EBMeDS
Evidence-Based Medicine electronic Decision Support

Context-Sensitive Guidance at the point of care

Syed Tirmizi, MD
Associate Professor
George Mason University
What is EBMeDS?

• A plug-in open-source decision support service that can be integrated with any electronic health record (EHR) or personal health record (PHR)

• A collaborative tool for authoring and commenting on decision support contents
Automatic, patient-specific guidance

Knowledge is pushed to the user

Sends XML patient data (request message)

Decision support service (e.g. EBMeDS)

Receives decision support
Objective of EBMeDS

The right information for the professional or patient

– automatically
– at the right place
– at the right time
The EBMeDS decision support service

• Based on best EBM sources
  – The Cochrane Library
  – EBM Guidelines
  – InfoPOEMs

• Open source
  – Both knowledge and functionality built in simple text files, using JavaScript

• Customizable with local contents

• Integrated with any system containing patient data (EHR or PHR)
  – Using a simple XML message interface
EBM Guidelines provides the evidence summaries for EBMMeDS
2233 Cochrane reviews are summarized
130 Cochrane reviews are linked to EBMMeDS rules by 10/2009
What does EBMeDS provide?

• Decision support messages (reminders, prompts, alerts) automatically based on data in the EHR or personal health record (PHR)
• Links to guidelines, evidence summaries and Cochrane reviews from codes in the electronic health record (EHR)
• Calculators and forms with data filled from the EHR
**Diagnoses**

30.05.2008  **Non-insulin-dependent diabetes mellitus, duration 1 years**
04.01.2008  Migraine, unspecified
04.11.1992  Predominantly allergic asthma

**Acute diagnoses**

12.06.2008  **Total cholecystectomy nec**

**Procedures and treatments**

**Medication and dosage**

04.01.2009  Beclometasone 200microgram inhalation powder capsules
12.06.2008  Enalapril 20mg tablets
30.05.2008  Simvastatin 40mg tablets

1 + 1 /day
1 /day
1 /day

**Measurements**

- **Height (cm):** 179 cm (6/5/2008)
- **Weight (kg):** 94 kg (6/2/2008)
- **BMI:** 29.3 (6/2/2008)
- **BP (Systolic):** 138 mmHg (6/3/2008)
- **BP (Diastolic):** 72 mmHg (6/3/2008)
- **GHbA1C:** 7.2% (3/31/2008)
- **fs-Chol:** 3.9 mmol/l (3/31/2008)
- **fs-Chol-HDL:** 1.2 mmol/l (3/31/2008)
- **fs-Trigly:** 2.17 mmol/l (3/31/2008)

**Medication and Drug Allergies from GP Systems**

Penicillin

**Other allergies**

**Special diet**

**Lifestyle and risks**

BERTIE
DESMOND
Diabetes X-pert Programme
DAFNE

© Copyright 2008 ProWellness UK Ltd. - All rights reserved
O'Connor, Betty
NHS no.: 052157-9456 Age: 52

Diagnoses
30.05.2008 Non-insulin-dependent diabetes mellitus
04.01.2008 Migraine, unspecified
04.11.1992 Predominantly allergic asthma

Acute diagnoses

Diagnosis Date

Medication and dosage
04.01.2009 Beclometasone 200microgram inhalation powder capsules
12.06.2008 Enalapril 20mg tablets
30.05.2008 Simvastatin 40mg tablets

Medication and Drug Allergies from GP Systems

Other allergies

Special diet

Lifestyle and risks

Reminders:
- The patient has type 2 diabetes. Metformin is the primary choice for better glycemic control. Check renal function and start metformin? (scr00016)
- The patient has type 2 diabetes and no indication of ASA allergy. Based on current knowledge, ASA treatment is encouraged using a dose 100 mg 1x1. As the patient has asthma check first, whether the patient is intolerant to ASA or other NSAIDs. (scr00108)
- The patient has diabetes. More than 13 months have passed since blood glucose or cholesterol were determined. Time for follow-up? (scr00492)
- The patient has type 2 diabetes and the HbA1c value is increased (7.2%). Intensify hyperglycaemic treatment? (scr00564)

Guidelines:
- Metabolic syndrome
- Newly diagnosed type 2 diabetes
- Diabetes: definition, differential diagnosis and classification
- Treatment and follow-up in type 2 diabetes
- Lifestyle education in type 2 diabetes
- Oral antidiabetic drugs in the treatment of type 2 diabetes
- Insulin therapy in type 2 diabetes
- Migraine
- Headache
- Occupational asthma
- Long-term management of asthma
- Asthma: symptoms and diagnosis
- Treatment of acute exacerbation of asthma
Metformin as a primary choice for an oral hypoglycemic agent

Script description

The script is launched if the diagnosis is type 2 diabetes. First, the script checks whether the drug list contains metformin. If it does not, the script checks for the plasma/serum creatinine value. If the GFR is in the normal range, reminder (1) is shown. If GFR < 60 ml/min, reminder (2) is shown.

Evidence and Guidelines

EBMG source(s)

- Metformin is a well-tolerated oral hypoglycemic agent, which reduces hepatic glucose production and provides proved evidence against cardiovascular events in type 2 diabetic subjects. It belongs to insulin sparing antihyperglycemic agents which do not introduce a risk for hypoglycemia. Metformin has been shown to be especially useful in insulin-resistant states and as the primary drug-of-choice in type diabetes, if the body mass index exceeds 23-25 kg/m2.

- The available oral antidiabetic agents are equally effective at lowering glucose levels. Only the sulfonylureas and metformin are proven to reduce long-term complications and only metformin is cardioprotective.
Metformin monotherapy for type 2 diabetes mellitus

Evidence Summaries
12.12.2005

Level of evidence = A

Metformin monotherapy in type 2 diabetes proved more beneficial changes in glycaemia control, and many lipids, insulinaemia and diastolic blood pressure than metformin alone.

A Cochrane review 1 (abstract 1, review 1) included 37 arms (5259 participants), comparing metformin (4203 participants) with sulphonylureas (13167), thiazolidinediones (three and 493), and glitazides (two and 208) and glucose inhibitors reported data on primary outcomes. Obese patients allocated to intensive blood glucose showed a greater benefit than medication alone.
Deep venous thrombosis in femoral vein (compression ultrasonography)

Video database
10.9.2009
Ilkka Kunnamo

An old woman had swelling of the whole right leg. Compression ultrasonography on the level of the inguinal ligament shows an incompressible femoral vein, when gentle pressure is repeatedly applied to the probe (first a transverse view, then a longitudinal view of the vein). The thrombus in the vein is slightly echogenic. The slightly smaller artery is visible above the vein. In the longitudinal view the tail of the thrombus is visible inside the vein on the left. On the right the vein is normally compressible. The second transverse and longitudinal views show a normal left femoral vein.

Interactive algorithms
EBMeDS as a tool for continuous professional development and quality measurement
In a virtual health check all rules are executed in a population of patients, and resulting reminders are listed.

<table>
<thead>
<tr>
<th>SSN</th>
<th>Name</th>
<th>Care recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>040432-0404</td>
<td>Lisa Jones</td>
<td><strong>Reminders:</strong> The creatinine level is increased (190 umol/l). Furosemide is recommended instead of a thiazide diuretic at least when the creatinine level exceeds 200 µmol/l. (scr00005)</td>
</tr>
<tr>
<td>060629-0606</td>
<td>Martha Kinsley</td>
<td><strong>Reminders:</strong> The patient has a diagnosis of congestive heart failure, but no information on left ventricular ejection fraction. (scr00272) The patient's weight has increased more than 2 kg (79 kg). The dose of furosemide should be increased. (scr00274)</td>
</tr>
<tr>
<td>050548-0505</td>
<td>Robert Lawson</td>
<td><strong>Reminders:</strong> The patient is overweight (BMI 33.1) and no blood glucose test has been performed during the last two years. Consider ordering the test. (scr00490) The patient is overweight (BMI 33.1), and no lipid tests have been performed during the last 2 years. Consider ordering the test (scr00490)</td>
</tr>
<tr>
<td>030459-0405</td>
<td>Sam Meady</td>
<td><strong>Reminders:</strong> Selective beta-blockers are better tolerated non-selective beta-blockers in patients with asthma or COPD. (scr00422)</td>
</tr>
<tr>
<td>030369-0303</td>
<td>Homer</td>
<td><strong>Reminders:</strong></td>
</tr>
</tbody>
</table>
Questions to EHR or PHR vendors interested in implementing EBMeDS

- Do you have clinical data such as test results, diagnoses, medications, physiological measurements (weight, height, blood pressure) in electronic format?
- Are any of the data in structured format (coded)?
- Can you produce the XML-query message from the data?

If the answer is yes to all questions, EBMeDS can be implemented.
Expected benefits from using EBMeDS

• Improves quality of care by decreasing errors
• Provides active guidance triggered by data in the EHR/PHR supports also “passive” users
• Targets also patients that have dropped out from follow-up prevents complications of disease or treatment
• Provides automated transfer of patient data to forms and calculators -> saves time
• Improves and speeds up the access of the professional and citizen to reliable and up-to-date medical information
• Offers an opportunity to quality measurement and reporting improving quality of care and outcomes
• Guides the patients (using a PHR) to healthy living and contacting health care professionals at the right time
Reminders for doctors, nurses, and patients

Example: Inhaled corticosteroids with or instead of long-acting beta-agonists for asthma

- **Doctor**: The patient is using a long-acting beta-agonist (<Trade name>) but no inhaled corticosteroid. For efficacy and safety reasons, add or replace with the latter.

- **Nurse**: as above + Consult a doctor. Not urgent

- **Patient**: You seem to be using an asthma medicine (<Trade name>) which is usually recommended only in conjunction with an inhaled corticosteroid. Inhaled corticosteroids should usually constitute the backbone of asthma treatment when long-term medication (lasting more than a few weeks) is needed. Long-acting beta-agonists, such as (<Trade name>), are usually used for additional effect if inhaled corticosteroids alone are not adequate. Discuss adjusting your medication with your doctor.
Patient’s user interface to EHR

• Coded data is translated into lay language by means of a metathesaurus

• The terms are linked to definitions and explanations, "The Patient’s Handbook", and local sources of patient information

**Diagnoses**
Lactose intolerance (poor absorption of )

- What is lactose intolerance
- Diet advice

**Laboratory results**

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
<th>Normal range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haemoglobin</td>
<td>124</td>
<td>Normal range</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>5.9</td>
<td>Normal range</td>
</tr>
<tr>
<td>LDL cholesterol</td>
<td>3.8</td>
<td>Normal range</td>
</tr>
</tbody>
</table>

("evil cholesterol")

Cardiovascular risk (10 yrs) 6.2 %

**Treatment plan**

Your cholesterol is above the agreed limit. Contact your doctor

What does Hb tell

How can I reduce my risk?
What is ATHENA DSS?

• Automated decision support system (DSS)
  – Knowledge-based system automating guidelines
    • Built with EON technology for guideline-based decision support, developed at Stanford Medical Informatics
  – For patients with primary hypertension who meet eligibility criteria

• Patient specific information and recommendations at the point of care

• Purpose is to improve hypertension control and prescription concordance with guidelines

  • Athena in Greek mythology is a symbol of good counsel, prudent restraint, and practical insight

  • Goldstein MK et al Proc AMIA 2000
Developing a Model Program

To Provide a Model Program that can be extended to other clinical areas

We selected hypertension as a model for guideline implementation because...

- Hypertension is highly prevalent in adult medical practice
- There are excellent evidence-based guidelines for management
- There is also evidence that the guidelines are not well-followed
  - a big ‘improvability gap’ in IOM terms

What the Clinician Sees...

ATHENA Hypertension Advisory

Patient SSN: None
Most Recent BP in Database: 165.82/100.5, Date: 10-25-2006
ENTER Today's Decision BP: 123.0/80.0, Date: 12-12-2006

Guideline Goal: SBP < 140 and DBP < 90 (presence of diabetes, heart failure or renal insufficiency)
BP apparently NOT UNDER CONTROL, based on most recent available BP.
(Factor: Today's Decision BP is not yet filled or entered.)

Update Advisory

Recommendations
Precautions
Assumptions
Lifestyle
Adherence
Glossary
BP-Prescription Graphs

Prescription(s) for insulin have NOT BEEN FILLED RECENTLY.
Consider INTENSIFYING drug treatment: BP ELEVATED based on most recent available BP.

Compelling Indication
Relative Indication
Strong Contraindication
Relative Contraindication
Adverse Events

Consider one of the following therapeutic possibilities:
Add ACE Inhibitor (lisinopril)
Add Thiazide Diuretic (HCTZ)

Reasons
Diabetes & Renal Manifestation
Heart Failure
Renal Insufficiency
Isolated Systolic Hypertension
Heart Failure

Your comments for the Guidelines Team (optional and welcome!)

Complete clinical information may not be available through the computer system. Please use all information that you have about the patient together with your clinical judgment to decide on the best therapy for this patient.

Recommendations considered
Not Read
Not a clinical priority today
Building ATHENA System From EON Components

ATHENA Clients
Advisory
Client
Event
Monitor

VA VISTA (DHCP)

VA CPRS

EON Servers

Temporal
Mediator

Pre-computed
Advisories

SQL
Patient
Database

Athens

Guideline
Interpreter

Data Converter

nightly
data
extraction

ATHENA Clients

Event
Monitor

Advisory
Client

ATHENA GUI

ATHENA
HTN
Guideline
Knowledge
Base

PROTÉGÉ

nightly
data
extraction

nightly
data
extraction
Demos

Email: worldmed@gmail.com