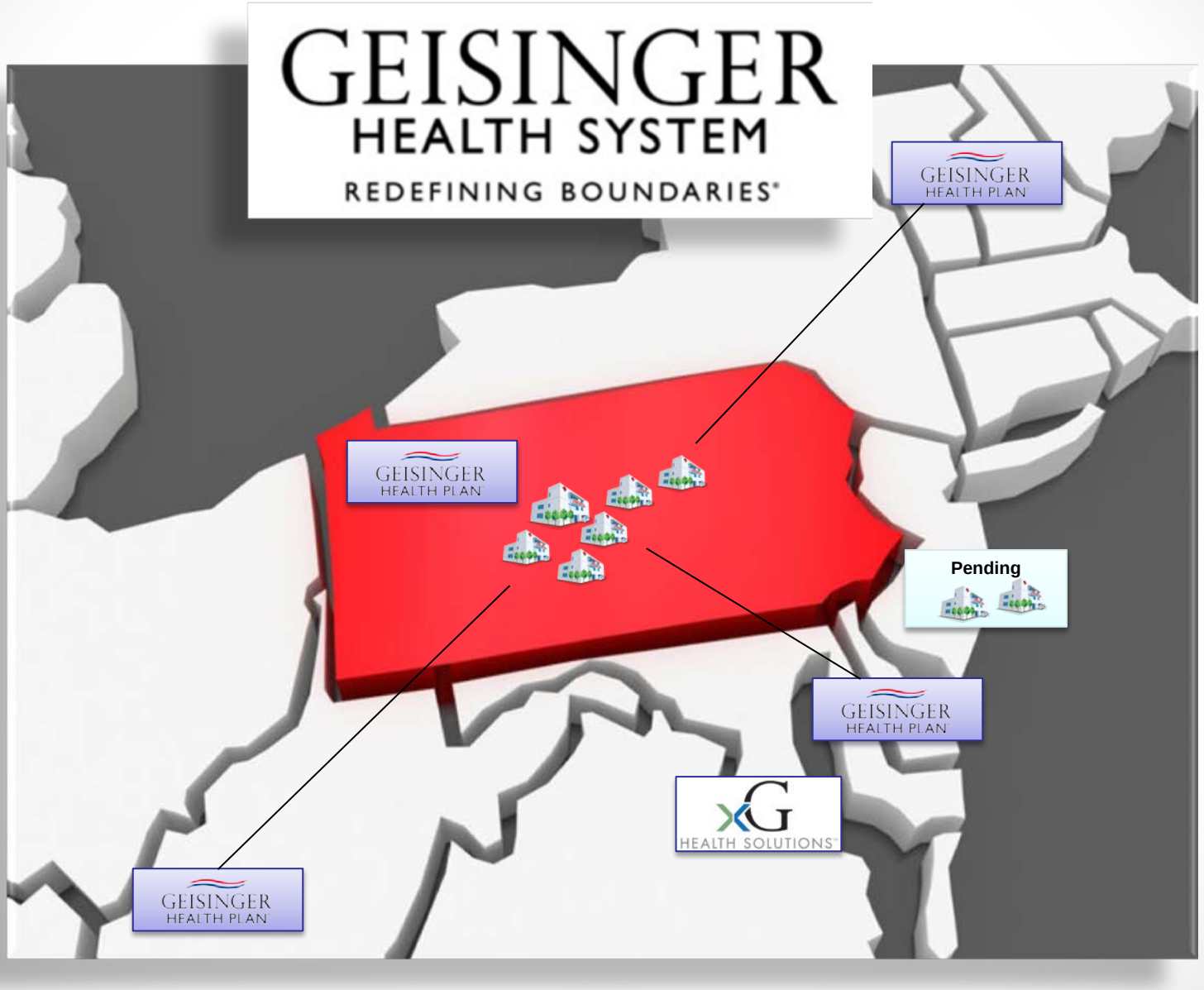
Geisinger inter-APP-ability: Experience with SMART/FHIR

Alistair Erskine, MD
Chief Clinical Informatics Officer
Geisinger Health System

GEISINGER
REDEFINING BOUNDARIES®


GEISINGER
HEALTH SYSTEM
REDEFINING BOUNDARIES®
GEISINGER HEALTH PLAN
GEISINGER HEALTH PLAN
Pending
GEISINGER HEALTH PLAN
HEALTH SOLUTIONS
GEISINGER HEALTH PLAN

GEISINGER HEALTH SYSTEM

REDEFINING BOUNDARIES®

- 6 hospitals (Pending: AtlantiCare)
- 4 outpatient surgery centers
- 2 Nursing Homes
- Home health & hospice services
- >100K admissions/OBS & SORUs
- 2,045 licensed inpatient beds

- Multispecialty group
- ~1,220 physician FTEs
- ~750 advanced practitioners
- 113 primary & specialty clinic sites (60 community practice)
- 1 outpatient surgery center
- ~2.8 million outpatient visits
- ~430 resident & fellow FTEs
- ~335 medical students

GEISINGER HEALTH PLAN®

- ~500,000 members (including ~100,000 Medicare Advantage members and ~132,000 Medicaid members)
- Diversified products
- ~50,000 contracted providers/facilities
- 43 PA counties
- Offered on public & private exchanges
- Members in 5 states

Moody's Aa2/Stable
Standard & Poor's AA/Stable

Geisinger Patient-Centered Continuum of Care

Community-Based Care

Specialty Outreach ("Face-to-face" & Telemedicine)

Ambulatory Care & Surgery Center

Urgent Care Center

Multi-Specialty Clinic

After-Hours Care Center

Specialty Center, e.g. Cancer or Sleep

Community Practice Site

E-Visit MyGeisinger

Retail Clinic

Imaging Center

Wellness

Lab Outreach Site

Work Site Clinic

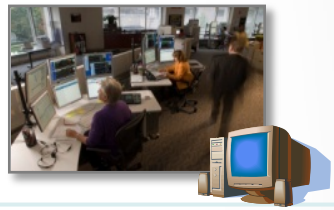
Retail Pharmacy

Acute Care

Destination Medicine

Tertiary/Quaternary Medical Center

eICU



Post-Acute & Transitional Care

Inpatient Rehab

Adult Health Program & Day Center

Outpatient Rehab

LIFE LIVING INDEPENDENTLY FOR ELDERS Geisinger

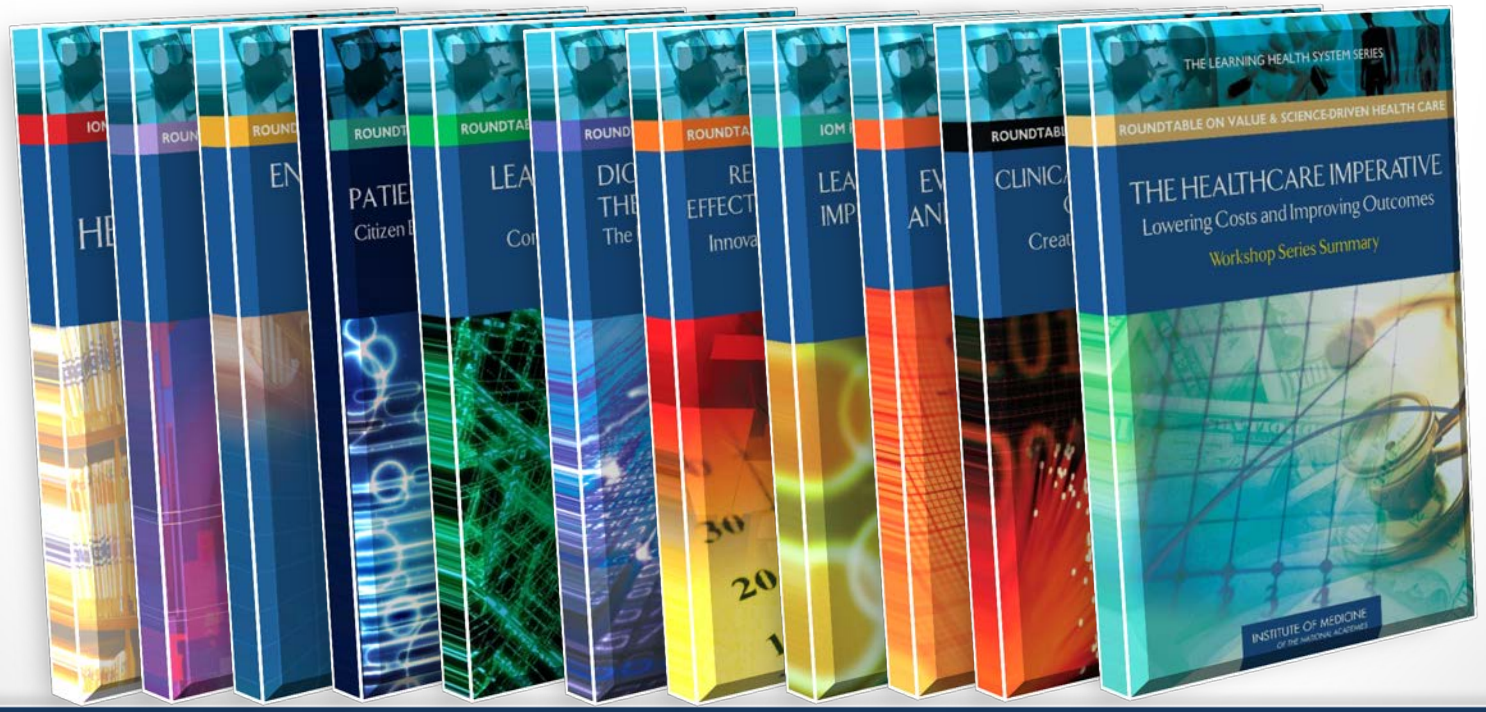
Nursing Homes/SNF

Home Care Hospice

ProvenHealth Navigator

The Learning Health System – IOM series

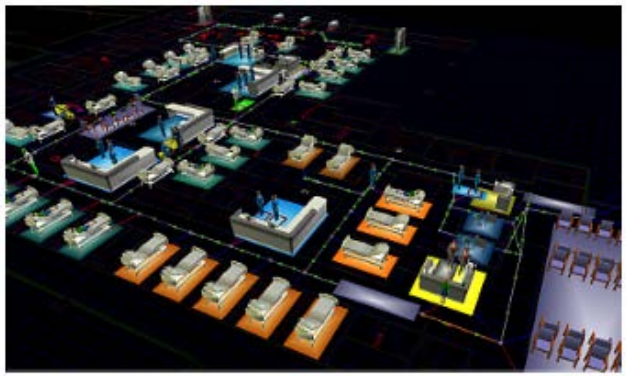
"progress in *science*, *informatics*, and *care culture* align to *generate new knowledge* as an ongoing, natural *byproduct of the care experience*, and seamlessly refine and deliver best practices for continuous improvement in health and healthcare."



Hardwire Learning

Step 1

Center for Clinical Innovation



Geisinger Center for Healthcare Systems Re-Engineering

Center for Emerging Technology & Informatics

Institute for Advanced Application

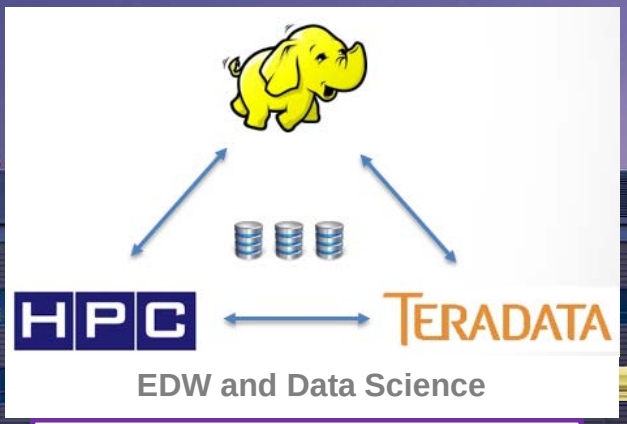
Transforming healthcare through continual innovation & reengineering

Applied Research and Clinical Informatics

Step 2

EHR Optimization and Apps

Care Gaps
72-hr readmission
OpenNotes
EHR Apps



EDW and Data Science

EDW/Big Data
Genomics
i2b2/REDCap

Geisinger in Motion

Bluetooth Scales
OpenNotes
eICU
Patient Mobiles

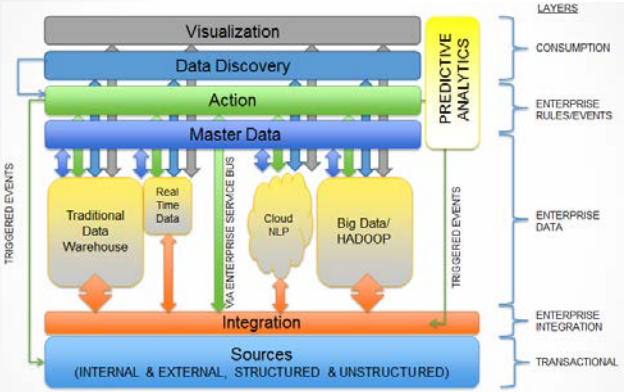
Learning Health System enabled by HIT

Step 3

Analyze

Innovate

Change Behavior



EnrG | Rheum

SuperNote

Compass

ProvenCare®

Care Gaps®

INFOR LAWSON

PHILIPS

Epic

caradigm
a Microsoft | GE Healthcare company

Office

SIEMENS

IDX

Wi Fi ZONE

Scaling and Generalizing

Step 4

GEISINGER

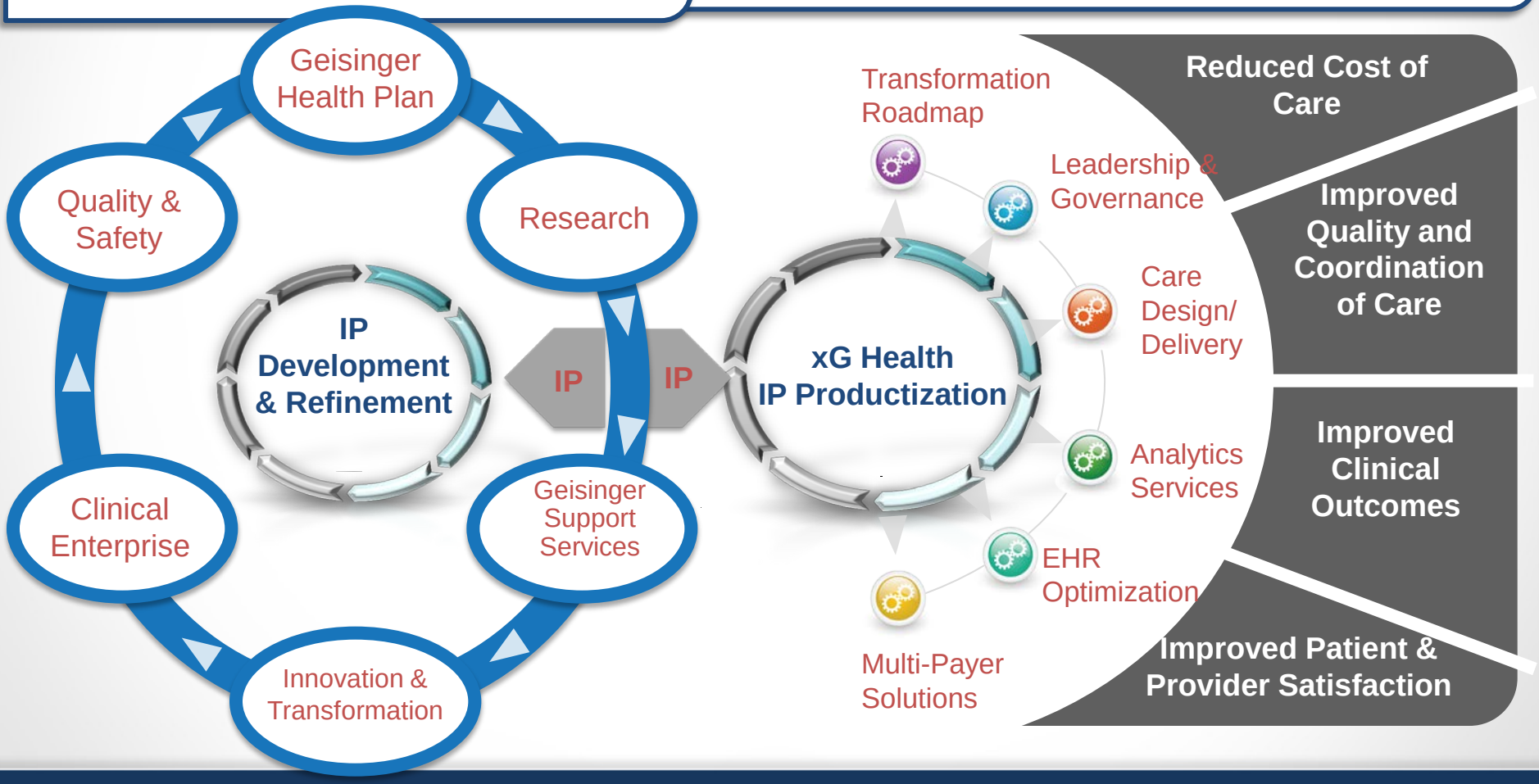
CORE OPERATIONS

Mission: Execute Core Business / Innovate

xG HEALTH SOLUTIONS

PRODUCT DEVELOPMENT & SERVICE DELIVERY

Mission: Generalize / Disseminate / $ Return



Disruptive Innovation & Value Reengineering

Patient and condition

Population Identification

Populations

Bundle Development

100% Care Processes and Protocols (Digital)

Low → Efficiency and Reliability → High

Regular Care

Workflow Modification

Delegation and Algorithms

Automation

Patient Activation

ProvenCare® Chronic Disease

Portfolio of ProvenCare® Chronic Disease Programs

- Diabetes
- Congestive Heart Failure
- Coronary Artery Disease
- Hypertension
- COPD
- Prevention Bundle

Improving Diabetic Care for 30,005 patients

	3/06	1/14	12/14	1/15
Number of Patients	20,178	27459	29,805	30,005
Diabetes Bundle Percentage	2.4%	13.7%	19.1%	18.5%
% Pneumococcal Vaccination	59%	79%	80%	80%
% Microalbumin Result	58%	80%	76%	76%
% HgbA1c at Goal	33%	47%	50%	49%
% LDL at Goal *Change to @ Goal on patient list July 2014	50%	60%	65%	65%
% BP at Goal *Change to @ Goal on patient list July 2014	39%	79%	76%	76%
% Documented Non-Smokers	74%	85%	85%	85%

ProvenCare® Type 2 Diabetes Value Driven Care Outcome Improvements

Heart Attack

- Less than 3 years
- **305 prevented with estimated savings of $27,111/case = $8.3M**

Stroke

- Less than 3 years
- **140 prevented with estimated savings of $2,921/case = $412K**

Retinopathy

- Less than 3 years
- **166 cases prevented!**
- **Quality of life maintained**
- **Savings…priceless**

THE AMERICAN JOURNAL OF MANAGED CARE

Primary Care Diabetes Bundle Management: Three-Year Outcomes for Microvascular and Macrovascular Events (FBloom; TGraf; WStewart; GSteele, et. al**. , June 2014 (20(6); 175-182)**

ProvenCare® Portfolio

ProvenCare®:

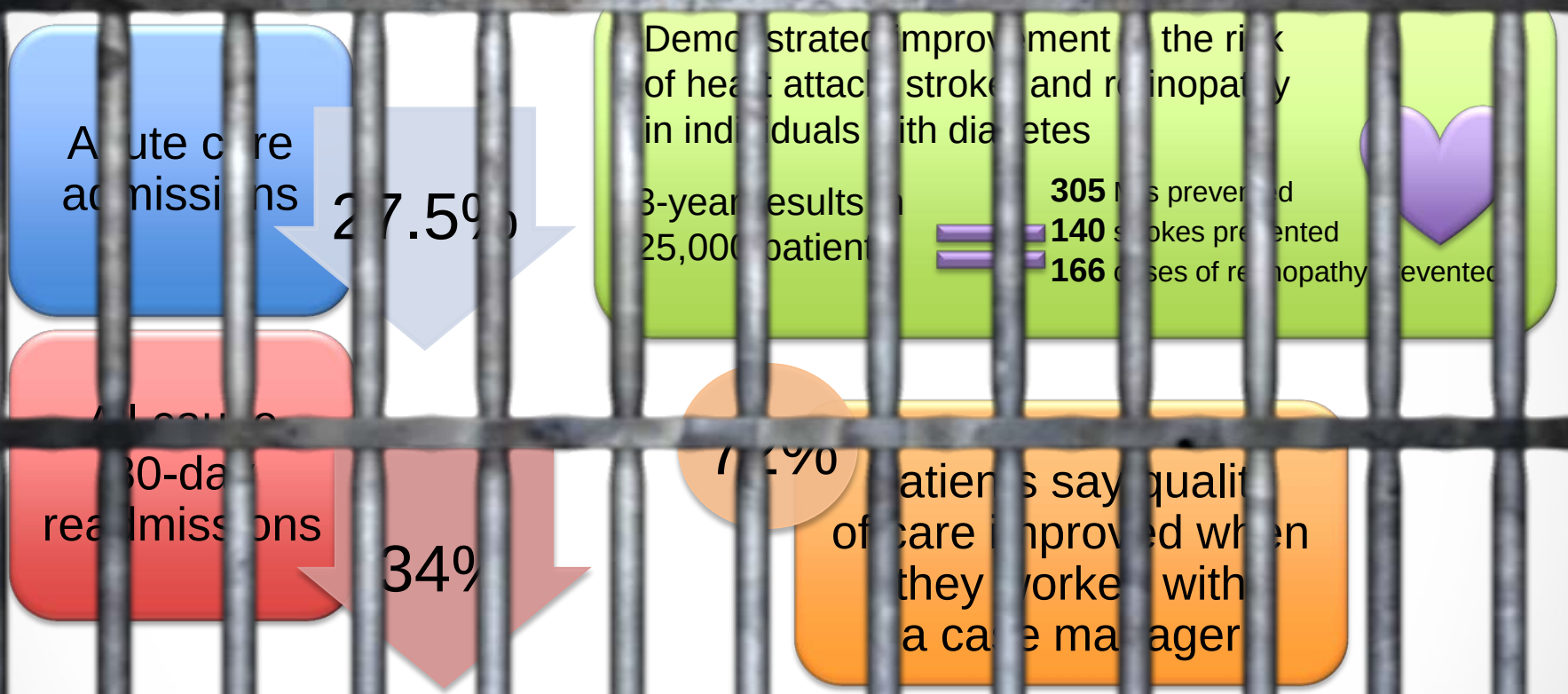
- ProvenCare® Autism
- ProvenCare® Bariatric Surgery
- ProvenCare® Cellulitis
- ProvenCare® COPD
- ProvenCare® Coronary Artery Bypass Graft (CABG)
- ProvenCare® CNS Mets
- ProvenCare® Epilepsy
- ProvenCare® Fragility Hip Fracture
- ProvenCare® Heart Failure
- ProvenCare® Hepatitis C
- ProvenCare® Hysterectomy
- ProvenCare® Inflammatory Bowel
- ProvenCare® Lung Cancer (CoC Collaborative)
- ProvenCare® Lumbar Spine
- ProvenCare® Migraine
- ProvenCare® Multiple Sclerosis
- ProvenCare® Percutaneous Coronary Intervention (PCI)
- ProvenCare® Perinatal
- ProvenCare® Psoriasis
- ProvenCare® Rectal Cancer
- ProvenCare® Rheumatoid Arthritis
- ProvenCare® Total Hip
- ProvenCare® Total Knee

ProvenCare® Evidence-Based Guidelines (EBG) (in conjunction with PRIDE):

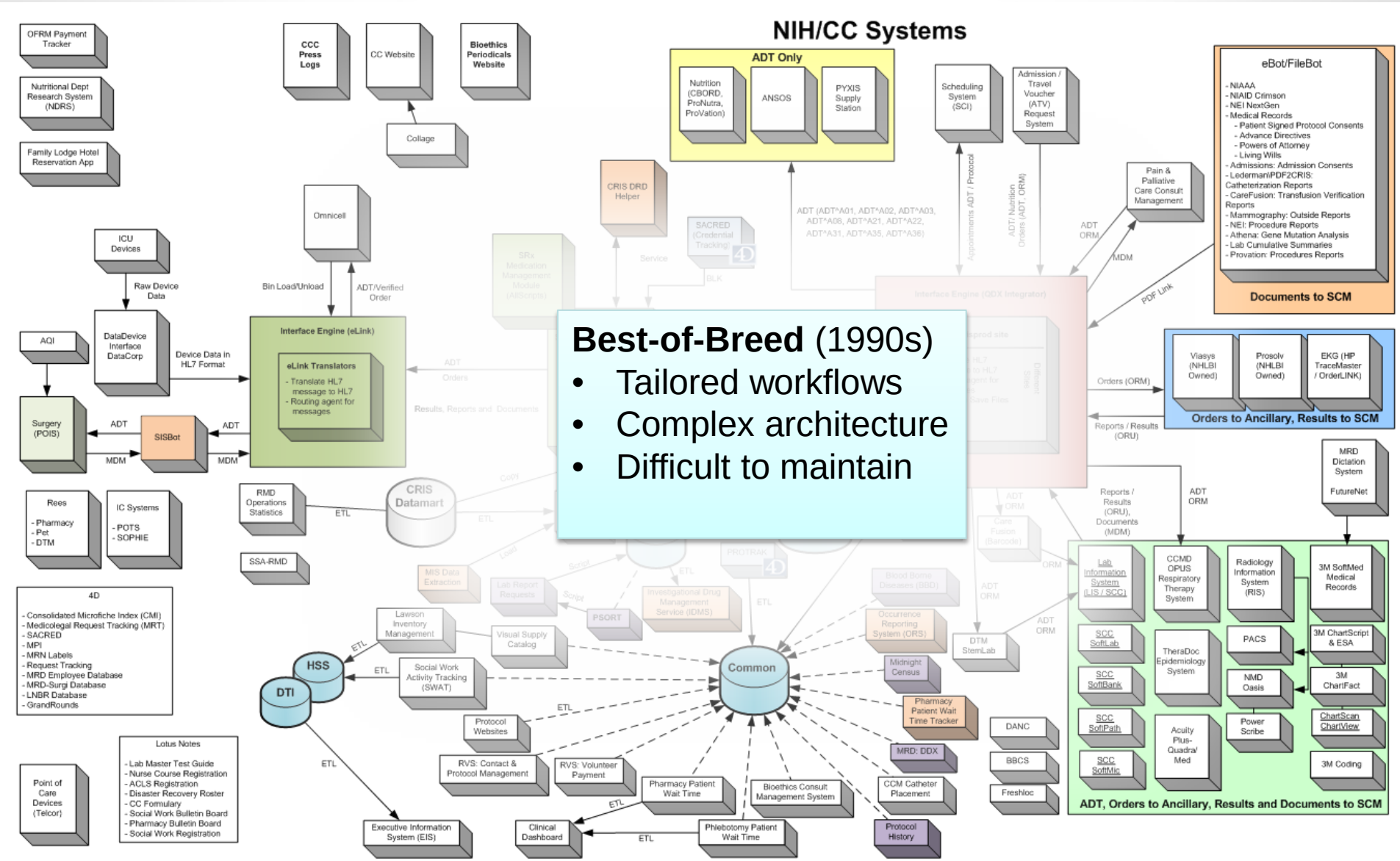
- Chest Pain – R/O MI (ED)
- Kidney Stone (ED)
- Newborn Protocols
- Pediatric Abdominal Pain (R/O Appendicitis (ED))
- Pediatric Head Injury (ED)
- Pediatric Pulmonary Embolism (ED)
- Sepsis (ED) & Sepsis (Med/Surg)
- Vent Management

Portfolio as of: 01/23/15

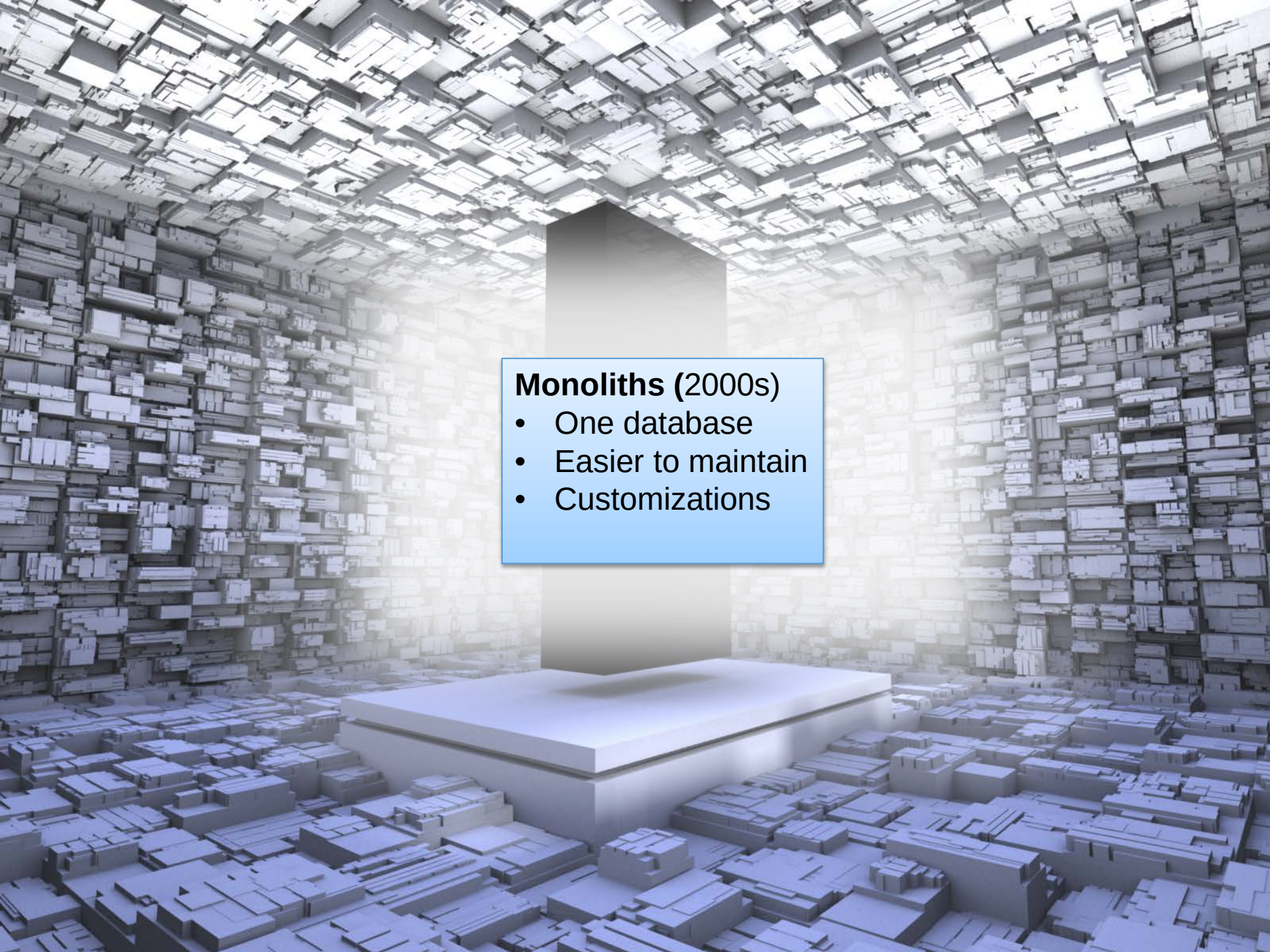
ProvenHealth Navigator® Results



Outcomes represent the period 20[illegible]—2012 and more than 0,000 Geisinger Health Plan members in Geisinger Health System practices.



Ref: NIH Clinical Research Information System available at http://cris.cc.nih.gov/images/Figure_2-lg.png


Monoliths (2000s)
• One database
• Easier to maintain
• Customizations

Tower of Babel

Painting: Pieter Bruegel the Elder c. 1563

NAMES

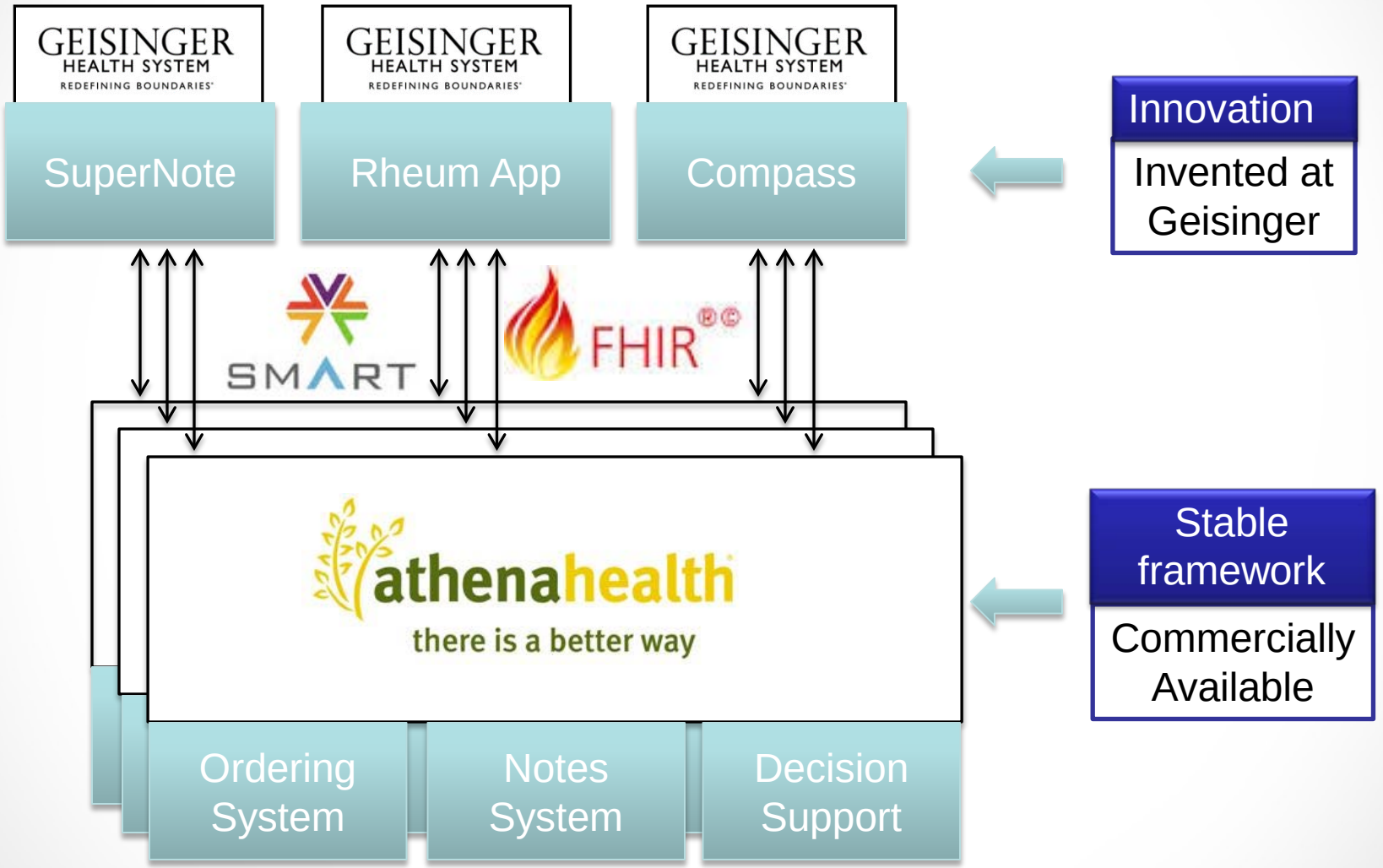
CHIN: Community Health Information Network — 1990s

RHIO: Regional Health Information Exchange — 2000s

HIE: Health Information Exchange — 2010s

Apps: Use SMART on FHIR resources — next

Inter-APP-able - Geisinger/xG Health Solutions



Rheum App: Key Improvement Domains

- Empowering the Provider
- Improving Efficiency and Productivity
- Better more Cost Effective Decision Making
- Improving Quality of Care

Key Point:
Design to co-exist and augment EHR capabilities;
Not design to replace the EHR

Epic

Cerner

Cerner Store

Start Publishing

Market and distribute your innovations in the Cerner Store.

Allscripts | Application Store

Rheum App Achievements

•Grants and Contracts

- AHRQ, AMGA, and Pharma Grants - $382,000
- MedMining Opportunities ($1.37 million)

•Patent Pending

- Submitted 9/12/13 - U.S. Continuation Patent Application No. 14/448,211

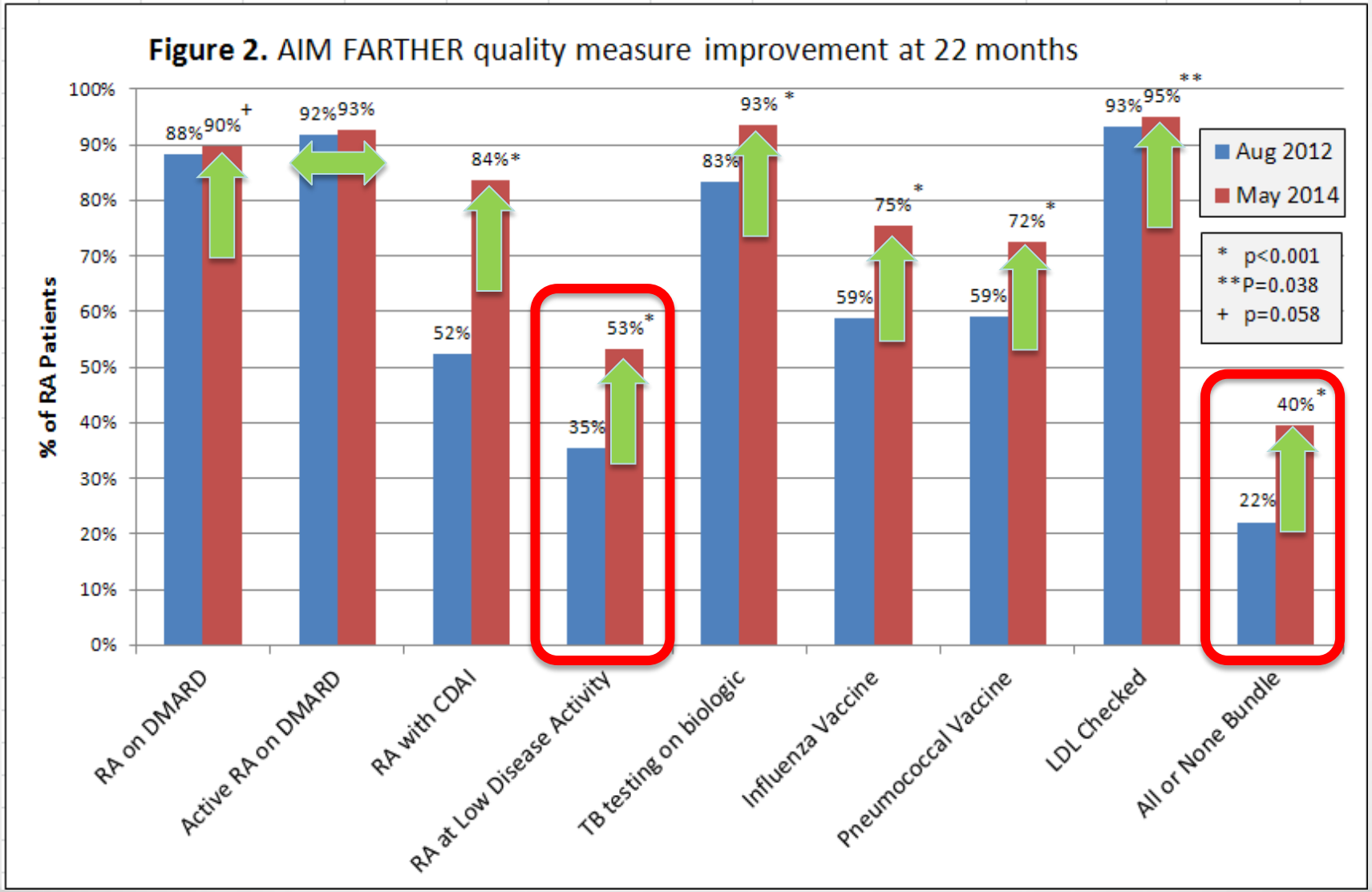
•National Presentations (5)

- ACR Quality Performance Indicators for Rheumatoid Arthritis
- Rheumatology Dashboard – An Efficient Summary that Alters Physician Treatment
- Rheumatology Touchscreen Questionnaire - Improve Efficiency/Care
- Rheumatoid Arthritis Quality Measure Bundle – Development and Implementation
- Rheum PACER – Design, Implementation, and Adoption

•Manuscripts in Top Peer-reviewed Journal (2)

- Newman ED, Lerch V, Jones JB, Stewart W. ***Touchscreen questionnaire patient data collection in rheumatology practice: Development of a highly successful system using process redesign.*** Arthritis Care and Research 2012;64:589-596
- Newman ED, Lerch V, Billet J, Berger A, Kirchner HL***. Improving the Quality of Care of Patients with Patients with Rheumatic Disease Using Patient-Centric Electronic Redesign Software***. Arthritis Care and Research 2014; DOI 10.1002/acr.22479

Improving Quality (2,378 RA patients)



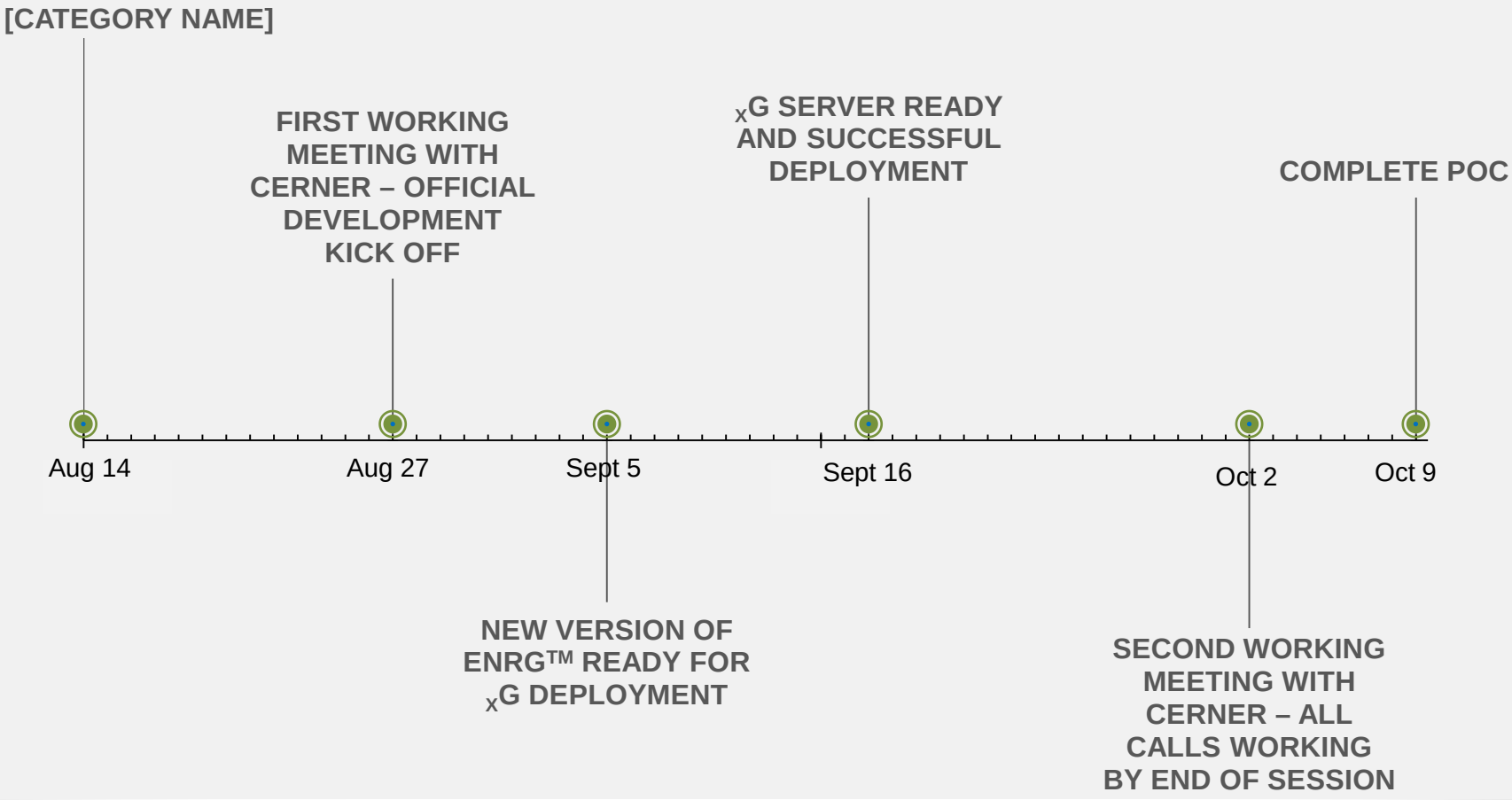
Rheum App: Reducing Cost

Biologic De-escalation Analysis CY 2013*

Total Number of patient charts for review	**940**
Number of Patients De-escalated	87 (9.3%)
Number (%) of Successful De-escalations	74 (85.1%)
Total Savings	$719,702
1 year Extrapolation for Successful De-escalations	$1,256,886

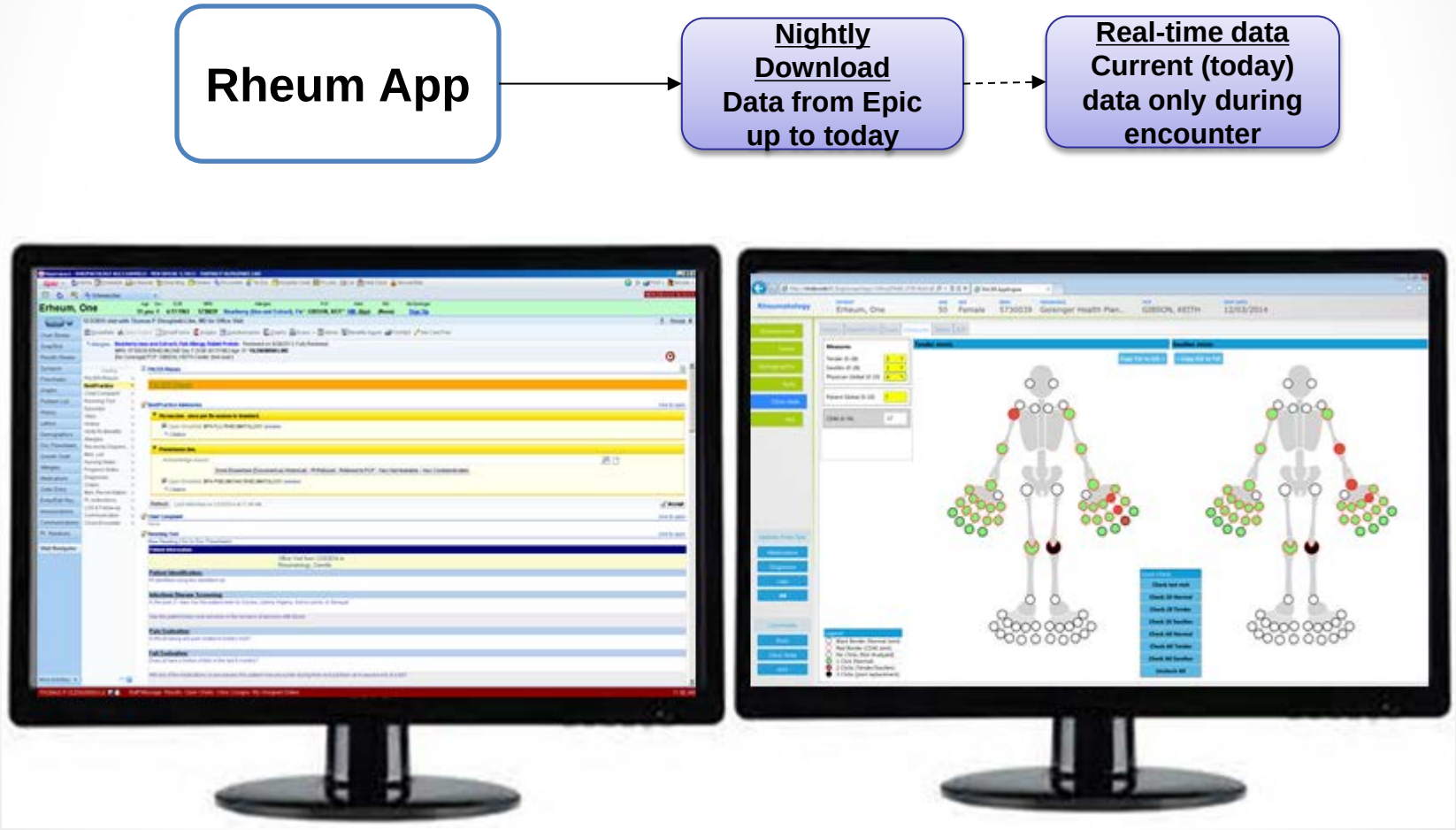
*Session "Rheumatoid Arthritis - Clinical Aspects II: Remission and De-escalation of Therapy", Presentation #941 on 11/16/14

Conversion to SMART/FHIR: Timelines



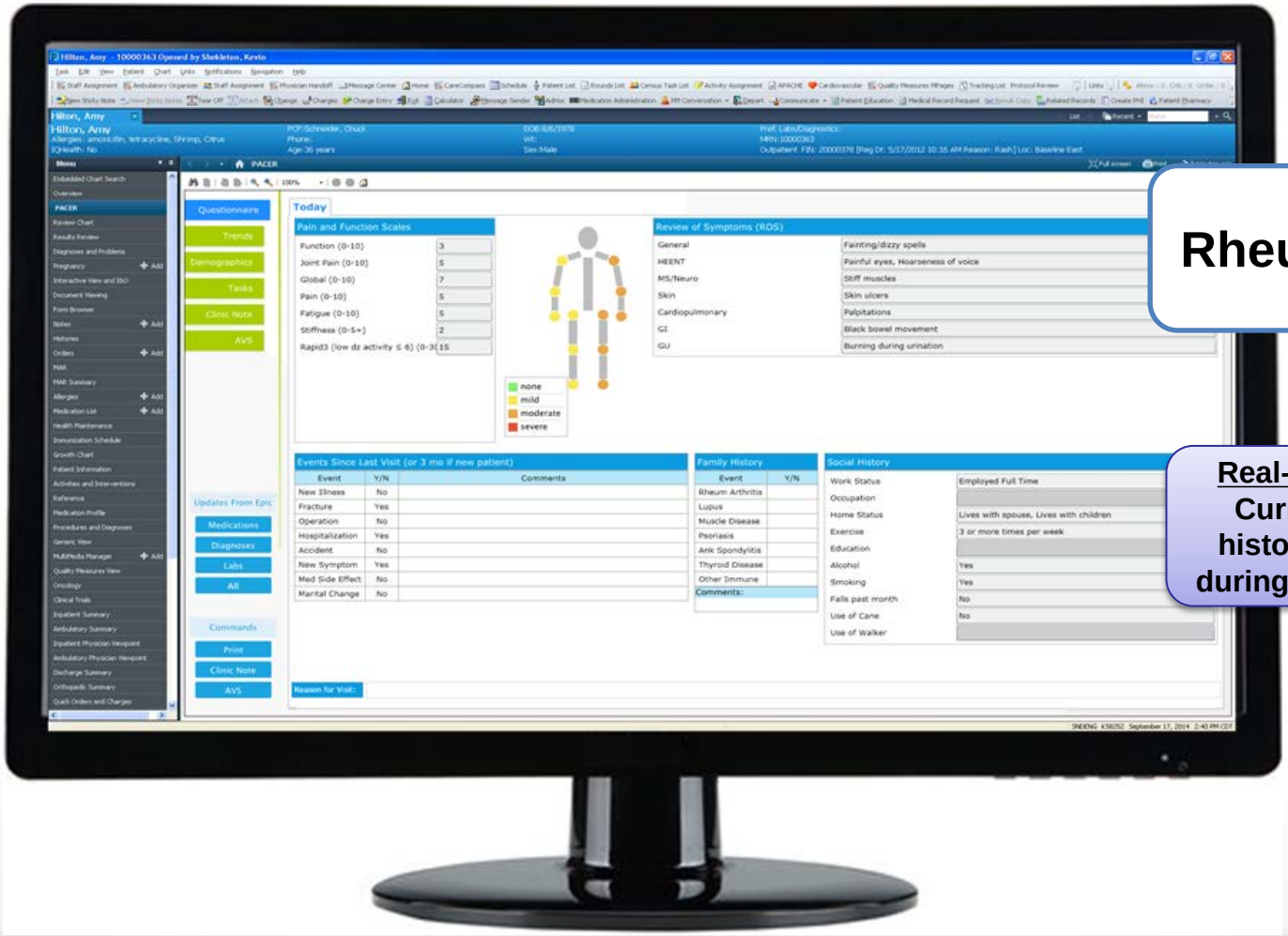
Before FHIR: Epic Application Integration

- External Application in a Side-by-side implementation



After FHIR: Cerner Application Integration

- External Application Embedded In EHR Workflow



enrG rheum

Questionnaire
Trends
HPI
Tasks
Clinic Note
AVS

Update From EHR
Medications
Diagnoses
Labs
All

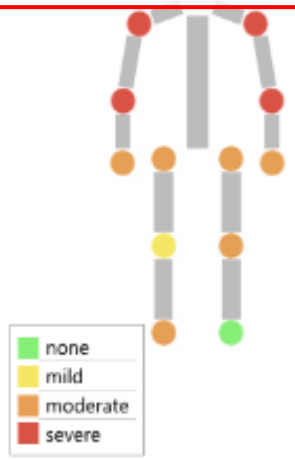
Commands
Print
Clinic Note
AVS

Today

FUNCTION

Pain and Function Scales	
Function (0-10)	9
Joint Pain (0-10)	7.1
Global (0-10)	8
Pain (0-10)	9
Fatigue (0-10)	8
Stiffness (0-5+)	8
Rapid3 (low dz activity ≤ 6) (0-30)	26

PAIN



REVIEW OF SYSTEMS

Review of Symptoms (ROS)	
General	Feeling depressed
HEENT	Painful eyes, Hoarseness of voice
MS/Neuro	Stiff muscles
Skin	Fingers turning purple
Cardiopulmonary	Palpitations
GI	Diarrhea, Heartburn
GU	Burning during urination

SINCE LAST VISIT

Events Since Last Visit (Yes, Comments)		
Event	Y/N	Comments
New Illness	No	
Fracture	No	
Operation	Yes	Knee Surgery
Hospitalization	No	
Accident	No	
New Symptom	No	
Med Side Effect	No	
Marital Change	No	

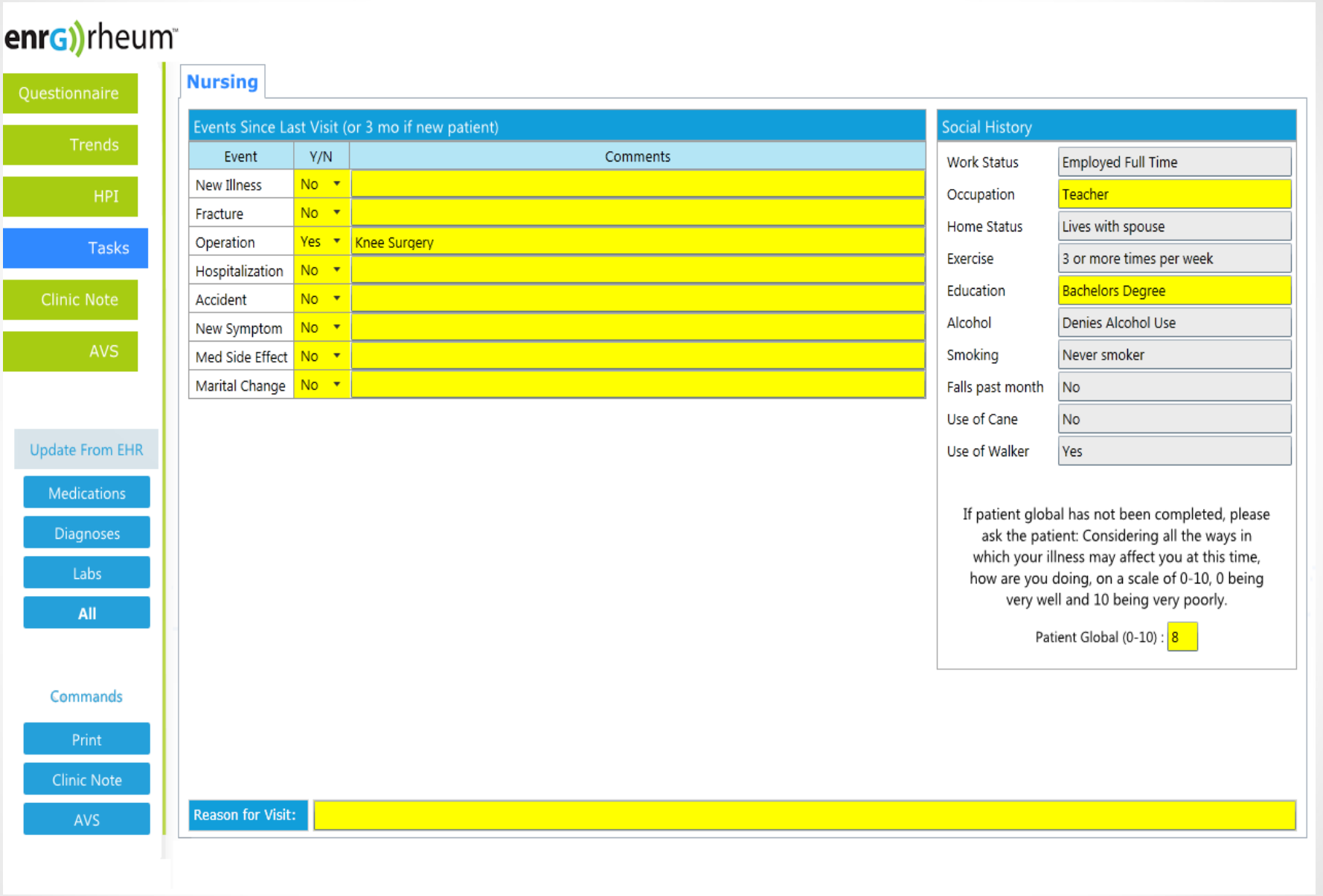
Family HX

Family History	
Event	Y/N
Rheum Arthritis	No
Lupus	No
Muscle Disease	No
Psoriasis	Yes
Ank Spondylitis	No
Thyroid Disease	No
Other Immune	No
Comments:	

SOCIAL HISTORY

Social History	
Work Status	Employed Full Time
Occupation	Teacher
Home Status	Lives with spouse
Exercise	3 or more times per week
Education	Bachelors Degree
Alcohol	Denies Alcohol Use
Smoking	Never smoker
Falls past month	No
Use of Cane	No
Use of Walker	Yes

Reason for Visit: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Clinic Note
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Update From EHR
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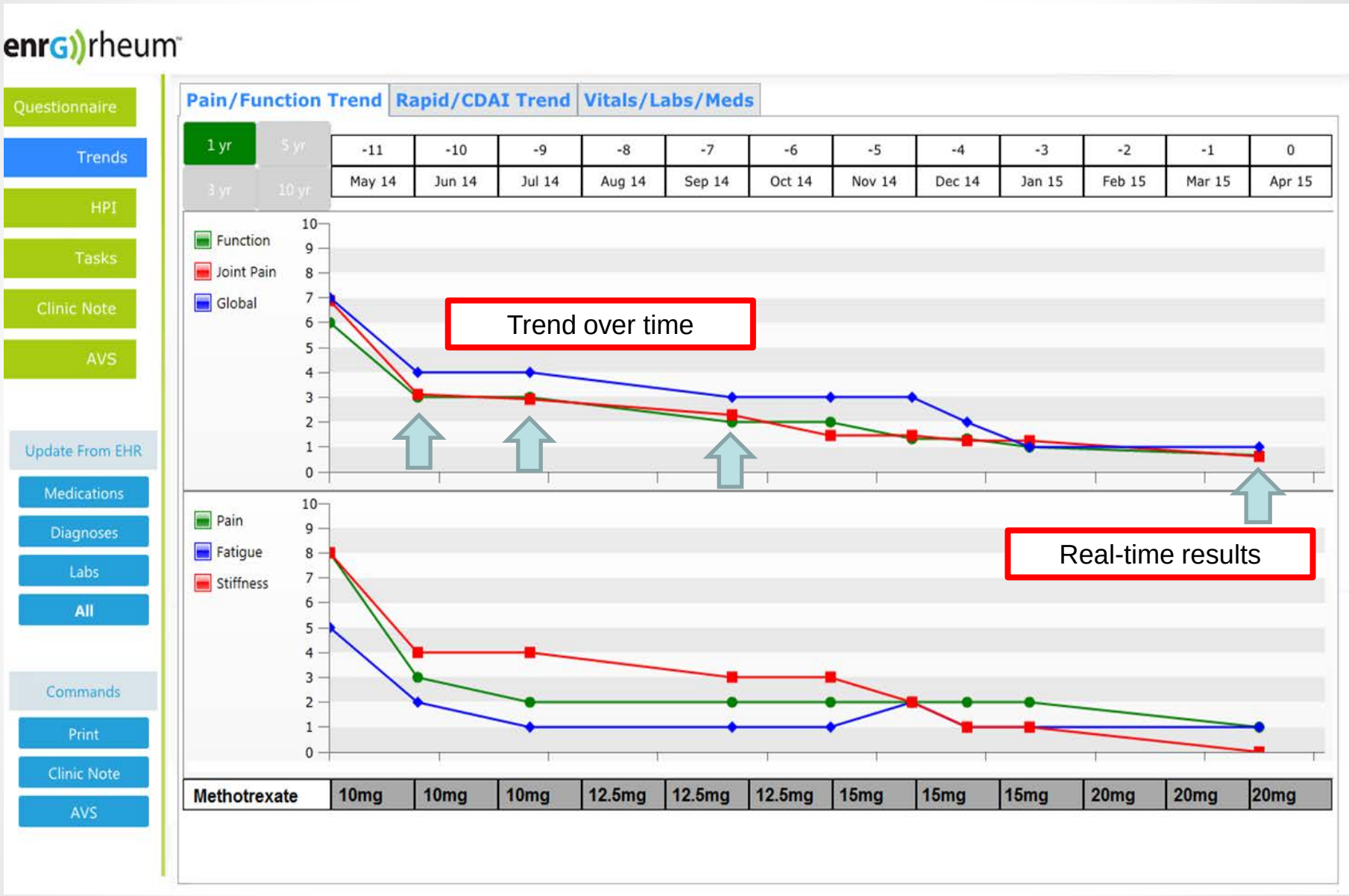
Diagnoses
Labs
All
Commands
Print
Clinic Note
AVS
Nursing
Events Since Last Visit (or 3 mo if new patient)
Event
Y/N
Comments
New Illness
No
Fracture
No
Operation
Yes
Knee Surgery
Hospitalization
No
Accident
No
New Symptom
No
Med Side Effect
No
Marital Change
No
Social History
Work Status
Employed Full Time
Occupation
Teacher
Home Status
Lives with spouse
Exercise
3 or more times per week
Education
Bachelors Degree
Alcohol
Denies Alcohol Use
Smoking
Never smoker
Falls past month
No
Use of Cane
No
Use of Walker
Yes
If patient global has not been completed, please ask the patient: Considering all the ways in which your illness may affect you at this time, how are you doing, on a scale of 0-10, 0 being very well and 10 being very poorly.
Patient Global (0-10) :
8
Reason for Visit: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Update From EHR
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Diagnoses
Labs
All
Commands
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Clinic Note
AVS
Pain/Function Trend
Rapid/CDAI Trend
Vitals/Labs/Meds
1 yr
5 yr
3 yr
10 yr
-11 -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0
May 14 Jun 14 Jul 14 Aug 14 Sep 14 Oct 14 Nov 14 Dec 14 Jan 15 Feb 15 Mar 15 Apr 15
Function
Joint Pain
Global
Trend over time
Pain
Fatigue
Stiffness
Real-time results
Methotrexate
10mg 10mg 10mg 12.5mg 12.5mg 12.5mg 15mg 15mg 15mg 20mg 20mg 20mg

enrG rheum

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Clinic Note
AVS

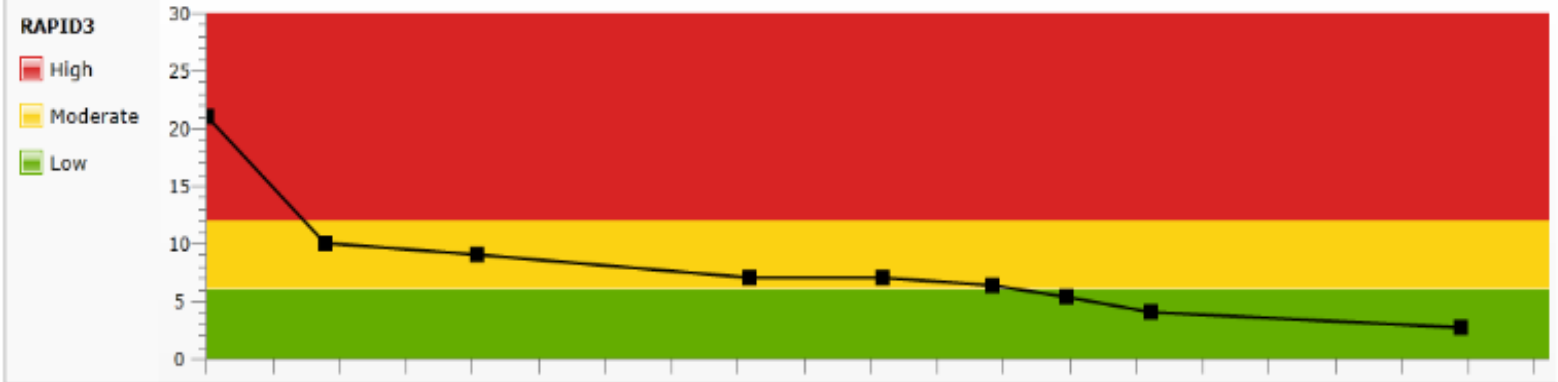
Update From EHR
Medications
Diagnoses
Labs
All

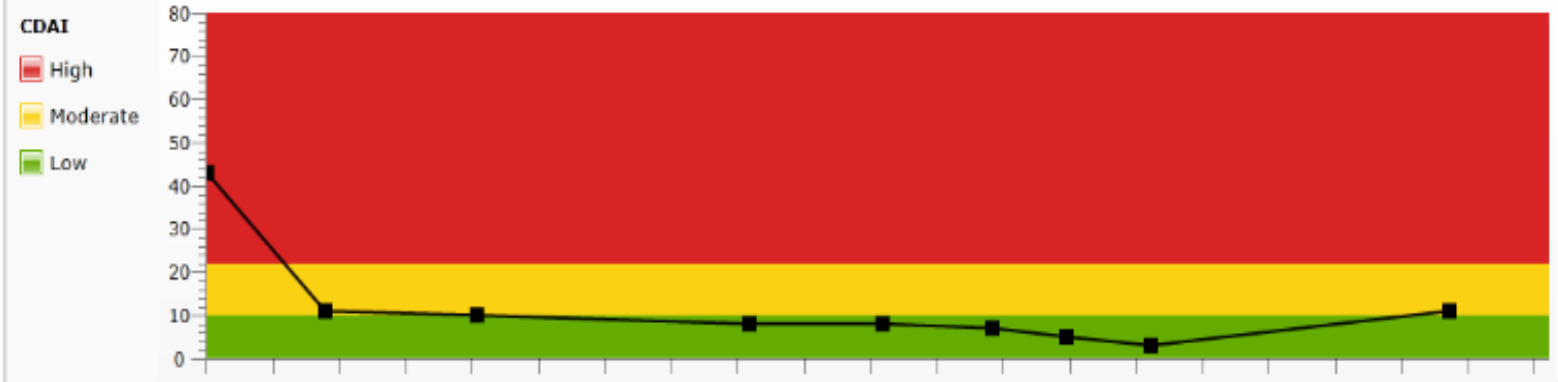
Commands
Print
Clinic Note
AVS

Pain/Function Trend | Rapid/CDAI Trend | Vitals/Labs/Meds

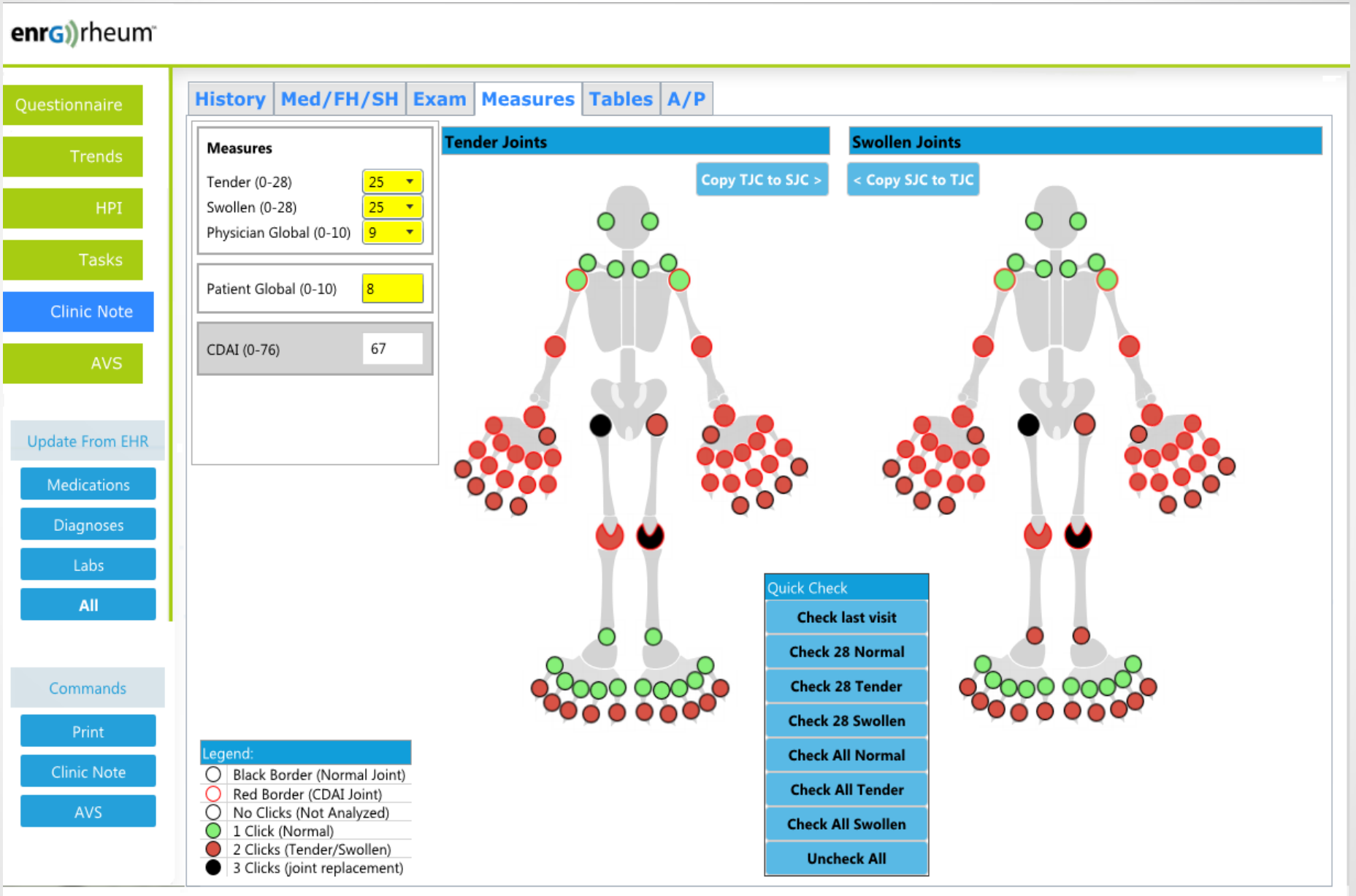
1 yr | 5 yr | 3 yr | 10 yr

-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0
May 14	Jun 14	Jul 14	Aug 14	Sep 14	Oct 14	Nov 14	Dec 14	Jan 15	Feb 15	Mar 15	Apr 15





Methotrexate	10mg	10mg	10mg	12.5mg	12.5mg	12.5mg	15mg	15mg	15mg	20mg	20mg	20mg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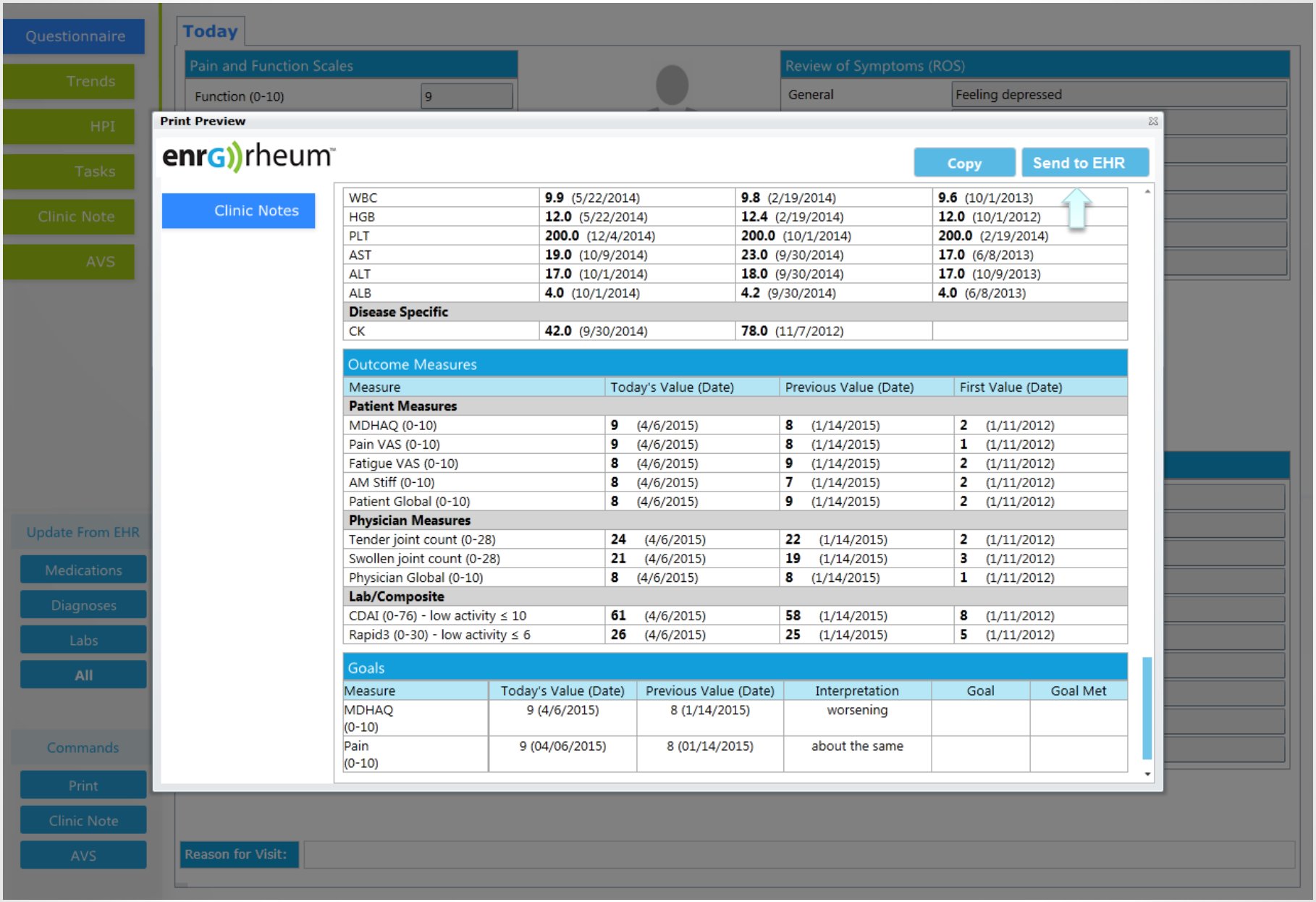
All
Commands
Print
Clinic Note
AVS
History
Med/FH/SH
Exam
Measures
Tables
A/P
Measures
Tender (0-28) 25
Swollen (0-28) 25
Physician Global (0-10) 9
Patient Global (0-10) 8
CDAI (0-76) 67
Tender Joints
Copy TJC to SJC >
Swollen Joints
< Copy SJC to TJC
Quick Check
Check last visit
Check 28 Normal
Check 28 Tender
Check 28 Swollen
Check All Normal
Check All Tender
Check All Swollen
Uncheck All
Legend:
Black Border (Normal Joint)
Red Border (CDAI Joint)
No Clicks (Not Analyzed)
1 Click (Normal)
2 Clicks (Tender/Swollen)
3 Clicks (joint replacement)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Today
Pain and Function Scales
Function (0-10)
9
Review of Symptoms (ROS)
General
Feeling depressed
Print Preview
enrG rheum
Copy
Send to EHR
Clinic Notes
WBC 9.9 (5/22/2014) 9.8 (2/19/2014) 9.6 (10/1/2013)
HGB 12.0 (5/22/2014) 12.4 (2/19/2014) 12.0 (10/1/2012)
PLT 200.0 (12/4/2014) 200.0 (10/1/2014) 200.0 (2/19/2014)
AST 19.0 (10/9/2014) 23.0 (9/30/2014) 17.0 (6/8/2013)
ALT 17.0 (10/1/2014) 18.0 (9/30/2014) 17.0 (10/9/2013)
ALB 4.0 (10/1/2014) 4.2 (9/30/2014) 4.0 (6/8/2013)
Disease Specific
CK 42.0 (9/30/2014) 78.0 (11/7/2012)
Outcome Measures
Measure | Today's Value (Date) | Previous Value (Date) | First Value (Date)
Patient Measures
MDHAQ (0-10) 9 (4/6/2015) 8 (1/14/2015) 2 (1/11/2012)
Pain VAS (0-10) 9 (4/6/2015) 8 (1/14/2015) 1 (1/11/2012)
Fatigue VAS (0-10) 8 (4/6/2015) 9 (1/14/2015) 2 (1/11/2012)
AM Stiff (0-10) 8 (4/6/2015) 7 (1/14/2015) 2 (1/11/2012)
Patient Global (0-10) 8 (4/6/2015) 9 (1/14/2015) 2 (1/11/2012)
Physician Measures
Tender joint count (0-28) 24 (4/6/2015) 22 (1/14/2015) 2 (1/11/2012)
Swollen joint count (0-28) 21 (4/6/2015) 19 (1/14/2015) 3 (1/11/2012)
Physician Global (0-10) 8 (4/6/2015) 8 (1/14/2015) 1 (1/11/2012)
Lab/Composite
CDAI (0-76) - low activity ≤ 10 61 (4/6/2015) 58 (1/14/2015) 8 (1/11/2012)
Rapid3 (0-30) - low activity ≤ 6 26 (4/6/2015) 25 (1/14/2015) 5 (1/11/2012)
Goals
Measure | Today's Value (Date) | Previous Value (Date) | Interpretation | Goal | Goal Met
MDHAQ (0-10) 9 (4/6/2015) 8 (1/14/2015) worsening
Pain (0-10) 9 (04/06/2015) 8 (01/14/2015) about the same
Update From EHR
Medications
Diagnoses
Labs
All
Commands
Print
Clinic Note
AVS
Reason for Visit:

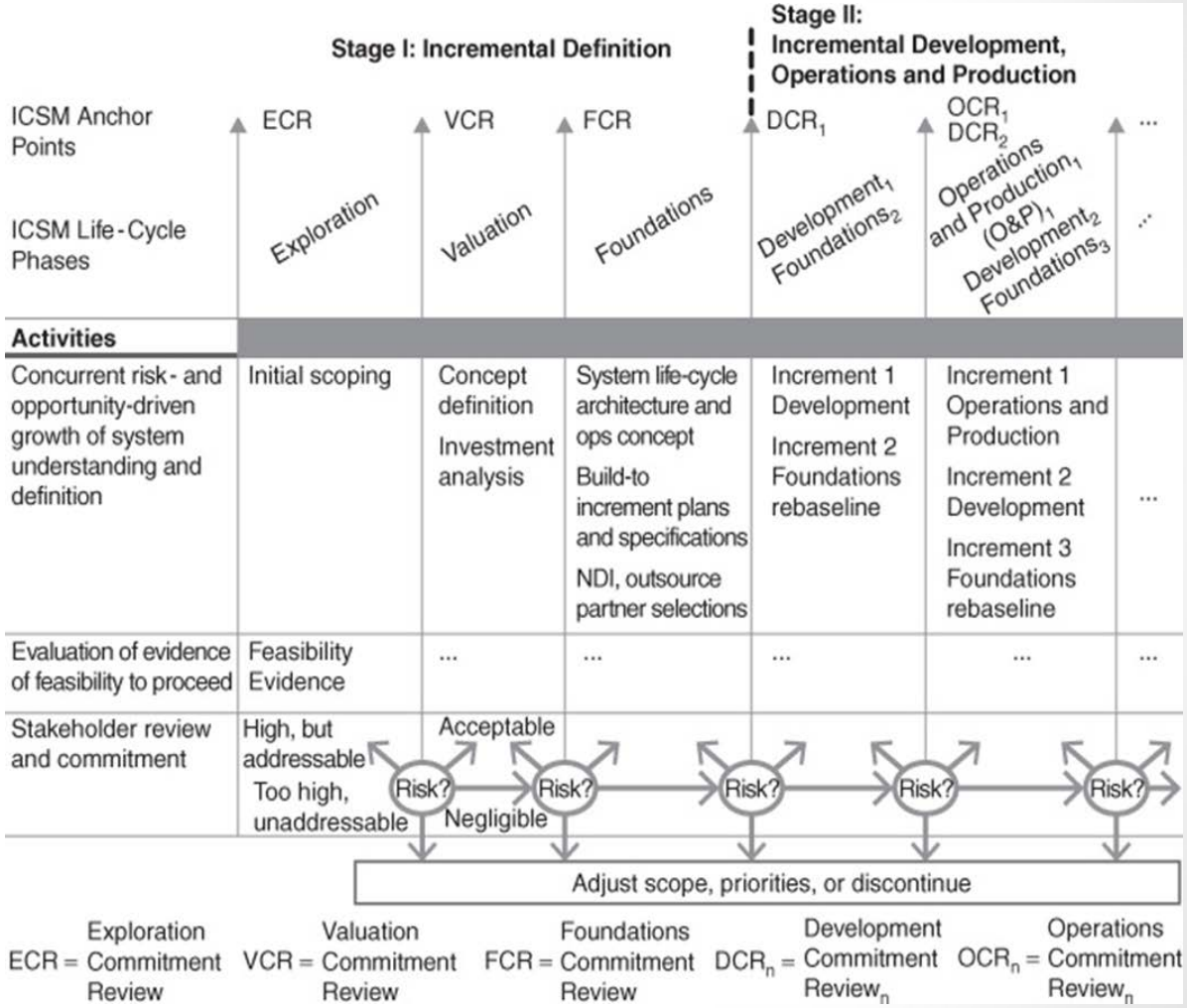
“SMART/FHIR” Rheum App: Accomplishments

- The Rheum App allowed us to transition data integration points quickly and efficiently via data virtualization layer
- No prior knowledge working with SMART on FHIR – team gained knowledge in the 40 day POC timeframe
- Most FHIR resources utilized with the Rheum App at Proof of Concept completion
- Real time data for current and historical data
- Additional functionality coded at the time of SMART/FHIR conversion:
  - Problem list Diagnoses Insert via FHIR Services
  - Progress note Insert via FHIR Services

SMART/FHIR Rheum App: System Engineering

The Four ICSM Principles

- **Stakeholder value-based guidance.**
- **Incremental commitment and accountability.**
- **Concurrent multi-discipline engineering**
- **Evidence and risk-based decisions.**



Ref: Boehm B et al, The Incremental Commitment Spiral Model, ISBN-13 978-0-321-80822-6

SMART/FHIR Rheum App: Learning

Not all HIT developers are FHIR-ready:

- More negotiation about the expected attributed exchange between App and EHR is likely
- Significant amount of “code conversion” as HIT developers adapt their proprietary APIs to SMART/FHIR
- Each FHIR resource needs agreement between App and EHR on which profile to use to transmit data
- Nevertheless, most of the App code was re-usable across multiple HIT developers

Several types of Apps are emerging from exercise:

- EHR-agnostic Apps: functions purely through data exchange
- EHR-dependent Apps: combine App with ordersets/templates
- EHR embedded Apps: App entirely dependent on EHR functionality

SMART/FHIR Rheum App: Learning

Testing and Validation

- Used SMART Platform for testing*
- Created a particular dataset for validation of App-specific needs
- Only used 11 of the 49 FHIR resources for Rheum App
- Found it better to use FHIR calls in real-time rather than store in local database

Consortium/Alliances Support

- HSPC (http://healthcaresoa.org/Introduction.html)
- Project Argonaut (https://hl7-fhir.github.io/argonauts.html)
- Commonwell (http://www.commonwellalliance.org)

Questions remain:

- External Apps writing back to EHR database
- Vendor neutral “App-Store”, currently only HIT developer stores

* SMART Platform at http://www.smartplatforms.org

SMART/FHIR Project Resources/Cost

Duration

- 40 Business days from kickoff to completion of POC
- 31 Business days of development

Programming Resources

- 3 Web App Developers
- 1 Lead Web App Developer

Programming Hours

- 736

Programming Cost

- $17,859

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