



AFIX Coverage Service:

Pre-Calculating Statistics to Support New and Future AFIX
Guidance and Improve Report Performance

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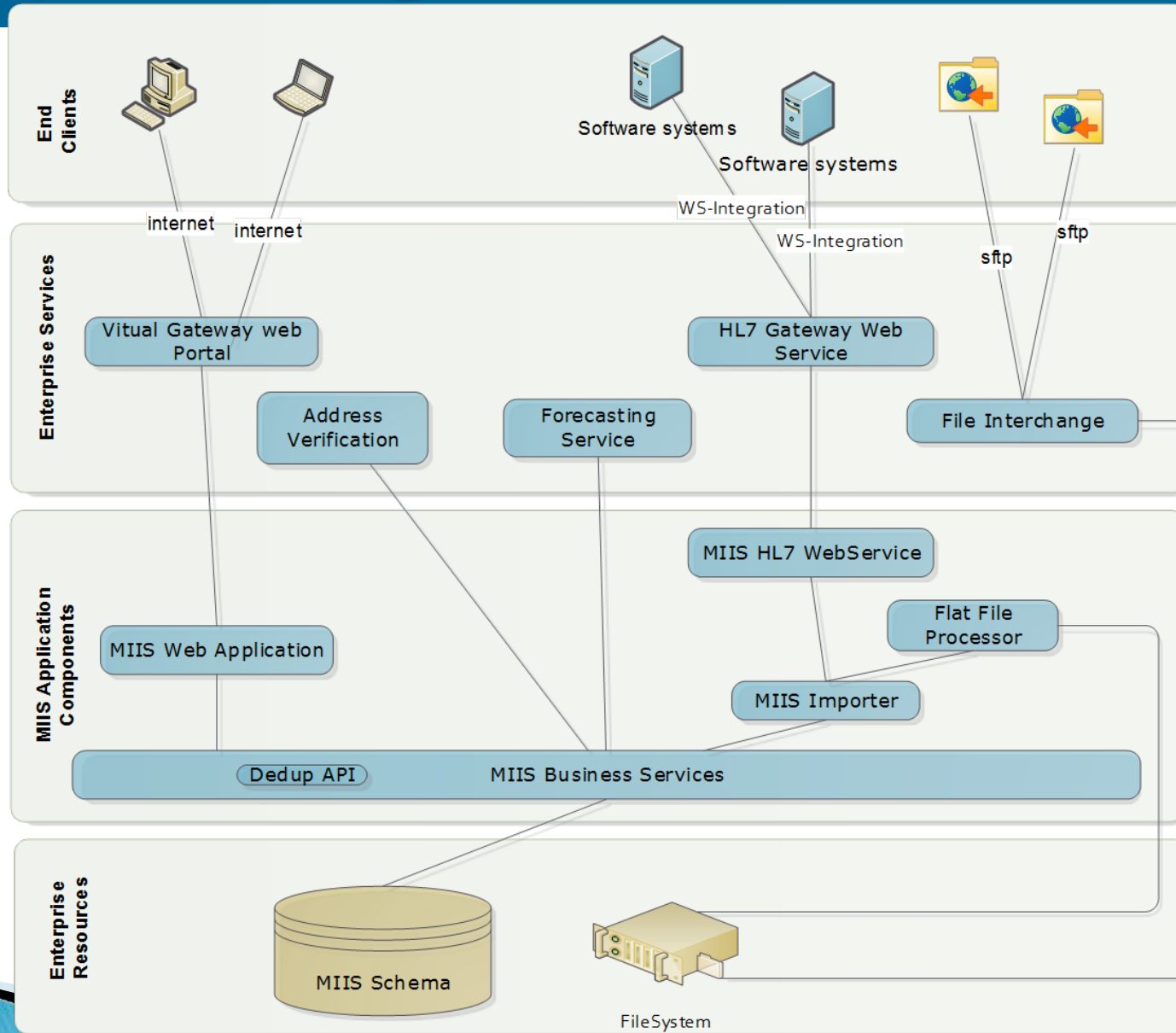
Agenda

1. MIIS Background
2. MIIS Coverage Reports
3. Previous Approach
4. New Approach
5. Benefits

Massachusetts IIS (MIIS) History

- ▶ **2010:** Legislation passed mandating that *all* healthcare providers must report administered immunizations to the state
- ▶ **2011:** Launched MIIS
- ▶ **June 2013:** Launch of *new,* open source-based MIIS
- ▶ **2014:** Provider Hierarchy, Data sharing updates, Temp Log Uploads, VM Enrollment Updates
- ▶ **June 2015:** Migration to cloud
- ▶ **Sep 2015:** 1.4M historical patients loaded in 2 weeks
- ▶ **Oct 2015:** Major Report, UI and Workflow Updates
- ▶ **June 2016:** Vaccine Recall, Returns & Wastage, Provider Flu Ordering, System Usage Reporting
- ▶ **Sep 2016:** School Module, **AFIX Coverage Updates**

Simplified High Level Architecture



Development Process

- ▶ Waterfall/Agile Hybrid
- ▶ Continuous Integration with Daily Builds
- ▶ Selenium Automated UI Test Scripts
- ▶ Custom Built HL7 Automated Test Scripts

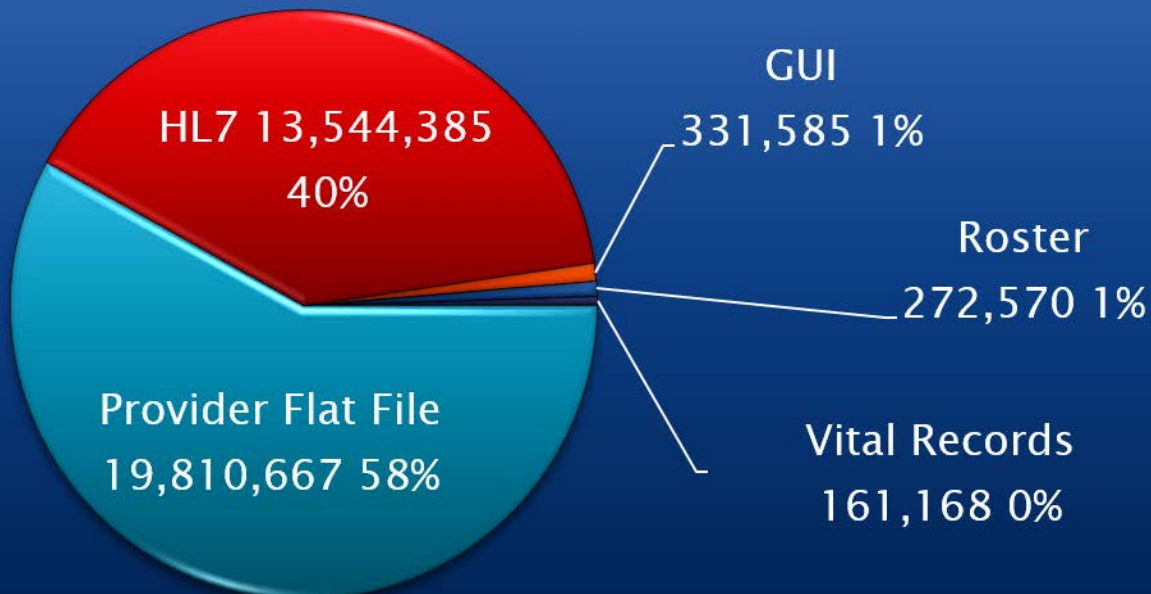
MIIS Data So Far...



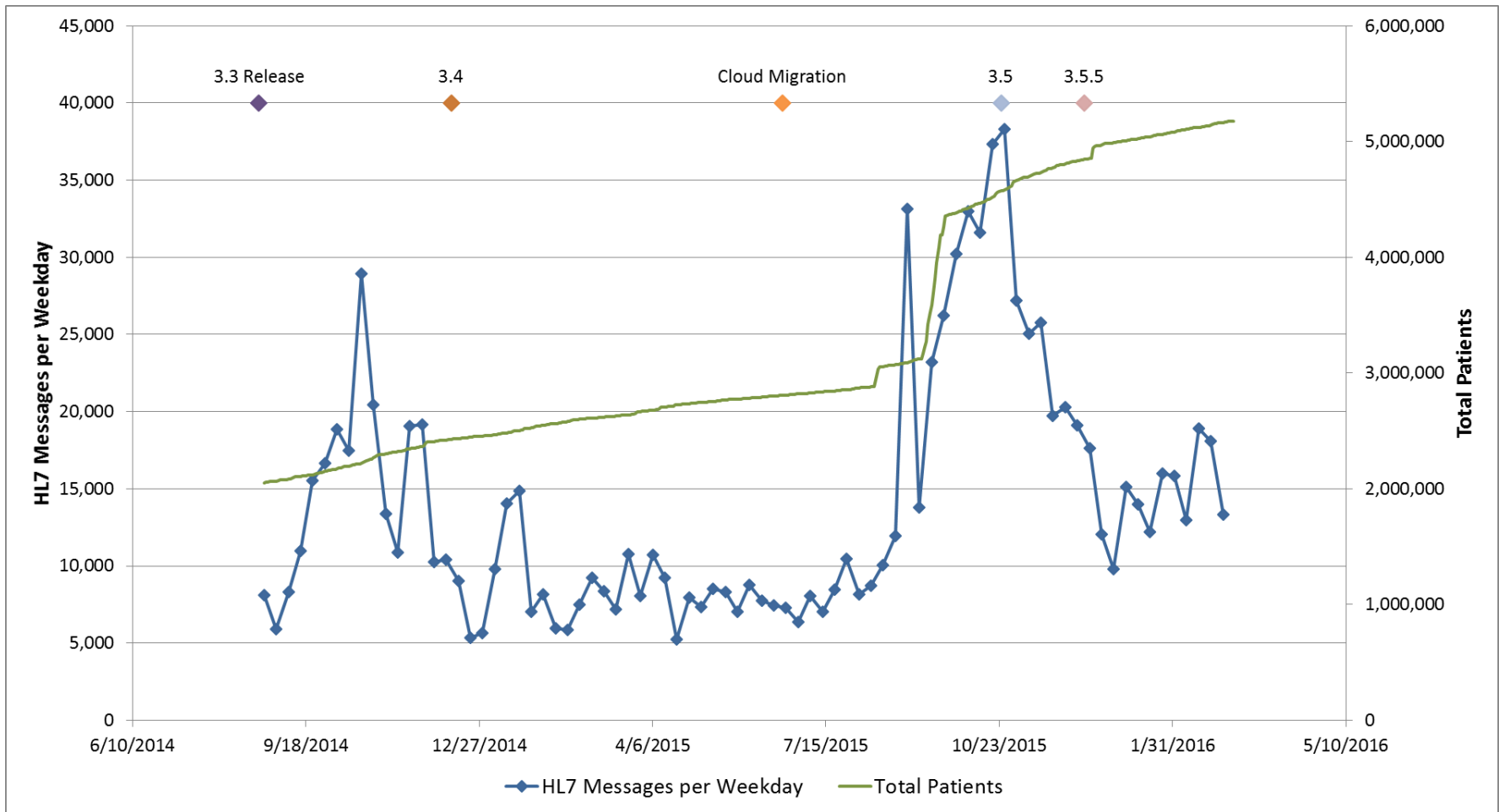
• Total Sites: 9 • Total Sites: 55 • Total Sites: 341 • Total Sites: 532 • Total Sites: 1168
• Total Patients: 3,902 • Total Patients: 815,928 • Total Patients: 1,539,629 • Total Patients: 2,370,194 • Total Patients: 4,606,572
• Total Shots: 69,505 • Total Shots: 3,371,434 • Total Shots: 7,303,293 • Total Shots: 13,597,285 • Total Shots: 34,863,125

• Total Sites: 1207
• Total Patients: 4,714,225
• Total Shots: 34,120,375

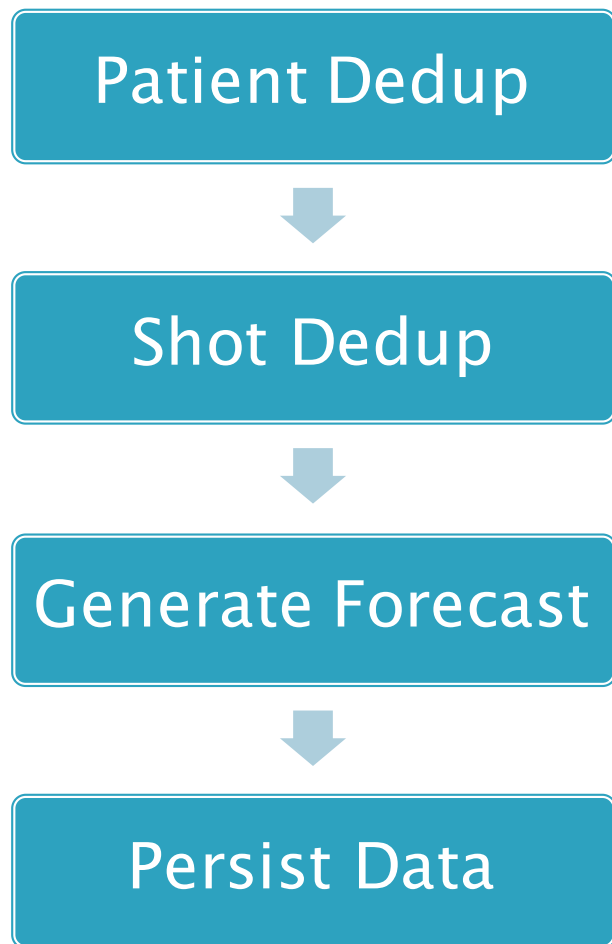
Shot Count by Data Source



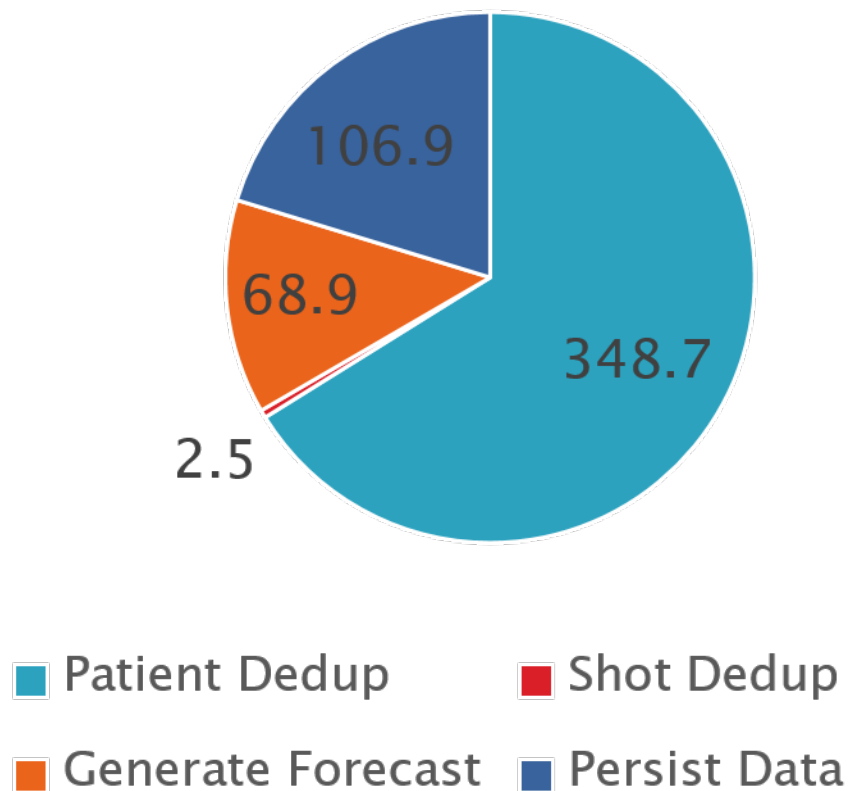
MIIS HL7 Load



Patient Real-Time Processing



Avg Processing Time
(milliseconds)



MIIS Coverage Reports

- ▶ Can be run for all sites a user has access to, even statewide
- ▶ Run on-demand
- ▶ Result emailed if run on large patient data set
- ▶ 3 Flavors
 - Standard Childhood
 - Standard Adolescent
 - Custom

Input Parameters

Coverage Report Input Parameters

Report Type:

Report Name:

* Reference Date:

Provider Site(s) Selection Method: ☒ By Site PINs ☐ By Type

Filter by Provider Status:

Filter by PIN or Provider Site Name:

Available Site PINs:

Abington Pediatrics - 14691
About Women By Women - 22098
Abraham P Dietz, MD - 40295
Academy School Based Health Center - 14356
Accessible Medical Arts - 24065
Acclaim Home Health Care - 22633

= Add all

→ Add

← Remove

= Remove all

*Selected Site PINs:

Limit Report By Patient Information:

Current WIC Participant Status:

VFC Eligibility:

Patient Race:

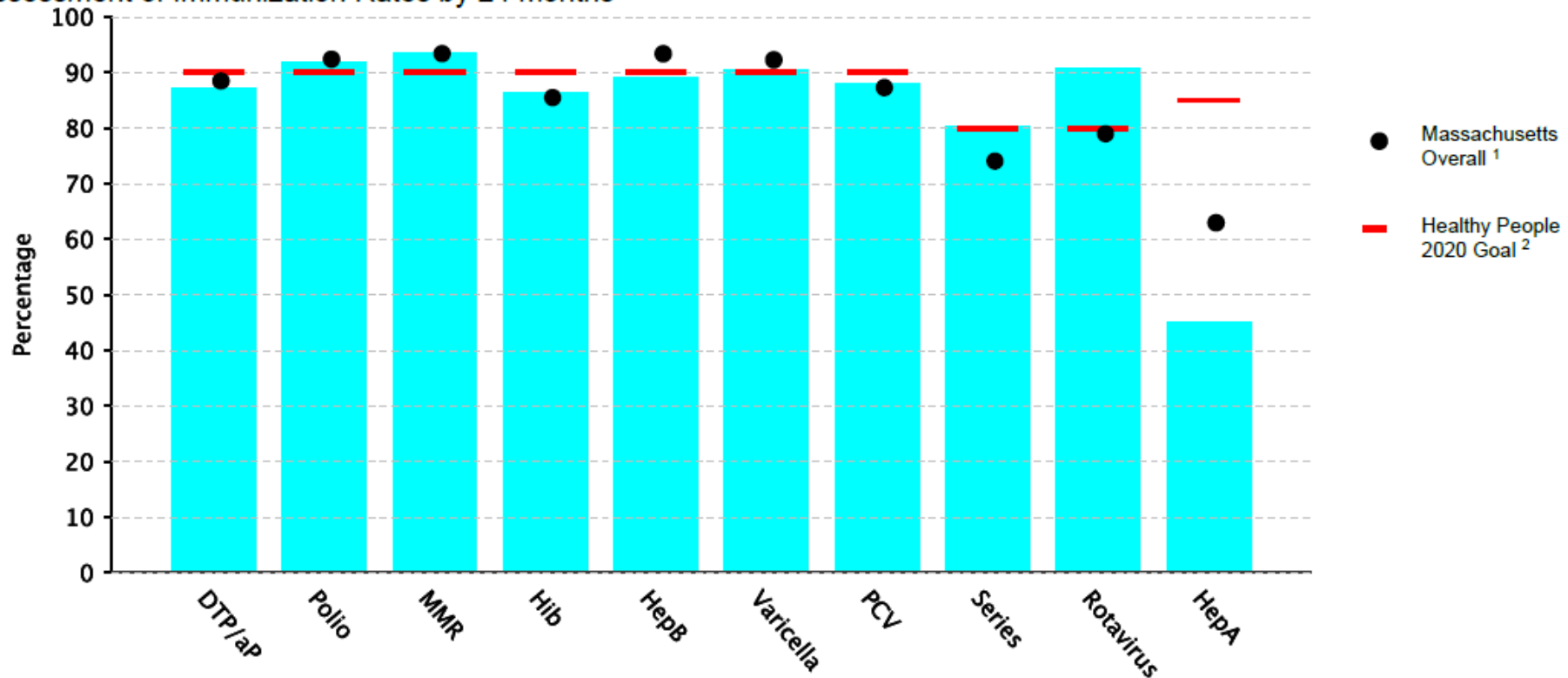
Patient Ethnicity:

Patient Status:

City:

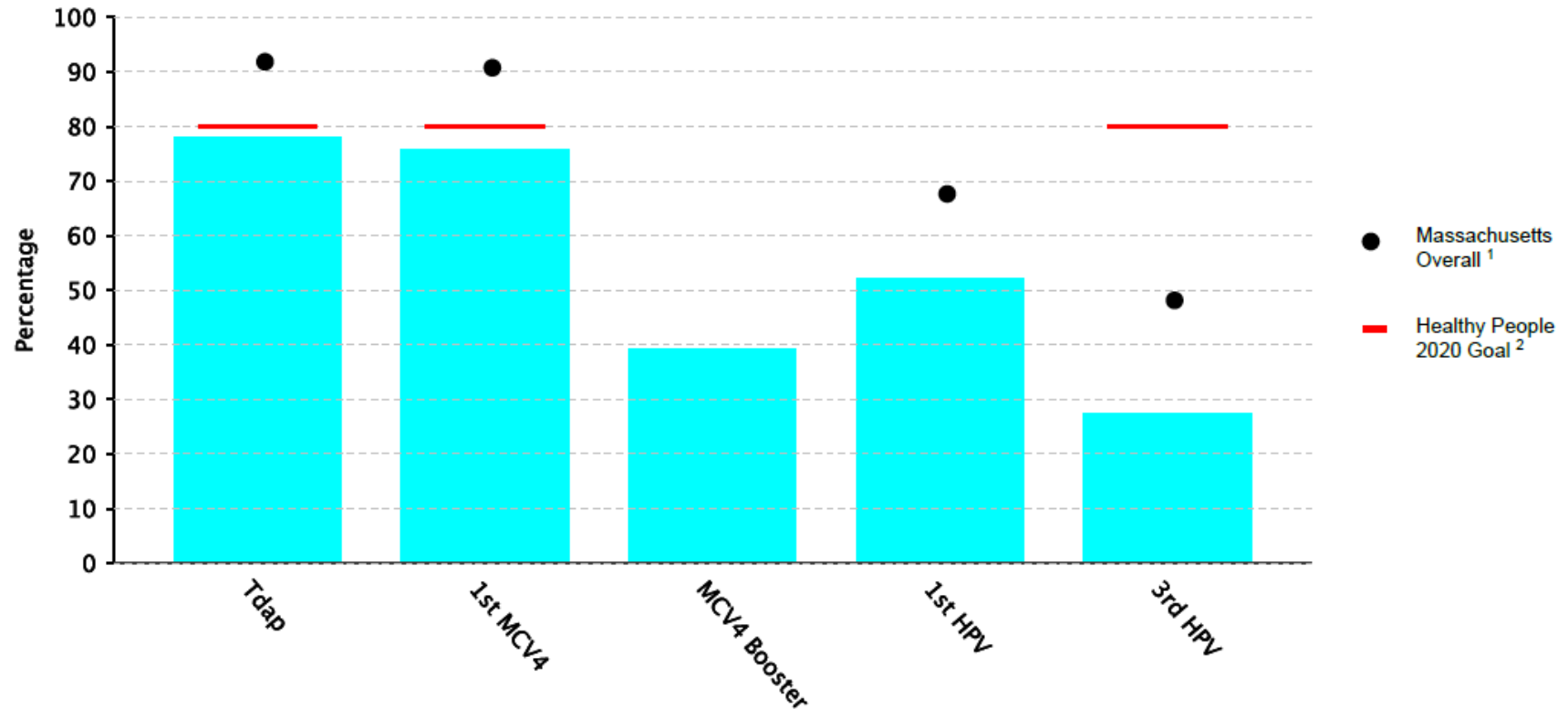
Sample Childhood Report Output

Assessment of Immunization Rates by 24 months



Sample Adolescent Report Output

Assessment of Immunization Rates



Previous Approach

- ▶ Code logic directly in SQL
- ▶ Simply counts shots
- ▶ Special SQL for MCV4 Booster
- ▶ Complicated missed opportunities query
- ▶ Some simple one dose away logic

Old SQL Sample

```

SELECT COUNT(*)
FROM (
  (SELECT PLPATIENT_UUID
   FROM PATIENT_IMMUNIZATION PL
   (SELECT DISTINCT PUUID PATIENT_UUID
    FROM
      (SELECT PUUID
       FROM PATIENT P
       FROM PROVIDER_PATIENT_MAP PPM
       WHERE EXISTS
         (SELECT '1'
          FROM PROVIDER PR
          WHERE PR.VACMAN_PN IN (10645)
          AND PR.UUID      = PPM.PROVIDER_UUID
        )
       AND PPM.PATIENT_PROV_STATUS_TYPE_ID IN (1901)
      ) PPM
      WHERE PUUID = PMPATIENT_UUID
    ) AP,
    (SELECT VACCINE_ID
     FROM REF_VACCINE_GROUP_MAP RVGM
     WHERE RVGM.VACCINE_GROUP_ID = 1014
    ) RVGM
    WHERE PLPATIENT_UUID      = AP.PATIENT_UUID
    AND PLUS_SHOT_VALID       = 1
    AND PLUSHOT_ADMINISTERED_DATE <= TO_DATE('03/09/2016','mm/dd/yyyy')
    AND PL.VACCINE_ID         = RVGM.VACCINE_ID
    AND (PL.INVALID_GROUP_INFO NOT LIKE '%1014%'
    OR PL.INVALID_GROUP_INFO IS NULL)
    GROUP BY PATIENT_UUID
    HAVING COUNT(*) >= 1
  )
)
INTERSECT
  (SELECT PLPATIENT_UUID
   FROM PATIENT_IMMUNIZATION PL
   (SELECT DISTINCT PUUID PATIENT_UUID
    FROM
      (SELECT PUUID
       FROM PATIENT P
       WHERE P.BIRTH_DATE BETWEEN TO_DATE('3/9/1997','mm/dd/yyyy') AND TO_DATE('3/9/2003','mm/dd/yyyy')
       AND P.PATIENT_STATUS_TYPE_ID = 5301
      ) P,
      (SELECT PMPATIENT_UUID
       FROM PROVIDER_PATIENT_MAP PPM
       WHERE EXISTS
         (SELECT '1'
          FROM PROVIDER PR
          WHERE PR.VACMAN_PN IN (10645)
          AND PR.UUID      = PPM.PROVIDER_UUID
        )
       AND PPM.PATIENT_PROV_STATUS_TYPE_ID IN (1901)
      ) PPM
      WHERE PUUID = PMPATIENT_UUID
    ) AP,
    (SELECT VACCINE_ID
     FROM REF_VACCINE_GROUP_MAP RVGM
     WHERE RVGM.VACCINE_GROUP_ID = 1014
    ) RVGM
    WHERE PLPATIENT_UUID      = AP.PATIENT_UUID
    AND PLUS_SHOT_VALID       = 1
    AND PLUSHOT_ADMINISTERED_DATE <= TO_DATE('03/09/2016','mm/dd/yyyy')
    AND PL.VACCINE_ID         = RVGM.VACCINE_ID
    AND (PL.INVALID_GROUP_INFO NOT LIKE '%1014%'
    OR PL.INVALID_GROUP_INFO IS NULL)
    GROUP BY PATIENT_UUID
    HAVING COUNT(*) >= 1
  )
)

```

```

FROM REF_VACCINE_GROUP_MAP RVGM
) RVGM
WHERE PLPATIENT_UUID = APPATIENT_UUID
AND PLS_SHOT_VALID = 1
AND PLSHOT_ADMINISTERED_DATE <= TO_DATE('03/09/2016','mm/dd/yyyy')
AND PLVACCINE_ID = RVGMVACCINE_ID
AND (PLINVALID_GROUP_INFO NOT LIKE '%1010%'
OR PLINVALID_GROUP_INFO IS NULL)
GROUP BY PLPATIENT_UUID
HAVING COUNT(*)>=1
)
INTERSECT
(SELECT PLPATIENT_UUID
FROM PATIENT_IMMUNIZATION PL
(SELECT DISTINCT P.UUID PATIENT_UUID
FROM
(SELECT P.UUID
FROM PATIENT P
WHERE P.BIRTH_DATE BETWEEN TO_DATE('3/9/1997','mm/dd/yyyy') AND TO_DATE('3/9/2003','mm/dd/yyyy')
AND P.PATIENT_STATUS_TYPE_ID = 5301
) P,
(SELECT PPM.PATIENT_UUID
FROM PROVIDER_PATIENT_MAP PPM
WHERE EXISTS
(SELECT 'T'
FROM PROVIDER PR
WHERE PR.VACMAN_PN IN (10645)
AND PR.UUID = PPM.PROVIDER_UUID
)
) PPM
AND PPM.PATIENT_PROV_STATUS_TYPE_ID IN (1901)
) PPM
WHERE P.UUID = PPM.PATIENT_UUID
) AP,
(SELECT VACCINE_ID
FROM REF_VACCINE_GROUP_MAP RVGM
WHERE RVGMVACCINE_GROUP_ID=1010
) RVGM
WHERE PLPATIENT_UUID = APPATIENT_UUID
AND PLS_SHOT_VALID = 1
AND PLSHOT_ADMINISTERED_DATE <= TO_DATE('03/09/2016','mm/dd/yyyy')
AND PLVACCINE_ID = RVGMVACCINE_ID
AND (PLINVALID_GROUP_INFO NOT LIKE '%1010%'
OR PLINVALID_GROUP_INFO IS NULL)
GROUP BY PLPATIENT_UUID
HAVING COUNT(*)>=1
)
INTERSECT
(SELECT PLPATIENT_UUID
FROM PATIENT_IMMUNIZATION PL
(SELECT DISTINCT P.UUID PATIENT_UUID
FROM
(SELECT P.UUID
FROM PATIENT P
WHERE P.BIRTH_DATE BETWEEN TO_DATE('3/9/1997','mm/dd/yyyy') AND TO_DATE('3/9/2003','mm/dd/yyyy')
AND P.PATIENT_STATUS_TYPE_ID = 5301
) P,
(SELECT PPM.PATIENT_UUID
FROM PROVIDER_PATIENT_MAP PPM

```

```

WHERE EXISTS
(SELECT 'T'
FROM PROVIDER PR
WHERE PR.VACMAN_PN IN (10645)
AND PR.LUID = PPMPROVIDER_UID
)
AND PMPATIENT_PROV_STATUS_TYPE_ID IN (1901)
) PPM
WHERE P.LUID = PMPATIENT_UID
) AP.
(SELECT VACCINE_ID
FROM REF_VACCINE_GROUP_MAP RVGM
WHERE RVGM.VACCINE_GROUP_ID = 1012
) RVGM
WHERE P.PATIENT_UID = AP.PATIENT_UID
AND P.IS_SHOT_VALID = 1
AND P.IS_SHOT_ADMINISTERED_DATE <= TO_DATE('03/09/2016','mm/dd/yyyy')
AND P.VACCINE_ID = RVGM.VACCINE_ID
AND (P.INVALID_GROUP_INFO NOT LIKE '%1012%'
OR P.INVALID_GROUP_INFO IS NULL)
GROUP BY P.PATIENT_UID
HAVING COUNT(*) >= 1
)
INTERSECT
(SELECT P.PATIENT_UID
FROM PATIENT_IMMUNIZATION PI
(SELECT DISTINCT P.LUID PATIENT_UID
FROM
(SELECT P.LUID
FROM PATIENT P
WHERE P.BIRTH_DATE BETWEEN TO_DATE('3/9/1997','mm/dd/yyyy') AND TO_DATE('3/9/2005','mm/dd/yyyy')
AND P.PATIENT_STATUS_TYPE_ID = 5301
) P.
(SELECT PMPATIENT_UID
FROM PROVIDER_PATIENT_MAP PRM
WHERE EXISTS
(SELECT 'T'
FROM PROVIDER PR
WHERE PR.VACMAN_PN IN (10645)
AND PR.LUID = PPMPROVIDER_UID
)
AND PMPATIENT_PROV_STATUS_TYPE_ID IN (1901)
) PPM
WHERE P.LUID = PMPATIENT_UID
) AP.
(SELECT VACCINE_ID
FROM REF_VACCINE_GROUP_MAP RVGM
WHERE RVGM.VACCINE_GROUP_ID = 1012
) RVGM
WHERE P.PATIENT_UID = AP.PATIENT_UID
AND P.IS_SHOT_VALID = 1
AND P.IS_SHOT_ADMINISTERED_DATE <= TO_DATE('03/09/2016','mm/dd/yyyy')
AND P.VACCINE_ID = RVGM.VACCINE_ID
AND (P.INVALID_GROUP_INFO NOT LIKE '%1012%'
OR P.INVALID_GROUP_INFO IS NULL)
GROUP BY P.PATIENT_UID
HAVING COUNT(*) >= 3
);

```

New AFIX Requirements

- ▶ Vaccine Count vs. UTD Logic:
- ▶ Immunity Logic – If a patient has evidence of Immunity for any of the following vaccines, the patient is not required to have received the vaccine and will be counted in the Numerator: HepA, HepB, Varicella, MMR
- ▶ New rules for missed opportunities
- ▶ New Flu handling
- ▶ Multiple Antigens – The validity of each individual component contained in multiple antigen vaccines must be assessed separately.
- ▶ Movable as of date

Childhood Assessment Vaccine Info

- ▶ 4 DTaP
- ▶ 3 Polio
- ▶ 1 MMR
- ▶ UTD Hib – If the most recent dosage was given at ≥ 15 months old OR, the 2 most recent dosages were given at ≥ 12 months OR, if there were ≥ 3 doses given and most recent dosage ≥ 12 months
- ▶ 3 HepB
- ▶ 1 Varicella
- ▶ UTD PCV – If most recent dosage was given at ≥ 24 months OR if the 2 most recent dosages were given at ≥ 12 months OR if there were ≥ 3 doses given and most recent dosage ≥ 12 months
- ▶ UTD Rotavirus – If given ≥ 2 doses of CVX 119, OR if given ≥ 3 doses of any Rota vaccine
- ▶ 1 Influenza – Influenza assessment calculations must be based on the most recently completed flu season (not a flu season in progress) based on the day the report is being run, regardless of “As of Date” or Age, for any patient returned in the Assessment Cohort. A flu season is defined as July 1 through June 30. Vaccination completion will be defined as “at least 1 valid dose of influenza vaccine for the prior completed season”.
- ▶ 2 HepA
- ▶ 4:3:1:3:3:1:4 Series – Given all the doses of the following antigens: ≥ 4 DTP/aP; ≥ 3 Polio; ≥ 1 MMR; UTD Hib; ≥ 3 HepB; ≥ 1 Varicella; UTD PCV

Adolescent Assessment Vaccine Info

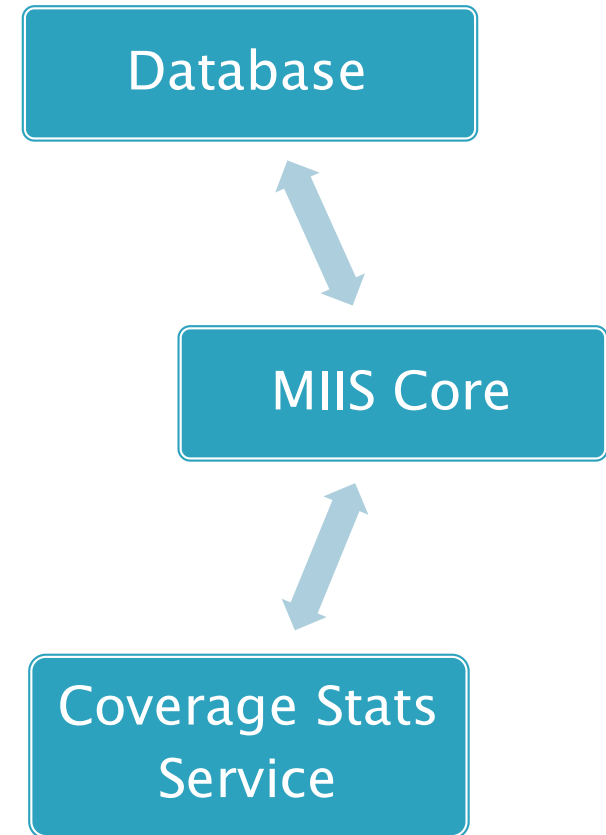
- ▶ UTD HepB – If given ≥ 3 doses of any HepB OR given 2 doses of Adult Recombivax HB where both dosages are between 11 to 15 years old (inclusive).
- ▶ 2 MMR
- ▶ 2 Varicella
- ▶ 1 Tdap
- ▶ UTD Meningococcal (MCV and MPSV) – If patient is < 16 and has been given ≥ 1 dose, or if the patient is ≥ 16 and the most recent dose was given on or after the patient turned 16.
- ▶ 2 HepA
- ▶ UTD Polio – If given ≥ 3 doses and at least one dosage ≥ 4 years old
- ▶ 1 HPV (include all adolescents with 1+ valid doses)
- ▶ 2 HPV (include all adolescents with 2+ valid doses)
- ▶ 3 HPV (include only adolescents with 3 valid doses)
- ▶ 1 Influenza – Influenza calculations must be based on the most recently completed flu season (not a flu season in progress) based on the day the report is being run, regardless of “As of Date” or Age, for any patient returned in the Assessment Cohort. A flu season is defined as July 1 through June 30. Vaccination completion will be defined as “at least 1 valid dose of influenza vaccine for the prior completed season”.

Forecasting Service Background

- ▶ SOAP interface
- ▶ Multiple instances deployed in virtualized load balanced cluster in production
- ▶ Send birthdate, gender, shots, clinical comments
- ▶ Forecast dates (min, recommended, overdue, max) returned are saved per patient
- ▶ All dates valid until record touched again
- ▶ Stored dates used for real-time reminder recall queries and reports

New Coverage Approach

- ▶ Use same service oriented approach as forecasting
- ▶ Send same information utilized by forecasting service
- ▶ Receive and store date for each assessment metric
- ▶ Metrics only need to be updated when immunization or clinical comment added/removed for patient
- ▶ Query compares as of date to metric date



Coverage Metrics

▶ Childhood

DTP/aP	HepA	HepB*
Hib*	MMR	PCV*
Polio	Rotavirus*	Varicella
Influenza	Series	

▶ Adolescent

HPV1 / 2 / 3 All	HPV1 / 2 / 3 F	HPV1 / 2 / 3 M
HepA	HepB*	Influenza
MCV1 *	MCV2*	MMR
Polio*	Tdap	Varicella

* UTD calculation

New Data Model – STATS Table

Data Element	Type	Description
UUID	Varchar	Unique Identifier
PATIENT_UUID	Varchar	Unique Patient Identifier
REPORT_TYPE	Varchar	Type of report: childhood, adolescent, etc
STAT_TYPE	Varchar	Statistic type: Hib UTD, Series, HPV2 UTD, etc
UTD_DATE	Date	Date when patient became up to date for the associated vaccine group
END_DATE	Date	Date when patient up to date ends for the associated vaccine group (for clinical comments)

New SQL Sample

```
SELECT PS.VACCINE_GROUP_ID,  
       PS.VACCINE_GROUP_KEY,  
       COUNT(PS.UTD_DATE)  
FROM  
  (SELECT P.UUID,  
         P.BIRTH_DATE  
   FROM PATIENT P  
   WHERE P.BIRTH_DATE BETWEEN TO_DATE ('1/1/1997', 'mm/dd/yyyy') AND TO_DATE  
( '12/31/2001', 'mm/dd/yyyy')  
   AND P.PATIENT_STATUS_TYPE_ID = 5301  
  ) P,  
  (SELECT PPM.PATIENT_UUID  
   FROM PROVIDER_PATIENT_MAP PPM  
   WHERE EXISTS  
     (SELECT 'T'  
      FROM PROVIDER PR  
      WHERE PR.VACMAN_PIN IN (10645)  
      AND PR.UUID          = PPM.PROVIDER_UUID  
     )  
   AND PPM.PATIENT_PROV_STATUS_TYPE_ID IN (1901)  
  ) PPM ,  
  PATIENT_STATS PS  
WHERE P.UUID = PPM.PATIENT_UUID  
AND P.UUID   = PS.PATIENT_UUID  
AND PS.UTD_DATE BETWEEN TO_DATE ('01-Jan-1997') AND TO_DATE ('31-Dec-2014')  
AND PS.REPORT_TYPE = 'ADOLESCENT_UTD'  
GROUP BY PS.VACCINE_GROUP_ID,  
         PS.VACCINE_GROUP_KEY;
```

Patient Level Coverage

Name: MAE W/WHITMAN

Birth Date: 09/10/1988 Age: 27 yr 6 mo

MIIS ID: 1848404

Data Sharing: Yes

Phone: N/A

Gender: Unknown/Undifferentiated

Address: KZPFGNIRBTAGVTSKD, IPSWICH, MA, 01938

VFC Eligibility: Not VFC Eligible

Save Close

Patient Demographics Data Sharing Provider Information Birth Information Immunizations **Coverage**

Coverage AIRA

Childhood UTD

Vaccine name	Date
HepB	01/23/1997
Rotavirus	
DTP/aP	
Hib	
Series	
PCV	
Varicella	
Polio	
HepA	
MMR	12/15/1989

Adolescent UTD

Vaccine name	Date
MCV2	
HPV1Male	
HPV2Female	
HPV1All	01/05/2009
Varicella	
HPV3Female	
HepB	01/23/1997
HPV2Male	
Polio	
HPV1Female	
HPV3All	08/05/2011
HPV2All	05/11/2010
HepA	
MMR	07/18/1996
HPV3Male	
Tdap	08/05/2011
MCV1	
Influenza	

Childhood Missed

Vaccine name	Date
Varicella	03/14/2016
HepB	
Polio	
PCV	
DTP/aP	
Influenza	03/14/2016
Hib	
Rotavirus	
MMR	
HepA	

Adolescent Missed

Vaccine name	Date
HepB	
HPV	
MMR	
Influenza	03/14/2016
HepA	
MCV	
Polio	
Tdap	
Varicella	03/14/2016

Cost/Benefits

► Costs

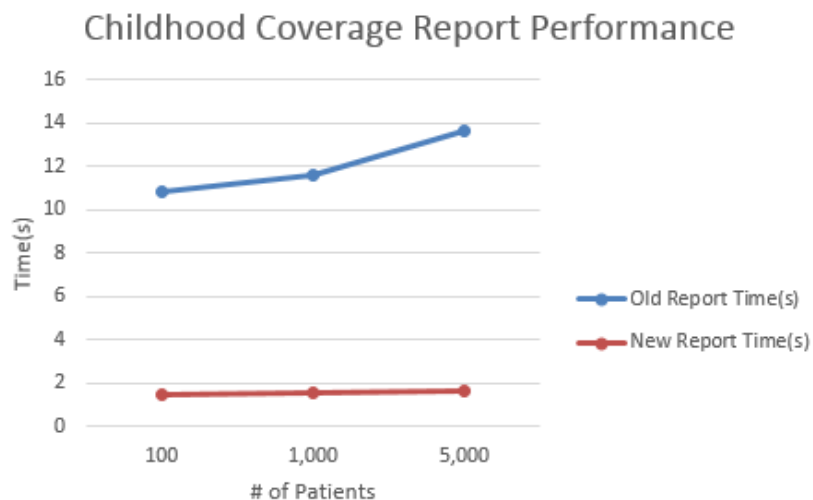
- Small performance hit when saving patient
- Mechanism needed to re-run patient stats when rules change

► Benefits

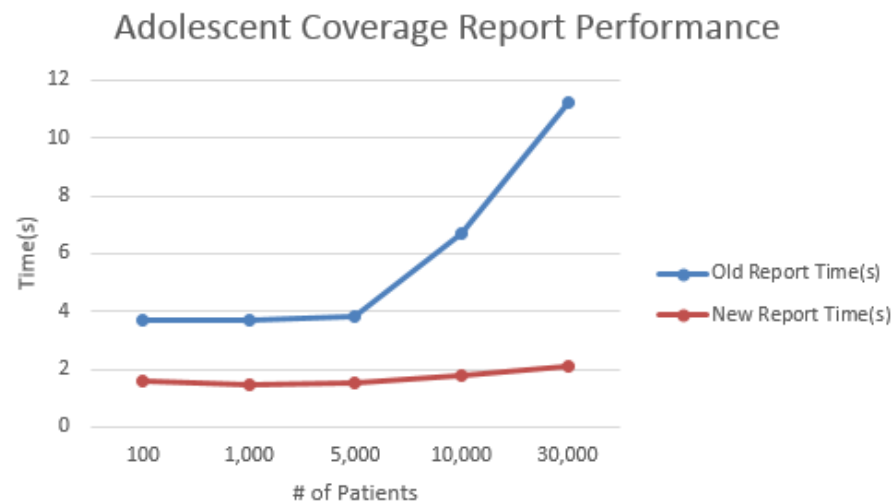
- Abstraction of functionality
- New rules can be easily incorporated
- Report Performance
- Helps with diving into details for assessments
- Ease of Testing
- Scale up as needed

Performance Benefits

CHILDHOOD		
# of Patients	Old Report Time (s)	New Report Time (s)
100	10.848	1.472
1,000	11.617	1.589
5,000	13.652	1.697



ADOLESCENT		
# of Patients	Old Report Time (s)	New Report Time (s)
100	3.722	1.618
1,000	3.71	1.482
5,000	3.807	1.522
10,000	6.715	1.802
30,000	11.251	2.069



Future Enhancements

- ▶ Extend for school entry requirements reporting
- ▶ Add new statistics like one dose away, late up to date
- ▶ Add support for alternative schedules
- ▶ Expose as web service
- ▶ Share code

Thank You



Questions?
Comments?
Suggestions?

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