Introduction

The Harvard Medical School (HMS) Library of Evidence is a collaboration between the HMS Francis A. Countway Library of Medicine and a number of HMS teaching hospitals and other Harvard institutions. It was founded in collaboration with the Center for Evidence-Based Medicine at Brigham and Women’s Hospital. The Library of Evidence team catalogues medical evidence within a public online database designed to be easily exported into clinical decision support systems.

The HMS Library of Evidence focuses on the accumulation, curation and organization of medical evidence found in professional society guidelines, peer-reviewed articles, and local best practices in order to serve as a functional public resource for evidence-based medicine.

The literature review process performed by our team results in lists of available evidence linking specific patient conditions and relevant imaging studies. The HMS Library of Evidence assesses and grades such evidence using a methodology based on the 2009 version of the Oxford Centre for Evidence-based (CEBM) medicine Levels of Evidence and the U.S. Preventative Task Force (USPSTF) I–Scores and NS (not scoreable).

The HMS Library of Evidence is accessible online by visiting libraryofevidence.med.harvard.edu/app and is freely available to everyone. Simply sign up for access and you can browse the online repository of evidence, complete with corresponding CEBM Oxford Levels of Evidence grade and links to relevant sources.

The graded pieces of evidence are then presented as clinical logic statements that can be formulated as discrete Appropriate Use Criteria by qualified Provider-Led Entities or easily consumed by CDS systems and deployed through EHRs.

To find out more about the Harvard Medical School Library of Evidence and our team, visit us at libraryofevidence.med.harvard.edu.
Curators and Countway

The immense success of the HMS Library of Evidence and its ability to flourish can be greatly attributed to the dedication and commitment of our team of curators (specially trained medical librarians).

The Library’s specific statements of clinical logic, representing recommendations extracted from published guidelines or other trusted sources, are accompanied by an objective quality rating of the evidence underlying each recommendation (level of evidence/grade of recommendation). This quality rating is applied and annotated by the curators who have broad medical knowledge in the application of evidence-based medicine, but are without inherent conflicts of interest or profession-related biases. Our curators are trained in the use of the CEBM and USPSTF methodologies, grade each piece of assigned evidence, record the rationale for their decisions, and pass the work on to validating clinicians.

While we include a broad range of clinical scenarios, we currently prioritize grading recommendations that relate to the Priority Clinical Areas focused on by the Centers for Medicare & Medicaid Services (CMS).
Evidence Grading

The Library’s evidence grading methodology is based on the 2009 version of the Oxford Centre for Evidence-based Medicine (CEBM) – Levels of Evidence and the U.S. Preventive Services Task Force (USPSTF) I–Scores.

Recommendations chosen from professional society guidelines, local best practices and peer-reviewed literature are converted into Health–IT consumable clinical logic and then graded by two independent parties – a curator and a validating clinician.

Once agreement on a final grade is reached, the full record is made freely available to the public.

Each Oxford CEBM 2009 level grade of 5, indicative of expert opinion, is accompanied by a corresponding USPSTF I–score:

1 – Insufficient evidence – not supported by direct validation or a general body of evidence

Non–I – Non–insufficient – synthesis of a large body of evidence

OR

NS–contradicts – Not scoreable, the evidence cited contradicts the recommendation
Clinical Logic

Clinical logic is derived for each unique piece of evidence in order to be consumable by CDS (clinical decision support) systems and deployed through electronic health records (EHRs). Clinical criteria are used to formulate a logical IF–THEN statement. The purpose of logic creation is to translate the written guideline content into a structured representation.

\[ \text{IF} \text{[clinical signs and symptoms]} \text{ AND [clinical signs and symptoms]} \text{ OR [clinical signs and symptoms]} \]
\[ \text{AND NOT [clinical signs and symptoms]} \text{ THEN / THEN NOT [imaging procedure]} \]

Variations in Logic: Single–Decision Statements

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Rule criteria: [age >=1] AND [blunt trauma]
IF [neurologic deficit] OR [midline spinal tenderness*] OR [altered consciousness] OR [intoxication] OR
[distracting injury*] THEN [Xray cervical spine]
IF NOT [(neurologic deficit) OR [midline spinal tenderness*] OR [altered consciousness] OR [intoxication] OR
[distracting injury*]] THEN NOT [Xray cervical spine]

*indicates term unmapped to standard ontology
```

“The USPSTF recommends annual screening for lung cancer with low-dose computed
tomography in adults aged 55 to 80 years who have a 30 pack-year smoking history and
currently smoke or have quit within the past 15 years. Screening should be discontinued once a
person has not smoked for 15 years or develops a health problem that substantially limits life
expectancy or the ability or willingness to have curative lung surgery.”

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Rule criteria: [age >55] AND [age <80]
IF [cigarette pack-years >= 30] AND [(smoking) OR [time since stopped smoking <15 years]] AND NOT [limited
life expectancy*] AND [candidate for curative lung surgery*] THEN [Low-dose CT Chest]
IF NOT [cigarette pack-years >= 30] AND [(smoking) OR [time since stopped smoking <15 years]] AND NOT
[limited life expectancy*] AND [candidate for curative lung surgery*] THEN NOT [Low-dose CT Chest]

*indicates term unmapped to standard ontology
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Clinical Logic continued

Variations in Logic: Branching Statements

The Quebec decision rule for radiography in shoulder dislocation(22) determines which patients presenting with an anterior shoulder dislocation are at high likelihood for a humeral fracture and warrant X-ray of the shoulder. It applies different criteria to patients under the age of 40 then to patients aged 40 or over. As this particular algorithm produces five final decision points (see Figure 3), five logic statements can be produced:

**Rule criteria:** [anterior dislocation of shoulder] AND [age >=18] AND NOT [Glasgow coma scale score <13]

IF [age <40] AND [[(motor vehicle accident] OR [assault] OR [injury while engaged in sports activity] OR [fall from greater than patient's own height*]) THEN [Xray shoulder]
IF [age <40] AND NOT [(motor vehicle accident] OR [assault] OR [injury while engaged in sports activity] OR [fall from greater than patient's own height*]) THEN NOT [Xray shoulder]
IF [age >=40] AND [superficial ecchymosis of the shoulder] THEN [Xray shoulder]
IF [age >=40] AND NOT [superficial ecchymosis of the shoulder] AND NOT [first episode anterior dislocation of shoulder] THEN NOT [Xray shoulder]

*Indicates term unmapped to standard ontology*

Variations in Logic: Score-Based Statements

[Wells’ Score for stratifying risk of pulmonary embolism(23). Each criterion is assigned a point value (Table 3). The sum of the values generates either the attribute [Wells’ Score >=4] or [Wells’ Score <4].

**Rule criteria:** [age >=18] AND NOT [[(pregnant] OR [anticoagulated in the past 48 hours])

IF [Wells’ Score <=4] AND [D-dimer elevated] THEN NOT [CT chest]
IF [Wells’ Score >4] THEN [CT chest]
HMS Library of Evidence and

The HMS Library of Evidence content is now available through our newly designed HMS Library of Evidence SMART (Substitutable Medical Apps, Reusable Technology) App. It is an open standards platform which allows medical apps to connect to EHRs using FHIR (Fast Healthcare Interoperability Resources).

The HMS Library of Evidence App provides evidence-based decision rules to guide appropriate imaging in the context of patient clinical data. Our scoring of evidence is meant to guide imaging across multiple clinical indications.

"The HMS Library of Evidence App provides evidence-based decision rules to guide appropriate imaging in the context of patient clinical data."

Currently, the app integrates SMART with FHIR, lists all available rules from evidence sources, allows the user to filter by body area, symptoms and more to evaluate specific patient data from an EHR, and provide recommended procedures based on evidence. The evidence grade and links to evidence sources are also provided.

Try out the HMS Library of Evidence SMART App in the SMART App Gallery or by visiting apps.smarthealthit.org/app/55.
Content Update
As of 7/20/2017

# of Guidelines

- Peer reviewed article
- Local best practice
- Professional society guideline

# of Rules

- Peer reviewed article
- Local best practice
- Professional society guideline

Rules by Oxford Grade

- 1a
- 1b
- 2b
- 3b
- 4
- 5

Ranging 1a strongest evidence - 5 expert opinion.

Rules by Type

- Peer reviewed article
- Local best practice
- Professional society guideline

- Peer reviewed article: 468
- Local best practice: 45
- Professional society guideline: 1530

Total: 223

Total: 1976