Context-Aware Knowledge Delivery into Electronic Health Records

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

> 50% of questions left unanswered (Ely, 2005)
DrugPoint® Summary
Donepezil Hydrochloride (see details in DRUGDEX®)

Dosing & Indications

- 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
Preliminary work

INFOBUTTONS
Clinical significance

Overview

- Hematocrit (Hct) is a measure of blood volume occupied by red blood cells (RBC).
  - Indirectly measures red blood cell mass.
- Hct, erythrocytes, and blood hemoglobin are closely related, with the same conditions causing decreases simultaneously.

Interpretation

- Hct, erythrocytes, and Hb should be interpreted together.
  - In general, Hct is used to evaluate high numbers of RBC (polycythemia) and Hb is used to evaluate low numbers (anemia).
- Anemia is categorized as:
  - increased RBC destruction (eg, hemolysis, acute or chronic blood loss)
    - Reticulocyte index is >2% indicating adequate bone marrow response to anemia.
  - decreased RBC production (eg, iron deficiency, folate deficiency).
    - Reticulocyte index is <2% indicating inadequate bone marrow response to anemia.
- Factors causing spuriously decreased levels include:
  - recumbent position (5% lower values)
  - age 2-4 months (see reference ranges for normal values by age)
Azithromycin
Female
81 years
User: MD
Order entry

Electronic Health Record

Infobutton Manager

HL7

Micromedex
Adult Dose
Azithromycin
Female
81 years
What is Alport syndrome?

Alport syndrome is a genetic condition characterized by the progressive loss of kidney function and hearing. Alport syndrome can also affect the eyes. The presence of blood in the urine (hematuria) is almost always found in this condition. Many people with Alport syndrome also exhibit high levels of protein in their urine (proteinuria). As this condition progresses, the kidneys become less able to function properly and kidney failure results. Hearing loss is a common feature of Alport syndrome, but the abnormalities in the eyes seldom lead to loss of vision.
Diabetes Mellitus, Type 2

Overview
Diagnosis
Etiology
Prognosis
Therapy

Patient education

MD Consult

Choose a resource:

IHC Care Process Models
UpToDate
Clinelink
MD Consult
PubMed

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

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Diabetes Mellitus, Type 2

What is type 2 diabetes mellitus?

Type 2 diabetes is a disorder that happens when your body does not make enough insulin or is unable to use insulin properly. The inability to use your insulin is called insulin resistance. This problem with insulin causes the level of sugar in your blood to become abnormally high.

When you digest food, your body breaks down much of the food into sugar (glucose). Your blood carries the sugar to the cells of your body for energy. The pancreas gland makes insulin, which helps move the sugar from the bloodstream into the cells.

When your body does not have enough insulin or cannot use insulin properly, sugar cannot get into your cells. Sugar builds up in your blood. Too much sugar in your blood can cause many problems. These problems can be life-threatening if they are not treated. However, proper treatment can control your blood-sugar level.

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<table>
<thead>
<tr>
<th>Stage 2 Hypertension</th>
<th>2-drug combinations for most (usually thiazide-type diuretic and ACEI, ARB, BB, CCB, or combination)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 2 Hypertension</td>
<td></td>
</tr>
<tr>
<td>SBP ≥160 or DBP ≥100</td>
<td></td>
</tr>
</tbody>
</table>

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Custom Header

Intermountain Health Care, Inc.
Generic Edition
Physicians Division
36 South State Street #2100
Salt Lake City, Utah 84111
000-000-0000
Impact of Infobuttons

Maviglia et al., 2006
- Answers to 84% of questions
- 15% of sessions: decision enhancement

Del Fiol et al., 2008
- Answers to 87% of questions
- Average session time: 35 seconds
- 62% of sessions: decision enhancement or learning

Slow usage uptake in both studies
Limitations of Infobutton Approach to Knowledge Integration

Opportunities for use are limited by:

Information need is recognized…
…while using an EHR system…
…an infobutton is available…
…clinician believes it is worth to pursue an answer…
…and the clinician decides to click.
CAN WE OVERCOME THE LIMITATIONS?
Career development components

Mentored research

- Eric Peterson, MD, MPH
- David Lobach, MD, PhD
- James Cimino, MD

Duke Clinical Research Training Program

Standards development at HL7
Research Plan

Design, develop, and evaluate alternate knowledge integration method

Aim1: Build knowledge base

- Systematic review of clinician knowledge needs
- Focus groups & in-depth interviews
- Chronic conditions and new models of care
Research Plan

Aim 2: Develop **infrastructure**
- Standards-based Web services
- Open-source distribution model

Aim 3: pilot **implementation** and **evaluation** at Medical Home site
- Mixed-method observational study
- Log analysis
- Critical incident analysis
Knowledge Broker

Knowledge request

EHR
Knowledge summary

Knowledge Broker

Knowledge requests

HL7
Medications

HL7
Diseases

HL7
Patient education
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
Information needs systematic review (Aim 1)

Research questions

Who, how often, what kind, in what context?
Are they being met, how, how often?

Current status

PubMed search strategy – 8,860 citations
Abstract screening – 750 citations

Likely to be the first systematic review on this topic
Contributions of knowledge integration

Evidence of **effectiveness, efficiency, and usefulness**
- Quick answers to most medication questions
- Clinician self-reported positive impact
- Increasing use trends
- Widespread support among knowledge resources

**Challenge**: higher use and adoption
- Wide dissemination via open-source, standards-compliant Web service
- Higher use through alternate integration approach
Thank you

Questions?

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