Remote Decision Support with

Kevin Shekleton
HSPC HIT Developers Conference
March 31, 2017

ITEM
MAGIC
WEAPON
ARMOR
STATUS

KEVIN SHEKLETON

DISTINGUISHED ENGINEER

HP
13/ 37

15 YEARS

@kpshek

If you’re going to take
a picture of a slide, do it now

Slides:
bit.ly/cds-hooks-hspc2017

The problem with SMART apps

Bilirubin Chart

Newborns < 120 hours old

Transcutaneous bilirubin results that are either:

- Not documented
- Outside of the accepted range

The user needs to know the app is available

The user needs to know the app is relevant

The user has to find the app and launch it

CDS HOOKS

CDS Hooks

A vendor agnostic remote decision support specification

Created by the team behind SMART

Open source (Apache)

Emerging standard with active development and widespread participation from stakeholders

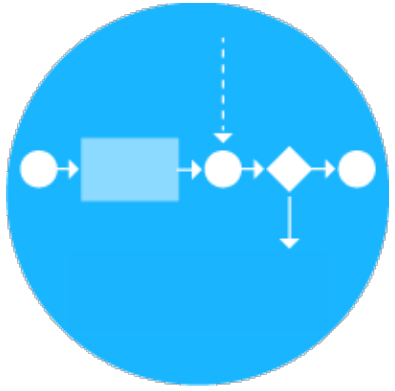
CDS Service

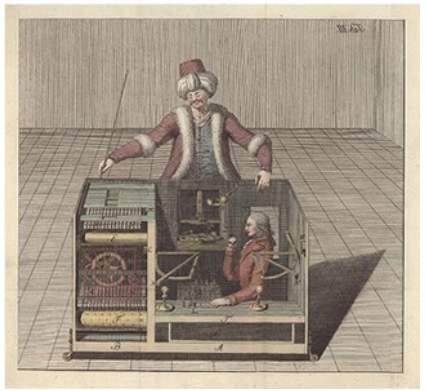
A service that is:

invoked by the EHR via a hook,

evaluates its own logic using FHIR data,

returns decision support via cards





Example Hooks

patient-view

When a patient’s chart is opened

medication-prescribe

When a medication is selected for prescription

order-review

Viewing pending orders for signing

EHR Med Order

℞ Toprol XL
50 mg daily

1

EHR triggers a **CDS hook** and invokes a remote service

CDS Services

2

CDS Service executes it's own rules, leveraging FHIR data as needed

EHR FHIR Server

3

Returns **CDS cards** (rendered and displayed by EHR)

information card

$200 per month
(patient pays $30)

suggestion card

Try HCTZ as first-line

Switch to HCTZ

smart app link card

Managing hypertension?
Launch JNC 8 Rx Pro

EHR

CDS Service

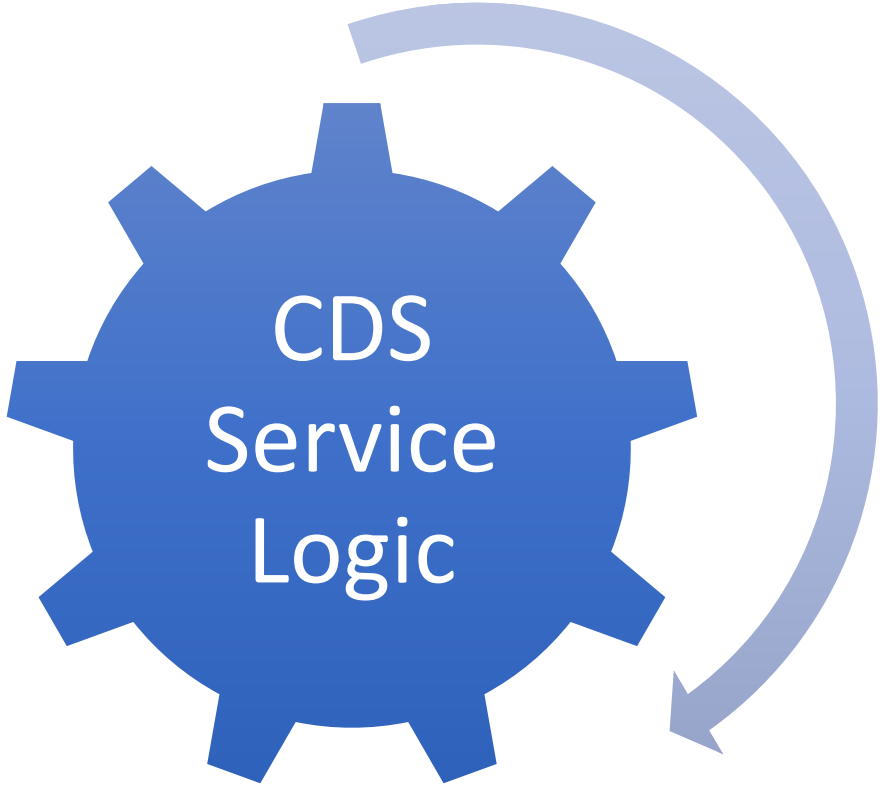
POST https://example.com/cds-services/example-service

```
{
  "hook": "patient-view”,
  "fhirServer": "https://fhir.example.com",
  "user": "Practitioner/789",
  "patient": "123",
  "encounter": "456",
  ...
}
```

EHR

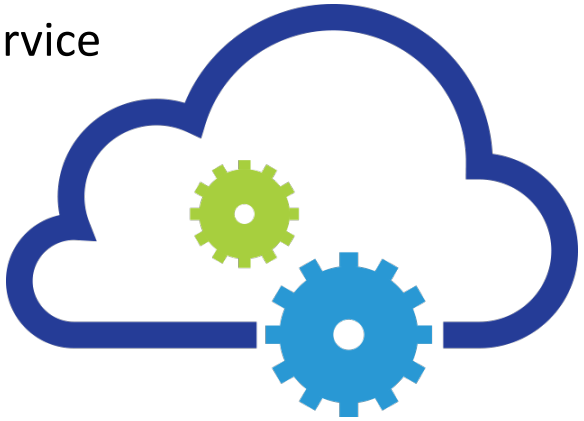
CDS Service

POST https://example.com/cds-services/example-service



EHR

CDS Service



POST https://example.com/cds-services/example-service

HTTP 1.1/ 200 OK

```
{
  "cards": [
    {
      "summary": "Example card",
      "indicator": "info",
      "source": {
        "name": "Demo CDS Service”
}}]}
```

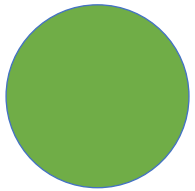
Cards

- A CDS Service can return any number of cards
- The EHR renders each card as it sees fit
- Each card must have:
  - A concise summary (140 characters)
  - An indicator noting the importance of the card
  - Information on the organization or data set that is the source of the card's data

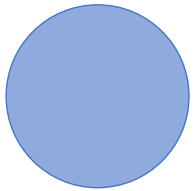
CDS Service Response JSON

```
{
  "cards": [
    {
      "summary": "Example card",
      "indicator": "info",
      "source": {
        "name": "Demo CDS Service”
      }
    }
  ]}
```

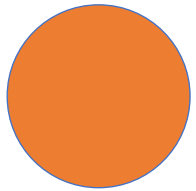
Card Indicator



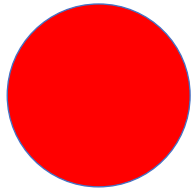
Success



Informational

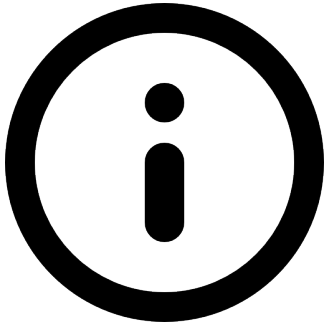


Warning



Hard Stop

Common Card Examples



Information Only

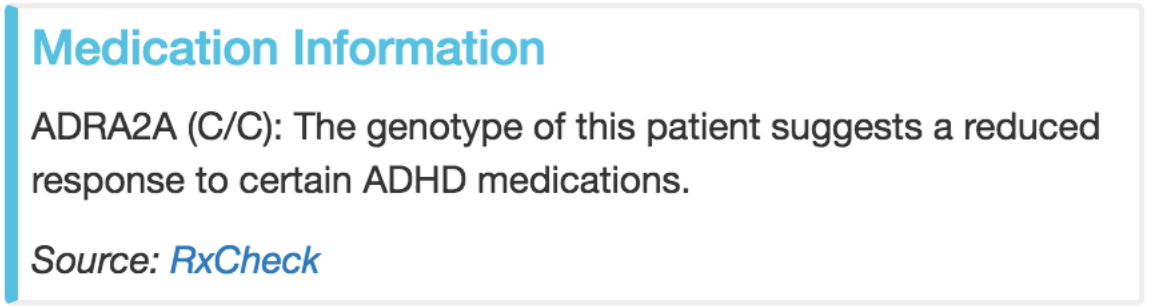
Textual information for the provider

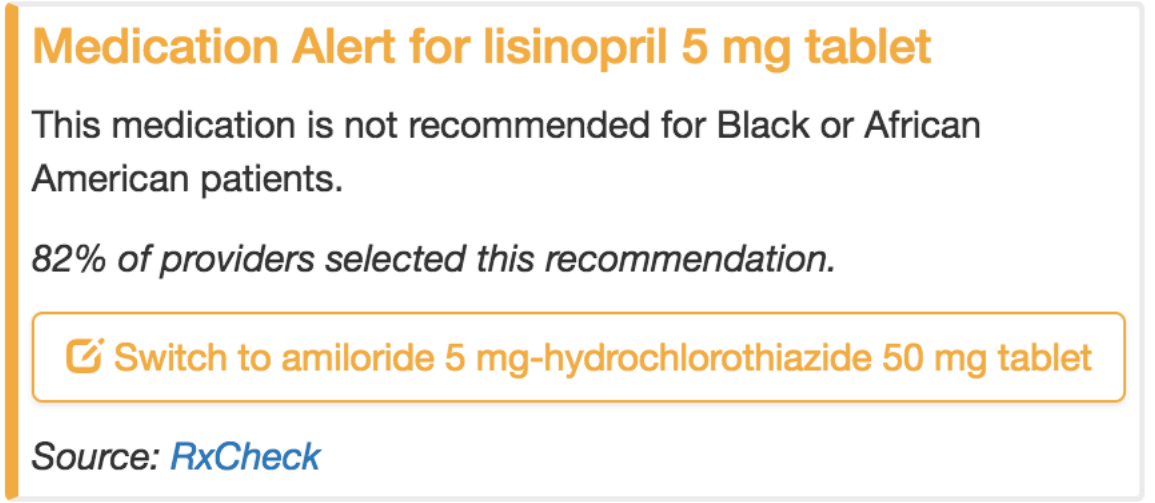
Suggestions

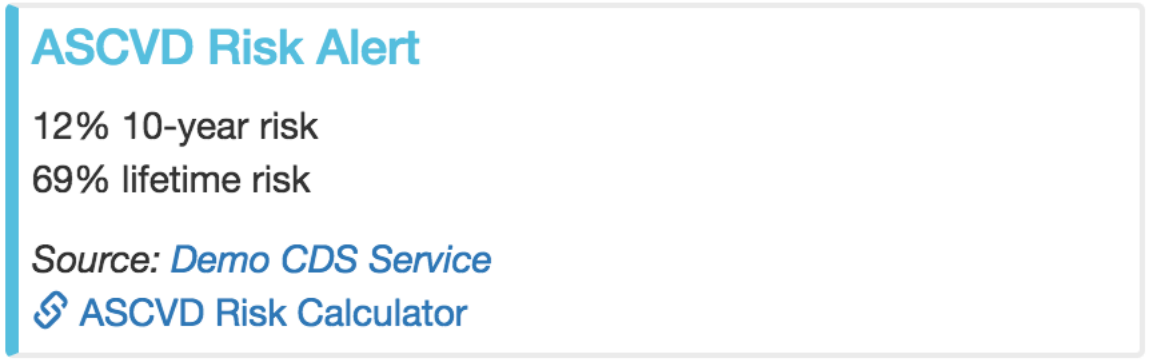
Proposed actions encoded as FHIR resources

App Links

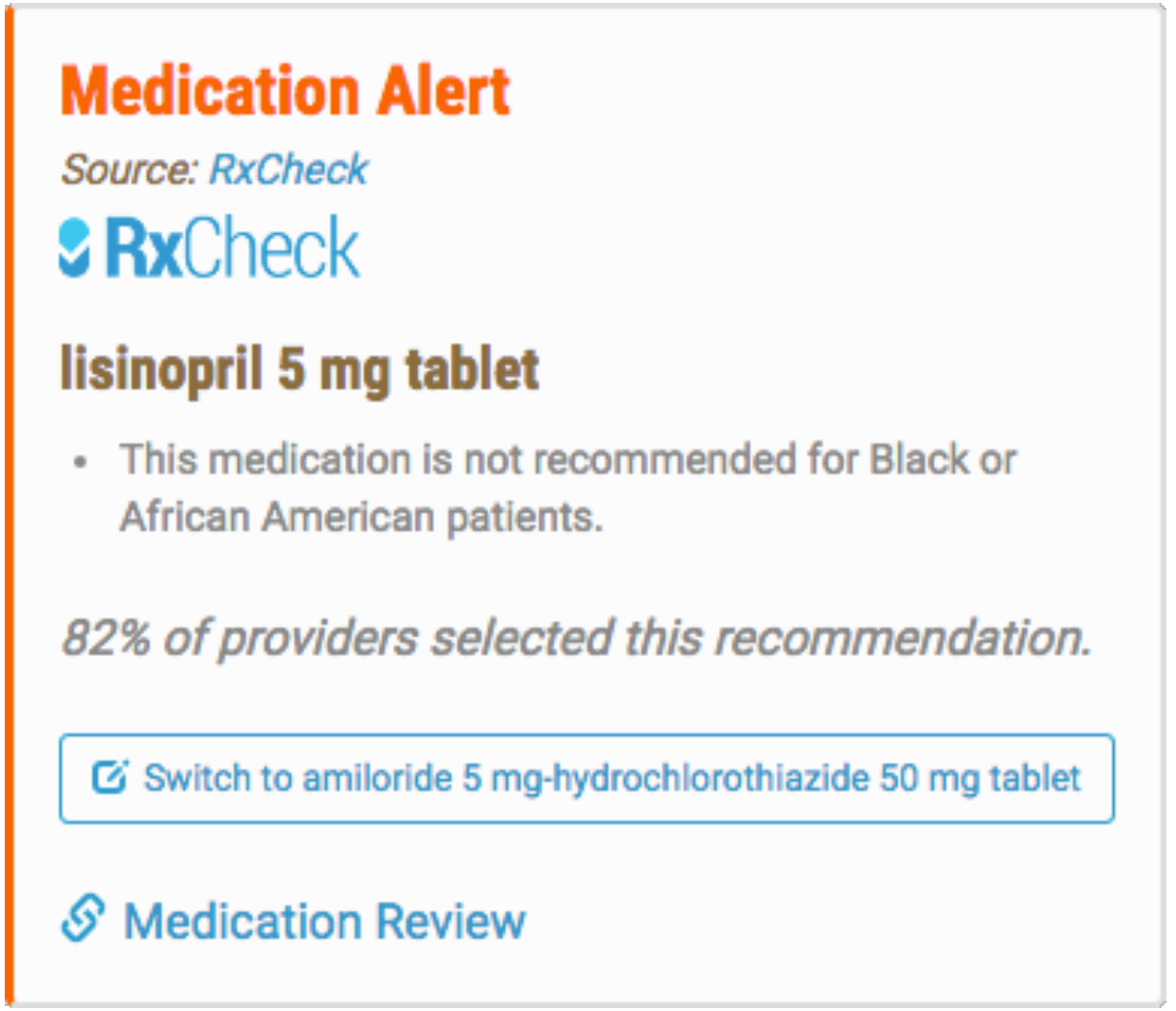
Proposed SMART app that should be used







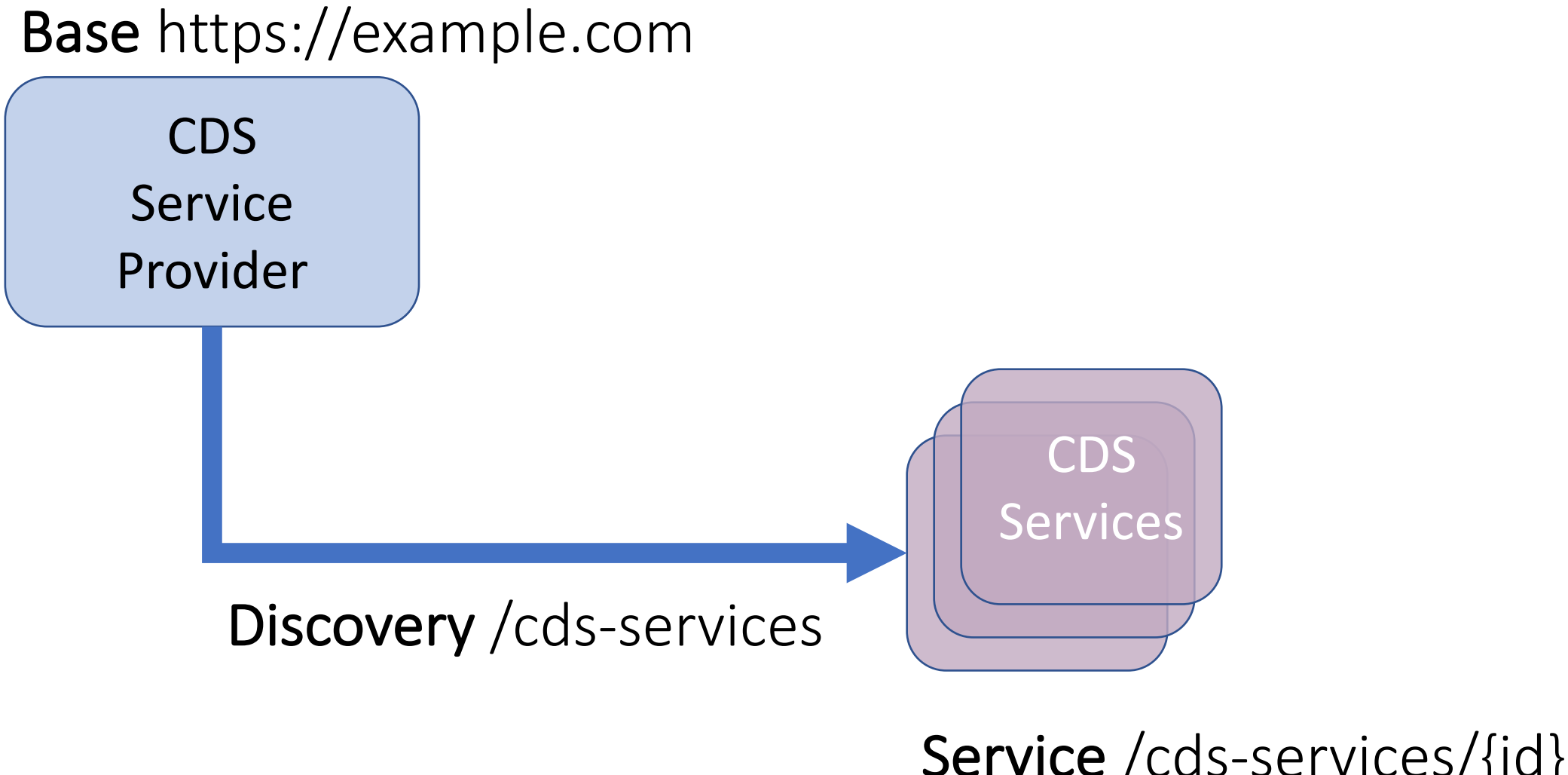
Cards can contain any combination of information, suggestions, and links



Capturing user behavior for analytics

- Since CDS Services return purely JSON, they don’t know how users interact with their suggestion
- Each suggestion *may* contain a **UUID**
- The UUID allows the EHR to notify the CDS Service that the user interacted with their suggestion

```
POST {cds-service}/analytics/{uuid}
```


Base https://example.com
CDS
Service
Provider
CDS
Services
Discovery /cds-services
Service /cds-services/{id}

Discovery

```
GET https://example.com/cds-services
{
  "services": [
    {
      "hook": "patient-view",
      "name": "CDS Service Example",
      "description": "An example CDS service",
      "id": "example-service",
      "prefetch": {
        "patientToGreet": "Patient/{{Patient.id}}"
      }
    },
    {...}
}
```

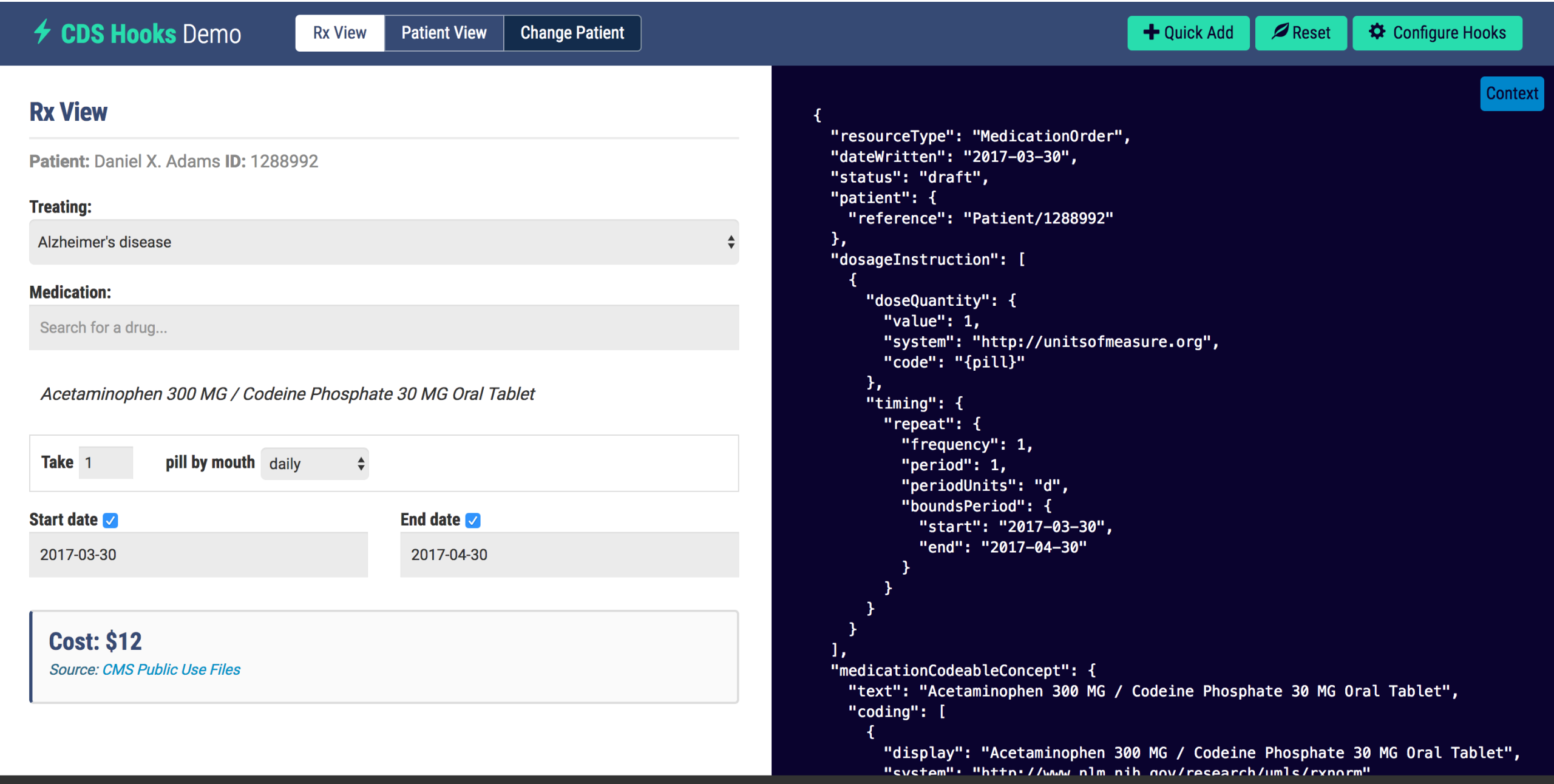
CDS Service Invocation

```
{
  "services": [
    {
      "hook": "patient-view",
      "name": "CDS Service Example",
      "description": "An example CDS service",
      "id": "example-service",
```

```
POST https://example.com/cds-services/example-service
```

```
  }
```

demo.cds-hooks.org



Separation of Concerns

Concern	Owner
Workflow & hooks (triggers)	EHR
CDS logic	CDS Service Provider
Initial context data	EHR
Additional data	CDS Service Provider (via FHIR or other sources)
CDS presentation	EHR

NON SOLUS
ELSEVIER

fdb
First Databank

HSPC
the healthcare
services platform
consortium™

MAYO
CLINIC

McKESSON

NANTHEALTH

PREMIER

visualDx

QVERA

Cerner

Epic

healthwise
for every health decision

Intermountain
Healthcare

Allscripts

athenahealth

IMO
Intelligent Medical Objects

mcg

RxREVU

Wolters Kluwer
Health

surescripts

stanson health

PHILIPS
Healthcare

MITRE

syapse

"polyglot"
Health Through Understanding™

medical-objects
CLINICAL APPLICATIONS, MESSAGING AND INTEGRATION

2017 Resolutions

Release a 1.0 specification

Launch production pilots

Argonauts ❤️ CDS Hooks

The EHR invokes a CDS service via a patient-view hook, resulting in a SMART app link card that the clinician uses to launch the SMART app.

Validate and implement the CDS Hooks security model

What’s after 1.0?

Performance: trigger guards, SLAs

Event & time based hooks

Specific use cases
(ACR ordering guidelines, CDC opioid guidelines, etc)

Wait, doesn't FHIR already define an approach for CDS?

Level 5 Providing the ability to reason about the healthcare process

Clinical Reasoning	Library, ServiceDefinition & GuidanceResponse, Measure/MeasureReport, etc

Let's compare*!*

	Clinical Reasoning	CDS Hooks
Management	HL7 INTERNATIONAL	
Rule definition	✔	
Local execution	✔	
Remote execution	✔	✔

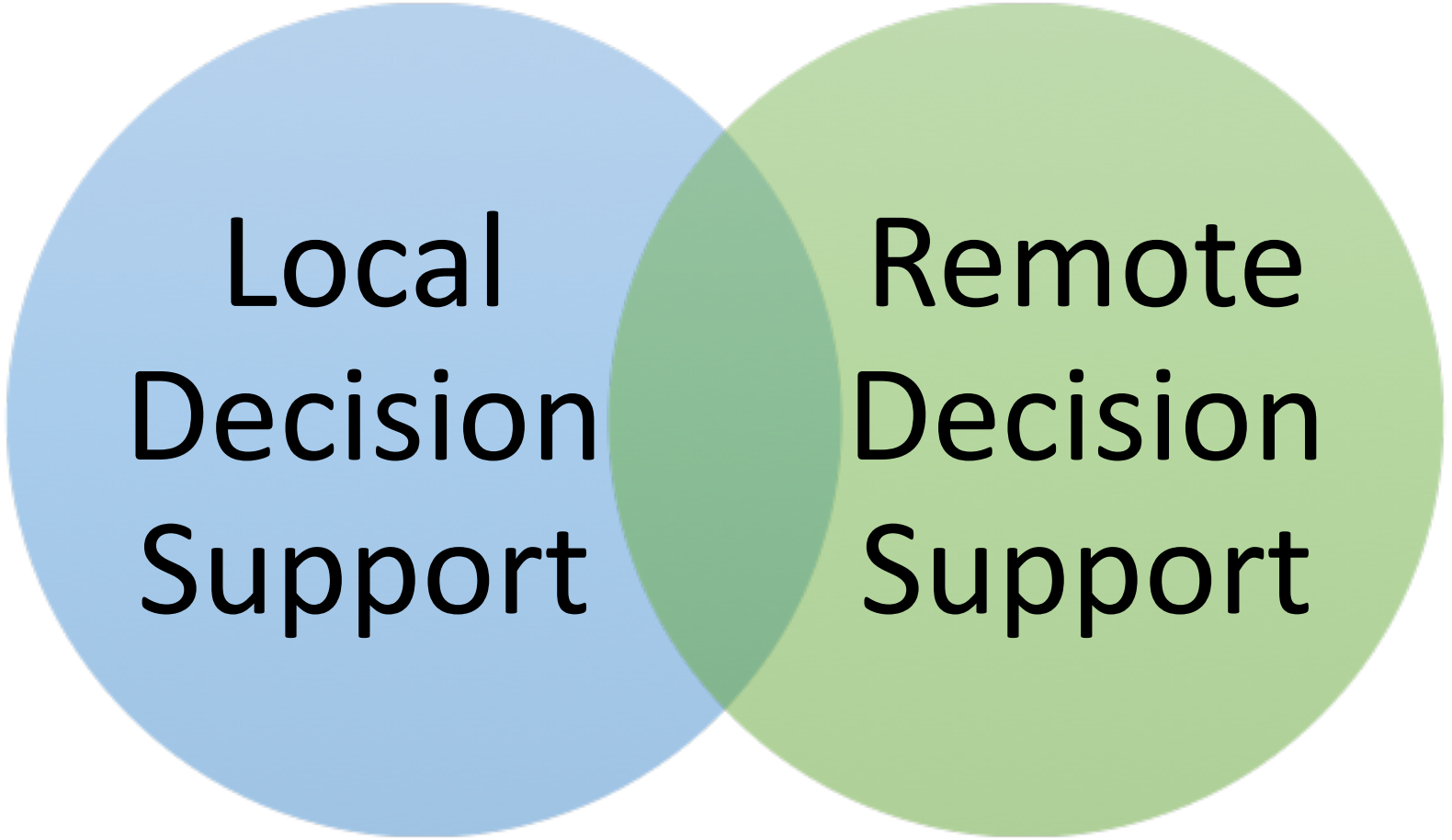
What the?*!*

More ✔ wins, right?

broad vs narrow

🧠 Clinical Reasoning

CDS HOOKS



Let me predict your questions…

Q: Is CDS Hooks in production?

A: Not yet :'-(

Q: Will CDS Hooks support <insert feature>?

A: Log a Github issue or let’s discuss over our Google Group or Zulip chat!

Let me predict your questions…

Q: What is the planned support for <insert your favorite EHR, hospital, etc>?

A: ¯_(ツ)_/¯

Q: What is the business model for CDS Hooks?

A: ¯_(ツ)_/¯

References

Specification & documentation
http://cds-hooks.org

Demo sandbox
http://demo.cds-hooks.org

Source code
https://github.com/cds-hooks

Thanks*!*

Addendum

Sample content from CDS vendors developing on CDS Hooks

Healthwise helps people make better health decisions with CDS Hooks

Review patient education at the moment in care

Patient Education

Source: Healthwise

The following patient education resources were found.

Conditions

Dementia associated with another disease(2008-08-08)

Essential hypertension(2008-04-20)

Other persistent mental disorders due to conditions classified elsewhere(2007-09-15)

- Medical History and Physical Exam for Dementia or Alzheimer's Disease,
- Memory Problems: Wandering,
- Memory Problems: Tips for Helping the Person With Daily Tasks

Prevent medication interactions at the time of prescription

Drug Interactions

Source: Healthwise

The following drug interactions were found.

Interactions

ACE INHIBITORS; ARBS; ALISKIREN/POTASSIUM PREPARATIONS (moderate)

lisinopril (bulk) and potassium acetate may interact based on the potential interaction between ACE INHIBITORS; ARBS; ALISKIREN and POTASSIUM PREPARATIONS.

KEEP VITAMIN K CONTENT OF DIET CONSISTENT. (serious)

The use of warfarin (bulk) may interact with food in that FOOD HIGH IN VITAMIN K MAY DECREASE EFFECT.

PerfectChoice™

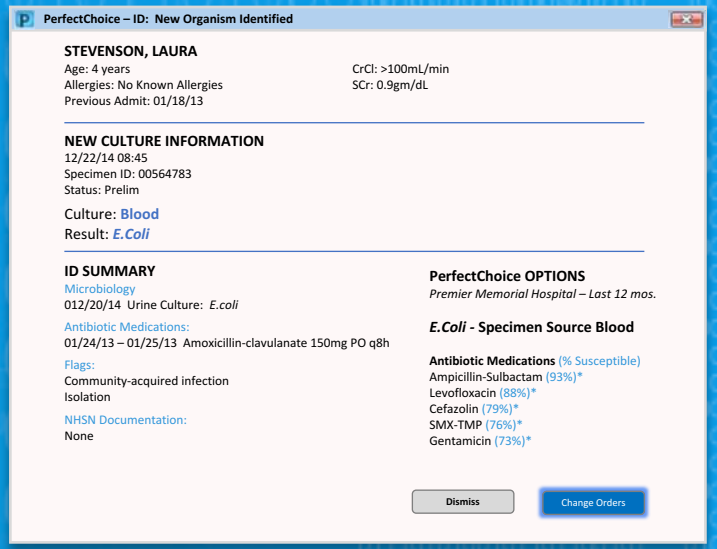
Helping physicians make the perfect antibiotic choices.

IDENTIFY.

> PerfectChoice Notification: Based on new culture information and facility antibiogram, the following antinfectives have the highest likelihood (% susceptible) of effectively treating the infection.
>
> *Source:*
> Launch Premier TheraDoc for more details.

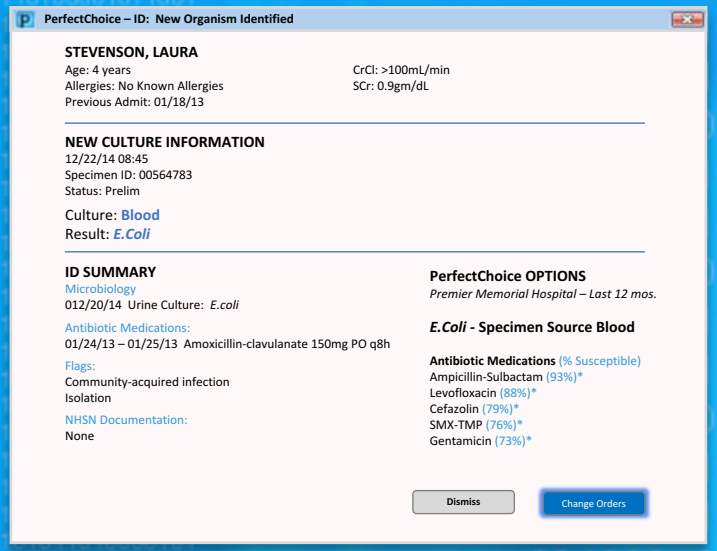
Know the priority patients with new microbiology results with automated surveillance that notifies clinicians in their workflow.

DECIDE.



View the best antibiotic options based on facility antibiogram in context of the patient's relevant clinical data to reach the right decision.

ACT.



Access the EMR to make the appropriate medication order decisions.

A Premier Solution

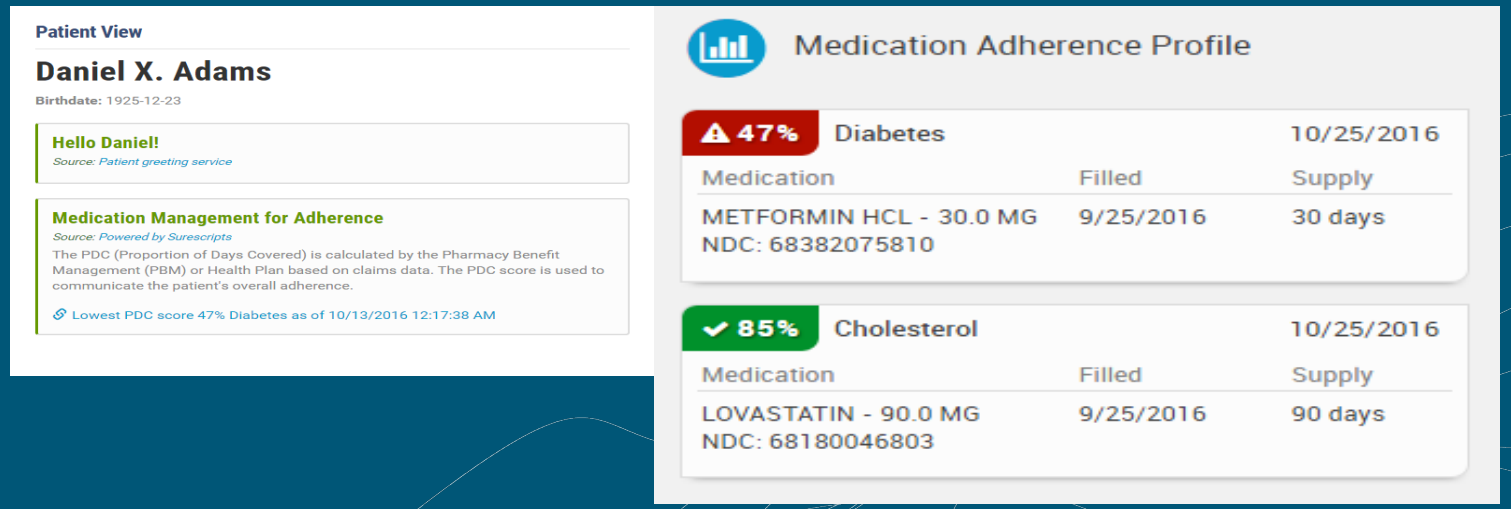
surescripts®

Medication Management for Adherence

(CDS Hooks)

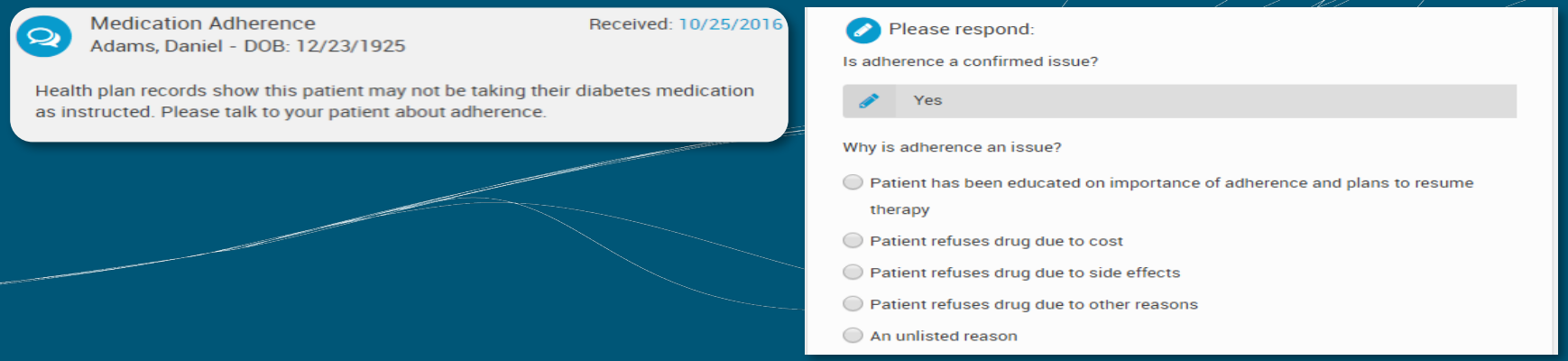
Real-time medication adherence insights

delivered directly into workflow during patient visits

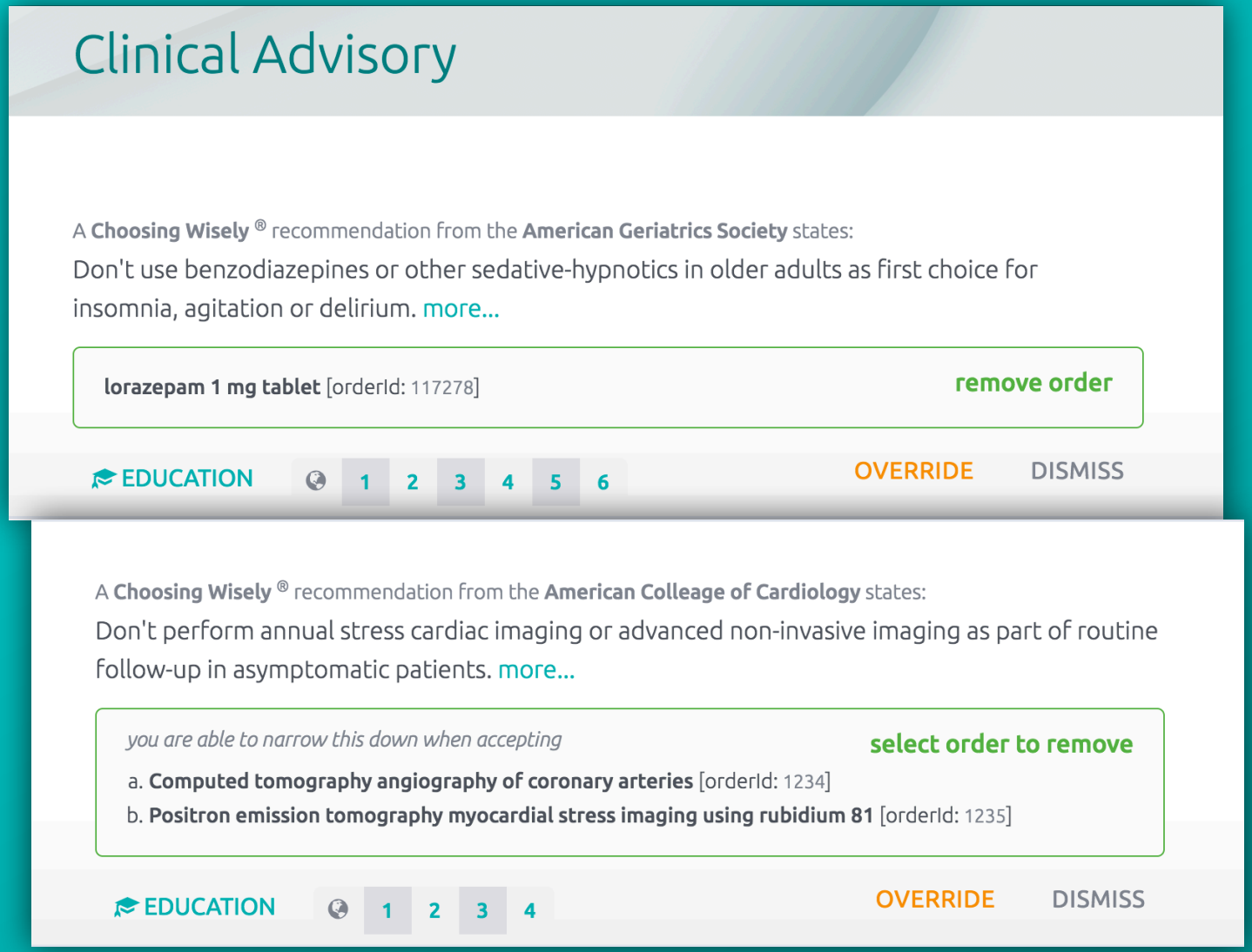


Bi-directional communication

to enable users to provide real-time feedback



Stanson Health's CDS Hooks service



Real time, workflow integrated, patient specific, evidence based

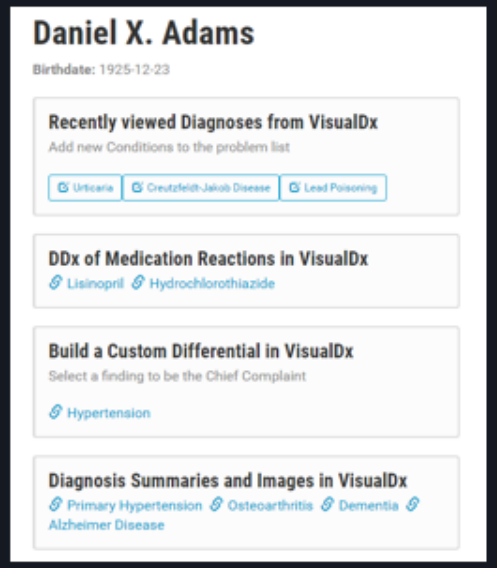
Reduces low-value and unnecessary care

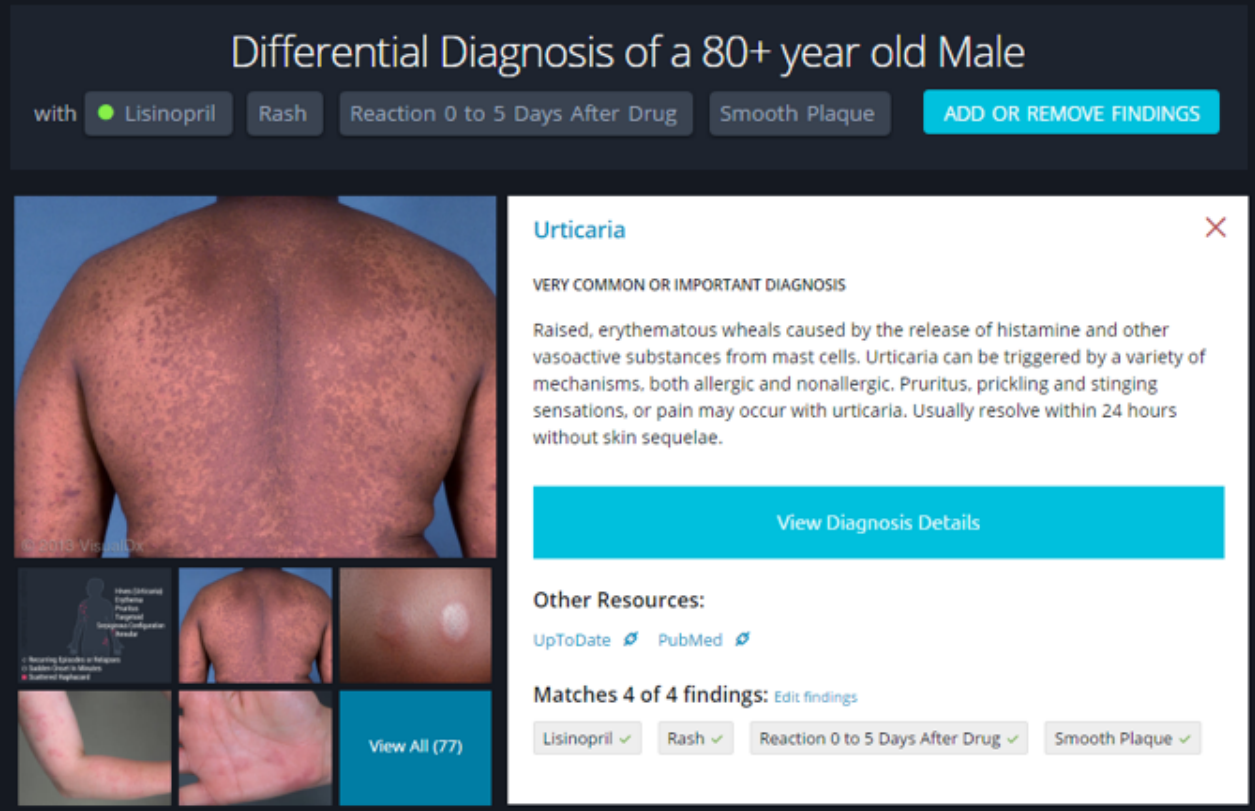
stanson health

preparing for risk at the point of care

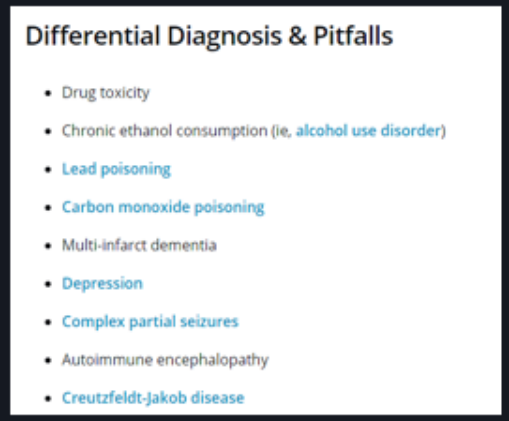
visualDx

Build custom differentials from patient information

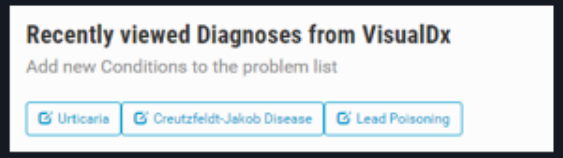




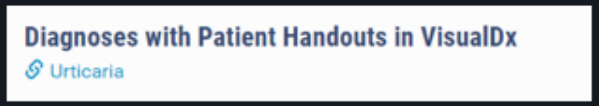
Find diagnosis summaries and textbook differentials



Update record with new diagnoses and findings



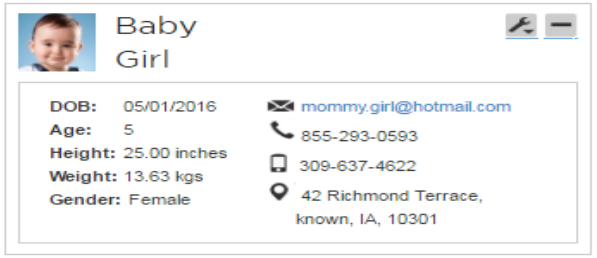
Find patient handouts

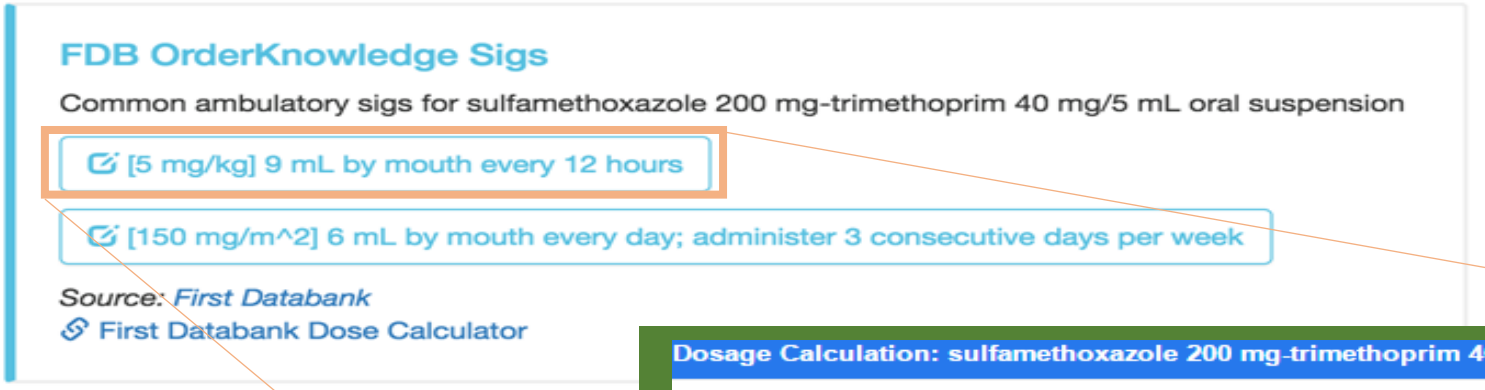


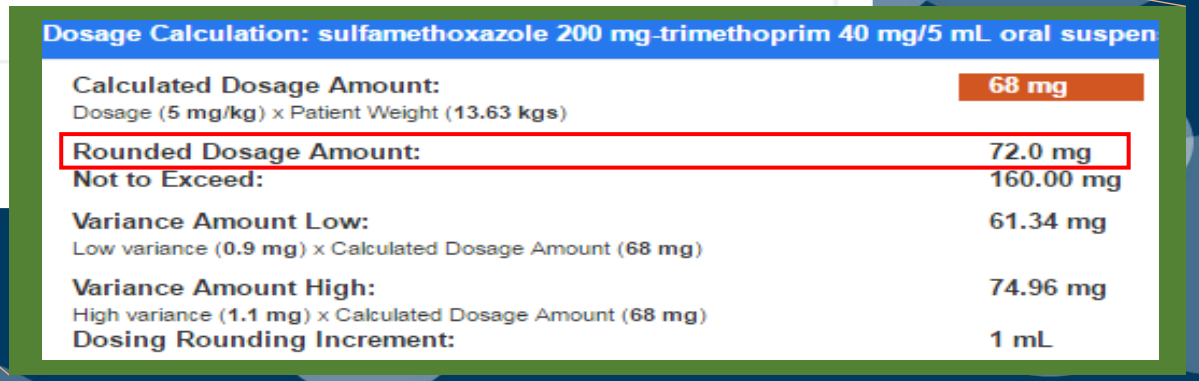
CDS Hooks Dose Calculator

Prevent ADEs with system-calculated, safe, patient-specific doses

Med ordering workflow: pediatric patient, sulfamethoxazole/trimethoprim







Leverages FDB Cloud Connector web services

Calculations happen in real-time using current knowledge base

- *See common orders for **this patient** based on their age and the ordered drug*
- *Smart logic knows this order should be **dosed as trimethoprim***
- *Select from **safe** rounded admin amounts*

meducation®
(CDS Hooks)

Meducation Personalized Medication Information
meducation®

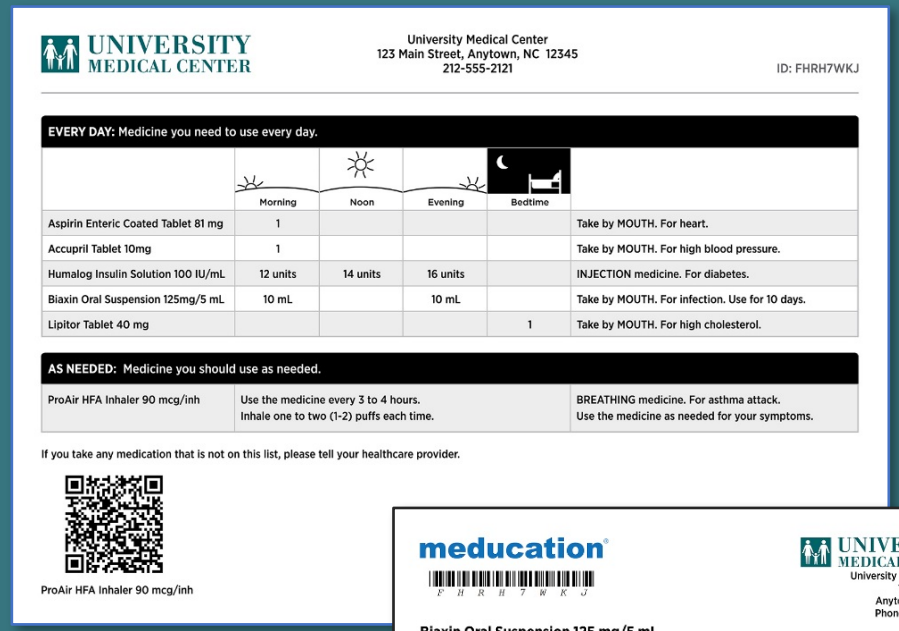
Meducation® provides patient-specific medication instructions & regimen summaries at 5-8 grade reading level & 21 languages to reduce errors & improve adherence.

Interact with Meducation PMI Viewer

Meducation Regimen Summary
meducation®

Meducation® provides patient-specific medication instructions & regimen summaries at 5-8 grade reading level & 21 languages to reduce errors & improve adherence.

Interact with MeducationRS



UNIVERSITY MEDICAL CENTER

University Medical Center
123 Main Street, Anytown, NC 12345
212-555-2121

ID: FHRH7WKJ

EVERY DAY: Medicine you need to use every day.

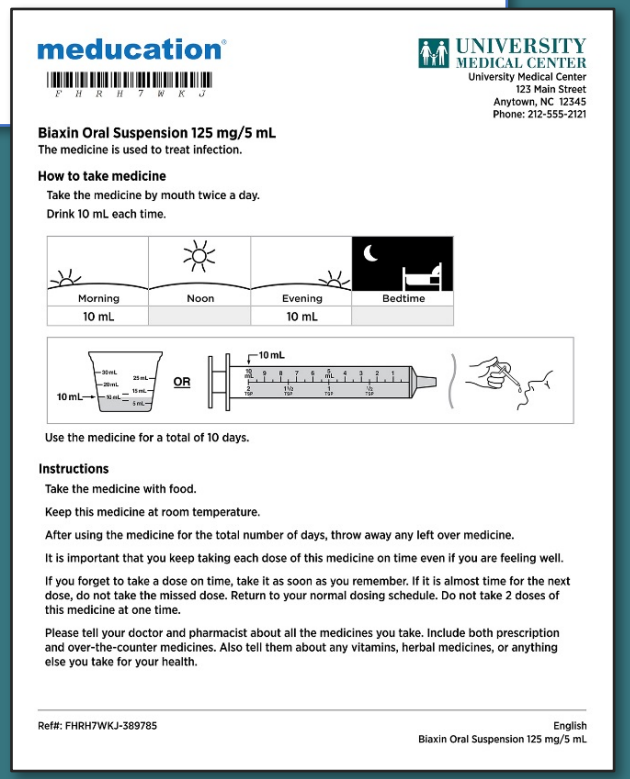
	Morning	Noon	Evening	Bedtime	
Aspirin Enteric Coated Tablet 81 mg	1				Take by MOUTH. For heart.
Accupril Tablet 10mg	1				Take by MOUTH. For high blood pressure.
Humalog Insulin Solution 100 IU/mL	12 units	14 units	16 units		INJECTION medicine. For diabetes.
Biaxin Oral Suspension 125mg/5 mL	10 mL		10 mL		Take by MOUTH. For infection. Use for 10 days.
Lipitor Tablet 40 mg				1	Take by MOUTH. For high cholesterol.

AS NEEDED: Medicine you should use as needed.

ProAir HFA Inhaler 90 mcg/inh	Use the medicine every 3 to 4 hours. Inhale one to two (1-2) puffs each time.	BREATHING medicine. For asthma attack. Use the medicine as needed for your symptoms.

If you take any medication that is not on this list, please tell your healthcare provider.

ProAir HFA Inhaler 90 mcg/inh



meducation®

UNIVERSITY MEDICAL CENTER
University Medical Center
123 Main Street
Anytown, NC 12345
Phone: 212-555-2121

Biaxin Oral Suspension 125 mg/5 mL
The medicine is used to treat infection.

How to take medicine

Take the medicine by mouth twice a day.

Drink 10 mL each time.

Morning	Noon	Evening	Bedtime
10 mL		10 mL	

10 mL OR 10 mL

Use the medicine for a total of 10 days.

Instructions

Take the medicine with food.

Keep this medicine at room temperature.

After using the medicine for the total number of days, throw away any left over medicine.

It is important that you keep taking each dose of this medicine on time even if you are feeling well.

If you forget to take a dose on time, take it as soon as you remember. If it is almost time for the next dose, do not take the missed dose. Return to your normal dosing schedule. Do not take 2 doses of this medicine at one time.

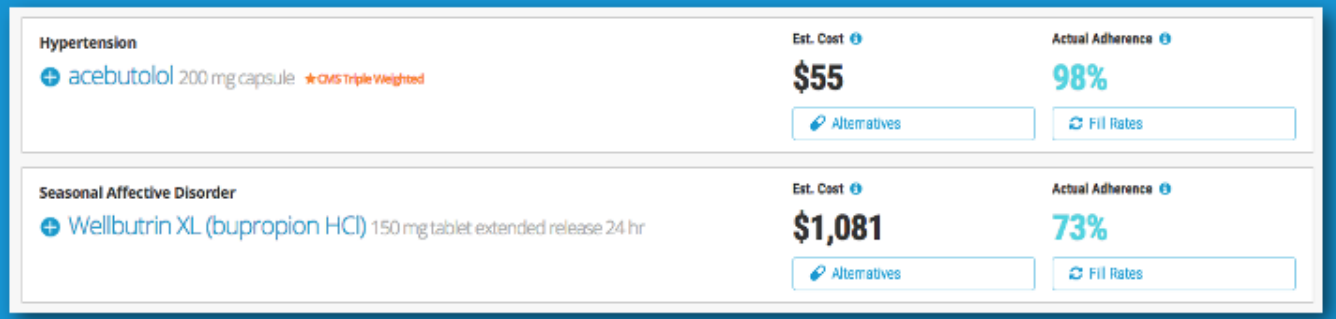
Please tell your doctor and pharmacist about all the medicines you take. Include both prescription and over-the-counter medicines. Also tell them about any vitamins, herbal medicines, or anything else you take for your health.

Ref#: FHRH7WKJ-389785

English
Biaxin Oral Suspension 125 mg/5 mL

RxCheck (CDS Hooks)

Optimize pharmacy spend using **actionable recommendations**.



Improve outcomes through **consistent prescribing**.

Name	Patients	GDR	Prescribing Compliance	Prescriptions	High-risk Meds	Total Spend	Potential Savings
Jamil Miller	52	94%	87%	310	22	$2,467	$713
Darron Durgan	24	98%	76%	279	14	$3,322	$616

Drive performance metrics (e.g., adherence) through **prescribing behavior surveillance**.

Precision Link at Boston Children's: PGx Recommendations via CDS Hooks

Adjusting medication order based upon genomic data

An **azathioprine** prescription based upon a patient's expression of **TPMT enzyme**

Normal metabolizer

PGX Recommendation

Start with normal starting dose (e.g., 2-3 mg/kg/d) and adjust doses of azathioprine based on disease-specific guidelines. Allow 2 weeks to reach steady state after each dose adjustment.

Intermediate metabolizer

PGX Recommendation

If disease treatment normally starts at the "full dose", consider starting at 30-70% of target dose (e.g., 1-1.5 mg/kg/d), and titrate based on tolerance. Allow 2-4 weeks to reach steady state after each dose adjustment.

Poor metabolizer

PGX Recommendation

Consider alternative agents. If using azathioprine start with drastically reduced doses (reduce daily dose by 10-fold and dose thrice weekly instead of daily) and adjust doses of azathioprine based on degree of myelosuppression and disease-specific guidelines. Allow 4-6 weeks to reach steady state after each dose adjustment. Azathioprine is the likely cause of myelosuppression.

chip Boston Children's Hospital Until every child is well