Use of Curriculum Mapping Tools to Identify Learning Opportunities and Deficiencies II: KnowledgeMap

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The Flexner Report

- Medical education in the United States and Canada, 1910
- Set the foundation for modern medical education
- Current pressures challenge this model:
  - "publish or perish" (researcher)
  - Demand on throughput (clinician)

Part #1: Assessing Curricula

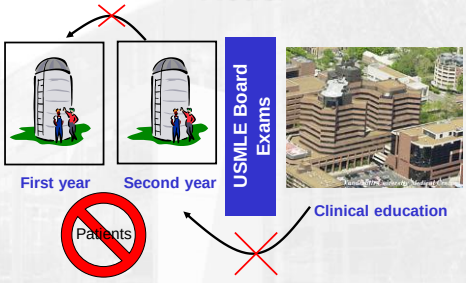
LIAISON COMMITTEE ON MEDICAL EDUCATION

ACGME

- LCME and ACGME require increasing documentation of **curriculum objectives, coverage**, and student **patient experiences**
- Accreditation standards specific content, competencies, amount of training, etc. for periodic reviews
- ED-2:

  "The institution that offers a medical education program is required to establish a system to specify the types of patients or clinical conditions that medical students must encounter and to monitor and verify the medical students' experiences with patients so as to remedy any identified gaps."

Traditional Medical Education Model



Guiding questions

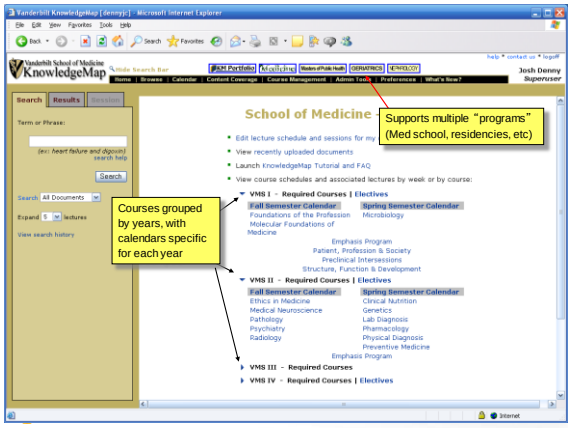
- **Faculty**: "I am teaching about congestive heart disease – what have students already learned about this?"
- **Students**: Studying immunoglobulins, need to find relevant prior concepts like splicing
- **Administrators**: Where do we cover large concepts, like geriatrics?

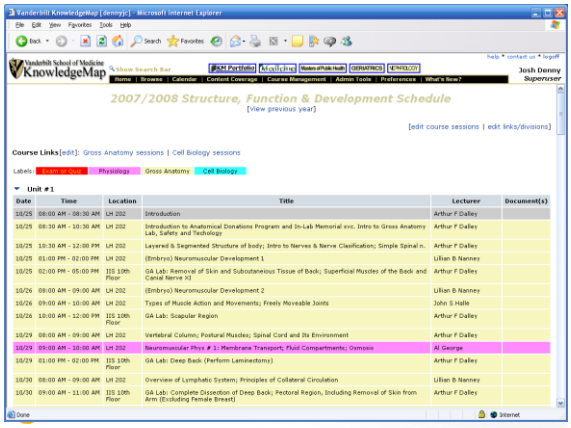
Traditional Solutions

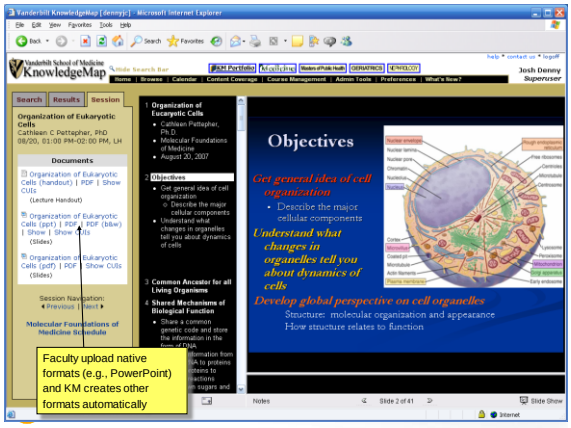
- Web pages for courses
- Course management software (Blackboard, WebCT)
- Finding what is taught where:
  - Curriculum committee meetings
  - Emails
  - Manual logs
  - External, manually maintained curricular databases such as CurrMIT

An Informatics Model

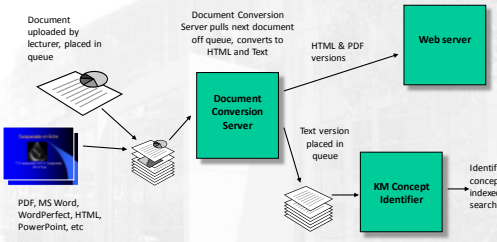
- Let learners access work at their own rate (finding old and new data)
- Use multiple methods to delivery content
- Faculty are busy – focus on easing content capture, and create tools to accurately capture
- Provide robust searching tools across the entire curriculum





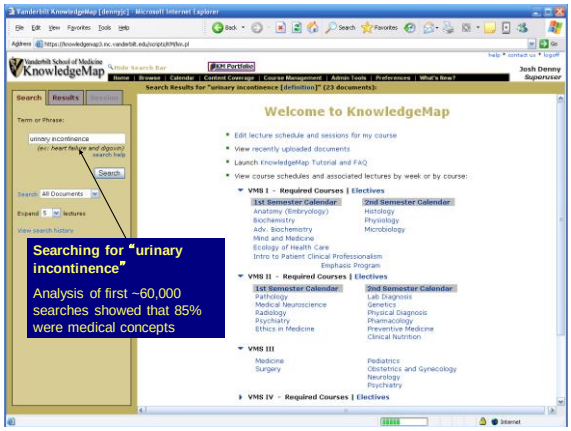


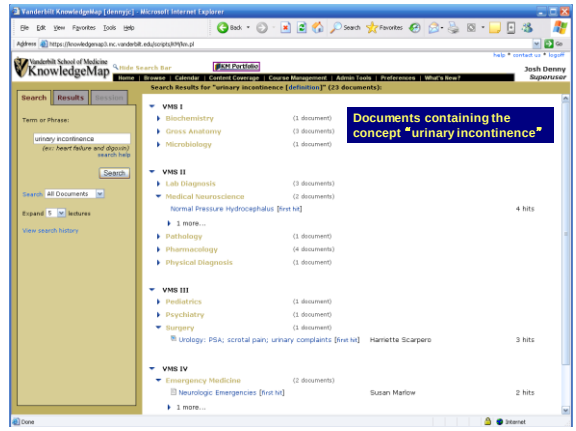
Document Processing

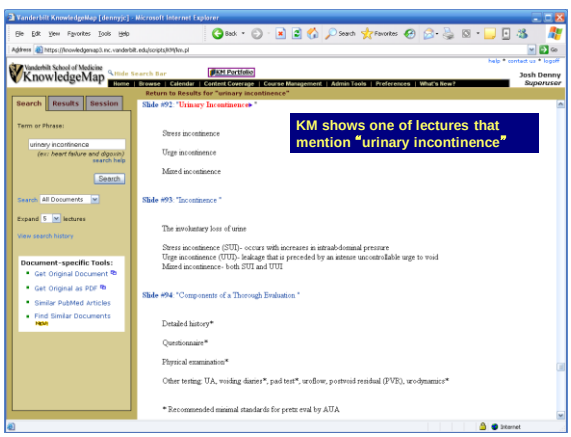


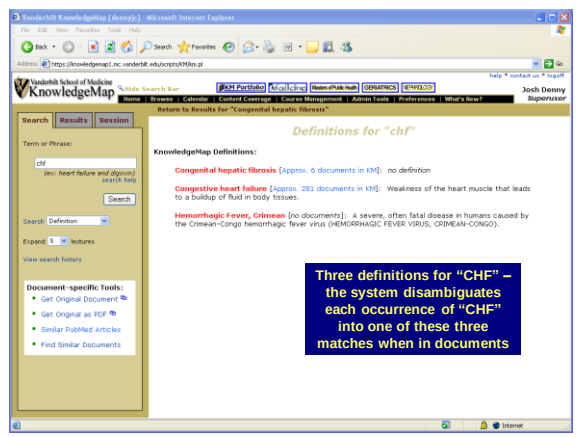
Concept vs. Text indexing

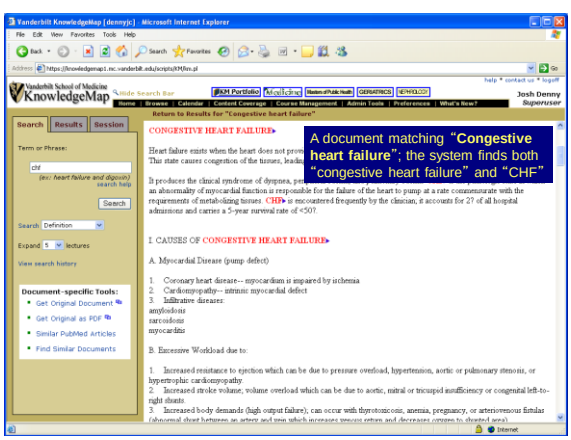
- Text indexing
  - Indexing by words of document
  - "Hepatolenticular degeneration" ≠ "Wilson's Disease"
- Concept indexing / Natural language processing
  - Recognizes words in document to a controlled vocabulary
    - Unified Medical Language System, contains >100 vocabularies, >2 million concepts mapped to >8 million English synonyms)
  - "Hepatolenticular degeneration" = "Wilson's disease"
  - Figures out ambiguous concepts:
    - "CHF" – "Congestive Heart Failure" or "Congenital Hepatic Fibrosis"?
    - "BSE" – "Bovine spongiform encephalopathy" or "Breast self exam"
  - Interprets phrases
    - "The aortic valve was stenosed" = "aortic stenosis"
    - "gram negative infection" = "gram-negative *bacterial* infection"

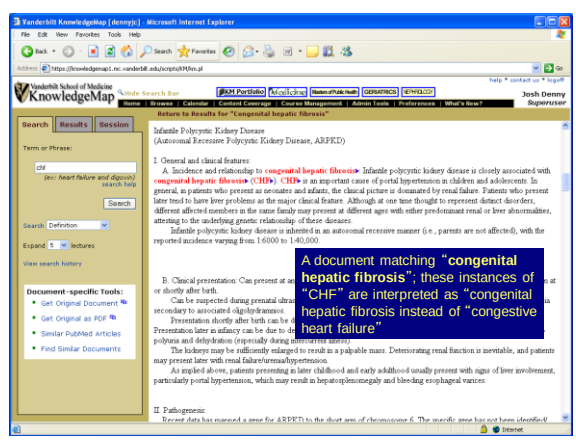

Searching for "urinary incontinence"
Analysis of first ~60,000 searches showed that 85% were medical concepts


Documents containing the concept "urinary incontinence"

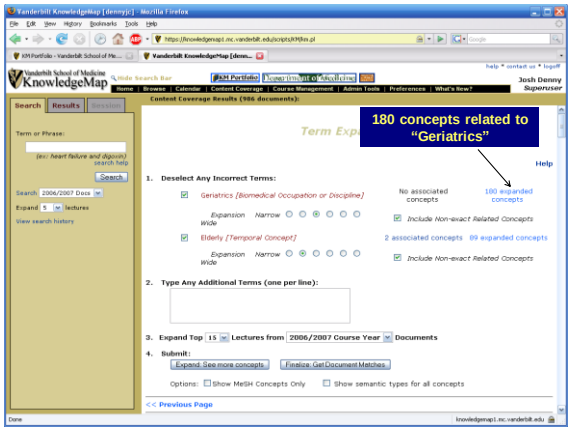

KM shows one of lectures that mention "urinary incontinence"

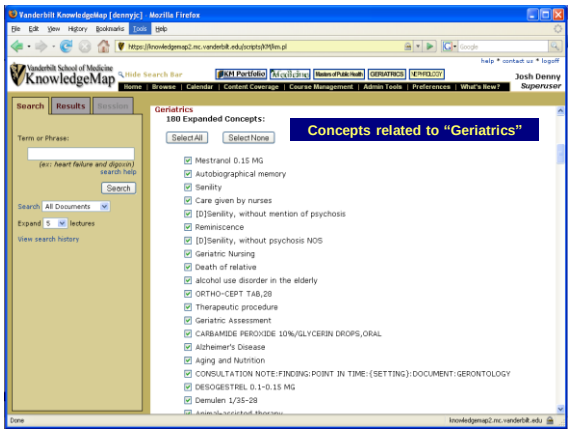

Three definitions for "CHF" – the system disambiguates each occurrence of "CHF" into one of these three matches when in documents

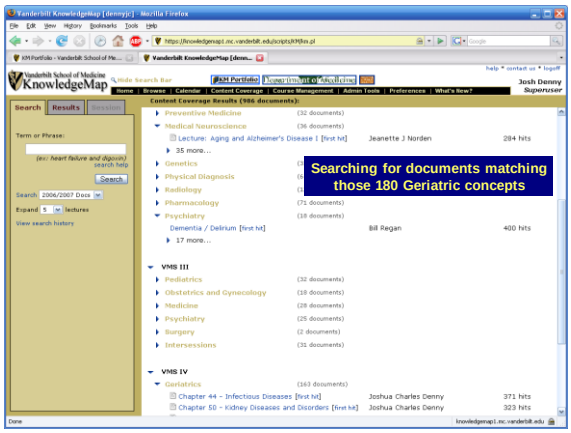

A document matching "Congestive heart failure"; the system finds both "congestive heart failure" and "CHF"

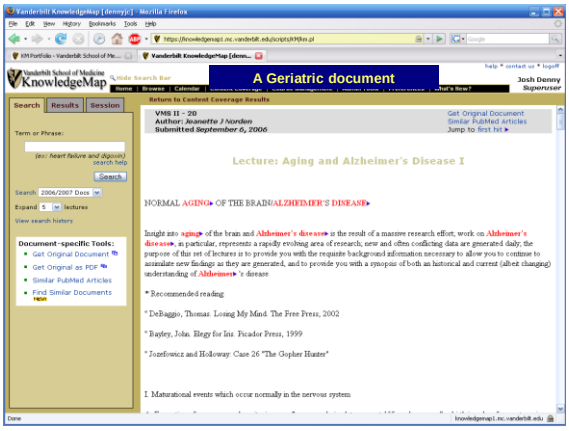

A document matching "congenital hepatic fibrosis"; these instances of "CHF" are interpreted as "congenital hepatic fibrosis instead of "congestive heart failure"

How do we find broad concepts like "geriatrics" or "women's health"?









How well does KM find metaconcepts?

- Identified gold standard set of 380 documents as containing high, medium or low relevance to each topic
- Used KM to generate a variable number of subconcepts for each broad concept and calculated a relevance score for each document.

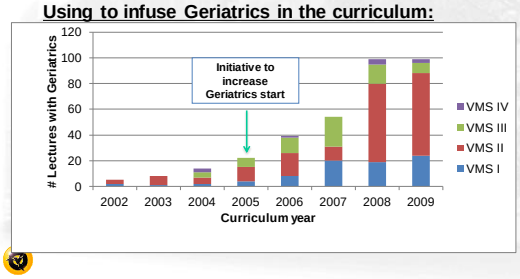
Topic	ROC area
Genetics	0.98
Women's Health	0.93
Dermatology	0.95
Radiology	0.97

Denny, Smithers, Armstrong, Spickard, JGIM, Oct, 2005

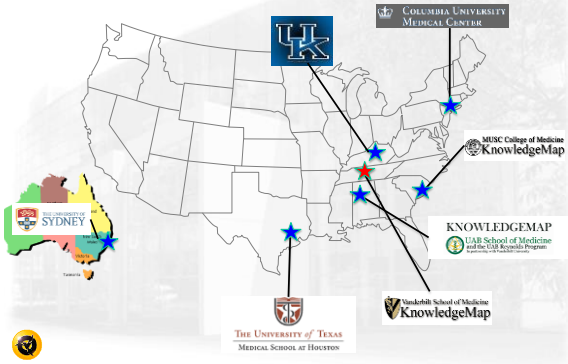
Finding broad curricular topics

- Used for LCME, creating/rearranging courses, revising curriculum

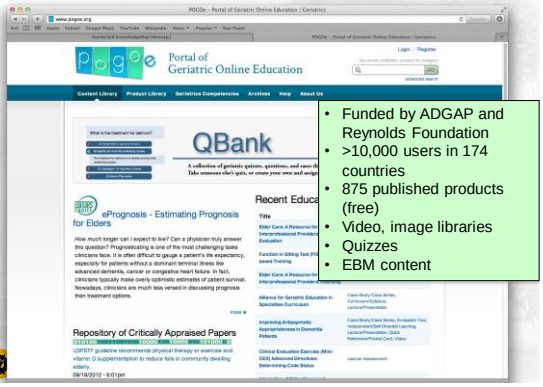
Using to infuse Geriatrics in the curriculum:



KM has been adopted by others



POGOe.org, a free geriatrics site based on KM



- Funded by ADGAP and Reynolds Foundation
- >10,000 users in 174 countries
- 875 published products (free)
- Video, image libraries
- Quizzes
- EBM content

Part #2: Assessment in Clinical Years

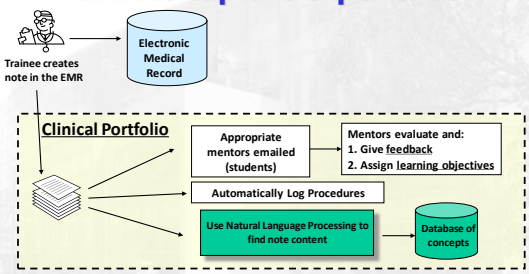
- Testing based: USMLE, NCLEX, Residency Board Exams
- Experience Based:
  - ACGME and RRC
  - Nursing requirements
- Both current methods tend to aggregate at high levels
- Experience is an important part of competency

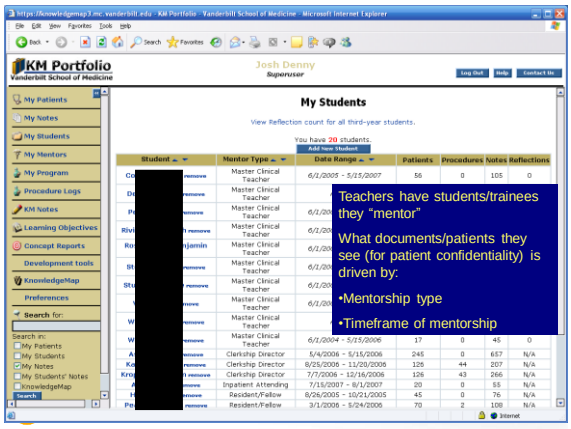
Components of "Learning Portfolio"

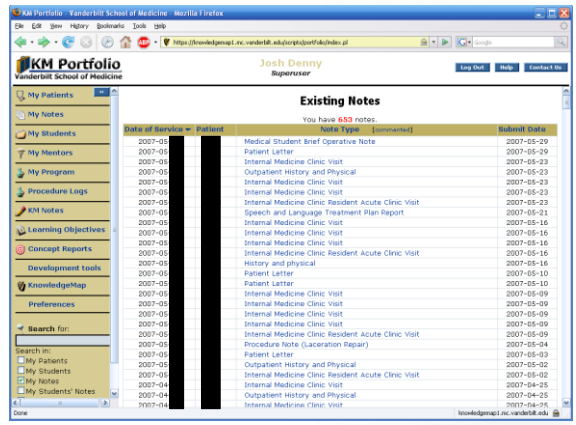
- Clinical notes
- Mentor feedback on notes and other documents
- Logs of procedures/patients
- Reflections
- Tests/academic work
- Essays and other documents

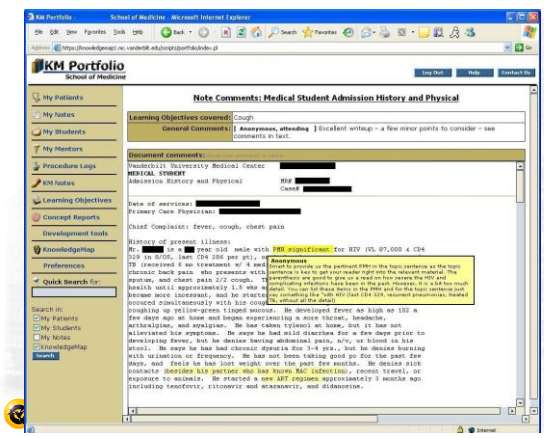
We will focus on these

Learning Portfolio – leveraging EMR to capture experience









RCT evaluation of mentor feedback on student notes

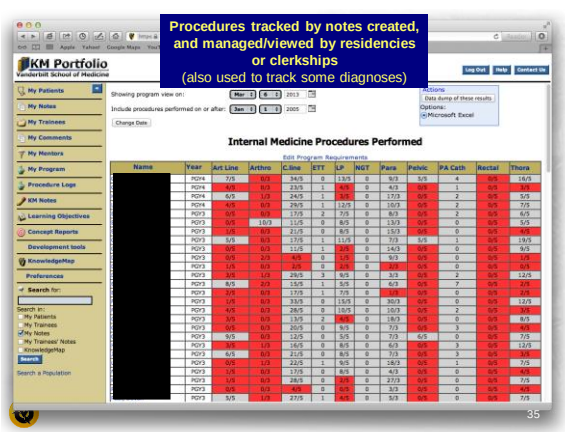
Survey of Residents and Attending physicians

Compared with prior rotations:	Electronic	Paper	p
"I reviewed more notes"	40%	12%	0.014
"I provided more feedback"	40%	12%	0.010
"I was more satisfied with feedback given"	33%	10%	0.045

Analysis of student write-ups

- Evaluated 142 write-ups using 13-point rating scale
- Performance on "Assessment and Plan" ratings improved in electronic feedback group (p=0.036)

Spickard et al. J Gen Int Med. 2008;23(7):979-84



Tracking experience: Vanderbilt Core Clinical Curriculum (VC3)

25 Core Clinical Problems (CCP)

Abdominal pain	Headache
Abnormal uterine bleeding	Jaundice
Abnormal vaginal discharge	Loss of consciousness
Abnormalities of mood	Obesity
Altered mental status	Pelvic pain
Back pain	Pharyngitis
Breast disease	Rash
Chest pain	Seizures
Cough	Shock
Dysuria	Shortness of breath
Fever	Substance abuse
GI bleeding	Trauma
	Weight loss

Extracting "knowledge" from clinical notes

H&P entered by user

CC: SOB
HPI: This is a 65yo w/ h/o CHF, … no chest pain
…

→ **Clinical Note Section Tagger**

<chief_complaint>
SOB
</chief_complaint>
<history_present_illness>
This is a 65yo w/ h/o CHF.... Denies chest pain.
</history_present_illness>

→ **KnowledgeMap Concept Identifier**

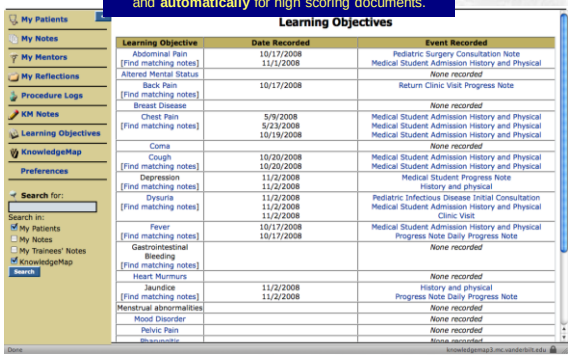
Structured Output
Text labeled with Unified Medical Language System concepts, organized by section

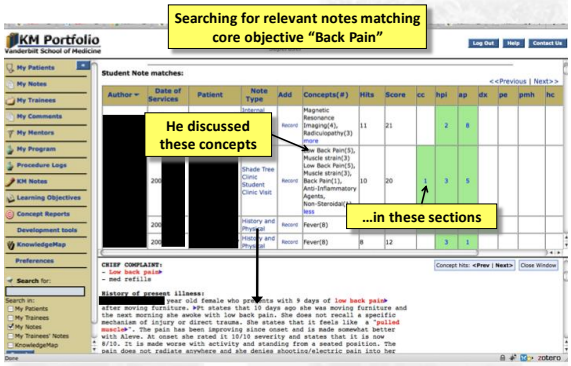
<chief_complaint>
C0392680: Shortness of Breath
</chief_complaint>
<history_present_illness>
C0018802: Congestive Heart Failure
C0008031: Chest Pain, *Negated*
</history_present_illness>

Denny et al. JAMIA 2003, 2009; AMIA 2008; JBI 2009
Xu et al. JAMIA 2010
Doan et al. JAMIA 2010

Student view of how many VC3 topics they've completed. (Teachers can see this also.)

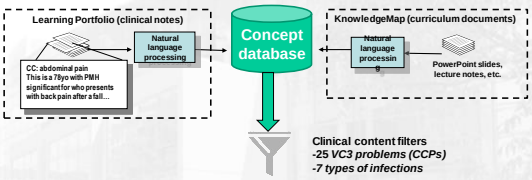
Mapping of a note to a VC3 topic happens **manually** and **automatically** for high scoring documents.





Part #3: Evaluating and integrating

Study 1: Curriculum vs. Notes

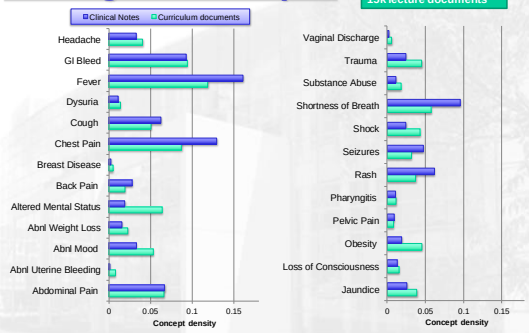


Clinical content filters
-25 *VC3 problems (CCPs)*
-7 *types of infections*

Compare content, identify discrepancies

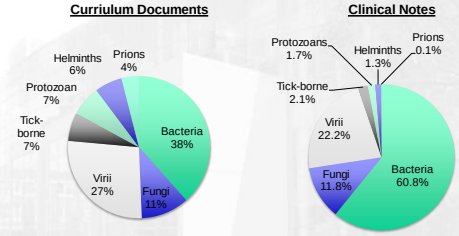
Coverage of VC3 Topics

300k notes
15k lecture documents



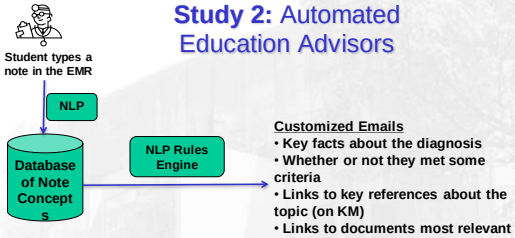
Denny et al. AMIA 2010

Coverage of Infectious Diseases



Denny et al. AMIA 2010

Study 2: Automated Education Advisors



- Current Email Advisors:
  - Advanced directives (pts > 65, if they don't mention them)
  - Altered mental status (must say AMS concept in key section of note)

Step 1. Student sees a patients, writes a note

```
CHIEF COMPLAINT: confusion, weakness, and lethargy
HISTORY OF PRESENT ILLNESS: Mrs. X is a 70 year old female with
metastatic undifferentiated carcinoma, likely lung in origin, who
was recently discharged from the hospital s/p left femoral
fracture and biopsy due to a fracture who now presents with
increasing confusion, weakness, and lethargy.
…
PHYSICAL EXAMINATION: General: waxing and waning alertness,
…
SUMMARY: This is a 72 year old female with metastatic lung
carcinoma admitted for delirium most likely secondary to
hypercalcemia.
…
ASSESSMENT AND PLAN:
1. Hypercalcemia Hyperparathyroidism… malignancy…
6. Disp -Will keep hospitalized until altered mental status
improves…
```

Step 2. Portfolio finds AMS concepts found in note

```
CHIEF COMPLAINT: confusion, weakness, and lethargy
HISTORY OF PRESENT ILLNESS: Mrs. X is a 70 year old female with
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```

Step 3. Portfolio finds related curriculum documents and emails the student

You are getting this email as part of a project to improve your understanding of **altered mental status**. This email is generated based on your note: Medical Student Admission History and Physical, written on 2011-01-15 19:42:15.

Key facts about Altered Mental Status:
•The differential diagnosis of altered mental status is extensive including dementia, delirium, substance induced, drug side effects, infection, intracranial lesions or strokes, trauma, and metabolic entities such as liver disease or hypoglycemia.
•Alzhiemer's disease, vascular dementia, and dementia with Lewy bodies are the most common forms of degenerative dementias seen in late life.

KM documents most like yours:
•Typical Laboratory Results in the Differential Diagnosis of Hypercalcemia | Joshua Charles Denny | Geriatrics Review Syllabus (Geriatrics)
•Hypercalcemia | Natasha Janelle Schneider | Outpatient Medicine Curriculum (Core Lecture Series)
•Fluid Management for Students | Kyle Bertram Brothers | Pediatrics (VMS III)
•Pharmacological Concepts | Joseph A Awad | Pharmacology (VMS II)

Other searches that may be relevant to this patient:
•Differential diagnosis of metobolic (liver ds, electrolytes, gluocose abnormalities) as causes of AMS. (4 overlapping concepts)
•Differential diagnosis of delerium as a cause of AMS. (2 overlapping concepts)
•Signs and symptoms of AMS (2 overlapping concepts)
•Evaluation of AMS (1 overlapping concepts)

Acknowledgements

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- Anderson Spickard, III, MD MS
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- National Library of Medicine
- Reynolds Foundation
- National Board of Medical Examiners

Questions?