VistA Novo Developer Toolkit

Overview and Demo

19 Jan 2014

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Outcome Leads: Mary Pulvermacher, Mike Dowe

Task Outcome: Technical contributions to accelerate open source VistA's ability to successfully serve our nation and share information with entities that do not use VistA

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Outline

- **VistA Novo Conceptual Overview**
  - Problem
  - Key Principles
  - Key Technical Principles
  - VistA Novo Developer Toolkit
  - Using VistA Novo
  - Deploying a VistA Novo based app
- **Unified Architecture**
  - VSA – VistA Novo Relationship
  - Unified Architecture: The Big Picture
  - Unified Architecture Value
- **VistA Novo Architecture**
  - VistA Novo Production Architecture
  - VistA Novo Design Time Architecture
  - Implementation
  - Security Approach
  - Schedule
- **Demo**
  - VistA Novo Use Case with Patient Scenarios
  - VistA Novo Demo
  - What's Happening Behind the Scenes
  - Future Scenario
- **Conclusions**

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Problem

- **VistA is a robust software product, but daunting to beginners**
  - Development environment and interfaces are obscure
  - Often frustrates potential new users before they can see VistA's potential
- **The current VistA environment hinders a healthy open source ecosystem**
  - Simply setting up an instance of VistA and adding a patient can take hours to days for a novice user
- **MUMPS skills are difficult to find**
  - Developers and organizations typically don't know MUMPS and new developers are reluctant to invest in MUMPS
  - Recent pushes for everyone to learn to code, from places like Code Academy, are creating a new wave of developers in modern, scripting languages
- **Current technologies offer a wealth of tools and services advantages not available with MUMPS**
  - Automated testing and support for Behavior Driven Development (BDD)
    - Including the ability to track the exact code covered by the tests
  - Performance tuning
  - Rich open source library and tool ecosystem
    - Support for health standards, newest web technologies

Key Principles

- **Make VistA an attractive project for open source developers**
  - Most open source projects have a way to let new users get something up and running in less than 30 minutes
  - Open source developers have their choices for EHR systems
    - OpenMRS, OpenEHR and others
  - A healthy open source ecosystem will benefit the VA, iEHR and the nation
- **Allow for the creation of new capabilities in VistA using current software development languages and tools**
  - Leverage current talent pool and modern software tools and services to create a healthy open source ecosystem
- **Use what is available**
  - Don’t reinvent the wheel
  - Leverage projects that are working on incorporating current development tools into the MUMPS/VistA environment
- **Keep it Open**
  - All code and documentation must be open to allow a community to function
  - Dependencies on commercial software inhibit newcomers and low resource parties
- **Be Transparent**
  - Transparently share to invite ideas, advice, support and contribution
  - Leverage collective intelligence of the open source community

Key Technical Principles

- **Robust test suites enable correctness, confidence, and software evolution –** All software should have robust, automated, repeatable testing.
  - This enables change in software. Developers more confidently make changes if they are provided with some assurance that they haven't broken other pieces of the software.
- **Keep it Simple –** Create the most simple implementation possible. Do not implement a feature until it is required.
- **Use Design Patterns** – Create software solutions that follow well accepted patterns. This will increase familiarity for developers.
- **Developers First** – Modern toolkits hide mundane code/tasks from developers. This toolkit should focus on developer convenience, leading toward greater productivity.

What VistA Novo Provides

- **Open Standards Support**
  - Open standard, RESTful API to VistA Based Services
  - Fast Healthcare Interoperability Resources (FHIR) standard data format
    - Data interoperability, across internal VA systems and external systems
    - FHIR has lots of momentum at HL7
    - Risk reduction for possible DOD-VA health data exchange standard
    - Uses the automated FHIR code generator with new JavaScript module
- **Potential army of innovators, reviewers, and quality assurance help**
    - Using mainstream technologies
- **A Test Stub to accelerate innovation**
  - Simplifies testing, particularly corner cases and error conditions
  - Apps can be developed in parallel with service development
    - Test Stub provides simulation before real service is available
- **A possible test case for combining VistA and patient-generated data**
- **Underpinnings to foster tremendous opportunities for better care at lower cost**
  - Get healthcare “off the mainframe”[1]
  - More empowered patients

[1] E. Dishman, “Take health care off the mainframe,” TEDMED 2009.

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Using VistA Novo

Work with the VistA Novo Test Stub to create your test health data

Build your application in JavaScript

Work with clinical data using FHIR services

Test using Jasmine to follow Behavior Driven Development (BDD) best practices

Use tools like HRCov for code coverage and NewRelic for performance tuning

Technology Details

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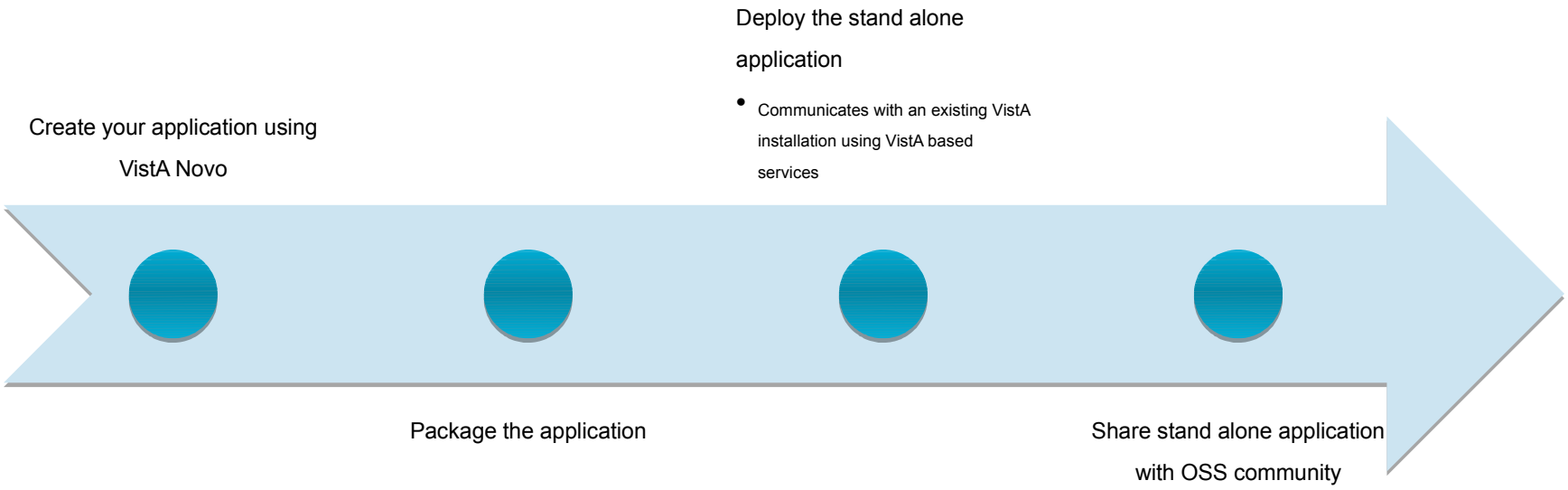
Deploying a VistA Novo based app



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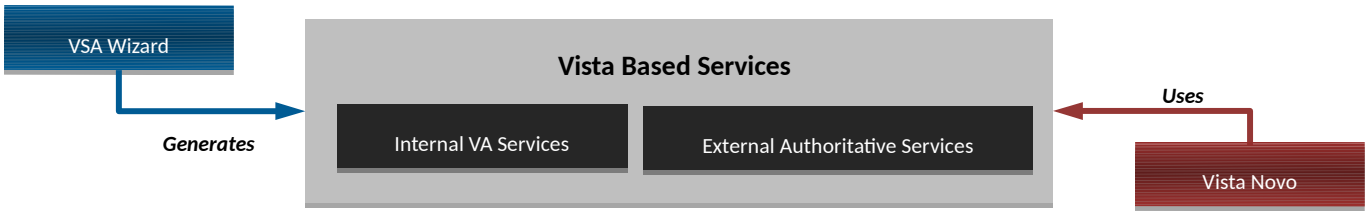
VSA – VistA Novo Relationship



- **VistA Service Assembler (VSA)**
  - Provide utilities to build VistA Based Services as authoritative services for use by other systems and technologies
- **VistA Novo (Open Source VistA Developer Toolkit)**
  - Proof-of-concept open source toolkit for building VistA-based applications using mainstream development environments

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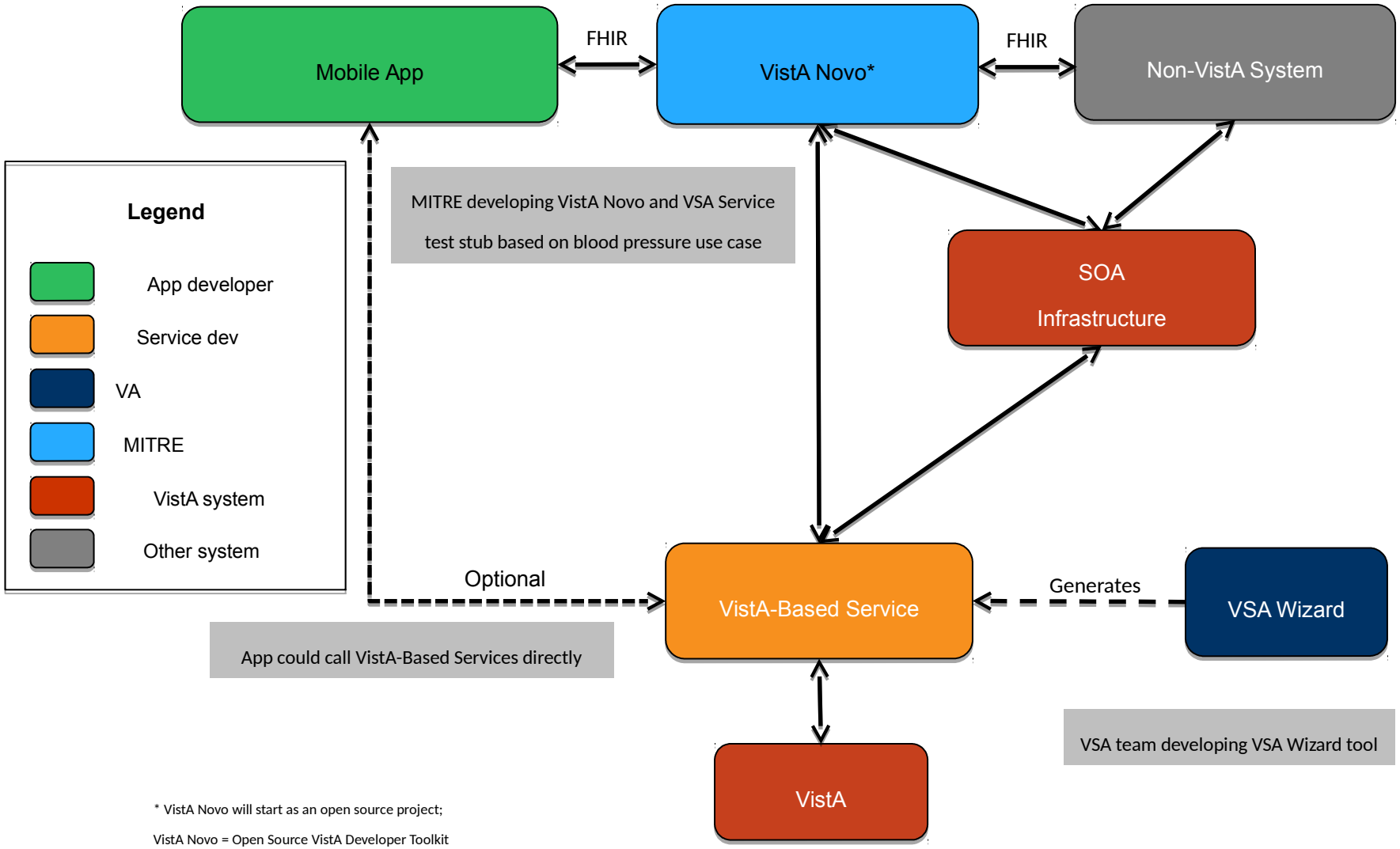
Unified Architecture: The "Big Picture"



* VistA Novo will start as an open source project;

VistA Novo = Open Source VistA Developer Toolkit

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Unified Architecture Value

Stakeholder	Potential Value
Veteran/Patient	• New tools for patient empowerment • Increased access to their own health data • Broader network of “connected” providers
Clinician	• Increased access to computable patient health data • Tighter feedback loop to adjust care plan • Easier to collect, share and use health data meaningfully • Better care at lower cost
Developer	• VistA innovation open to larger community • Ability to leverage mainstream technologies to increase developer efficiency and decrease sustainment costs • Better data interoperability via open standards

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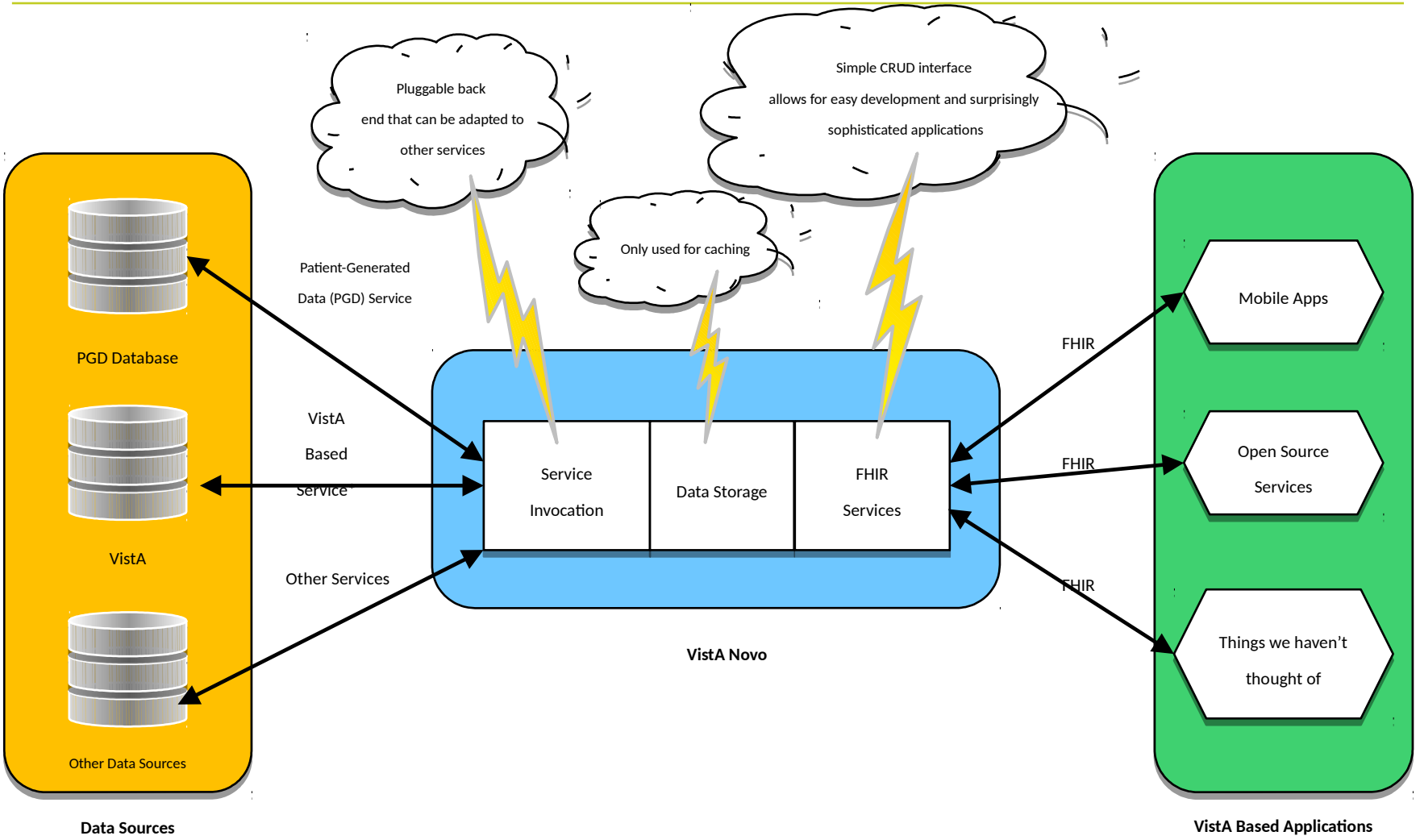
VistA Novo

Production Architecture



*VistA Based Services may be generated using the VistA Service Assembler (VSA)

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VistA Novo

Development Architecture

Web User Interface

Use to enter synthetic BP readings for testing

Mock Authoritative VistA Based Services

- Get BP (RESTful API)
  - VistA or patient-generated data
- Set BP (RESTful API)
  - Patient-generated data

Use HTTP utility, such as cURL, Poster, etc. to invoke FHIR service and view results

Test Data Creation User Interface

Mock Services

Test Data

Test Stub

Service Invocation

Data Storage

FHIR Services

VistA Novo Framework

Mock Service Calls

CRUD FHIR calls on patient data

FHIR Services

- Get Observation (RESTful API)
- Set Observation (RESTful API)

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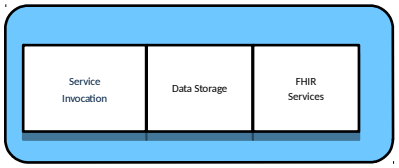
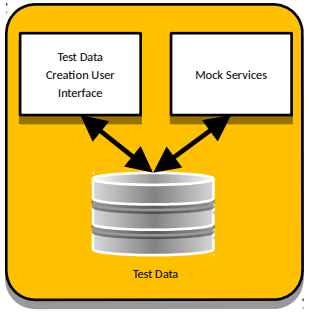
VistA Novo Proof of Concept Implementation

- **VistA Novo Framework**
  - JavaScript Implementation
    - Data Storage and FHIR Services generated with the help of HL7 tooling
  - JSON representations of resources
    - Ease of creation in JavaScript environment
    - XML representation is out of scope
- **Test Stub for Proof of Concept Use Case (BP Service)**
  - Ruby on Rails application
  - Mock implementation of BP service
    - RESTful service with JSON payload
  - Web-Based User Interface
    - Enter/edit patient demographics and BP readings
    - Can incorporate new data models with minimal effort (rails_admin)





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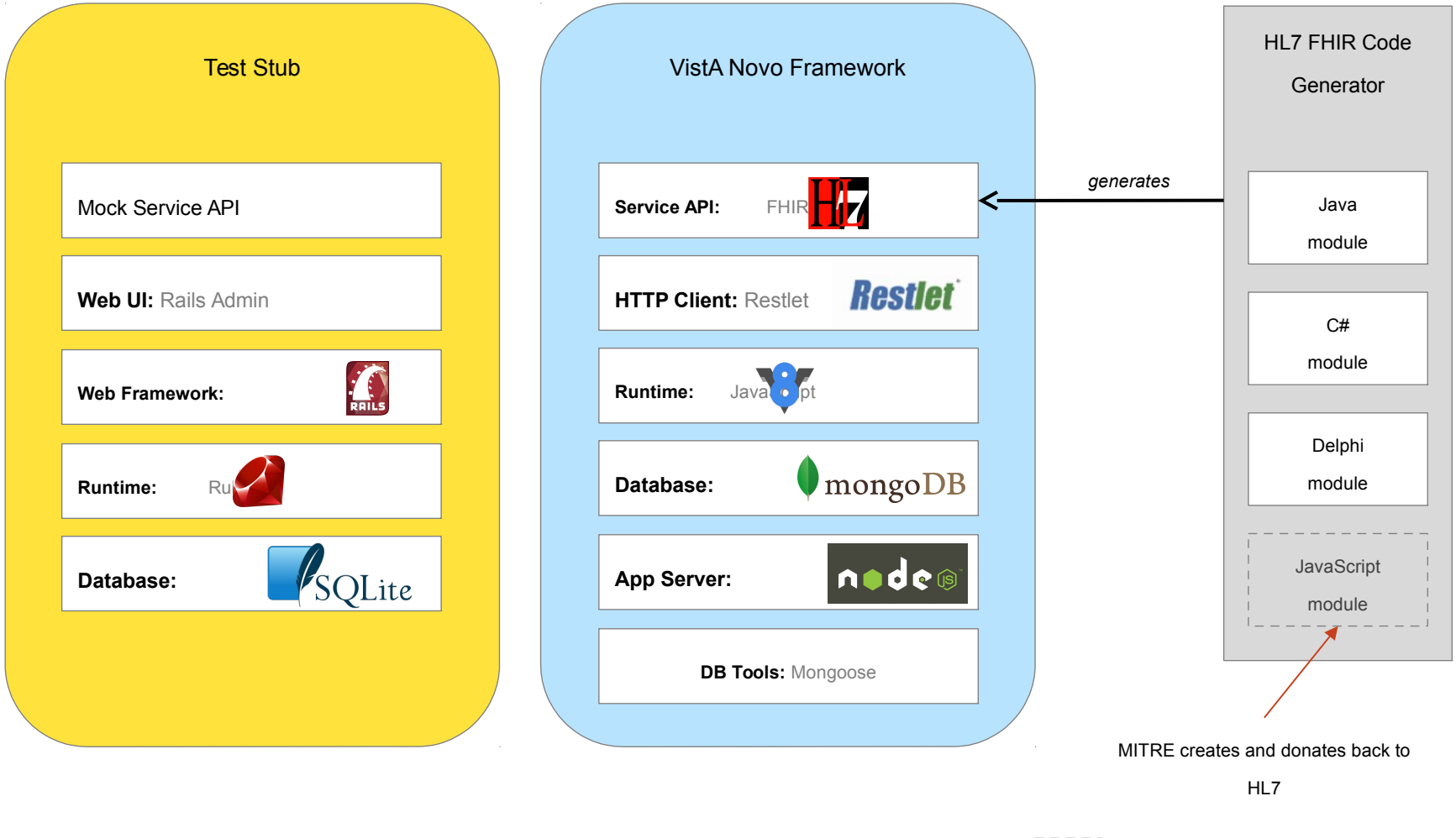
VistA Novo Technical Architecture



VistA Novo Proof of Concept

Security Approach

- **Summary**
  - Using simplistic approach for proof of concept
    - Defer security implementation
    - Use security component of underlying VistA Based Services
  - Consider features of future RESTful approach
- **Proof of Concept Approach**
  - Send authentication information to VistA Based Service
  - Assume Patient id is a string that can be used as a FHIR identifier and VistA Record IEN/SID
  - Use HTTP Basic Authentication to authenticate services for now
  - Assume that authorization will happen at the data source
    - Test stub assumes that authentication is equal to authorization
- **Possible future RESTful approach**
  - Secure communications using https
  - Use proven open standards for identity management as well as user and service authentication
    - OpenID Connect for distributed identity management and user authentication
    - OAuth 2 for service to service authentication
  - Enforce privacy at the provider location at the time the information is requested
  - Leverage approach profiled by RESTful Health Exchange (RHEx) *wiki.siframework.org/RHEx*
    - Original proof of concept sponsored by ONC Federal Health Architecture (FHA)
    - Endorsed by ONC Health IT Standards Committee, 19 June 2013

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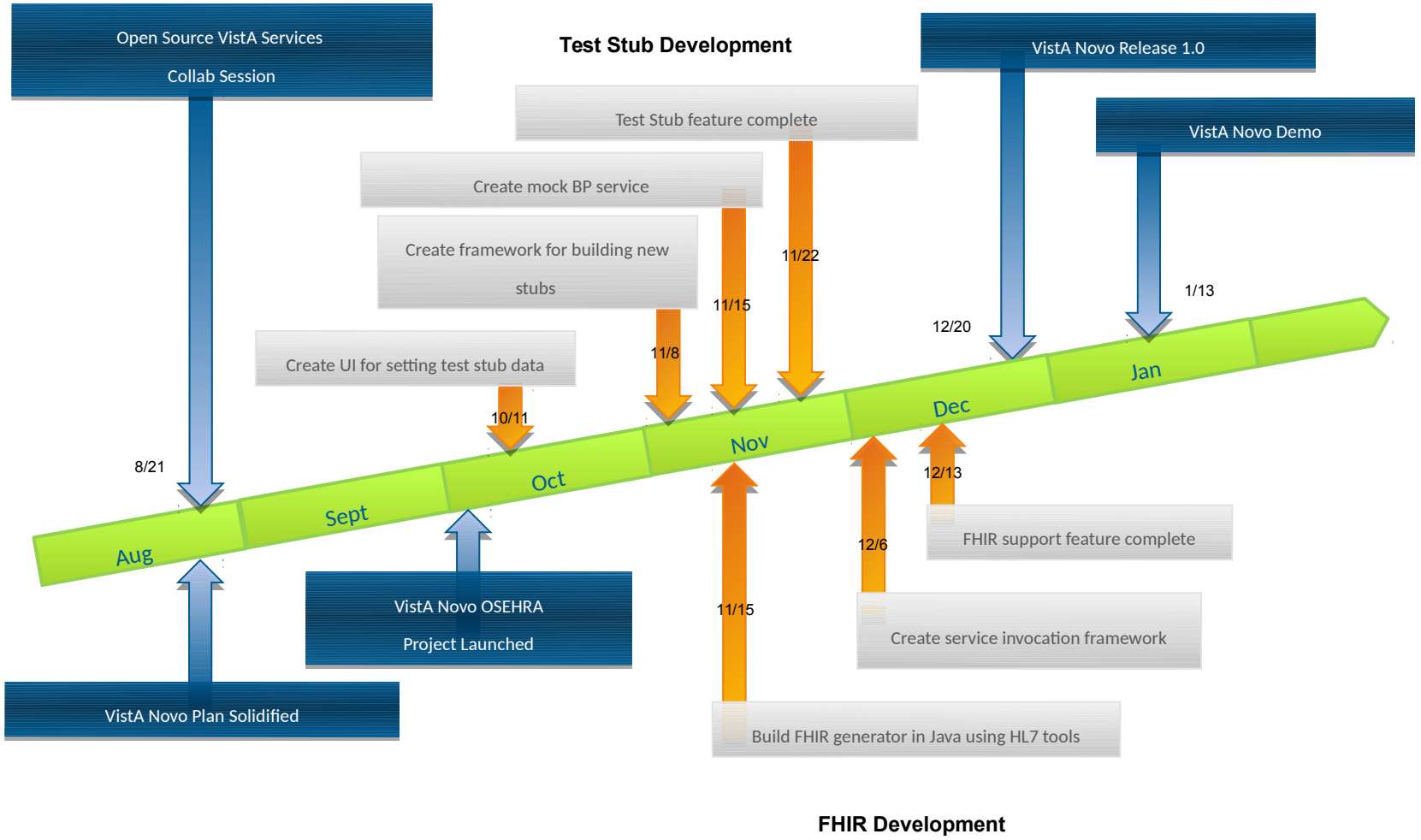
VistA Novo Schedule



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Key Points of Demo

- **The functionality of the demo is not the important take-away**
  - It is what is happening *behind* the scenes that is important
- **RESTful, FHIR-based API for VistA-based services**
  - FHIR for better data interoperability across sources
  - RESTful APIs for better support across a broad range of devices
    - Existing services as well as services created with VistA Service Assembler
- **Foundation for API of APIs**
  - Can provide basis for VA app store for Veterans
    - Ensure apps use only authoritative services, federated business logic
- **Shows viability of open source developer toolkit to access VistA capabilities**
  - Using mainstream technologies
  - Opens innovation, review, and sustainment of VistA platform to an army of open source developers to defray VA costs
- **Just the first step**

VistA Novo Proof of Concept Use Case

- **Tests Unified Architecture Concepts**
  - Selected to test key concepts of a unified architecture that combines an:
    - Open Source VistA Developer Toolkit,
    - VistA Based Services to access VistA data, and
    - Services to access other patient-generated data
- **Proposes Simple Blood Pressure Use Case**
  - Simple proof-of-concept implementation
  - Use case proposed by VHA Office of Informatics & Analytics Patient-Generated Data Connected Health Team in June 2013
  - Helps VA explore patient-generated data topics
- **Serves up consolidated data using FHIR and simple CRUD interfaces**
  - Reduces risk on use of FHIR (Fast Healthcare Interoperability Resources), a fast emerging health data exchange standard
  - Uses mobile friendly RESTful approach
    - Resources identified by URLs
    - Uses standard set of stateless services (Create, Read, Update, Delete) to interact with resources
    - Small learning curve for developers
- **Demonstrates use of a test stub to mock the VistA Based Services allowing coordination on the interface to those access services**

Patient Scenarios

- **Illustrate value of clinical access to both VistA and patient-generated data to Veterans**
  - Scenarios show possible outcome with and without patient-generated data and VistA Novo
  - Big potential impact in outcomes
- **Developed in partnership with the Patient Toolkit project**
  - A MITRE Innovation Project
  - Leverages MITRE research investment
  - Kristina Sheridan, MITRE Project Lead
- **Scenarios vetted through Dr. Tom Neal MD**
  - MITRE employee and practicing DoD physician

Hypertension Patient Scenario

Without Patient Generated Data and VistA Novo

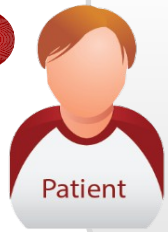
1

Mr Fred Tompson is a 55 y/o with a 10 year history of hypertension (BP averages 126/86) on lisinopril 20 mg daily.

2

3 mth: Lost 10 lbs on low sodium diet. Takes BP daily with home machine every morning (“Most of the time”) and is ‘feeling much better’.

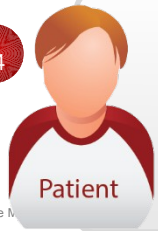
3



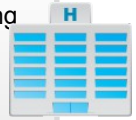
6 mth: Morning headache, snoring that wakes wife, ‘snorting’ and halty breathing. Sleep study confirms moderate OSA (obstructive sleep apnea). Awaiting CPAP (Continuous positive airway pressure).

VA Hospital

4



8 mth: Seen in ED: protracted headache, BP 220/186, nausea, slurring of speech and left sided facial parasthesia. ED team institutes stroke protocol.



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Hypertension Patient Scenario

With Patient Generated Data and VistA Novo

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Mr Fred Tompson is a 55 y/o with a 10 year history of hypertension (BP averages 126/86) on lisinopril 20 mg daily.

2

Provider requests patient to take BP daily at home and submit results to office.

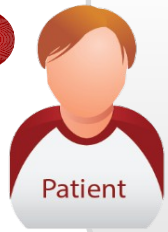
3

Patient visits office to calibrate home BP device and learn correct use.

4

3 mth: Lost 10 lbs on low sodium diet. Takes BP daily with home machine every morning (“Most of the time”) and is ‘feeling much better’.

5



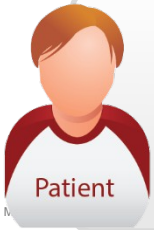
6 mth: Morning headache, snoring that wakes wife, ‘snorting’ and halty breathing. Sleep study confirms moderate OSA (obstructive sleep apnea). Awaiting CPAP (Continuous positive airway pressure).

VA Hospital

6

Alert: BP of 180/130 sent to care team. Patient called to schedule appointment

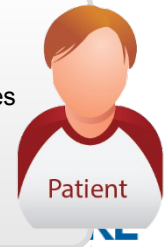
7



8 mth: seen in ED: protracted headache, BP 220/186, nausea, slurring of speech and left sided facial parasthesia. ED team institutes stroke protocol.

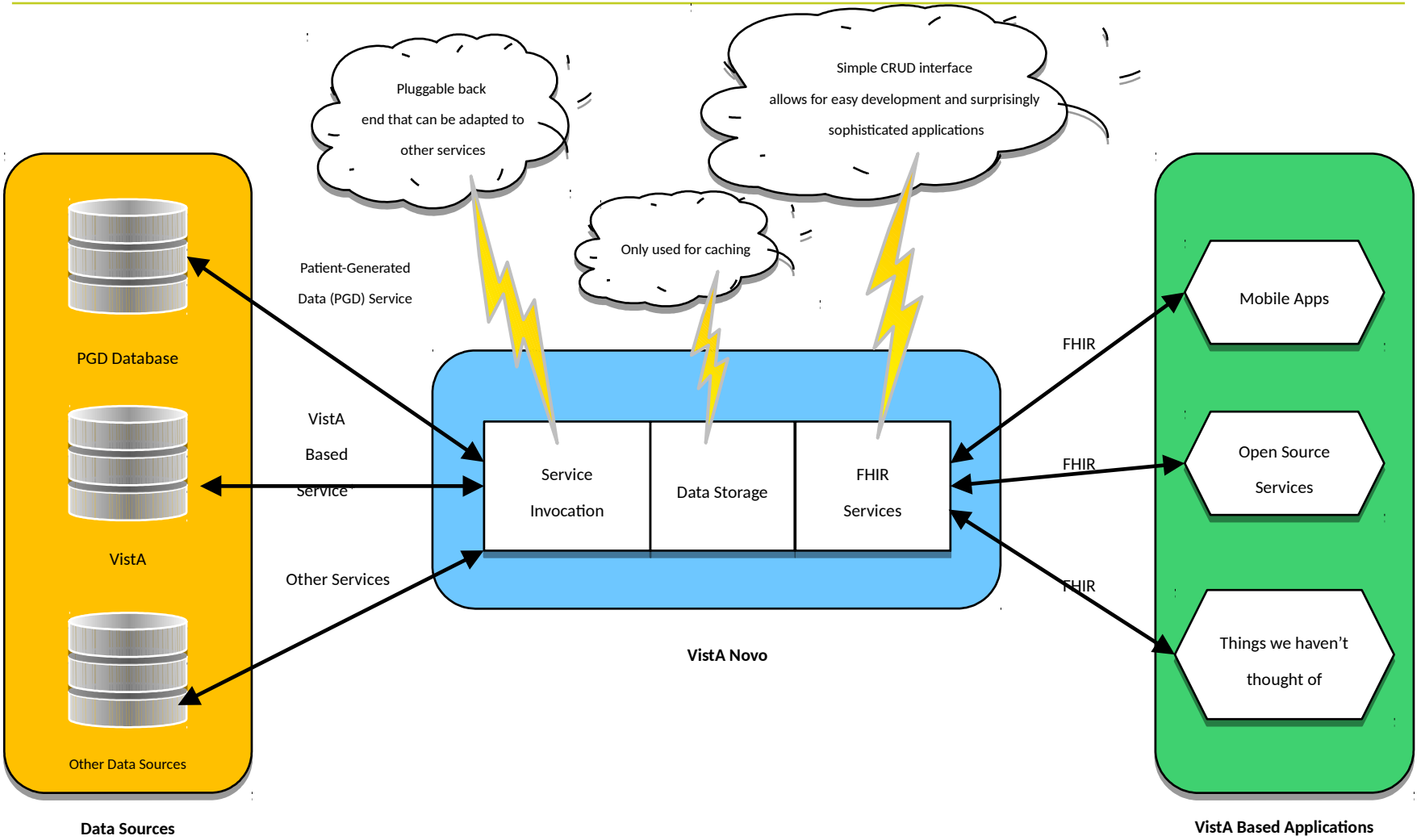
ER

Elevation in BP treated with increase in lisinopril. BP comes down.



VistA Novo Use Case

Production Architecture



*VistA Based Services may be generated using VistA Service Assembler (VSA)

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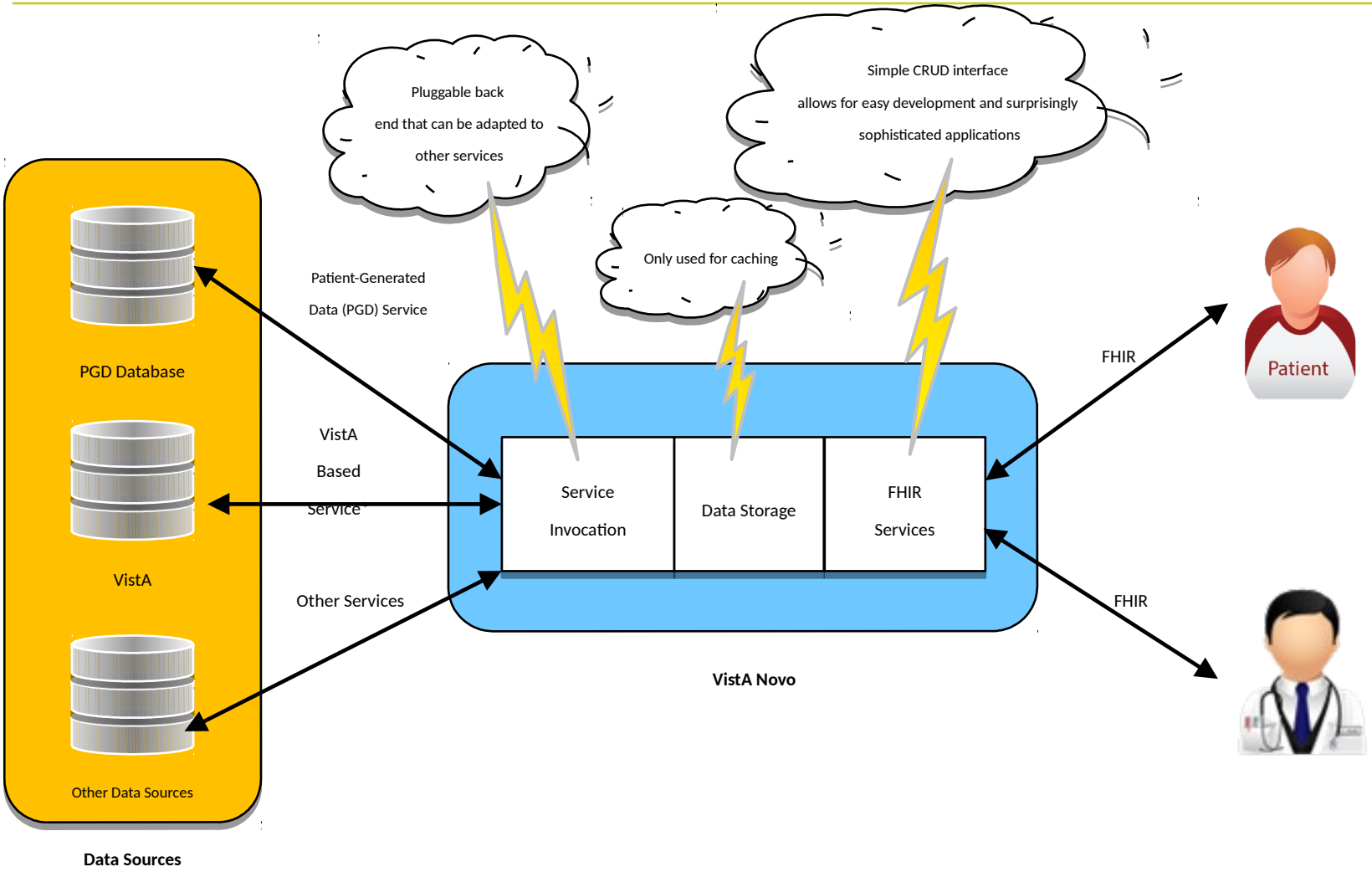
VistA Novo Use Case

Patient Scenario with Fred



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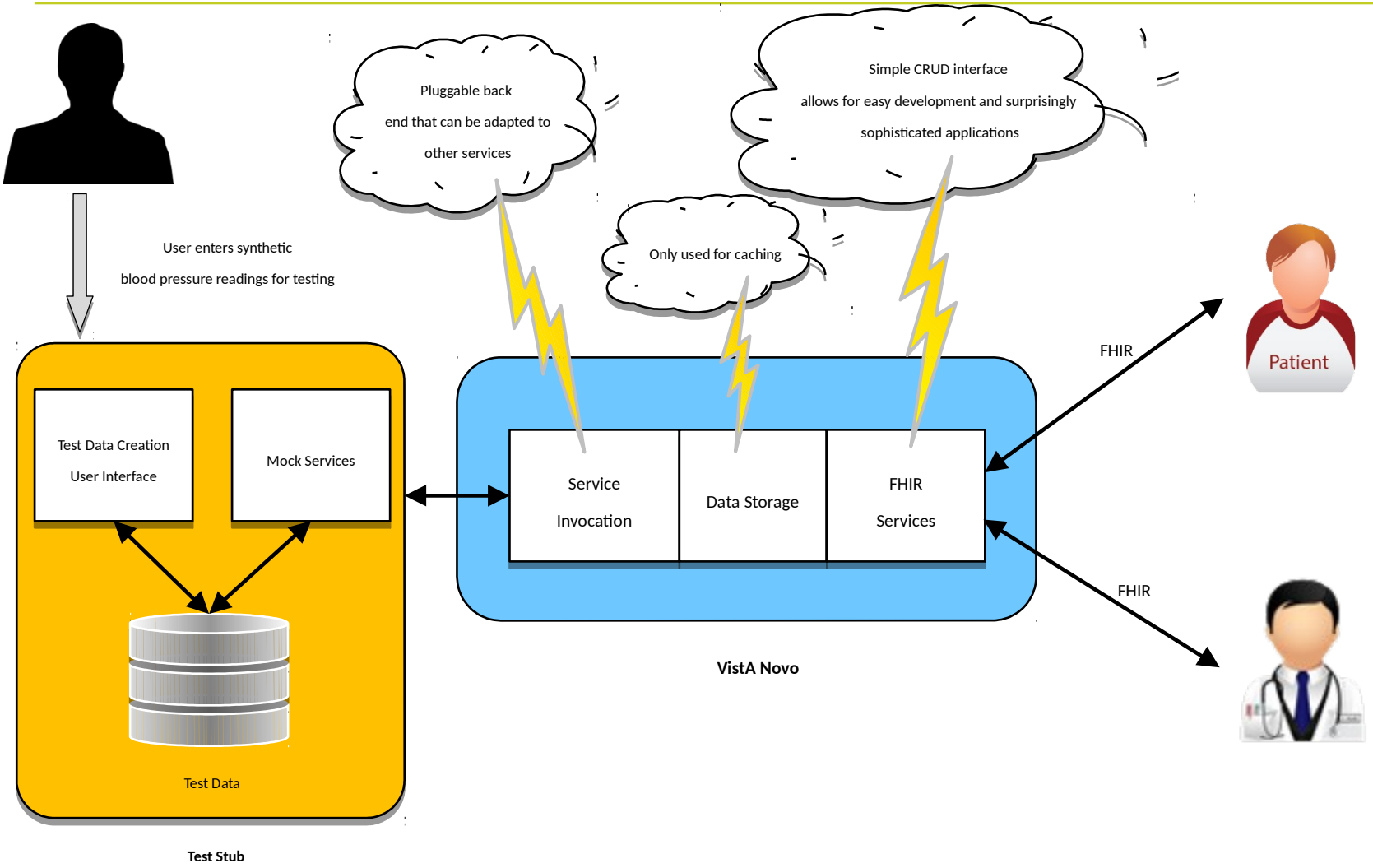
VistA Novo Use Case

Design Time Architecture



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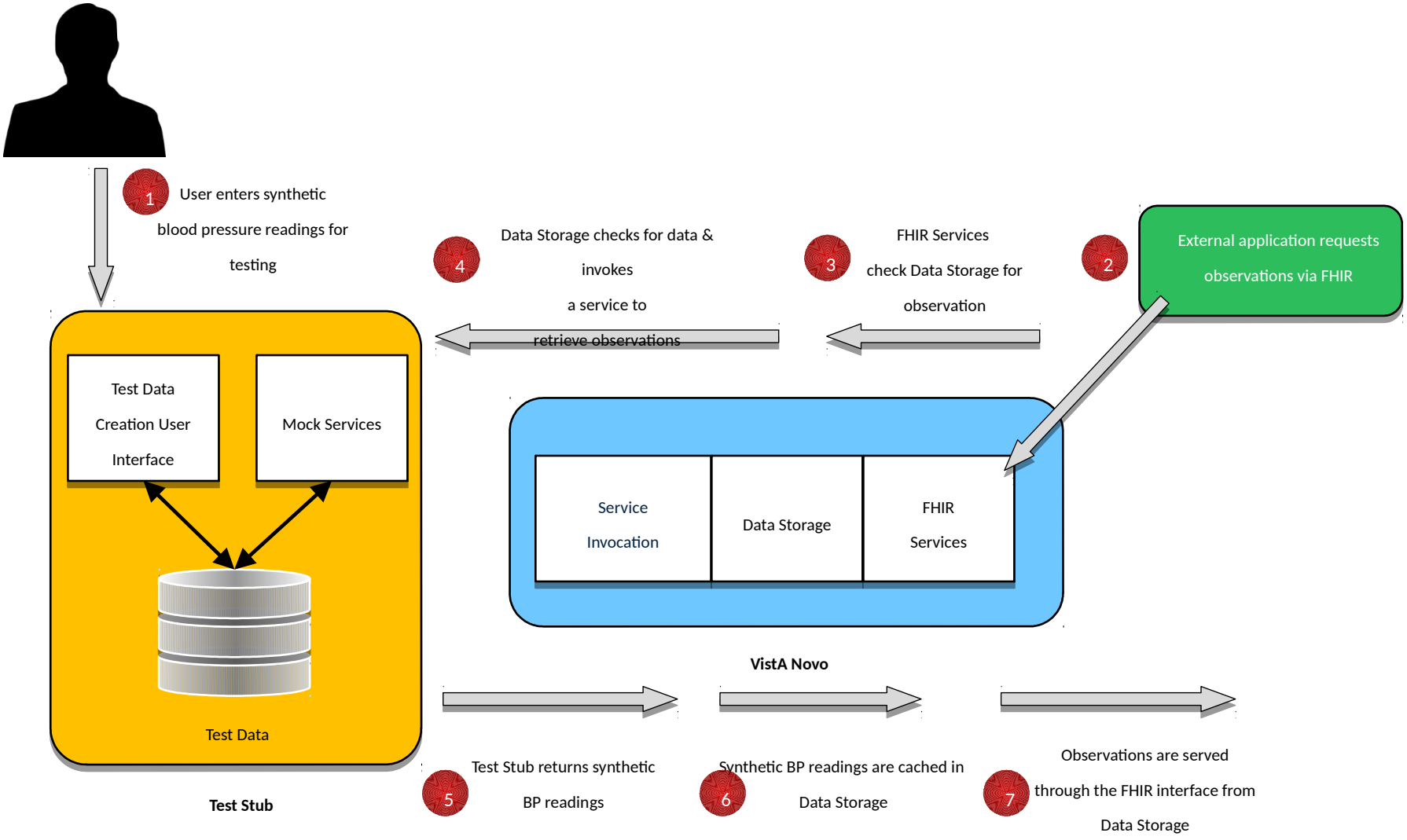
Blood Pressure (BP) Scenario with VistA Novo Test Stub



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Demo

- **What you will see**
  - Entering data into the Test Stub
  - Test Stub dashboard
  - Add a patient into Test Stub using web interface
  - Request blood pressure readings with VistA Novo
  - Add new blood pressure reading with VistA Novo
  - Request blood pressure updated readings with VistA Novo

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Demo

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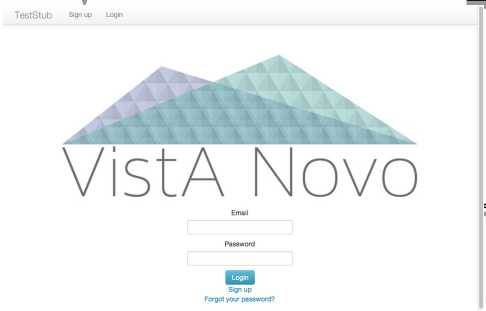
VistA Novo Demo

Behind the Scenes

Web User Interface

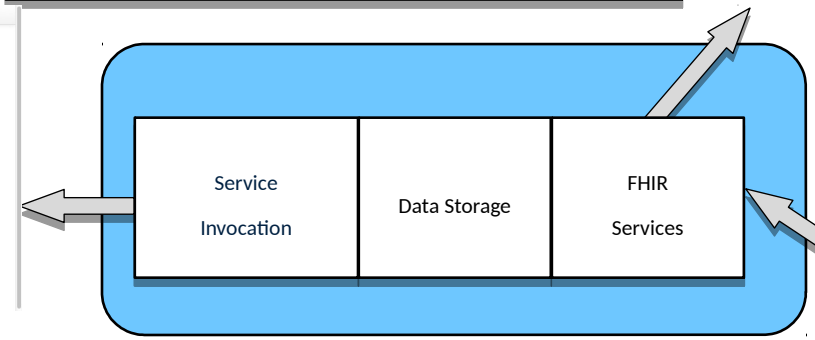
Use to enter synthetic BP readings for testing



Test Stub

Mock Authoritative VistA Based Services

- GET http://teststub/observations
  - VistA or patient-generated data
- POST http://teststub/observations
  - Patient-generated data



VistA Novo Framework

```
{
  "resourceType": "Observation",
  "text": {
    "status": "generated",
    "div": "<div>Sept 17, 2012:
          Blood pressure 128/83
          (normal)</div>"
  },
  . . .
}
```

Application

FHIR Services

- GET http://vistanovo/observations
- POST http://vistanovo/observations

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VistA Novo with Patient Scenario

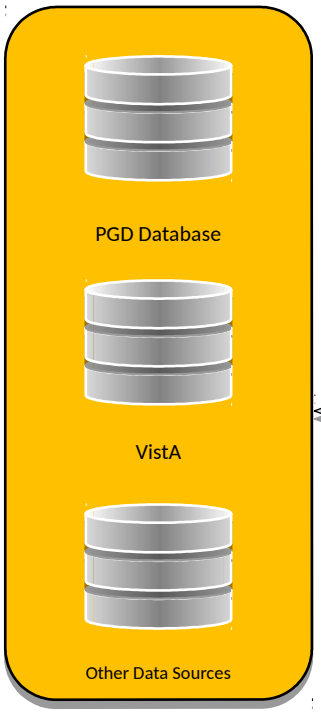
Behind the Scenes – Patient enters BP data

1

Mr Fred Tompson is a 55 y/o with a 10 year history of hypertension (BP averages 126/86) on lisinopril 20 mg daily.

2

Provider requests patient to take BP daily at home and submit results to office.



Data Sources

Authoritative VistA Based Services

- POST http://va-server/observations
  - Patient-generated data

```
{
  "resourceType": "Observation",
  "text": {
    "status": "generated",
    "div": "<div>Sept 17, 2012:
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  },
  . . .
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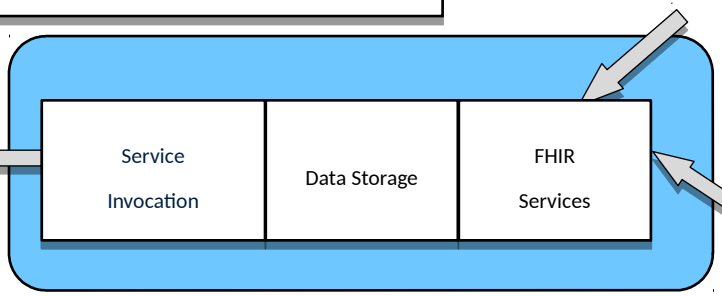

VistA Novo Framework

FHIR Services

- POST http://vistanovo/observations

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VistA Novo with Patient Scenario

Behind the Scenes – Clinician reviews BP data

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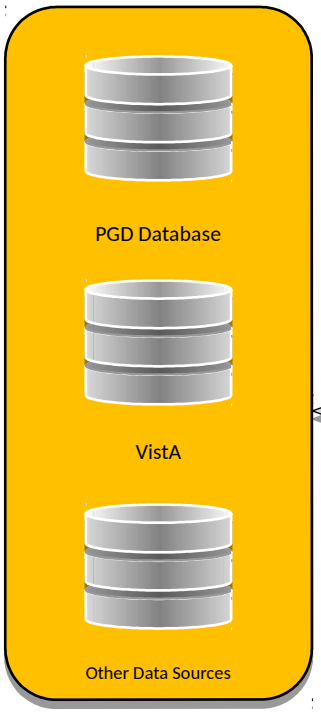
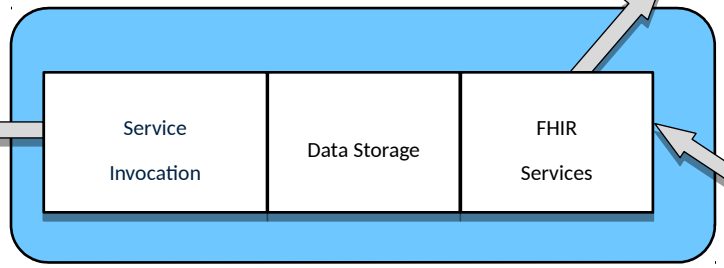


Authoritative VistA Based Services

- GET http://va-server/observations
  - VistA or patient-generated data

```
{
  "resourceType": "Observation",
  "text": {
    "status": "generated",
    "div": "<div>Sept 24, 2012:
          Blood pressure 130/87
          (normal)</div>"
  },
  . . .
```



FHIR Services

- GET http://vistanovo/observations

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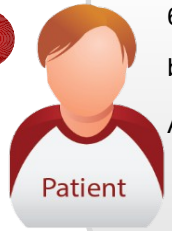
VistA Novo with Patient Scenario

Behind the Scenes – Patient enters BP data

5



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VA Hospital

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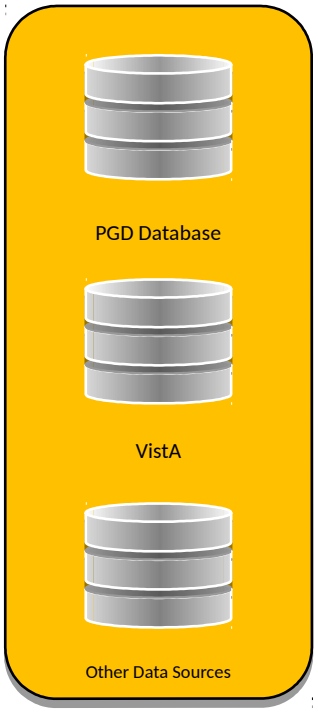

Data Sources

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VistA Novo Framework

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The Future Is Bright

- **VistA Novo is a foundational first step**
- **Building block for passive data collection instead of active data collection**
  - Leverage open standards in VistA Novo with mainstream technologies
  - Mobile sensors provide patient-generated data automatically
  - Fewer data errors
  - Easier for the patient
  - Leverages WiFi devices and sensors available today – patient's "black box"
    - Scales
    - Blood pressure cuffs
    - Sleep monitors
    - Vitals monitors
    - Diabetes monitors
    - Fitness monitors
  - More engaged patient
  - Better communication
  - Faster diagnosis and treatment
  - Better care, lower cost

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Future Hypertension Patient Scenario

With Passive Data Sensors and VistA Novo

1

Mr Fred Tompson is a 55 y/o with a 10 year history of hypertension (BP averages 126/86) on lisinopril 20 mg daily.

2

Provider requests patient to take BP daily at home and submit results to office.

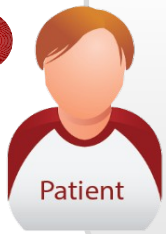
3

Patient visits office to calibrate home BP device and learn correct use.

4

Ongoing: Losing excess weight on low sodium diet with **WiFi-capable scale**, and takes BP daily with **WiFi-capable BP cuff** every morning with **auto reminders** and is 'feeling great'. **Data automatically sent** to VA with patient permission.

5



Ongoing: Confirmed moderate OSA with CPAP. **WiFi-capable sleep monitor** confirms patient compliance.

VA Hospital

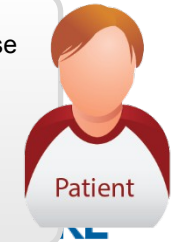
6

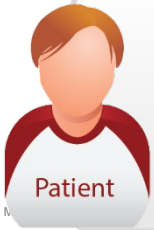
Alert: BP of 180/130 and WiFi CPAP non-compliance. Patient called to schedule appointment

7

Elevation in BP treated with increase in lisinopril and CPAP use re-education.

BP comes down.





8 mth: seen in ED: protracted headache, BP 220/186, nausea, slurring of speech and left sided facial parasthesia. ED team institutes stroke protocol.

ER

Conclusions regarding VistA Novo

- **Provides open standard-based interface for authoritative VistA and patient-generated data with:**
  - Significant health and cost benefits for Veterans and patients
  - Significant step forward toward VA Architecture, Strategy, and Design targeted outcome
- **Demo provides evidence on Open Source VistA Developer Toolkit viability**
  - Founded on actual experience
  - Demonstrating the use of mainstream development technologies
- **VistA Novo Test Stub demonstrates the viability of a unified architecture that tests and uses authoritative VistA Based Services**
- **Reduces risk on the use of FHIR: a rapidly emerging HL7 standard**
- **Creating excellent partnership with OSEHRA to engage and encourage broader Open Source VistA community involvement**

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More Information

- **Mailing List: vistanovo@groups.osehra.org**
- **Code Repositories:**
  - Test Stub: https://github.com/OSEHRA/vista-novo-test-stub
  - FHIR Code: https://github.com/OSEHRA/vista-novo-generated-fhir
  - FHIR HL7 Generator: https://github.com/OSEHRA/vista-novo-fhir
    - Includes JavaScript FHIR generator module
  - Demo applications: https://github.com/OSEHRA/vista-novo-demos
- **Wiki: http://wiki.osehra.org/display/VN/VistA+Novo+Home**
- **Issue Tracking: http://issues.osehra.org/browse/VN**
- **RESTful Health Exchange (RHEx): http://wiki.siframework.org/RHEx**

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