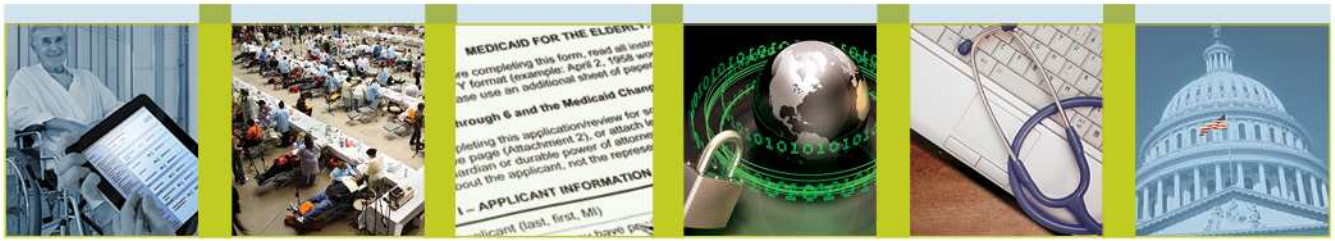
popHealth® code

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

MITRE

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

The Office of the National Coordinator for Health Information Technology

Approved for Public Release: 12-0676

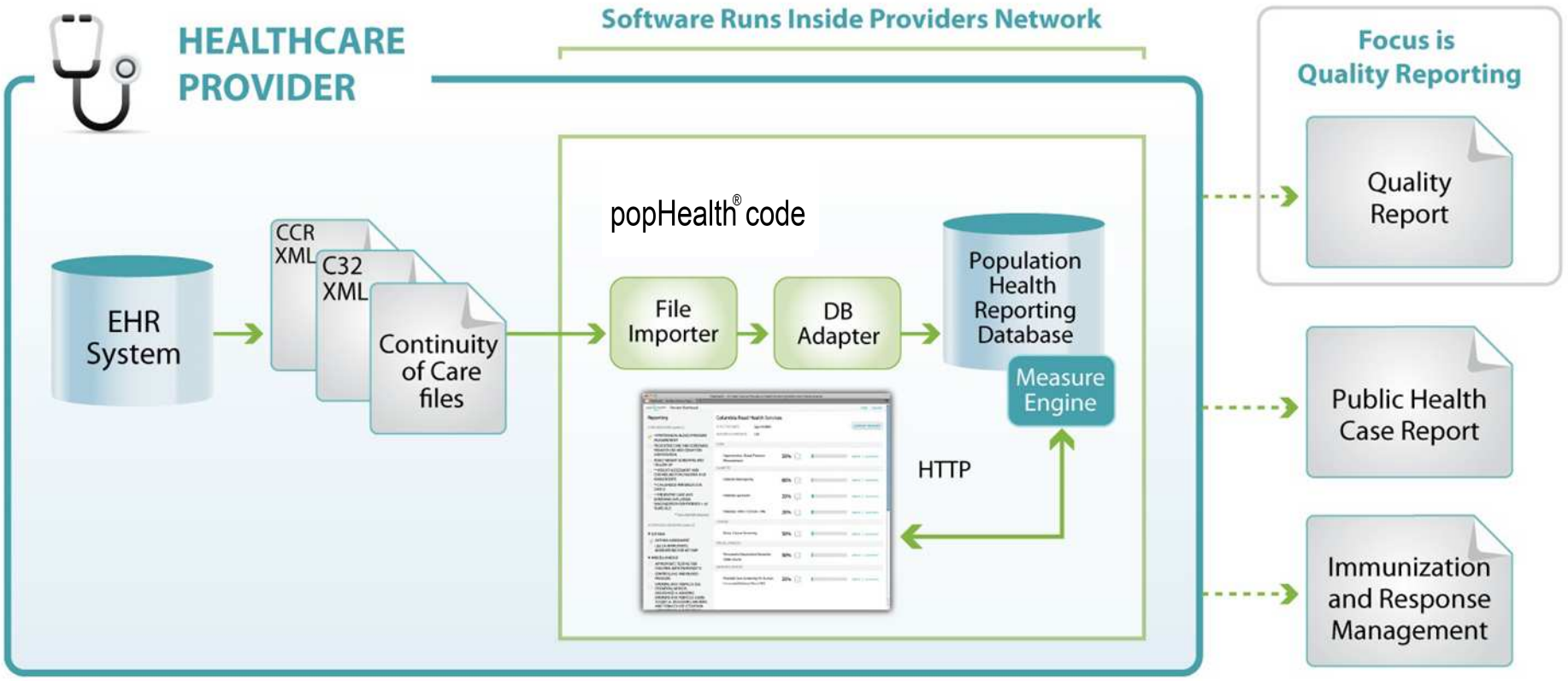
Overview

- **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

popHealth® code

- **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

popHealth® code | Fort Defiance Health | Welcome, Renee | help | account | providers | logout

▼ 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

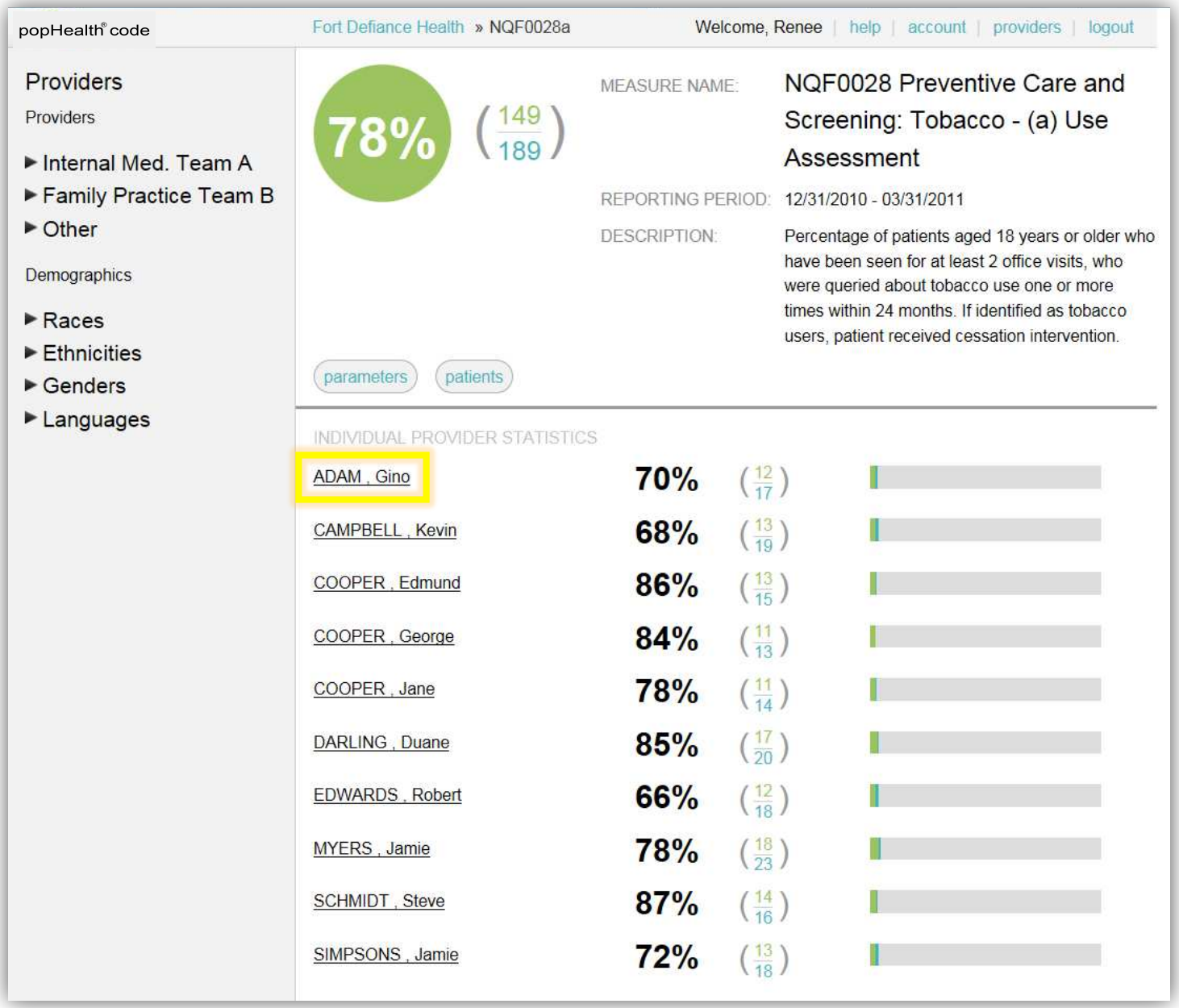
OF PATIENTS: 500

OF PROVIDERS: 10

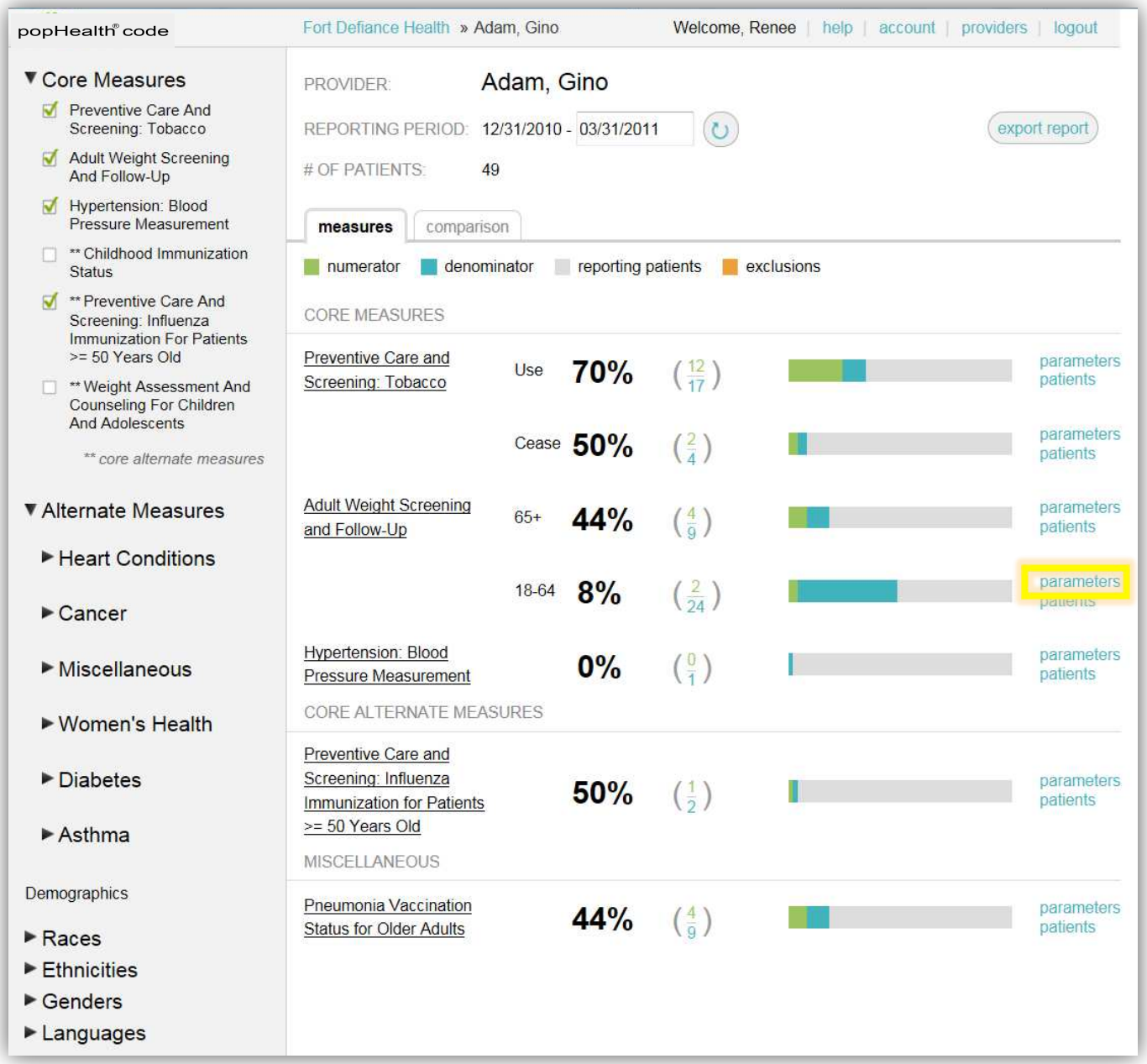
measures | comparison

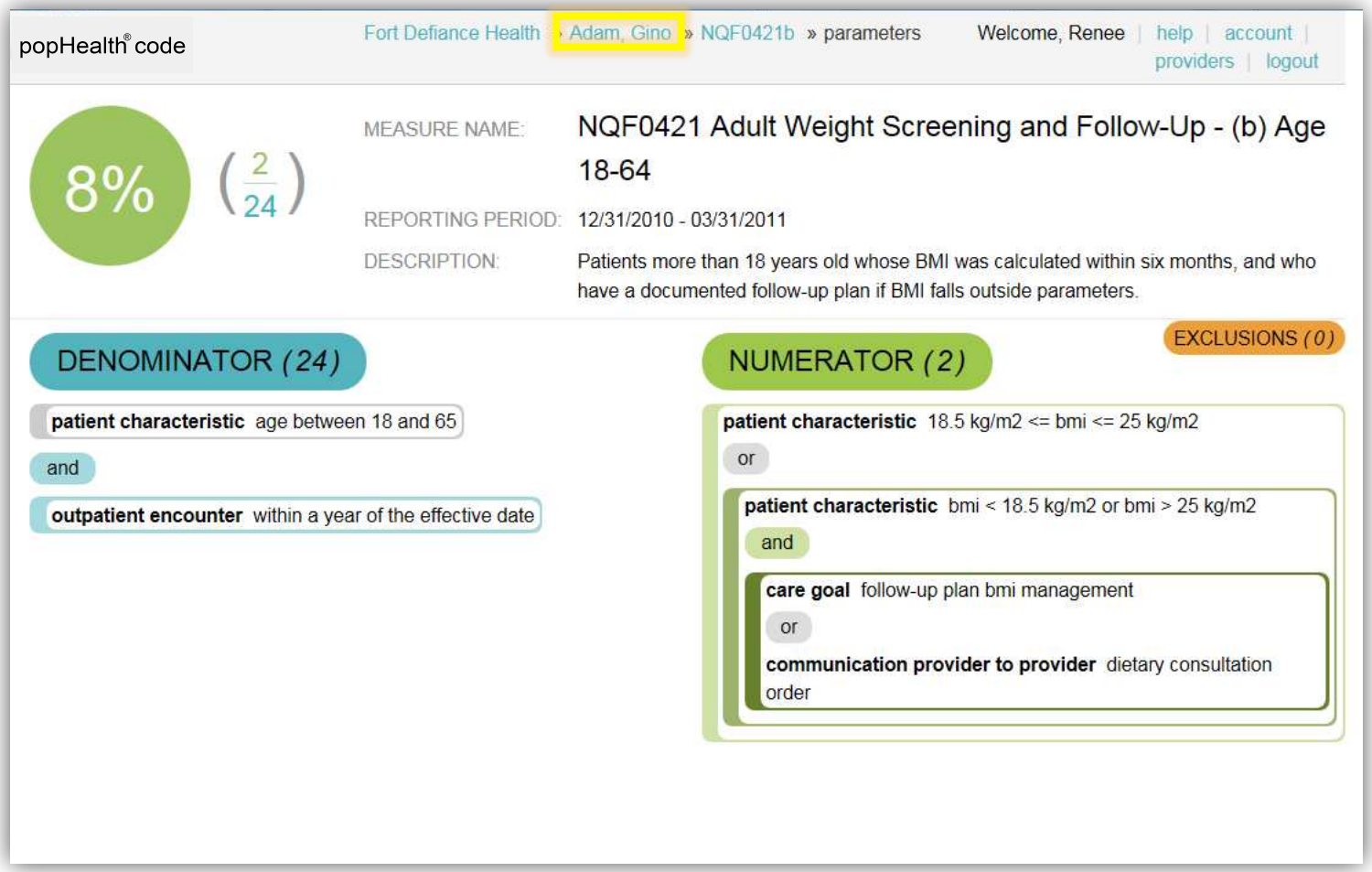
numerator | denominator | reporting patients | exclusions

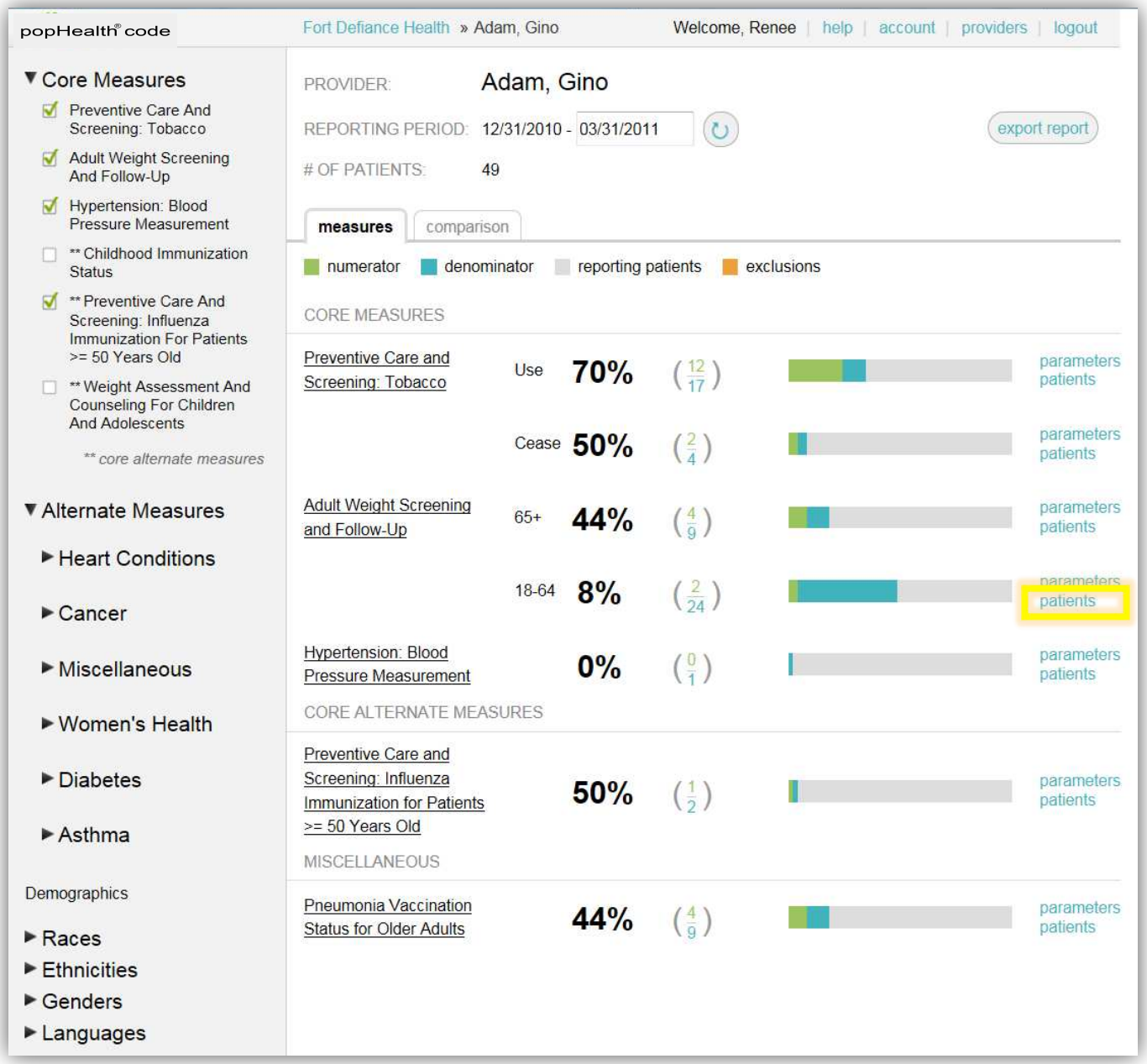
CORE MEASURES				
Preventive Care and Screening: Tobacco	Use	78%	(149/189)	parameters patients
	Cease	67%	(33/49)	parameters patients
Adult Weight Screening and Follow-Up	65+	50%	(37/74)	parameters patients
	18-64	21%	(54/256)	parameters patients
Hypertension: Blood Pressure Measurement		76%	(19/25)	parameters patients
CORE ALTERNATE MEASURES				
Preventive Care and Screening: Influenza Immunization for Patients >= 50 Years Old		45%	(20/44)	parameters patients
MISCELLANEOUS				
Pneumonia Vaccination Status for Older Adults		47%	(38/80)	parameters patients



popHealth® code







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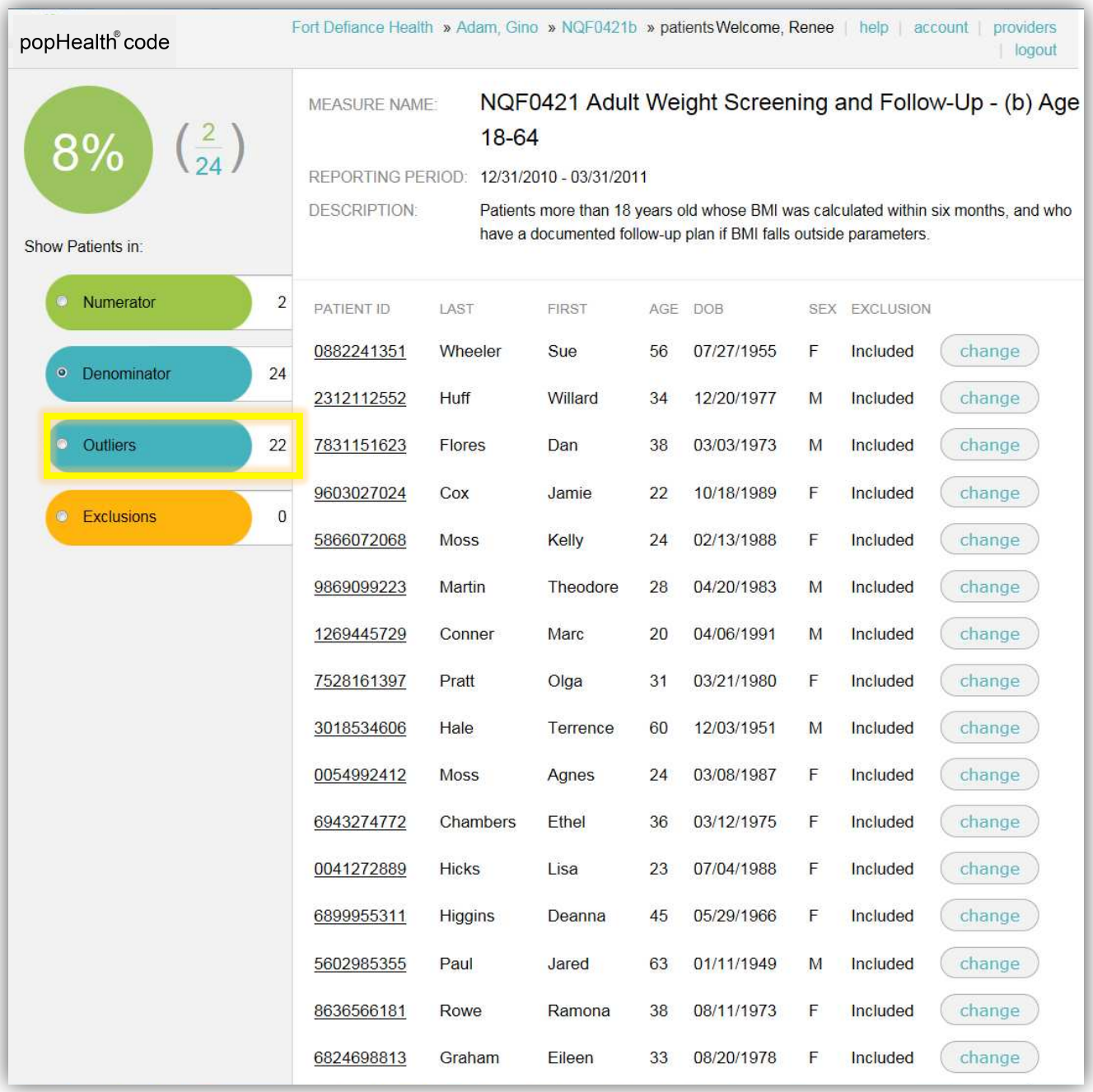
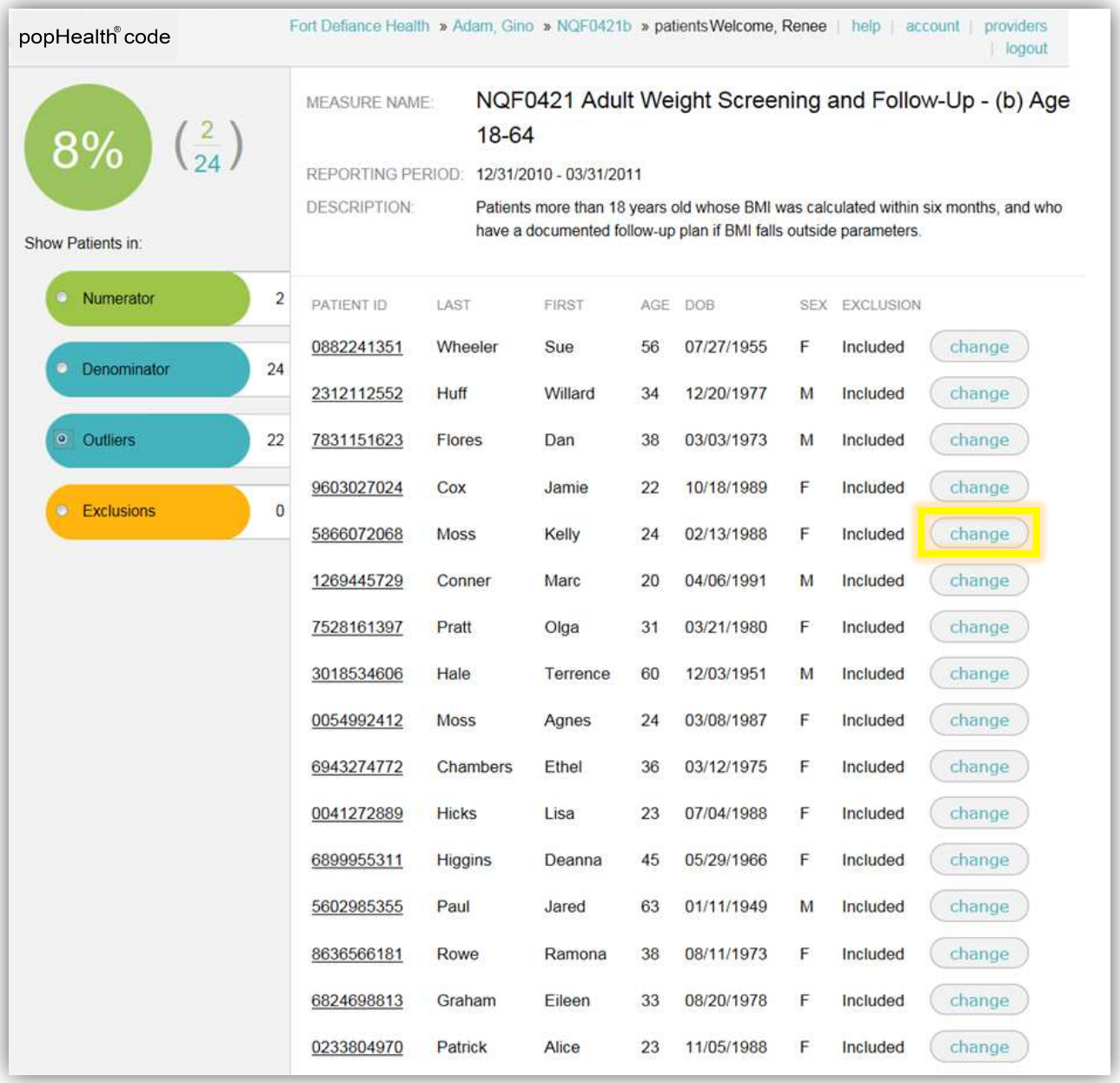
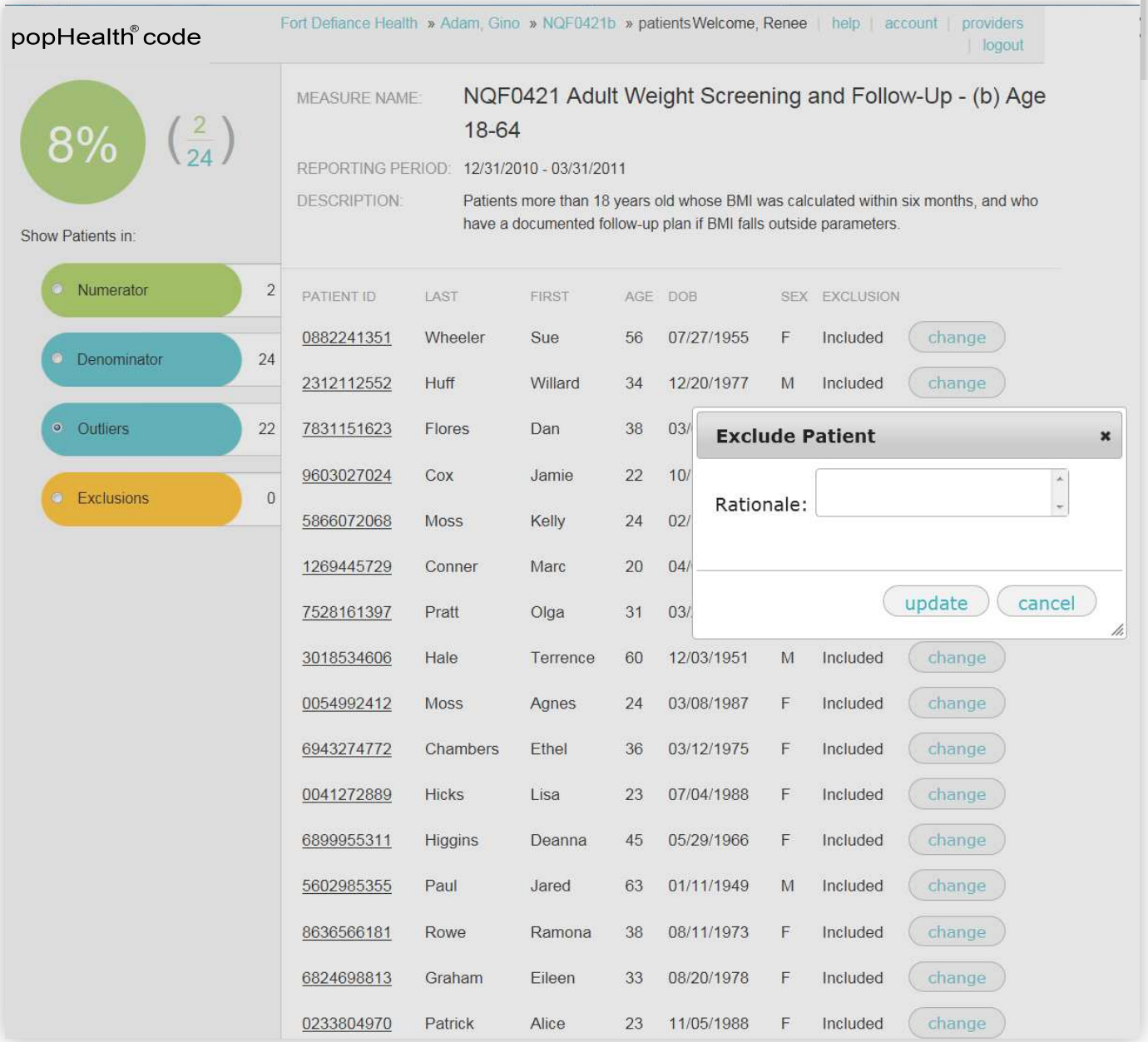


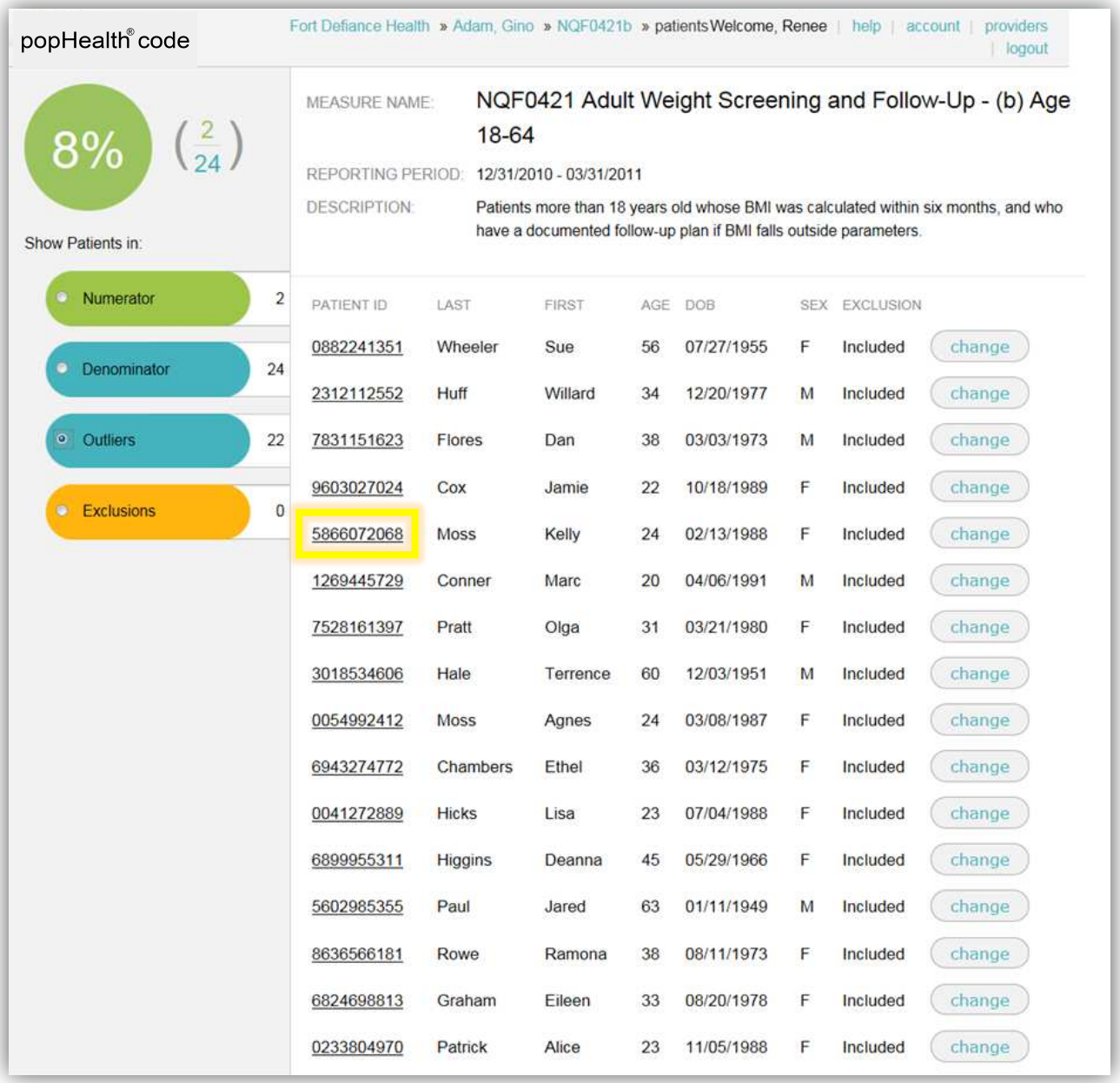
PATIENT ID	LAST	FIRST	AGE	DOB	SEX	EXCLUSION	
0882241351	Wheeler	Sue	56	07/27/1955	F	Included	change
2312112552	Huff	Willard	34	12/20/1977	M	Included	change
7831151623	Flores	Dan	38	03/03/1973	M	Included	change
9603027024	Cox	Jamie	22	10/18/1989	F	Included	change
5866072068	Moss	Kelly	24	02/13/1988	F	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
6943274772	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

popHealth® code

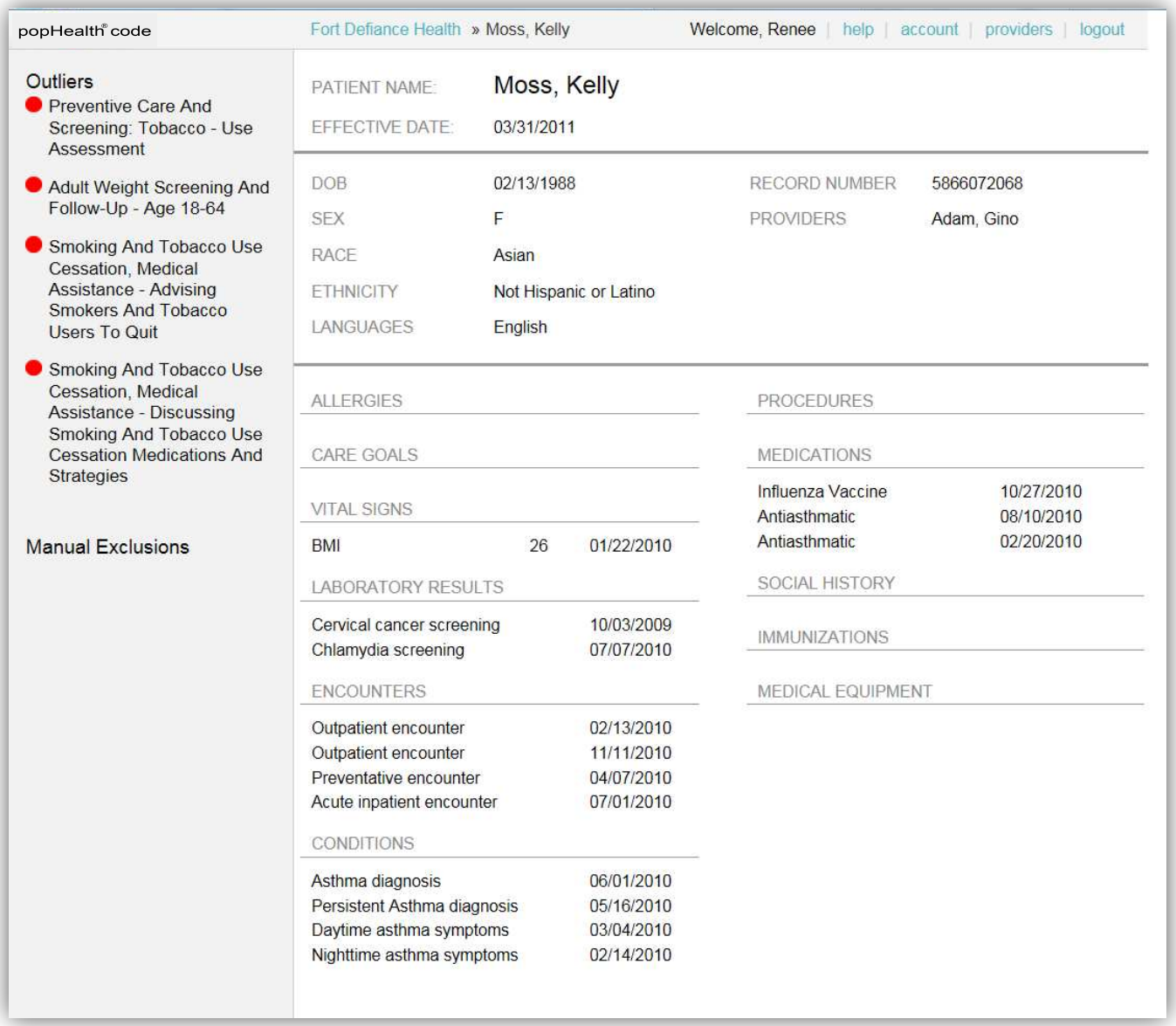


popHealth® code





popHealth® code



Key Messages for EHR Vendors

popHealth® code

- 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

popHealth® code

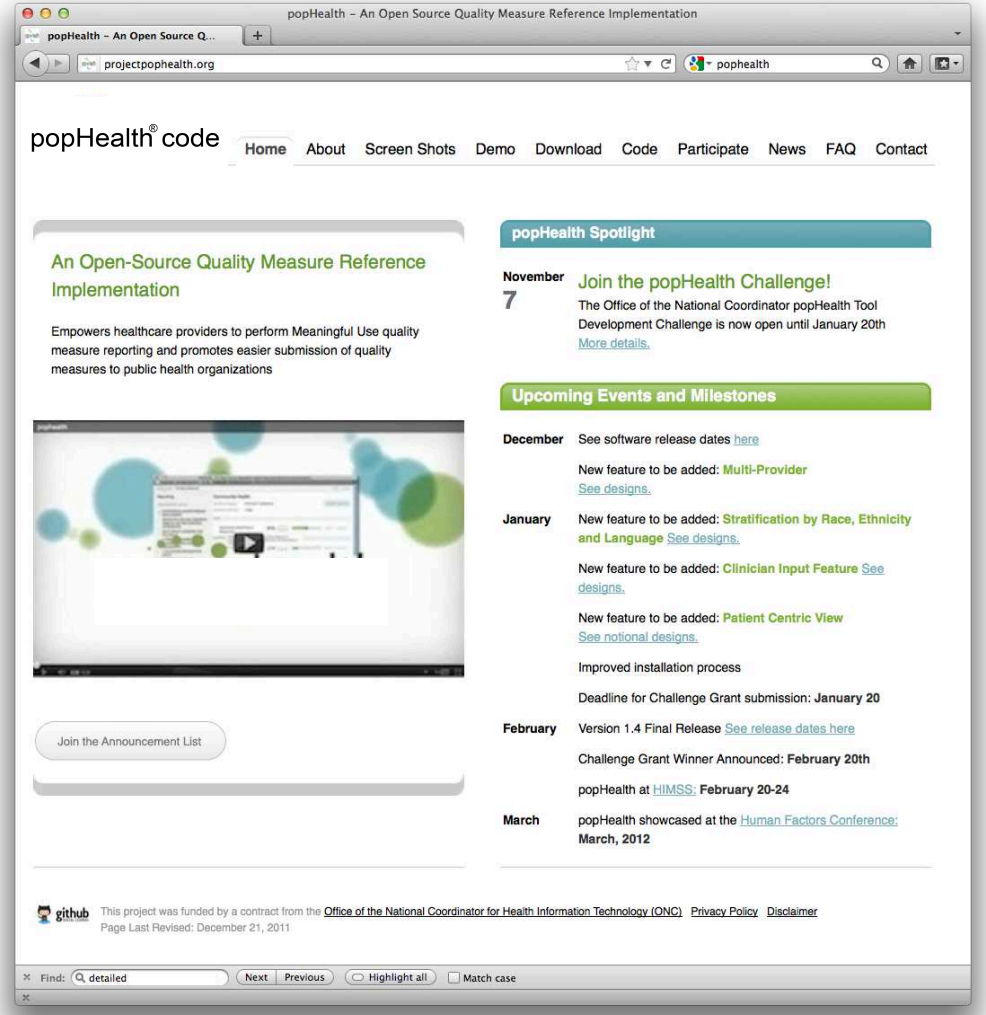
- 3 EHR vendors have integrated popHealth and successfully passed certification testing using popHealth:
  - Well Logic
  - FEI Systems
  - Epocrates

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 Proejct Website
http://projectpophealth.org/

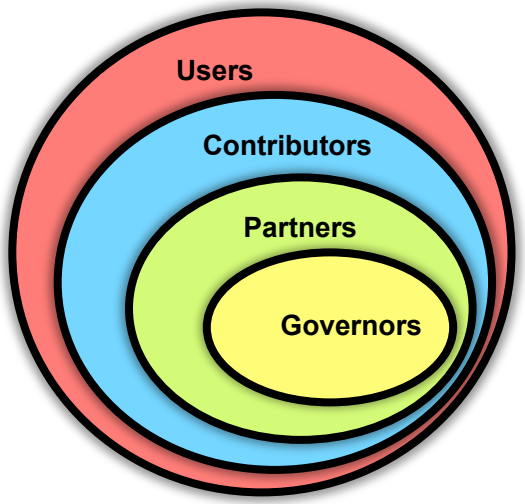


Website Traffic Since Initial Release of popHealth v1.0

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

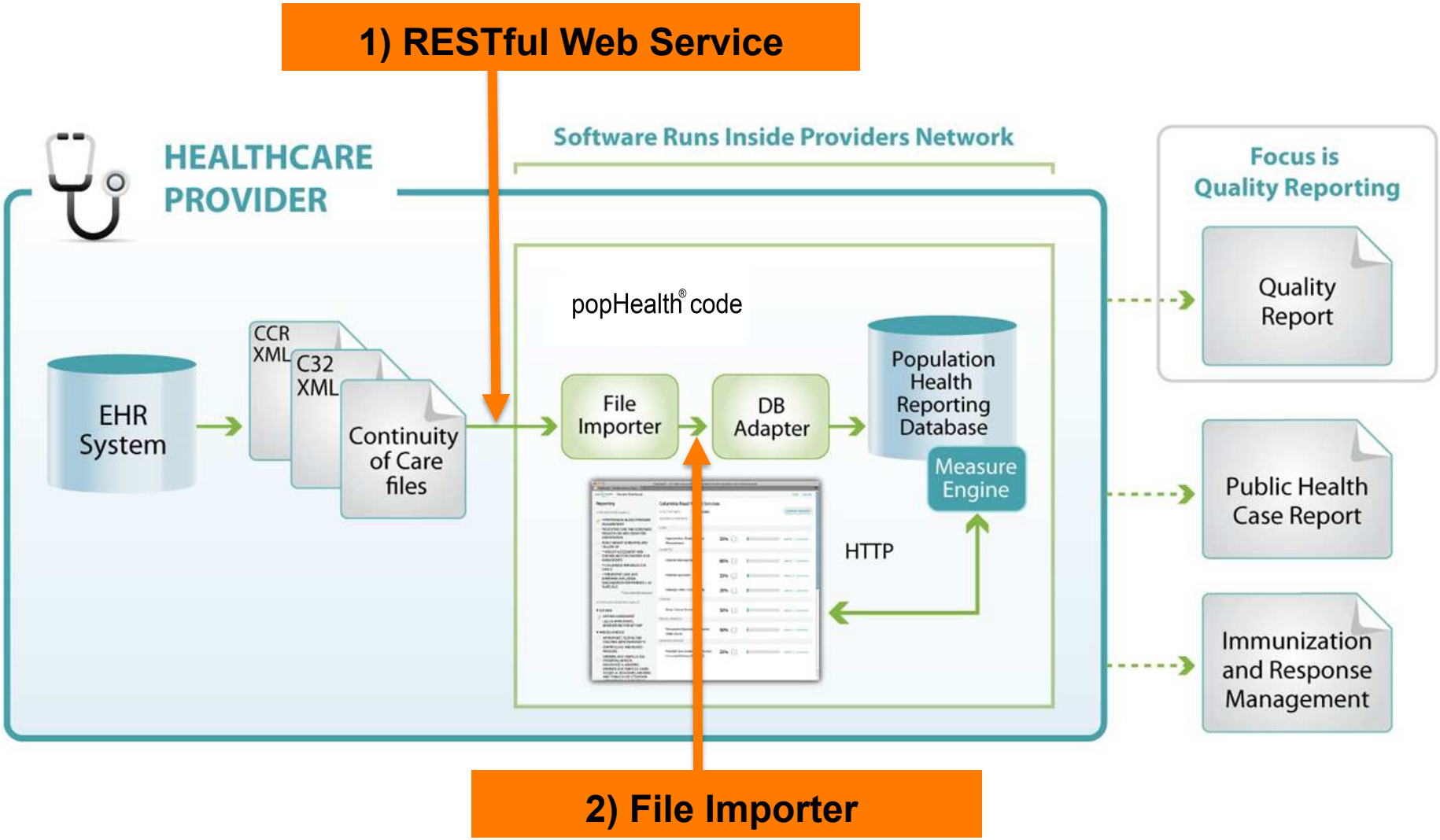
Scalability

- 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
  - Translating an algorithm into 2 simple functions provides major benefits to scalability

Vendor Integration Points



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

popHealth® code

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

popHealth® code

```
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

popHealth® code

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	Procedure	procedure performed	N_c1061	CPT	06/2009	90669, 90670
N_3186	pneumococcal vaccination ages 2 and older	Procedure	procedure performed	N_c1068	CPT	06/2009	90732
N_3187	pneumococcal vaccination ages 2 years and older	Procedure	procedure performed	N_c1069	CVX	06/2009	33

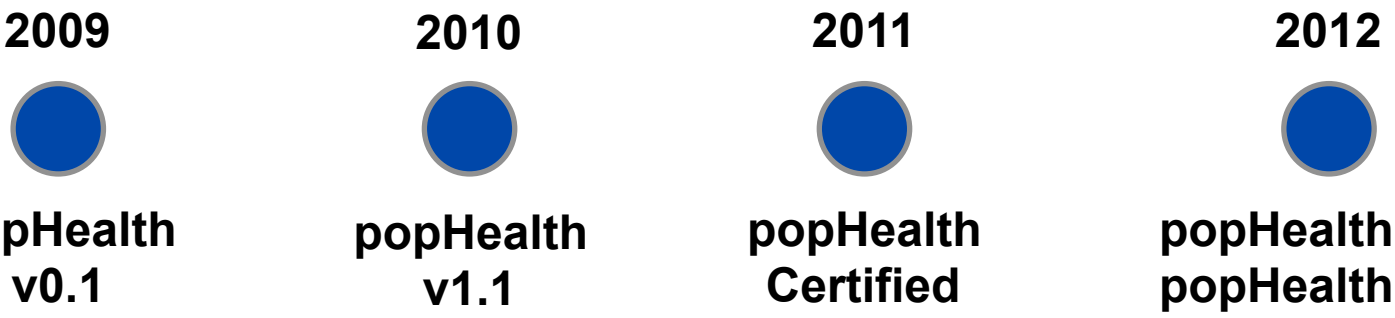
JSON encoding of Value Sets

popHealth® code

```
"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"
      ]
    }
  ]
},
```

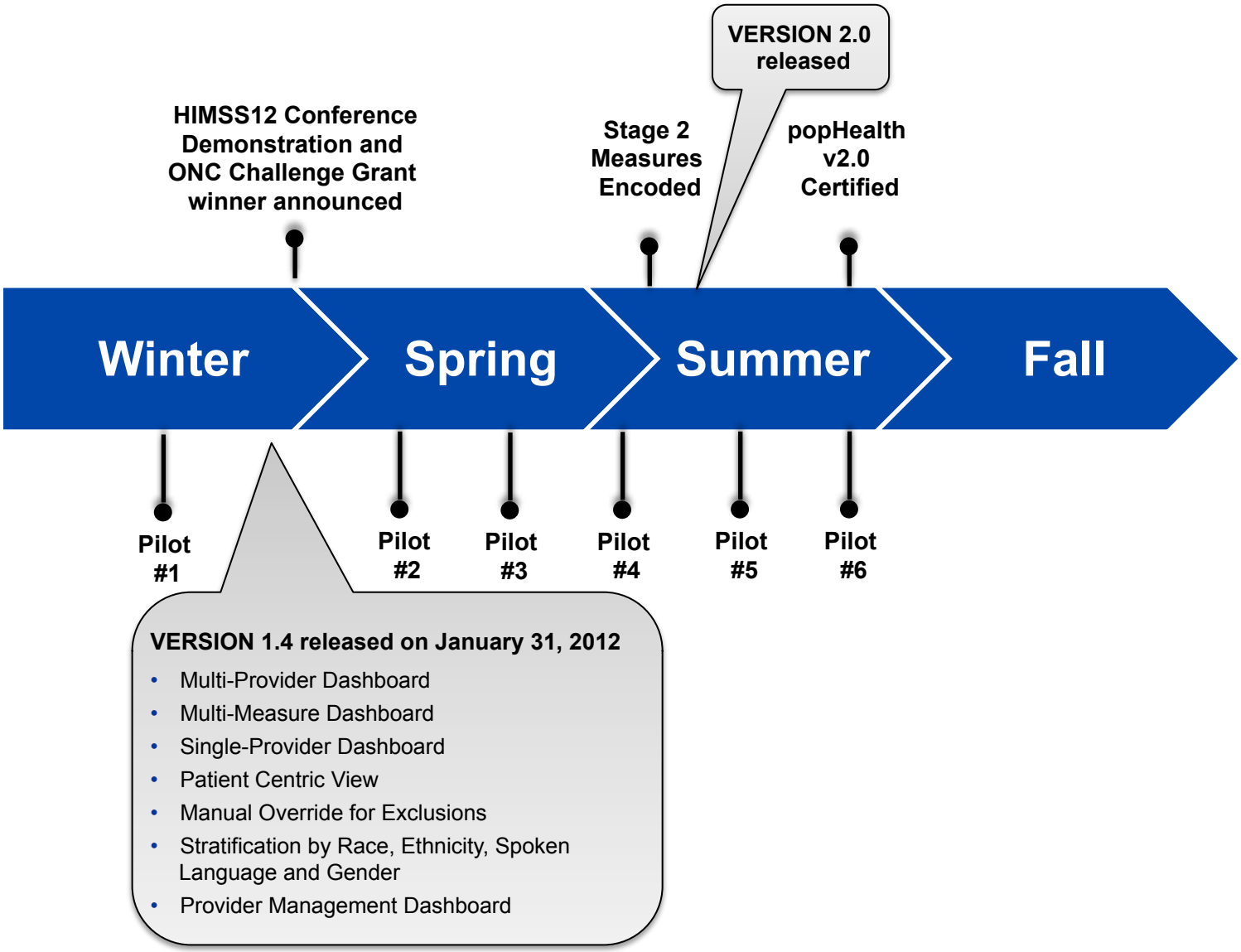
Background

- 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



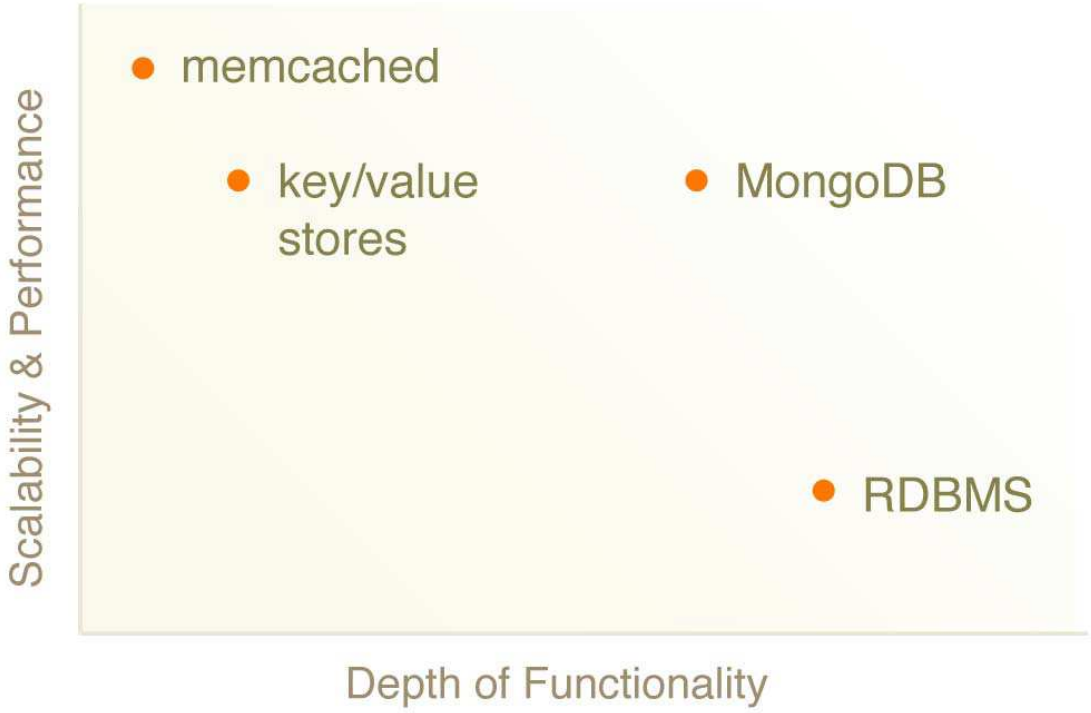
popHealth FY 2012 Timeline

popHealth® code



Scalability

MongoDB Scales

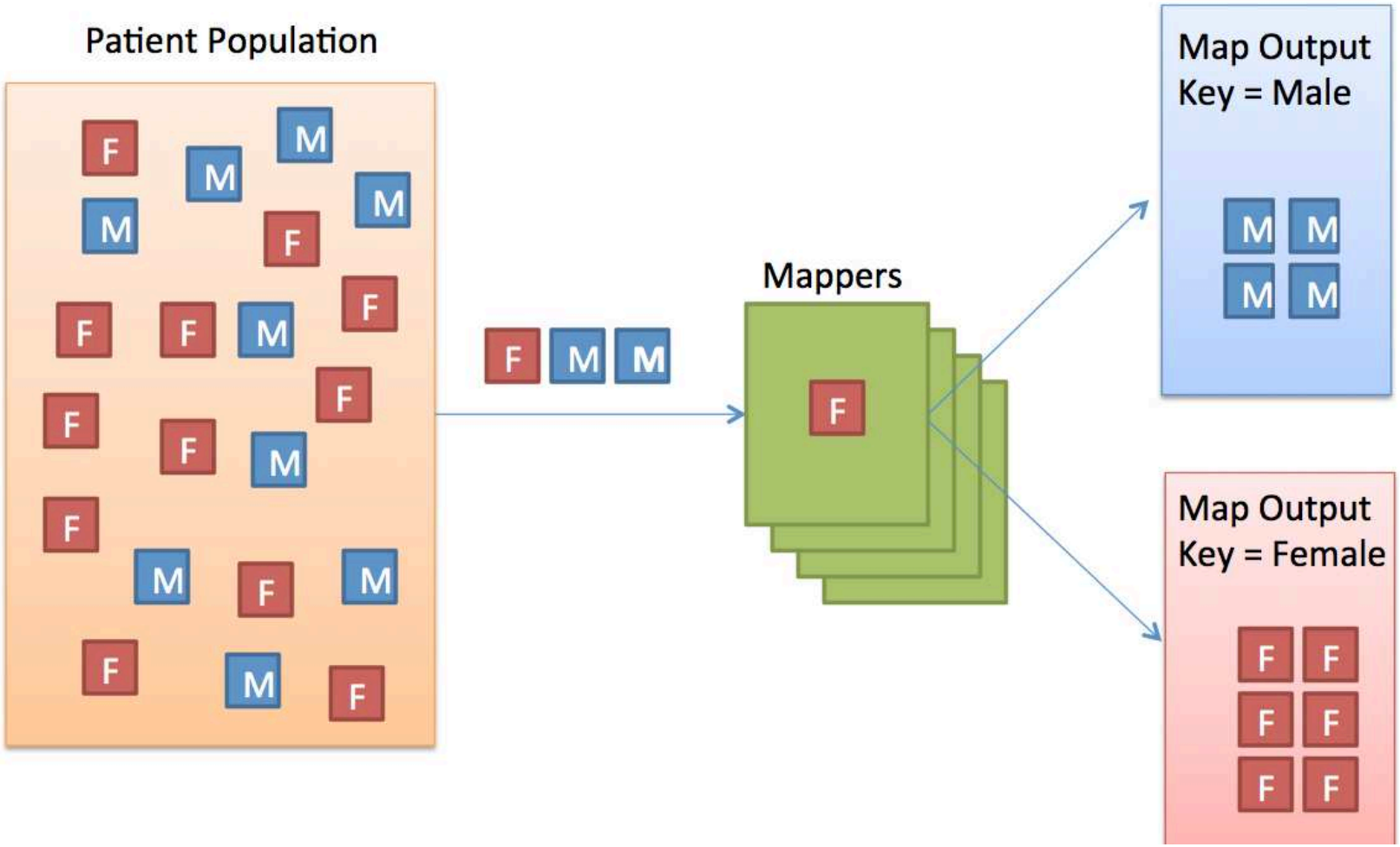


RDMS Scales Vertically

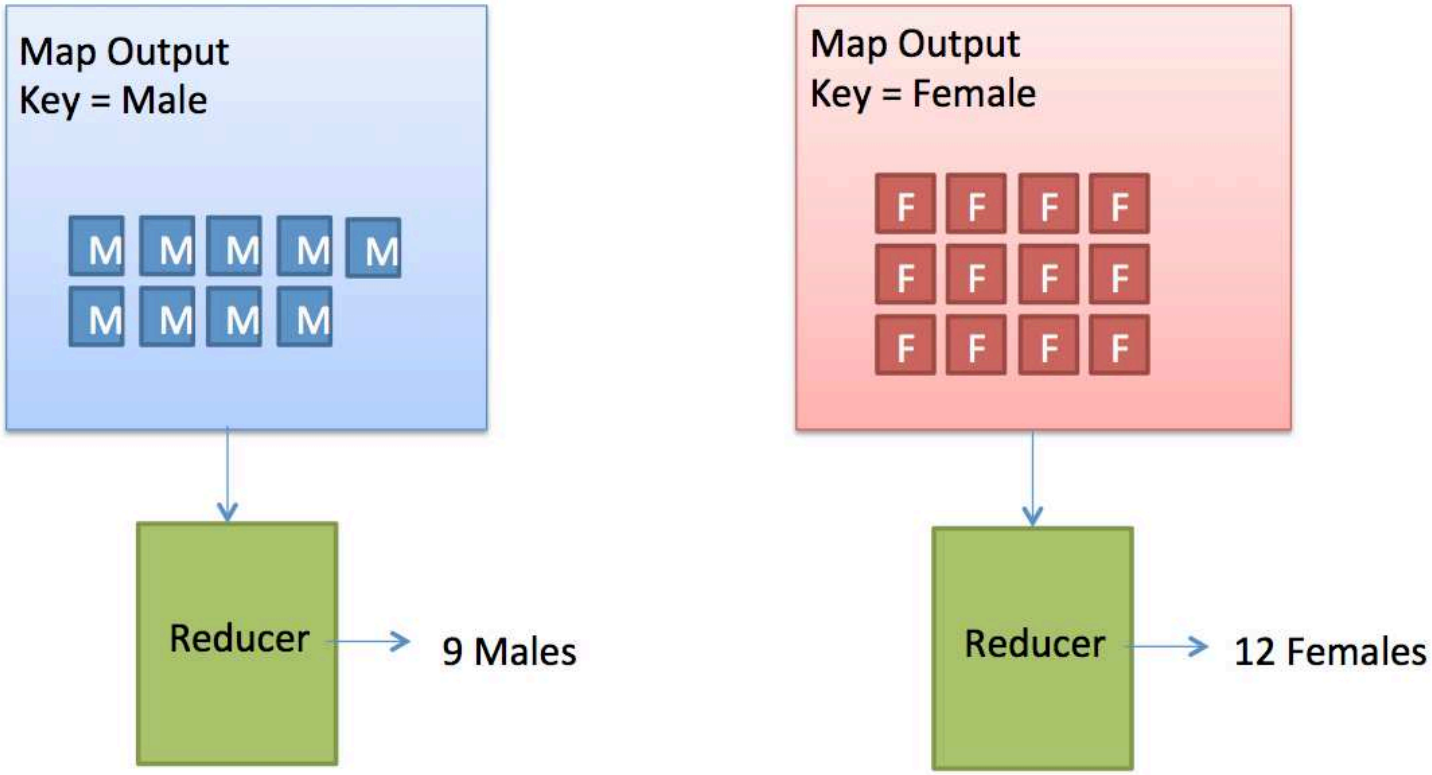
Map Reduce with MongoDB

- 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

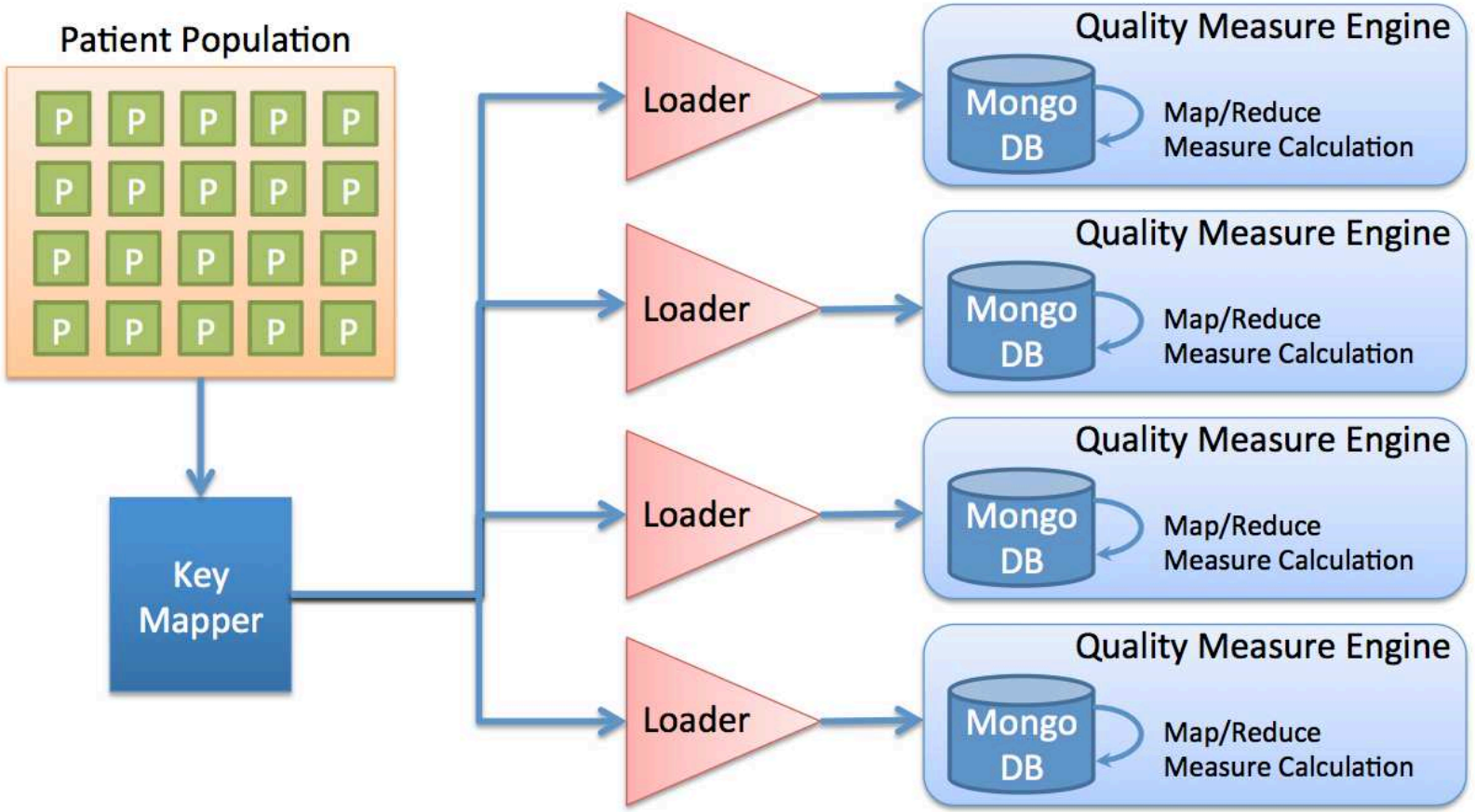
Map



Reduce



Sharding – Data Loading



Sharding – Measure Calculation