



CDS Hooks and DynaMed: Integration and Interoperability

Stephanie Crillo

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CAROLINA HEALTH INFORMATICS PROGRAM

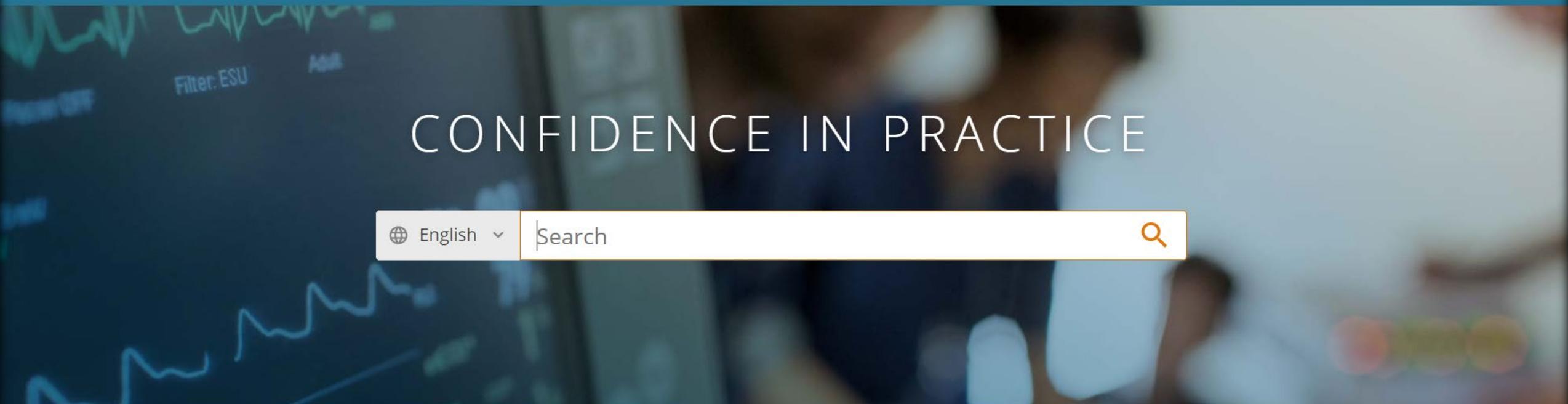
Improving Healthcare with Intelligence

EBSCO

What is DynaMed?

- High-quality suite of CDS services
 - Allows the clinician to search for any medical topic
 - Subjects are returned in a clean and concise format, and are updated on a regular basis
 - A quick search provides clinicians with best practice recommendations, diagnosis and management, and informative images (1)
- Has expanded to include Micromedex, Dynamic Health, and DynaMed Decisions (1)

CONFIDENCE IN PRACTICE

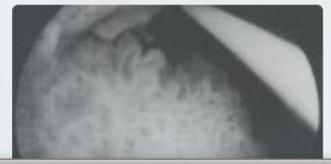


CONFIDENCE IN PRACTICE

English ▾ Search 



Cardiology
Acute Coronary Syndromes,
Stable Coronary Artery Disease



Oncology
Breast Cancers, Lung Cancers,
Colorectal Cancers



Dermatology
Eczematous Dermatoses,
Melanocytic Lesions



Overview and Recommendations

- Background
- Evaluation
- Management

Related Summaries

- General Information
- Epidemiology
- Etiology and Pathogenesis
- History and Physical
- Diagnosis
- Management
- Complications and Prognosis
- Prevention and Screening
- Guidelines and Resources
- Patient Information
- ICD Codes
- References



Overview and Recommendations



Background

- Discoid lupus erythematosus is a chronic form of lupus erythematosus limited to the skin
 - Cutaneous lupus erythematosus has distinct acute, subacute, and chronic subtypes.
 - Discoid lupus erythematosus is the most common form of chronic cutaneous lupus erythematosus.
- Discoid lupus erythematosus is characterized by purplish scaly papules and plaques that occur on sun-exposed areas and the hair-bearing scalp and may result in significant scarring and permanent hair loss.
- Systemic lupus erythematosus (SLE) is reported to develop in 12%-28% of patients with discoid lupus.
- Patients with SLE may have a 20%-25% lifetime risk of developing at least 1 classic discoid lesion.

Evaluation

- The typical discoid lesion starts as a well-demarcated purplish macule or papule with an adherent scale, often on the head or neck, and spreads centrifugally, gradually expanding into a discoid (coin-shaped) plaque.
- Adjacent plaques may coalesce into larger irregular plaques and the adherent scale may extend into dilated hair follicles causing follicular plugging.

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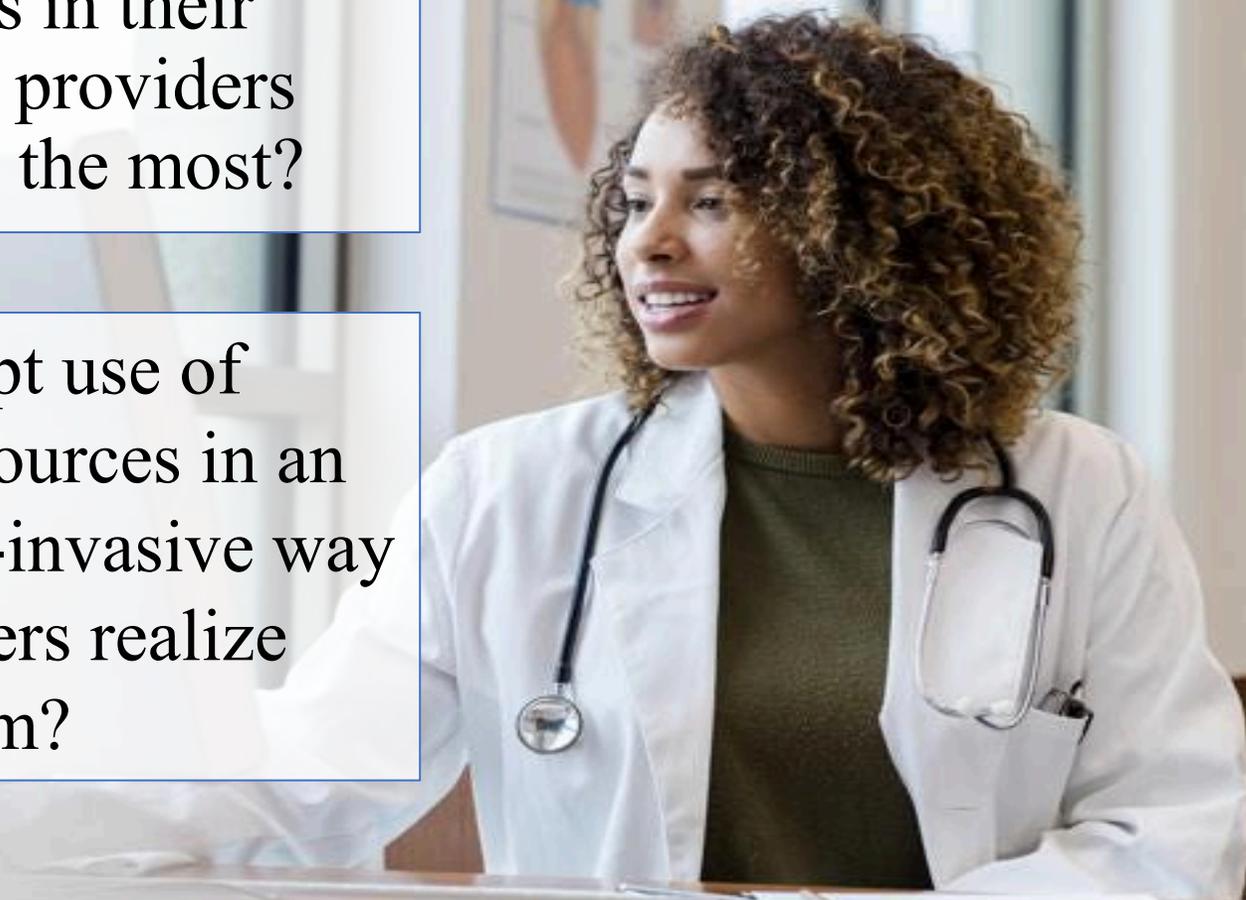




Need: Integration of DynaMed Resources

At what points in their workflows do providers use DynaMed the most?

Can we prompt use of DynaMed resources in an intuitive, non-invasive way *before* providers realize they need them?



University of Utah CMIO
Maia Hightower:

“The “coolest app in the world” may not be enough to overcome the barrier of logging out of Epic to use it. Our clinicians will use a clunky app that's integrated in the workflow over a sleek app outside of it.”(2)

1. <https://www.healthcareitnews.com/news/cios-cmios-still-seeing-challenges-ehr-integration-third-party-apps>



**“An HL7
published
specification
for clinical
decision
support.” (3)**

**Hooks reach out
to external CDS
Services**

**CDS Services
return cards to
be displayed in
the EHR**

**Allows EHRs to
invoke CDSs based on
triggering events
(hooks) that occur
during the normal
workflow**

These can be:

- **Information Cards**
- **Suggestion Cards**
- **SMART App link cards**



Example Hooks

patient-view

When a patient's chart is opened

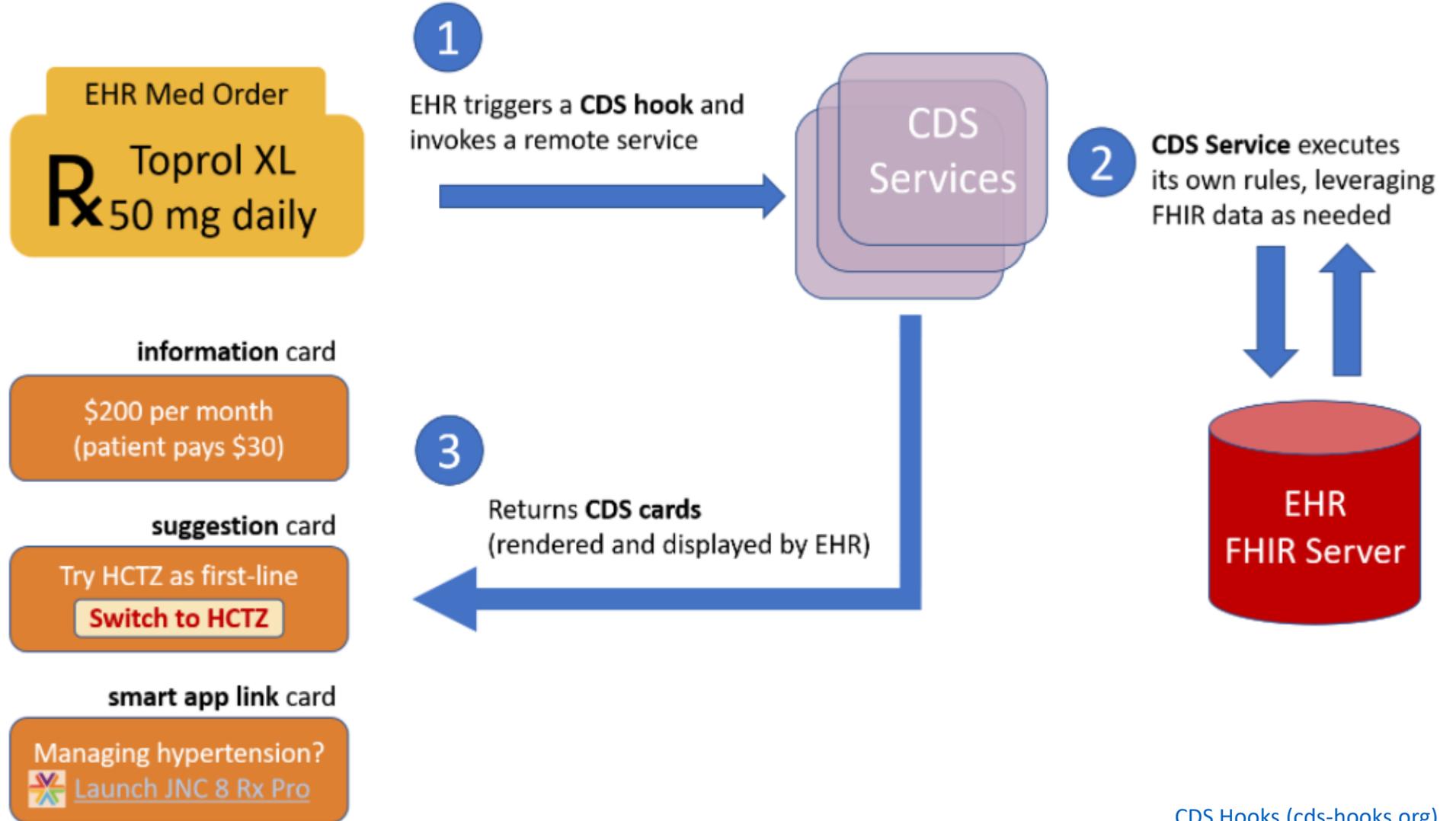
order-select

When a clinician selects one or more orders to place for a patient

order-sign

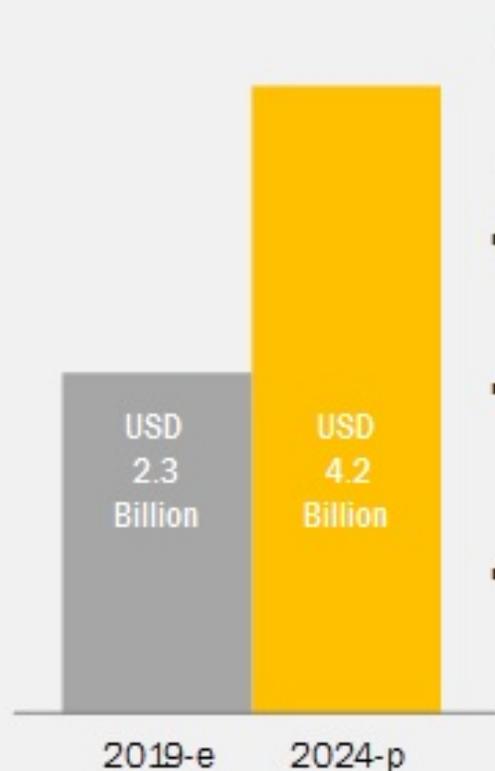
When a clinician is ready to sign one or more orders for a patient

Simple Workflow Example



Market Analysis

Attractive Opportunities in the Healthcare Interoperability Solutions Market



CAGR

12.6%

- The global healthcare interoperability solutions market is projected to reach USD 4.2 billion by 2024 from USD 2.3 billion in 2019, at a CAGR of 12.6% during the forecast period.
- Growth in this market is driven by the growing need to curtail healthcare costs, government initiatives for enhancing patient care, rising focus on patient-centric care delivery, and government funding for healthcare interoperability.
- The improving healthcare infrastructure in emerging markets is expected to offer significant growth opportunities for market players during the forecast period.

[Healthcare Interoperability Solutions Market - 2024 | MarketsandMarkets](#)

Not only is the market for features such as CDS Hooks growing at a staggering pace; DynaMed's main competitors are also working on CDS-Hooks-enabled applications.



Technology: Overview

- Connects CDS Clients (EHRs) to CDS Services (DynaMed)
- All data exchanged as JSON structures (4)
- Data is transmitted over HTTPS-secured channels (4)
- Communicating with a CDS Service happens in three phases: Discovery, Calling the CDS Service, and Service Response (4)

Technology: Discovery

CDS Service developers provide an endpoint that allows the EHR to “discover” the service (4)

This endpoint includes: a description of the service, if there is any data that needs to be prefetched, and when the service is to be called (4)

The CDS Service responds with a list of services the application offers (4)

Discovery Example

```
1 curl "https://example.com/cds-services"
```

The above command returns JSON structured like this:

```
1 {
2   "services": [
3     {
4       "hook": "patient-view",
5       "title": "Static CDS Service Example",
6       "description": "An example of a CDS Service that returns a static set of
7       "id": "static-patient-greeter",
8       "prefetch": {
9         "patientToGreet": "Patient/{{context.patientId}}"
10      }
11    },
12    {
13      "hook": "order-select",
14      "title": "Order Echo CDS Service",
15      "description": "An example of a CDS Service that simply echos the order(
16      "id": "order-echo",
17      "prefetch": {
18        "patient": "Patient/{{context.patientId}}",
19        "medications": "MedicationRequest?patient={{context.patientId}}"
20      }
21    }
22  ]
23 }
```

Technology: Calling the CDS Service

A CDS Client (EHR) posts a JSON document to the CDS Service to call it (4)

CDS Services require FHIR resources to compute the request – these resources can be obtained either by passing prefetch data from the EHR or via a secure bearer token passed by the EHR to the CDS Service (4)

```
1 curl
2   -X POST \
3   -H 'Content-type: application/json' \
4   --data @hook-details-see-example-below
5   "https://example.com/cds-services/static-patient-greeter"
```

```
1 {
2   "hookInstance" : "d1577c69-dfbe-44ad-ba6d-3e05e953b2ea",
3   "fhirServer" : "http://hooks.smarthealthit.org:9080",
4   "hook" : "patient-view",
5   "fhirAuthorization" : {
6     "access_token" : "some-opaque-fhir-access-token",
7     "token_type" : "Bearer",
8     "expires_in" : 300,
9     "scope" : "patient/Patient.read patient/Observation.read",
10    "subject" : "cds-service4"
11  },
12  "context" : {
13    "userId" : "Practitioner/example",
14    "patientId" : "1288992",
15    "encounterId" : "89284"
16  },
17  "prefetch" : {
18    "patientToGreet" : {
19      "resourceType" : "Patient",
20      "gender" : "male",
21      "birthDate" : "1925-12-23",
22      "id" : "1288992",
23      "active" : true
24    }
25  }
26 }
```

Technology: Service Response

CDS Services respond with a 200 HTTP (“Success”) message and a cards array (4)

Cards contain decision support information (4)

Example response

```
1  {
2    "cards": [
3      {
4        "uuid": "4e0a3a1e-3283-4575-ab82-028d55fe2719",
5        "summary": "Example Card",
6        "indicator": "info",
7        "detail": "This is an example card.",
8        "source": {
9          "label": "Static CDS Service Example",
10         "url": "https://example.com",
11         "icon": "https://example.com/img/icon-100px.png"
12       },
13       "links": [
14         {
15           "label": "Google",
16           "url": "https://google.com",
17           "type": "absolute"
18         },
19         {
20           "label": "Github",
21           "url": "https://github.com",
22           "type": "absolute"
23         },
24         {
25           "label": "SMART Example App",
26           "url": "https://smart.example.com/launch",
27           "type": "smart",
28           "appContext": "{\"session\":3456356,\"settings\":{\"module\":4235}}\"
29         }
30       ]
31     },
32     {
33       "summary": "Another card",
34       "indicator": "warning",
35       "source": {
36         "label": "Static CDS Service Example"
37       }
38     }
39   ]
40 }
```

Adoption and EHR Support

- Epic currently supports order-sign, order-select, and patient-view hooks, but not encounter-start (as of July 2021)
- Epic supports user-specific profiles, and department-specific configurations
- Clean, non-intrusive format for informational hooks



DynaMed Use Case 1: Integrating Decisions

Could be triggered via the **encounter-start** or **patient-view** hook:

Doe, Jane
MRN 78941456, Female

Age: 64 years
Weight: 180 lbs

Allergies: None ⓘ

- Chart Review
- Plan of Care
- Vitals**
- Problem List
- DynaMed Decisions
- Orders
- MAR
- Results Review
- Flowsheets
- Patient Education

Reason for Visit

High blood pressure follow-up. BP was elevated a month ago.

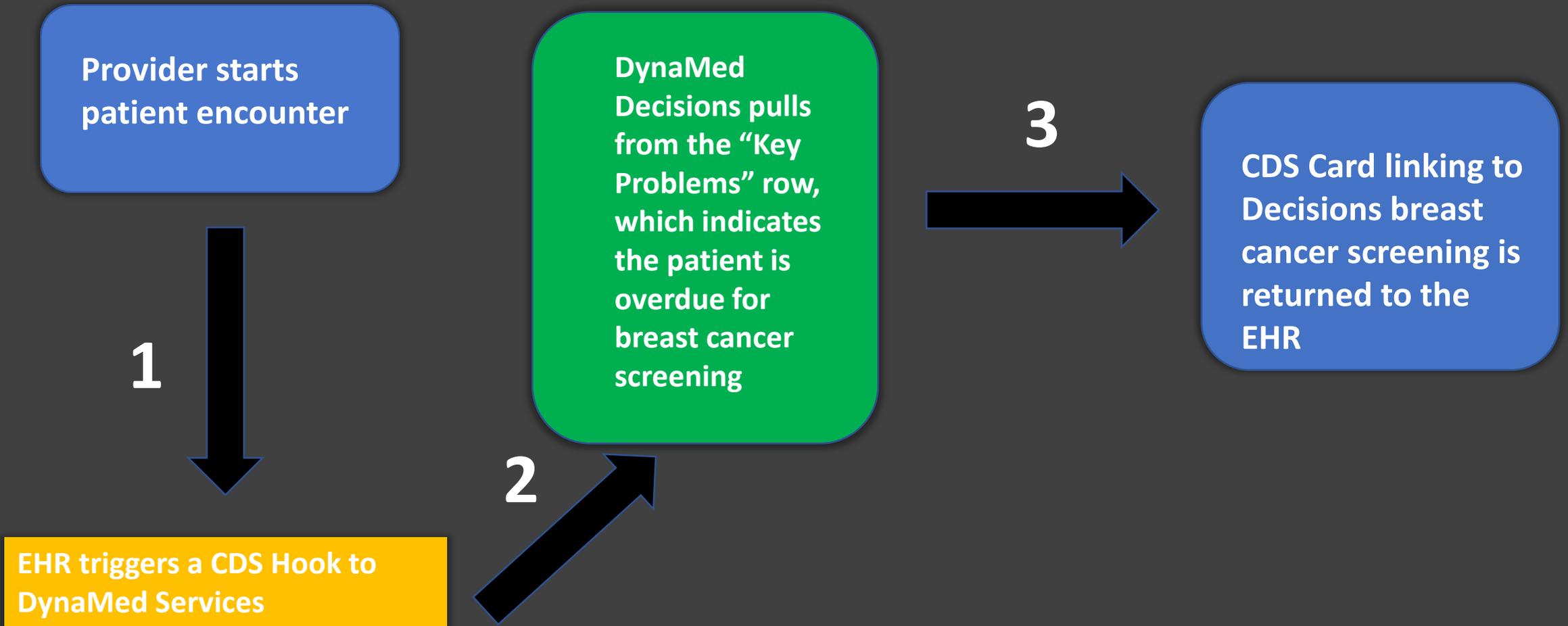
Chief Complaint

68 year old White Female with elevated blood pressures one month ago. Back for recheck and possible discussions about medications. She is interested in non-pharmacologic therapies.

Key Problems

- Overdue Breast Cancer Screening (last Mammogram April 4, 2013) ⓘ

DynaMed Use Case 1: Integrating Decisions



Doe, Jane

MRN 78941456, Female

Age: 64 years

Weight: 180 lbs

Allergies: None 

Chart Review

Plan of Care

Vitals

Problem List

DynaMed Decisions

Orders

MAR

Results Review

Flowsheets

Patient Education

Reason for Visit

High blood pressure follow-up. BP was elevated a month ago.

Chief Complaint

68 year old White Female with elevated blood pressures one month ago. Back for recheck and possible discussions about medications. She is interested in non-pharmacologic therapies.

Key Problems

- Overdue Breast Cancer Screening (last Mammogram April 4, 2013) 

A breast cancer screening is recommended



[Launch DynaMed Decisions](#)

[Override](#)



Breast Cancer Screening

The tool is for people 35-74 years old with average risk for breast cancer who are considering mammogram screening.

It is not for people with new breast symptoms, high-risk genes for breast cancer, a history of breast cancer or chest radiation for childhood cancer, a high-risk family history, or who would decline treatment if cancer were found. People with a prior breast augmentation or mastectomy are not eligible to use the Breast Cancer Screening Consortium (BCSC) model.

Risk Model *

BCSC Gail



Age *

years

Race/Ethnicity *

▼



Previous Breast Biopsy *

▼

Family History of Breast Cancer *

No Yes Unknown



*=required

[View Assessment & Guidance >](#)

DynaMed Use Case 2: Medical Education

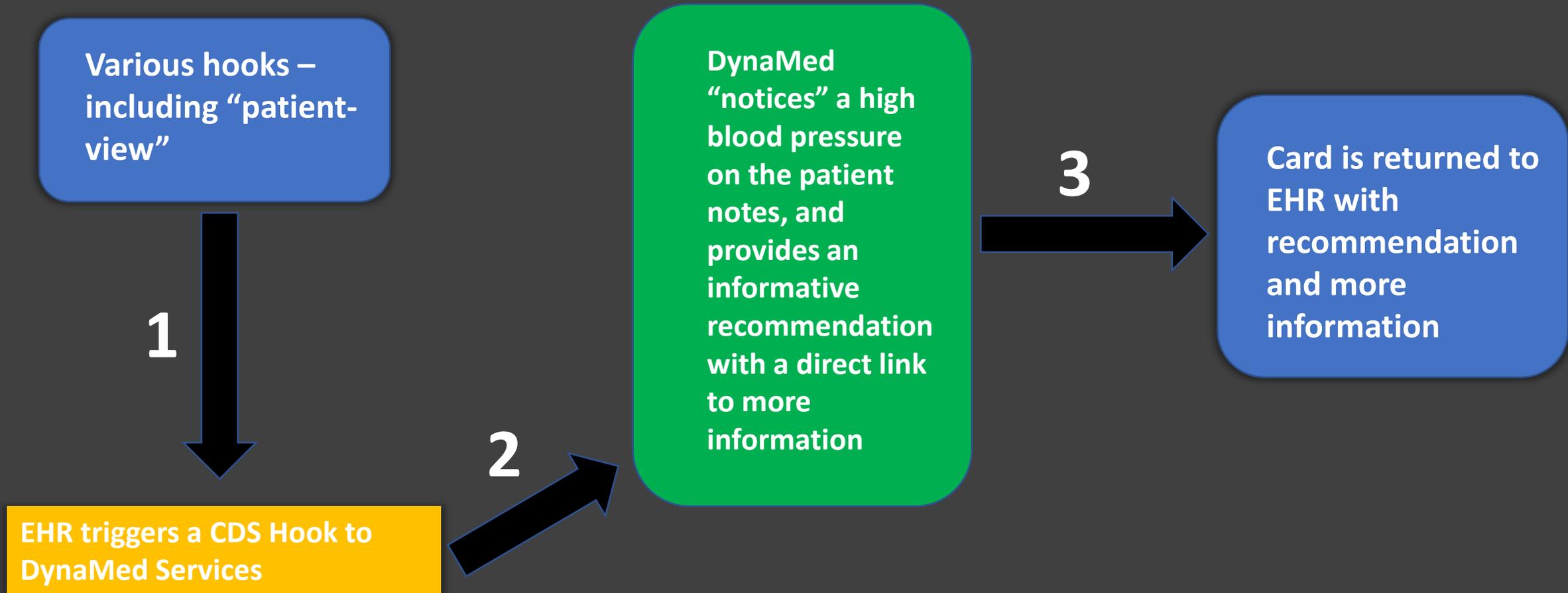
Could be triggered via various hooks, including **patient-view**:

Doe, Jane MRN 78941456, Female	Age: 64 years Weight: 180 lbs	Allergies: None ⓘ
Chart Review	Reason for Visit High blood pressure follow-up. BP was elevated a month ago.	
Plan of Care	Chief Complaint 68 year old White Female with elevated blood pressures one month ago. pharmacologic therapies.	
Vitals	Key Problems <ul style="list-style-type: none">Overdue Breast Cancer Screening (last Mammogram April 4, 2013)	d in non-
Problem List		
DynaMed Decisions		
Orders		

Consider a target blood pressure of < 140/90 mm Hg for patients with low-to-moderate cardiovascular risk

 [See more in DynaMed](#)

DynaMed Use Case 2: Medical Education



Doe, Jane

MRN 78941456, Female

Age: 64 years
Weight: 180 lbs

Allergies: None 

Chart Review

Plan of Care

Vitals

Problem List

DynaMed Decisions

Orders

MAR

Results Review

Flowsheets

Patient Education

Reason for Visit

High blood pressure follow-up. BP was elevated a month ago.

Chief Complaint

68 year old White Female with elevated blood pressures one month ago. Back for recheck and possible discussions about medications. She is interested in non-pharmacologic therapies.

Key Problems

- Overdue Breast Cancer Screening (last Mammogram April 4, 2013) 

How To: Taking a Blood Pressure Measurement



[Launch in Dynamic Health](#)

Future Work

- CDS Hooks v.1.1 includes a Feedback feature
- This feature allows the CDS Service to gather data on what happened with its suggestion – how many times was the suggestion card accepted, vs. ignored, declined, or overridden?
- Continuous improvement is key!

```
POST {baseUrl}/cds-services/{serviceId}/feedback

{
  "feedback":[
    {
      "card":"`card.uuid` from CDS Hooks response",
      "outcome":"accepted",
      "acceptedSuggestions": [ { "id" : "`card.suggestion.uuid` from CDS Hooks response" } ],
      "outcomeTimestamp": "iso timestamp in UTC when action was taken on card"
    } ]
}
```

[Current \(draft\) - CDS Hooks \(cds-hooks.org\)](#)



Conclusion

- DynaMed has a vast array of always-current medical knowledge that can be used by the entire healthcare team
- CDS Hooks helps clinicians and patients both by providing DynaMed services at the point of care, without leaving the EHR
- The standard is supported by major EHR providers, and is quickly becoming integrated by competitors
- Early adoption of CDS Hooks will remove barriers between DynaMed and the EHR, and will be a benefit to EBSCO and DynaMed users both

References

1. EBSCO Industries, Inc. (2021). *Dynamed*. dynamed.com. <https://www.dynamed.com/>.
2. Jercich, K. (2020, November 17). *CIOs, CMIOs still seeing challenges with EHR integration of third-party apps*. Healthcare IT News. <https://www.healthcareitnews.com/news/cios-cmios-still-seeing-challenges-ehr-integration-third-party-apps>.
3. HL7 & Boston Children's Hospital. (2018). *CDS Hooks Overview*. CDS Hooks. <https://cds-hooks.org/>.
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