



Clinical Quality Measure Reporting For Meaningful Use



Health in the 21st Century

MITRE

Agenda

- Overview of popHealth
- New in 2012
- Demonstration
- Adoption and pilots

Partners



A not-for-profit organization
chartered to work in the public interest

The Office of the National Coordinator for
Health Information Technology



Overview

■ An Open Source Reference Implementation for Meaningful Use Clinical Quality Measures

- Empowers healthcare providers
- Enables EHR vendors to calculate clinical quality measures for Meaningful Use

■ Key Features

- Intuitive provider-friendly design
- Supports all 44 Meaningful Use Stage 1 Ambulatory Clinical Quality Measures
- Integrates with Electronic Health Record systems via nationally recognized data standards
- Plans to support Meaningful Use Stage 2 when specifications are available
- ONC-ATCB Certified EHR Module

Design

■ **Leverages Standards-Based Data Inputs**

- Integrates with EHR Continuity of Care data standards for patient inputs:
 - HITSP C32 XML
 - ASTM CCR XML

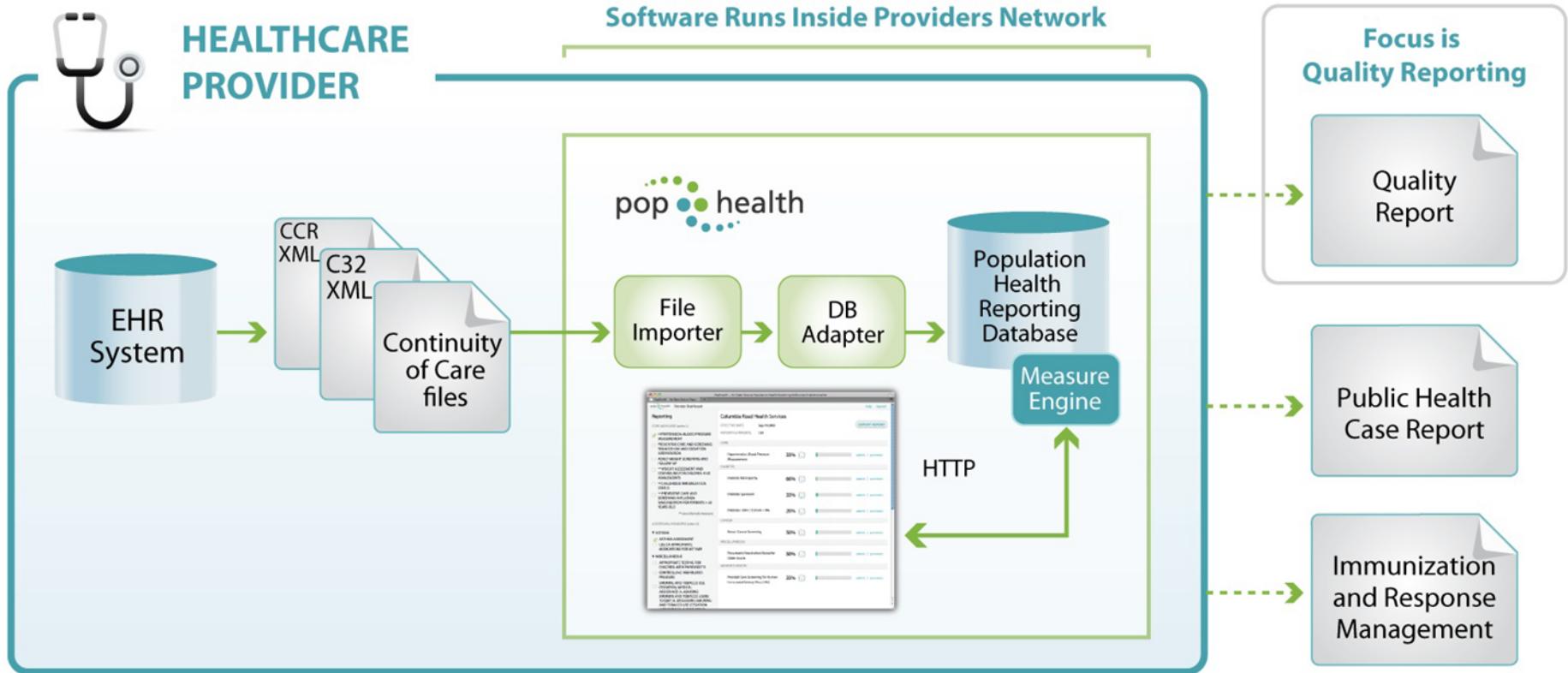
■ **Deployed within a Healthcare Provider's Firewall**

- Identifiable patient data remains in the provider's practice

■ **Open Source with Apache 2.0 License**

- Enables vendors to leverage the popHealth application or components without redistribution of source code
- Attribution is the only requirement for use, integration, redistribution of popHealth

Concept of Operations



New in 2012! Provider-Centric Features

■ Multi-Provider Dashboard View

- Multiple measures across multiple providers within one practice
- Single measure across multiple providers within one practice

■ Stratification on Race, Ethnicity and Language

- Separate results based on these demographic data points

■ Manual Override for Exclusions

- Physicians can provide rationale to exclude patients from the measure

■ Patient-Centric View

- View an individual patient's quality data

■ Easy Installation on Windows

popHealth v1.4
Software Released
January 31, 2012

New in 2012! Support for Stage 2 CQMs

- **Plans to encode all Stage 2 Ambulatory CQMs**
 - Target date 5 months after release of NPRM
 - Refinements to be made after Final Rule

- **Re-certification Planned**

popHealth v2.0
Software Release
Summer 2012

Demo

- Publicly available demonstration via the popHealth website or <http://demo.projectpophealth.org>



ADOPTION AND PILOTS

Outreach and Adoption: Providers

- **Reporting on clinical quality can be difficult for the small provider**
 - Streamlines report submission
- **popHealth brings clinical quality reporting to the physician**
 - Easy to use
 - Minimal training required
- **RECs and Beacons**
 - These organizations support the small providers
 - MITRE, in turn, can support RECs and Beacons either through “hands on” interaction (historically expensive) to “remote train the trainer” deployment support
 - Opportunity to align with regional quality improvement goals

2012 Pilot Plans

■ Target Audience: Provider-practice sites

- 4 provider pilots successfully completed to date
- 6 pilots planned for FY12
- Pilot sites are recommended by MITRE, approved by ONC
- 1 pilot completed with Beth Israel Deaconess Medical Center (BIDMC) and Massachusetts E-Health Collaborative (MAeHC)
 - Operationally deployed with 1.9M records representing over 200K patients

■ Pilot Objectives

1. Test and report CQM using live patient data
2. Evaluate healthcare provider usability of popHealth
3. Compare CQM results to vendor or in-house solutions
4. Promote ongoing adoption of popHealth by both healthcare providers and EHR vendors

BACKUP

▼ Core Measures

- Preventive Care And Screening: Tobacco
- Adult Weight Screening And Follow-Up
- Hypertension: Blood Pressure Measurement
- ** Childhood Immunization Status
- ** Preventive Care And Screening: Influenza Immunization For Patients >= 50 Years Old
- ** Weight Assessment And Counseling For Children And Adolescents

** core alternate measures

▼ Alternate Measures

► Heart Conditions

► Cancer

▼ Miscellaneous

- Primary Open Angle Glaucoma (POAG): Optic Nerve Evaluation
- Initiation And Engagement Of Alcohol And Other Drug Dependence Treatment
- Appropriate Testing For Children With Pharyngitis
- Pneumonia Vaccination Status For Older Adults
- Smoking And Tobacco Use Cessation, Medical Assistance

PRACTICE: Fort Defiance Health

REPORTING PERIOD: 12/31/2010 - 03/31/2011



export report

OF PATIENTS: 500

OF PROVIDERS: 10

measures

comparison

 numerator
 denominator
 reporting patients
 exclusions

CORE MEASURES

Preventive Care and Screening: Tobacco

Use **78%** ()

parameters patients

Cease **67%** ()

parameters patients

Adult Weight Screening and Follow-Up

65+ **50%** ()

parameters patients

18-64 **21%** ()

parameters patients

Hypertension: Blood Pressure Measurement

76% ()

parameters patients

CORE ALTERNATE MEASURES

Preventive Care and Screening: Influenza Immunization for Patients >= 50 Years Old

45% ()

parameters patients

MISCELLANEOUS

Pneumonia Vaccination Status for Older Adults

47% ()

parameters patients

Providers

Providers

► Internal Med. Team A

► Family Practice Team B

► Other

Demographics

► Races

► Ethnicities

► Genders

► Languages

(149
189)

MEASURE NAME:

NQF0028 Preventive Care and Screening: Tobacco - (a) Use Assessment

REPORTING PERIOD: 12/31/2010 - 03/31/2011

DESCRIPTION:

Percentage of patients aged 18 years or older who have been seen for at least 2 office visits, who were queried about tobacco use one or more times within 24 months. If identified as tobacco users, patient received cessation intervention.

[parameters](#)[patients](#)

INDIVIDUAL PROVIDER STATISTICS

ADAM , Gino**70%** (12
17)CAMPBELL , Kevin**68%** (13
19)COOPER , Edmund**86%** (13
15)COOPER , George**84%** (11
13)COOPER , Jane**78%** (11
14)DARLING , Duane**85%** (17
20)EDWARDS , Robert**66%** (12
18)MYERS , Jamie**78%** (18
23)SCHMIDT , Steve**87%** (14
16)SIMPSONS , Jamie**72%** (13
18)

pop health

Fort Defiance Health > Adam, Gino » NQF0421b » parameters

Welcome, Renee | help | account | providers | logout



8%

($\frac{2}{24}$)

MEASURE NAME: NQF0421 Adult Weight Screening and Follow-Up - (b) Age 18-64

REPORTING PERIOD: 12/31/2010 - 03/31/2011

DESCRIPTION: Patients more than 18 years old whose BMI was calculated within six months, and who have a documented follow-up plan if BMI falls outside parameters.

DENOMINATOR (24)

patient characteristic age between 18 and 65

and

outpatient encounter within a year of the effective date

EXCLUSIONS (0)

NUMERATOR (2)

patient characteristic 18.5 kg/m² <= bmi <= 25 kg/m²

or

patient characteristic bmi < 18.5 kg/m² or bmi > 25 kg/m²

and

care goal follow-up plan bmi management

or

communication provider to provider dietary consultation order



▼ Core Measures

- Preventive Care And Screening: Tobacco
 - Adult Weight Screening And Follow-Up
 - Hypertension: Blood Pressure Measurement
 - ** Childhood Immunization Status
 - ** Preventive Care And Screening: Influenza Immunization For Patients >= 50 Years Old
 - ** Weight Assessment And Counseling For Children And Adolescents

**** core alternate measures**

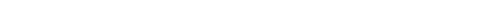
▼ Alternate Measures

► Heart Conditions

► Cancer

► Miscellaneous

► Women's

► Women's Health	CORE ALTERNATE MEASURES
► Diabetes	<u>Preventive Care and Screening: Influenza</u>  parameter

CORE ALTERNATE MEASURES



MISCELLANEOUS

MISCELLANEOUS

Demographics

► Races

► Ethnicities

► Genders

► Languages

Pneumonia Vaccination Status for Older Adults



8% $(\frac{2}{24})$

Show Patients in:

- Numerator 2
- Denominator 24
- Outliers 22
- Exclusions 0

MEASURE NAME: NQF0421 Adult Weight Screening and Follow-Up - (b) Age 18-64

REPORTING PERIOD: 12/31/2010 - 03/31/2011

DESCRIPTION: Patients more than 18 years old whose BMI was calculated within six months, and who have a documented follow-up plan if BMI falls outside parameters.

PATIENT ID	LAST	FIRST	AGE	DOB	SEX	EXCLUSION	change
0882241351	Wheeler	Sue	56	07/27/1955	F	Included	change
2312112552	Huff	Willard	34	12/20/1977	M	Included	change
7831151623	Flores	Dan	38	03/03/1973	M	Included	change
9603027024	Cox	Jamie	22	10/18/1989	F	Included	change
5866072068	Moss	Kelly	24	02/13/1988	F	Included	change
9869099223	Martin	Theodore	28	04/20/1983	M	Included	change
1269445729	Conner	Marc	20	04/06/1991	M	Included	change
7528161397	Pratt	Olga	31	03/21/1980	F	Included	change
3018534606	Hale	Terrence	60	12/03/1951	M	Included	change
0054992412	Moss	Agnes	24	03/08/1987	F	Included	change
0943274772	Chambers	Ethel	36	03/12/1975	F	Included	change
0041272889	Hicks	Lisa	23	07/04/1988	F	Included	change
6899955311	Higgins	Deanna	45	05/29/1966	F	Included	change
5602985355	Paul	Jared	63	01/11/1949	M	Included	change
8636566181	Rowe	Ramona	38	08/11/1973	F	Included	change
6824698813	Graham	Eileen	33	08/20/1978	F	Included	change

pop health

Fort Defiance Health » Adam, Gino » NQF0421b » patientsWelcome, Renee | help | account | providers | logout

8%
(2 / 24)

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Show Patients in:

- Numerator 2
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Show Patients in:

 Numerator

2

 Denominator

24

 Outliers

22

 Exclusions

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7528161397	Pratt	Olga	31	03/10/1986			update cancel
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Exclude Patient

Rationale:

[update](#)[cancel](#)

8% ($\frac{2}{24}$)

Show Patients in:

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Outliers

- Preventive Care And Screening: Tobacco - Use Assessment
- Adult Weight Screening And Follow-Up - Age 18-64
- Smoking And Tobacco Use Cessation, Medical Assistance - Advising Smokers And Tobacco Users To Quit
- Smoking And Tobacco Use Cessation, Medical Assistance - Discussing Smoking And Tobacco Use Cessation Medications And Strategies

Manual Exclusions

 PATIENT NAME: **Moss, Kelly**

 EFFECTIVE DATE: **03/31/2011**

 DOB **02/13/1988**

 RECORD NUMBER **5866072068**

 SEX **F**

 PROVIDERS **Adam, Gino**

 RACE **Asian**

 ETHNICITY **Not Hispanic or Latino**

 LANGUAGES **English**
ALLERGIES
PROCEDURES
CARE GOALS
MEDICATIONS
VITAL SIGNS

 Influenza Vaccine **10/27/2010**

 BMI **26** **01/22/2010**

 Antiasthmatic **08/10/2010**
LABORATORY RESULTS

 Antiasthmatic **02/20/2010**

 Cervical cancer screening **10/03/2009**
 Chlamydia screening **07/07/2010**
ENCOUNTERS
SOCIAL HISTORY

 Outpatient encounter **02/13/2010**
 Outpatient encounter **11/11/2010**
 Preventative encounter **04/07/2010**
 Acute inpatient encounter **07/01/2010**
IMMUNIZATIONS
CONDITIONS
MEDICAL EQUIPMENT

 Asthma diagnosis **06/01/2010**
 Persistent Asthma diagnosis **05/16/2010**
 Daytime asthma symptoms **03/04/2010**
 Nighttime asthma symptoms **02/14/2010**

Key Messages for EHR Vendors

- **popHealth is open source, freely available sponsored by ONC to help accelerate clinical quality reporting for meaningful use**
 - Uses a Permissive Apache 2.0 Open Source Distribution License
- **popHealth is a certified EHR CQM module that can be used for clinical quality reporting in its entirety or in part**
 - popHealth User interface
 - Quality Measure Engine
- **popHealth is a reference implementation and can serve as a guide for vendors to accurately encode clinical quality measures**
- **popHealth can help EHR vendors with new Stage 2 measures**
 - popHealth will support MU Stage 2 within 5 months of the release of the NPRM

Outreach and Adoption: EHR Vendors

- **3 EHR vendors have integrated popHealth and successfully passed certification testing using popHealth:**
 - Well Logic
 - FEI Systems
 - Epocrates

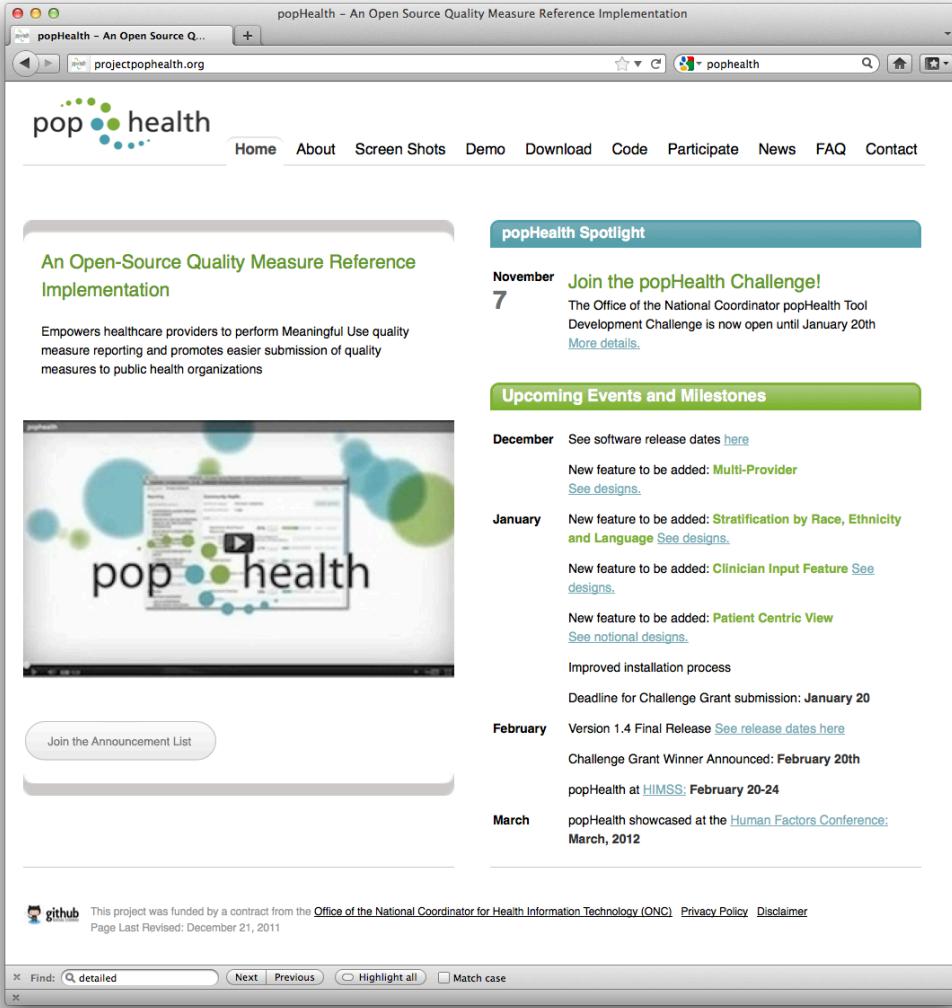
Continuity of Care Data Requirements

- Extensive clinical data is needed to be present in C32 or CCR records for automating the generation of Meaningful Use Clinical Quality Measures in popHealth
 - Allergies: RxNorm*, SNOMED-CT*
 - Care Goals, Social History, Medical Equipment: SNOMED-CT*
 - Conditions: SNOMED-CT*, ICD-9-CM, ICD-10-CM
 - Encounters: CPT
 - Immunizations, Medications: RxNorm*, CVX*
 - Procedures: CPT, ICD-9-CM, ICD-10-CM, SNOMED-CT*
 - Vitals, Results, Assessments: LOINC*, SNOMED-CT*
 - Communications: SNOMED-CT
- Requires that all continuity of care entries are time-stamped
- Requires that results and vitals must be provided structured with units and values

OPEN SOURCE COMMUNITY

popHealth Project Website

<http://projectpophealth.org/>



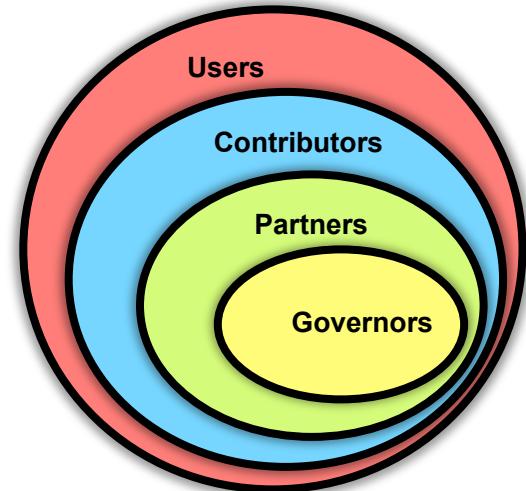
The screenshot shows the homepage of the popHealth project website. The header includes the pop health logo and navigation links for Home, About, Screen Shots, Demo, Download, Code, Participate, News, FAQ, and Contact. The main content area features a section titled "An Open-Source Quality Measure Reference Implementation" with a brief description and a screenshot of the software interface. Another section, "Upcoming Events and Milestones," lists events from November to March, including the "Join the popHealth Challenge!" and various software releases and milestones.

Website Traffic Since Initial Release of popHealth v1.0

16,249	Unique Visits
9,408	Unique Visitors
43,106	Page Views
2.65	Pages/Visit

Open Source Software

- All the popHealth source code is freely available under an open source license via GitHub:
<http://github.com/pophealth>
- Objective: Grow a community of popHealth contributors with transparent governance spanning
 - US Government
 - Commercial EHR Vendors
 - Healthcare Provider and Stakeholders
 - Academic and Non-Profit Organizations
 - Individual Contributors
- ONC and MITRE welcome commercial EHR vendor participation and contributions in the popHealth community



Open Source License

- **popHealth is freely available via an Apache 2.0 Open Source distribution license**
 - <http://www.apache.org/licenses/LICENSE-2.0.html>
- **Apache 2.0 is very industry-friendly and permissive for integrators**
 - Provides numerous freedoms on the use of popHealth code
 - Use, Integration, Modification, and even Re-Distribution
- **Meaningful Use CQM measure definitions are the only exception to the Apache 2.0 license**
 - CQM measure questions should be directed to the appropriate measure steward

TECHNICAL DETAILS

Technology Stack

- **popHealth Server**
 - Ruby (version 1.9.2) on Rails (version 3.0 or higher)
- **Database**
 - MongoDB (version 2.0.1)
- **CQM Calculation**
 - Leverages MapReduce framework in MongoDB
- **popHealth Internal Measure Representation**
 - Uses JSON and JavaScript

Scalability

■ MongoDB

- Provides an infrastructure for storing large data sets across multiple nodes
- Efficiently shards and replicates data for distribution
- Schema-less, non-relational, document-oriented

■ Map/Reduce

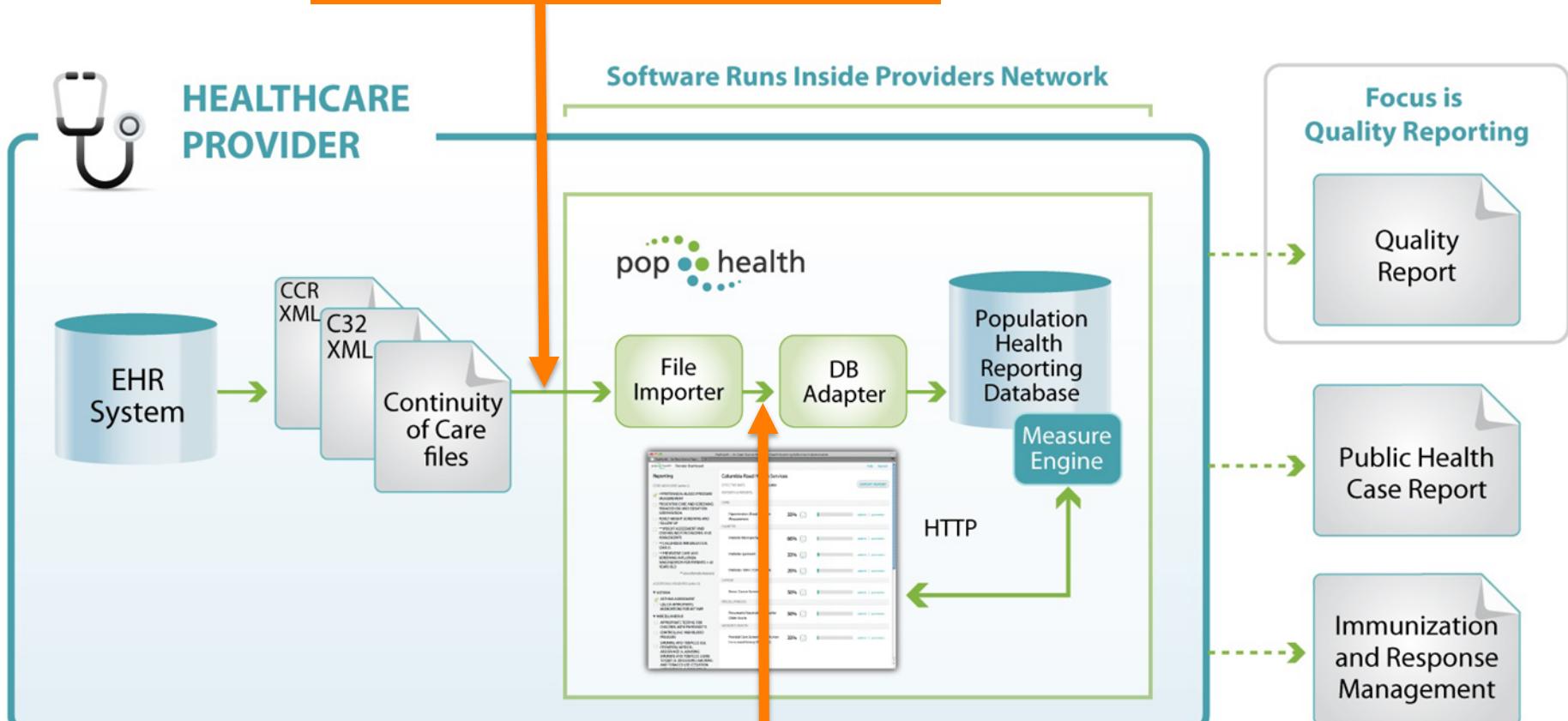
- A framework for scaling execution and data processing
- Conceptually simple, but allows for near limitless scalability in execution

Map Reduce with MongoDB

- Centerpiece of CQM calculation in popHealth
 - Map Reduce is a successful programming model for processing big data
 - First Described by Google: [http://labs.google.com/papers/
mapreduce.html](http://labs.google.com/papers/mapreduce.html)
 - Translating an algorithm into 2 simple functions provides major benefits to scalability

Vendor Integration Points

1) RESTful Web Service



2) File Importer

Integration via HTTPS/XML

- Other vendors leveraging this integration point
- Import of Files via HTTPS Post with Credentials
 - Supports C32 or CCR data import over network
- Data Importer distributed with popHealth uses this interface
 - JRuby Client developed as Java Swing application
- Pro
 - Existing interface
- Cons
 - Data must be rendered in CCD format (C32 or CCR)

Alternate File Importer

- Similar to popHealth support for C32/CCR
 - Could leverage web-services interface
- Convert input data to format compatible with popHealth representation in MongoDB
- Con:
 - Would require development of code based on popHealth code base
- Pro:
 - Avoids rendering clinical data in CCD format (C32 or CCR)

MU CQM Stage 1 Logic

Population criteria

- **Initial Patient Population =**
 - AND: "Patient characteristic: birth date" >= 64 year(s) starts before start of "Measurement period"
- **Denominator=**
 - AND: "Initial Patient Population"
 - AND: "Encounter: encounter outpatient" during "Measurement period"
- **Numerator =**
 - AND:
 - OR: "Medication administered: Pneumococcal Vaccine all ages"
 - OR: "Procedure performed: Pneumococcal Vaccination all ages"
 - during "Measurement period"
- **Exclusions =**
 - None

JavaScript Logic

```

function () {
  var patient = this;
  var measure = patient.measures["0043"];
  if (measure==null)
    measure={};

<%= init_js_frameworks %>

var year = 365*24*60*60;
var effective_date = <%= effective_date %>;
var measurement_period_start = effective_date - 1*year;
/*
  "Patient characteristic:birthdate"(age)>=64 years before the "measurement period" to
  capture all patients who will reach the age of 65 and older during the "measurement period";
*/
var earliest_birthdate = measurement_period_start - 64*year;
var earliest_encounter = effective_date - 1*year;

var population = function() {
  return (patient.birthdate <= earliest_birthdate);
}

var denominator = function() {
  outpatient_encounter = inRange(measure.encounter_outpatient_encounter, earliest_encounter, effective_date);
  return (outpatient_encounter);
}

var numerator = function() {
  vaccination = lessThan(measure.pneumococcal_vaccination_all_ages_procedure_performed, effective_date);
  vaccine = lessThan(measure.pneumococcal_vaccine_all_ages_medication_administered, effective_date);
  return vaccination || vaccine;
}

var exclusion = function() {
  return false;
}

map(patient, population, denominator, numerator, exclusion);
};

```

Example MU Stage 1 Value Sets

QDS_id	standard_concept	standard_category	QDS_data_type	standard_concept_id	standard_taxonomy	standard_taxonomy_version	standard_code_list
N_3185	pneumococcal vaccination	Procedure	procedure performed	N_c1060	CVX	06/2009	100, 133
N_3184	pneumococcal vaccination pneumococcal vaccination ages 2 and older	Procedure	procedure performed	N_c1061	CPT	06/2009	90669, 90670
N_3186	pneumococcal vaccination ages 2 years and older	Procedure	procedure performed	N_c1068	CPT	06/2009	90732
N_3187		Procedure	procedure performed	N_c1069	CVX	06/2009	33

JSON encoding of Value Sets

```

"pneumococcal_vaccination_all_ages_procedure_performed"
  "standard_concept": "pneumococcal_vaccination_all_age",
  "standard_category": "procedure",
  "standard_concept_id": "N_c1070",
  "qds_data_type": "procedure_performed",
  "qds_id": "N_3188",
  "type": "array",
  "items": {
    "type": "number",
    "format": "utc-sec"
  },
  "codes": [
    {
      "set": "CVX",
      "version": "06/2009",
      "standard_concept": "pneumococcal_vaccination",
      "standard_concept_id": "N_c1060",
      "qds_id": "N_3185",
      "values": [
        "100",
        "133"
      ]
    },
    {
      "set": "CPT",
      "version": "06/2009",
      "standard_concept": "pneumococcal_vaccination",
      "standard_concept_id": "N_c1061",
      "qds_id": "N_3184",
      "values": [
        "90669",
        "90670"
      ]
    }
  ]
}

```

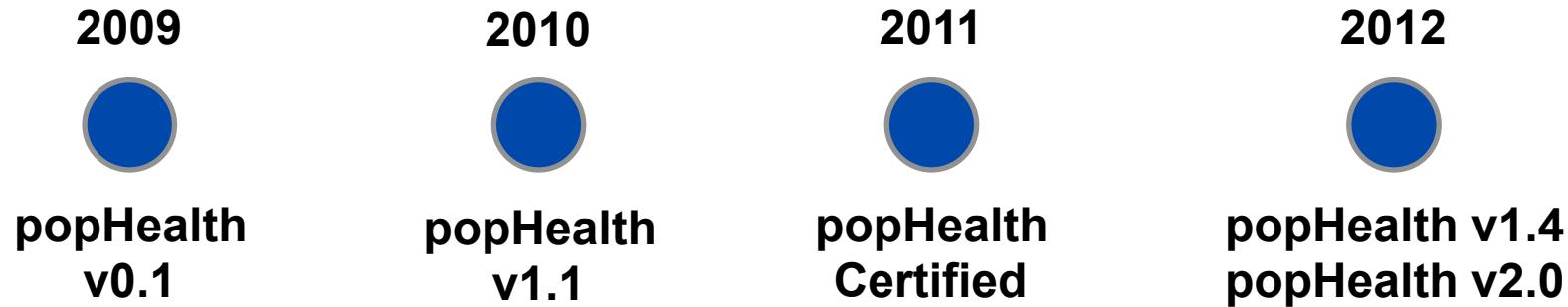
```

{
  "set": "CPT",
  "version": "06/2009",
  "standard_concept": "pneumococcal_vaccination_ages_2_and_older",
  "standard_concept_id": "N_c1068",
  "qds_id": "N_3186",
  "values": [
    "90732"
  ],
  "set": "CVX",
  "version": "06/2009",
  "standard_concept": "pneumococcal_vaccination_ages_2_years_and_older",
  "standard_concept_id": "N_c1069",
  "qds_id": "N_3187",
  "values": [
    "33"
  ]
}

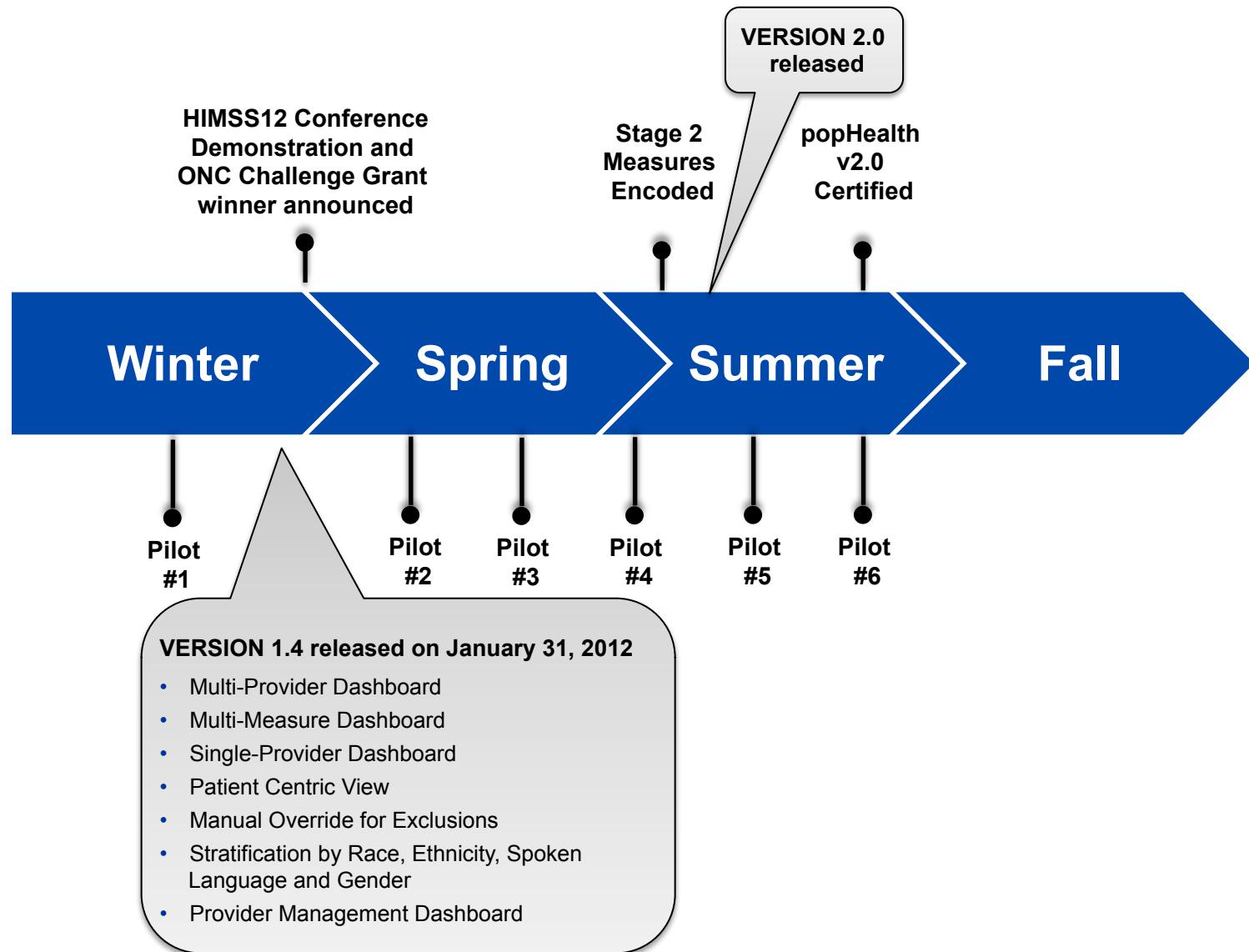
```

Background

- September 2009: popHealth started as a prototype, proof-of-concept for a Clinical Quality Measure (CQM) reporting module: [popHealth v0.1](#)
- September 2010: popHealth formally supported by ONC as a MU Stage 1 reference implementation
 - Encoded electronic specifications for all 44 of the ambulatory MU CQMs, [popHealth v1.1](#)
 - Certified as an EHR module in July 2011
- October 2011: Enhancements for Meaningful Use and Providers
 - Affordable Care Act Section 3014 Features: [popHealth v1.4](#)
 - Meaningful Use Stage 2 Support planned for summer 2012: [popHealth v2.0](#)

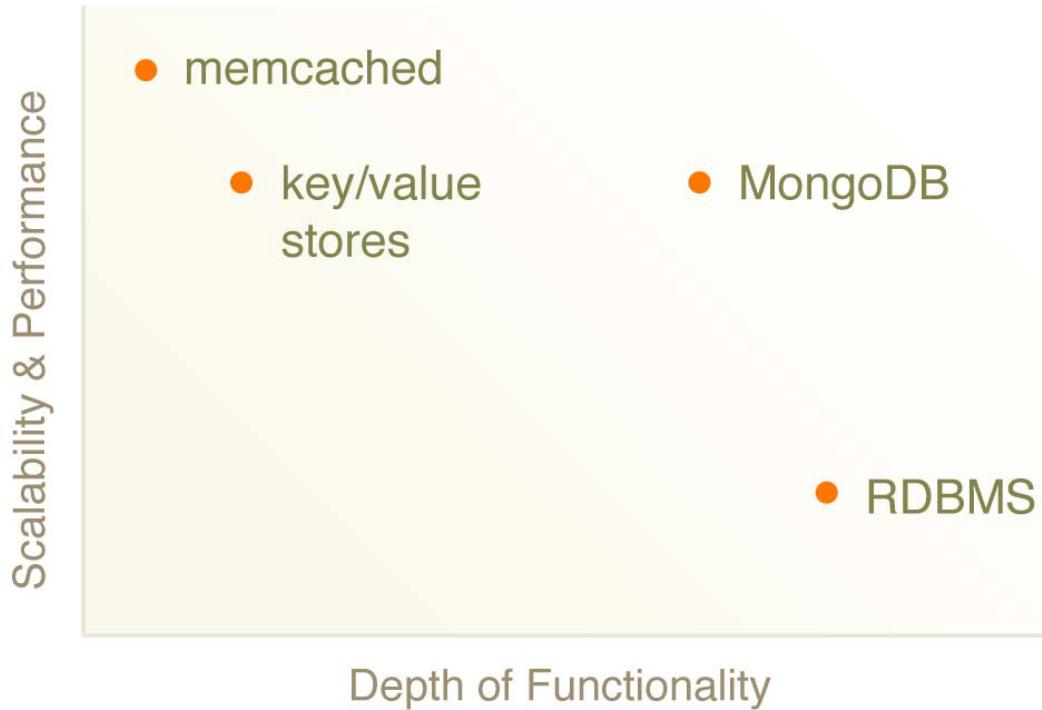


popHealth FY 2012 Timeline



Scalability

MongoDB Scales



RDMS Scales Vertically

Map Reduce with MongoDB

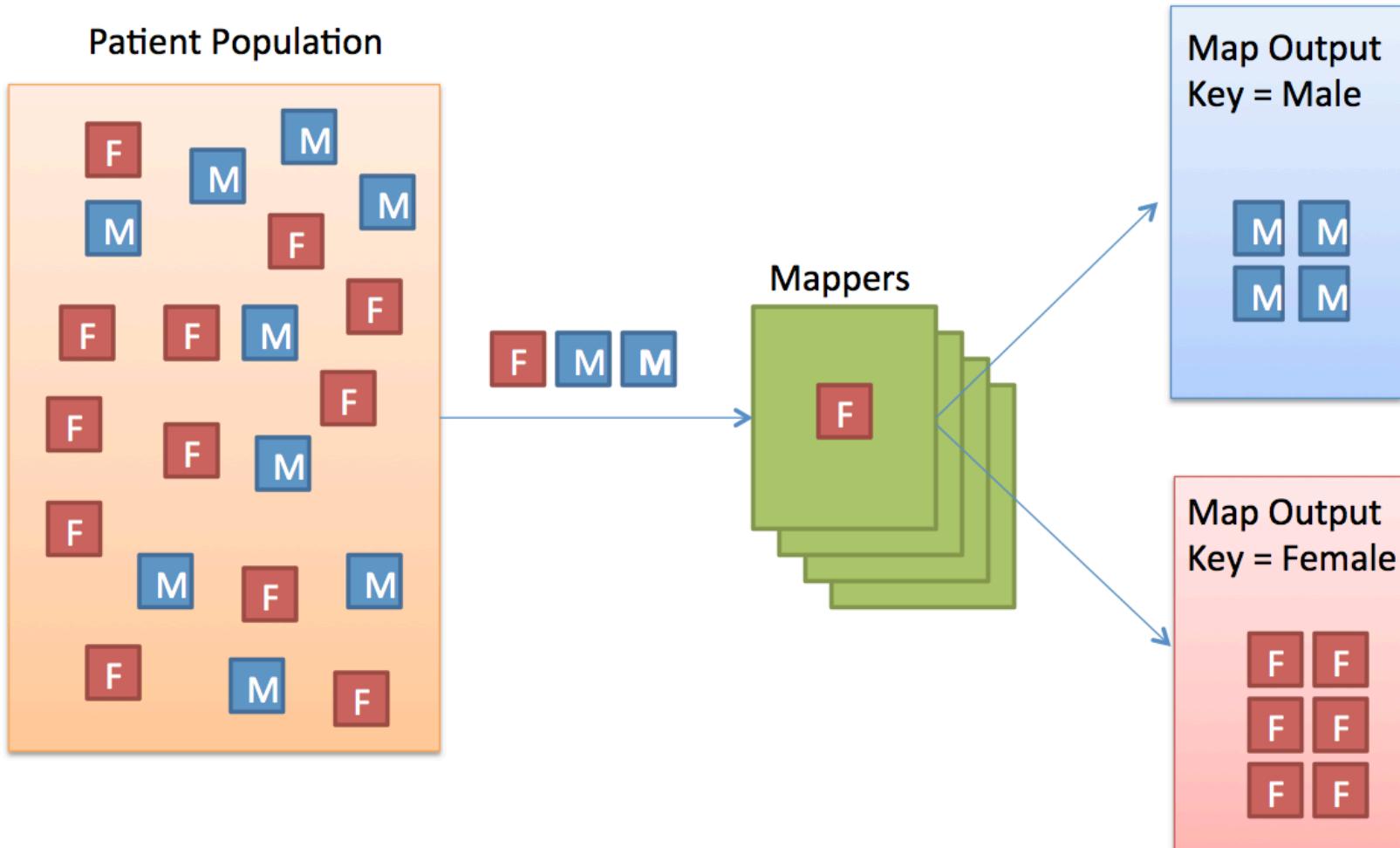
■ Map

- Takes an input list
- Runs logic against all elements on the list
- Output a list of key-value pairs

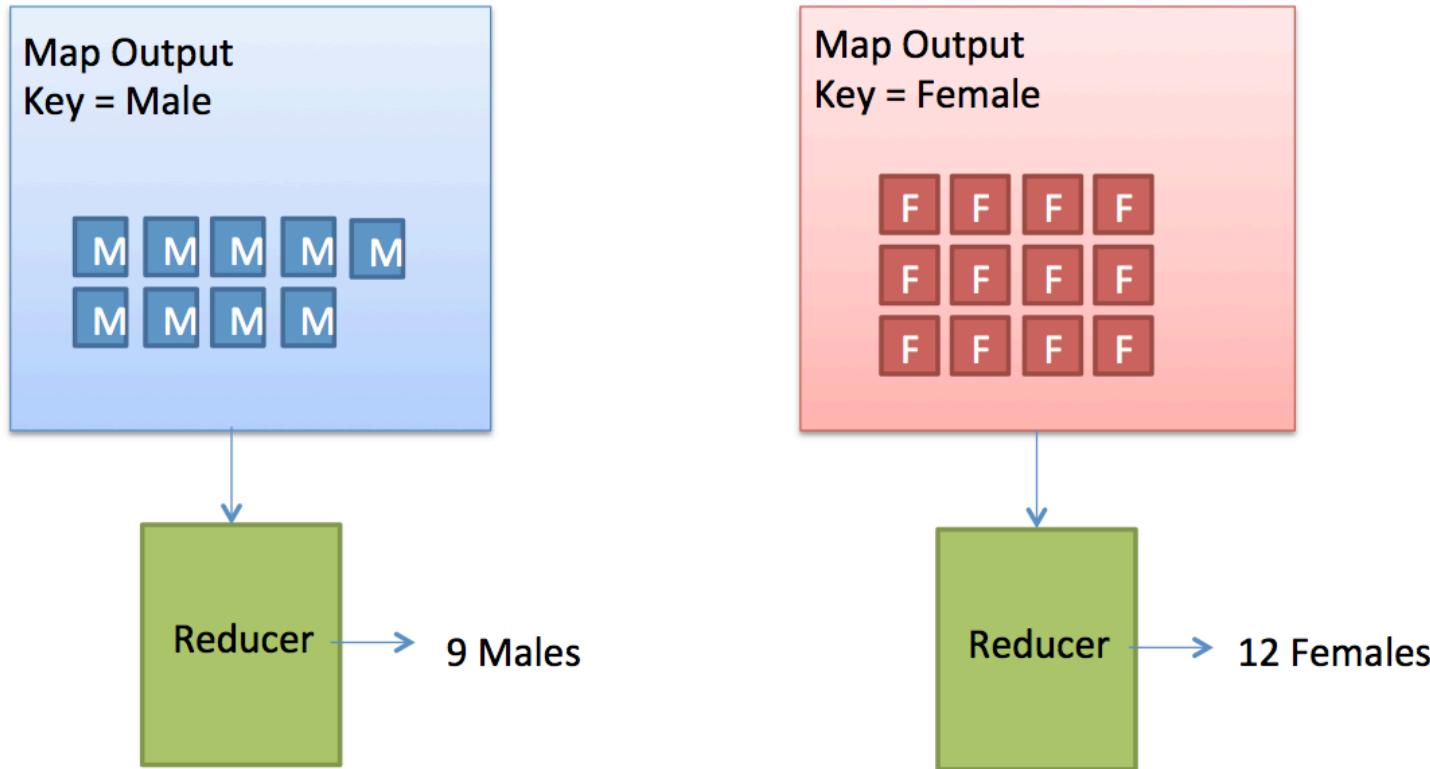
■ Reduce

- Takes a key and a list of values
- Runs logic on the list of values to provide some aggregation, combination, or summary
- Returns the key and result

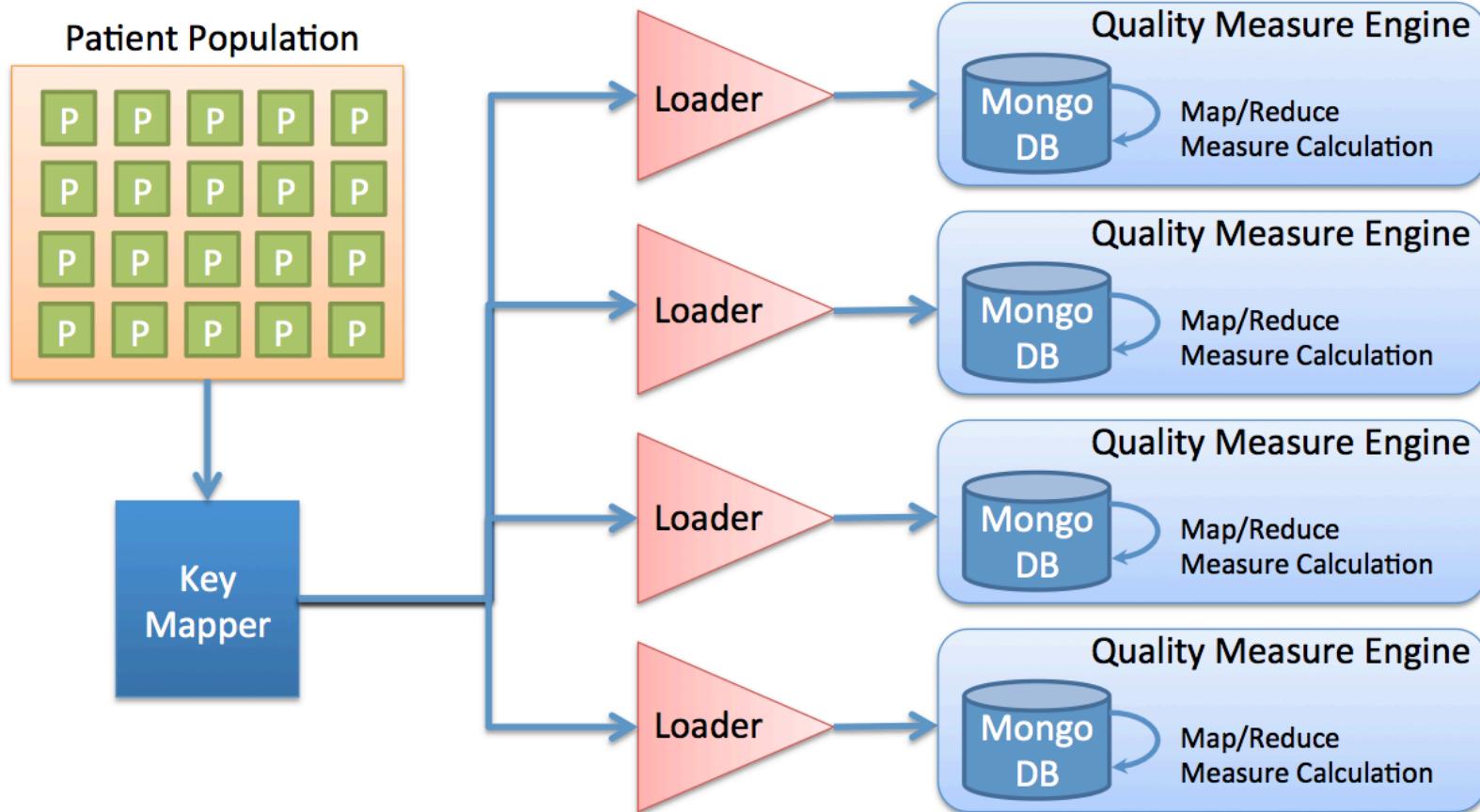
Map



Reduce



Sharding – Data Loading



Sharding – Measure Calculation

