Office of the National Coordinator for Health Information Technology

ONC Tech Forum
Clinical Decision Support Series
Session #1

What to Know About Clinical Decision Support through Real World Examples

June 7, 2023

Upcoming workshops

Session #2 The Future of Clinical Decision Support

- **Wednesday, Sept. 27, 2023, 11 a.m. – 4 p.m. ET**
- This session will cover topics important to the future of clinical decision support.

Session #3 Creating Value by Modernizing and Measuring Clinical Decision Support

- **Wednesday, Nov. 8, 2023, 12 p.m. – 3 p.m. ET**
- This session will discuss how new technologies can add value to CDS and how the impact of CDS can be measured and evaluated.
- Registration for both opens June 19.

More information about workshops here

Agenda

- CDS workshop sessions
- Overview of CDS
  - Tom Mason, MD, Chief Medical Officer, ONC
- How to implement CDS locally
  - Bill Russell, MD, Conviva Care Centers
- Questions at 12:54 p.m.
- Break at 1:05 p.m.
- Examples of interoperable CDS in the real world
  - Buck Rogers, Medical University of South Carolina
  - Lydia Drumright, PhD, University of Washington
  - Patrick O'Connor, MD, and Deepa Appana, HealthPartners Institute
- Questions at 2:22 p.m.

Overview of CDS

- Definition and Types of CDS
- Benefits of CDS
- Challenges and Limitations
- Trends of CDS
- Today’s Case Studies

Definition and Types of CDS

- Clinical decision support (CDS) provides clinicians, staff, patients or other individuals with knowledge and person-specific information, intelligently filtered or presented at appropriate times, to enhance health and health care. CDS encompasses a variety of tools to enhance decision-making in the clinical workflow.

- Key components and stakeholders that support a typical CDS system
  - Data integration by technology developers
  - Knowledge base by providers/researchers
  - User interface by providers/patients

- Types of CDS include
  - Alerts and reminders to care providers and patients
  - Clinical guidelines
  - Condition-specific order sets
  - Contextually relevant reference information
  - Documentation templates
  - Diagnostic support
  - Focused patient data reports and summaries

Benefits of CDS

- When CDS is effectively designed to provide the right information, to the right person, in the right format, through the right channel, at the right time in the workflow, benefits can include:
  - Increased quality of care and enhanced health outcomes
  - Avoidance of errors and adverse events
  - Improved efficiency, cost-benefit, and provider and patient satisfaction

The CDS Five Rights were first articulated by Jerry Osheroff, MD, in 2007.

Key Challenges

- Increasing interoperability
- Keeping content up-to-date
- Increasing access to sharable CDS
- Improving workflow integration

Current Trends of CDS

- Integration with electronic health records (EHRs)
- Mobile and wearable technology
- Decision support for precision medicine
- Standards for integrated quality improvement
- Patient-centered decision support
- Health Data, Technology, and Interoperability: Certification Program Updates, Algorithm Transparency, and Information Sharing (HTI-1) Proposed Rule

More information about HTI-1 Proposed Rule here

Today's Case Studies

- CDC Clinical Practice Guideline for Prescribing Opioids Recommendations Pilot
  - Buck Rogers, Medical University of South Carolina
- Clinical Opioid Summary with Rx Integration (COSRI) tool and PainTracker
  - Lydia Drumright, PhD, University of Washington
- Priority Wizard
  - Patrick O'Connor, MD, and Deepa Appana, HealthPartners Institute

How to Implement CDS Locally

Bill Russell, MD, Conviva Care Centers

Questions

Break

Examples of Interoperable CDS in the Real World

MUSC/CDC Clinical Practice Guideline for Prescribing Opioids for Pain Recommendations Pilot

Epic FHIR Opioid Prescribing CDS-Hooks Support Implementation

Dr. Leslie Lenert, Director, Biomedical Informatics Center / CRIO

Wei Ding, Senior Interface Developer/Architect

Buck Rogers, Epic Research Manager

Contact Info: rogersbr@musc.edu

MUSC
Medical University of South Carolina

Changing What's Possible | MUSC.edu

BMIC Team

Director: Dr. Leslie Lenert
Senior Interface Developer/Architect: Wei Ding
Project Manager: Luke Sox
Epic Research Manager: Buck Rogers

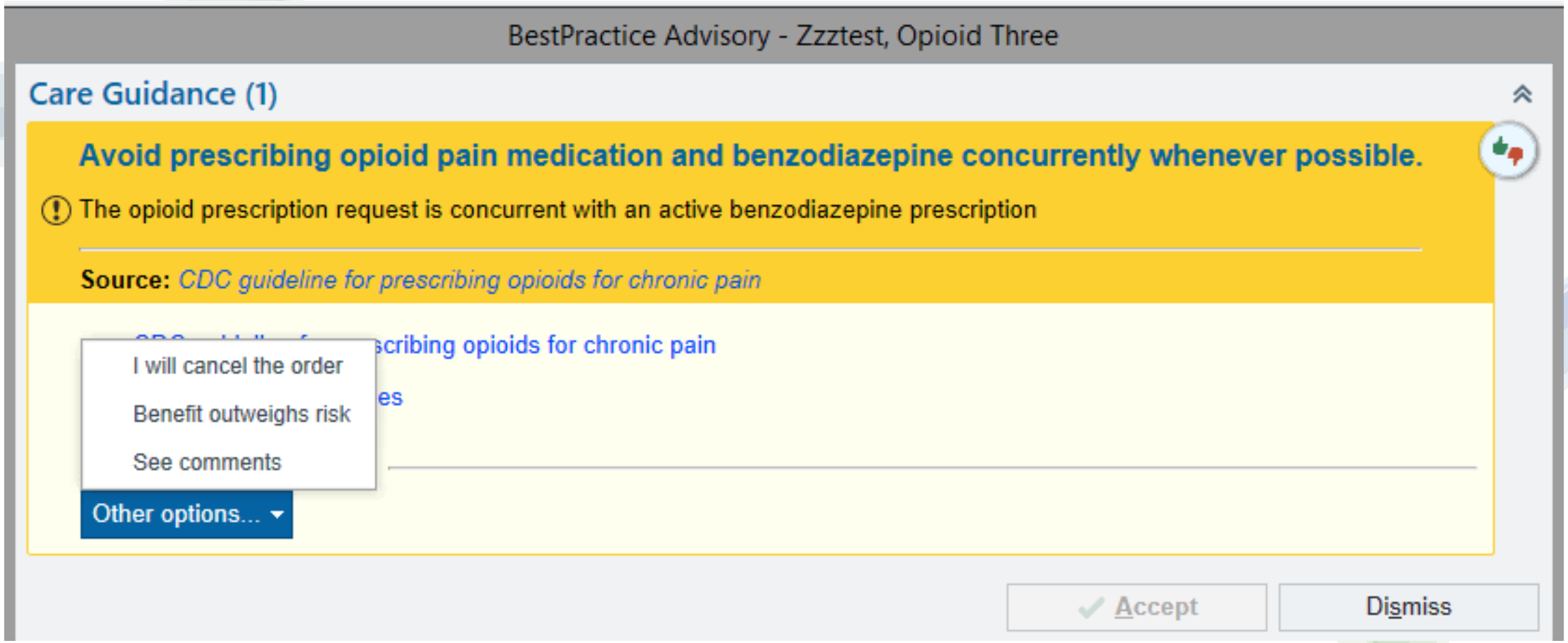
Contract Team

NAME	ROLE	PHONE	EMAIL
Johnathan Coleman, CISSP	Program Manager	843-442-9104	jc@securityrs.com
Amber Patel, LLM	Project Manager	832-427-8401	ayp@securityrs.com
Greg White, MS, MA	Program Coordinator/Technical Lead	843-442-0149	gw@securityrs.com
Trish Austin, PMP, MBA	Comptroller/Contracts Mgr.	843-416-4880	taustin@securityrs.com
Kensaku Kawamoto, MD, PhD, MHS	Subject Matter Expert	919-358-9361	kkinformatics@gmail.com
Floyd Eisenberg, MD, MPH	Subject Matter Expert	202-643-6350	feisenberg@iparsimony.com
Rob McClure, MD	Subject Matter Expert	303-926-6771	rmcclure@mdpartners.com
Bryn Rhodes	Subject Matter Expert	801-368-4628	bryn@smilecdr.com

Government Leadership

NAME	ROLE	PHONE	EMAIL
Lolita Kachay, MPH	COR, ONC	202-969-3368	lolita.kachay@hhs.gov
Alison Kemp, MPH	ONC	202-820-7158	alison.kemp@hhs.gov
Anastasia Perchem	ONC	202-969-3375	anastasia.perchem@hhs.gov
Wes Sargent, EdD	CDC	770-488-7740	ylt5@cdc.gov
Jan Losby, PhD	CDC	770-488-8085	kfy9@cdc.gov
Terry Davis, EdD	CDC	770-488-3940	ddu8@cdc.gov
Andrew Terranella, MD, MPH	**CDC**		**aqt1@cdc.gov**

Traditional BPA Pop-Up



BPA Alert Fatigue

- The term alert fatigue describes how busy workers (in the case of health care, clinicians) become desensitized to safety alerts, and as a result ignore or fail to respond appropriately to such warnings. This phenomenon occurs because of the sheer number of alerts, and it is compounded by the fact that the vast majority of alerts generated by CPOE systems (and other health care technologies) are clinically inconsequential—meaning that in most cases, clinicians *should* ignore them.
- The problem is that clinicians then ignore both the bothersome, clinically meaningless alarms *and* the critical alerts that warn of impending serious patient harm.

Interruptive vs. Non-Interruptive alerts in EHR

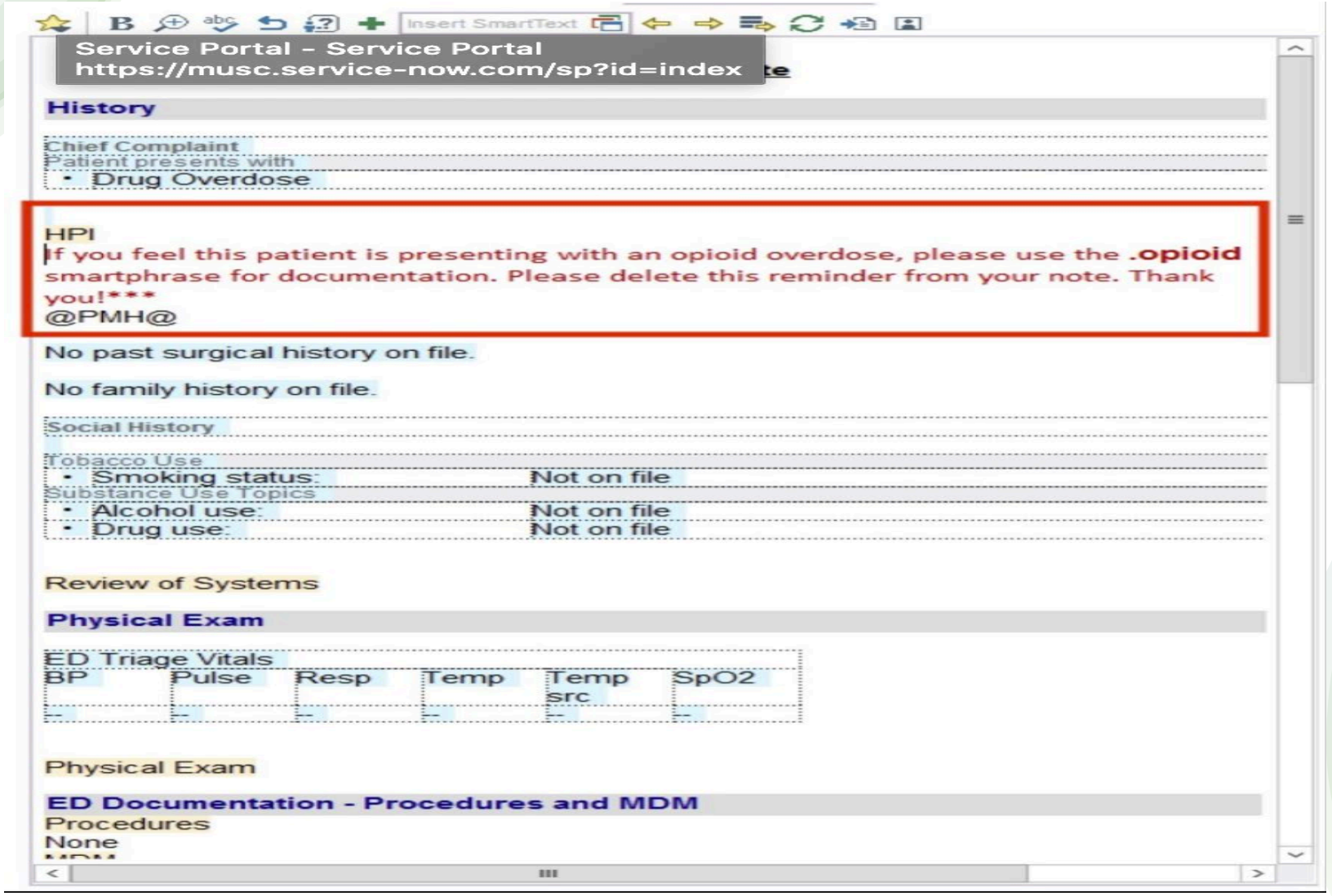
1.) **Interruptive BPA** – Standard Flu screening pop up for example.

2.) **Non-interruptive** – Background BPA that sends an in-basket message to a provider.

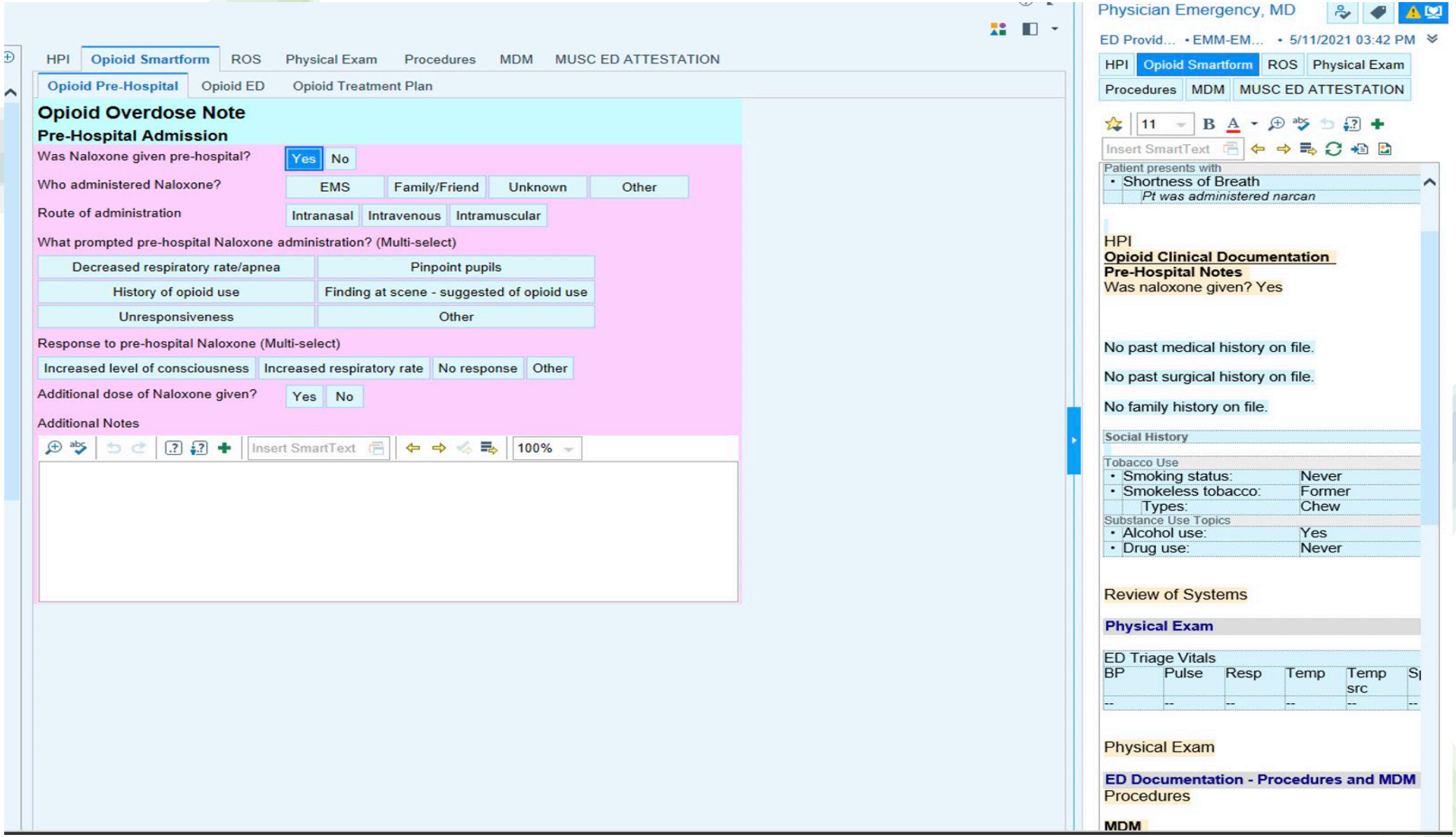
3.) ***New Innovation*** – note/smartform in clinicians note instead of a pop-up BPA

    a.) Alert fatigue – Does not interrupt clinician's workflow
    b.) Interruption adds to cognitive loads – Heavy lift on the system.

BPA alternative used in Opioid overdose in ED



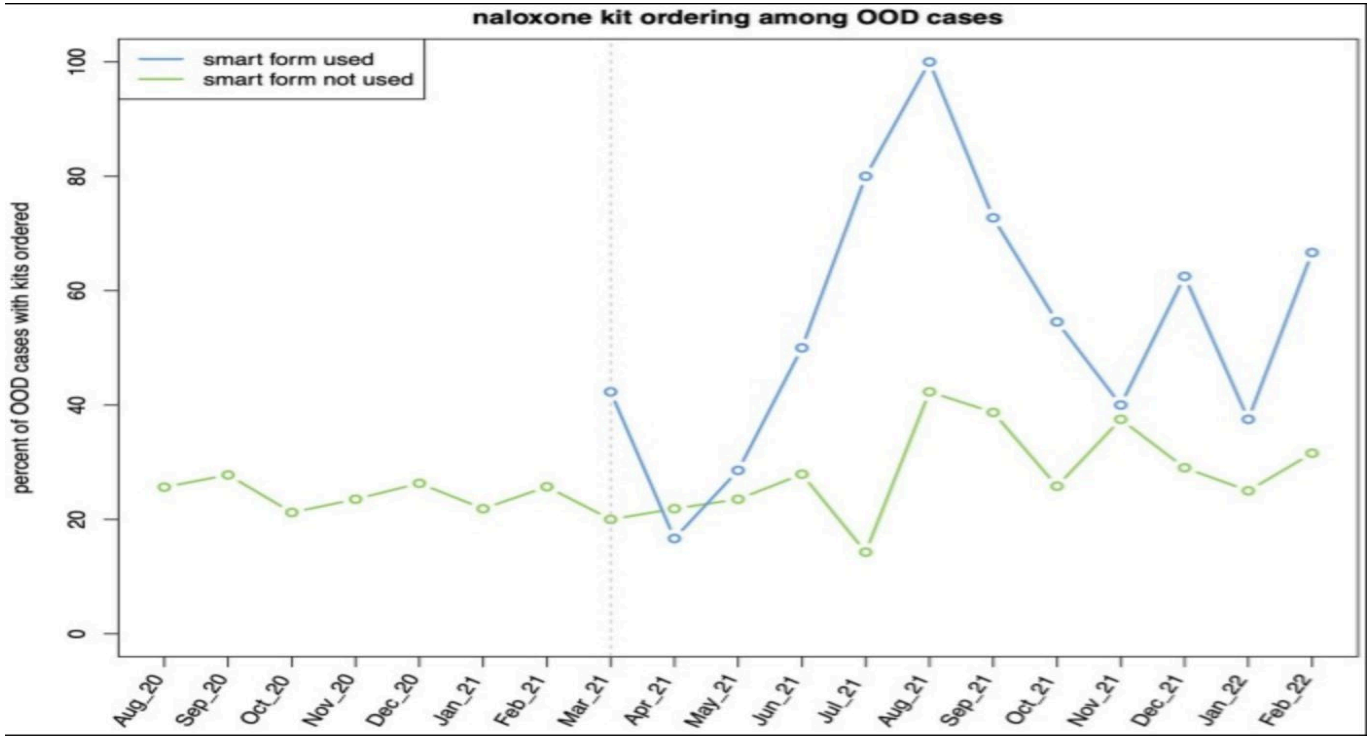
Opioid OD Smart Form



Effectiveness of non interruptive template

- **A noninterrupted decision support intervention was associated with higher take-home naloxone prescribing in a pre-post study across a multi-institution health system.**

- **Timing is different from traditional BPA. Presented during documentation time rather than during ordering. Doesn't interrupt cognition, may be better accepted.**



BMIC Gateway

Purpose

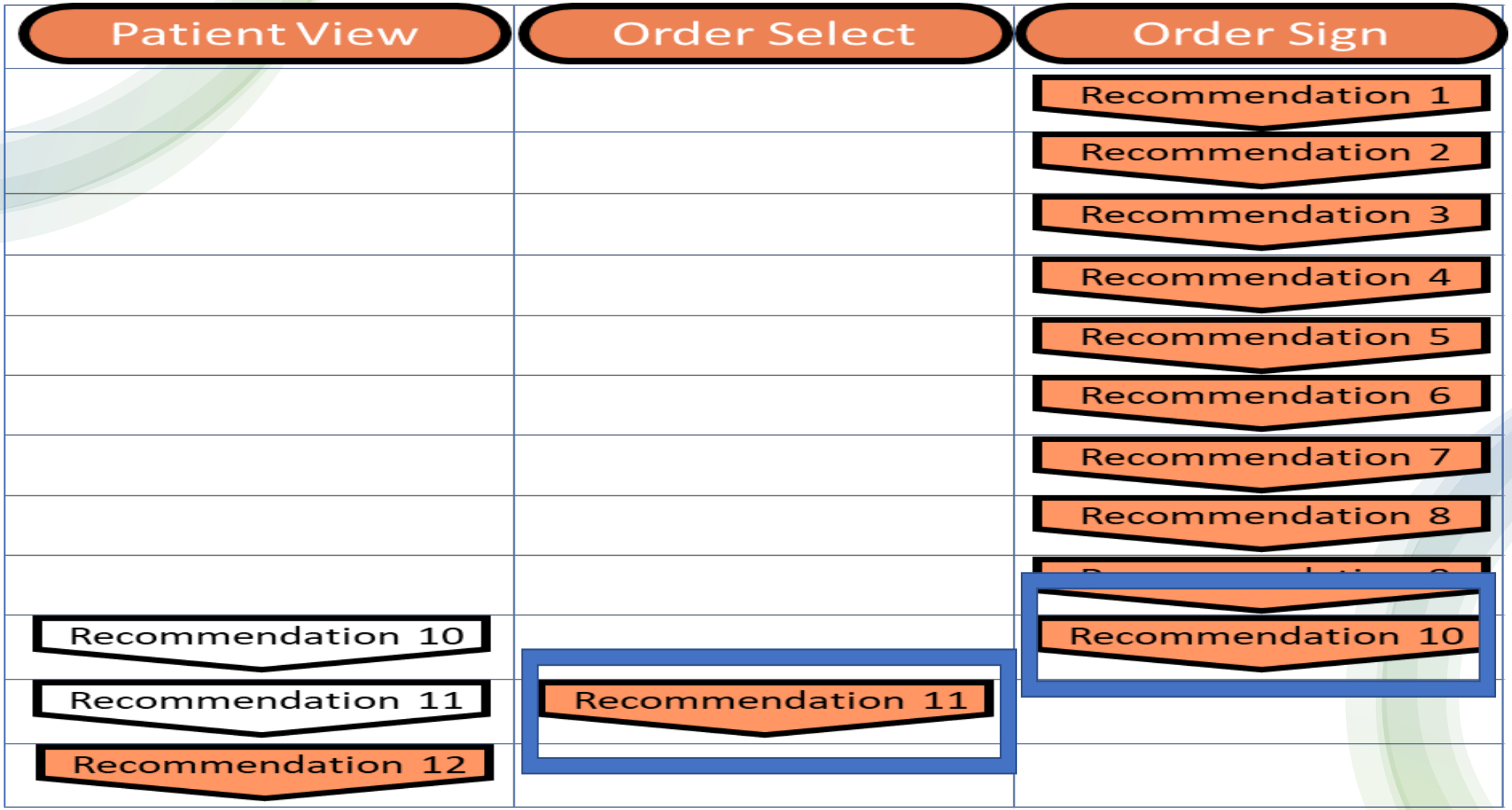
BMIC Gateway providers bi-directional EMR integration, secure real-time data exchange, workflow automation with Epic

Streamline data ingestion and management to drive faster research innovation and ML development, reduce operational workloads, increase clinical data control, improve real-time PHI data de-identification, and enable our researchers, study teams, data scientists to move faster with data normalized in the FHIR standard that benefits from a community of developers based upon FHIR resources.

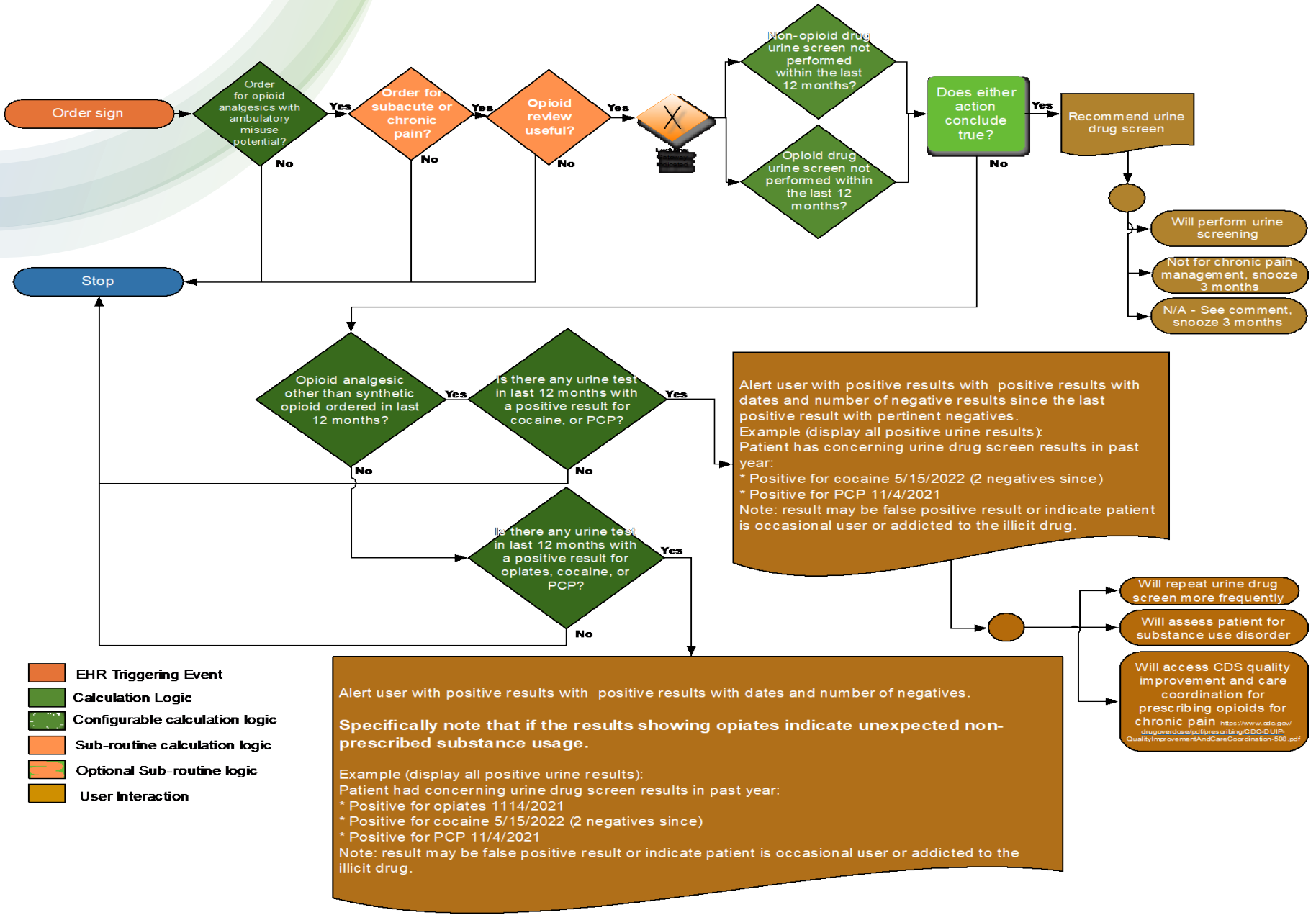
Provide a scalable real-time solution for parsing CDS-Hooks' response cards and write them back to Epic flowsheets, physicians have the option of getting feedbacks from smarttext documents instead of showing alerts. It also support **seamlessly invoke the proper** either FHIR or Non-FHIR clinical **decision support applications in real-time and provide within context of the Epic**

BMIC OAuth2 authorization and Epic FHIR OAuth2 Authorization provide privacy and security access to the Epic FHIR Server and clinical data warehouse.

Trigger Overview

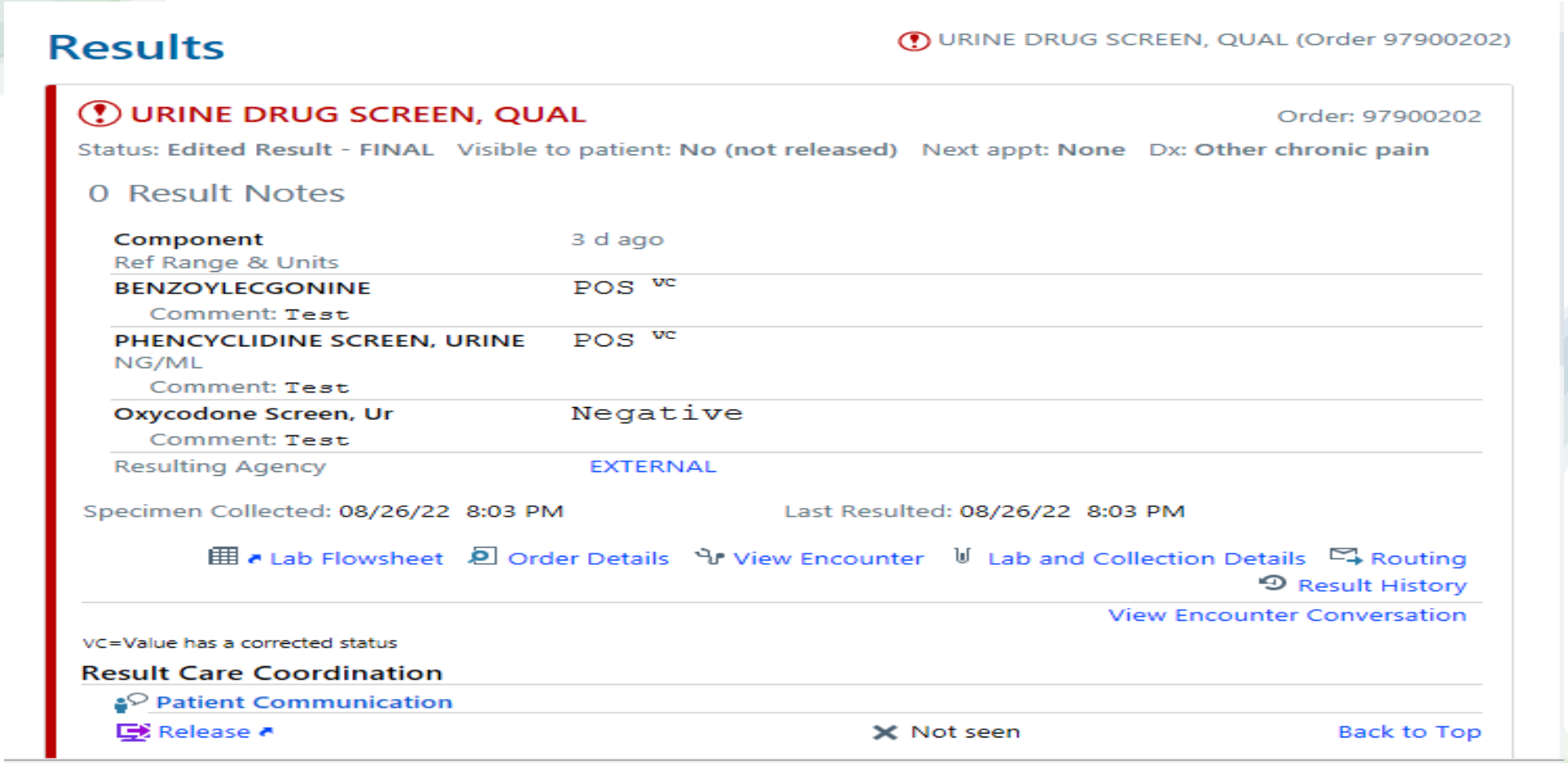


Recommendation 10



When prescribing opioids for chronic pain, clinicians should use urine drug testing before starting opioid therapy and consider urine drug testing at least annually to assess for prescribed medications as well as other controlled prescription drugs and illicit drugs.

Recommendation 10 - UDT
Test case – Order Sign – 1 Positive UDS test results



Results

URINE DRUG SCREEN, QUAL (Order 97900202)

URINE DRUG SCREEN, QUAL

Order: 97900202

Status: Edited Result - FINAL Visible to patient: No (not released) Next appt: None Dx: Other chronic pain

0 Result Notes

Component Ref Range & Units	3 d ago
BENZOYLECGONINE Comment: Test	POS vc
PHENCYCLIDINE SCREEN, URINE NG/ML Comment: Test	POS vc
Oxycodone Screen, Ur Comment: Test	Negative
Resulting Agency	EXTERNAL

Specimen Collected: 08/26/22 8:03 PM Last Resulted: 08/26/22 8:03 PM

Lab Flowsheet Order Details View Encounter Lab and Collection Details Routing Result History

View Encounter Conversation

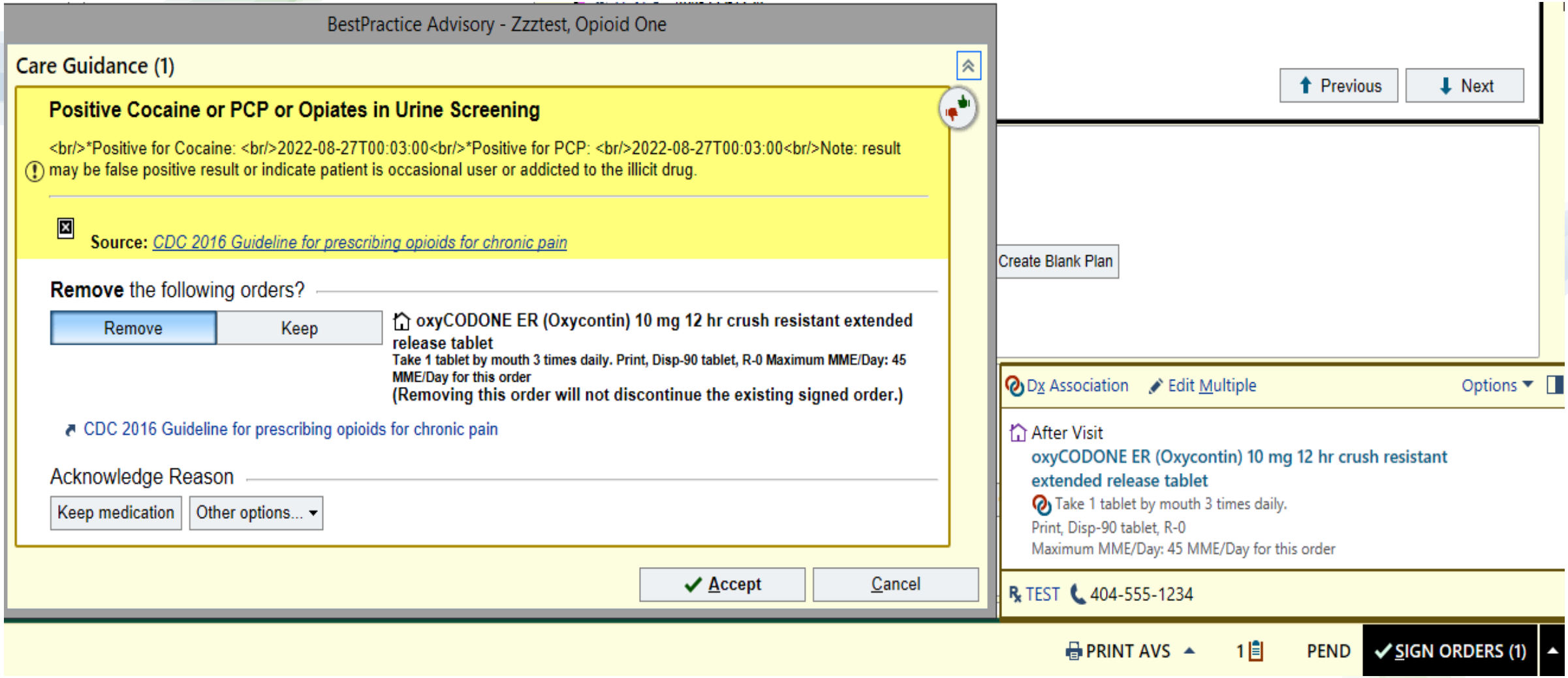
VC=Value has a corrected status

Result Care Coordination

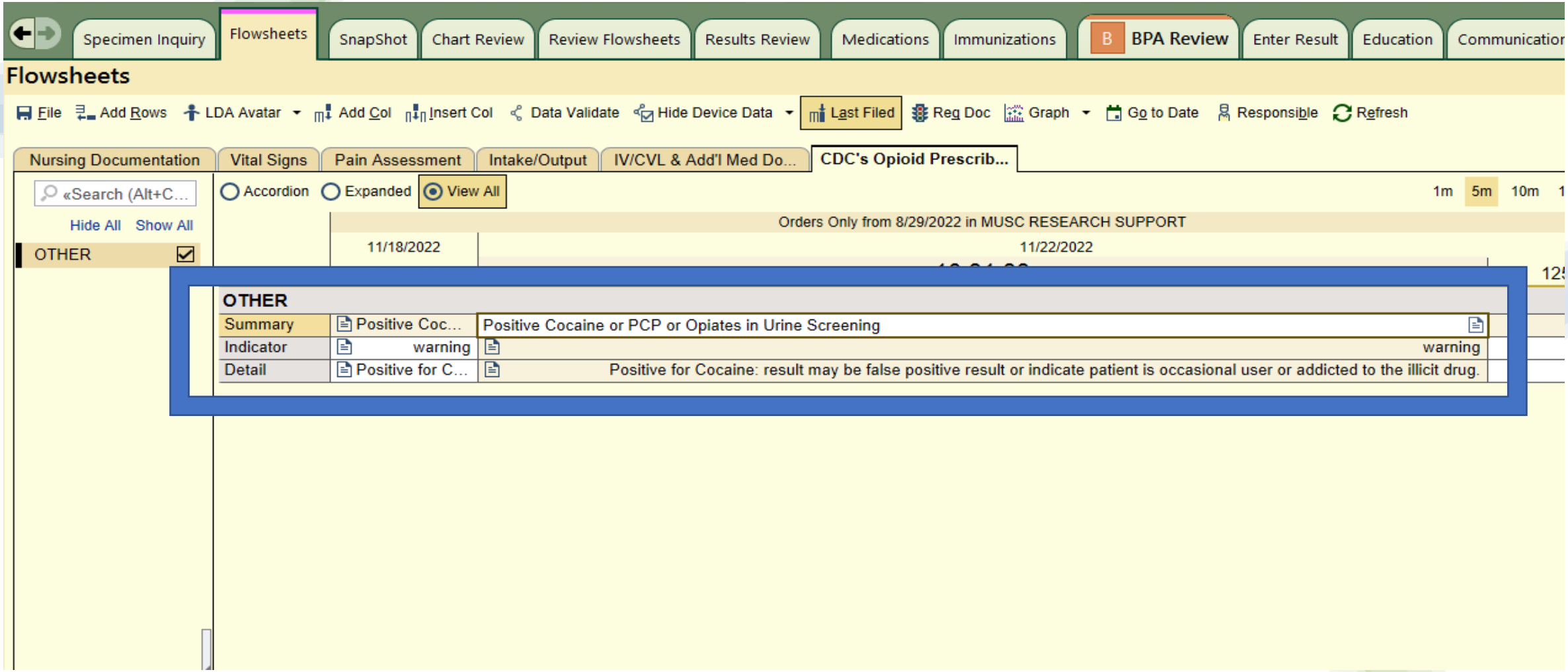
Patient Communication

Release Not seen Back to Top

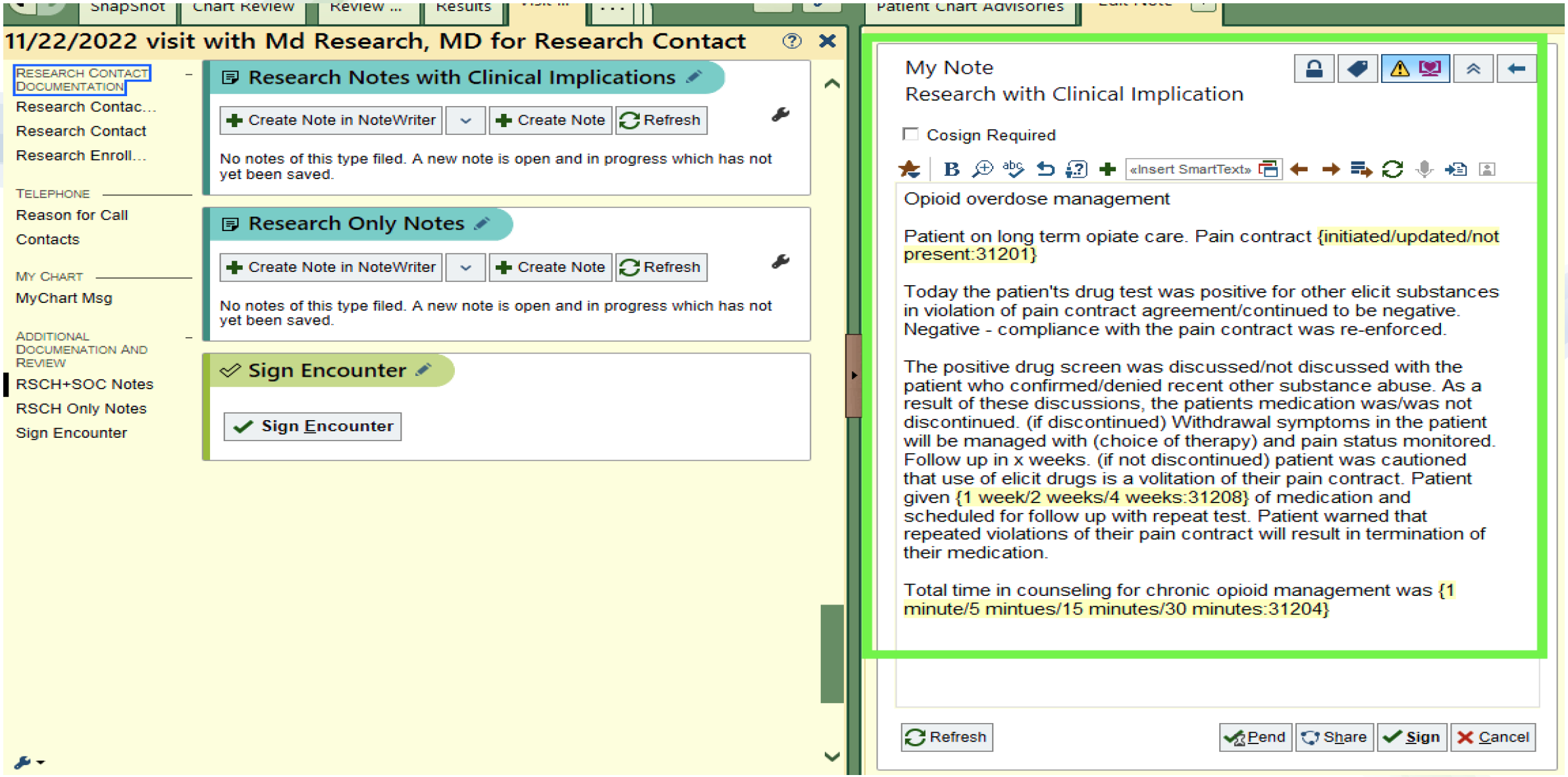
Recommendation 10 - UDT
Test case unexpected – Order Sign – **Interruptive Alert**



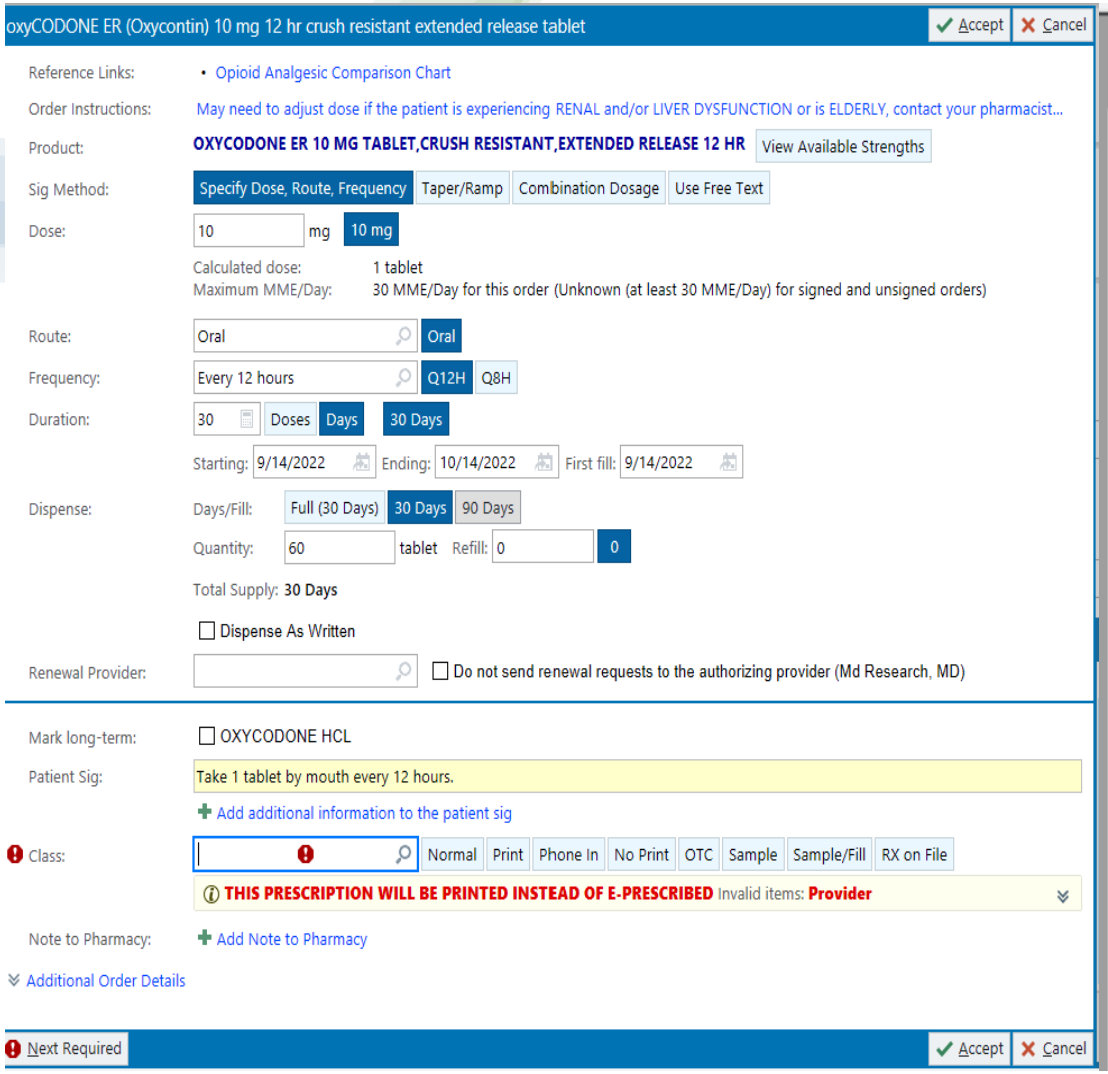
Recommendation 10 Test case 1 – Flowsheets/Data Storage

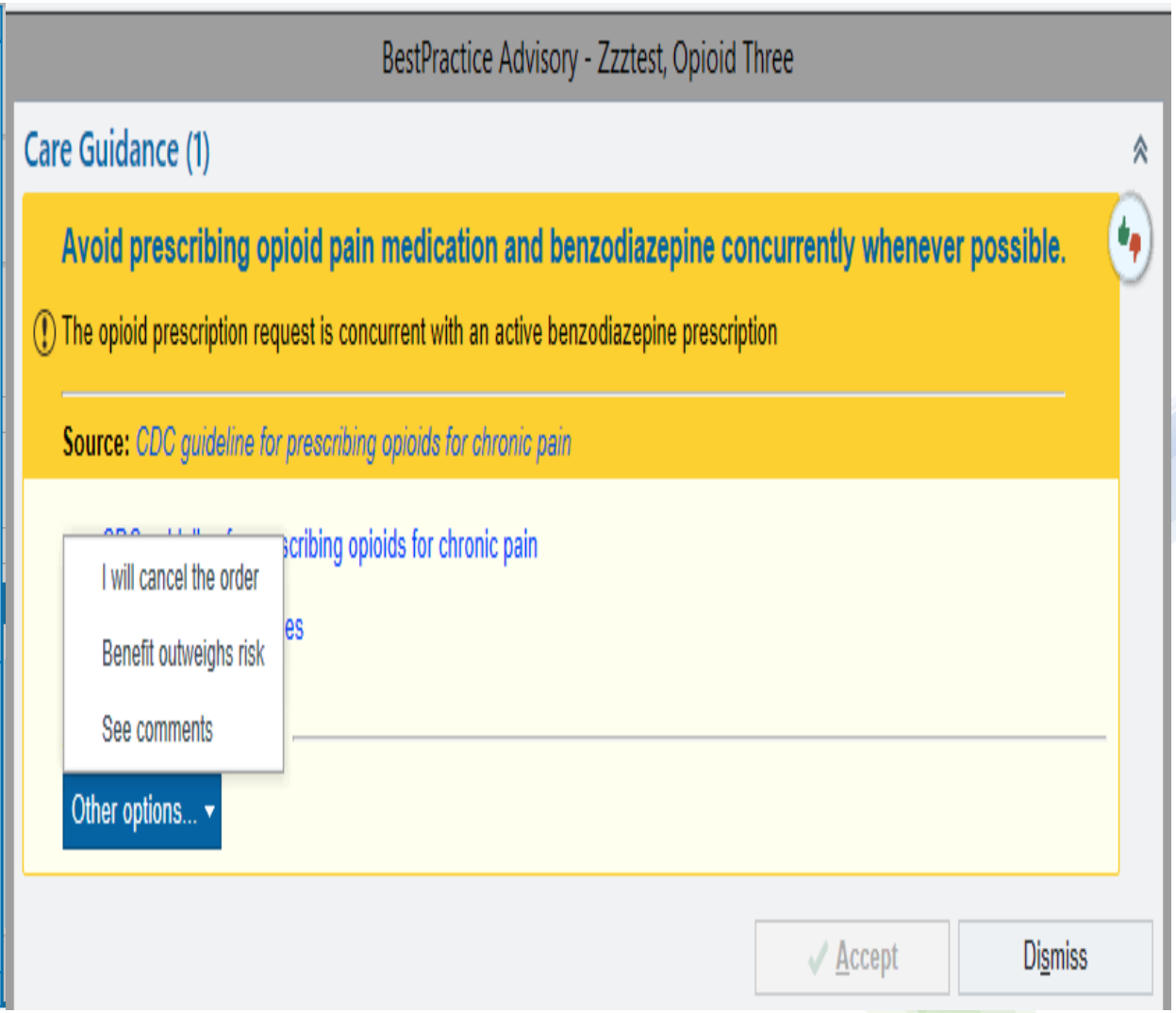


Recommendation 10 – **Non-Interruptive alert** in Epic note template



Recommendation 11 – Interruptive Alert





Conclusion

1.) Non interruptive alerts that add new tools to physician templates are a promising new technology for decision support

2.) These tools can be integrated into both traditional (inside Epic or other EHR) decision support or advanced external method

feasible to bring CDS Hooks cards back into an EHR using Smart-on-FHIR gateway using two methods.

a.) Interruptive alert pop up

b.) Non-interruptive alert in clinician's note

3.) Further study is need to assess where this new approach to non-interruptive alerts is most effective.

Lydia Drumright, PhD MPH
University of Washington
LND23@UW.EDU

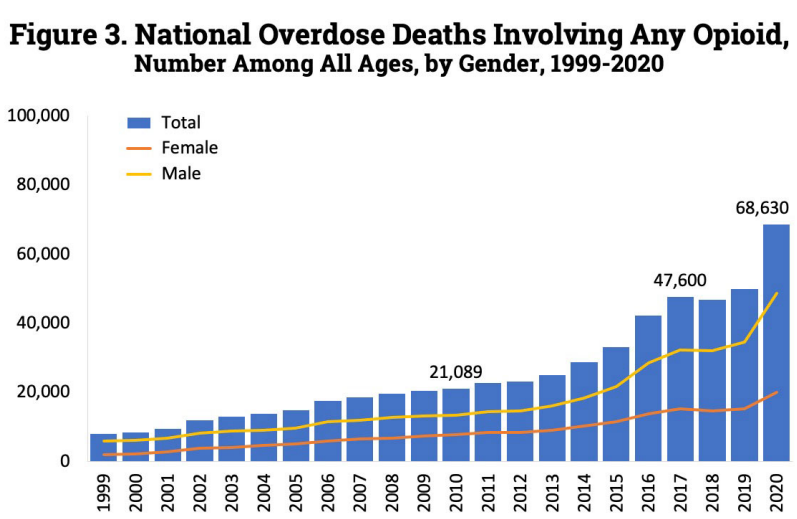
Clinical Opioid Summary with Rx Integration (COSRI) & PainTracker Integration:

Extending a SMART-on-FHIR Application for a More Integrated Patient Experience

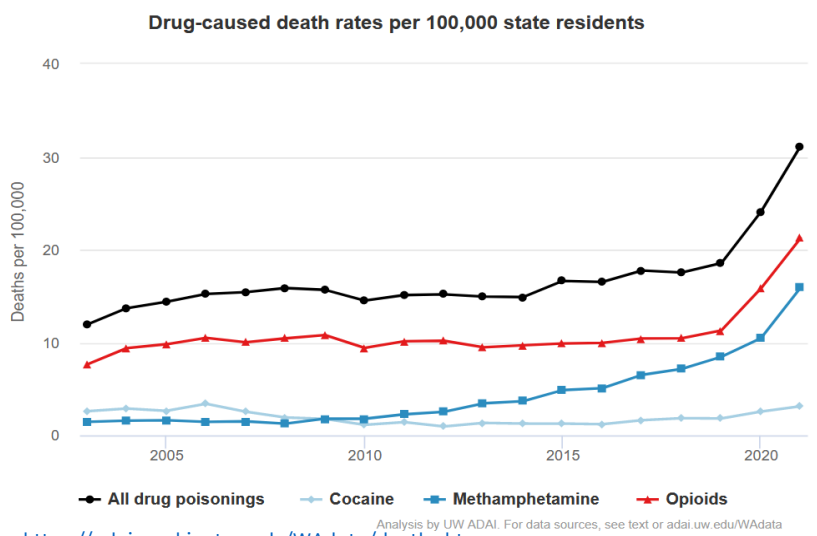
COSRI Background

Rationale for Building COSRI

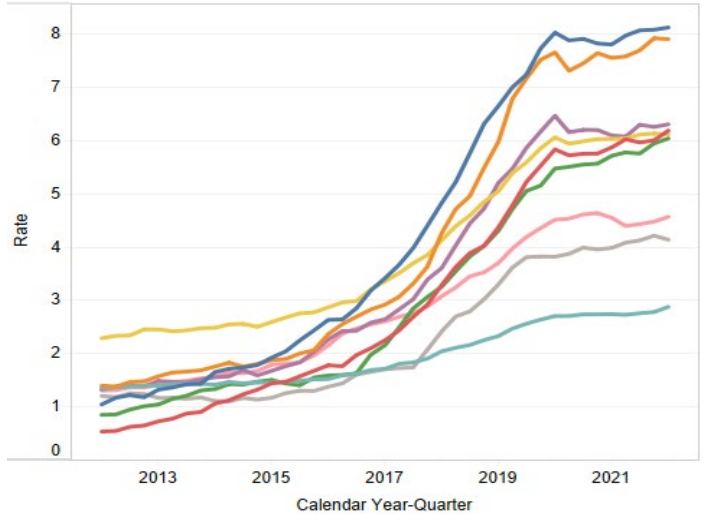
- Prescription drug monitoring programs (PDMPs) established to curtail US opioid epidemic
  - Increased information exchange to support more informed prescribing
  - Suboptimal use reported by prescribers
- Washington (WA) State
  - Fatal overdoses of non-heroin opioids continue to increase
  - Despite Department of Health (DoH) efforts opioid Rx are high (~90/1000 population)
  - 2019 UW study, providers reported difficulty accessing and cost as barriers to PDMP use



https://nida.nih.gov/research-topics/trends-statistics/overdose-death-rates



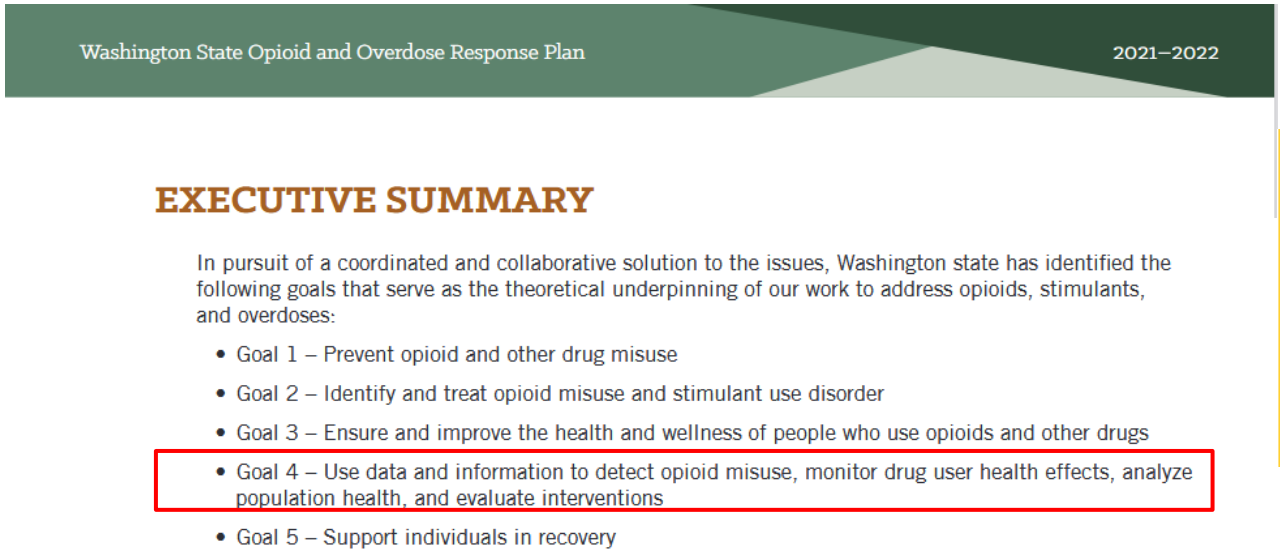
https://adai.washington.edu/WAdata/deaths.htm



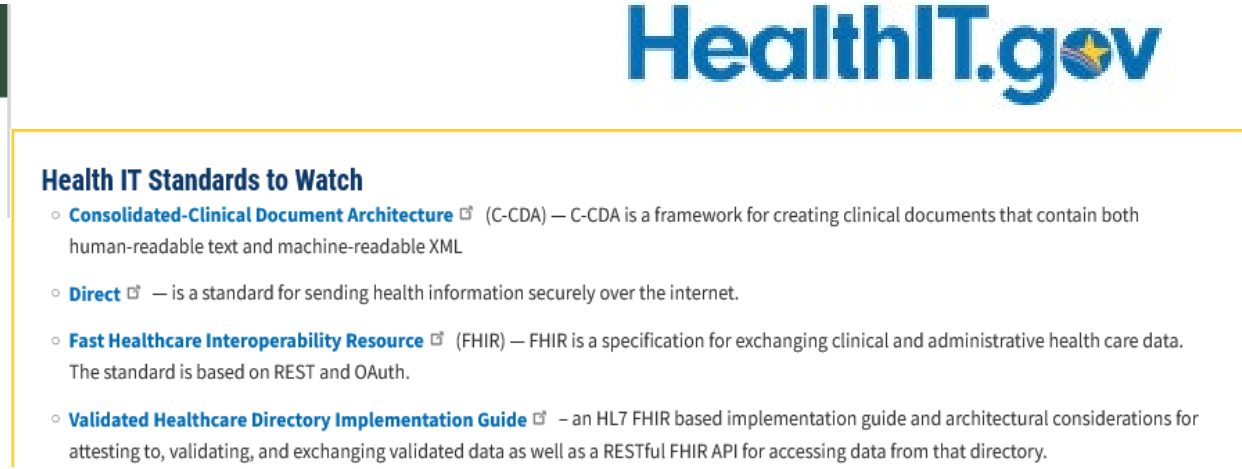
https://doh.wa.gov/data-statistical-reports/washington-tracking-network-wtn/opioids/county-prescriptions-dashboard

Framework for Building COSRI

- 2020-2021 Washington State Opioid and Overdose Response Plan
  - Strategies to promote best opioid prescribing practices and increase use of PDMP data
- UW Clinical Informatics Research Group (CIRG) & WA DoH collaboration
  - Develop a clinical decision support (CDS) app for opioid prescribing using current HIT standards
  - Goal: increased use of PDMP & support Health IT standards, demonstrate utilization of FHIR, SMART-on-FHIR and clinical quality language (CQL)



https://www.hca.wa.gov/assets/program/WashingtonStateOpioidandOverdoseResponsePlan-final-2021.pdf



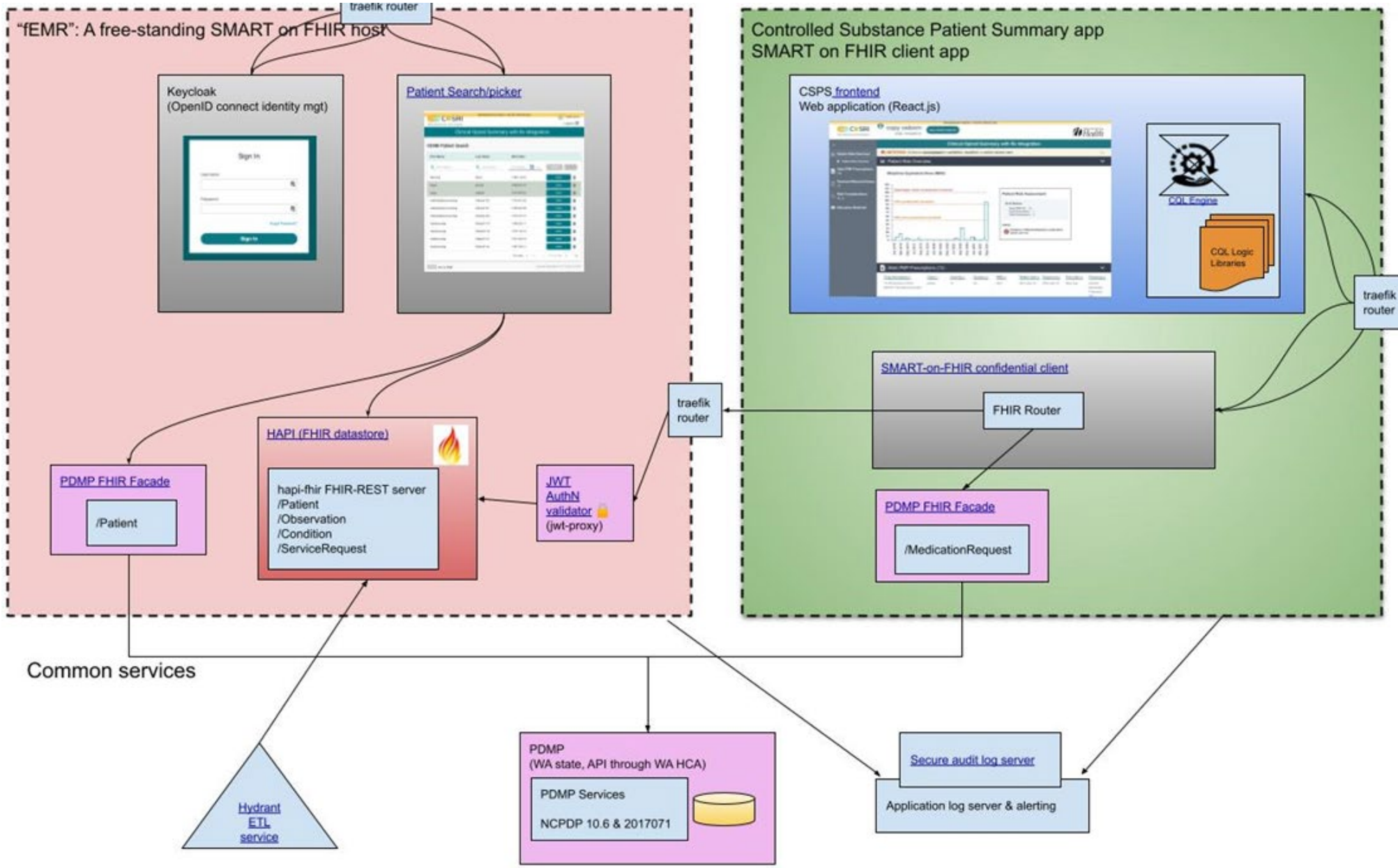
https://www.healthit.gov/topic/standards-technology/health-it-standards

Design

Utilized iterative design methodology to meet the needs of state/federal agencies (HIT standards, opioid prescribing guidelines) and providers (efficient, accessible, inexpensive)

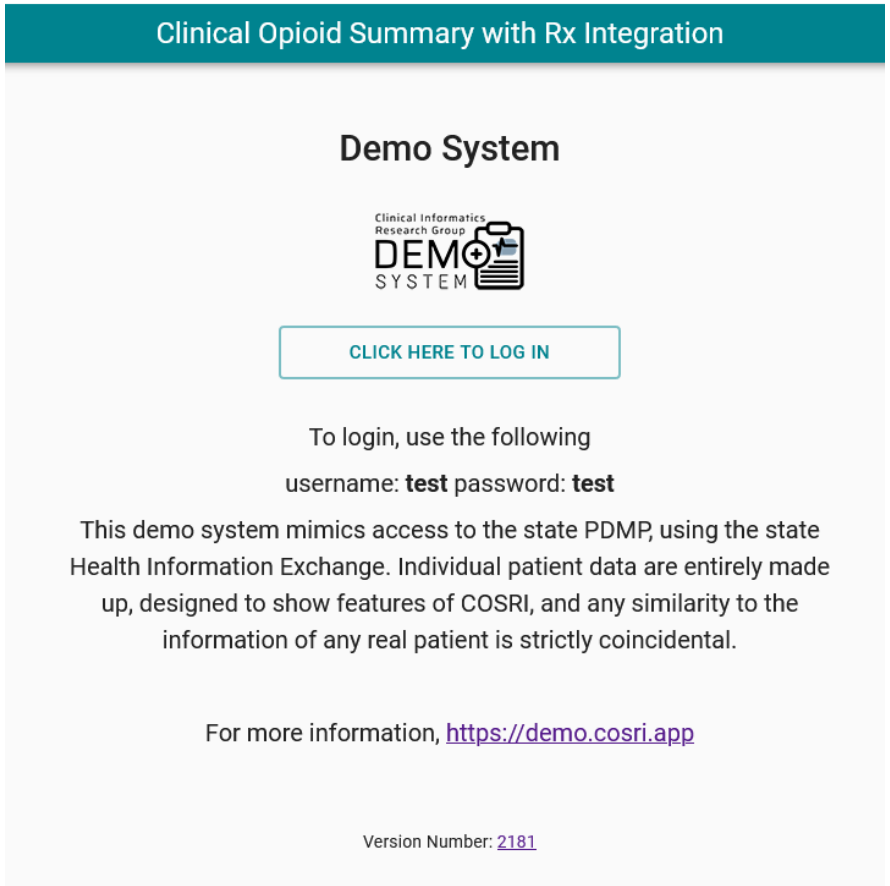
- Used open-source SMART-on-FHIR application codebase from the AHRQ CDS Connect Pain Management Summary project as template
- Extended code
  - Updated to FHIR R4 & developed a FHIR abstraction layer, or "facade" to present PDMP dispensing data
  - Incorporated milligrams of morphine equivalents (MME) CQL calculator
  - Established production connectivity to the WA State PDMP & added WA State prescribing rules to the guideline
- Iterative End User Participatory Design (focus groups & qualitative interviews)
  - Developed faux EHR ("fEMR") to serve as a SMART-on-FHIR host to launch COSRI when in free-standing mode (e.g., without integration with an EHR)
    - Supports authentication & authorization via Keycloak
  - Controlled substance classification implemented through logic mapping from NIH/NLM RxNav API returns
  - Developed extract load transform (ETL) services to receive information from clinics in the free-standing mode and store them as FHIR resources in fEMR's HAPI FHIR database
  - Ability to record urine drug screen (UDS) & controlled substance agreements (CSA) in HAPI FHIR database & present in user interface
  - Array of alerts for contra-indicated co-prescribing, UDS and CSA, high MME, failure of MME calculation, and other risks through rules implemented in Java script and CQL

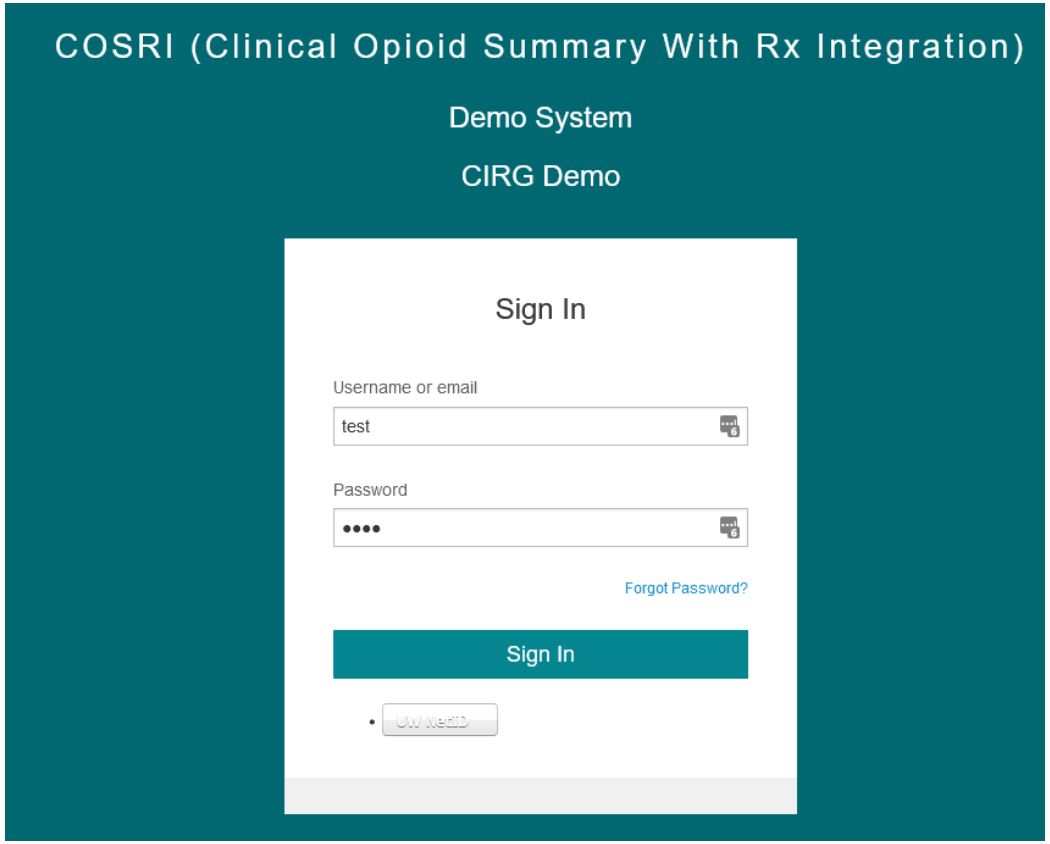
Architecture



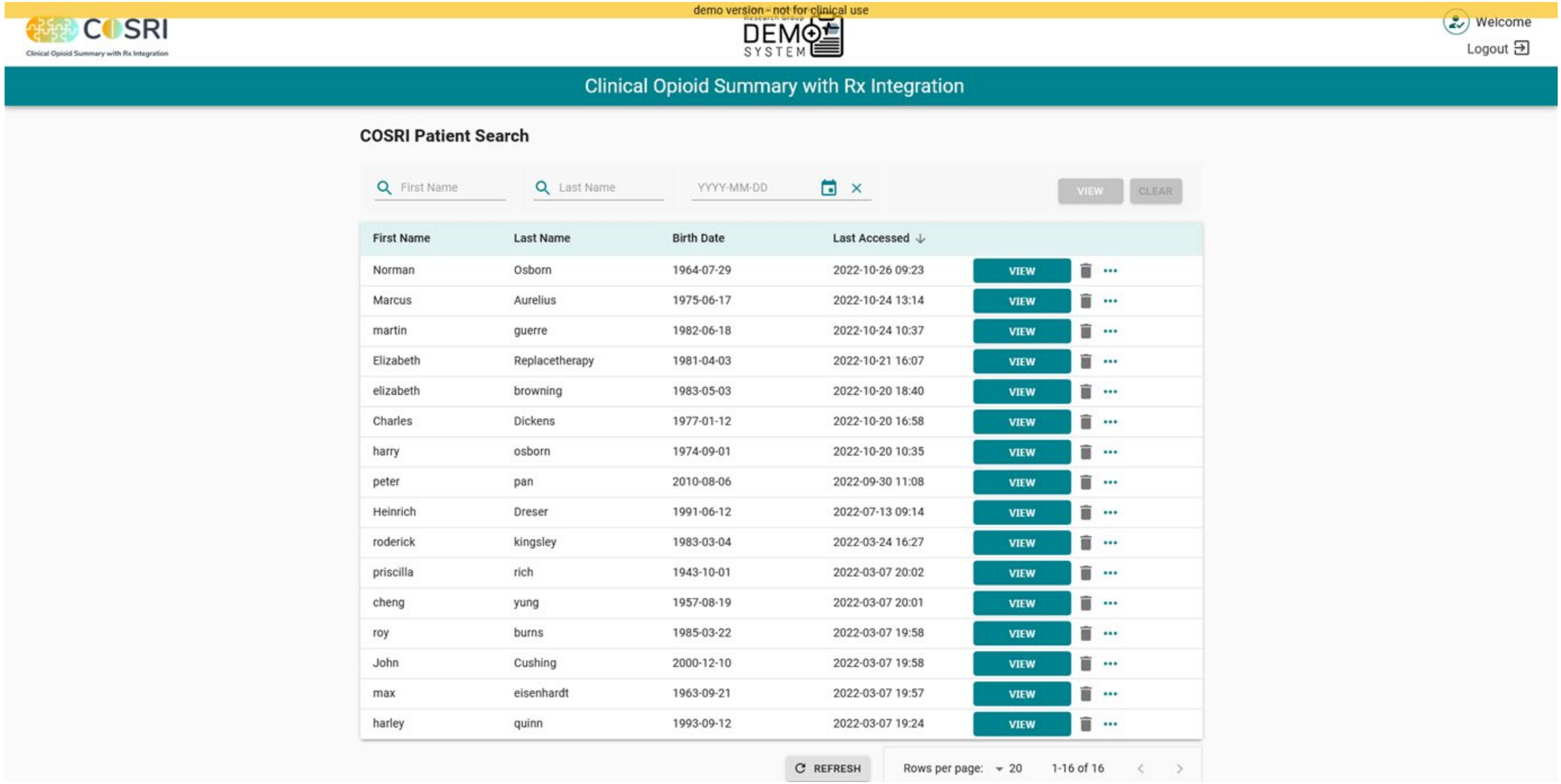
The COSRI Application

- Demo versions of COSRI can be found at:
  - Free-standing version: https://project.cosri.app/demo.html
  - EHR-integrated version:

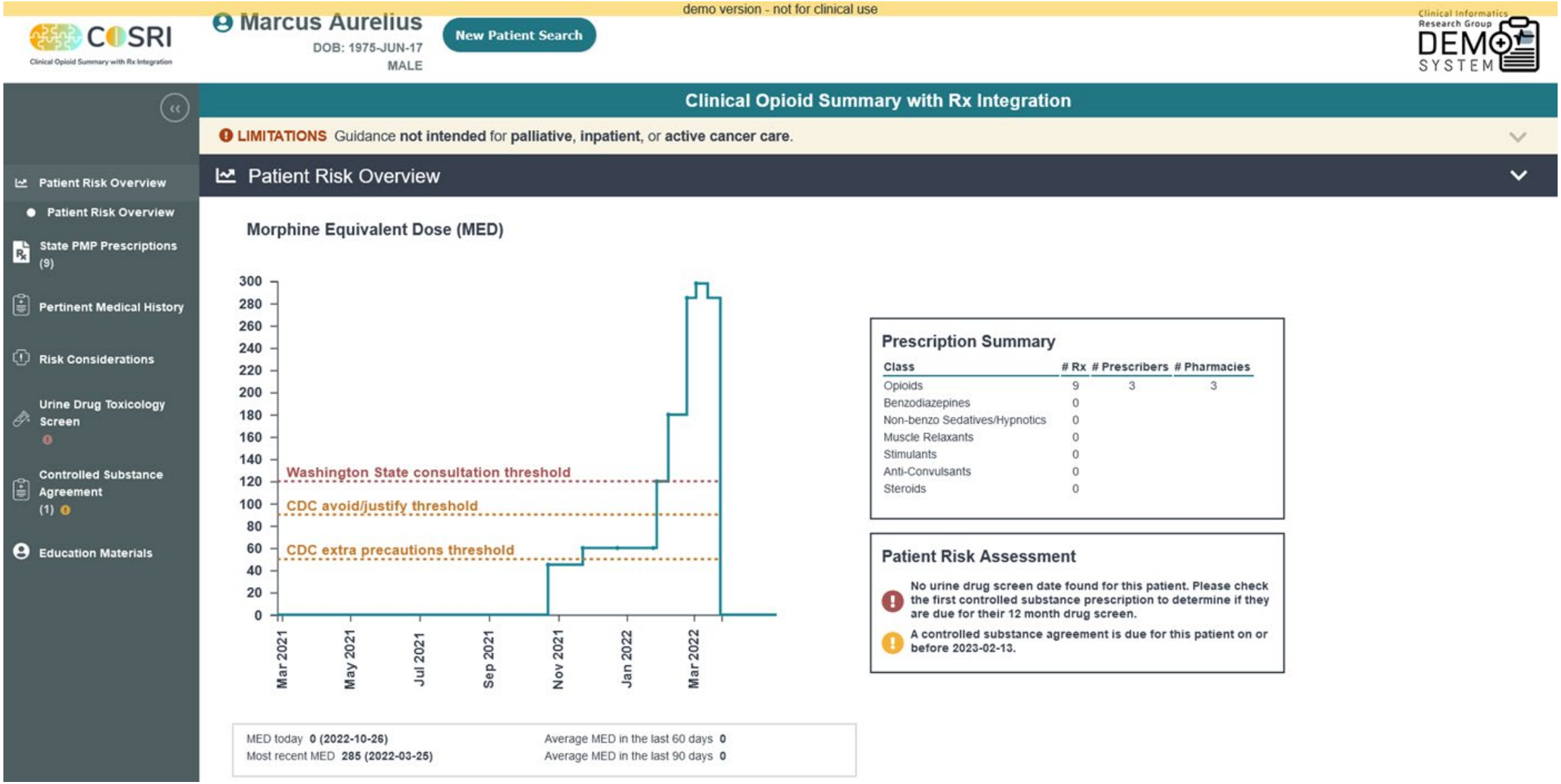




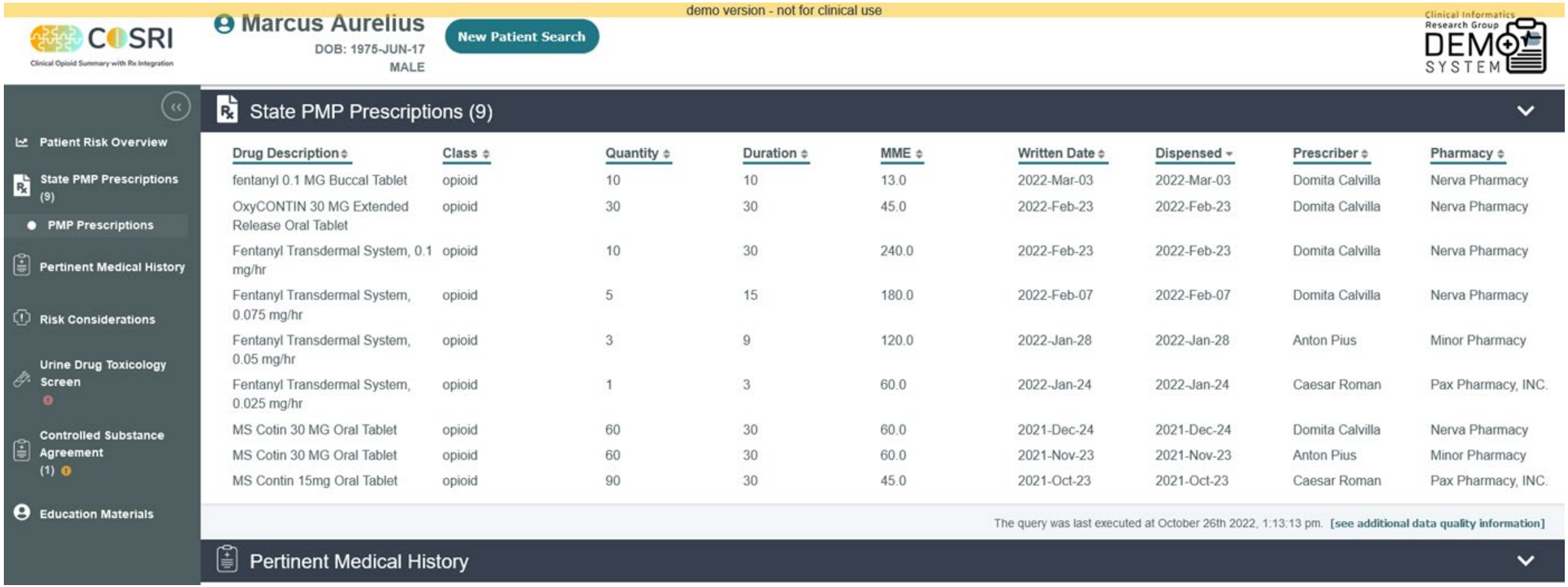
COSRI Application: Patient Search



COSRI Application: Rx Summary



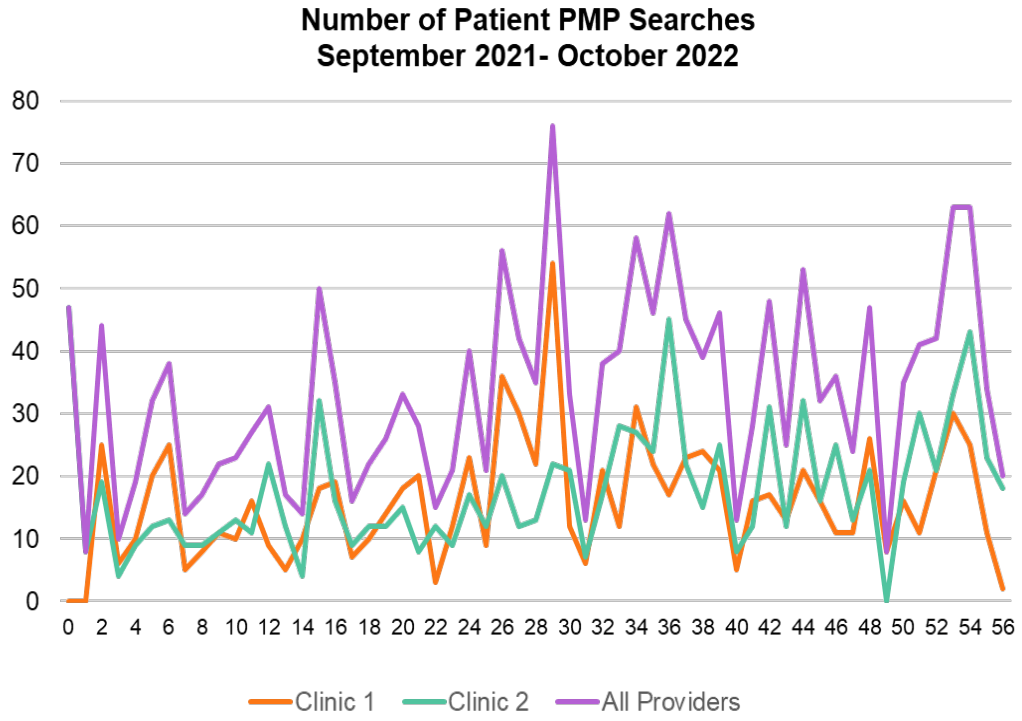
COSRI Application: Rx Details



Implementation & Evaluation

- Implemented at two primary care clinics in September/October 2021
  - Nurse practitioner owned & led
  - Low technology EHRs
  - Serving ~50% Medicaid patients
  - Standalone version
- Evaluated using a mixed methods approach
  - COSRI App logs
  - 1911 patient views/ 26 weeks
  - Qualitative interviews with providers
  - 9 user support issues logged

Provider Evaluation Interview Comments	
Ease of use	"...it's a pretty straightforward system which is nice... " "I was leaving a lot of time because before I would be like, oh login to secure access, oh go to this step go, let me send you a text message for code verification... and this is like this whole ordeal. And now I just go and I hit my Google tab and I have the bookmark saved for COSRI, and there's just the one login thing and then search the patient. It's really fast." "that's the biggest thing, its just very, very quick. A couple of clicks and you have the information..."
Patient Search	"I really like the patient search. I like how I don't have to have the patient's date of birth, you know, in front of me, like with the PDMP." "It's really fast when I type in the last name and I love how the patient, just pops up right there and it's so much easier than going into the secure access Washington."
Patient Engagement	"I like the like the display with the kind of bar chart of, you know, hitting the threshold. It can be a useful thing to show patients, like [talking to patient] 'Okay, see how it's red here? So that's the problem that I'm talking about. We've got this red line here, what are we going to do about that?'"
Favorite Features	"My favorite thing? How fast it is. It's very fast. I cannot emphasize how important that is to me." ".. Then its readability is also very nice, very clear..." "The layout is just very nice and easy to see. It's easier to look at than the PDMP [State Portal]"



Center for Pain Relief (CPR) Adoption

- CPR
  - UW Medicine
  - Chronic pain referral center providing a wide range of treatment, support, and guidance for chronic pain
  - One of the few chronic pain specialty centers that accepts Medicaid patients in WA

- Clinical Informatics Research Group (CIRG) provides CPR a patient-facing app (PainTracker)
  - PainTracker is a patient reported outcomes and measures (PRO) tool to capture key health information
    - Paper version used in clinic
    - Difficult for providers to integrate with EHR
  - CIRG implemented Web-based version in 2014
    - Produces a pdf sent electronically to the clinic

- Integration of COSRI and PainTracker
  - Could provide a holistic or “365” view of patient when assessing pain
  - Patient input into their experiences and care
  - Potential to improve delivery of care

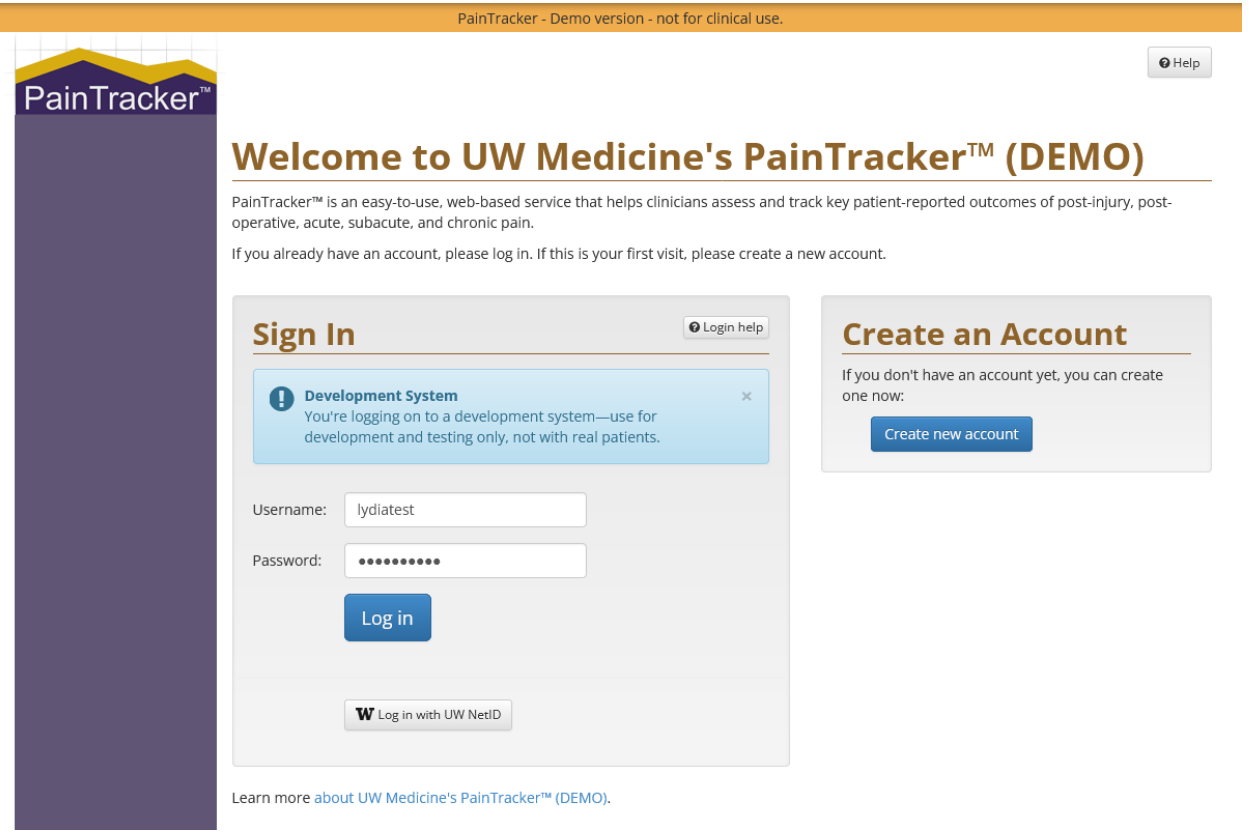
PainTracker

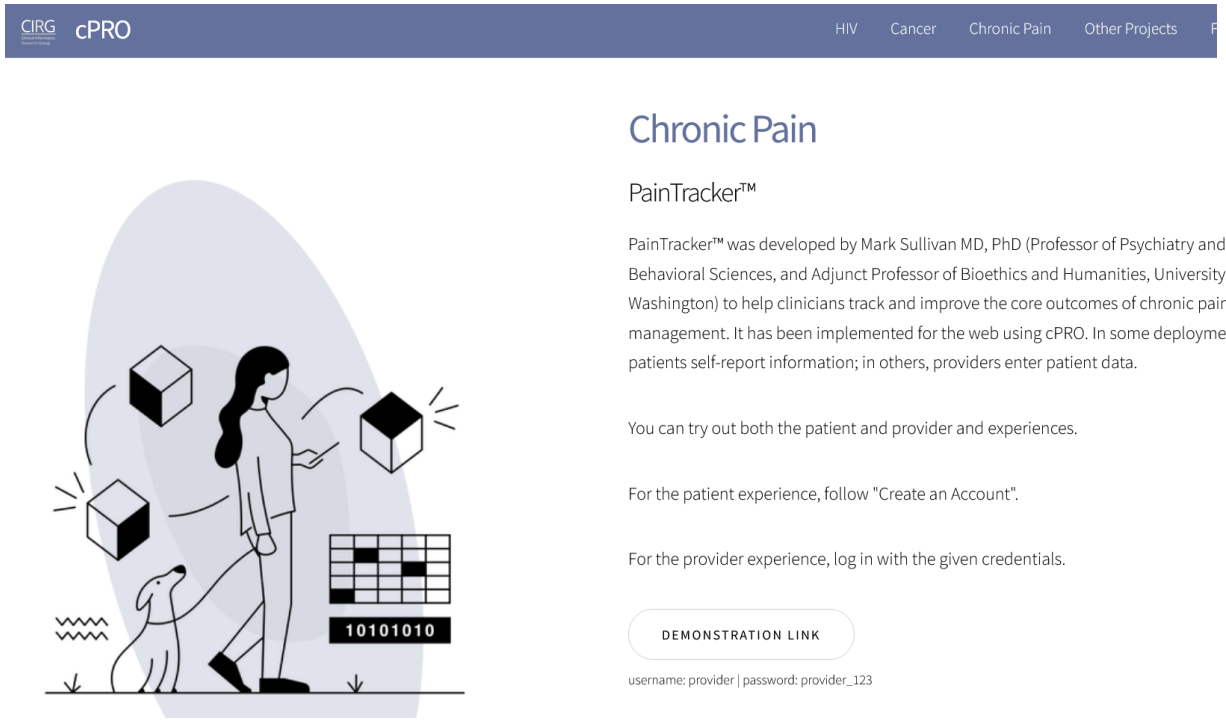
Chronic Pain is Complicated

- Can be impacted by other factors
  - Mental Health (e.g., depression, anxiety, post-traumatic stress disorder (PTSD))
  - Treatment for mental health concerns can reduce experience of pain
- Opioid therapy needs driven by other factors
  - Risk for dependency
  - Family history of dependency
  - Response to and dependency on opioids varies between individuals
  - Patients often unaware of dependency on prescribed opioids
- Goals for chronic pain management
  - Functionality, not pain free
  - PEG – Pain intensity, interference with Enjoyment of life, and interference with General activity

PainTracker Application

Demo link: https://cprohealth.org/





PainTracker PRO App

PainTracker - Demo version - not for clinical use.

PainTracker™

Help | Take a break

PainTracker

We realize that some of the questions might not address your exact situation, but we encourage you to answer them to your best ability.

Please rate your pain by choosing the one number that best describes your pain on **average**, in the last week

0 1 2 3 4 5 6 7 8 9 10

← No pain — Pain as bad as you can imagine →

Your pain may limit activities that are very important to you (e.g., sport activities, walking, working). We hope your treatment will make it easier for you to do these important activities. Please answer these following questions on your current state compared to pre-injury.

Fill in the circle of the one number that describes how, **during the past week, pain has interfered** with your:

	← Does not interfere 0	1	2	3	4	5	6	7	8	9	10 Completely interferes →
General activity	○	○	○	○	○	○	○	○	○	○	○
Enjoyment of Life	○	○	○	○	○	○	○	○	○	○	○
Falling asleep	○	○	○	○	○	○	○	○	○	○	○
Staying asleep	○	○	○	○	○	○	○	○	○	○	○

‹ Previous | Next ›

PainTracker - Demo version - not for clinical use.

PainTracker™

PainTracker

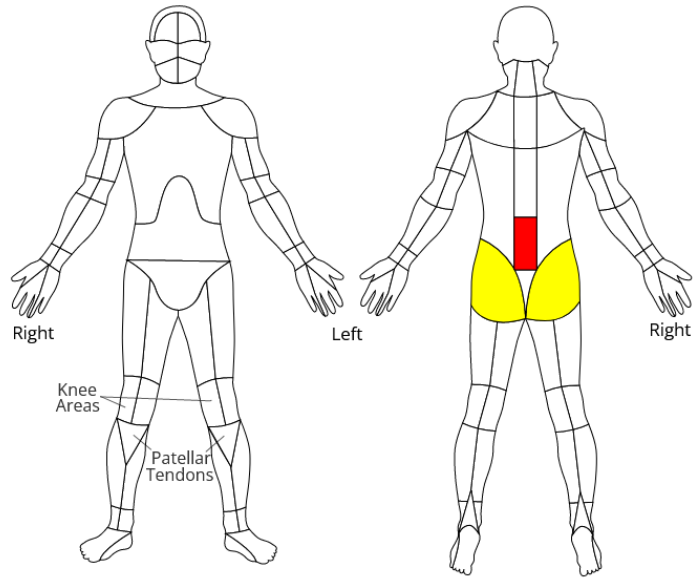
Which Areas of Your Body Are Painful?

On the diagrams below of the front and back of the body, choose which areas have pain.

- Click on the area with the worst pain—it will turn red.
- Click on any additional areas that have pain—they will turn yellow.
- If you made a mistake, click on the "Clear Areas" button to start over.
- When you're done, click the "Next" button at the bottom to continue.

Worst Pain Area: *Selected* ✔
Other Pain Areas: *2 selected*
When you're done, click the "Next" button below.

Made a mistake?
Clear Selected Areas

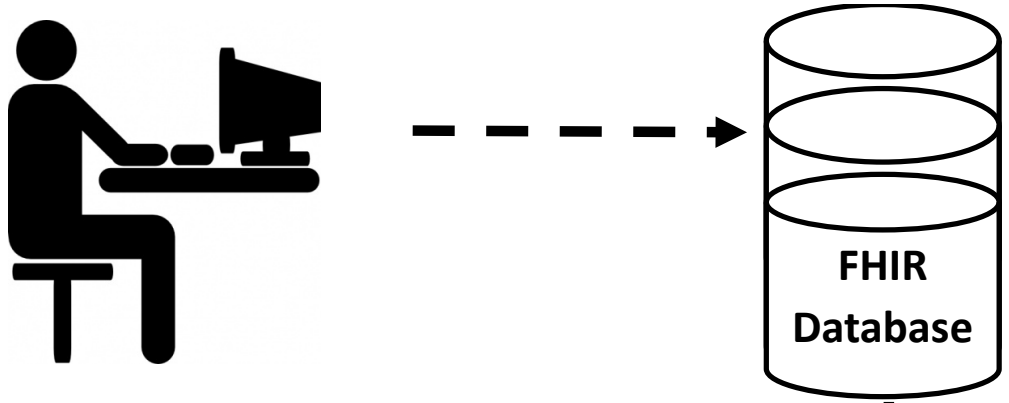


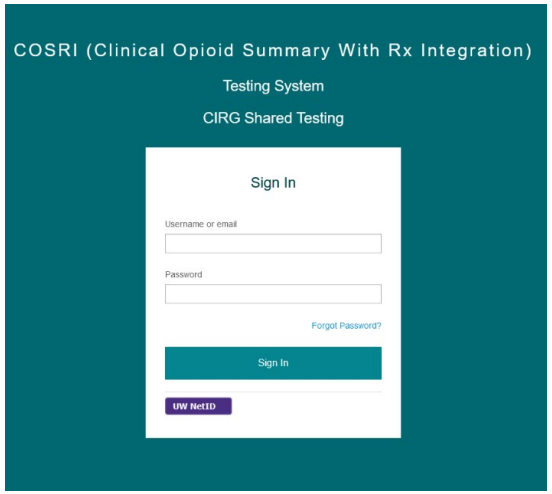
Items Assessed on the PainTracker PRO

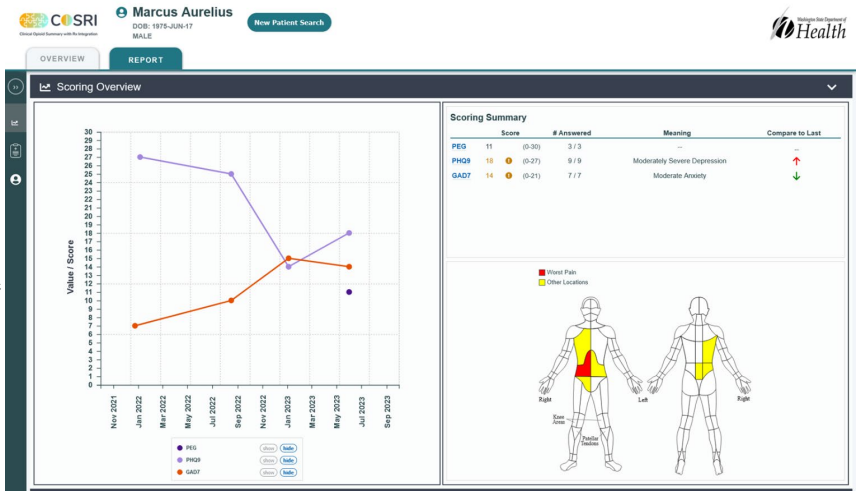
- Pain
  - Location
  - Intensity
  - Interference with life enjoyment
  - Interference with general activity
  - Interference with most important activity
- Sleep
  - STOP (from STOP-BANG)
- Depression
  - PHQ-9
- Anxiety
  - GAD-7
- PTSD
  - PC-PTSD
- Opioid Risk
  - TAPS-1
  - OPCT
- Other
  - Treatment satisfaction
  - PROMIS-GLOBAL
  - WHODAS

COSRI-PainTracker Integration

Information Flow







COSRI-PainTracker Application: Overview

COSRI
Clinical Opioid Summary with Rx Integration

Marcus Aurelius
DOB: 1975-JUN-17
MALE

New Patient Search

Washington State Department of Health

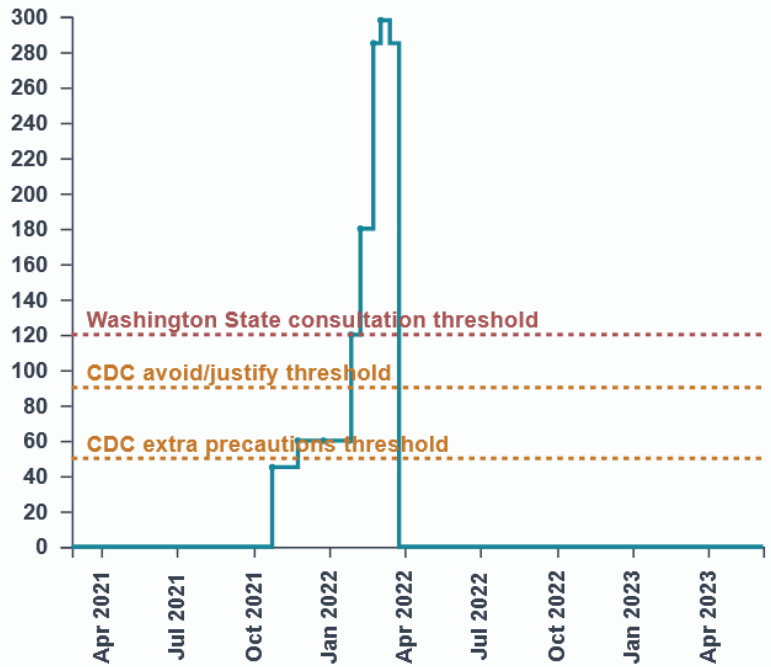
OVERVIEW | REPORT

Clinical Opioid Summary with Rx Integration

LIMITATIONS Guidance **not intended** for **palliative**, **inpatient**, or **active cancer care**.

Patient Risk Overview

Morphine Equivalent Dose (MED)



Prescription Summary

Class	# Rx	# Prescribers	# Pharmacies
Opioids	9	3	3
Benzodiazepines	0		
Non-benzo Sedatives/Hypnotics	0		
Muscle Relaxants	0		
Stimulants	0		
Anti-Convulsants	0		
Steroids	0		

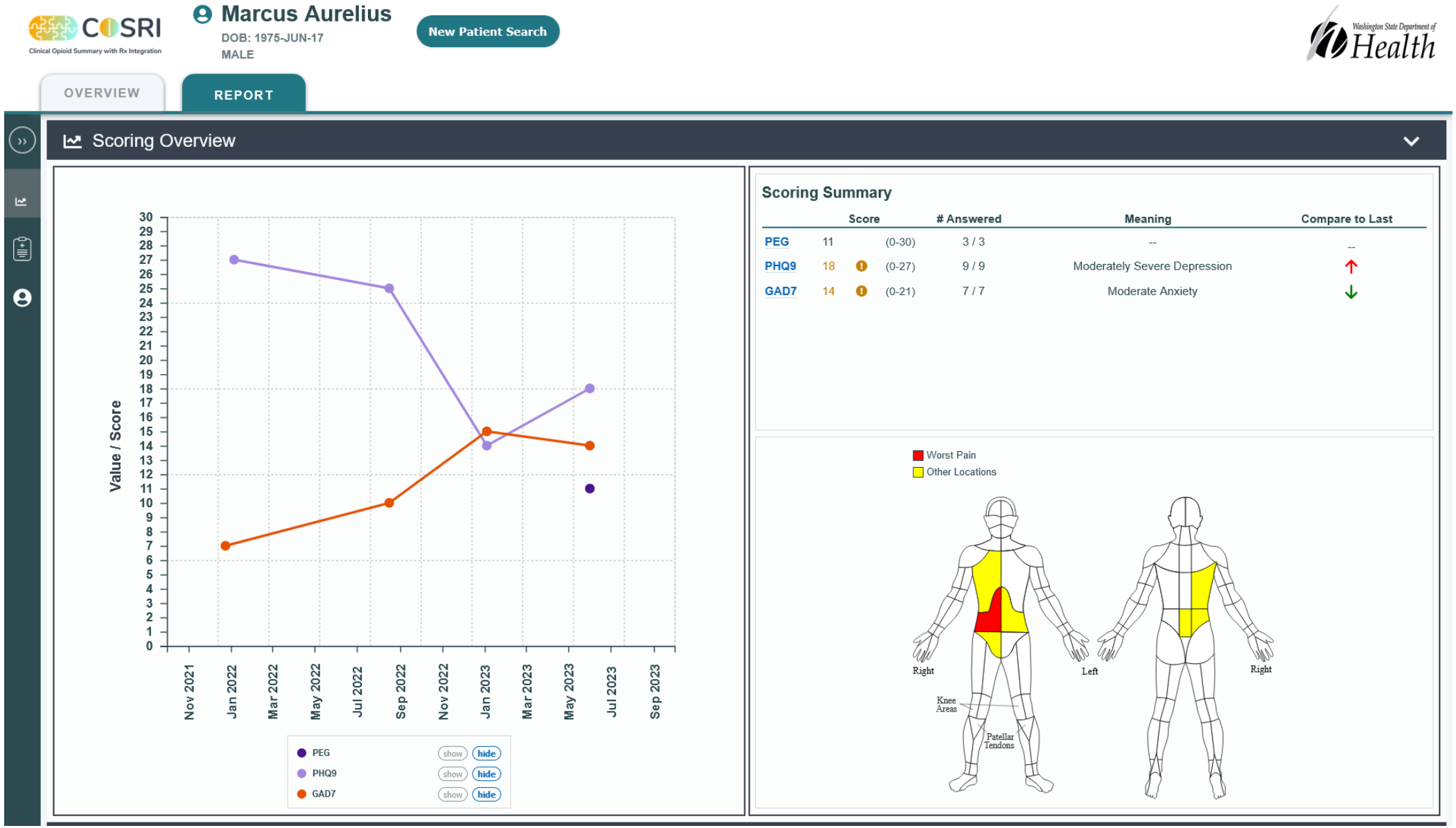
Patient Risk Assessment

No alert entries found

Questionnaire Summary

	Score		# Answered	Meaning	Compare To Last
PEG	11	(0-30)	3 / 3	--	--
PHQ9	18	(0-27)	9 / 9	Moderately Severe Depression	↑
GAD7	14	(0-21)	7 / 7	Moderate Anxiety	↓

COSRI-PainTracker Application: PainTracker Report



COSRI-PainTracker Application: PainTracker Report Details

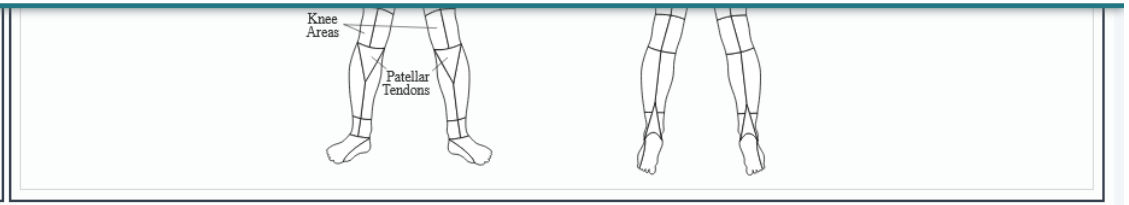
COSRI
Clinical Opioid Summary with Rx Integration

Marcus Aurelius
DOB: 1975-JUN-17
MALE

New Patient Search

Washington State Department of Health

OVERVIEW | REPORT



Pain and Limitation

Pain intensity, Enjoyment of life, General activity (PEG) 3 item pain scale more info

Sum Score	Mean Score	Responses completed	Responses
11	3	1	Last on Jun 02, 2023

Mental Health, Quality of Life and Sleep

PHQ-9 (Patient Health Questionnaire-9) more info

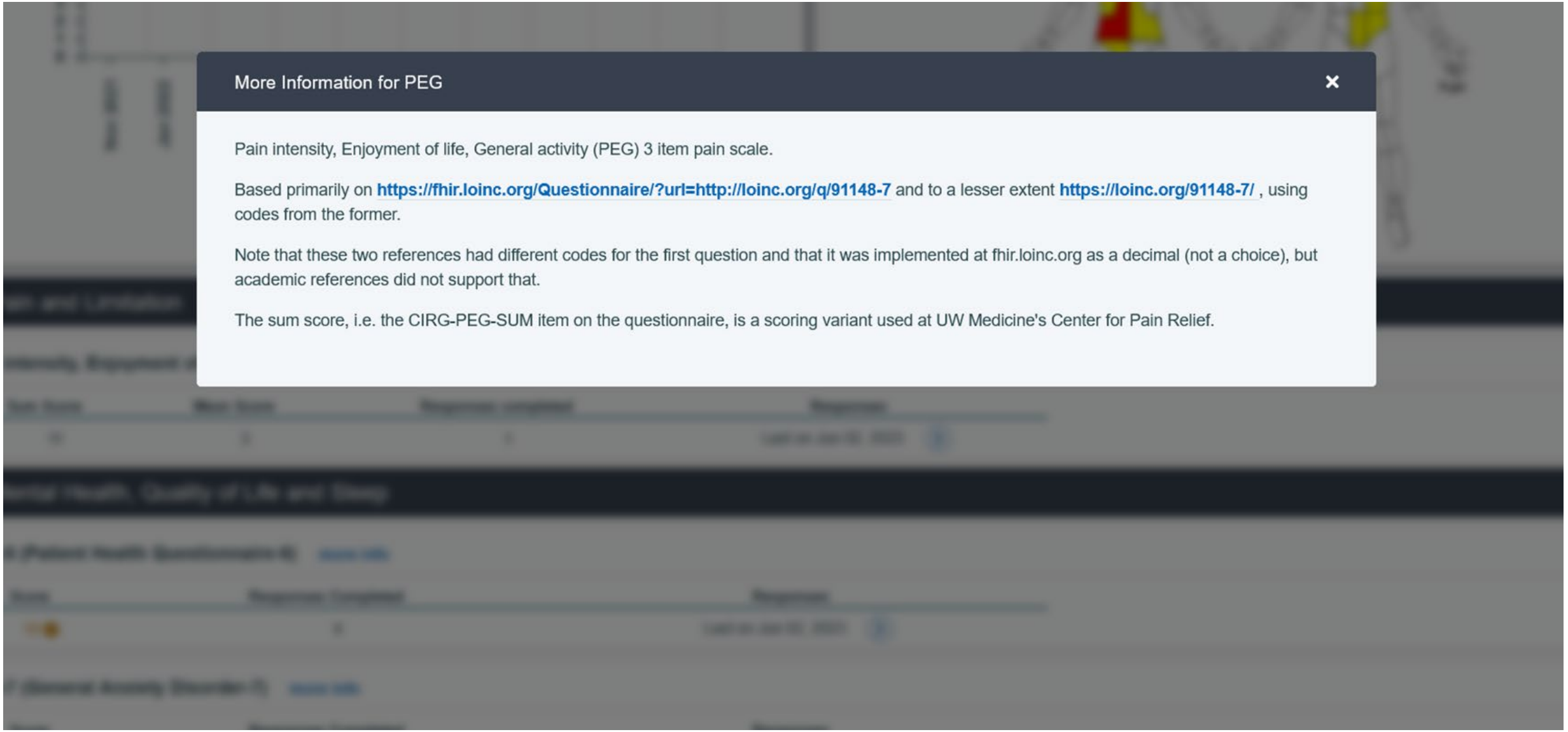
Score	Responses Completed	Responses
18	4	Last on Jun 02, 2023

GAD-7 (General Anxiety Disorder-7) more info

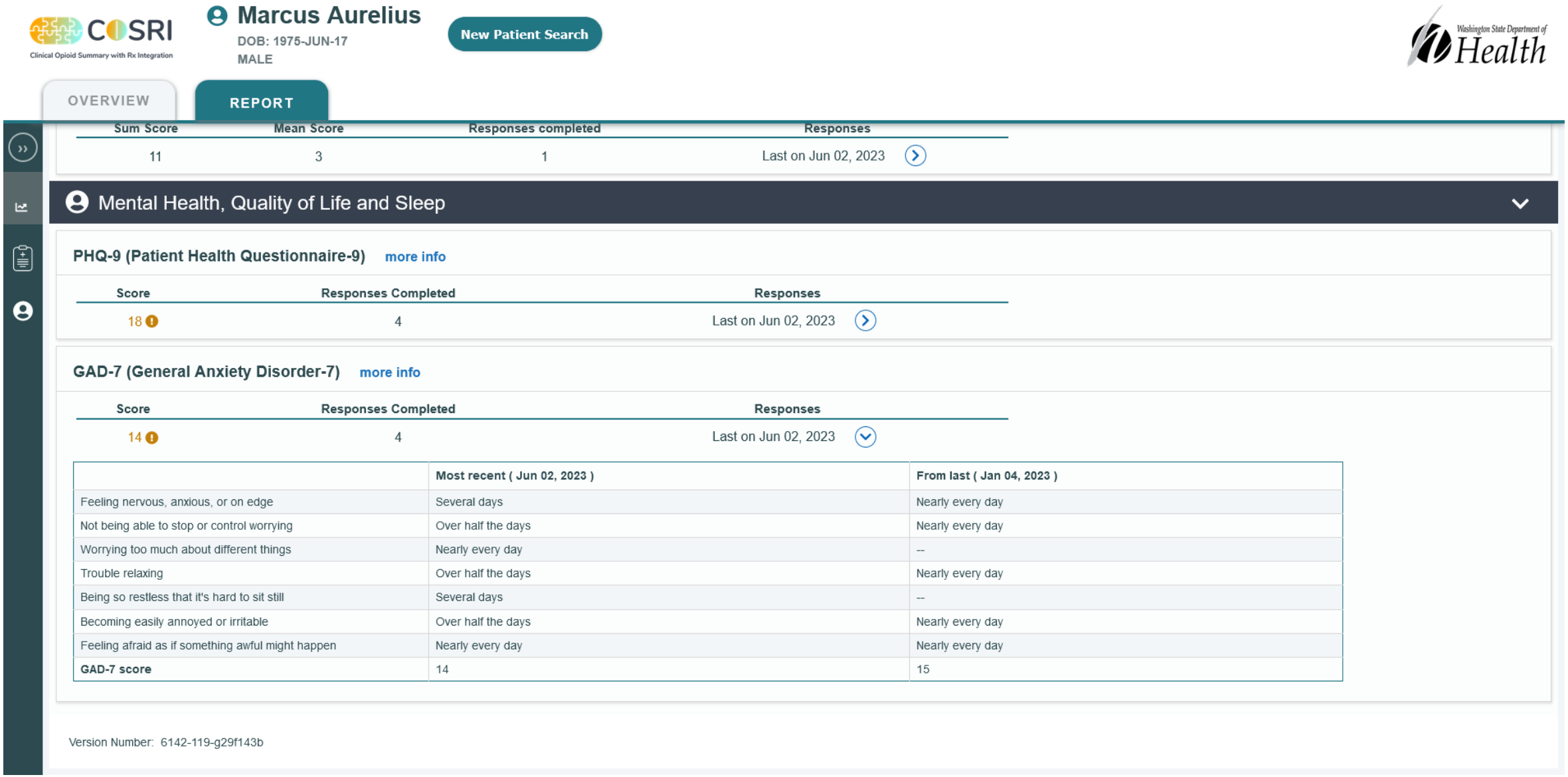
Score	Responses Completed	Responses
14	4	Last on Jun 02, 2023

Version Number: 6142-119-g29f143b

COSRI-PainTracker Application: PainTracker Report Details



COSRI-PainTracker Application: PainTracker Report Details



End User Development/ Assessment

- Prototype ready
  - Development
  - Stage

- End user input
  - Qualitative “think out loud” sessions
  - June 2023

- Measures
  - Usefulness of summary data
  - Ease of user interface layout
  - Match to workflow
  - Additional CDS
  - Additional tools
  - Current challenges

Future Activities

- Update COSRI-PainTracker based in end user input
- Create FHIR QuestionnaireResponses for all other questionnaires in PainTracker
- Develop implementation guidance
- Production Instance
- Training
- Pilot testing of COSRI-PainTracker at UW
- Iterative development
- Evaluation
  - Usage metrics
  - Qualitative interviews

Acknowledgements

COSRI & PT Development Team

Paul Bugni **Amy Chen**
Ivan Cvitkovic **John Howe**
Justin McReynolds **Daniel Lorigan**
Donna Berry Maggie Dorr
Jenny Lee Jan Flowers

Partners:

Washington State Department of Health

Washington State Health Care Authority

OneHealthPort

Other Research Partners

- Laura-Mae Baldwin
- WWAMI region Practice and Research Network (WPRN)
- Ginny Weir
- Bree Collaborative

Funding Provide by:

- **Development**: Washington State Healthcare Authority and the US Centers for Medicare & Medicaid Services
- **Initial Clinic Implementation**: Contract #GS-35F-540GA order# HHSP233201800327G, under which Accenture Federal Services served as a contractor to the Office of the National Coordinator for Health Information Technology (ONC)
- **Scaling**: Contract # GS-35F-0034W/75P00122F80168, under which Security Risk Solutions served a contractor to the ONC

Clinical Decision Support in Primary Care

Design and Outcomes of Wizard Projects @ HealthPartners

Deepa Appana

Patrick J. O'Connor, MD, MA, MPH

HealthPartners Institute, Minnesota

Conflict of Interest

Patrick J. O'Connor reports no industry funding, but has received current or recent Research Grants from NCI, NHLBI, NIDDK, NIA, NICHD, AHRQ, NIMH, NIDA, PCORI, CMS, and other federal sources.

Deepa Appana reports no industry funding.

Preview

- Priorities Wizard developed since 2006 with 12 NIH Grants ($40 M)
- Currently Used at adult and pediatric encounters in 12 medical groups in 10 states caring for about 3 million patients
- Tested for impact in a series of clinic-randomized trials
  - Better glucose and BP control in diabetes patients
  - Better BP care/control in high-risk safety net patients
  - Improves CVD risk in adults without DM or CVD
  - Improves reversible CVD risk in Serious mental Illness
  - May reduce Health Care Disparities based on race
  - No impact on Prediabetes Care
- Persistent High Use Rates and Clinician Satisfaction

Living in the Primary Care Jungle

- 300 clicks per encounter
- 18-25+ encounters per day; 3-5 problems per encounter
- EMR in-basket out of control
- Endless BPAs and alerts; interrupts thought and eye contact
- Hard stops = rage reaction
- In an EMR-lenghtened 11-hour day do >5 hours of EMR documentation (much of it “pajama time”)
- Paid less than any other types of clinicians
- >40% would not again choose to be a clinician (true of all docs)

	Priority Wizard CDS Design Elements
1.	**Web-based and EHR integrated**
2.	**Person centered rather than disease focused:** Delivers personalized and prioritized CDS content across multiple clinical domains
3.	**Prioritzed:** CDS based on EHR information and sophisticated algorithms housed in the Priority Wizard web service (suggestions based on distance from goal, comorbidities, allergies, lab values, previous procedures, safety considerations)
4.	**NO MOUSE CLICKS: Reliance on a BPA pop up to rooming staff to open and print CDS tools:** one page for patients and one page for clinicians print together when clicking on a link in the BPA for targeted high risk patients
5	**Discussion and shared decision making** about priority conditions is facilitated through patient engagement (one patient page) and clinician efficiency (one clinician page)
6	**Active Guideline Features (optional & rarely used):** Quick orders for labs, meds, referrals suggested by Wizard, access to patient info materials, facilitates documentation
7	**Dot Phrases**: Popular and widely used for documentation and for post-visit decisions

tals/Current Medications MTM/Pharmacy Outreach Notes

WIZARD© Suggestions FAQ

Clinical Priorities | Mayo Statin Tool

PRIORITY WIZARD © Provider Patient Print

Relevant Conditions: Diabetes

10-year Cardiovascular Risk : 3.4% (Risk of stroke or heart attack over the next 10 years)

#1 LIPID

Goal: Consider statin initiation.

Treatment Considerations

- Statin initiation or intensification is recommended due to diabetes and CV risk. Many experts recommend moderate therapy.

Other Alerts

- Baseline ALT measurement is recommended by many experts prior to statin therapy initiation.

Results		
LDL (mg/dl)	106	10/11/19
HDL (mg/dl)	54	10/11/19
TRIG (mg/dl)	204	10/11/19
TC (mg/dl)	201	10/11/19

No Medications

#2 GLYCEMIC CONTROL

Goal: A1C <= 6.9

Other Alerts

- Need updated A1c to guide recommendations.
- Consider monthly visits and/or interim phone calls until A1c goal achieved.
- Urinary albumin excretion test (e.g. UMACR) may be due.
- Diabetes educator and/or dietitian support is suggested.

Results		
A1C	7.4	8/16/18

Medications

Insulin Aspart Soln Pen-injector 100 Unit/ML
Insulin Glargine Soln Pen-Injector 100 Unit/ML

BMI (WEIGHT)

Treatment Considerations

- Discuss advantages of reducing weight by 10-20 lbs. Potential actions are listed on patient interface.

Results		
Weight(lbs)	220	10/11/19
BMI	29.84	10/11/19

No Medications

RELEVANT INFORMATION AND RECOMMENDATIONS

BLOOD PRESSURE

- Consider adding hypertension to the patient problem list based on meeting guidelines from the American Heart Association.
- A referral for ambulatory BP monitoring can be helpful to guide diagnostic and treatment decisions.

TOBACCO

- Passive smoking exposure is noted. Suggest smoke free home and auto.

ASPIRIN

- Aspirin is not recommended for primary prevention for adults at low to moderate CV risk (10-year CV risk less than 10%)

Results		
BP (mm Hg)	119/75	10/11/19
Last BP (mm Hg)	125/90	5/16/19
Smoking Status/Review Date	PASSIVE	10/11/19
Smokeless Tobacco	NOT ASKED	10/11/19

No medications

/Vitals/Current Medications MTM/Pharmacy Outreach Notes

WIZARD© Suggestions FAQ

Clinical Priorities | Mayo Statin Tool

PRIORITY WIZARD © Provider Patient Print

TALK TO YOUR DOCTOR ABOUT HOW YOU CAN IMPROVE YOUR HEALTH

Start the conversation! Use the priorities below as a guide to take action to better your health.

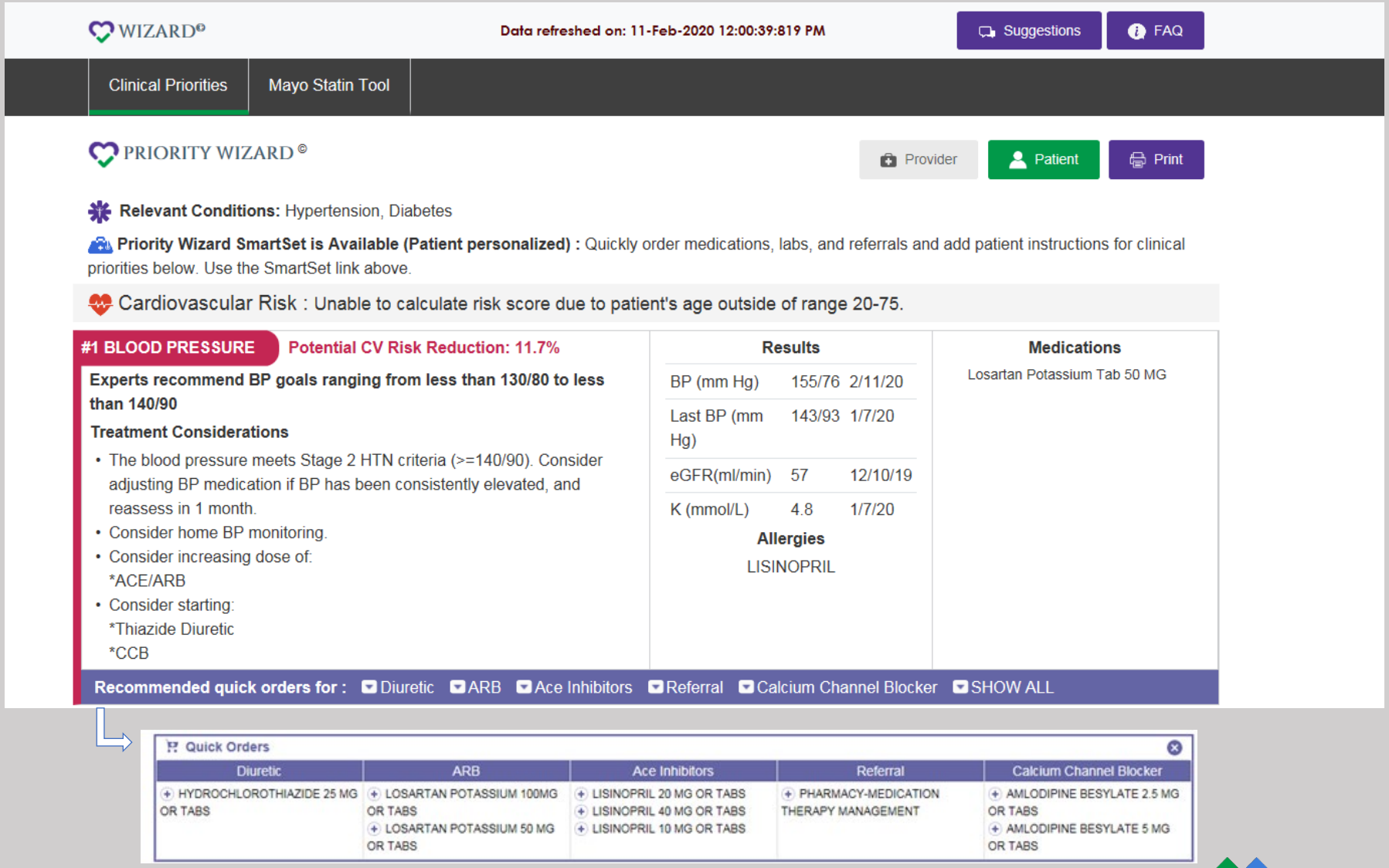
High Priority | Needs Attention | Doing well

CHOLESTEROL	Your LDL: 106	A cholesterol lowering drug called a statin may be beneficial for you. Talk to your doctor.
BLOOD SUGAR	Your A1C: 7.4	**Your Goal: A1C less than 7** You may be due for an A1c test. It would be a good idea for you to see a diabetes educator or dietitian.
WEIGHT	Your Weight : 220	For support with weight management contact: HP Nutrition Services (952-967-7616), or visit www.healthpartners.com/healthyliving, or call your clinic.
BLOOD PRESSURE	Your Blood Pressure:(119/75)	**Ideal BP < 120/80**
TOBACCO		**Good work maintaining your health!**

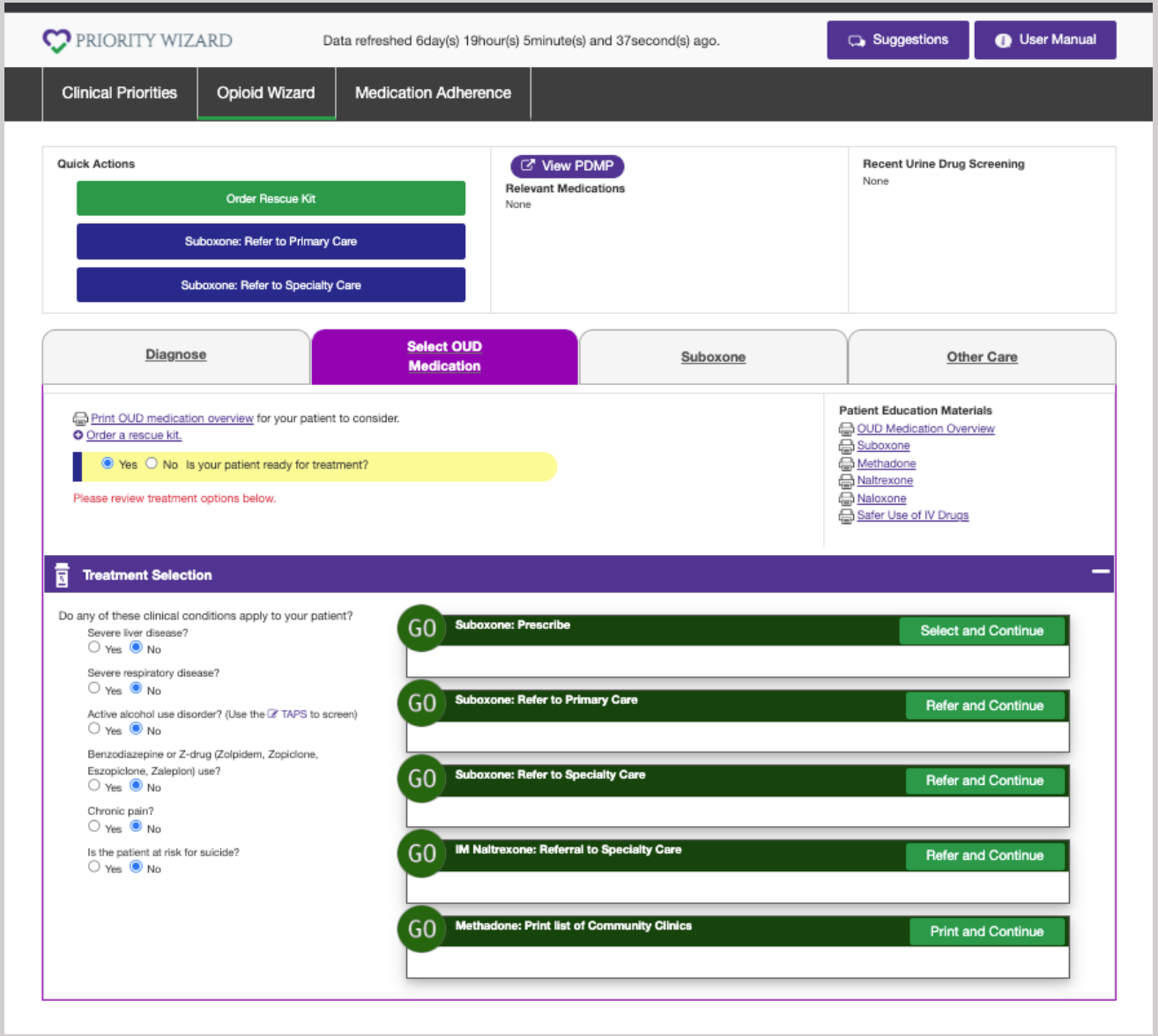
How are you liking the Wizard tool? Please take a quick survey to provide us feedback.
www.healthpartners.com/wizardsurvey

HealthPartners® Institute

Quick Orders in Active Guideline



Domain Specific Tools



Data

DATA

- Patient Demographics
- Vitals
- Labs
- Allergies
- Prescriptions
- Imaging
- Immunizations
- Procedures
- Diagnosis/Problem list
- Care Episodes
- Visit history
- Family History
- Referrals

DOMAINS

- BP
- A1C
- Lipids
- Smoking
- Aspirin
- Weight
- Opioid Use
- Cancer
- CKD
- Adherence
- Cognitive Impairment
- Pre-diabetes

Current Architecture

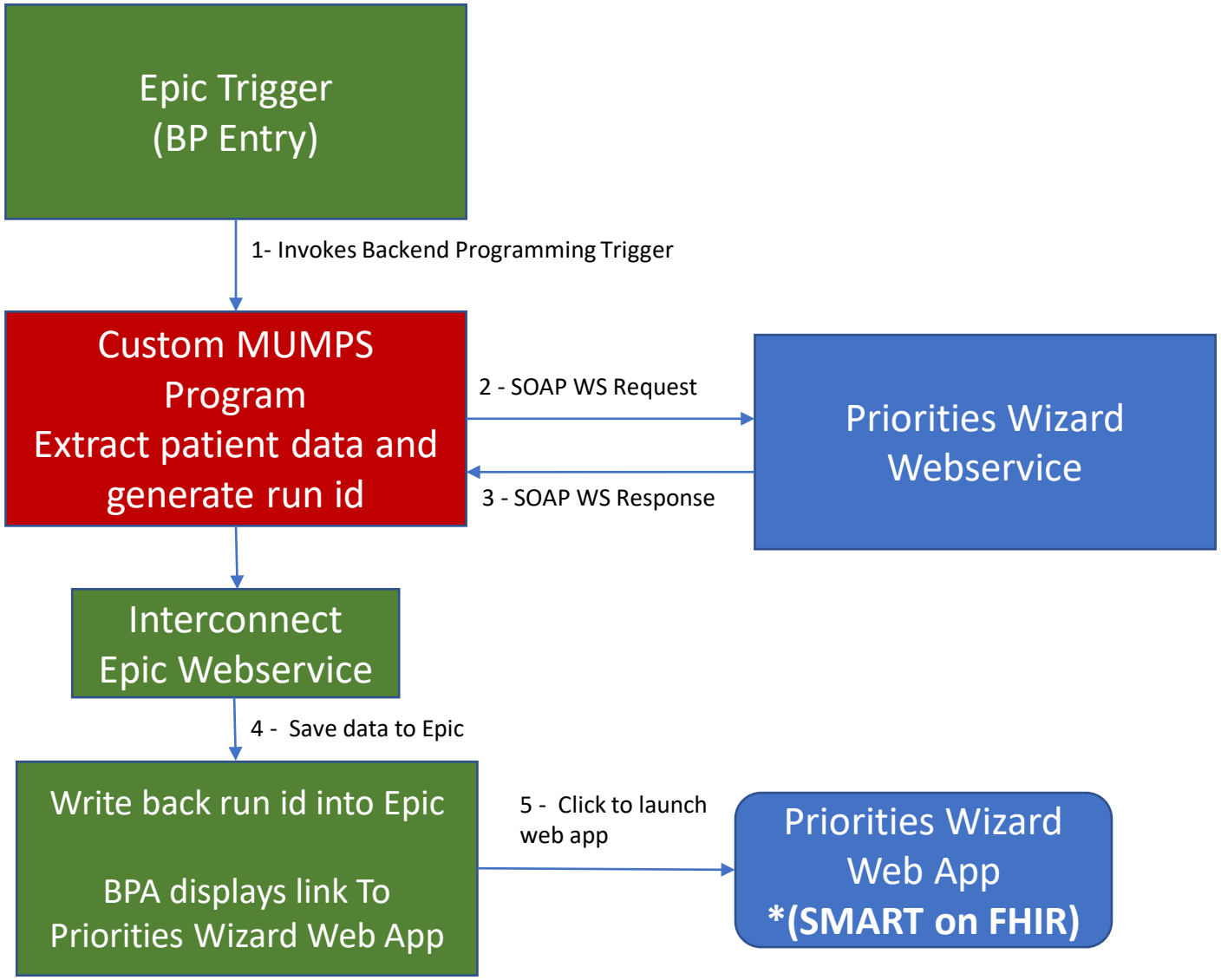
Technology

- Custom code in EHR
- Mapping client specific codes
- Security based on IP Whitelisting and SSL
- Reliance on EHR specific rules
- < 300 ms response time

Challenges

- Limited to Epic
- Long implementation 6-18 months
- Reluctance to maintain custom code
- Not many developers with the skillset at the implementation site

Current Architecture



HealthPartners Institute

FHIR

- CDS Hooks
- SMART on FHIR App Launch
- Writeback
- Standardized code sets

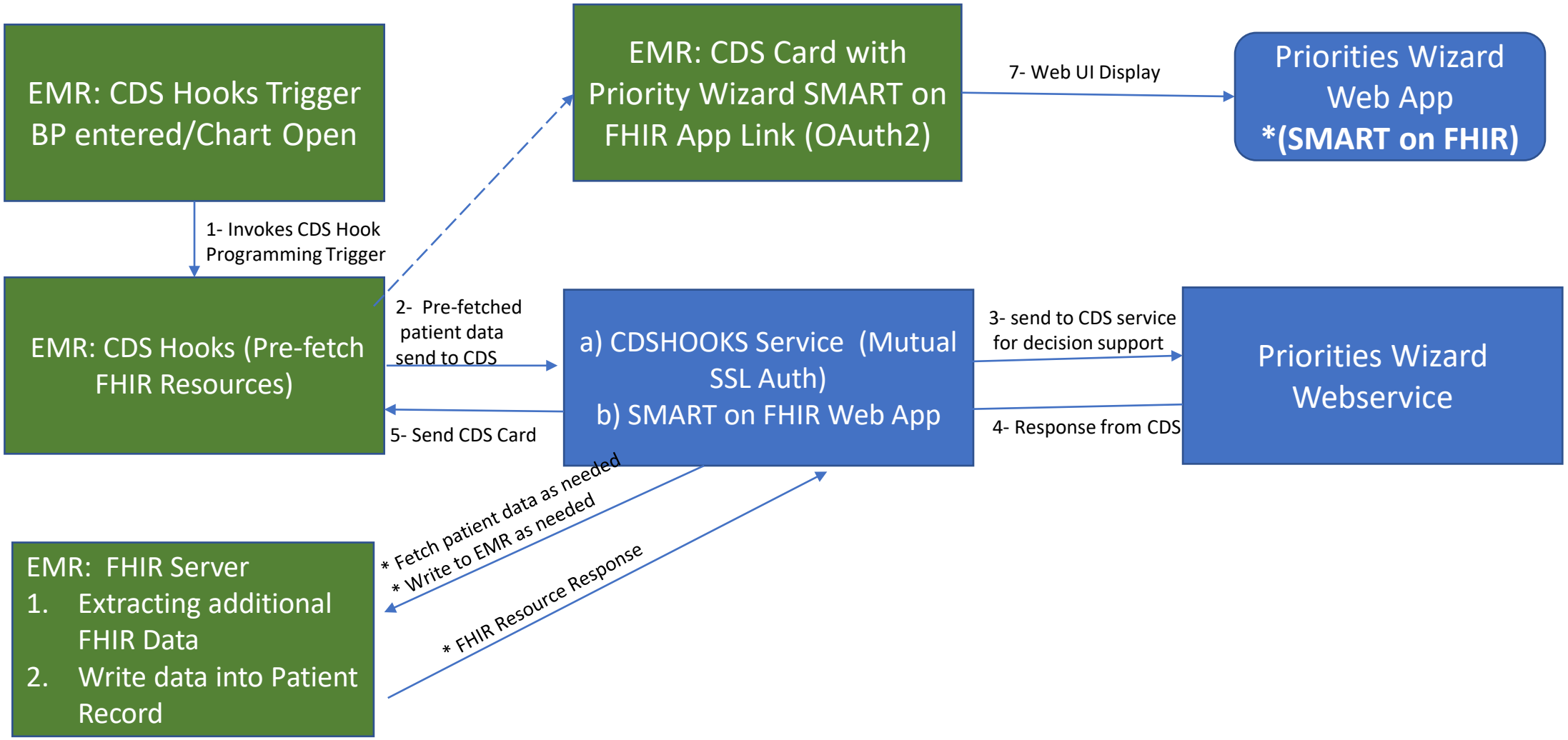
Advantages

- EHR Agnostic
- Quicker implementation
- Less build in the EHR

Challenges

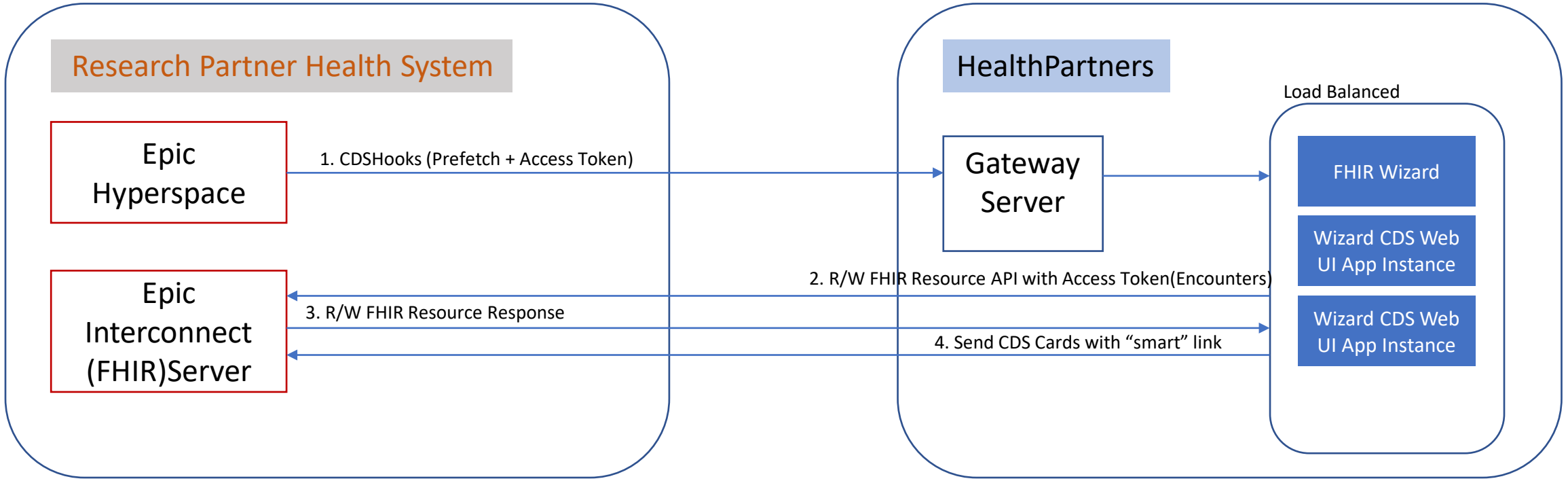
- Limited trigger points
- Limited flexibility (diagnosis, patient data)
- Latency
- Non-standard data is hard to find
- Not all orgs have the code sets implemented uniformly
- Implementation is not standard
- dotPhrase functionality

FHIR



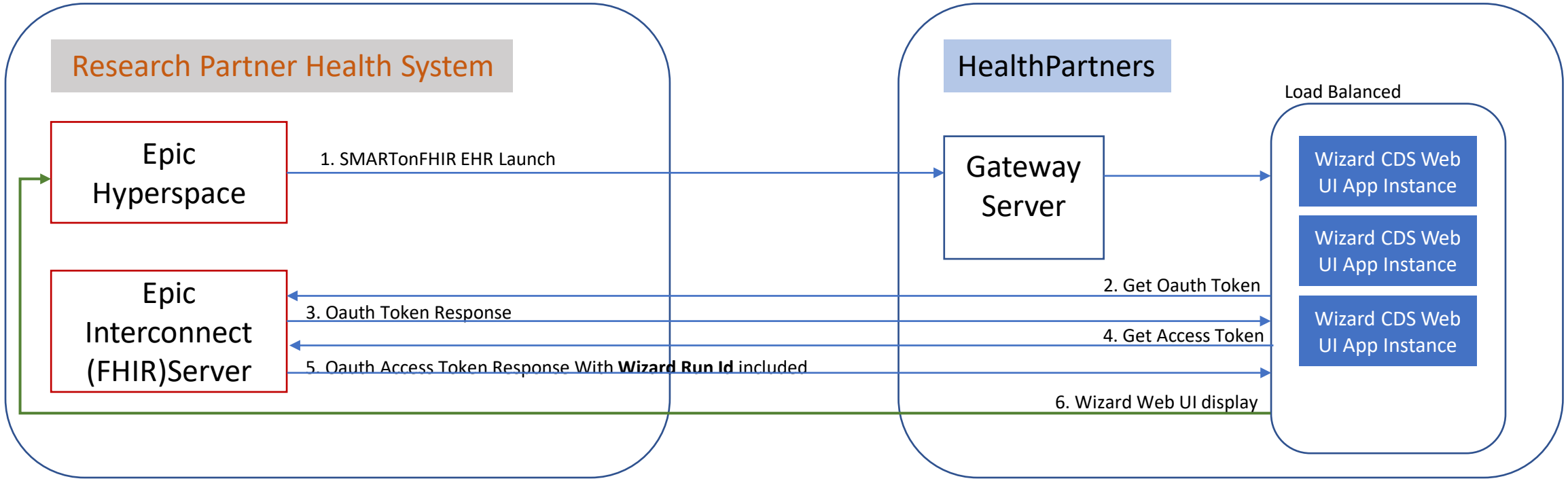
HealthPartners Institute

Wizard CDSHooks Launch Design



HealthPartners® Institute

Wizard Web UI SMARTonFHIR Launch Design



HealthPartners® Institute

FHIR

Latency

- Huge impact on user experience
- 19 sec vs 300 ms
- Split data extraction to 2 points in time
- Data caching
- Used prefetch

Standard codes

- Some things can only be accessed via URN which changes in each environment and client – eg writeback to flowsheet
- All codes systems are sent back. Makes message heavy

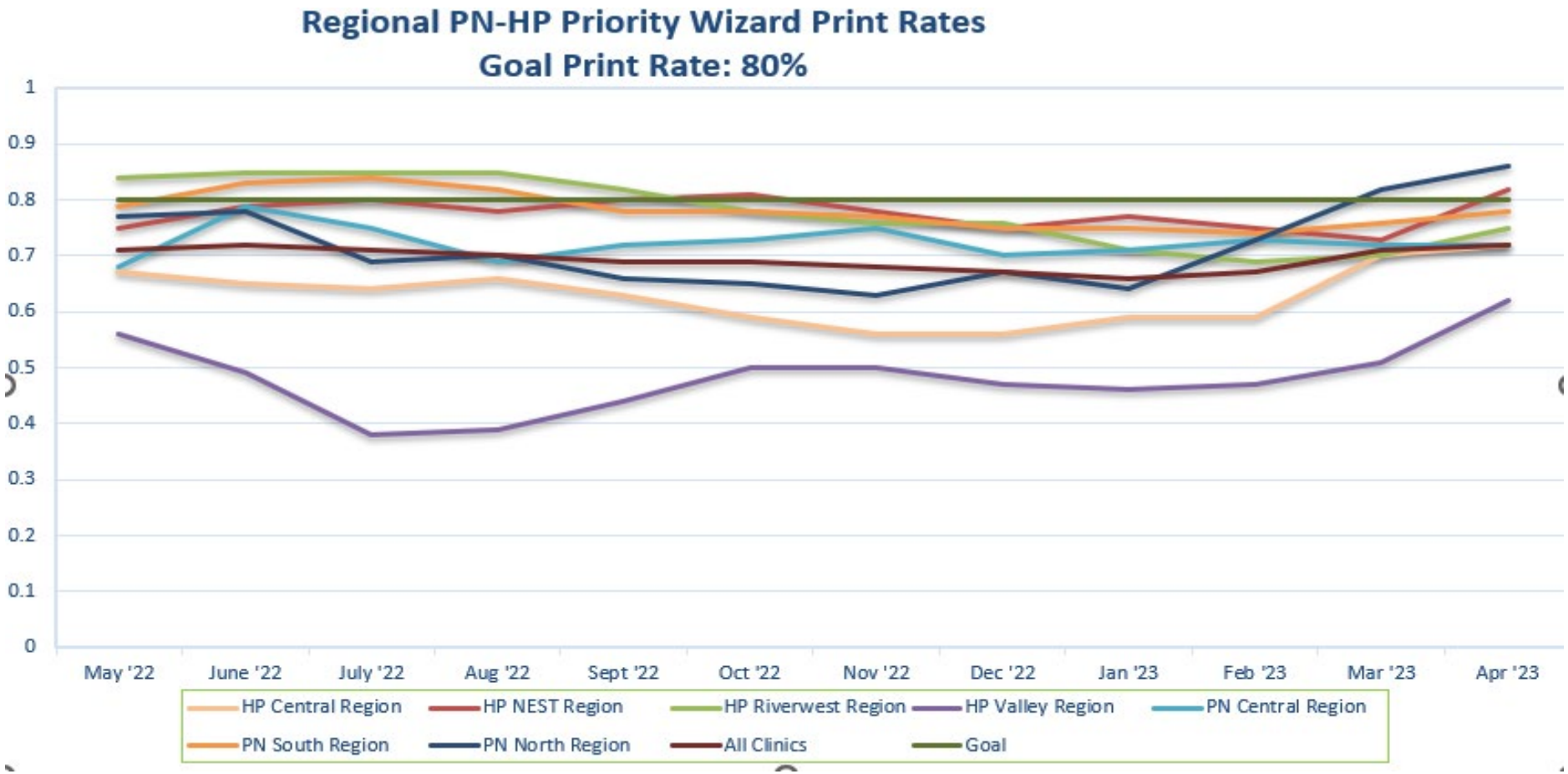
Wish List

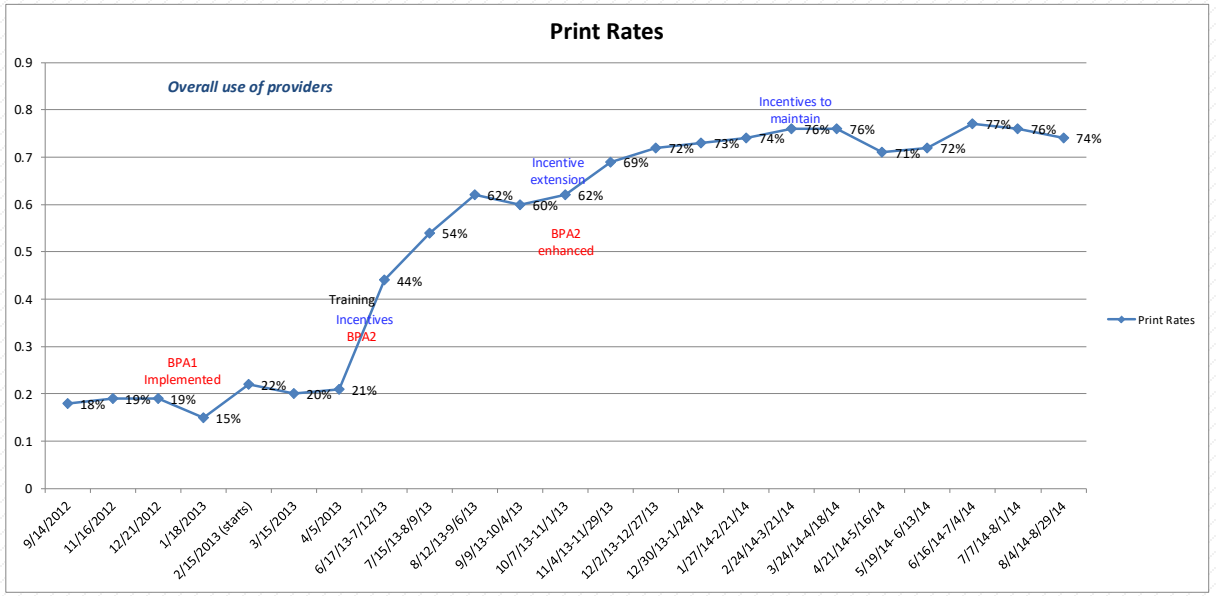
- More standard trigger points
- Specify code system
- Prefetch has more search parameters
- Option to limit data in resource
- Option to gather data across encounters
- Search by base name (limitation of LOINC)
- Ask for subset of data

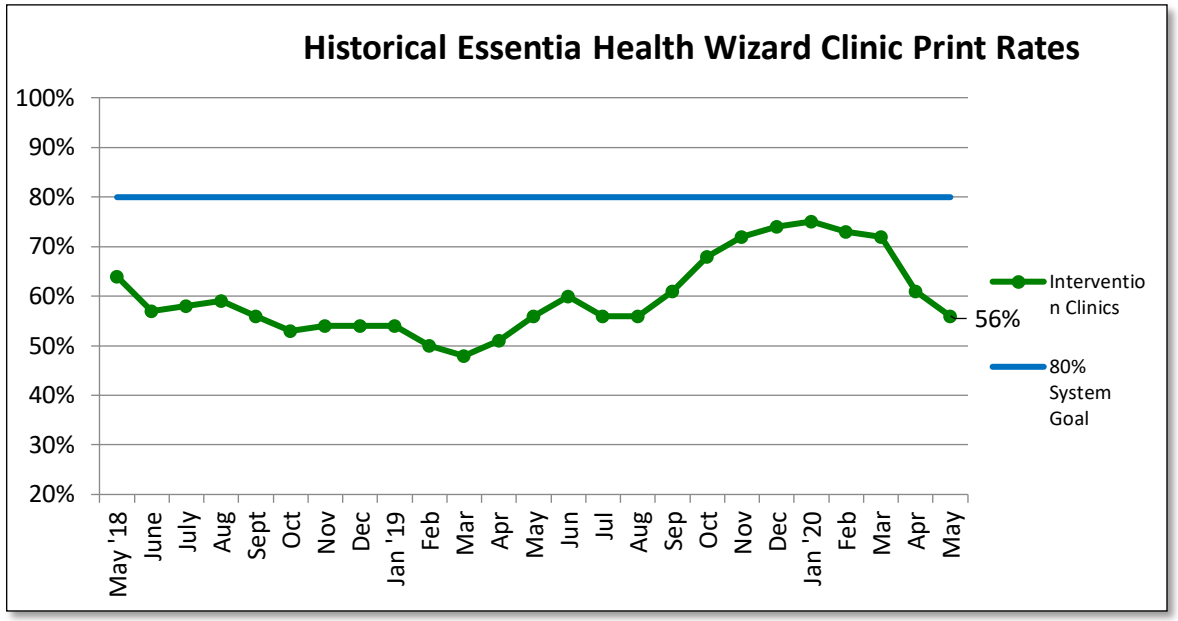
Results

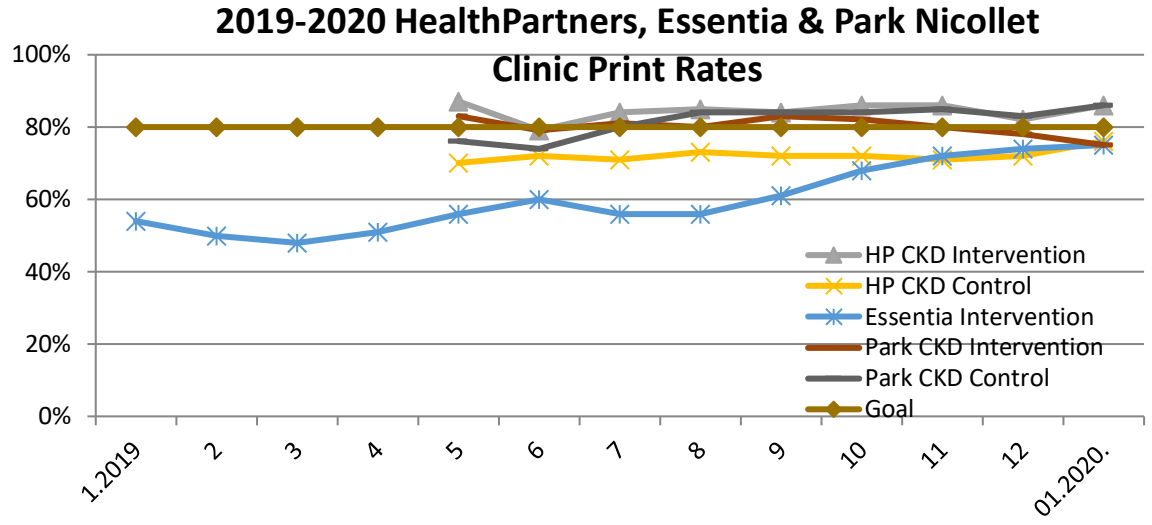
- Use rates
- Clinician Satisfaction
- Impacts on Care
- Safety Net Clinics
- Serious Mental Illness
- The challenges of OUD and CI
- Patient and Clinician Archetypes

Use Rates


Regional PN-HP Priority Wizard Print Rates
Goal Print Rate: 80%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
May '22
June '22
July '22
Aug '22
Sept '22
Oct '22
Nov '22
Dec '22
Jan '23
Feb '23
Mar '23
Apr '23
HP Central Region
HP NEST Region
HP Riverwest Region
HP Valley Region
PN Central Region
PN South Region
PN North Region
All Clinics
Goal


Print Rates
Overall use of providers
BPA1 Implemented
Training
Incentives
BPA2
Incentive extension
BPA2 enhanced
Incentives to maintain
Print Rates


Historical Essentia Health Wizard Clinic Print Rates
Intervention Clinics
80% System Goal
56%


2019-2020 HealthPartners, Essentia & Park Nicollet Clinic Print Rates
HP CKD Intervention
HP CKD Control
Essentia Intervention
Park CKD Intervention
Park CKD Control
Goal

Primary Care Clinician Satisfaction with Wizard

Wizard User Comments (N=107)	% Agree/Strongly Agree
Useful for shared decision making	86%
Ranking clinical issues based on potential benefit is helpful	89%
Influences what addressed during visit	64%
Encourages patients to initiate conversation about listed opportunities	60%
Lengthens appointment time	68%
Time constraints are barrier to using Wizard	75%
Use at preventative visits most often	50%
Use at follow-up visits most often	79%
Would be more helpful if in after visit summary	78%
Would use more if easier to access in EHR	71%
Would like if available to patients via myChart	85%
Preference toward patient view being only option in myChart	79%

Primary Care Clinician Satisfaction with CV Wizard

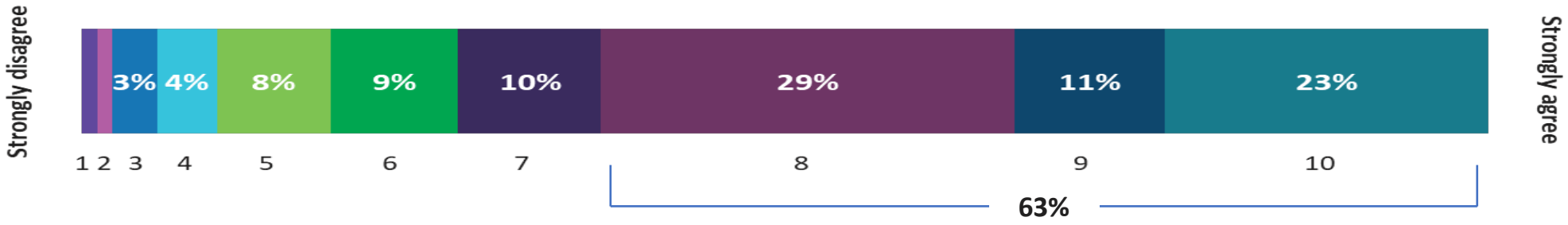
Wizard User Comments (N=47)	% Agree/Strongly Agree
Improved CV risk factor control	98%
Saved time when talking to patients about CV risk reduction	93%
Efficiently elicited patient treatment preferences	90%
Useful for shared decision-making	95%
Influenced treatment recommendations	89%
Helped initiate CV risk discussions	94%
My patients liked the Wizard	85%

How useful is Priority Wizard in helping with care for the following issues

Clinical Issue	Somewhat Useful/Very Useful
Hyperlipidemia	90%
Hypertension	88%
Diabetes	88%
Obesity	67%
Tobacco	80%
Aspirin	76%
Anticoagulation for AFib	39%
Chronic Kidney Disease	44%
Opioid Use	25%
Medication Adherence	36%
High CV Risk	90%

HP myVoice Survey Results

- myVoice participants were shown Priority Wizard through a survey and asked how likely they were to take action based on the handout.
- 63% of panelists rate their likelihood to take action based on this handout 8, 9 or 10 on a 10-point scale
  - Likely to Take Action Based on Wizard Handout



Publications

Hauschildt J, Lyon-Scott K, Sheppler CR, Larson AE, McMullen C, Boston D, O'Connor PJ, Sperl-Hillen JM, Gold R. Adoption of shared decision-making and clinical decision support for reducing cardiovascular disease risk in community health centers. JAMIA Open. 2023 Mar 10;6(1):ooad012. doi: 10.1093/jamiaopen/ooad012. PMID: 36909848; PMCID: PMC10005607. https://pubmed.ncbi.nlm.nih.gov/36909848/

Saman DM, Allen CI, Freitag LA, Harry ML, Sperl-Hillen JM, Ziegenfuss JY, Haapala JL, Crain AL, Desai JR, Ohnsorg KA, O'Connor PJ. Clinician perceptions of a clinical decision support system to reduce cardiovascular risk among prediabetes patients in a predominantly rural healthcare system. BMC Med Inform Decis Mak. 2022 Nov 19;22(1):301. doi: 10.1186/s12911-022-02032-z. PMID: 36402988; PMCID: PMC9675125. https://pubmed.ncbi.nlm.nih.gov/36402988/

Rebecca C. Rossom, A. Lauren Crain, Patrick J. O'Connor, Eric Wright, Irina V. Haller, Stephanie A. Hooker, JoAnn M. Sperl-Hillen, Anthony Olson, Katrina Romagnoli, Leif Solberg, Steven P. Dehmer, Jacob Haapala, Caitlin Borgert-Spaniol, Lorraine Tusing, Jule Muegge, Clayton Allen, Heidi Ekstrom, Kristen Huntley, Jennifer McCormack, Gavin Bart. Design of a pragmatic clinical trial to improve screening and treatment for opioid use disorder in primary care. Contemporary Clinical Trials. Volume 124, 2023,107012. https://doi.org/10.1016/j.cct.2022.107012. https://www.sciencedirect.com/science/article/pii/S155171442200338X

Sperl-Hillen JM, Anderson JP, Margolis KL, Rossom RC, Kopski KM, Averbeck BM, Rosner JA, Ekstrom HL, Dehmer SP, O'Connor PJ. Bolstering the Business Case for Adoption of Shared Decision-Making Systems in Primary Care: Randomized Controlled Trial. JMIR Form Res. 2022 Oct 6;6(10):e32666. doi: 10.2196/32666. PMID: 36201392; PMCID: PMC9585448. https://formative.jmir.org/2022/10/e32666

Desai J, Saman D, Sperl-Hillen JM, Pratt R, Dehmer SP, Allen C, Ohnsorg K, Wuorio A, Appana D, Hitz P, Land A, Sharma R, Wilkinson L, Crain AL, Crabtree BF, Bianco J, O'Connor PJ. Implementing a prediabetes clinical decision support system in a large primary care system: Design, methods, and pre-implementation results. Contemp Clin Trials. 2022 Mar;114:106686. doi: 10.1016/j.cct.2022.106686. Epub 2022 Jan 25. PMID: 35091135. https://pubmed.ncbi.nlm.nih.gov/35091135/

Melissa L. Harry, Stephen E. Asche, Laura A. Freitag, JoAnn M. Sperl-Hillen, Daniel M. Saman, Heidi L. Ekstrom, Ella A. Chrenka, Anjali R. Truitt, Clayton I. Allen, Patrick J. O'Connor, Steven P. Dehmer, Joseph A. Bianco & Thomas E. Elliott (2022) Human Papillomavirus vaccination clinical decision support for young adults in an upper midwestern healthcare system: a clinic cluster-randomized control trial, Human Vaccines & Immunotherapeutics, DOI: 10.1080/21645515.2022.2040933. PMID: 35302909 https://www.tandfonline.com/doi/full/10.1080/21645515.2022.2040933

Rossom RC, Crain AL, O'Connor PJ, et al. Effect of Clinical Decision Support on Cardiovascular Risk Among Adults With Bipolar Disorder, Schizoaffective Disorder, or Schizophrenia: A Cluster Randomized Clinical Trial. JAMA Netw Open. 2022;5(3):e220202. doi:10.1001/jamanetworkopen.2022.0202. https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2789688

Rossom RC, Hooker SA, O'Connor PJ, Crain AL, Sperl-Hillen JM. Cardiovascular Risk for Patients With and Without Schizophrenia, Schizoaffective Disorder, or Bipolar Disorder. J Am Heart Assoc. 2022 Mar 15;11(6):e021444. doi: 10.1161/JAHA.121.021444. Epub 2022 Mar 9. PMID: 35261265; PMCID: PMC9075298.https://www.ahajournals.org/doi/abs/10.1161/JAHA.121.021444

Elliott TE, Asche SE, O'Connor PJ, et al. Clinical Decision Support with or without Shared Decision Making to Improve Preventive Cancer Care: A Cluster-Randomized Trial. Medical Decision Making. February 2022. doi:10.1177/0272989X221082083. PMID: 35209775 https://journals.sagepub.com/doi/10.1177/0272989X221082083

HealthPartners Institute

Publications

Gold R, Larson AE, Sperl-Hillen JM, Boston D, Sheppler CR, Heintzman J, McMullen C, Middendorf M, Appana D, Thirumalai V, Romer A, Bava J, Davis JV, Yosuf N, Hauschildt J, Scott K, Moore S, O'Connor PJ. Effect of Clinical Decision Support at Community Health Centers on the Risk of Cardiovascular Disease: A Cluster Randomized Clinical Trial. JAMA Netw Open. 2022 Feb 1;5(2):e2146519. doi: 10.1001/jamanetworkopen.2021.46519. PMID: 35119463. https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2788645

Pratt R, Saman DM, Allen C, Crabtree B, Ohnsorg K, Sperl-Hillen JM, Harry M, Henzler-Buckingham H, O'Connor PJ, Desai J. Assessing the implementation of a clinical decision support tool in primary care for diabetes prevention: a qualitative interview study using the Consolidated Framework for Implementation Science. BMC Med Inform Decis Mak. 2022 Jan 15;22(1):15. doi: 10.1186/s12911-021-01745-x. PMID: 35033029. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8760770/

Harry ML, Chrenka EA, Freitag LA, Saman DM, Allen CI, Asche SE, Truitt AR, Ekstrom HL, O'Connor PJ, Sperl-Hillen JAM, Ziegenfuss JY, Elliott TE. Primary care clinicians' opinions before and after implementation of cancer screening and prevention clinical decision support in a clinic cluster-randomized control trial: a survey research study. BMC Health Serv Res. 2022 Jan 6;22(1):38. doi: 10.1186/s12913-021-07421-0. PMID: 34991570; PMCID: PMC8739981. https://bmchealthservres.biomedcentral.com/articles/10.1186/s12913-021-07421-0

Solberg LI, Hooker SA, Rossom RC, Bergdall A, Crabtree BF. Clinician Perceptions About a Decision Support System to Identify and Manage Opioid Use Disorder. J Am Board Fam Med. 2021 Nov-Dec;34(6):1096-1102. doi: 10.3122/jabfm.2021.06.210126. PubMed PMID: 34772765. https://www.jabfm.org/content/34/6/1096.long

Sperl-Hillen JM, Crain AL, Chumba L, Ekstrom HL, Appana D, Kopski KM, Wetmore JB, Wheeler J, Ishani A, O'Connor PJ. Pragmatic clinic randomized trial to improve chronic kidney disease care: Design and adaptation due to COVID disruptions. Contemp Clin Trials. 2021 Oct;109:106501. doi: 10.1016/j.cct.2021.106501. Epub 2021 Jul 13. PMID: 34271175; PMCID: PMC8276567. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8276567/

Rossom RC, Sperl-Hillen JM, O'Connor PJ, Crain AL, Nightingale L, Pylkas A, Huntley KV, Bart G. A pilot study of the functionality and clinician acceptance of a clinical decision support tool to improve primary care of opioid use disorder. Addict Sci Clin Pract. 2021 Jun 15;16(1):37. doi: 10.1186/s13722-021-00245-7. PMID: 34130758; PMCID: PMC8207778. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8207778/

Saman DM, Harry ML, Freitag LA, Allen CI, O'Connor PJ, Sperl-Hillen JM, Bianco JA, Truitt AR, Ekstrom HL, Elliott TE. Patient Perceptions of Using Clinical Decision Support for Cancer Screening and Prevention: "I wouldn't have thought about getting screened without it.". J Patient Cent Res Rev. 2021 Oct 18;8(4):297-306. doi: 10.17294/2330-0698.1863. PMID: 34722797; PMCID: PMC8530236. https://pubmed.ncbi.nlm.nih.gov/34722797/

Saman DM, Chrenka EA, Harry ML, Allen CI, Freitag LA, Asche SE, Truitt AR, Ekstrom HL, O'Connor PJ, Sperl-Hillen JM, Ziegenfuss JY, Elliott TE. The impact of personalized clinical decision support on primary care patients' views of cancer prevention and screening: a cross-sectional survey. BMC Health Serv Res. 2021 Jun 21;21(1):592. doi: 10.1186/s12913-021-06551-9. PMID: 34154588; PMCID: PMC8215810. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8215810/

Elliott TE, O'Connor PJ, Asche SE, Saman DM, Dehmer SP, Ekstrom HL, Allen CI, Bianco JA, Chrenka EA, Freitag LA, Harry ML, Truitt AR, Sperl-Hillen JM. Design and rationale of an intervention to improve cancer prevention using clinical decision support and shared decision making: a clinic-randomized trial. Contemp Clin Trials. 2021 Jan 24;102:106271. PMID: 33503497. DOI: 10.1016/j.cct.2021.106271. https://www.sciencedirect.com/science/article/pii/S1551714421000070?via%3Dihub

HealthPartners Institute

Publications

Gold R, Middendorf M, Heintzman J, Nelson J, O'Connor P, Sperl-Hillen J, Appana D, Geissal E, Thirumalai V, Sheppler C, Dunne M. Challenges involved in establishing a web-based clinical decision support tool in community health centers. Healthc (Amst). 2020 Dec;8(4):100488. doi: 10.1016/j.hjdsi.2020.100488. Epub 2020 Oct 22. PMID: 33132174; PMCID: PMC7680381. https://pubmed.ncbi.nlm.nih.gov/33132174/

Harry ML, Saman DM, Truitt AR, Allen CI, Walton KM, O'Connor PJ, Ekstrom HL, Sperl-Hillen JM, Bianco JA, Elliott TE. Pre-implementation adaptation of primary care cancer prevention clinical decision support in a predominantly rural healthcare system. BMC Med Inform Decis Mak. 2020 Jun 23;20(1):117. doi: 10.1186/s12911-020-01136-8. PMID: 32576202; PMCID: PMC7310565. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7310565/

Dehmer SP, Sinaiko AR, Trower NK, Asche SE, Ekstrom HL, Nordin JD, O'Connor PJ, Kharbanda EO. Clinical Decision Support for Recognizing and Managing Hypertensive Blood Pressure in Youth: No Significant Impact on Medical Costs. Acad Pediatr. 2020 Aug;20(6):848-856. doi: 10.1016/j.acap.2020.01.011. Epub 2020 Jan 28. PMID: 32004709; PMCID: PMC7872738. https://pubmed.ncbi.nlm.nih.gov/32004709/

Rossom RC, O'Connor PJ, Crain AL, Waring S, Ohnsorg K, Taran A, Kopski K, Sperl-Hillen JM. Pragmatic trial design of an intervention to reduce cardiovascular risk in people with serious mental illness. Contemp Clin Trials. 2020 Apr;91:105964. doi: 10.1016/j.cct.2020.105964. Epub 2020 Feb 20. PMID: 32087336; PMCID: PMC7263956. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7263956/

O'Connor PJ, Sperl-Hillen JM. Current Status and Future Directions for Electronic Point-of-Care Clinical Decision Support to Improve Diabetes Management in Primary Care. Diabetes Technol Ther. 2019 Jun;21(S2):S226-S234. doi: 10.1089/dia.2019.0070. PMID: 31169426.

Harry, Melissa L, Anjali R Truitt, Daniel M Saman, Hillary A Henzler-Buckingham, Clayton I Allen, Kayla M Walton, Heidi L Ekstrom, Patrick J O'Connor, JoAnn M Sperl-Hillen, and Joseph A Bianco. 2019. 'Barriers and facilitators to implementing cancer prevention clinical decision support in primary care: a qualitative study', BMC Health Serv Res, 19: 534. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6668099/

Saman, Daniel M., Kayla M. Walton, Melissa L. Harry, Stephen E. Asche, Anjali R. Truitt, Hillary A. Henzler-Buckingham, Clayton I. Allen, Heidi L. Ekstrom, Patrick J. O'Connor, JoAnn M. Sperl-Hillen, Jeanette Y. Ziegenfuss, Joseph A. Bianco, and Thomas E. Elliott. 2019. 'Understanding primary care providers' perceptions of cancer prevention and screening in a predominantly rural healthcare system in the upper Midwest', BMC Health Serv Res, 19: 1019. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6937782/

Sperl-Hillen, JoAnn M, Rebecca C Rossom, Elyse O Kharbanda, Rachel Gold, Erik D Geissal, Thomas E Elliott, Jay R Desai, D Brad Rindal, Daniel M Saman, and Stephen C Waring. 2019. 'Priorities wizard: multisite web-based primary care clinical decision support improved chronic care outcomes with high use rates and high clinician satisfaction rates', eGEMs, 7. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6450247/

Kharbanda, EO and Ekstrom HL. Recognizing childhood and adolescent hypertension: A new clinical decision support tool. Minnesota Physician, Volume XXXIII, No 6, September 2019. http://mppub.com/mp-s4-0919.html

Kharbanda EO, Asche SE, Sinaiko A, et al. Improving hypertension recognition in adolescents, a small but important first step in cardiovascular disease prevention. Academic Pediatrics. Academic Peds Progress Report. Aug 2019. DOI: https://doi.org/10.1016/j.acap.2019.08.010 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7032989/

Kharbanda EO, Asche SE, Dehmer SP, et al. Impact of updated pediatric hypertension guidelines on progression from elevated blood pressure to hypertension in a community-based primary care population. J Clin Hypertens. 2019; 21:560–565. https://doi.org/10.1111/jch.13539

HealthPartners® Institute

Publications

Kharbanda EO, Asche SE, Sinaiko AR, Ekstrom HL, Nordin JD, Sherwood NE, Fontaine PL, Dehmer SP, Appana D, O'Connor P. Clinical Decision Support for Recognition and Management of Hypertension: A Randomized Trial. Pediatrics. 2018 Feb; 141(2):e20172954. doi: 10.1542/peds.2017-2954. PubMed PMID: 29371241; PubMed Central PMCID: PMC5810603. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5810603/

Kharbanda EO, Asche SE, Sinaiko A, Nordin JD, Ekstrom HL, Fontaine P, Dehmer SP, Sherwood NE, O'Connor PJ. Evaluation of an Electronic Clinical Decision Support Tool for Incident Elevated BP in Adolescents. Acad Pediatr. 2018 Jan-Feb;18(1):43-50. doi: 10.1016/j.acap.2017.07.004. Epub 2017 Jul 16. PubMed PMID: 28723587; PubMed Central PMCID: PMC5756693. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5756693/

Sperl-Hillen JM, Crain AL, Margolis KL, Ekstrom HL, Appana D, Amundson G, Sharma R, Desai JR, O'Connor PJ. Clinical decision support directed to primary care patients and providers reduces cardiovascular risk: a randomized trial. J Am Med Inform Assoc. 2018 Sep 1;25(9):1137-1146. doi: 10.1093/jamia/ocy085. PMID: 29982627; PMCID: PMC6658854. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6658854/

Kharbanda EO, Nordin JD, Sinaiko AR, Ekstrom HL, Stultz JM, Sherwood NE, Fontaine PL, Asche SE, Dehmer SP, Amundson JH, Appana DX, Bergdall AR, Hayes MG, O'Connor PJ. TeenBP: Development and Piloting of an EHR-Linked Clinical Decision Support System to Improve Recognition of Hypertension in Adolescents. EGEMS (Wash DC). 2015 Jul 9;3(2):1142. PMCID: PMC4537153. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4537153/

Desai JR, Pawloski PA, Sperl-Hillen JM, O'Connor PJ. Personalized and prioritized diabetes treatment recommendations to reduce cardiovascular risk. Diabetes Manage. 2014;4(2):105-8. https://www.openaccessjournals.com/articles/personalized-and-prioritized-diabetes-treatment-recommendations-to-reduce-cardiovascular-risk.pdf

Desai JR, Sperl-Hillen JM, O'Connor PJ. Patient preferences in diabetes care: overcoming barriers using new strategies. J Comp Eff Res. 2013 Jul;2(4):351-4. https://www.futuremedicine.com/doi/10.2217/cer.13.36

O'Connor PJ, Desai JR, Butler JC, Kharbanda EO, Sperl-Hillen JM. Current status and future prospects for electronic point-of-care clinical decision support in diabetes care. Curr Diab Rep. 2013 Apr;13(2):172-6. PMCID: PMC3595375. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3595375/

Gilmer TP, O'Connor PJ, Sperl-Hillen JM, Rush WA, Johnson PE, Amundson GH, Asche SE, Ekstrom HL. Cost-effectiveness of an electronic medical record based clinical decision support system. Health Serv Res. 2012 Dec;47(6):2137-58. PMCID: PMC3459233. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3459233/

O'Connor P. Opportunities to Increase the Effectiveness of EHR-Based Diabetes Clinical Decision Support. Appl Clin Inform. 2011 Aug 31;2(3):350-4. PMCID: PMC3631926. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3631926/

O'Connor PJ, Sperl-Hillen JM, Rush WA, Johnson PE, Amundson GH, Asche SE, Ekstrom HL, Gilmer TP. Impact of electronic health record clinical decision support on diabetes care: a randomized trial. Ann Fam Med. 2011 Jan-Feb;9(1):12-21. PMCID: PMC3022040. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3022040/

Sperl-Hillen JM, Amundson JH, O'Connor PJ, Ekstrom HL, Rush WA. Outpatient EHR-Based Diabetes Clinical Decision Support that Works: Lessons Learned from Implementing Diabetes Wizard. Diabetes Spectr. 2010 Jul;23(3):150-4. https://diabetesjournals.org/spectrum/article/23/3/150/32023/Outpatient-EHR-Based-Diabetes-Clinical-Decision

HealthPartners® Institute

Thank you!

Deepa Appana
Deepika.X.Appana@healthpartners.com

Patrick O'Connor
patrick.j.oconnor@healthpartners.com

HealthPartners Institute, Minnesota

Questions

Office of the National Coordinator for Health Information Technology

Contact ONC

Alison Kemp alison.kemp@hhs.gov

Phone: 202-690-7151

Health IT Feedback Form: https://www.healthit.gov/form/healthit-feedback-form

Twitter: @onc_healthIT

LinkedIn: Office of the National Coordinator for Health Information Technology

Youtube: https://www.youtube.com/user/HHSONC

HealthIT.gov

Subscribe to our weekly eblast at healthit.gov for the latest updates!