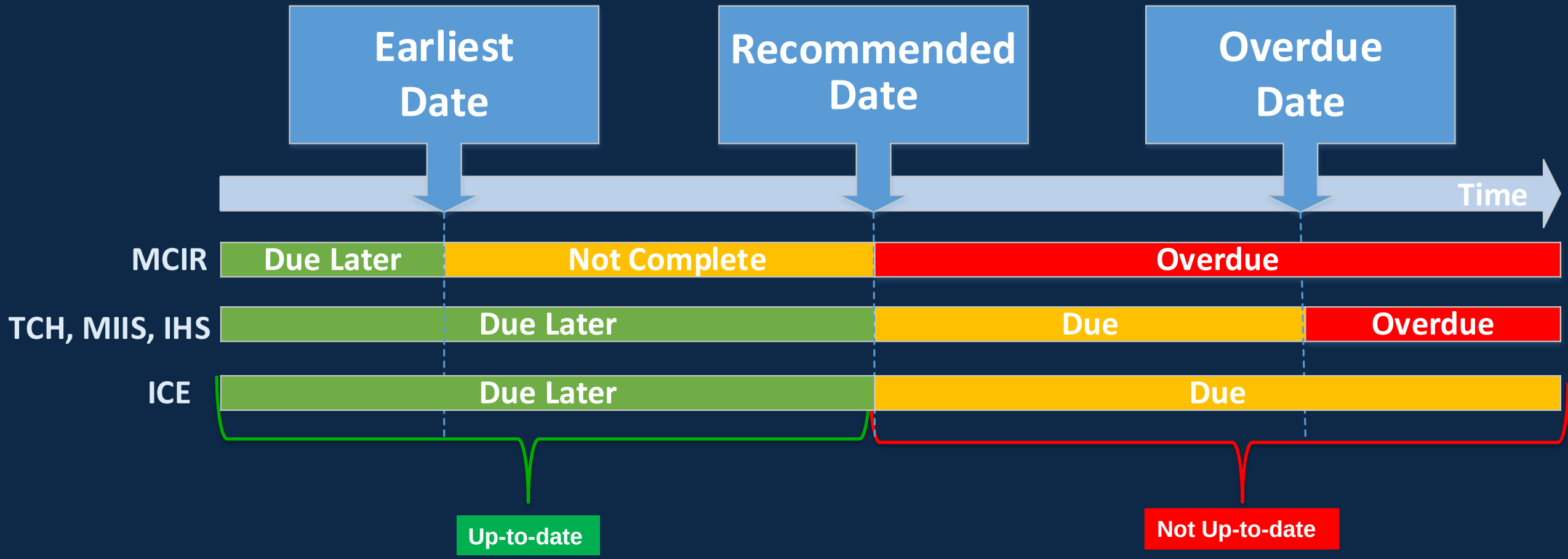
Status Agreement with MCIR

Percent (%) of statuses that agree with MCIR forecaster status exactly* (n=4154).

Forecaster	DTaP	Polio	MMR	Hib	Hep B	Varicella	PCV	Hep A	Flu
TCH	99.3	99.4	14.2	99.9	99.6	15.7	99.8	76.7	4.1
IHS	99.3	99.4	14.2	99.9	99.6	15.7	99.8	76.7	4.1
MIIS	99.0	99.4	14.2	99.8	99.1	15.7	99.6	78.7	92.0
ICE	79.1	87.9	2.8	86.2	89.3	3.8	85.1	64.4	0.9

*’Complete’ and ‘Complete for Season’ considered equivalent

Status Classification by Date



Limitations

- Very limited time available for this analysis
- No overdue dates available from MCIR via RSP
  - "Due" (most forecasters) vs. "Overdue" (MCIR)
- Iterative approach used to run, debug, re-run forecasts:
  - dates varied for MCIR sample cases, TCH evaluation

Conclusions

- It is feasible to test population-level differences in forecasters using standards-based queries and existing tools
- Fairly high overall agreement between forecasters (i.e., up to date vs. not)
- Important differences may exist at more granular levels of status (i.e., due, overdue, due later, etc.)

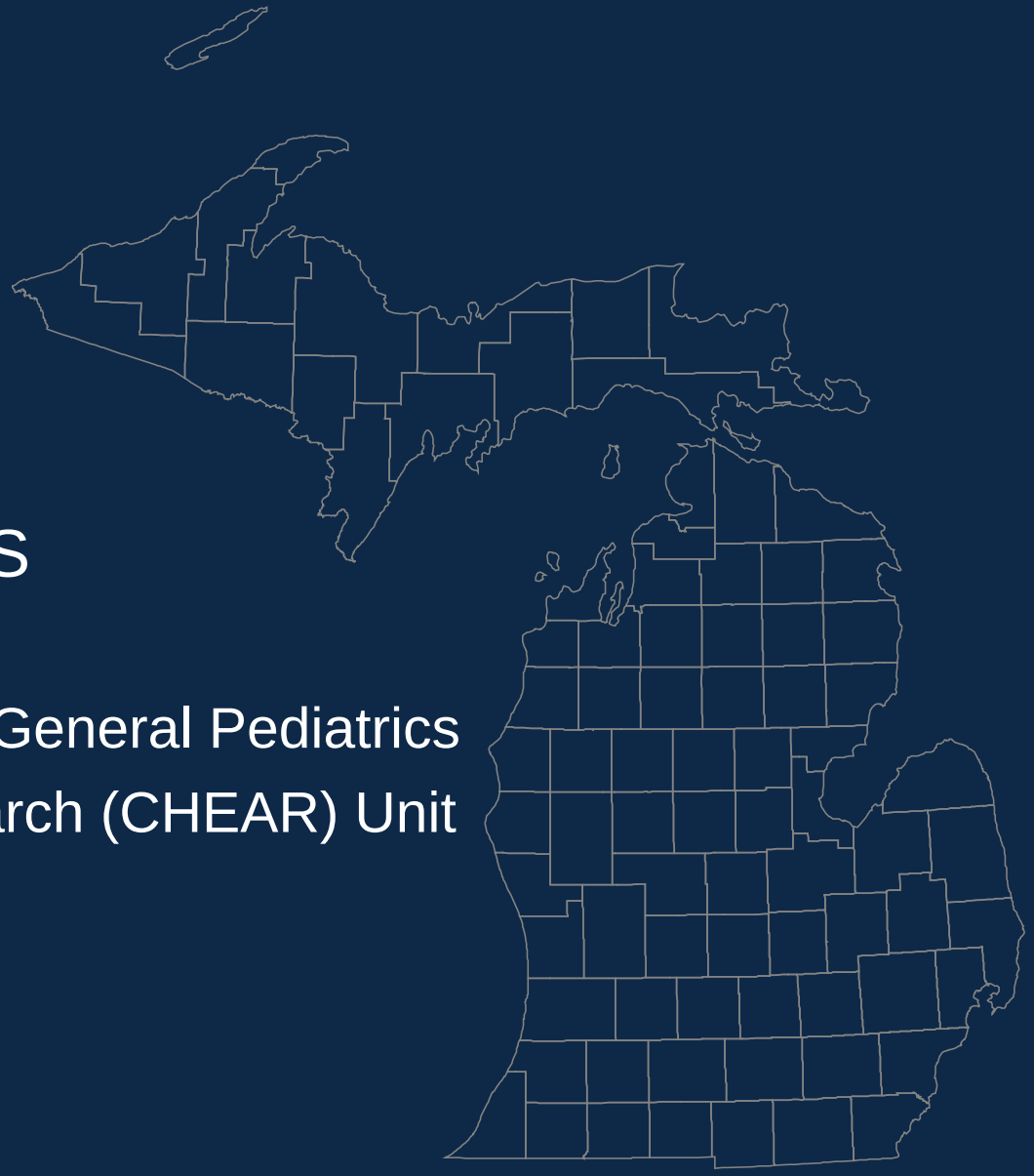
Potential Next Steps

- Additional analysis needed to clearly evaluate differences
- Obtain MCIR overdue date in RSP messages
- More precise understanding of forecaster differences will require:
  - in-depth coordination with each IIS
  - review of status designations by clinical expert

Acknowledgements

This project was a team effort:

- Hannah Jary
- Gerry Bragg
- Josh Hull
- Nathan Bunker



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