

SMART on FHIR and CDS Hooks Implementation Considerations

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Technology Overview – SMART on FHIR

Open framework for substitutable medical applications integration with EHR systems building on top of FHIR



Benefits

- Standards based approach to development of portable medical applications
- Multiple launch workflows
- OAuth security framework
- Predictable data profiles
- Maturity of technology

Features

- Launch context acquisition
- Authentication via OAuth
- Authorization based on scopes
- Public vs confidential applications
- Embedded and standalone applications
- Clients available for JavaScript, Python, iOS
- Argonaut profiles
- App Gallery
- Developer community

Technology Overview – CDS Hooks

Lightweight event-driven framework for integration of Clinical Decision Support Services into the EHR workflow



Benefits

- Separation of concerns between EHR and CDS vendors
- Substitutability of CDS services
- No end user training requirements
- Standardization of CDS integration

Features

- Subscription model
- Events-driven invocation
- Relevance determination
- Context prefetch
- Types of cards: Information, Warning, Full Stop Suggestion, App Launch
- Card presentation left to EHR
- FHIR-based messaging
- Rapidly evolving
- Supported by Argonaut and major EHR vendors

Risk Calculators

Bloodwork Cardiology Result

Patient info

NAME: Carl Lee
GENDER: M AGE: 75 DOB: 1939-08-30

Note: these results are valid for non-diabetics only!

- ☐ Current smoker?
- ☐ Family history of heart attack?
- ☐ Systolic blood pressure

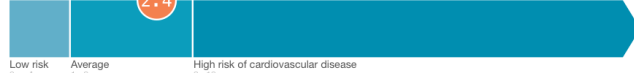
120

1 About this test

This report evaluates your potential risk of heart disease, heart attack, and stroke.

2 Your Results

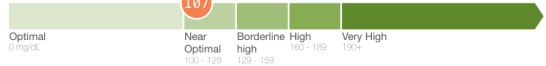
CRP level test



Total cholesterol level



LDL "bad" cholesterol



HDL "good" cholesterol



3 Your risk You show an elevated risk of cardiovascular disease

If you're a smoker with normal blood pressure, (130 mm/Hg) but family history of heart attack before the age of 60 (one or both parents) your risk over 10 years is:

15%

Your risk would be lowered to:
15% if your blood pressure were 120mm/Hg
10% if you didn't smoke and all levels were optimal
15% if you quit smoking

Use your test results to calculate your risk of a cardiovascular event at ReynoldsRisk.org

4 What now?



Diet and exercise can improve your cholesterol levels



Staying smoke-free is one of the best ways to improve your heart disease risk



Ask your doctor about statins or other medications that can lower cholesterol



Consider retesting in 1 or 2 weeks to exclude a temporary spike in blood levels

Original Design: David McCandless & Stefanie Posavec for Wired Magazine // informationisbeautiful.net/ReynoldsRiskScoreCalculator/

Development and validation of improved algorithms for the assessment of global cardiovascular risk in women: The Reynolds Risk Score. Ridker et al. JAMA 2007;297:2611-619
C-reactive protein and parental history improve global cardiovascular risk prediction: The Reynolds Risk Score for Men. Ridker et al. Circulation. 2008;118:2243-2251



John X. Doe

Gender: male | Birth Date: 1988-08-12 [28yo] | MRN: 123456789



Cardio Disease Risk

Stroke Risk

Stroke Risk Diabetes

Lung Cancer Risk

Lung Age



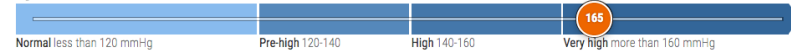
Stroke Risk Calculator



This risk assessment tool uses patient-specific data to estimate the risk of ischemic or hemorrhagic stroke over the 1-, 5- or 10-year interval. The tool is based on the results of the Framingham Heart Study using the Cox regression model of proportional hazards. This tool applies to patients 55-84 years of age.

1 Patient Measurements

Systolic Blood Pressure

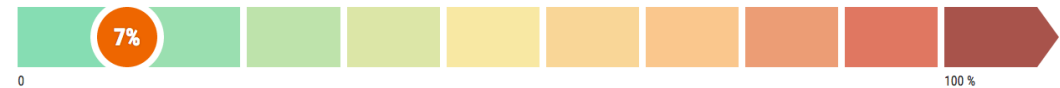


2 Risk interval in years



4 Your risk

Your risk of having a stroke in the next 10 years is:



5 Your risk would be lowered to:



6 What now?



Diet and exercise can improve your cholesterol levels

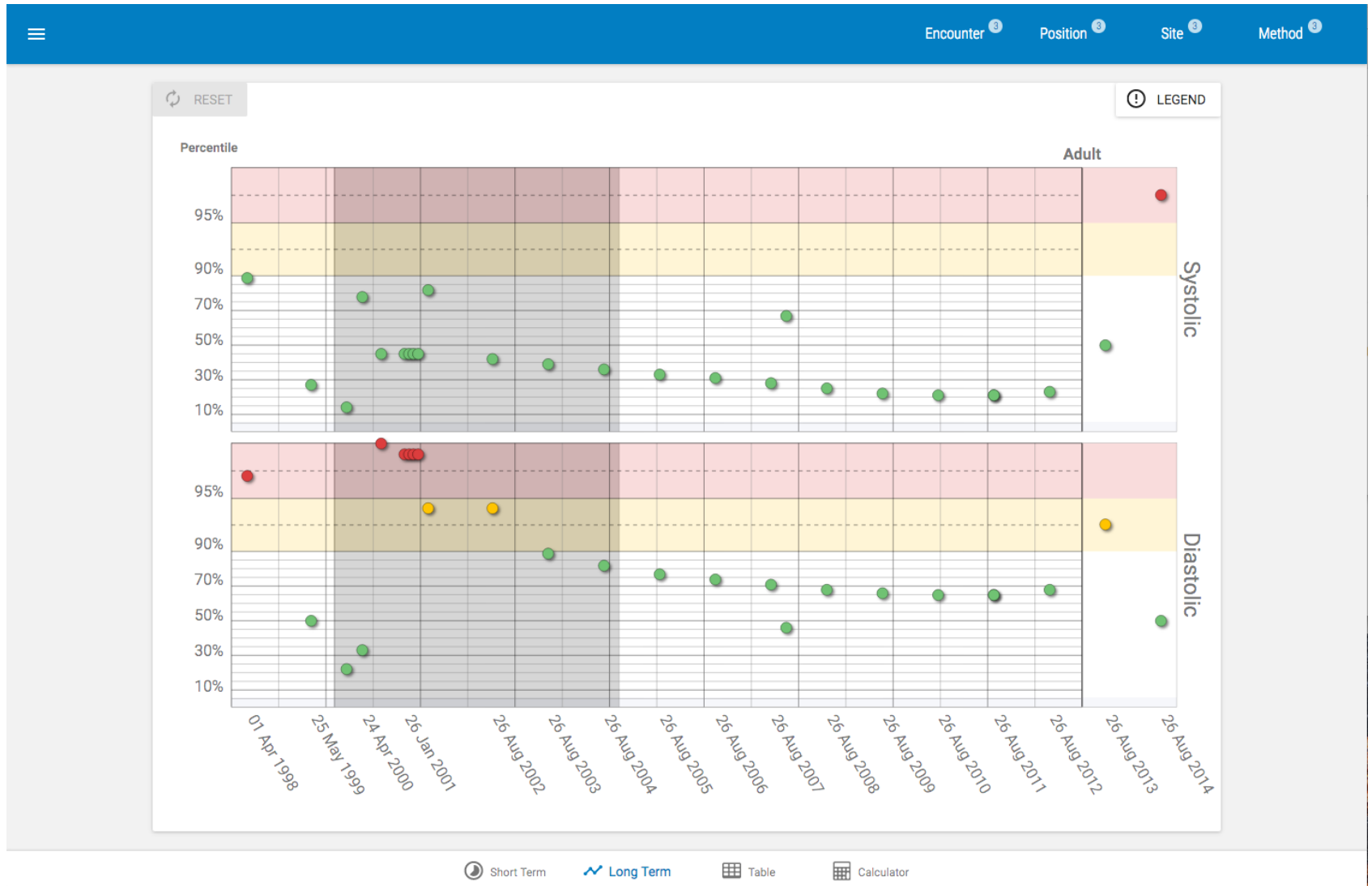


Staying smoke-free is one of the best ways to improve your heart disease risk



Certain medications may be important in decreasing your stroke risk

Blood Pressure Percentiles



Growth Charts



Duke PillBox

DukePillBox English

Daniel X. Adams DOB: 1925-12-23 MRN: 1288992

Morning

Lisinopril 20 MG Oral Tablet 1

donepezil 10 MG Oral Tablet [...] 1

Noon

Memantine 10 MG Oral Tablet... 1

potassium citrate 10 MEQ Ext... 1/2

Evening

Triamcinolone 1 MG/ML Topical Cream

Estrogens, Conjugated (USP)... 1

Bedtime

Estrogens, Conjugated (USP)... 1

Flomax 0.4 mg 1/2

Weekly

donepezil 10 MG Oral Tablet [...] 1

donepezil 10 MG Oral Tablet [...] 1

Lisinopril 20 MG Oral Tablet

Memantine 10 MG Oral T...

donepezil 10 MG Oral Ta...

potassium citrate 10 ME...

Triamcinolone 1 MG/ML To...

Flomax 0.4 mg

Estrogens, Conjugated (...)

Finish

Check

Hint

Help

Clear

Print

ClinDat (Rheumatology)

CLIN DAT on smart
John Smith

Patient's Right Patient's Left

L-WRIST
☒ Normal ☐ Tender ☐ Swollen

DANIEL X ADAMS **CLIN DAT on smart**

2. DISEASE ACTIVITY, DAMAGE and DISTRESS

a. Degree of inflammation or reversible disease (DOCINF) TODAY:
 EXCELLENT VERY POOR

b. Degree of joint or organ structural damage or irreversible disease (DOCDAM):
 EXCELLENT VERY POOR

c. Degree of symptoms due to neither inflammation nor damage (e.g. fibromyalgia) (DOCNON):
 EXCELLENT VERY POOR

e. If DOCGL > 2, % of DOCGL due to:

35% inflammation/reversible

10% damage

55% neither

f. If DOCGL > 2, proportion of DOCGL due to:

80% rheumatic disease(s)

20% non-RDs

PATFN: 5.0	DOCGL: 5.0	RAPID3: 15
PATPAIN: 5.0	ESR: 10.0	Normal: 25
PATGL: 5.0	CRP: 7.0	Tender: 2
		Swollen: 2

Language: English (US) ©Health Report Services 2015

John Smith

My Account
Daniel X. Adams

My Account
Daniel X. Adams

My Account
Daniel X. Adams

My Account
Daniel X. Adams

Pre-procedure Antibiotics



John X. Doe

Gender: male | Age: 37 yrs | Weight: 85 kg | Height: 175 cm [!] | MRN: 0123456789

Q Appendectomy for uncomplicated appendicitis

Indicated allergy

β -Lactam allergy indicated.

[See details](#)

Antimicrobial Agents

Recommended ☒ Alternative

Options

Preferred ☐ All

PREFERRED AGENTS FOR PATIENTS **WITHOUT β -LACTAM ALLERGY**

▼ Cefoxitin



Cefoxitin

Dose: 2000 mg

Redosing: 2 hr

RxNorm: –

Half-life: 0.7–1.1 hr

▼ Cefotetan



Cefotetan

Dose: 2000 mg

Redosing: 6 hr

RxNorm: –

Half-life: 2.8–4.6 hr

[Show all options...](#)

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Procedure Consent Form

PRINT

Print Consent Form

Print Empty Consent Form

EXPORT

Export as PDF

Export as PNG image

Export as JPEG image

LANGUAGE

☐ English

☐ Bulgarian

☐ Chinese

☐ German

☒ Spanish

☐ French

☐ Portuguese

☐ Russian

PATIENT NAME: Daniel X. Adams

PATIENT IDENTIFICATION NUMBER: 1288992

PROCEDURE/SURGERY: Endarterectomy femoral común

PROCEDURE SIDE: ☒ Left ☐ Right ☐ Both Sides ☐ Not applicable

Mi médico me ha explicado y entiendo el procedimiento o intervención quirúrgica al que me voy a someter. Entiendo por qué lo necesito, los posibles riesgos (incluyendo, entre otros, reacciones a medicamentos, hemorragias, dolor persistente, entumecimiento, infección y complicaciones derivadas de la transfusión de sangre o componentes sanguíneos) y que no existe ninguna garantía en relación con los resultados. Mi médico también me ha explicado lo que puede pasar si no me someto a este procedimiento o intervención quirúrgica, las alternativas que puedo elegir (incluyendo la de no recibir tratamiento) y lo que puede pasar si me decanto por otra opción. Entiendo que en cualquier procedimiento o intervención quirúrgica pueden surgir problemas inesperados, que pueden resultar eventualmente en incapacidad permanente o fallecimiento. Mi médico me ha explicado cómo evita las infecciones relacionadas con mi estado de salud. Asimismo, me ha explicado los siguientes riesgos o cuestiones específicas en relación con este procedimiento o intervención quirúrgica:

⚠️ Trombosis/Tromboembolia, ⚠️ Infección, con posibilidad de sepsis, ⚠️ Pérdida del miembro, ⚠️ Lesiones vasculares, que incluyen disección o pseudoaneurisma, ⚠️ Daño nervioso permanente, ⚠️ Fuga linfática, ⚠️ Restenosis


En caso de que se empleen técnicas de sedación para controlar el dolor durante este procedimiento o intervención quirúrgica, entiendo que dicho método de control del dolor conlleva riesgos. Dichos riesgos incluyen dificultad para respirar, que puede requerir asistencia respiratoria, y disminución de la presión arterial. Los efectos secundarios más comunes son náuseas y vómitos. En casos muy contados, se pueden producir reacciones alérgicas o paro cardíaco (parada del corazón). Estos riesgos pueden resultar eventualmente en incapacidad permanente o fallecimiento. Por último, es posible que sufra molestias o recuerdos del procedimiento o intervención quirúrgica, a pesar de la sedación.

Mi médico, Dr. Johnson, y/o su equipo serán los encargados de realizar el procedimiento o intervención quirúrgica. Entiendo que un equipo de profesionales médicos realizará el procedimiento o intervención quirúrgica y que dicho equipo puede incluir médicos y/u otros profesionales sanitarios en período de prácticas. Mi médico y/o su equipo estarán presentes en todos los momentos críticos del procedimiento o intervención quirúrgica, aunque otros profesionales médicos podrán realizar alguna de las partes del mismo si mi médico lo considera oportuno.

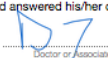

Entiendo que este procedimiento o intervención quirúrgica puede tener valor educativo o científico. El hospital podrá fotografiar o grabar mi procedimiento o intervención quirúrgica con fines relacionados con la educación, la investigación, la calidad y otros aspectos de los servicios sanitarios. Cualquier información utilizada para dichos propósitos no revelará mi identidad.

Entiendo que el centro médico podrá desechar la sangre, el tejido u otras muestras que se tomen durante el procedimiento o intervención quirúrgica. Asimismo, el centro médico, sus socios o afiliados para la investigación, la educación y otras actividades que apoyen la misión del centro médico podrán utilizar dichos materiales.

He tenido la oportunidad de plantear preguntas sobre los riesgos, los beneficios y las alternativas a este procedimiento o intervención quirúrgica. Estoy satisfecho con las respuestas recibidas. Con este conocimiento, otorgo libremente mi consentimiento para realizar este procedimiento o intervención quirúrgica.

DATE: 03/01 TIME: 23:35 FIRMA: 
Paciente

I attest that I discussed all relevant aspects of this procedure/surgery with the patient, including the indications, risks, and benefits as compared with alternative approaches, and answered his/her questions.

DATE: 03/01 TIME: 23:36 SIGNATURE:  
Doctor or Associate Witness

☐ Guardian/Surrogate ☒ Telephone Consent ☒ Translator Used

Save

SMART Apps Gallery

SMART App Gallery BETA

Hello nikolai 4 Administration Sign out


Browse Apps Organizations Build an App About SMART Me Search the gallery

Featured Apps

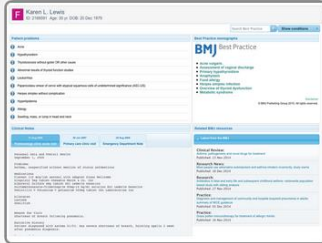
- Recently Updated
- Clinical Care
- Patient Education
- Genomics
- Open Source
- iPhone and iPad
- All Apps

25 apps

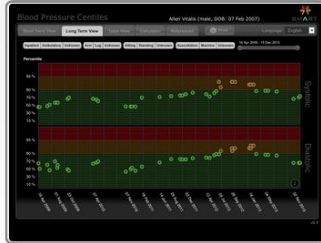
Name A to Z



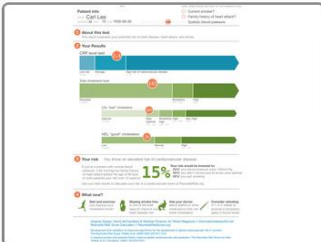
Bilirubin Chart



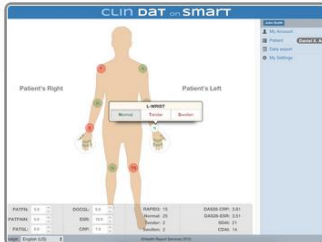
BMJ Content Discovery



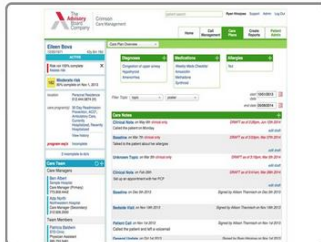
BP Centiles




Cardiac Risk



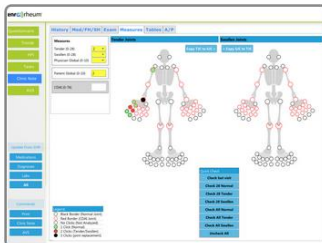
ClinDat




Crimson Care Management



Duke PillBox




EnrG | Rheum



ePRISM | Health Outcomes Sciences

CDS Hooks – Pharmacogenomics CDS Service

 Rx View Patient View Change Patient + Quick Add Reset Configure Hooks

Medication:

Azathioprine 25 MG Oral Tablet

Take pill by mouth

Start date ☒ 2017-03-21 End date ☒ 2017-04-21

TPMT - Thiopurine methyltransferase deficiency
Daniel X. Adams has a documented problem of Thiopurine Methyltransferase (TPMT) deficiency. TPMT is the enzyme responsible for the metabolism of azathioprine. Patients with TPMT deficiency MAY require REDUCED doses of azathioprine.

Please page the Pharmacogenomics Service (pager #7454) if further information is required.

SMART Health IT — About CDS Hooks — Rx Demo [source code](#)

An Application Vendor's Perspective

Success stories:

- **Technological leaps**
- **Alignment of vendors, health systems, government, and end user**
- **Community support**
- **Early marketplace for medical applications**

Challenges:

- **Level of expertise and effort required to be effective**
- **Data uniformity**
- **Uncertainty and lack of well defined business models**
- **Extreme risk averseness in health care organizations**