

Standards-Compliant SOA to Integrate Knowledge Resources into Electronic Health Records

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The University of Utah

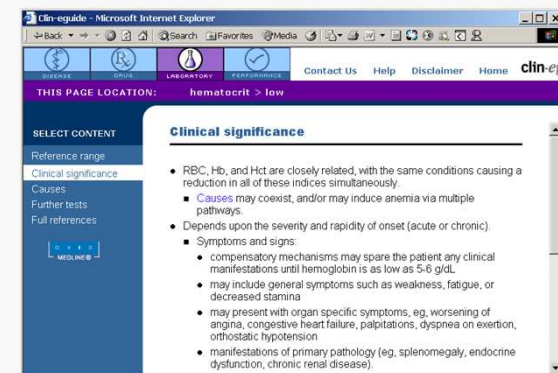
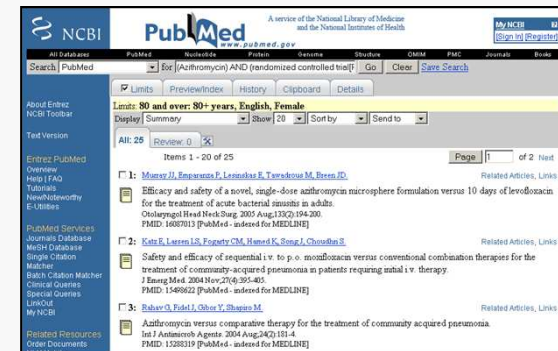
Biomedical Informatics

Background

2 questions out of every
3 patients seen (Covell, 1985)



> 50% of questions
left unanswered (Ely, 2005)



Rx



Cancel/Refresh

Status Filter: Outpatient Active

Print Options:

Print to default

Aricept (Donepezil HCl)

- ☒ [Adult Dose](#)
- [Adverse Effects](#)
- [Contraindications](#)
- [Drug Interaction](#)
- [Pregnancy Category](#)
- [Precautions](#)
- [How Supplied](#)

[More topics...](#)

Choose a resource:

- ☒ [Micromedex](#)
- [UpToDate](#)
- [MDConsult](#)
- [Medline Plus](#)

DrugPoint® Summary

Donepezil Hydrochloride [\(see details in DRUGDEX®\)](#)

Dosing & Indications

Topics

Adult Dosing [\(see details in DRUGDEX®\)](#)

- Alzheimer's disease - Dementia (Mild to Moderate): tablets/solution, 5 or 10 mg ORALLY once daily at bedtime, with or without food
- Alzheimer's disease - Dementia (Mild to Moderate): orally disintegrating tablets, 5 or 10 mg dissolve ORALLY on the tongue once daily
- Alzheimer's disease - Dementia (Severe): tablets, 10 mg ORALLY once daily at bedtime, with or without food
- Alzheimer's disease - Dementia (Severe): orally disintegrating tablets, 10 mg dissolve ORALLY once daily

Resources

Diabetes Mellitus, Type 2

[Overview](#)
[Diagnosis](#)
[Etiology](#)
[Prognosis](#)
[Therapy](#)

☒ [Patient education](#)

Choose a resource:

[IHC Care Process Models](#)
[UpToDate](#)
[Clineguide](#)
☒ [MDConsult](#)
[PubMed](#)

Topics

Resources

Intermountain Health Care,
Help | Newsletter | Create Account (Why Create an Account?) | Log in |

Clinics **Patient Education** Drugs Guidelines Images News CME

for Diabetes Mellitus Search

Diabetes Mellitus: Type 2

Email to Colleague Print Vers

Diabetes Mellitus: Type 2

Diabetes Mellitus?

Diabetes is a chronic condition that happens when your body does not make enough insulin or is unable to use insulin properly. Insulin is a hormone that your body makes. Your insulin is called insulin. Insulin causes the level of sugar in your blood to be normally high.

Diabetes is a chronic condition that happens when your body does not make enough insulin or is unable to use insulin properly. Your blood carries the sugar (glucose). Your blood carries the sugar (glucose). The pancreas gland makes insulin, which helps move the sugar from the blood into your cells. If you do not have enough insulin or cannot use insulin properly, sugar cannot get into your cells. Too much sugar in your blood can cause many problems. These problems can be prevented or treated. However, proper treatment can control your blood-sugar level.

Custom Header

Intermountain Health Care, Inc.
Generic Edition
Physicians Division
36 South State Street #2100
Salt Lake City, Utah 84111
801-434-0000

Azithromycin
Female
81 years
User: MD
Order entry

Electronic
Health
Record



HL7

Micromedex
Adult Dose
Azithromycin
Female
81 years

Resources & topics

HL7

Overview
☒ Adult Dose
Pediatric Dose
Contraindications
Adverse Effects

More topics...

Choose a resource:

☒ Micromedex
UpToDate
MDConsult
Medline Plus

AZITHROMYCIN	
Adult Dose	<ul style="list-style-type: none">• Acute exacerbation of chronic obstructive pulmonary disease (Mild to Moderate): either 500 mg ORALLY per day for 3 days OR 500 mg on day 1 followed by 250 mg/day on days 2-5• Babesiosis: 500 to 1000 mg ORALLY on day 1 followed by 250 mg/day thereafter plus doxycycline 750 mg ORALLY every 12 h for 7 to 10 days; 600 to 1000 mg/day of azithromycin may be used in immunocompromised patients• Bacterial sinusitis, acute (Mild to Moderate): tablets: 500 mg ORALLY daily for 3 days• Bacterial sinusitis, acute (Mild to Moderate): extended-release oral suspension: a single 2 gram ORAL dose• Chlamydia: 1 gram ORALLY as a single dose• Chlamydial infection: 1 gram ORALLY as a single dose• Community acquired pneumonia (Mild to Moderate): tablets: 500 mg ORALLY on day 1 followed by 250 mg/day on days 2-5• Community acquired pneumonia (Mild to Moderate): extended-release oral suspension: a single 2 gram ORAL dose• Community acquired pneumonia (Mild to Moderate): 500 mg IV every day for at least 2 days followed by 500 mg ORALLY every day to complete a 7-10 day course of therapy• Disseminated infection due to Mycobacterium avium-intracellulare group, in patients with advanced HIV infection: 600 mg ORALLY every day with ethambutol 15 mg/kg/day• Disseminated infection due to Mycobacterium avium-intracellulare group, in patients with advanced HIV infection, Prophylaxis: 1,200 mg ORALLY once weekly (may be combined with rifabutin)• Gonorrhea, urethritis or cervicitis: one single 2 gram dose ORALLY• Infection of skin AND/OR subcutaneous tissue, uncomplicated: 500 mg ORALLY on day 1 followed by 250 mg/day on days 2-5

Impact of Infobuttons

- Answers to over 85% of questions
- Decision enhancement or learning in over 62% of infobutton sessions
- Median session time: 35 seconds
- High user satisfaction
- Steady usage uptake in medications and lab results

Maviglia et al. J Am Med Inf Assoc, 2006.

Del Fiol et al. J Am Med Inf Assoc, 2008.

Why did we need a standard?

`http://resource1.com/
search = "azithromycin AND dose`

`http://resource2.com/query =
"azithromycin" [MeSH Terms]
AND dose [All Fields]`

Electronic
Health
Record



API

Info button
Me

No Context

API

Resource 1

Resource 2

API

Resource 3

`http://resource3.com/
searchConcept = 3333 ^ azithromycin
filter = 11 ^ dosage`

Participants / Implementers

- Health care & academic institutions
 - University of Utah, VA, Intermountain Healthcare, NIH Clinical Center, Columbia University, Partners Healthcare, Marshfield Clinic
- Content providers
 - Wolters Kluwer Health, Thomson Reuters, MedlinePlus, Ebsco, Healthwise, ACP, Elsevier, Lexicomp, Merck Manual, StatRef!, VisualDx
- EHR vendors
 - Epic, GE, Siemens, AllScripts

Example

- A physician reviews a **problem list** of a **female, 97 years-old** patient with **heart failure**.
- The physician needs information on the **treatment** of heart failure and **patient education** material on this condition

Heart failure

☒ [Patient Education](#)

Choose a resource:

[Clin-eGuide](#)
[DynaMed \(Ebsco\)](#)
[Medline \(Ebsco\)](#)
[Micromedex](#)

☒ [Patient Education \(Ebsco\)](#)
[PIER](#)
[UpToDate](#)

Have you found the answer to your question?

☐ Yes
☐ No

What impact has the content had on your patient care decision?

☐ Reinforced previous decision
☐ Changed my decision
☐ Did not affect my decision

[Submit Feedback](#)

Patient Education

Powered by

Congestive

Top

Definition

Causes

Risk Factors

Congestive Heart Failure

by: Rosalyn Carson-DeWitt, MD

<informationRecipient>

<patient>

<language code="eng"/>

<patient>

<informationRecipient>

displayname="therapy"/>

Lung

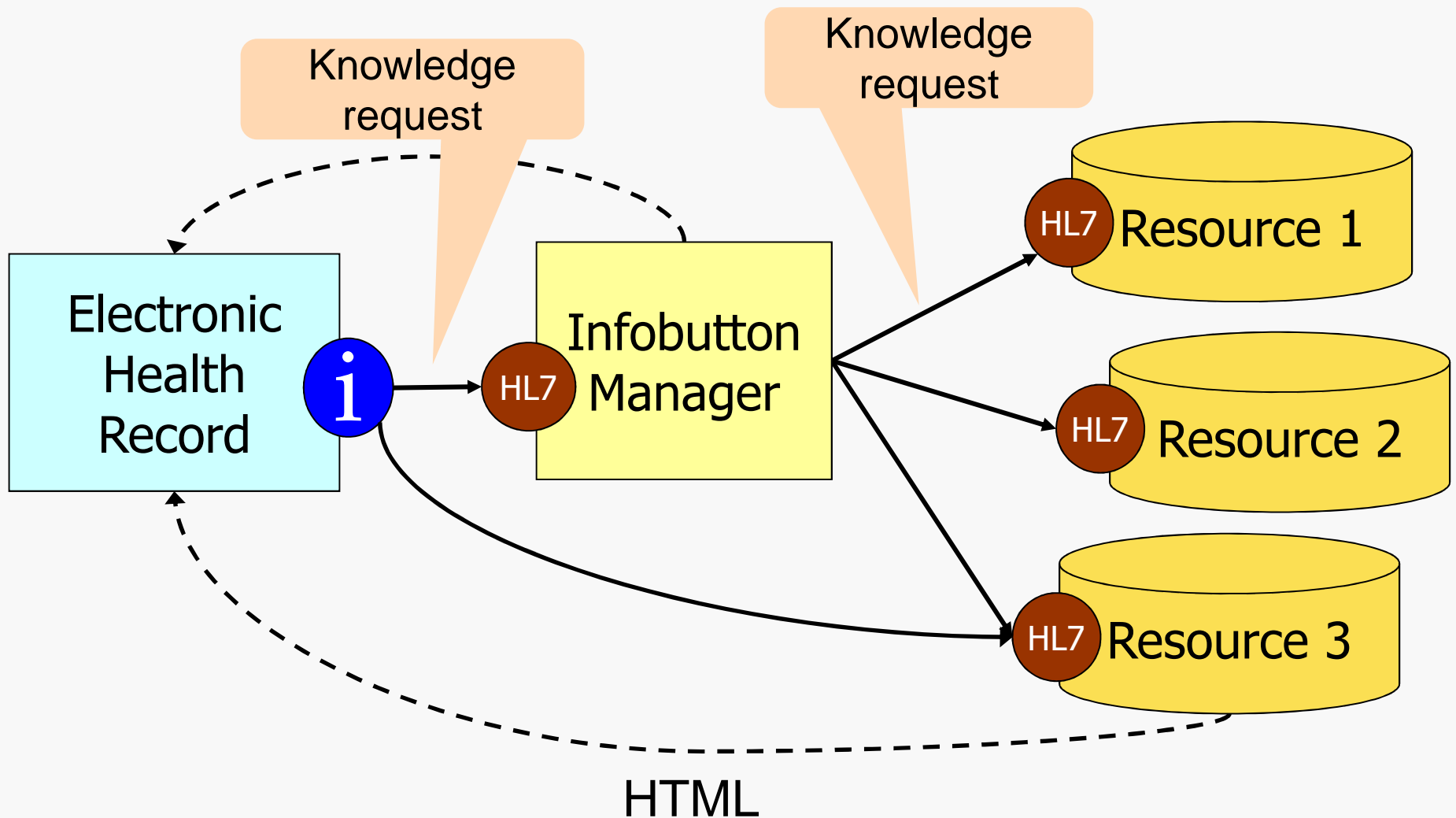
Tell us about your experience with the Infobutton Manager:

4-question Survey

Specifications

- Payloads
 - Knowledge **request** (normative standard)
 - Knowledge **response** (draft standard)
- Implementations
 - URL-based (normative)
 - SOA (draft standard)
 - REST and SOAP

URL-based Implementation



[Reference range](#)
[Clinical significance](#)
[Causes](#)
[Further tests](#)
[Full references](#)

Clinical significance

- [Management](#) depends on severity of hypokalemia.
 - **Severe hypokalemia requires immediate management.**
 - Risk of ventricular fibrillation if <2.5 mEq/L (<2.5 mmol/L).

Severe	<ul style="list-style-type: none">• <3.0 mEq/L (<3.0 mmol/L) WITH• premature ventricular complexes in setting of myocardial ischemia or digoxin toxicity
Moderate	<ul style="list-style-type: none">• <3.0 mEq/L (<3.0 mmol/L) WITH• premature atrial complexes but no or infrequent premature ventricular complexes and no digoxin toxicity
Mild	<ul style="list-style-type: none">• 3.1-3.5 mEq/L (3.1-3.5 mmol/L) WITH• no or infrequent premature ventricular complexes and patient asymptomatic

- Redefine patient
- Management overview
- [+] Disease characteristics
 - Definitions
 - Etiology
- [+] Diagnosis
 - Diagnostic guidelines
 - Clinical presentation
 - History
 - Differential diagnosis
 - Diagnostic tests
- [+] Therapy
 - Treatment guidelines
- [+] Prevention
 - Prevention guidelines
 - Chemoprophylaxis
- Complications
- New references
- Full references

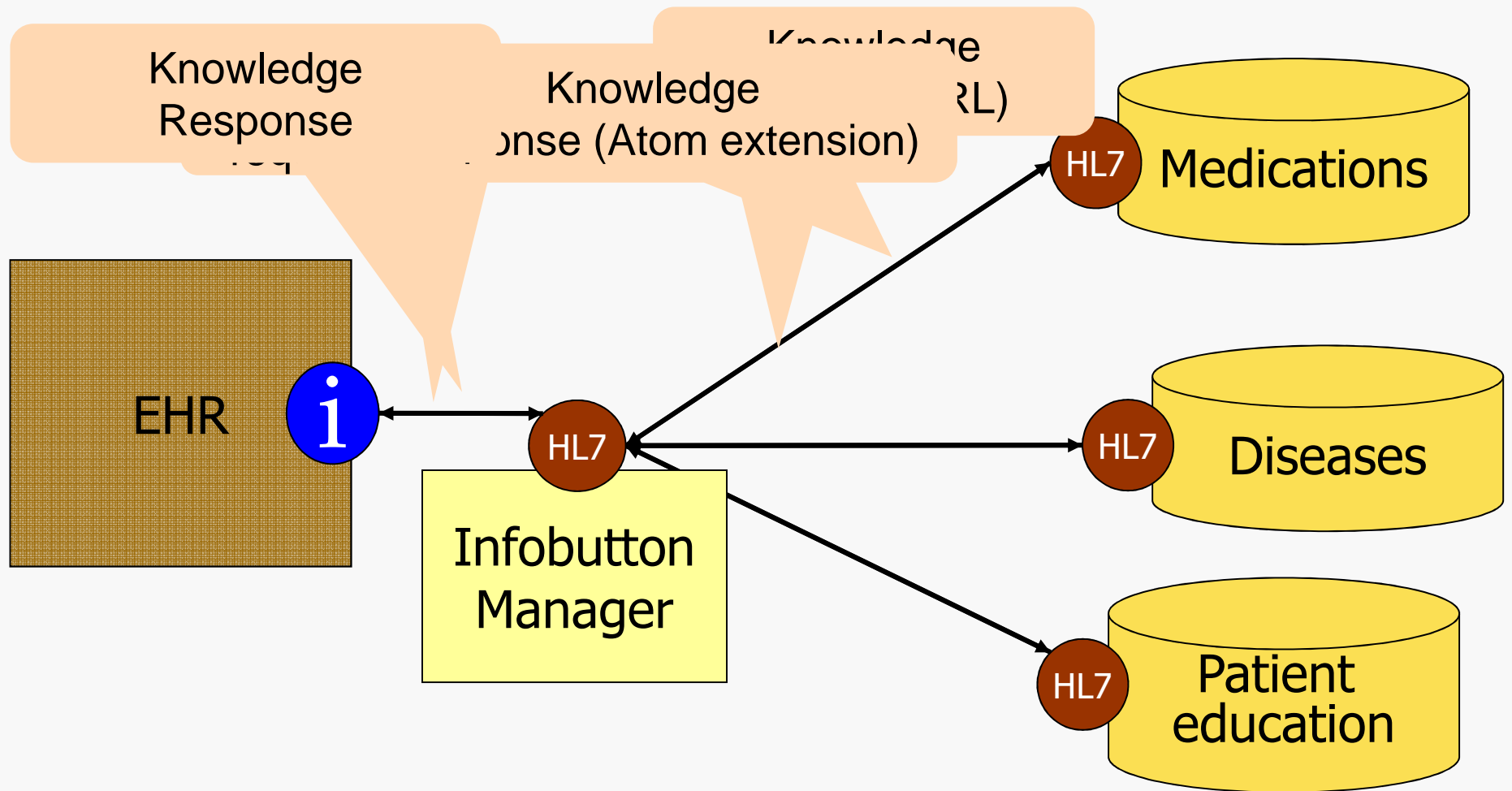
Treatment guidelines

For neonates requiring systemic treatment, the American Academy of Ophthalmology recommends prompt, joint management with a pediatrician and ophthalmologist.

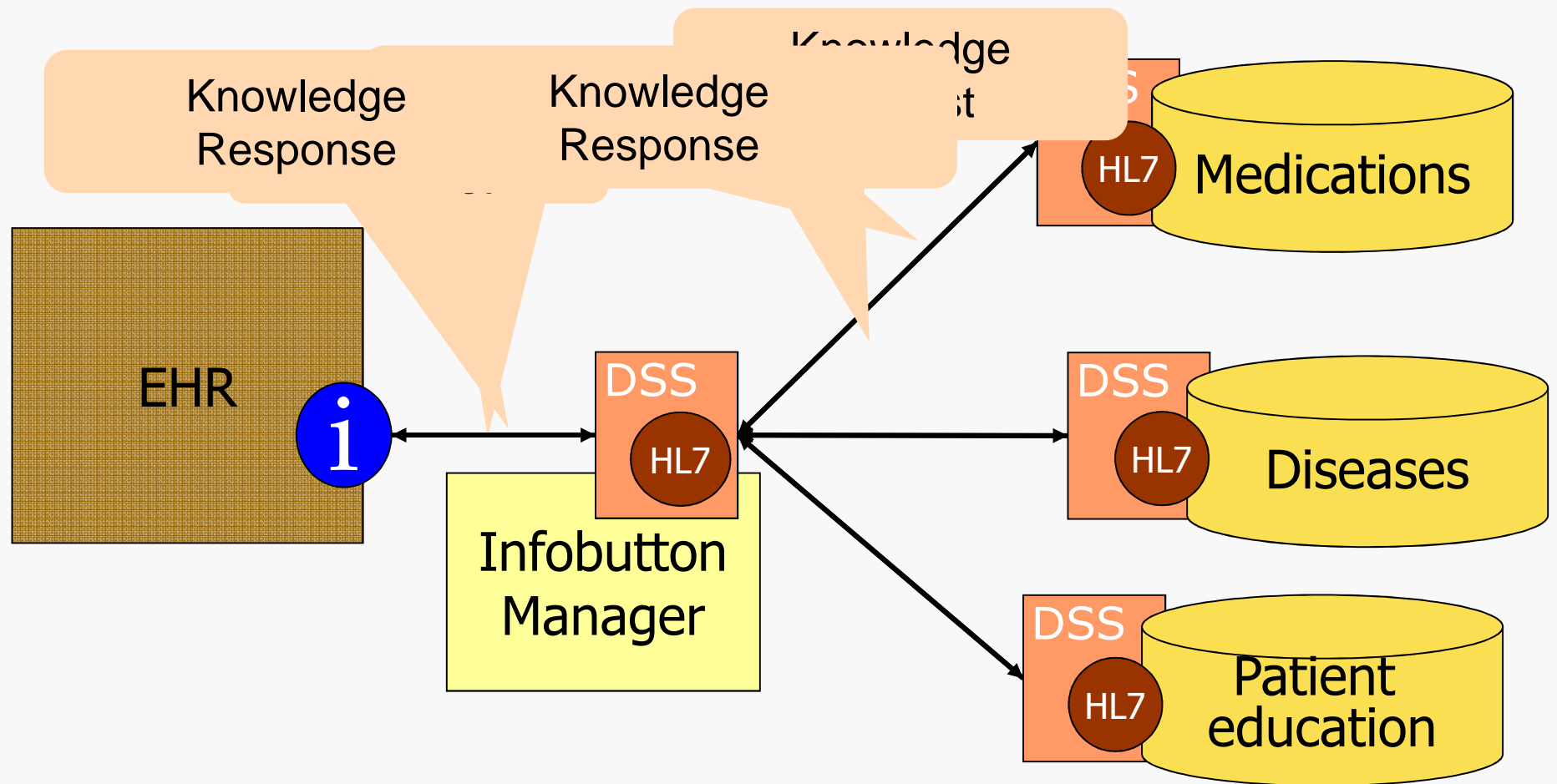
- Commence pathogen-directed therapy according to results of diagnostic tests.
[E_REF](#)

Pathogen	Therapy
Chlamydial infection	<ul style="list-style-type: none">Erythromycin oral B1_REF
Gram-positive organisms	<ul style="list-style-type: none">Erythromycin topical B1_REF
Gram-negative organisms (other than suspected gonococcus) ^a	Use either: <ul style="list-style-type: none">Gentamicin topical OR <ul style="list-style-type: none">Tobramycin topical B1_REF

SOA Implementation (REST)



SOA Implementation (SOAP/DSS)



Current Status

- Infobutton **knowledge request & URL-based** implementation guide
 - Normative ISO/HL7 specification
 - Strong adoption
- **SOA** implementation guide
 - Draft standard for trial use
 - A few implementations available
- Support for **meaningful use**
 - Integration of context-specific patient education into EHR

Conditions

Hypertension [choice of antihypertensive](#) [AHA/ACC guideline](#) [JNC7 guideline](#)

Treatment in diabetes: blood pressure target < 120 mm Hg reduce nonfatal stroke compared to target < 140 mm Hg
losartan and enalapril each associated with reduced retinopathy progression (N Engl J Med 2009 Jul 2) [details](#)

Diabetes [diabetic nephropathy](#) [glycemic goals](#) [lipid-lowering](#) [insulin](#)

Consensus algorithm issued by the ADA lists metformin as the initial drug therapy of choice for the management of type 2 diabetes mellitus. [details](#)

Medications

Enalapril [contraindications](#) [patient education](#) [how supplied](#) [interactions](#)

Dose

Adults: Initially, 2.5—5 mg PO once daily. In patients with hyponatremia, hypovolemia, moderate-severe CHF, renal dysfunction (ie., Scr > 1.6 mg/dl), or in those receiving diuretics, an initial dose of 2.5 mg is recommended. [details](#)

Side effects

agranulocytosis, anaphylactoid reactions, angioedema, aplastic anemia, azotemia, cholestasis, hepatic failure, hyperkalemia, hypotension, jaundice, neutropenia, orthostatic hypotension. [details](#)

Metformin [contraindications](#) [patient education](#) [how supplied](#) [interactions](#)

Dose:

Initially, 500 mg PO twice daily or 850 mg PO once daily, given with meals. Dosage increases should be made in increments of 500 mg weekly or 850 mg every 2 weeks, up to 2000 mg/day, given in divided doses. Patients can also be titrated from 500 mg PO twice daily to 850 mg PO twice daily after 2 weeks. Maximum is 2550 mg/day. [details](#)

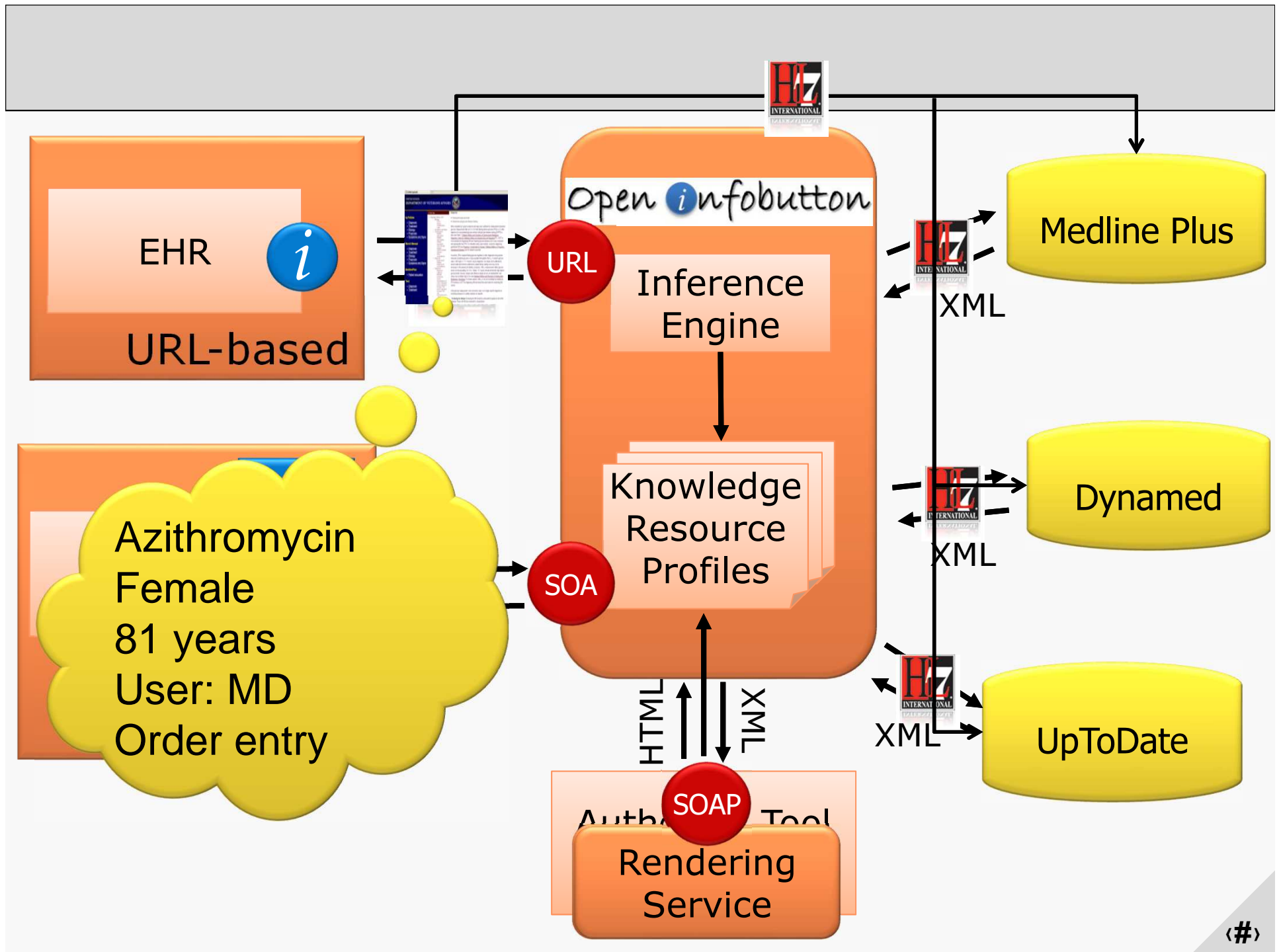
Side effects

anemia, anorexia, diarrhea, dysgeusia, dyspepsia, flatulence, hypoglycemia, hypotension, lactic acidosis, malaise, metabolic acidosis, metallic taste, myalgia, nausea, vitamin B12 deficiency, vomiting, weight loss. [details](#)

OpenInfobutton

- VA Innovations Project
 - Portland VAMC
 - Duke University
- Open source infobutton manager
 - Foster **wide adoption & innovations**
 - **HL7** reference implementation
 - Integrated with major knowledge resources

<http://www.OpenInfobutton.org>



File Edit View Action Tools Help

BCMA,EIGHT

666-33-0008

Apr 07,1935 (75)

BCMA 2-C

Provider: INNOVATIONS,VHA

Primary Care Team Unassigned

Attending: Radtech,Thirtynine

View options

Active
Inactive
Both active and inactive
Removed

New problem

Active Problems (9 of 9)

Stat...	Description
A	Methicilin ResistantStaphylococcus Aureus
A	Heartburn
A	Environmental Allergies
A	Asthma
A	Whooping Cough NEC
A	Attention-deficit hyperactivity disorder
A	Coronary Artery Disease
A	Diabetes
A	Congestive Heart Failure test

Change...

Inactivate

Verify...

Annotate...

Remove...

Restore

View Details

InfoButton

UpToDate

- [Diagnosis](#)
- [Treatment](#)
- [Etiology](#)

In This Topic

□ [Diabetes Mellitus \(DM\)](#)

• [Etiology](#)

- [Type 1](#)
- [Type 2](#)
- [Miscellaneous types](#)

• [Symptoms and Signs](#)

• [Complications](#)

- [Diabetic retinopathy](#)
- [Diabetic nephropathy](#)
- [Diabetic neuropathy](#)
- [Macrovascular disease](#)
- [Cardiomyopathy](#)
- [Infection](#)
- [Other complications](#)

- [Etiology](#)
- [Prognosis](#)

ClinicalTrials.gov

- [Clinical trials](#)

MedlinePlus

- [Patient education](#)

VETERANS AFFAIRS



Treatment

- Diet and exercise
- For type 1 diabetes, [insulin](#)
- For type 2 diabetes, oral antihyperglycemics, [insulin](#), or both
- Often ACE inhibitors and [aspirin](#) to prevent complications

Goals and methods: Treatment involves control of hyperglycemia to improve symptoms and prevent complications while minimizing hypoglycemic episodes.

Goals for glycemic control are

- Blood glucose between 80 and 120 mg/dL (4.4 and 6.7 mmol/L) during the day
- Blood glucose between 100 and 140 mg/dL (5.6 and 7.8 mmol/L) at bedtime
- HbA_{1c} levels < 7%

- [Insulin regimens for type 1 DM](#)
- [Insulin regimens for type 2 DM](#)
- [Oral antihyperglycemic drugs](#)
- [Other antihyperglycemic treatments](#)
- [Adjunctive treatments](#)

Key elements for all patients are patient education, dietary and exercise counseling, and monitoring of glucose control. All patients with type 1 diabetes require [insulin](#). Patients with type 2 diabetes who have mildly elevated plasma glucose should be prescribed a trial of diet and exercise followed by a single oral antihyperglycemic drug if lifestyle changes are insufficient, additional oral drugs as needed (combination therapy), and [insulin](#) when ≥ 2 drugs are ineffective for meeting recommended goals. Patients with type 2 diabetes who have more significant glucose elevations at diagnosis are typically prescribed lifestyle changes and oral antihyperglycemic drugs.

- Diagnosis
- Treatment
- Etiology
- Prognosis
- Symptoms and Signs

- Diagnosis
- Treatment
- Etiology
- Prognosis
- Symptoms and Signs

- Topic Summary

- Therapy
- Systemic
- Diagnosis
- Differential
- Etiology
- Prognosis

- Clinical trials

- Patient education



MedlinePlus® Connect

Información de salud para usted

Un servicio de la Biblioteca Nacional
NIH Instit

MedlinePlus encontró los siguientes resultados para su búsqueda.

Sin embargo, estos resultados pueden no coincidir exactamente con el enlace que usted ha seleccionado. Consulte médica para discutir sus preguntas y obtener la información que sea adecuada para usted.

Diabetes

Otros nombres: Azúcar en la sangre, Diabetes de comienzo en la edad adulta, Diabetes no insulino dependiente

La diabetes es una enfermedad en la que los niveles de glucosa (azúcar) de la sangre están muy altos. La glucosa proviene de los alimentos que consume. La insulina es una hormona que ayuda a que la glucosa entre a las células para suministrarles energía. En la diabetes tipo 1, el cuerpo no produce ... [más](#)

Folletos para el paciente

- [Cuando usted se enferma a causa de la diabetes](#)
- [Cuidados personales para hipoglucemia a causa de diabetes](#)
- [Diabetes y el ejercicio](#)
- [Exámenes y chequeos para la diabetes](#)
- [Manejo de su glucemia](#)

[vea todos](#)



MDConsult

- [Patient education](#)

Dynamed

- [Topic Summary](#)

Healthwise

- [Patient education](#)

MedlinePlus

- [Patient education](#)

American Diabetes Association

- [Patient Education](#)

Healthwise Search Results

Diabetes in Children: Preventing Low Blood Sugar

Tuesday, December 07, 2010, 7:00:00 AM

Low blood sugar, also called hypoglycemia, occurs when the sugar (glucose) level in the blood of a person with diabetes drops below what the body needs to function normally. Taking too much insulin, not eating enough food or skipping meals, or exercising more than usual can cause blood sugar levels to drop rapidly. If...

Diabetes in Children: Checking Blood Sugar in a Child

Tuesday, December 07, 2010, 7:00:00 AM

Describes monitoring blood sugar levels in children with diabetes. Covers list of supplies needed, including blood sugar meter, testing strips, and lancet. Gives step-by-step instructions. Links to info on type 1 and type 2 diabetes.

Diabetes in Children: Giving Insulin Shots to a Child

Tuesday, December 07, 2010, 7:00:00 AM

Insulin is available only in an injectable form that is given into the fatty tissue just under the skin. Most people use insulin in an injection, or shot. While it can also be given through an insulin pump or jet injector, this information does not pertain to these devices. Get information from your child's doctor about...

OpenInfobutton Status

- Implementations under development
 - VA: next generation EHR
 - University of Utah: Cerner & Epic
 - Intermountain Healthcare: family history portal
 - Duke University: order entry and medical library search page
 - University of Washington: pharmacogenomics

Standards-Based Integration: Benefits

- New market opportunity for knowledge resources
- Integration
 - Much simpler and more effective
- Evidence of decision-making improvement

Based on interviews with implementers
Preliminary findings

Challenges

- Competing priorities
 - EHR vendors & customers
 - Knowledge resource publishers driving adoption
- Standard terminologies
- Documentation / HL7 learning curve
- Lack of reference implementations

Lessons Learned

- Strengths
 - Simple
 - Compatible with today's implementations (URL-based & REST)
 - No need for HL7 expertise
- Need to improve
 - User-friendly documentation outside standard specification
 - More examples

Acknowledgements

- Portland VAMC
 - David Douglas
 - Clayton Curtis
- Duke & University of Utah team
 - Andrew Iskander – core software engineer
 - Ken Kawamoto - collaborator
- NIH Clinical Center
 - Jim Cimino
 - Xia Jing
- HL7 Clinical Decision Support WG

Thank you

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http://wiki.hl7.org/index.php?title=Product_Infobutton



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Biomedical Informatics