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Overview of EHR phenotyping – successes, challenges, and examples

Josh Denny, MD, MS

josh.denny@vanderbilt.edu

Vanderbilt University, Nashville, Tennessee, USA

AMIA 2015 NLP Tutorial

Disclaimers

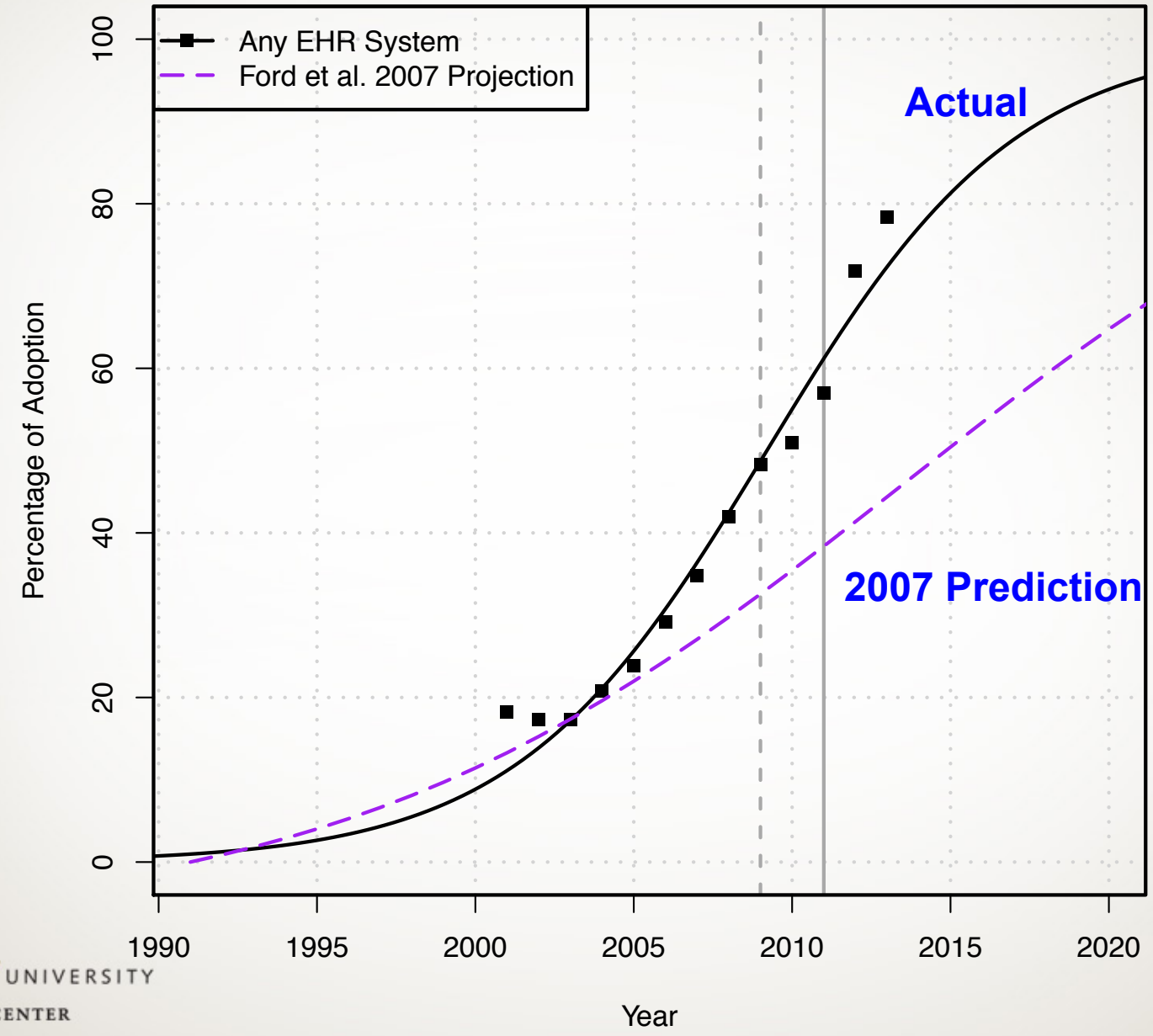
I receive funding from:

- NIH: NLM, NHGRI, NIGMS, NCI, NCATS
- Reynolds Foundation (Geriatrics Education)
- National Board of Medical Examiners

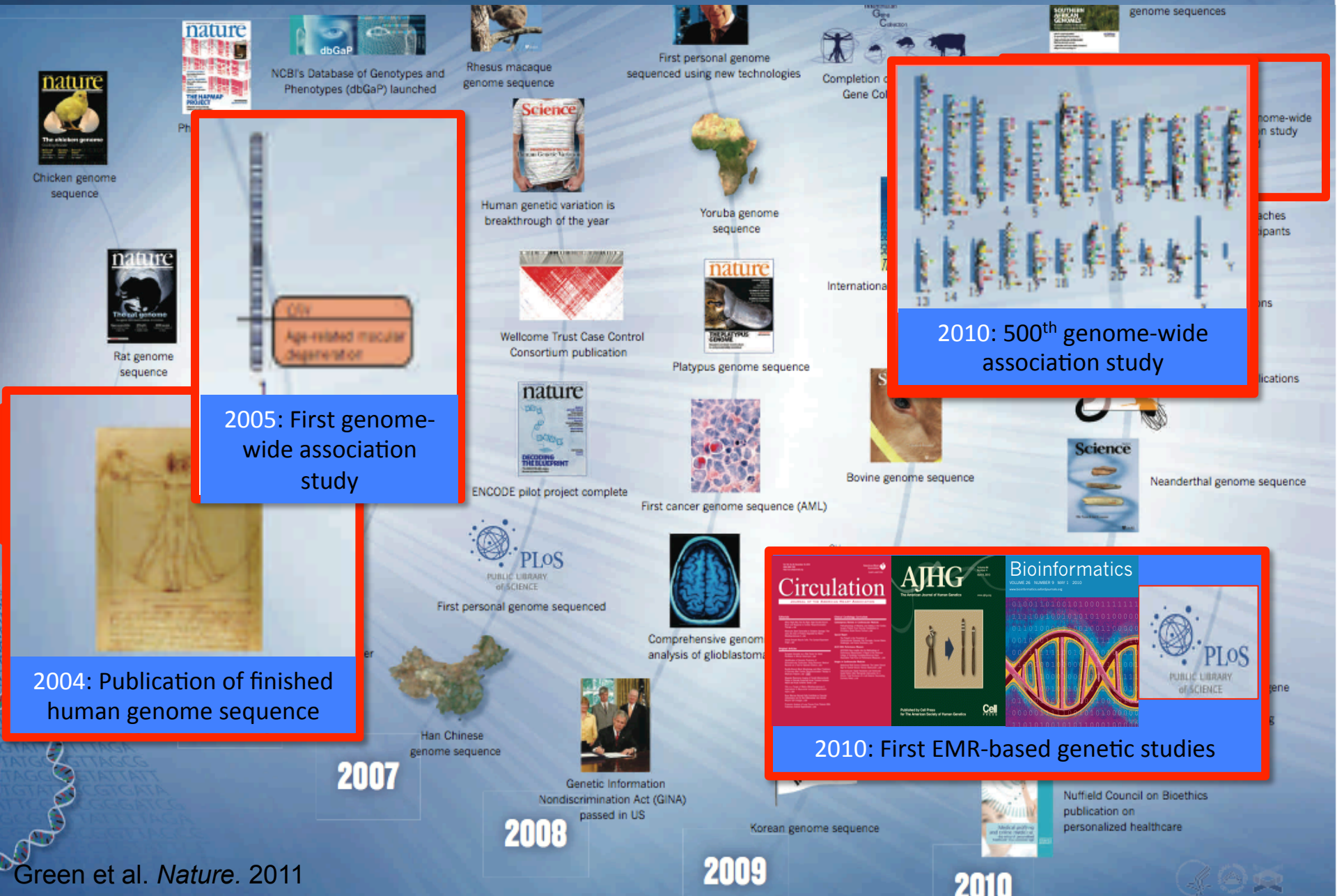
Outline for my block

- Intro to use of the EHR for genomic research
- NLP for EHR phenotyping
  - diseases/traits
  - Drug-response phenotypes
- NLP for medical education

EHR adoption increasing faster than anticipated



Genomic achievements since the Human Genome Project

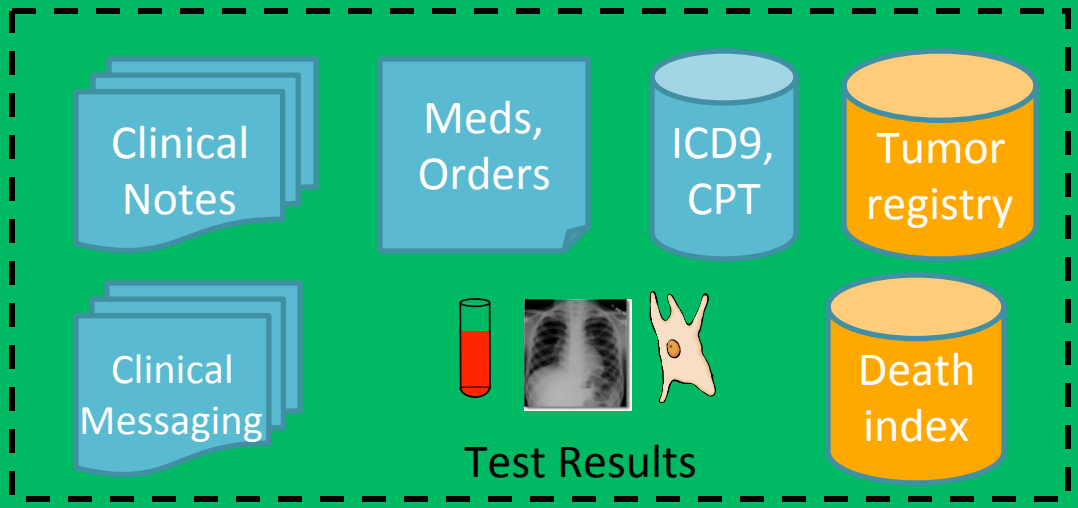


Green et al. *Nature.* 2011

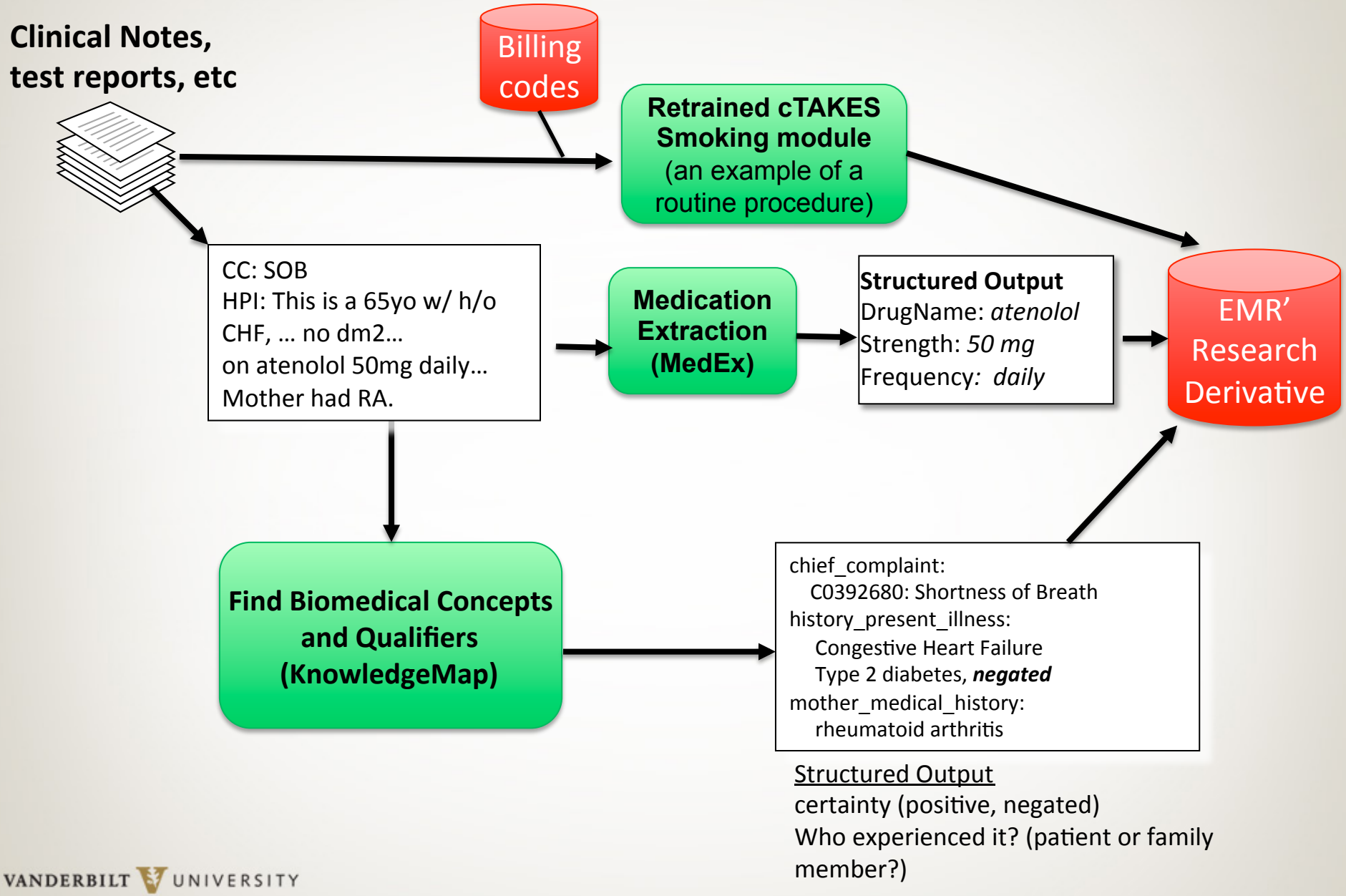
Resources for EMR-based research at Vanderbilt

The Synthetic Derivative

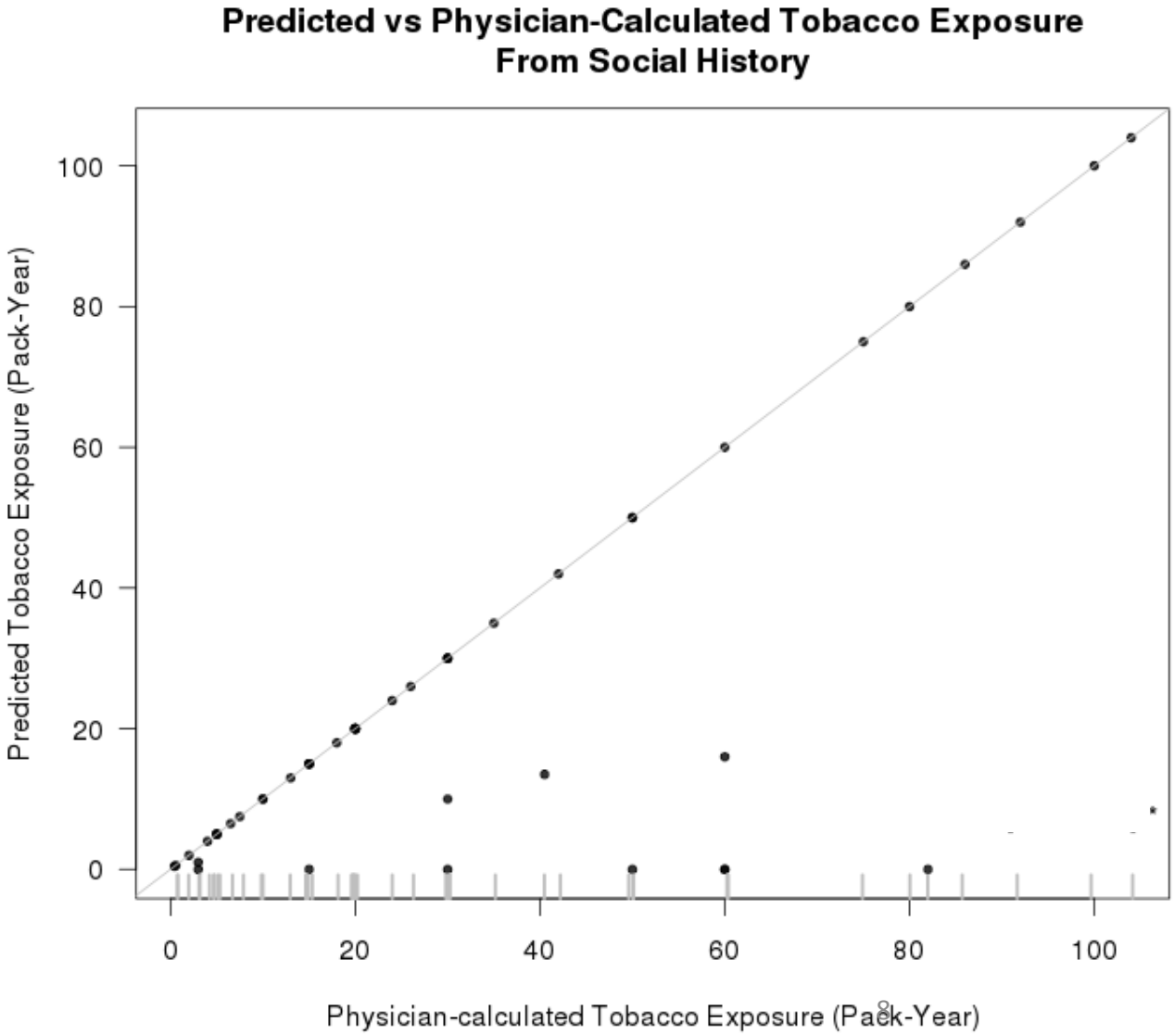
A **de-identified** and continuously-updated image of the EMR: 2,358,760 subjects



Using clinical notes to enhance knowledge



Extracted detailed smoking history from clinical narratives



Travis Osterman
AMIA
Weds 10:30-12 session

Example - Clinical Notes

CC: SOB

HPI: 71 yo woman h/o DM, HTN, Dilated CM/CHF, Afib s/p embolic event, chronic diarrhea, admitted with SOB. CXR pulm edema. Rx'd Lasix.

All: none

Meds Lasix 40mg IV bid, ASA, Coumadin 5, Prinivil 10, glucophage 850 bid, glipizide 10 bid, immodium prn

A/P:

- increase lasix to 80 bid
- maintain sao2 > 92% per RT protocol
- no fever and wbc wnl, so cont immodium prn
- dm2: ccm

Resources for EMR-based research at Vanderbilt

The Synthetic Derivative

A de-identified and continuously-updated image of the EMR: 2,358,760 subjects

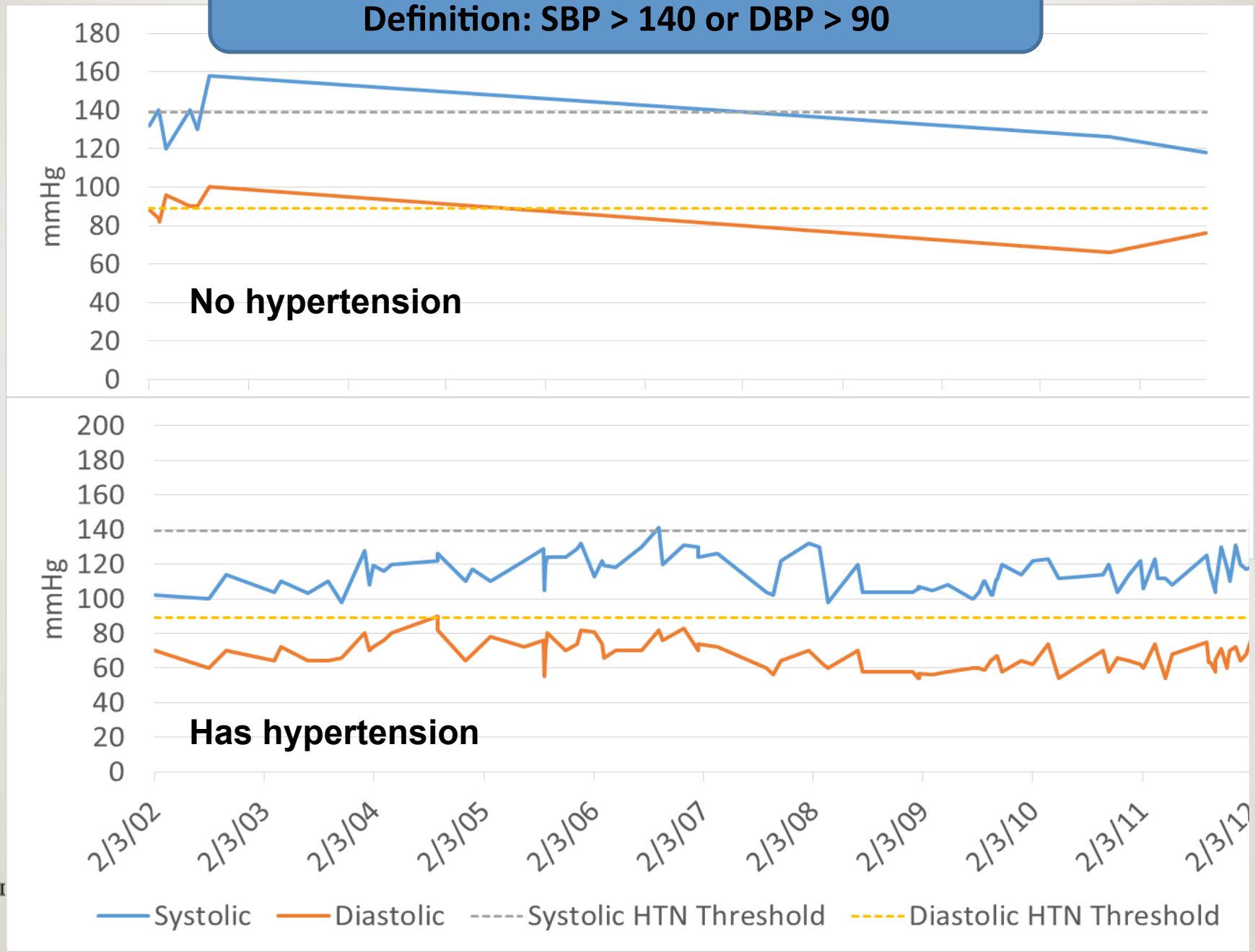
BioVU

Subjects with DNA: 197,330

- Dense (GWAS-level) genotypes: ~20,000
- Exome chip data: ~36,000

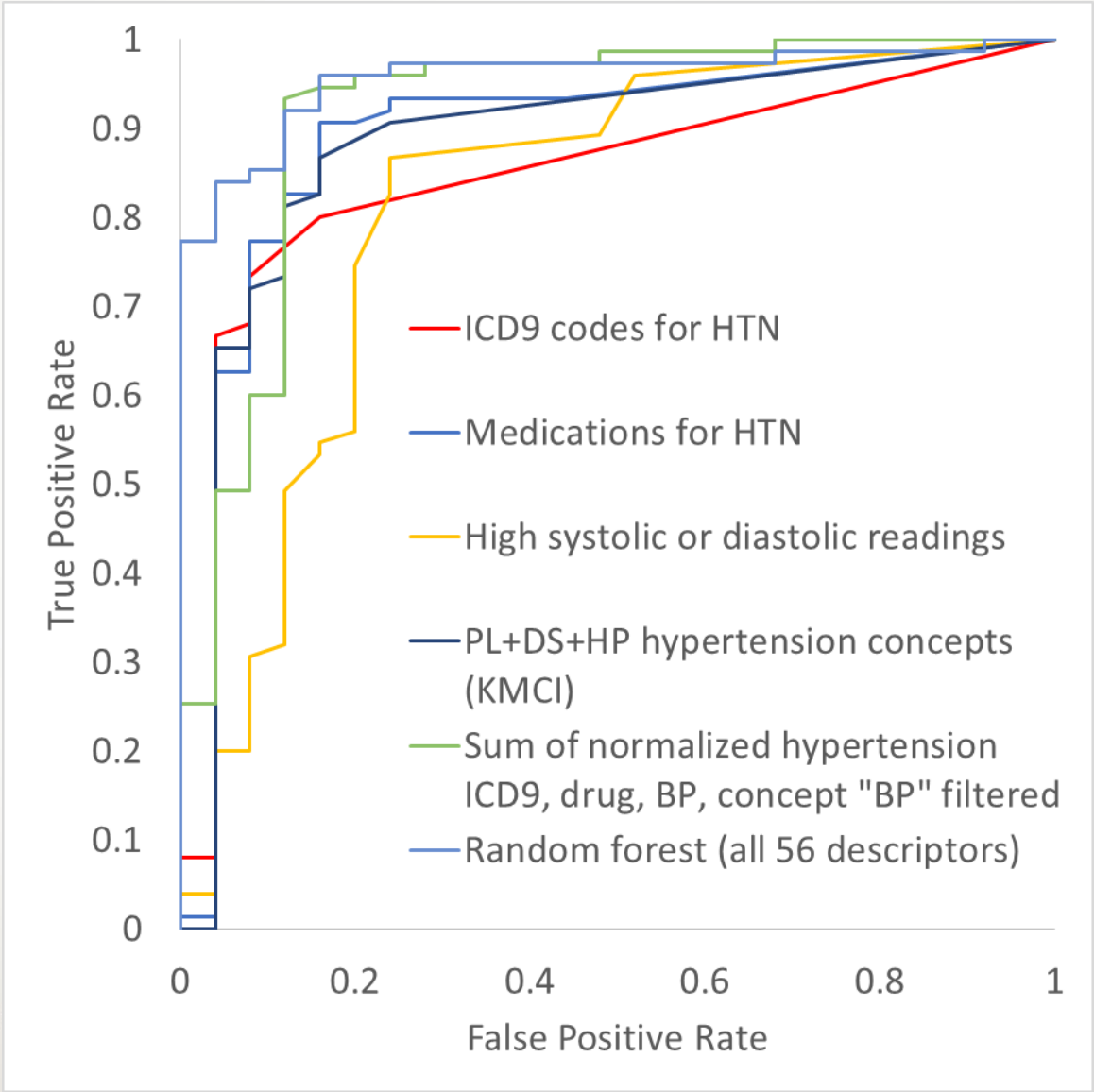
EHR Phenotyping

"Simple" Example: Who has hypertension?
Definition: SBP > 140 or DBP > 90



Our "simple" example: Hypertension

Multiple components are better
(and blood pressure is the worst)



The "demonstration project"

- Are genotype-phenotype relations replicated in BioVU?
- Genotype "high-value" SNPs in the first 10,000 samples accrued.
  - 21 established loci (>1 SNP for some)
  - in 5 diseases with known associations:

    Atrial fibrillation
    Crohn's disease
    Multiple Sclerosis
    Rheumatoid arthritis
    Type II Diabetes
- Develop "electronic phenotype algorithms" to identify cases and controls

RA – Case Definition Evolution

#	Definition	# Cases	Problem
1	ICD9 codes for RA + Medications (only in problem list)	371	Found incomplete problem lists
2	Same as above but searched notes	411	Patients billed as RA but actually other conditions, overlap syndromes such as psoriatic arthritis, juvenile RA
3	Above + require text “rheumatoid arthritis” and small list of exclusions	358	Overlap syndromes with other autoimmune conditions, conditions in which physicians did not agree
4	Above + exclusion of other inflammatory arthritides	255	PPV = 97%; a few “possible RA” or family history items remained

Final RA case definition

ICD 9 codes (any of the below)

- 714 Rheumatoid arthritis and other inflammatory polyarthropathies
- 714.0 Rheumatoid arthritis
- 714.1 Felty's syndrome
- 714.2 Other rheumatoid arthritis with visceral or systemic involvement

AND

Medications (any of the below)

methotrexate [MTX][amethopterin] sulfasalazine [azulfidine]; Minocycline [minocin][solodyn]; hydroxychloroquine [Plaquenil]; adalimumab [Humira]; etanercept [Enbrel] infliximab [Remicade]; Gold [myochrysine]; azathioprine [Imuran]; rituximab [Rituxan] [MabThera]; anakinra [Kineret]; abatacept [Orencia]; leflunomide [Arava]

AND

Keywords (any of the below)

rheumatoid [rheum] [reumatoid] arthritis [arthritides] [arthriris] [arthristis] [arthritus] [arthrtis] [artritis]

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=Narrative components

Final RA case definition - 2

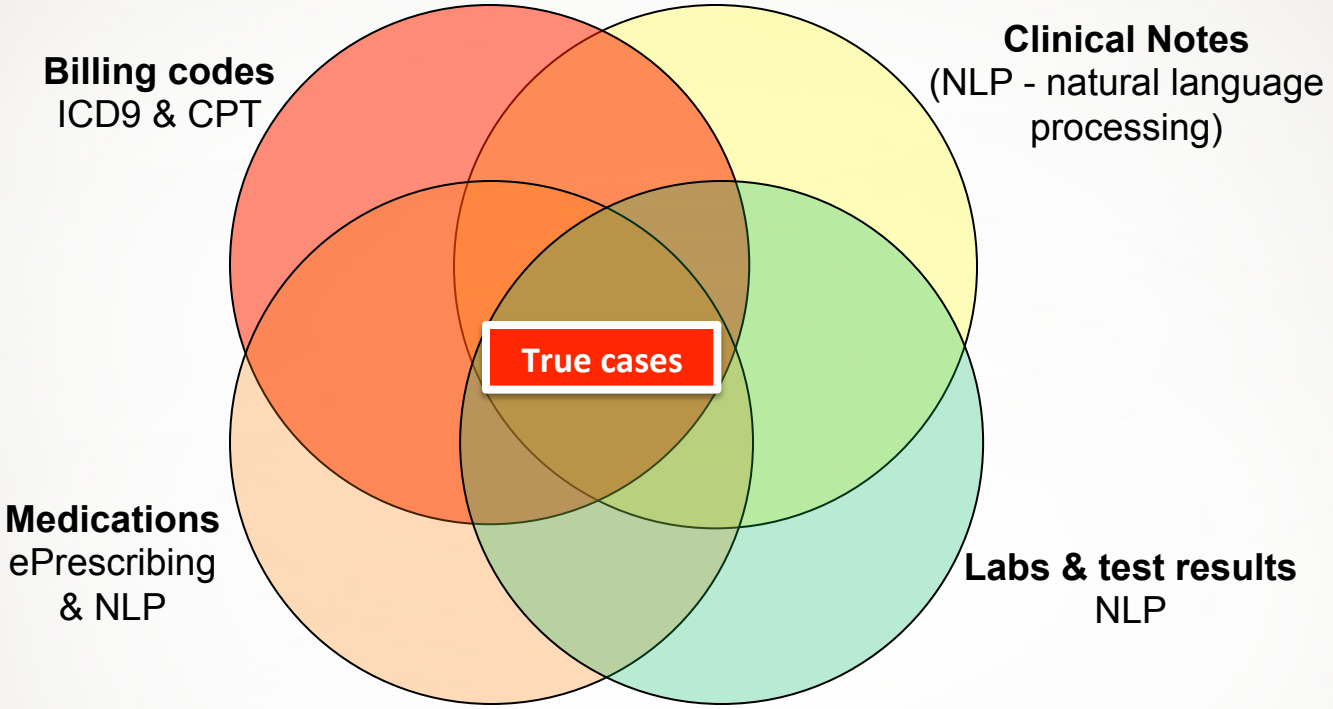
AND NOT
ICD 9 codes (any of the below)

- 714.30 Polyarticular juvenile rheumatoid arthritis, chronic or unspecified
- 714.31 Polyarticular juvenile rheumatoid arthritis, acute
- 714.32 Pauciarticular juvenile rheumatoid arthritis
- 714.33 Monoarticular juvenile rheumatoid arthritis
- 695.4 Lupus erythematosus
- 710.0 Systemic lupus erythematosus
- 373.34 Discoid lupus erythematosus of eyelid
- 710.2 Sjogren's disease
- 710.3 Dermatomyositis
- 710.4 Polymyositis
- 555 Regional enteritis
- 555.0 Regional enteritis of small intestine
- 555.1 Regional enteritis of large intestine
- 555.2 Regional enteritis of small/large intestine
- 555.9 Regional enteritis of unspecified site
- 564.1 Irritable Bowel Syndrome
- 135 Sarcoidosis
- 696 Psoriasis and similar disorders
- 696.0 Psoriatic arthropathy
- 696.1 Other psoriasis and similar disorders excluding psoriatic arthropathy
- 696.8 Other psoriasis and similar disorders
- 099.3 Reiter's disease
- 716.8 Arthropathy, unspecified
- 274.0 Gouty arthropathy
- 358.0 myasthenia gravis
- 358.00 myasthenia gravis without acute exacerbation
- 358.01 myasthenia gravis with acute exacerbation
- 775.2 neonatal myasthenia gravis
- 719.3 Palindromic rheumatism
- 719.30 Palindromic rheumatism, site unspecified
- 719.31 Palindromic rheumatism involving shoulder region
- 719.32 Palindromic rheumatism involving upper arm
- 719.33 Palindromic rheumatism involving forearm
- 719.34 Palindromic rheumatism involving hand
- 719.35 Palindromic rheumatism involving pelvic region and thigh
- 719.36 Palindromic rheumatism involving lower leg
- 719.37 Palindromic rheumatism involving ankle and foot
- 719.38 Palindromic rheumatism involving other specified sites
- 719.39 Palindromic rheumatism involving multiple sites
- 720 Ankylosing spondylitis and other inflammatory spondylopathies
- 720.0 Ankylosing spondylitis
- 720.8 Other inflammatory spondylopathies
- 720.81 Inflammatory spondylopathies in diseases classified elsewhere
- 720.89 Other inflammatory spondylopathies
- 720.9 Unspecified inflammatory spondylopathy
- 721.2 Thoracic spondylosis without myelopathy
- 721.3 Lumbosacral spondylosis without myelopathy
- 729.0 Rheumatism, unspecified and fibrositis
- 340 Multiple sclerosis
- 341.9 Demyelinating disease of the central nervous system unspecified
- 323.9 transverse myelitis
- 710.1 Systemic sclerosis
- 245.2 Hashimoto's thyroiditis
- 242.0 Toxic diffuse goiter
- 443.0 Raynaud's syndrome

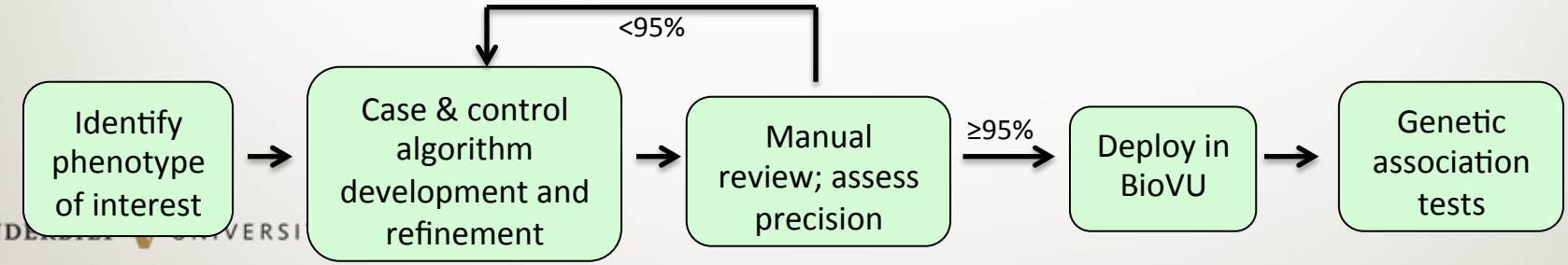
AND NOT
Keywords (any of the below)

juvenile [juv] rheumatoid [rheum] [reumatoid] [rhumatoid] arthritis [arthritides] [arthriris] [arthristis] [arthritus] [arthrtis] [artritis]
juvenile [juv] arthritis arthritis [arthritides] [arthriris] [arthristis] [arthritus] [arthrtis] [artritis]
juvenile chronic arthritis [arthritides] [arthriris] [arthristis] [arthritus] [arthrtis] [artritis]
juvenile [juv] RA; JRA
Inflammatory [inflamatory] [inflam] osteoarthritis [osteoarthrosis] [OA]
Reactive [psoriatic] arthritis [arthropathy] [arthritides] [arthriris] [arthristis] [arthritus] [arthrtis] [artritis]

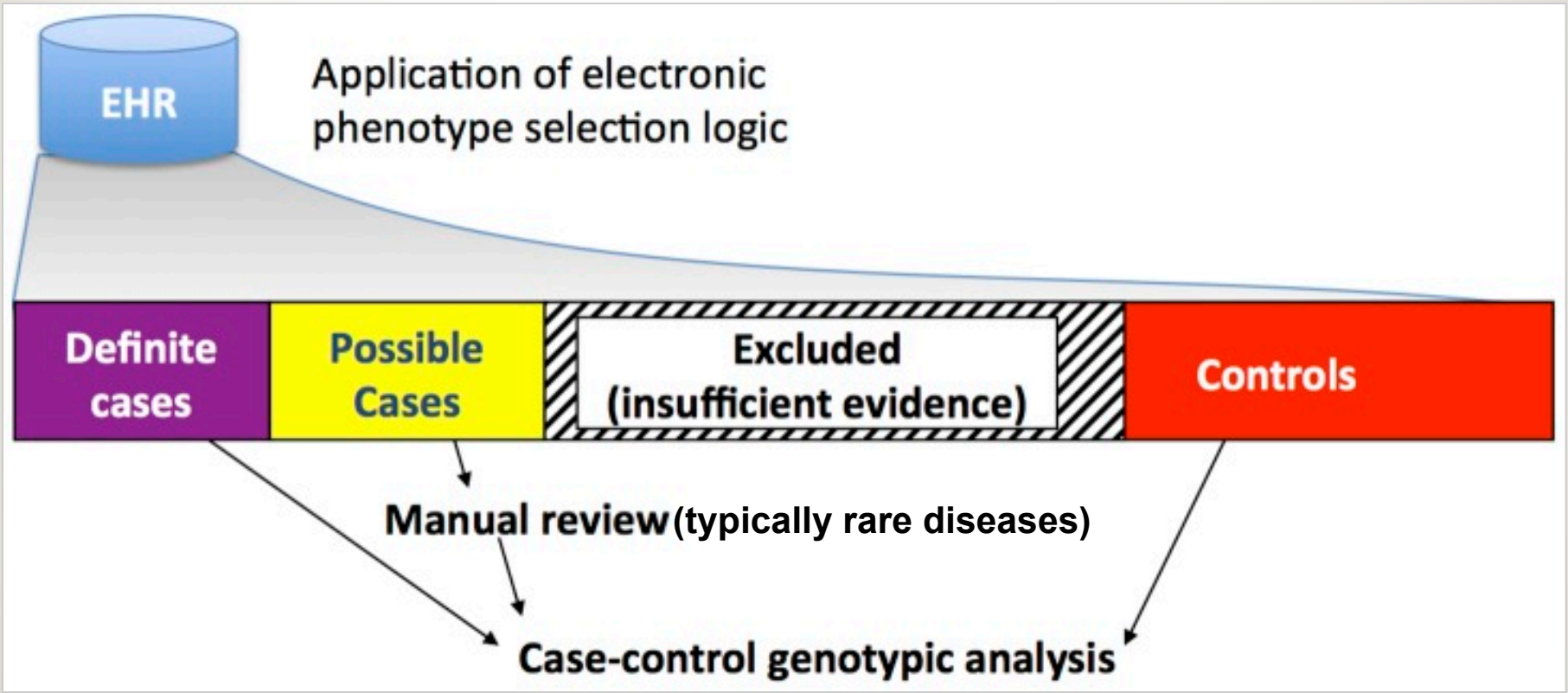
What we learned - Finding phenotypes in the EMR



Algorithm Development and Implementation



A common general approach to phenotyping



Denny. PLoS Comp Bio 2012

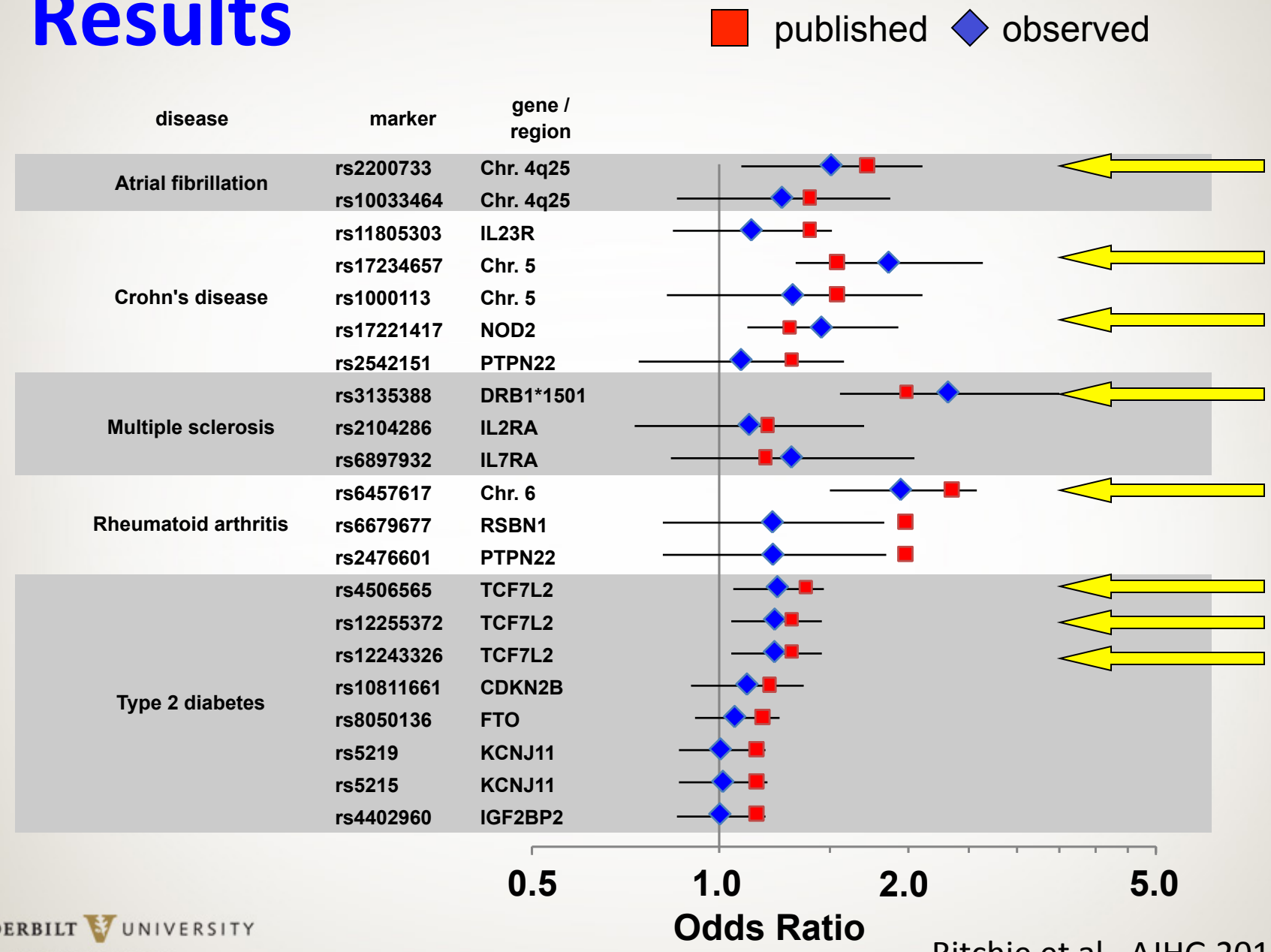
Validating EMR phenotype algorithms
(Using first 10,000 patients in BioVU)

Disease	Methods	Definite Cases	Controls	Case PPV	Control PPV
Atrial fibrillation	NLP of ECG impressions ICD9 codes CPT codes	168	1695	98%	100%
Crohn's Disease	ICD9 codes Medications (NLP)			100%	100%
Type 2 Diabetes	ICD9 codes Medications (NLP) NLP exclusions Labs			100%	100%
Multiple Sclerosis	ICD9 codes or text diagnosis	66	1857	87%	100%
Rheumatoid Arthritis	ICD9 codes Medications (NLP) NLP exclusions	170	701	97%	100%

Common themes:
Billing codes – 5/5
NLP – 5/5
Meds – 4/5
Labs – 2/5

NLP = Natural language processing

Results



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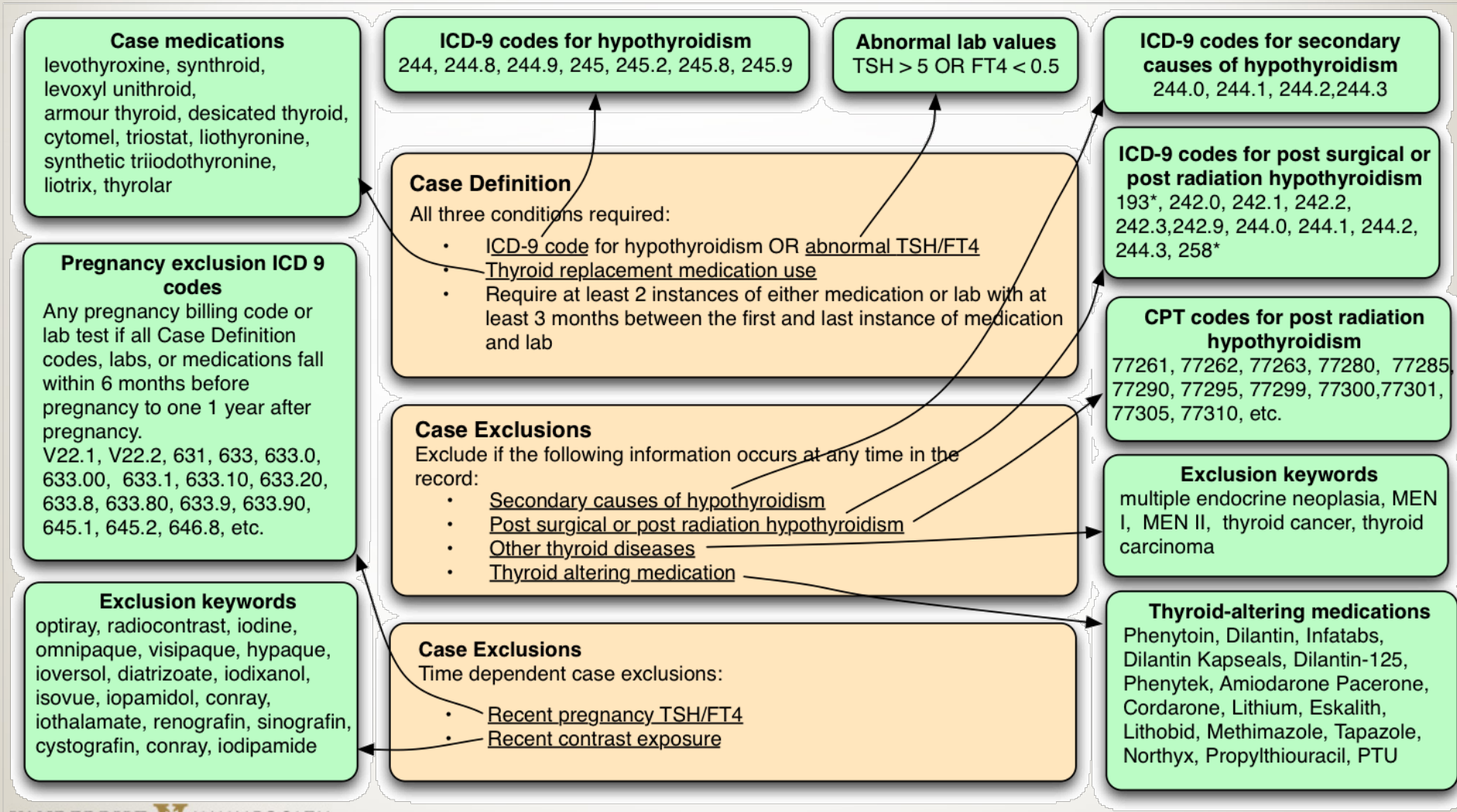
Ritchie et al., AJHG 2010

Identifying cases with precision from the EMR

requires structured and unstructured information

	RA	MS	CD	T2D
Had ICD-9 codes:	3.9%	1. 8%	1.8%	17.3%
Met algorithm definition:	2.7%	1. 2%	1.6%	9.7%
Accuracy of ICD9 codes:	69%	66%	89%	56%

Hypothyroidism algorithm



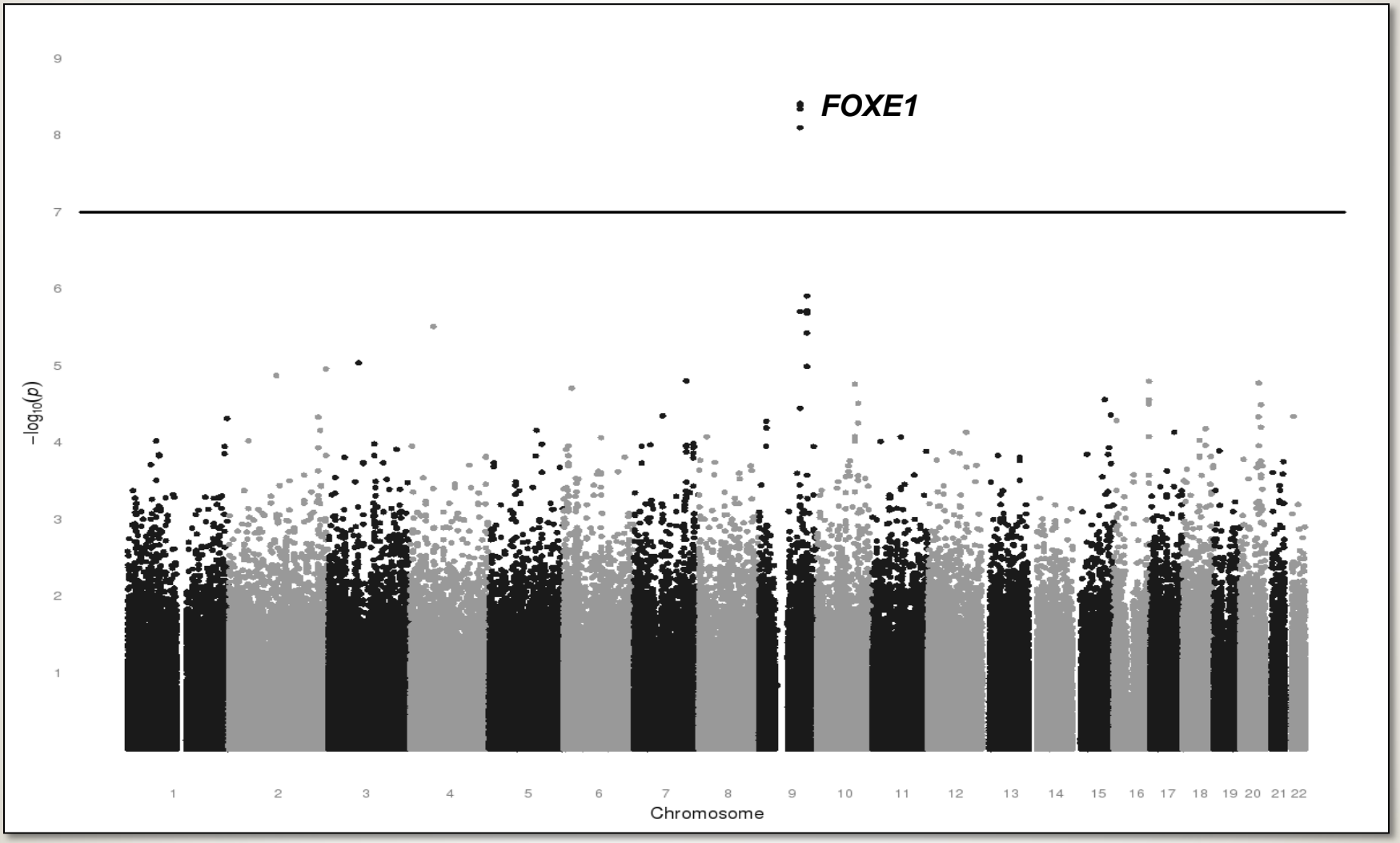
Hypothyroidism
Validation

Site	Case PPV (%)	Control PPV (%)
Group Health	98	100
Marshfield	91	100
Mayo Clinic	82	96
Northwestern	98	100
Vanderbilt	98	100
All sites (weighted)	92.4	98.5

Same algorithm, deployed at five sites

More examples of patients with secondary hypothyroidism without code evidence - only findable via more complex NLP not in algorithm

Hypothyroidism: "No-Genotyping" GWAS



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Denny et al., AJHG 2011

Sharing algorithms: PheKB.org

This is not just genetics!

PheKB a knowledgebase for discovering phenotypes from electronic medical records

Login | Register

Phenotypes | Implementations | Groups | Institutions

What is the Phenotype KnowledgeBase?

The reuse of data from electronic medical records (EMRs) and other clinical data systems holds tremendous promise for improving the efficiency and effectiveness of health research. Clinical data in the EMR is a potential source of rich longitudinal data for research, and the recent government efforts to promote the use of EMRs in the clinical setting may further pr… healthcare system. As… usable data from these…

One such effort by the… Network (eMERGE) ha… routine clinical care us… sufficient positive and… genome-wide associat… information (diagnoses, medications, laboratory tests) used to define phenotypes … language processing has also been shown to improve case identification rates.*

PheKB is an outgrowth of that validation effort and provides a collaborative enviro… phenotype algorithms. On this site you can:

- View existing algorithms
- Enter or create new algorithms
- Collaborate with others to create or review algorithms
- View implementation details for existing algorithms

Phenotype algorithms can be viewed by data modalities or methods used:

Most Recent Phenotypes

- White Blood Cell Indices
- Type II Diabetes Mellitus
- Red Blood Cell Indices
- Peripheral Arterial Disease

- eMERGE, PCORnet, NIH Collaboratory, PGRN, PGPop
- 381 active users, 48 institutions
- 21 publicly available phenotypes, 67 phenotypes in development
- There are 165 implementations
- social networking features; versioning; etc.
- Data dictionary and data set validation

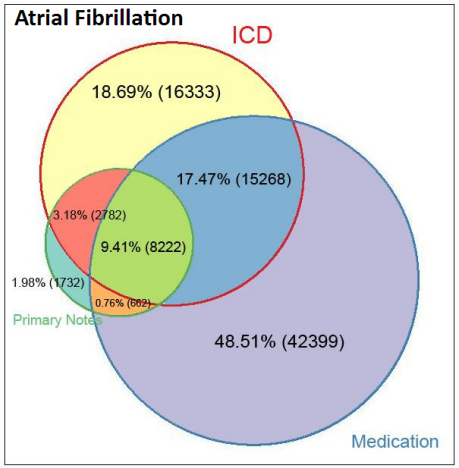
VAND

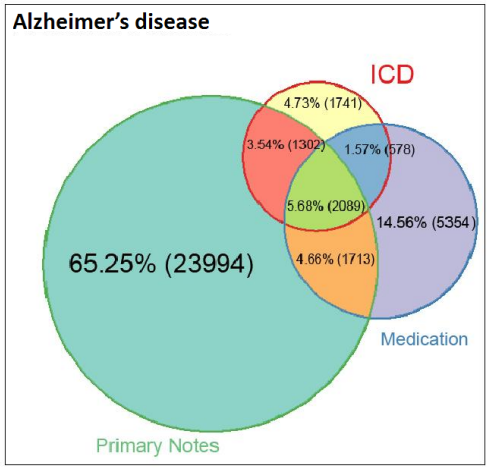
What EHR data do we need for research?

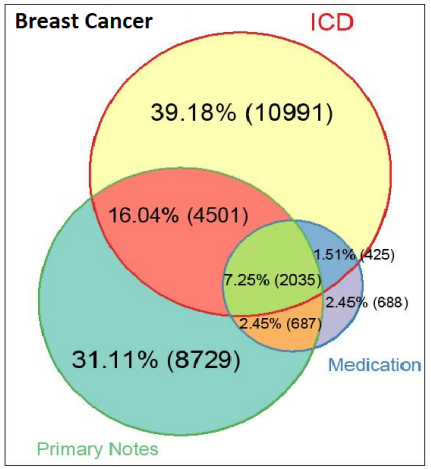
Evaluation of EHR data types used in 92 phenotypes posted on PheKB.org (median positive predictive value = 96%)

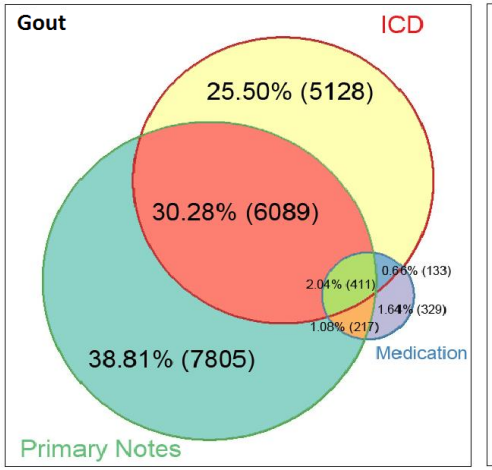
Data modalities or methods	Number of phenotypes utilizing these features		
	Public (N=30)	Non-Public (N=62)	Percent of Total
ICD-9 Codes	27	37	70%
Medications	25	32	62%
Natural Language Processing	21	21	46%
CPT Codes	14	24	41%
Laboratory/test results	14	21	38%

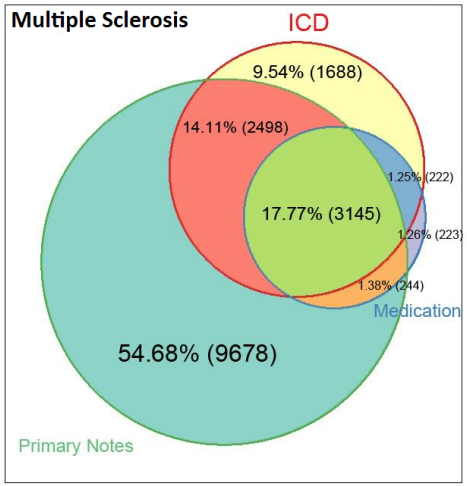
ICD, Meds, and (nonnegated) Text mentions identify different counts of possible cases for different diseases

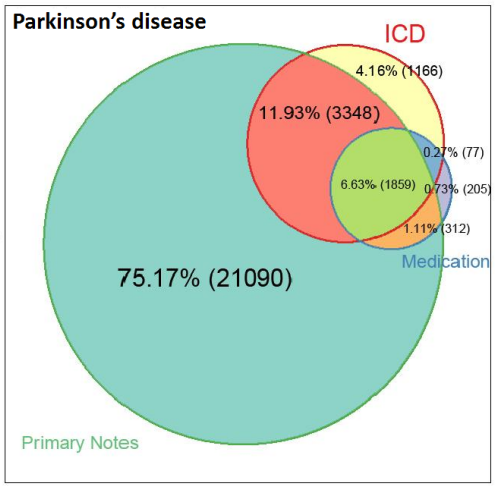


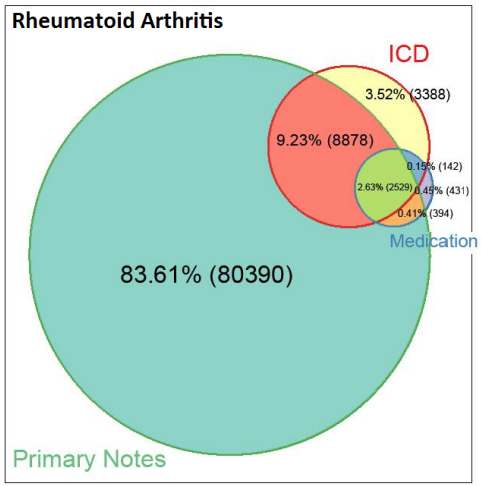


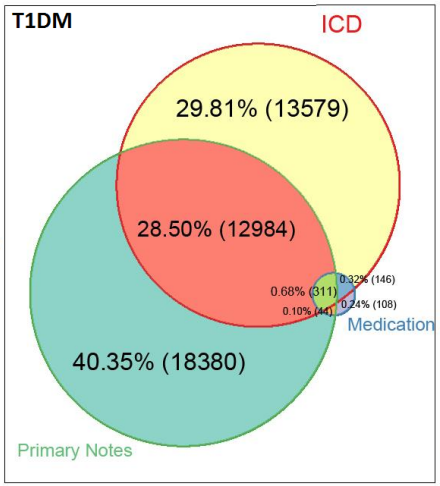












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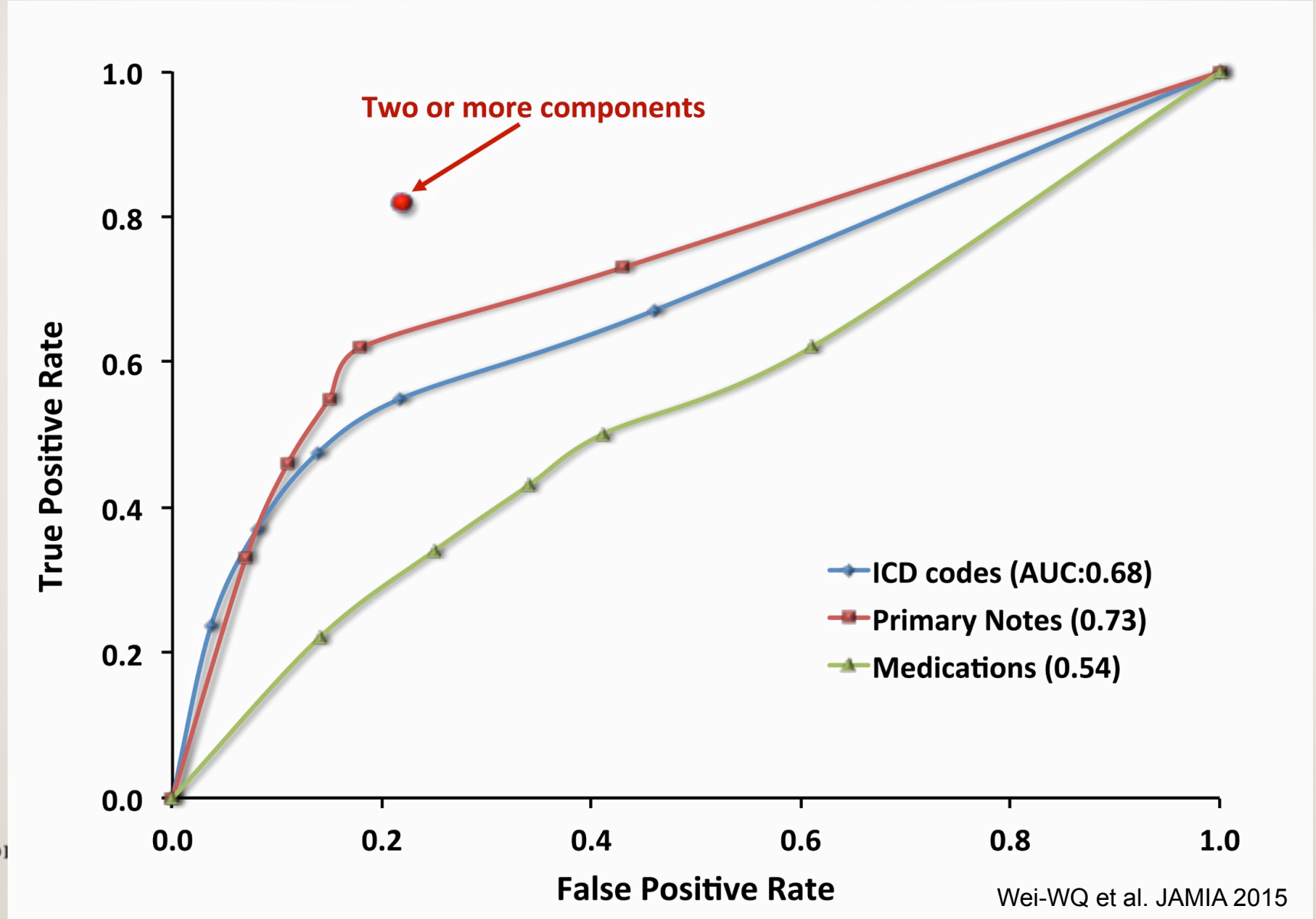
Wei-WQ et al. JAMIA 2015

ROC curves for ICD-9, primary notes, and specific medications for 10 diseases (1750 reviewed charts)

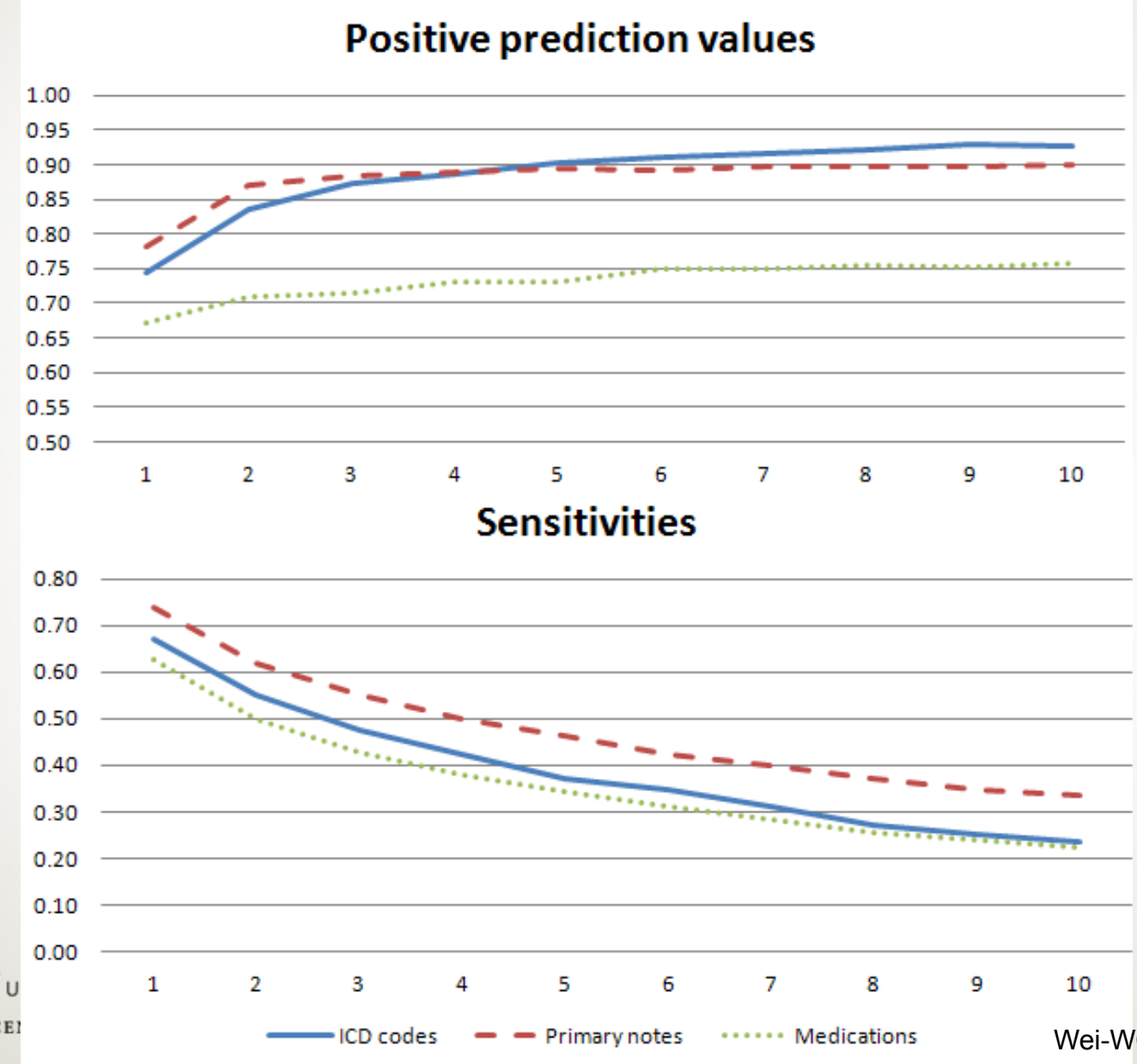


Wei-WQ et al. JAMIA 2015

How to find cases: general maxims

- ICD9s (and CPT) very useful but not sufficient
  - nearly all algorithms use them
  - good for sensitivity but not necessarily PPV
- Labs
- Meds – marker of disease and severity – not usually that helpful by itelf
- NLP – often confirmatory and refining, unless dealing with rare diseases

PPV and sensitivity over 10 diseases by counts of occurrence



Wei-WQ et al. JAMIA 2015

Completed eMERGE GWAS

All of these are on PheKB and will eventually be public

Diseases

- **Dementia**
- **Cataracts**
- **Autoimmune Hypothyroidism**
- Diverticulosis/**diverticulitis**
- **Type 2 Diabetes**
- Diabetic retinopathy
- **Herpes zoster**
- **PheWAS**
- Peripheral Arterial Disease
- Venous Thromboembolism
- Glaucoma
- Ocular hypertension
- Abdominal Aortic Aneurysm
- Colon polyps

Endophenotypes

- **PR Duration**
- **QRS Duration**
- **HDL/LDL**
- **height**
- **white blood cell counts**
- **red blood cell counts**
- Cardiorespiratory Fitness
- **ESR levels**
- **Platelet levels**

Selected consortia contributions

- **Height**
- **QTc**
- **Rheum. Arthritis**
- **Myocardial Infarction Genetics Consortium**
- **Intl. Mult Sclerosis Genet. Consort.**
- **Genomic Investigation of Statin Therapy**

Pharmacogenomic phenotypes

- **ACE inhibitor cough**
- **Heparin induced thrombocytopenia**
- Resistant hypertension
- Drug Induced Liver Injury
- *C. difficile* colitis

bold=GWAS completed with significant results

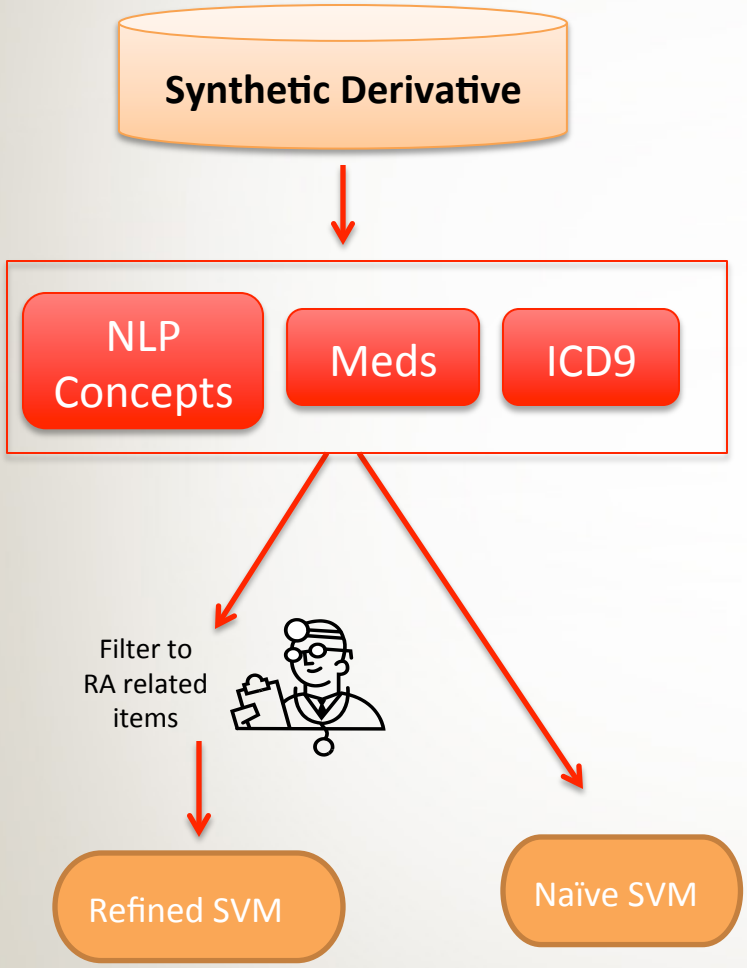
Are algorithms portable, part II: Rheumatoid Arthritis

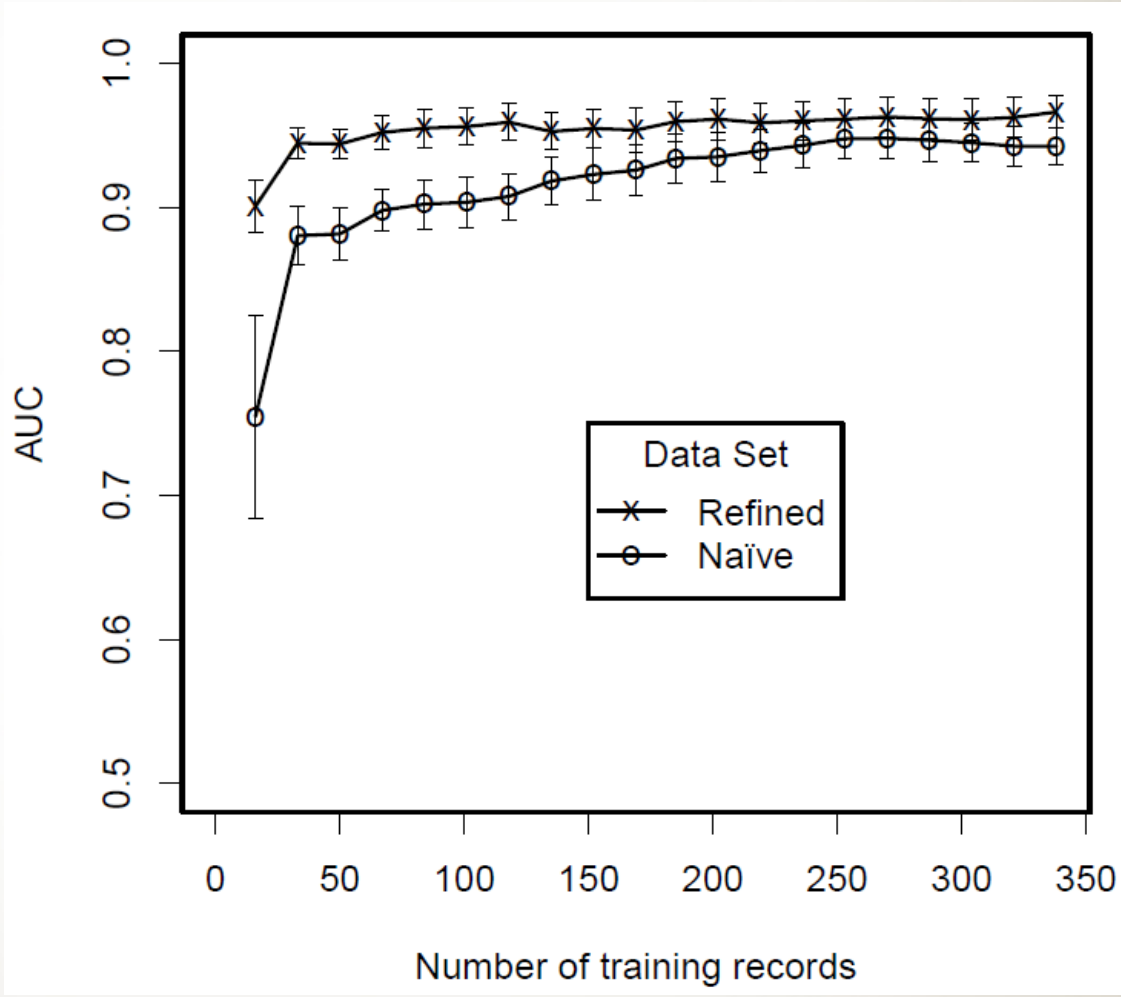
- Previously published logistic regression model
  - Developed at Partners Healthcare
  - ICD9, Labs, Meds, NLP
  - Tested at Northwestern and Vanderbilt
- Is the signature the same across
  - Differing healthcare **environments** and **EHR systems**?
  - **Differing NLP systems** (regular expression vs. out-of-the-bag KnowledgeMap)?

Site	n	PPV	Sensitivity	AUC
Original (Partners)	400	94%	63%	95%
Northwestern	390	87%	60%	92%
Vanderbilt	376	95%	57%	95%

Liao et al. Arth Care Res 2010
Carroll et al. JAMIA 2012

Using Machine Learning for Phenotyping





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Carroll et al, AMIA 2011

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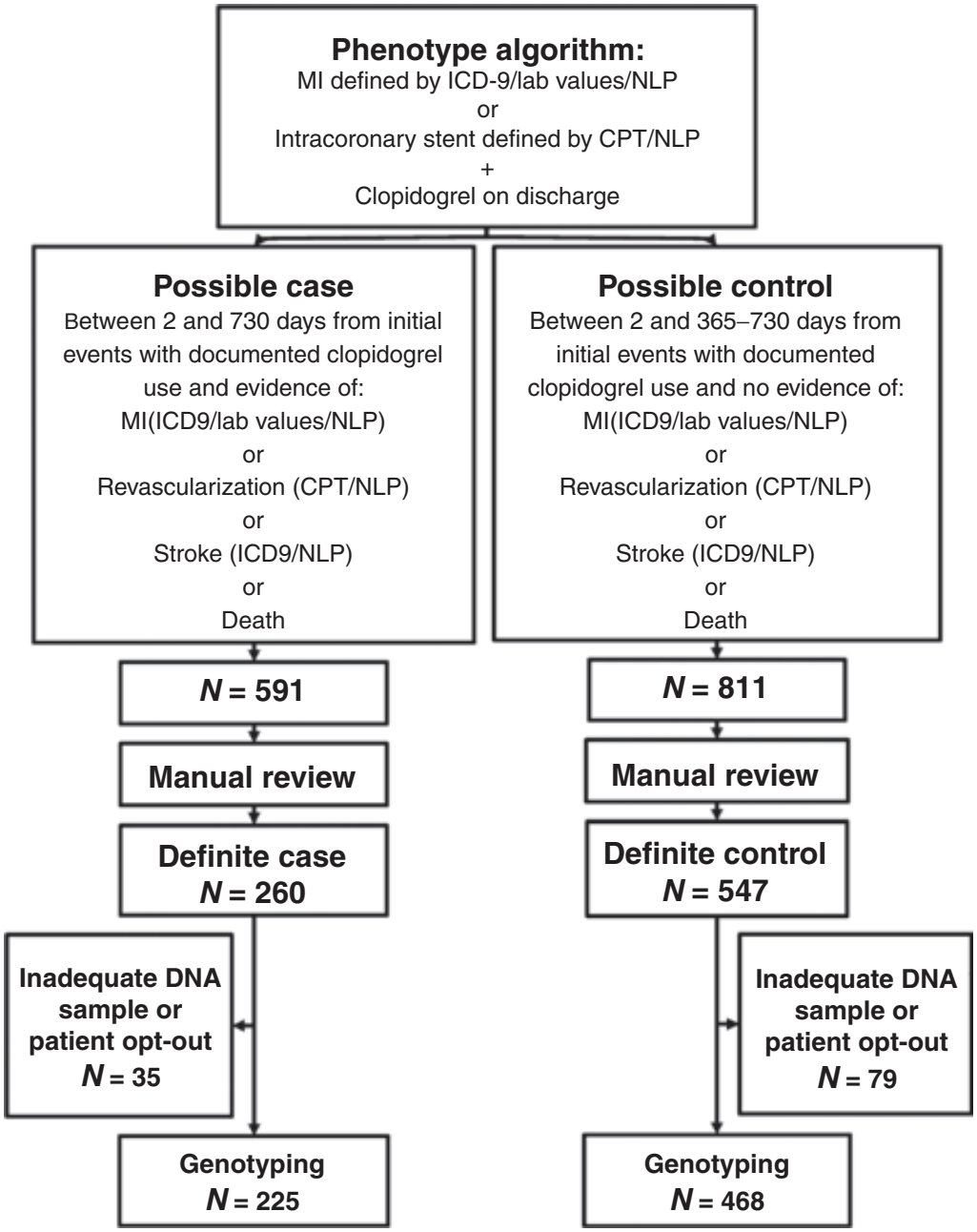

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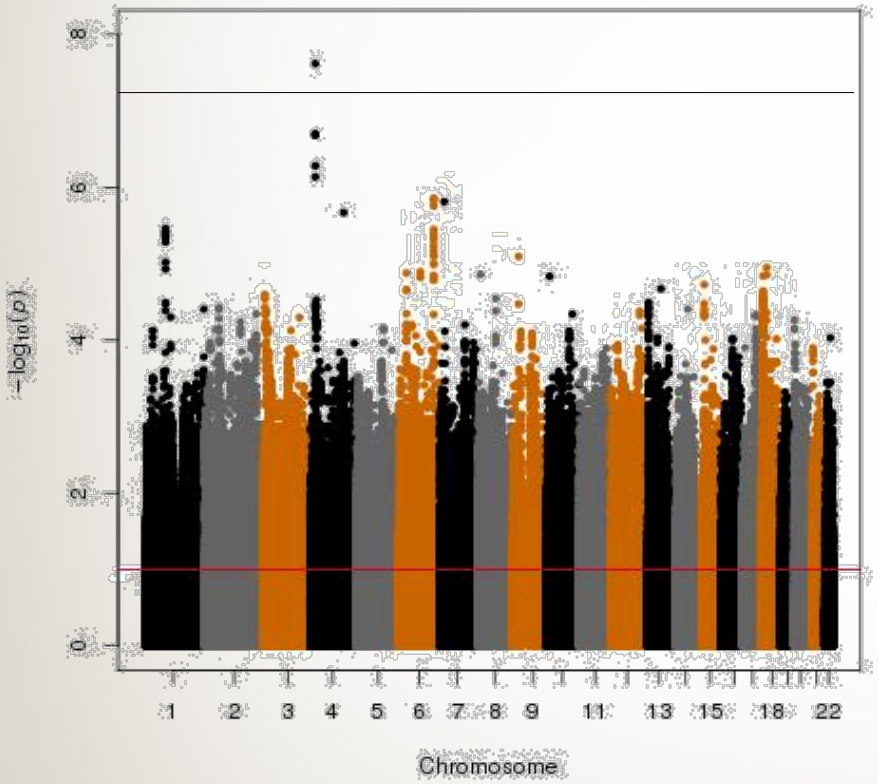
arm Ther. 2012

GWAS of ACEI-cough (no prior GWAS)

ACEI-cough
(NLP of allergy sections)



eMERGE phenotype – document ACEI cough allergies in the EMR

Our GWAS:
OR=1.3 [95%CI: 1.2-1.4]

eMERGE replication (same algorithm):
OR=1.32 [1.01-1.70]

European replication – people changed from ACEI to an ARB (reason unknown)

European replication
OR=1.15 [1.01-1.30]

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Mosley et al. TPJ 2014

Part 3 – Using NLP to assess and improve Medical Education

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
  - Patient case mix
  - Topics taught
  - Response to certain trans-course "hot topics" over time – women's health, substance abuse, etc.

Traditional Medical Curriculum


Anatomy

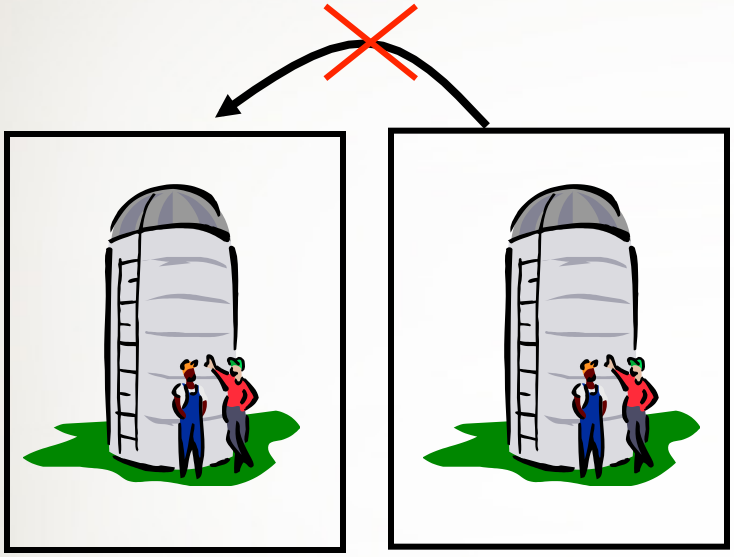

Physiology


Histology


Microbiology

…etc

Traditional Medical Education Model



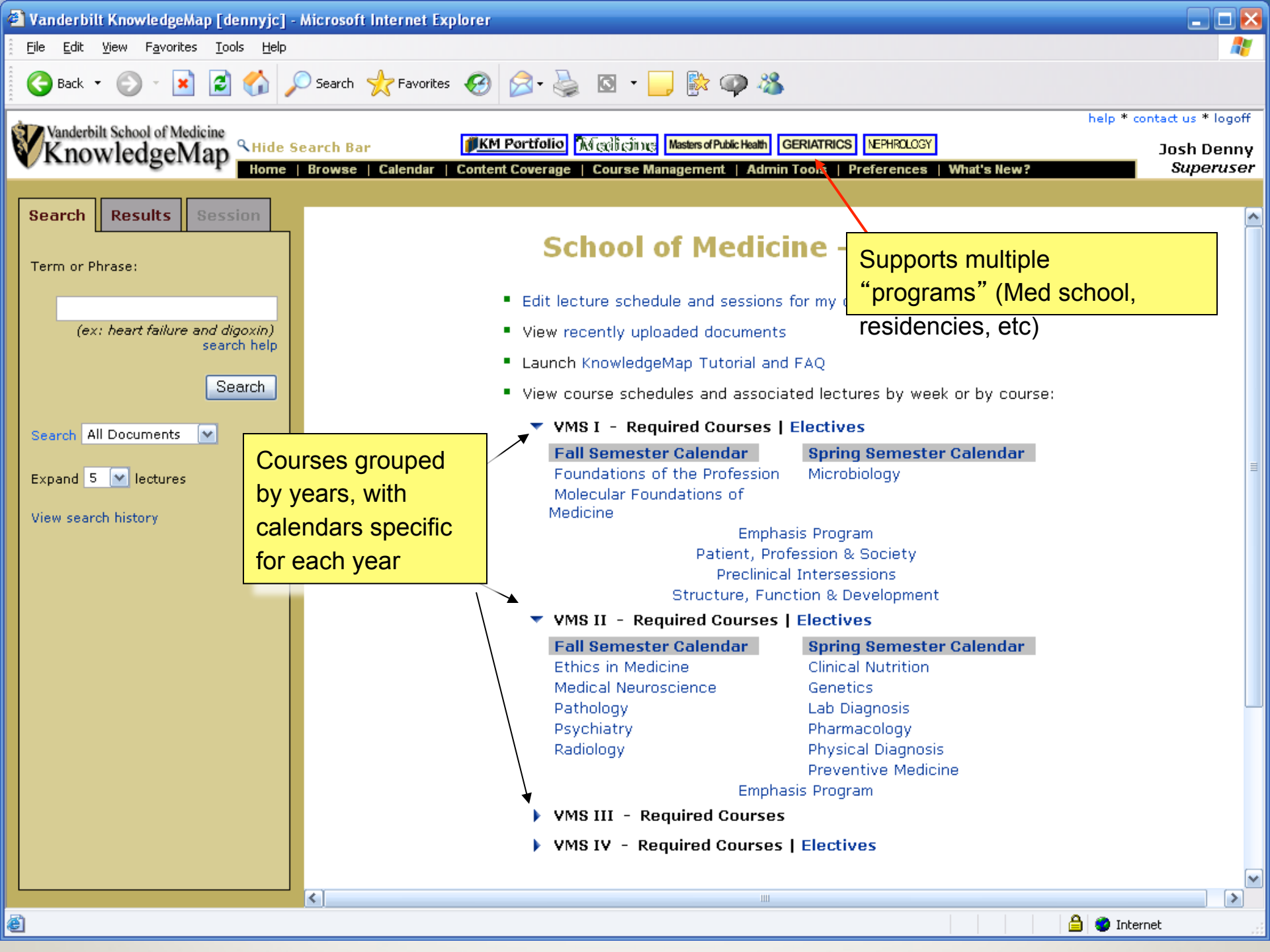
First year Second year

Clinical education

Patients

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?


Vanderbilt KnowledgeMap [dennyjc] - Microsoft Internet Explorer
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Hide Search Bar
help * contact us * logoff
KM Portfolio Medicine Masters of Public Health GERIATRICS NEPHROLOGY
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Home | Browse | Calendar | Content Coverage | Course Management | Admin Tools | Preferences | What's New?
Search Results Session
Term or Phrase:
(ex: heart failure and digoxin)
search help
Search
Search All Documents
Expand 5 lectures
View search history
School of Medicine -
Supports multiple "programs" (Med school, residencies, etc)
Edit lecture schedule and sessions for my
View recently uploaded documents
Launch KnowledgeMap Tutorial and FAQ
View course schedules and associated lectures by week or by course:
Courses grouped by years, with calendars specific for each year
VMS I - Required Courses | Electives
Fall Semester Calendar
Foundations of the Profession
Molecular Foundations of Medicine
Spring Semester Calendar
Microbiology
Emphasis Program
Patient, Profession & Society
Preclinical Intersessions
Structure, Function & Development
VMS II - Required Courses | Electives
Fall Semester Calendar
Ethics in Medicine
Medical Neuroscience
Pathology
Psychiatry
Radiology
Spring Semester Calendar
Clinical Nutrition
Genetics
Lab Diagnosis
Pharmacology
Physical Diagnosis
Preventive Medicine
Emphasis Program
VMS III - Required Courses
VMS IV - Required Courses | Electives
Internet

2007/2008 Structure, Function & Development Schedule

[View previous year]

[edit course sessions | edit links/divisions]

Course Links[edit]: Gross Anatomy sessions | Cell Biology sessions

Labels: Exam or Quiz | Physiology | Gross Anatomy | Cell Biology

Unit #1

Date	Time	Location	Title	Lecturer	Document(s)
10/25	08:00 AM - 08:30 AM	LH 202	Introduction	Arthur F Dalley	
10/25	08:30 AM - 10:30 AM	LH 202	Introduction to Anatomical Donations Program and In-Lab Memorial svc. Intro to Gross Anatomy Lab, Safety and Techology	Arthur F Dalley	
10/25	10:30 AM - 12:00 PM	LH 202	Layered & Segmented Structure of body; Intro to Nerves & Nerve Clasification; Simple Spinal n.	Arthur F Dalley	
10/25	01:00 PM - 02:00 PM	LH 202	(Embryo) Neuromuscular Development 1	Lillian B Nanney	
10/25	02:00 PM - 05:00 PM	IIS 10th Floor	GA Lab: Removal of Skin and Subcutaneious Tissue of Back; Superficial Muscles of the Back and Canial Nerve XI	Arthur F Dalley	
10/26	08:00 AM - 09:00 AM	LH 202	(Embryo) Neuromuscular Development 2	Lillian B Nanney	
10/26	09:00 AM - 10:00 AM	LH 202	Types of Muscle Action and Movements; Freely Moveable Joints	John S Halle	
10/26	10:00 AM - 12:00 PM	IIS 10th Floor	GA Lab: Scapular Region	Arthur F Dalley	
10/29	08:00 AM - 09:00 AM	LH 202	Vertebral Column; Postural Muscles; Spinal Cord and Its Environment	Arthur F Dalley	
10/29	09:00 AM - 10:00 AM	LH 202	Neuromuscular Phys # 1: Membrane Transport; Fluid Compartments; Osmosis	Al George	
10/29	01:00 PM - 02:00 PM	IIS 10th Floor	GA Lab: Deep Back (Perform Laminectomy)	Arthur F Dalley	
10/30	08:00 AM - 09:00 AM	LH 202	Overview of Lymphatic System; Principles of Collateral Circulation	Lillian B Nanney	
10/30	09:00 AM - 11:00 AM	IIS 10th Floor	GA Lab: Complete Dissection of Deep Back; Pectoral Region, Including Removal of Skin from Arm (Excluding Female Breast)	Arthur F Dalley	

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Search | Results | Session

Organization of Eukaryotic Cells
Cathleen C Pettepher, PhD
08/20, 01:00 PM-02:00 PM, LH

Documents

Organization of Eukaryotic Cells (handout) | PDF | Show CUIs
(Lecture Handout)

Organization of Eukaryotic Cells (ppt) | PDF | PDF (b&w) | Show | Show CUIs
(Slides)

Organization of Eukaryotic Cells (pdf) | PDF | Show CUIs
(Slides)

Session Navigation:
◂ Previous | Next ▸

Molecular Foundations of Medicine Schedule

1 **Organization of Eucaryotic Cells**
- Cathleen Pettepher, Ph.D.
- Molecular Foundations of Medicine
- August 20, 2007

2 **Objectives**
- Get general idea of cell organization
  - Describe the major cellular components
- Understand what changes in organelles tell you about dynamics of cells

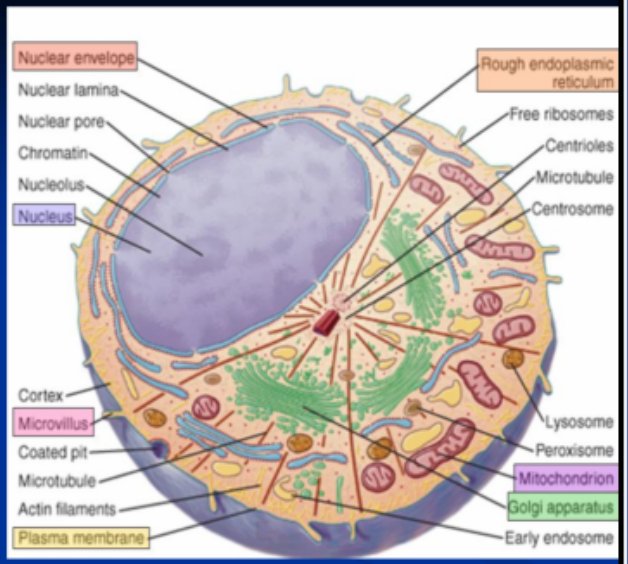
3 **Common Ancestor for all Living Organisms**

4 **Shared Mechanisms of Biological Function**
- Share a common genetic code and store the information in the form of DNA
- nformation from NA to proteins roteins to eactions wn sugars and

Objectives

Get general idea of cell organization
- Describe the major cellular components

Understand what changes in organelles tell you about dynamics of cells



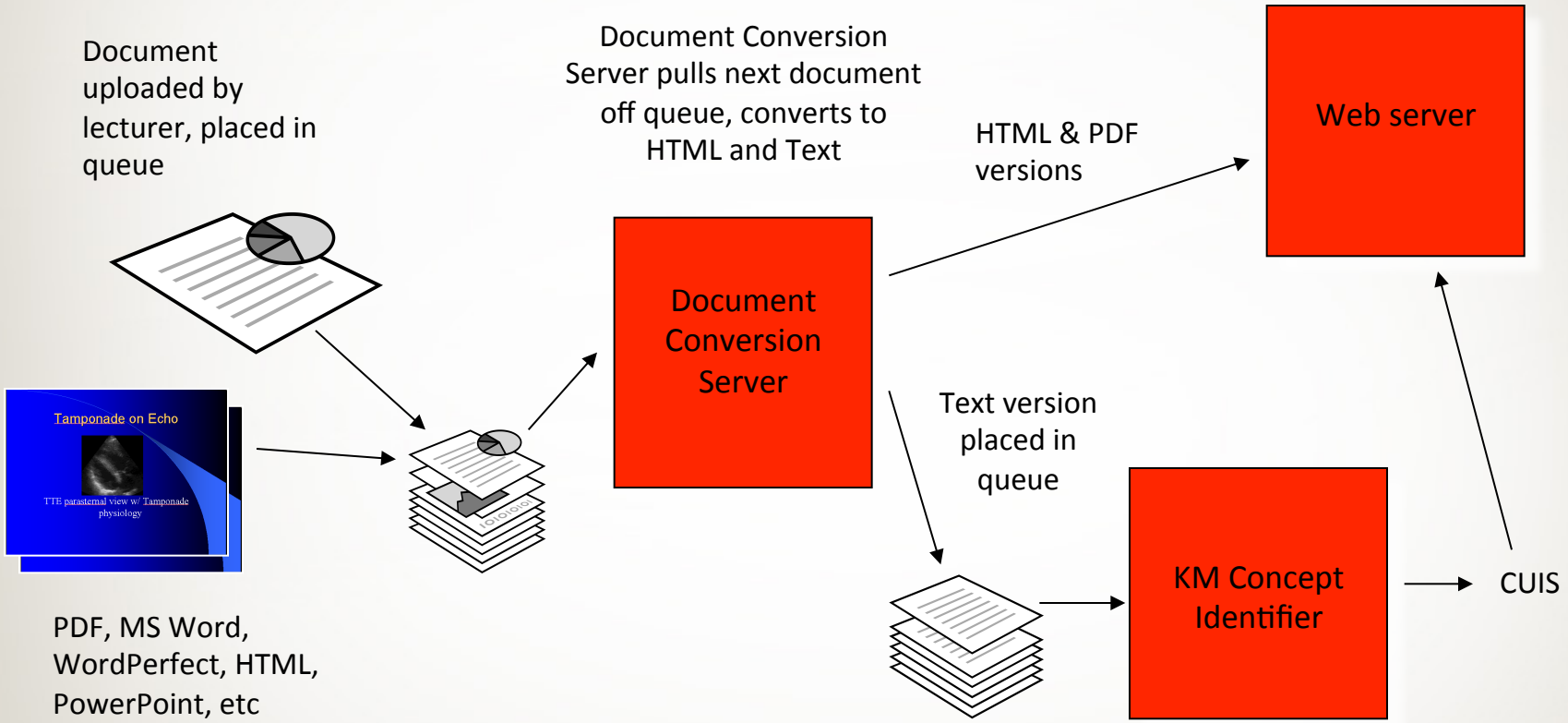
Develop global perspective on cell organelles
Structure: molecular organization and appearance
How structure relates to function

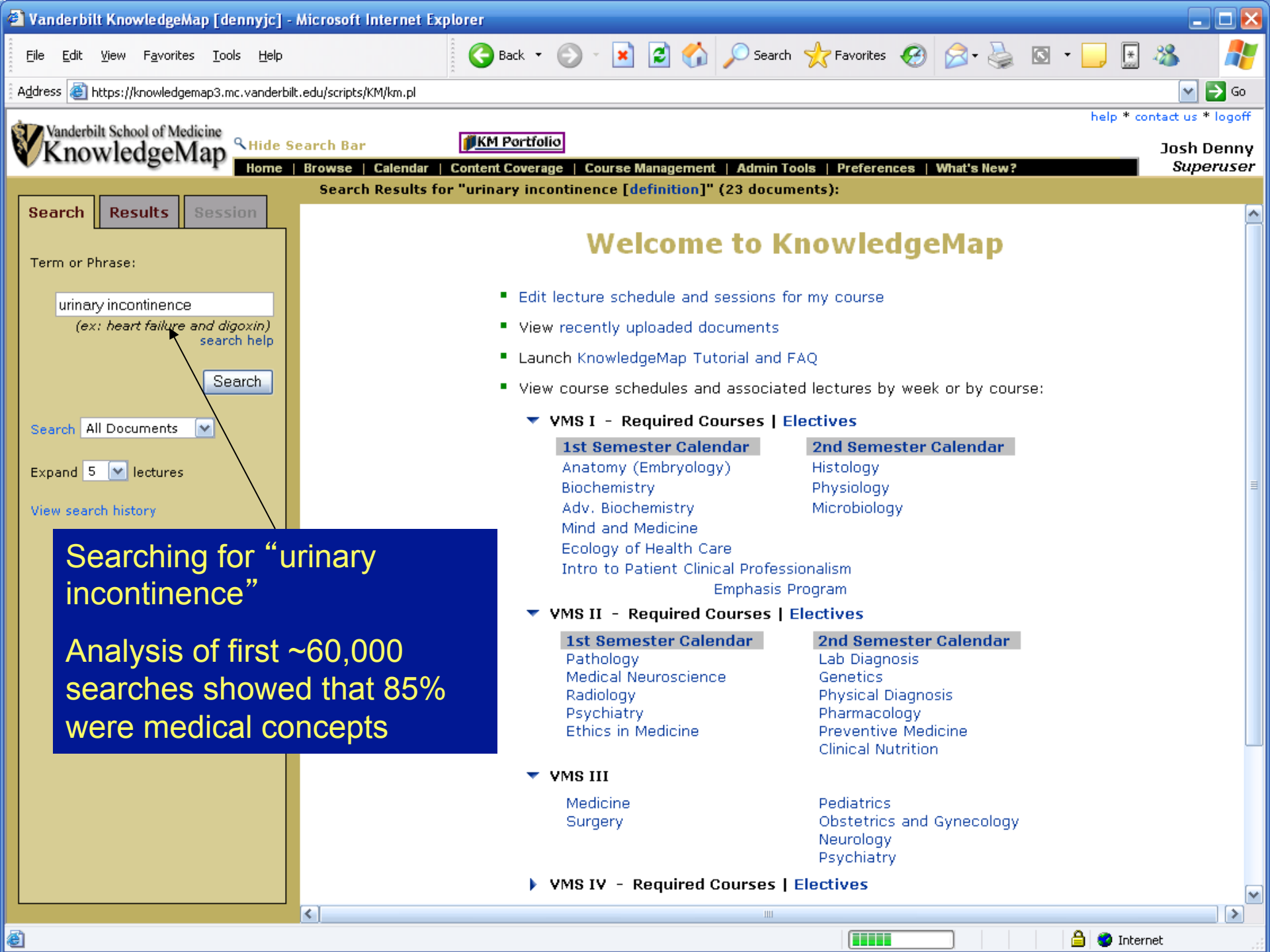
Faculty upload native formats (e.g., PowerPoint) and KM creates other formats automatically

Notes | Slide 2 of 41 | Slide Show

Internet

Document Processing

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Search Results for "urinary incontinence [definition]" (23 documents):
Search
Results
Session
Term or Phrase:
urinary incontinence
(ex: heart failure and digoxin)
search help
Search
Search All Documents
Expand 5 lectures
View search history
Searching for "urinary incontinence"
Analysis of first ~60,000 searches showed that 85% were medical concepts
Welcome to KnowledgeMap
Edit lecture schedule and sessions for my course
View recently uploaded documents
Launch KnowledgeMap Tutorial and FAQ
View course schedules and associated lectures by week or by course:
VMS I - Required Courses | Electives
1st Semester Calendar
Anatomy (Embryology)
Biochemistry
Adv. Biochemistry
Mind and Medicine
Ecology of Health Care
Intro to Patient Clinical Professionalism
Emphasis Program
2nd Semester Calendar
Histology
Physiology
Microbiology
VMS II - Required Courses | Electives
1st Semester Calendar
Pathology
Medical Neuroscience
Radiology
Psychiatry
Ethics in Medicine
2nd Semester Calendar
Lab Diagnosis
Genetics
Physical Diagnosis
Pharmacology
Preventive Medicine
Clinical Nutrition
VMS III
Medicine
Surgery
Pediatrics
Obstetrics and Gynecology
Neurology
Psychiatry
VMS IV - Required Courses | Electives
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Search Results for "urinary incontinence [definition]" (23 documents):

Search | Results | Session

Term or Phrase:

urinary incontinence

(ex: heart failure and digoxin)
search help

Search

Search All Documents

Expand 5 lectures

View search history

Documents containing the concept "urinary incontinence"

VMS I

- Biochemistry (1 document)
- Gross Anatomy (3 documents)
- Microbiology (1 document)

VMS II

- Lab Diagnosis (3 documents)
- Medical Neuroscience (2 documents)
  - Normal Pressure Hydrocephalus [first hit] 4 hits
  - 1 more...
- Pathology (1 document)
- Pharmacology (4 documents)
- Physical Diagnosis (1 document)

VMS III

- Pediatrics (1 document)
- Psychiatry (1 document)
- Surgery (1 document)
  - Urology: PSA; scrotal pain; urinary complaints [first hit] Harriette Scarpero 3 hits

VMS IV

- Emergency Medicine (2 documents)
  - Neurologic Emergencies [first hit] Susan Marlow 2 hits
  - 1 more...

Done

Internet

Return to Results for "urinary incontinence"

Slide #92: "Urinary Incontinence "

Stress incontinence

Urge incontinence

Mixed incontinence

KM shows one of lectures that mention "urinary incontinence"

Slide #93: "Incontinence "

The involuntary loss of urine

Stress incontinence (SUI)- occurs with increases in intraabdominal pressure
Urge incontinence (UUI)- leakage that is preceded by an intense uncontrollable urge to void
Mixed incontinence- both SUI and UUI

Slide #94: "Components of a Thorough Evaluation "

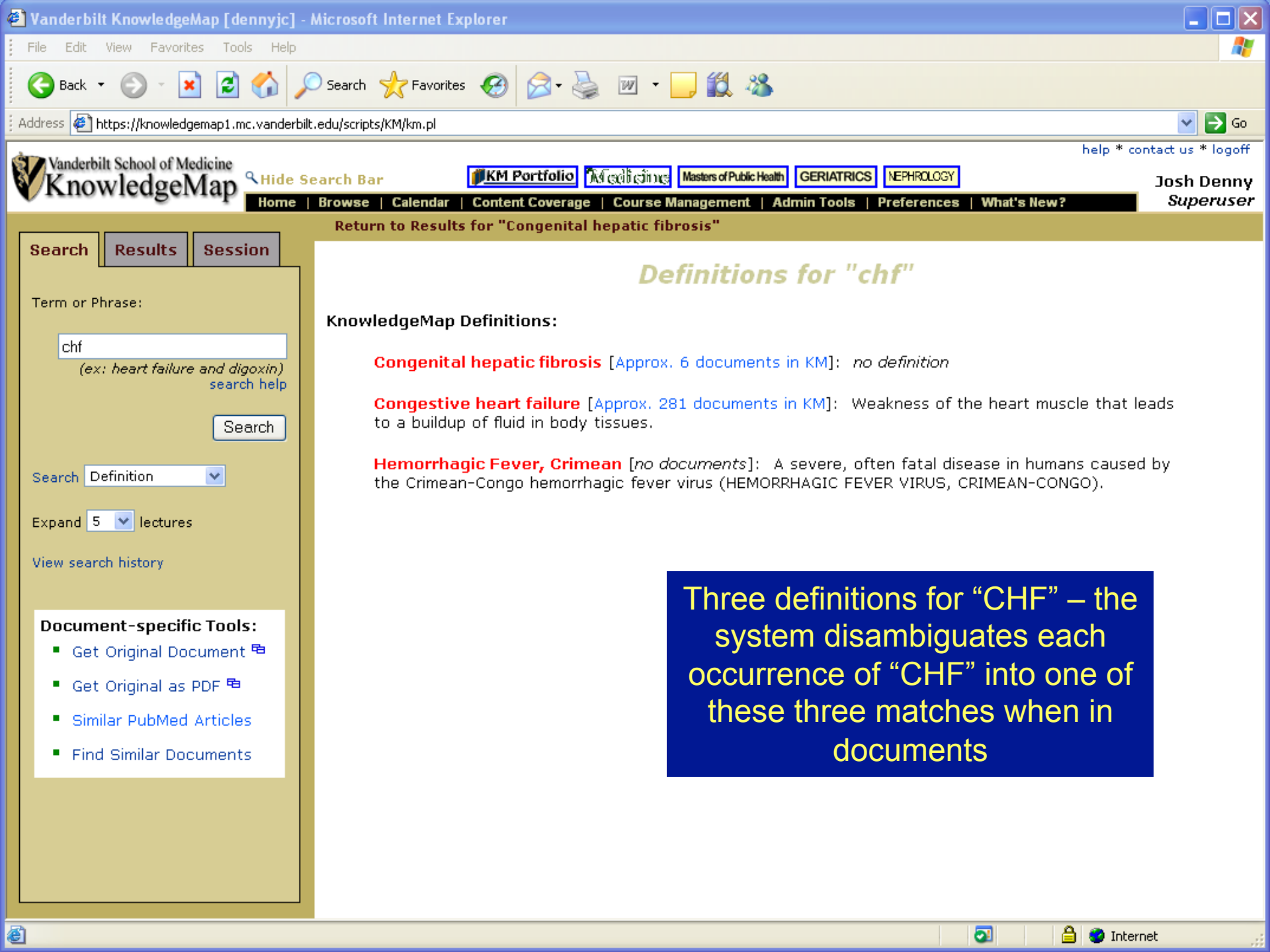
Detailed history*

Questionnaire*

Physical examination*

Other testing: UA, voiding diaries*, pad test*, uroflow, postvoid residual (PVR), urodynamics*

* Recommended minimal standards for pretx eval by AUA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Return to Results for "Congenital hepatic fibrosis"
Search
Results
Session
Term or Phrase:
chf
(ex: heart failure and digoxin)
search help
Search
Search Definition
Expand 5 lectures
View search history
Document-specific Tools:
Get Original Document
Get Original as PDF
Similar PubMed Articles
Find Similar Documents
Definitions for "chf"
KnowledgeMap Definitions:
Congenital hepatic fibrosis [Approx. 6 documents in KM]: no definition
Congestive heart failure [Approx. 281 documents in KM]: Weakness of the heart muscle that leads to a buildup of fluid in body tissues.
Hemorrhagic Fever, Crimean [no documents]: A severe, often fatal disease in humans caused by the Crimean-Congo hemorrhagic fever virus (HEMORRHAGIC FEVER VIRUS, CRIMEAN-CONGO).
Three definitions for “CHF” – the system disambiguates each occurrence of “CHF” into one of these three matches when in documents
Internet

Search | Results | Session

Term or Phrase:

chf

(ex: heart failure and digoxin)
search help

Search

Search Definition

Expand 5 lectures

View search history

Document-specific Tools:

- Get Original Document
- Get Original as PDF
- Similar PubMed Articles
- Find Similar Documents

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

CONGESTIVE HEART FAILURE

Heart failure exists when the heart does not provi
This state causes congestion of the tissues, leading

It produces the clinical syndrome of dyspnea, per
an abnormality of myocardial function is responsible for the failure of the heart to pump at a rate commensurate with the requirements of metabolizing tissues. CHF is encountered frequently by the clinician; it accounts for 2? of all hospital admissions and carries a 5-year survival rate of <50?.

I. CAUSES OF CONGESTIVE HEART FAILURE

A. Myocardial Disease (pump defect)

1. Coronary heart disease-- myocardium is impaired by ischemia
2. Cardiomyopathy-- intrinsic myocardial defect
3. Infiltrative diseases:

amyloidosis
sarcoidosis
myocarditis

B. Excessive Workload due to:

1. Increased resistance to ejection which can be due to pressure overload, hypertension, aortic or pulmonary stenosis, or hypertrophic cardiomyopathy.
2. Increased stroke volume; volume overload which can be due to aortic, mitral or tricuspid insufficiency or congenital left-to-right shunts.
3. Increased body demands (high output failure); can occur with thyrotoxicosis, anemia, pregnancy, or arteriovenous fistulas (abnormal shunt between an artery and vein which increases venous return and decreases oxygen to shunted area)

Infantile Polycystic Kidney Disease
(Autosomal Recessive Polycystic Kidney Disease, ARPKD)

I. General and clinical features:

A. Incidence and relationship to **congenital hepatic fibrosis**: Infantile polycystic kidney disease is closely associated with **congenital hepatic fibrosis** (**CHF**). **CHF** is an important cause of portal hypertension in children and adolescents. In general, in patients who present as neonates and infants, the clinical picture is dominated by renal failure. Patients who present later tend to have liver problems as the major clinical feature. Although at one time thought to represent distinct disorders, different affected members in the same family may present at different ages with either predominant renal or liver abnormalities, attesting to the underlying genetic relationship of these diseases.

Infantile polycystic kidney disease is inherited in an autosomal recessive manner (i.e., parents are not affected), with the reported incidence varying from 1:6000 to 1:40,000.

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

B. Clinical presentation: Can present at any ... n at or shortly after birth.

Can be suspected during prenatal ultras ... ia secondary to associated oligohydramnios.

Presentation shortly after birth can be d... Presentation later in infancy can be due to de... polyuria and dehydration (especially during intercurrent illness).

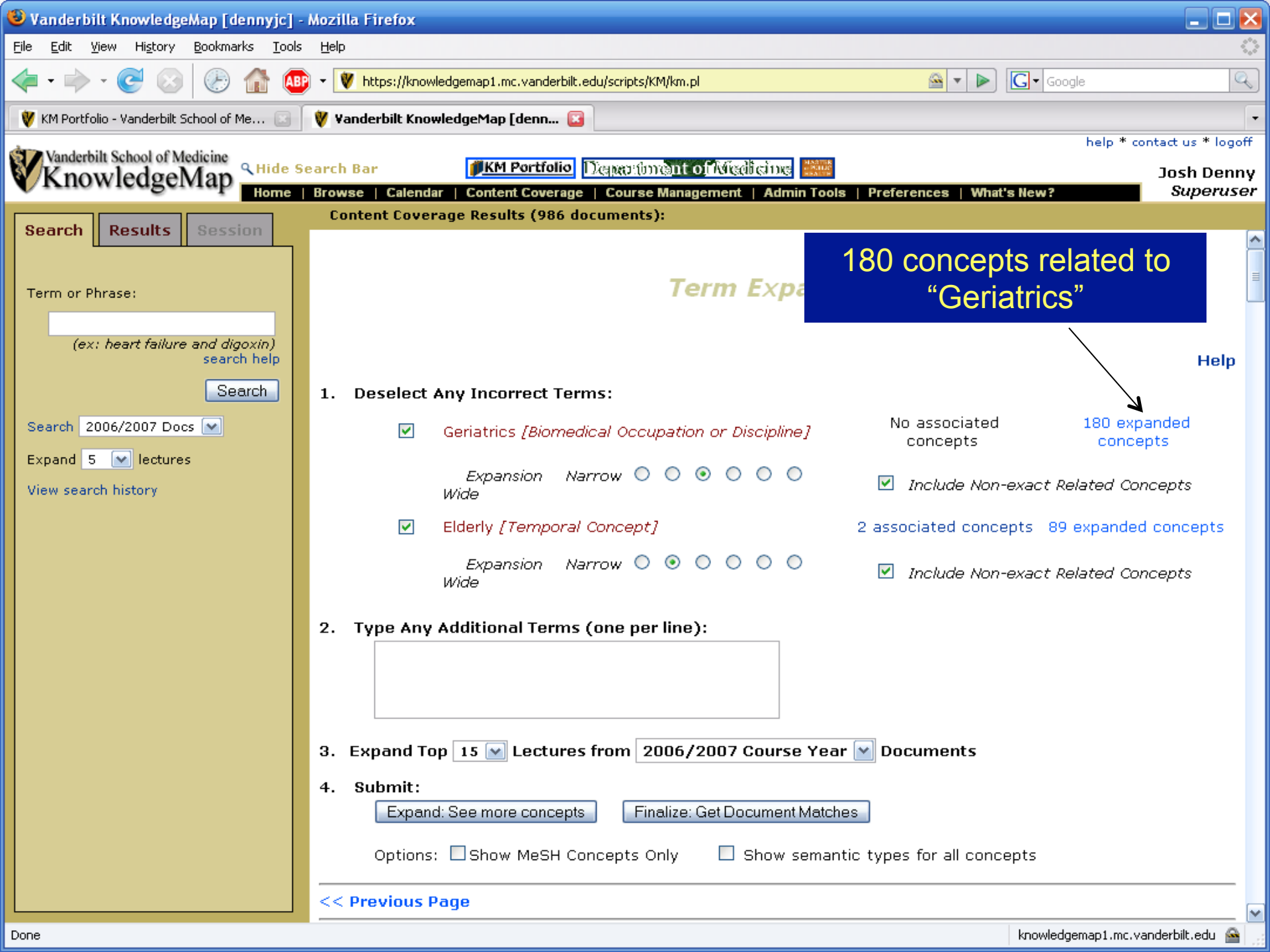
The kidneys may be sufficiently enlarged to result in a palpable mass. Deteriorating renal function is inevitable, and patients may present later with renal failure/uremia/hypertension.

As implied above, patients presenting in later childhood and early adulthood usually present with signs of liver involvement, particularly portal hypertension, which may result in hepatosplenomegaly and bleeding esophageal varices.

II. Pathogenesis:

Recent data has mapped a gene for ARPKD to the short arm of chromosome 6. The specific gene has not been identified/

How do we find broad concepts like “geriatrics” or “women’s health”?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Search
Results
Session
Term or Phrase:
(ex: heart failure and digoxin)
search help
Search
Search 2006/2007 Docs
Expand 5 lectures
View search history
Content Coverage Results (986 documents):
180 concepts related to "Geriatrics"
Help
1. Deselect Any Incorrect Terms:
Geriatrics [Biomedical Occupation or Discipline]
No associated concepts
180 expanded concepts
Expansion Narrow Wide
Include Non-exact Related Concepts
Elderly [Temporal Concept]
2 associated concepts
89 expanded concepts
Expansion Narrow Wide
Include Non-exact Related Concepts
2. Type Any Additional Terms (one per line):
3. Expand Top 15 Lectures from 2006/2007 Course Year Documents
4. Submit:
Expand: See more concepts
Finalize: Get Document Matches
Options: Show MeSH Concepts Only
Show semantic types for all concepts
<< Previous Page
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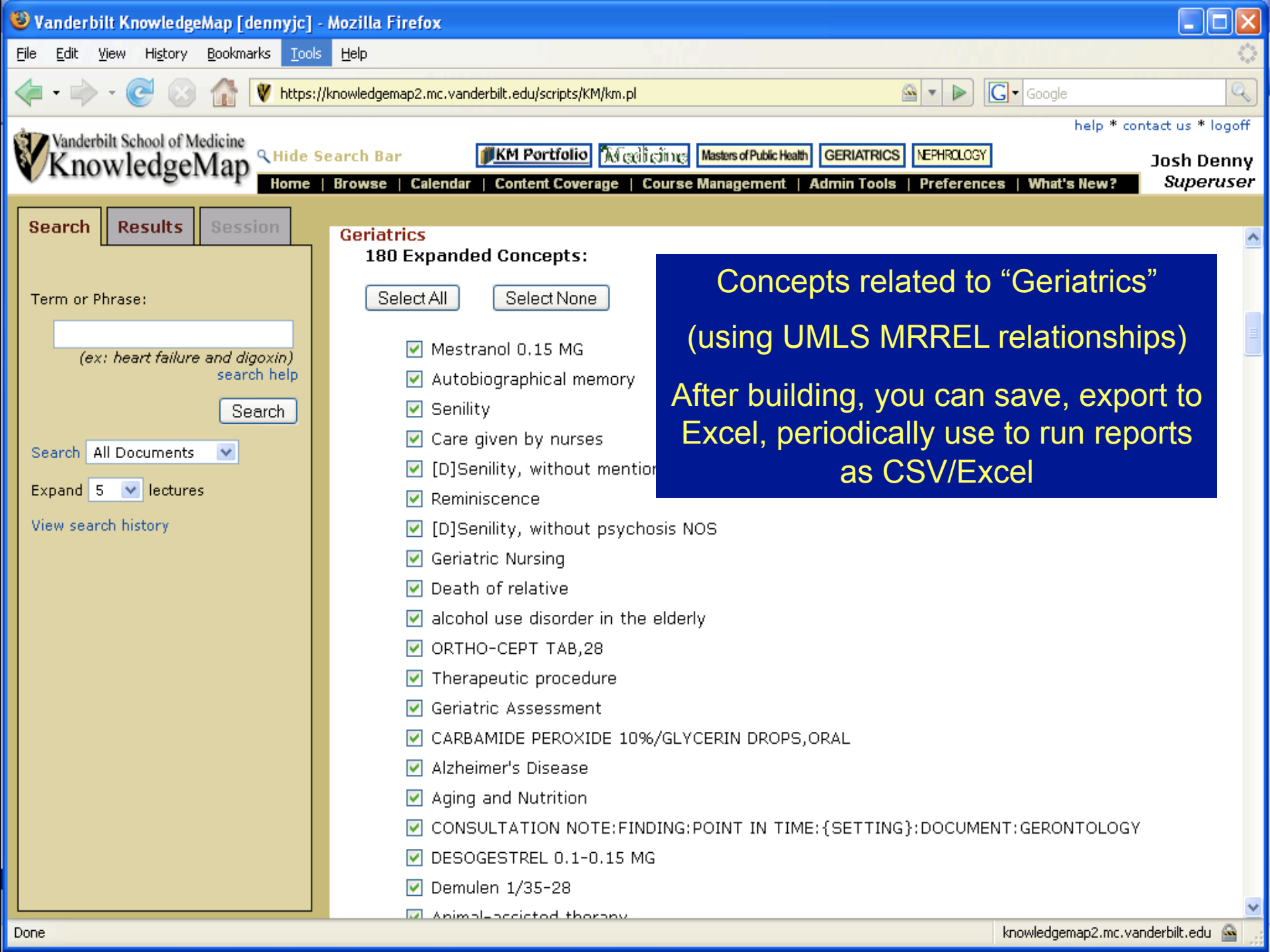
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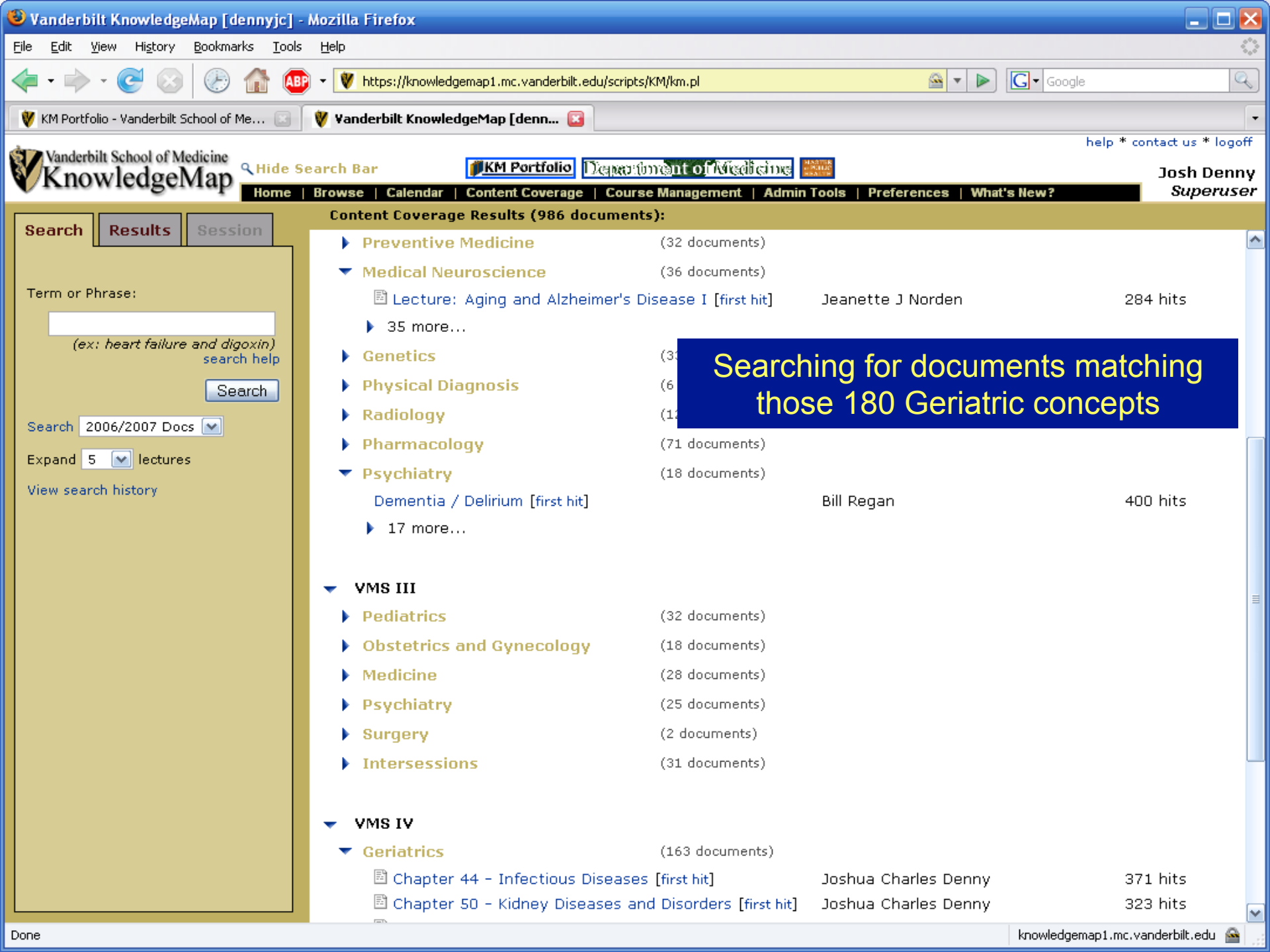
Results
Session
Term or Phrase:
(ex: heart failure and digoxin)
search help
Search
Search All Documents
Expand 5 lectures
View search history
Geriatrics
180 Expanded Concepts:
Select All
Select None
Concepts related to “Geriatrics”
(using UMLS MRREL relationships)
After building, you can save, export to Excel, periodically use to run reports as CSV/Excel
Mestranol 0.15 MG
Autobiographical memory
Senility
Care given by nurses
[D]Senility, without mention
Reminiscence
[D]Senility, without psychosis NOS
Geriatric Nursing
Death of relative
alcohol use disorder in the elderly
ORTHO-CEPT TAB,28
Therapeutic procedure
Geriatric Assessment
CARBAMIDE PEROXIDE 10%/GLYCERIN DROPS,ORAL
Alzheimer's Disease
Aging and Nutrition
CONSULTATION NOTE:FINDING:POINT IN TIME:{SETTING}:DOCUMENT:GERONTOLOGY
DESOGESTREL 0.1-0.15 MG
Demulen 1/35-28
Done
knowledgemap2.mc.vanderbilt.edu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Session
Term or Phrase:
(ex: heart failure and digoxin)
search help
Search
Search 2006/2007 Docs
Expand 5 lectures
View search history
Content Coverage Results (986 documents):
Preventive Medicine (32 documents)
Medical Neuroscience (36 documents)
Lecture: Aging and Alzheimer's Disease I [first hit] Jeanette J Norden 284 hits
35 more...
Genetics
Physical Diagnosis
Radiology
Pharmacology (71 documents)
Psychiatry (18 documents)
Dementia / Delirium [first hit] Bill Regan 400 hits
17 more...
Searching for documents matching those 180 Geriatric concepts
VMS III
Pediatrics (32 documents)
Obstetrics and Gynecology (18 documents)
Medicine (28 documents)
Psychiatry (25 documents)
Surgery (2 documents)
Intersessions (31 documents)
VMS IV
Geriatrics (163 documents)
Chapter 44 - Infectious Diseases [first hit] Joshua Charles Denny 371 hits
Chapter 50 - Kidney Diseases and Disorders [first hit] Joshua Charles Denny 323 hits
Done
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VMS II - 20
Author: *Jeanette J Norden*
Submitted *September 6, 2006*

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Lecture: Aging and Alzheimer's Disease I

NORMAL AGING▶ OF THE BRAIN/ALZHEIMER'S DISEASE▶

Insight into aging▶ of the brain and Alzheimer's disease▶ is the result of a massive research effort; work on Alzheimer's disease▶, in particular, represents a rapidly evolving area of research; new and often conflicting data are generated daily; the purpose of this set of lectures is to provide you with the requisite background information necessary to allow you to continue to assimilate new findings as they are generated, and to provide you with a synopsis of both an historical and current (albeit changing) understanding of Alzheimer▶ 's disease

* Recommended reading:

" DeBaggio, Thomas. Losing My Mind. The Free Press, 2002

" Bayley, John. Elegy for Iris. Picador Press, 1999

" Jozefowicz and Holloway: Case 26 "The Gopher Hunter"

I. Maturational events which occur normally in the nervous system

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.

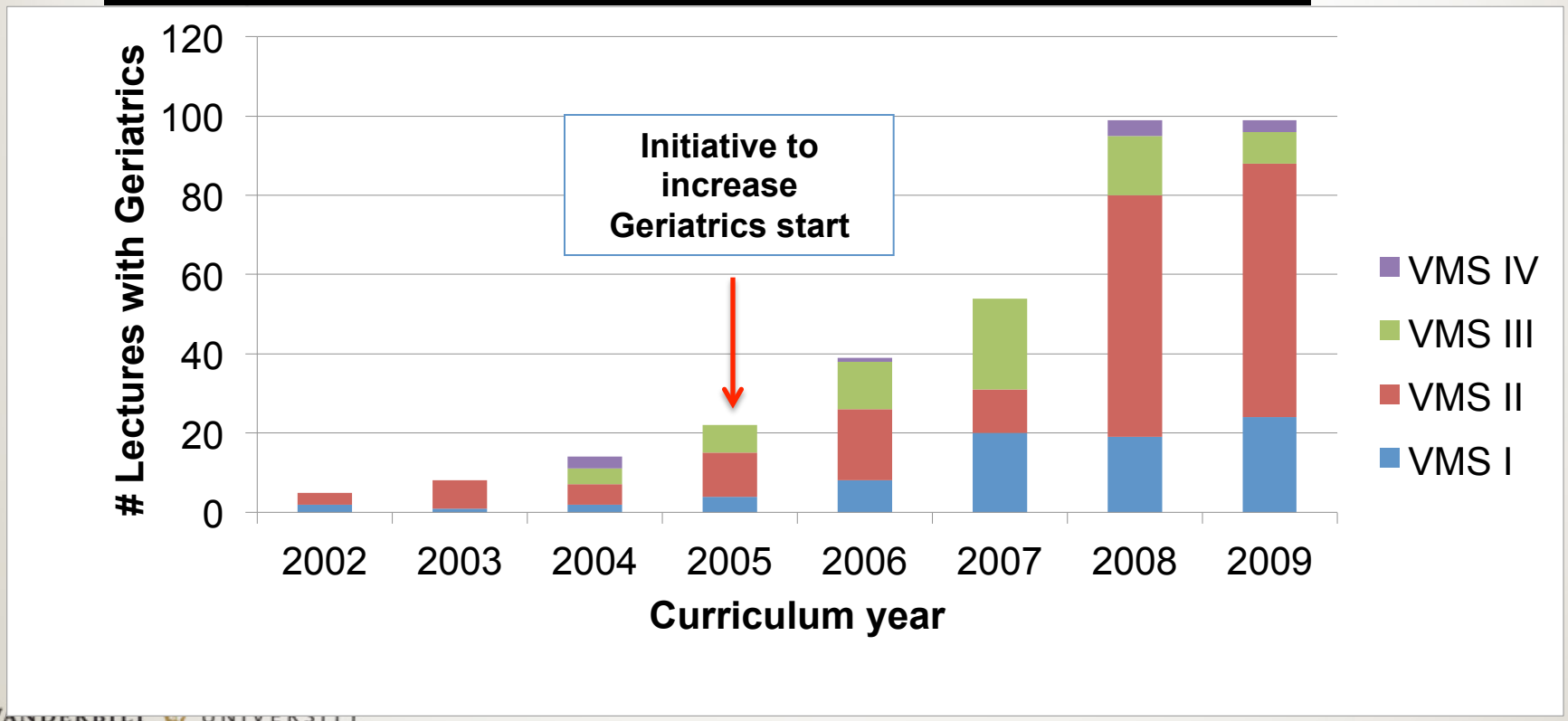
Topic	ROC area
Genetics	0.98
Women's Health	0.93
Dermatology	0.95
Radiology	0.97

Denny, Smithers, Armstrong , Spickard. JGIM 2005

Finding broad curricular topics

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

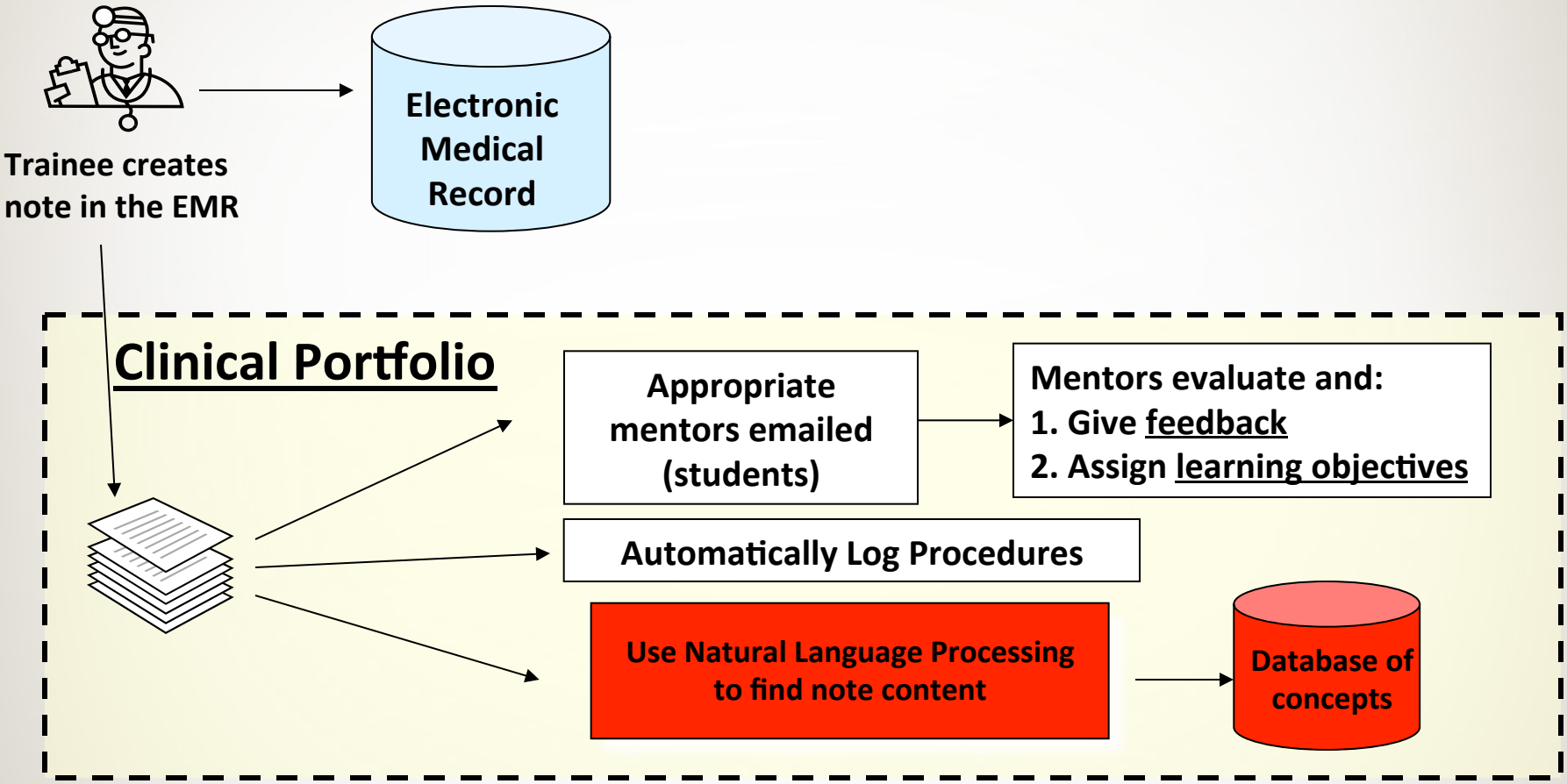
Using to infuse Geriatrics in the curriculum:

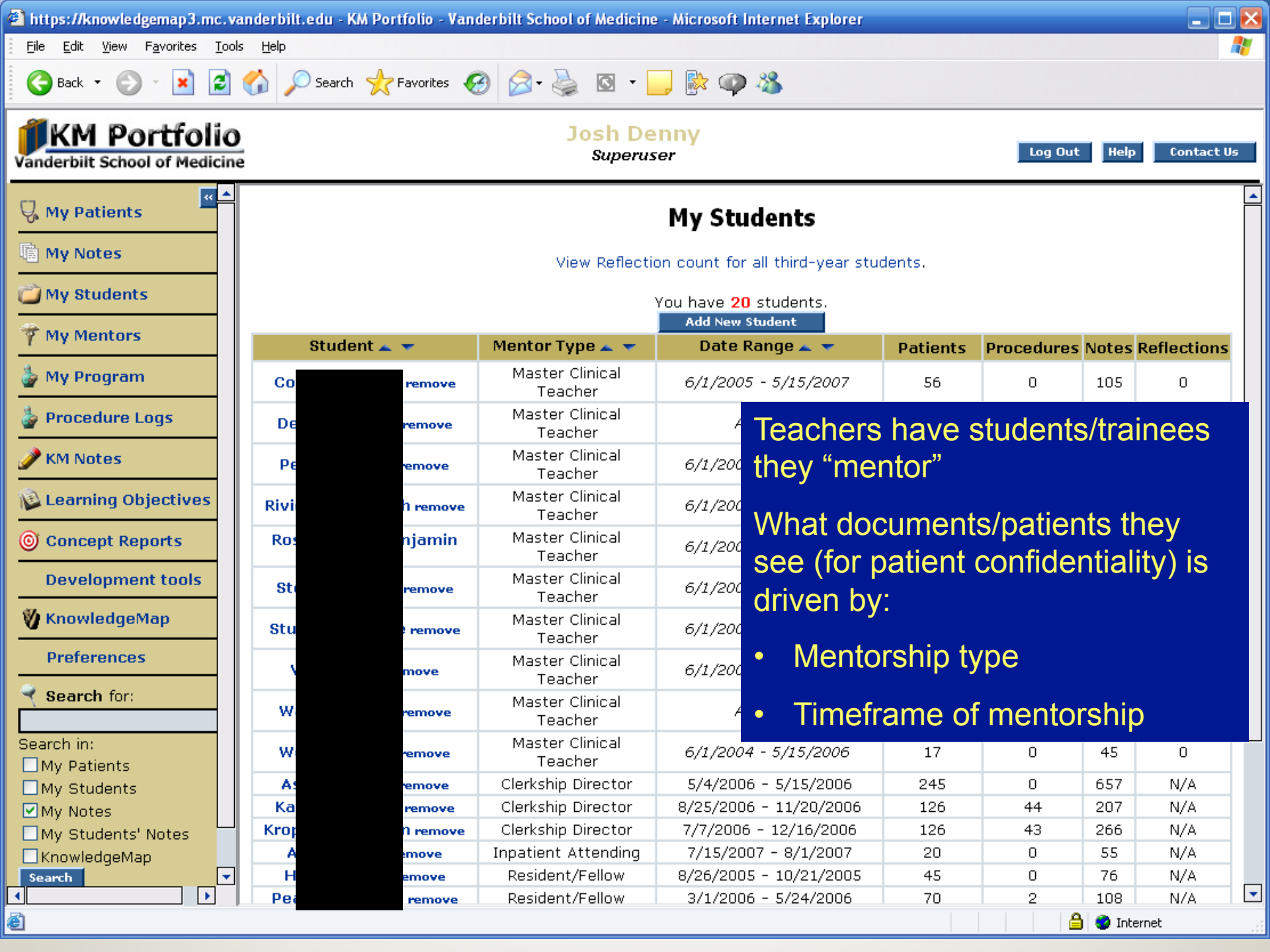


Part #2: Assessment in Clinical Years

- 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

Learning Portfolio – leveraging EMR to capture experience

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My Students
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My Program
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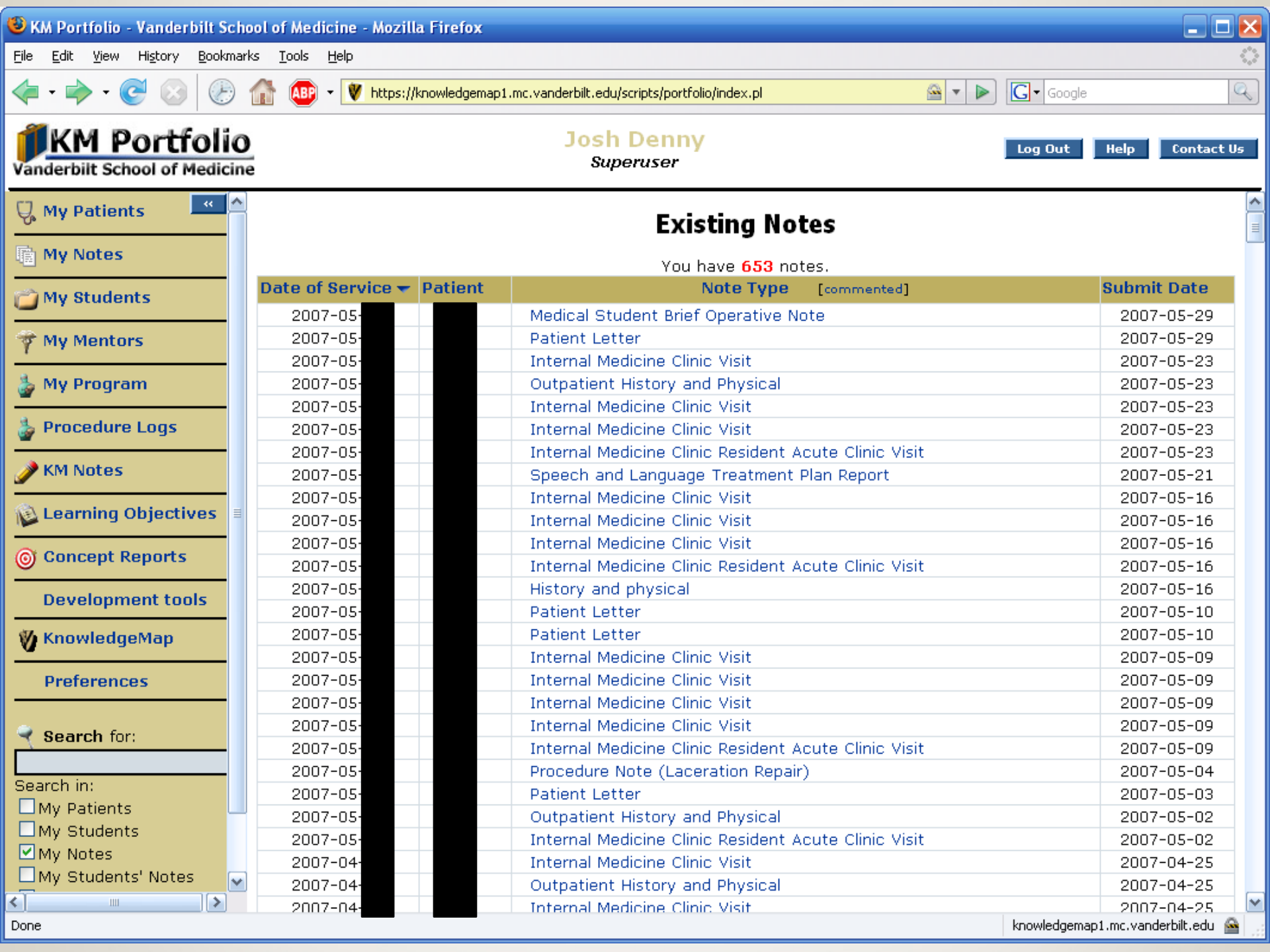
Learning Objectives
Concept Reports
Development tools
KnowledgeMap
Preferences
Search for:
Search in:
My Patients
My Students
My Notes
My Students' Notes
KnowledgeMap
Search
My Students
View Reflection count for all third-year students.
You have 20 students.
Add New Student
Student
Mentor Type
Date Range
Patients
Procedures
Notes
Reflections
Master Clinical Teacher 6/1/2005 - 5/15/2007 56 0 105 0
Master Clinical Teacher 6/1/2004 - 5/15/2006 17 0 45 0
Clerkship Director 5/4/2006 - 5/15/2006 245 0 657 N/A
Clerkship Director 8/25/2006 - 11/20/2006 126 44 207 N/A
Clerkship Director 7/7/2006 - 12/16/2006 126 43 266 N/A
Inpatient Attending 7/15/2007 - 8/1/2007 20 0 55 N/A
Resident/Fellow 8/26/2005 - 10/21/2005 45 0 76 N/A
Resident/Fellow 3/1/2006 - 5/24/2006 70 2 108 N/A
Teachers have students/trainees they “mentor”
What documents/patients they see (for patient confidentiality) is driven by:
• Mentorship type
• Timeframe of mentorship
Internet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My Students
My Mentors
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Procedure Logs
KM Notes
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Concept Reports
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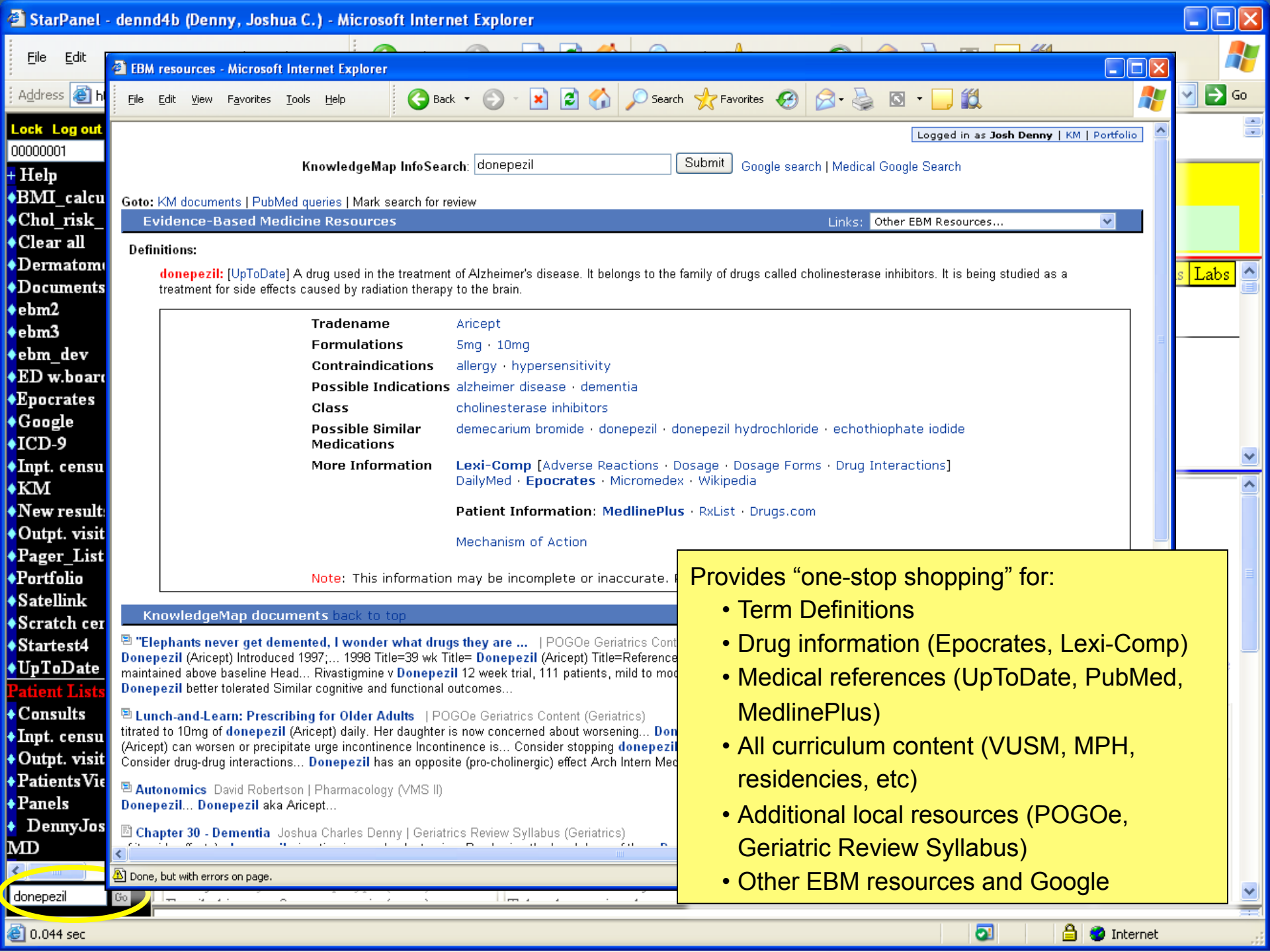
Preferences
Search for:
Search in:
My Patients
My Students
My Notes
My Students' Notes
Existing Notes
You have 653 notes.
Date of Service
Patient
Note Type [commented]
Submit Date
2007-05- [redacted] Medical Student Brief Operative Note 2007-05-29
2007-05- [redacted] Patient Letter 2007-05-29
2007-05- [redacted] Internal Medicine Clinic Visit 2007-05-23
2007-05- [redacted] Outpatient History and Physical 2007-05-23
2007-05- [redacted] Internal Medicine Clinic Visit 2007-05-23
2007-05- [redacted] Internal Medicine Clinic Visit 2007-05-23
2007-05- [redacted] Internal Medicine Clinic Resident Acute Clinic Visit 2007-05-23
2007-05- [redacted] Speech and Language Treatment Plan Report 2007-05-21
2007-05- [redacted] Internal Medicine Clinic Visit 2007-05-16
2007-05- [redacted] Internal Medicine Clinic Visit 2007-05-16
2007-05- [redacted] Internal Medicine Clinic Visit 2007-05-16
2007-05- [redacted] Internal Medicine Clinic Resident Acute Clinic Visit 2007-05-16
2007-05- [redacted] History and physical 2007-05-16
2007-05- [redacted] Patient Letter 2007-05-10
2007-05- [redacted] Patient Letter 2007-05-10
2007-05- [redacted] Internal Medicine Clinic Visit 2007-05-09
2007-05- [redacted] Internal Medicine Clinic Visit 2007-05-09
2007-05- [redacted] Internal Medicine Clinic Visit 2007-05-09
2007-05- [redacted] Internal Medicine Clinic Visit 2007-05-09
2007-05- [redacted] Internal Medicine Clinic Resident Acute Clinic Visit 2007-05-09
2007-05- [redacted] Procedure Note (Laceration Repair) 2007-05-04
2007-05- [redacted] Patient Letter 2007-05-03
2007-05- [redacted] Outpatient History and Physical 2007-05-02
2007-05- [redacted] Internal Medicine Clinic Resident Acute Clinic Visit 2007-05-02
2007-04- [redacted] Internal Medicine Clinic Visit 2007-04-25
2007-04- [redacted] Outpatient History and Physical 2007-04-25
2007-04- [redacted] Internal Medicine Clinic Visit 2007-04-25
Done
knowledgemap1.mc.vanderbilt.edu


StarPanel - dennd4b (Denny, Joshua C.) - Microsoft Internet Explorer
EBM resources - Microsoft Internet Explorer
Logged in as Josh Denny | KM | Portfolio
KnowledgeMap InfoSearch: donepezil Submit Google search | Medical Google Search
Goto: KM documents | PubMed queries | Mark search for review
Evidence-Based Medicine Resources
Links: Other EBM Resources...
Definitions:
donepezil: [UpToDate] A drug used in the treatment of Alzheimer's disease. It belongs to the family of drugs called cholinesterase inhibitors. It is being studied as a treatment for side effects caused by radiation therapy to the brain.
Tradename Aricept
Formulations 5mg · 10mg
Contraindications allergy · hypersensitivity
Possible Indications alzheimer disease · dementia
Class cholinesterase inhibitors
Possible Similar Medications demecarium bromide · donepezil · donepezil hydrochloride · echothiophate iodide
More Information Lexi-Comp [Adverse Reactions · Dosage · Dosage Forms · Drug Interactions]
DailyMed · Epocrates · Micromedex · Wikipedia
Patient Information: MedlinePlus · RxList · Drugs.com
Mechanism of Action
Note: This information may be incomplete or inaccurate.
KnowledgeMap documents back to top
"Elephants never get demented, I wonder what drugs they are ... | POGOe Geriatrics Cont
Donepezil (Aricept) Introduced 1997;... 1998 Title=39 wk Title= Donepezil (Aricept) Title=Reference
maintained above baseline Head... Rivastigmine v Donepezil 12 week trial, 111 patients, mild to mod
Donepezil better tolerated Similar cognitive and functional outcomes...
Lunch-and-Learn: Prescribing for Older Adults | POGOe Geriatrics Content (Geriatrics)
titrated to 10mg of donepezil (Aricept) daily. Her daughter is now concerned about worsening... Don
(Aricept) can worsen or precipitate urge incontinence Incontinence is... Consider stopping donepezil
Consider drug-drug interactions... Donepezil has an opposite (pro-cholinergic) effect Arch Intern Med
Autonomics David Robertson | Pharmacology (VMS II)
Donepezil... Donepezil aka Aricept...
Chapter 30 - Dementia Joshua Charles Denny | Geriatrics Review Syllabus (Geriatrics)
Done, but with errors on page.
Provides "one-stop shopping" for:
• Term Definitions
• Drug information (Epocrates, Lexi-Comp)
• Medical references (UpToDate, PubMed, MedlinePlus)
• All curriculum content (VUSM, MPH, residencies, etc)
• Additional local resources (POGOe, Geriatric Review Syllabus)
• Other EBM resources and Google
donepezil
0.044 sec
Internet

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

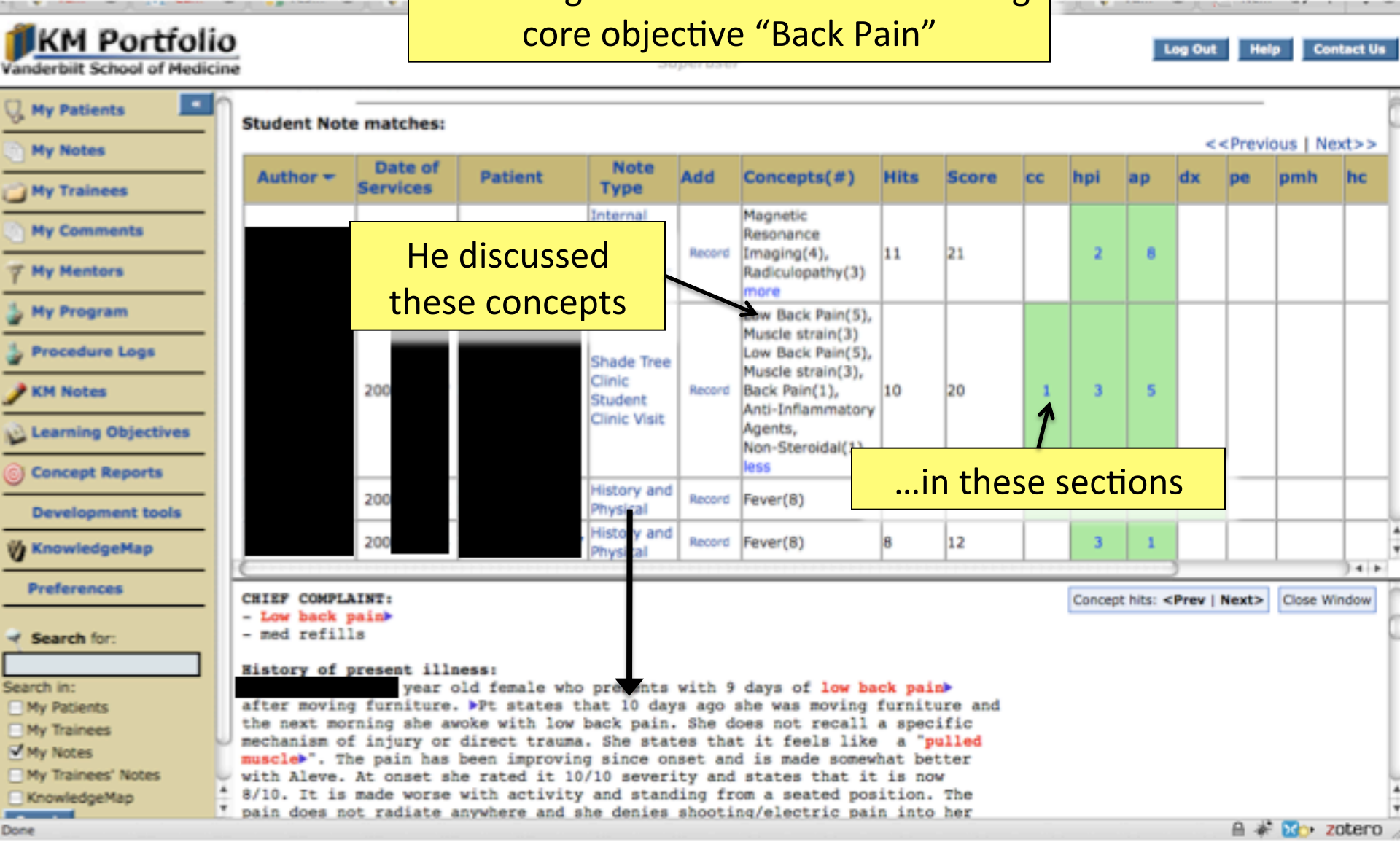
Student view of how many VC3 topics they've completed. (Teachers can see this also.)

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

Learning Objectives

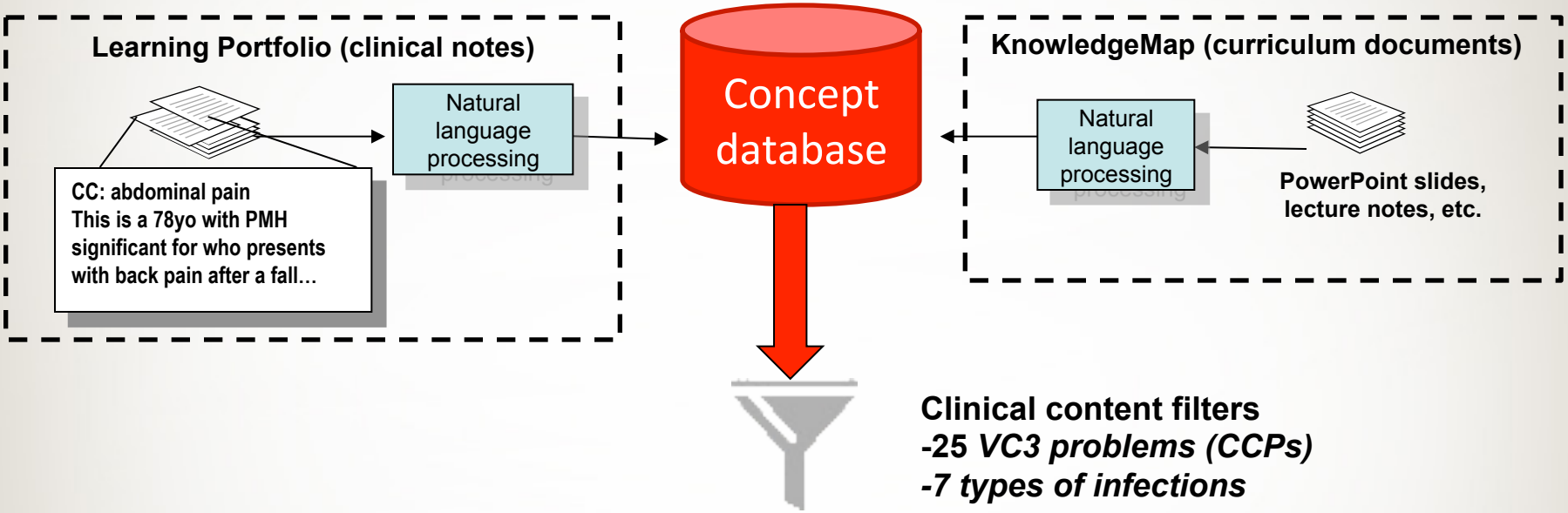
Learning Objective	Date Recorded	Event Recorded
Abdominal Pain [Find matching notes]	10/17/2008 11/1/2008	Pediatric Surgery Consultation Note Medical Student Admission History and Physical
Altered Mental Status		*None recorded*
Back Pain [Find matching notes]	10/17/2008	Return Clinic Visit Progress Note
Breast Disease		*None recorded*
Chest Pain [Find matching notes]	5/9/2008 5/23/2008 10/19/2008	Medical Student Admission History and Physical Medical Student Admission History and Physical Medical Student Admission History and Physical
Coma		*None recorded*
Cough [Find matching notes]	10/20/2008 10/20/2008	Medical Student Admission History and Physical Medical Student Admission History and Physical
Depression [Find matching notes]	11/2/2008 11/2/2008	Medical Student Progress Note History and physical
Dysuria [Find matching notes]	11/2/2008 11/2/2008 11/2/2008	Pediatric Infectious Disease Initial Consultation Medical Student Admission History and Physical Clinic Visit
Fever [Find matching notes]	10/17/2008 10/17/2008	Medical Student Admission History and Physical Progress Note Daily Progress Note
Gastrointestinal Bleeding [Find matching notes]		*None recorded*
Heart Murmurs		*None recorded*
Jaundice [Find matching notes]	11/2/2008 11/2/2008	History and physical Progress Note Daily Progress Note
Menstrual abnormalities		*None recorded*
Mood Disorder		*None recorded*
Pelvic Pain		*None recorded*
Pharyngitis		*None recorded*

Searching for relevant notes matching core objective “Back Pain”



Part #3: Evaluating and integrating

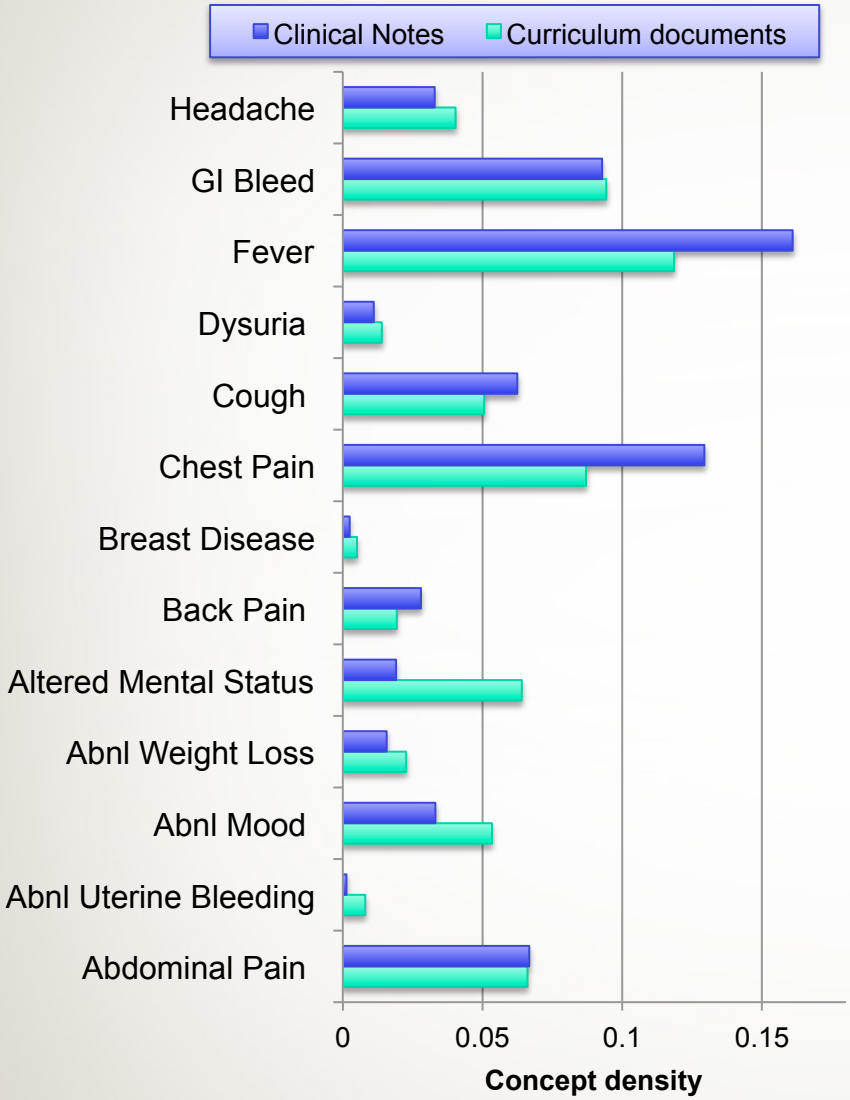
Study 1: Curriculum vs. Notes

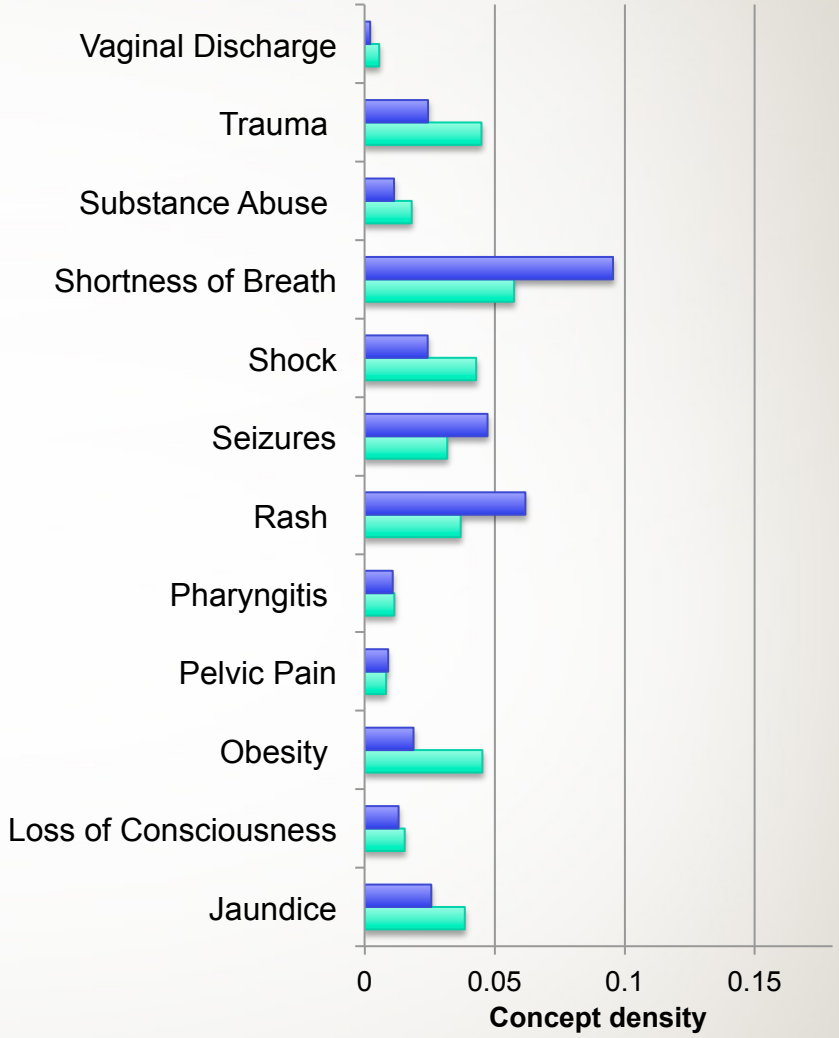


Compare content, identify discrepancies

Coverage of VC3 Topics

300k student notes
15k lecture documents





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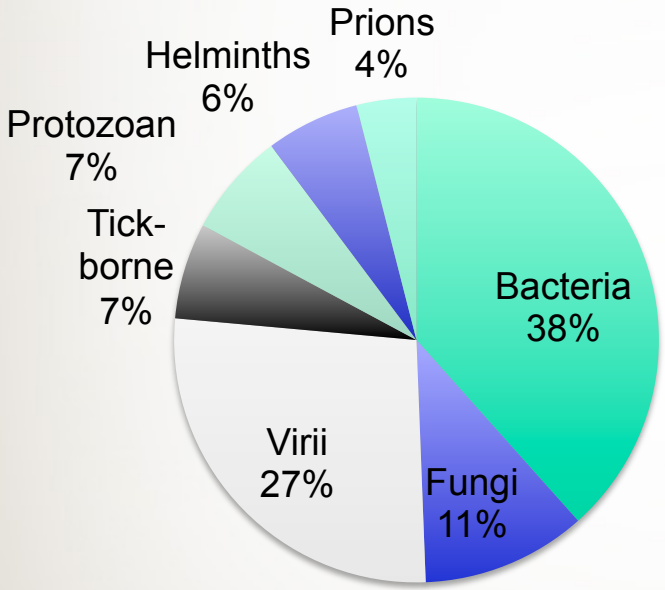
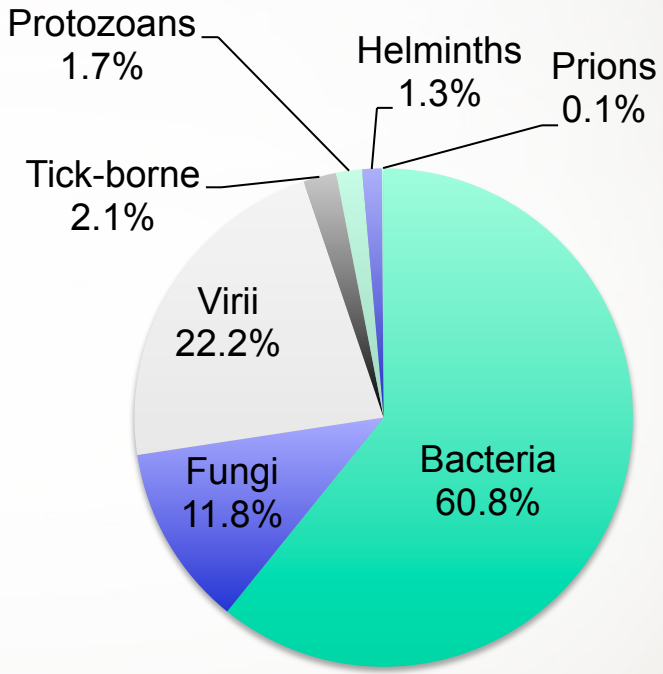
Denny et al. AMIA 2010

Coverage of Infectious Diseases

Curriulum Documents



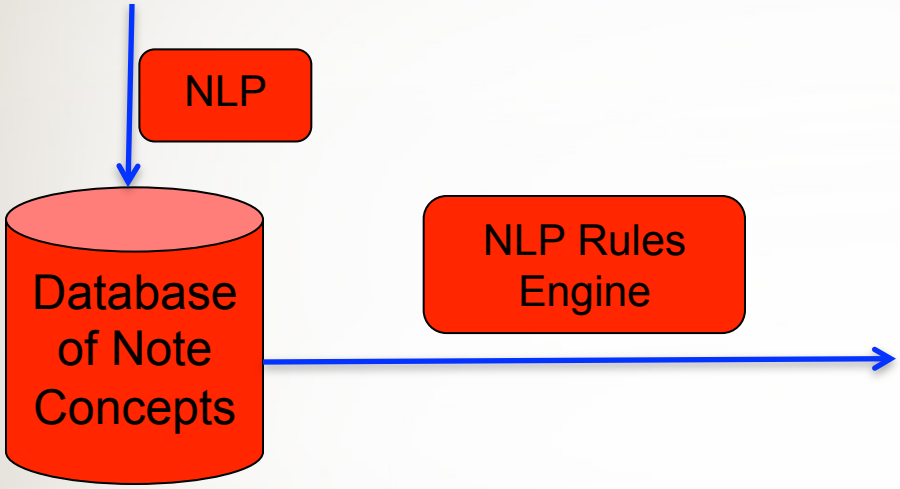
Clinical Notes



Denny et al. AMIA 2010

Study 2: Automated Education Advisors

Student types a note in the EMR



Customized Emails

- **Key facts about the diagnosis**
- **Whether or not they met some criteria**
- **Links to key references about the topic (on KM)**
- **Links to documents most relevant to their note**

- 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)

Denny et al. JBI 2015

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…

Denny et al. JBI 2015

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 **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…

CHIEF COMPLAINT: **confusion, weakness,** and **lethargy**

HISTORY O… …emale with **metastati**… …origin, who was recen… …oral

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)

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How does it actually work?

name	Altered Mental Status
classifications	VMS3, VMS4 (type of people to evaluate)
eval_saved_search_num	446 (list of CUIs related to AMS, built on website)
eval_wordsearch	AMS, altered mental status (extra words to search, nonnegated)
eval_limit_note_sections	1 (searches only "high value" note sections)
feedback_saved_searches	426,426,428,429,430,431...
feedback_saved_searches_programs	1,2,4 (what curricula to use; documents are ranked via TF-IDF from very broadly defined AMS CUIs in the saved searches)
email_matching_concepts	TRUE (tell the student what we found in their note)
min_age	18
max_age	9999
min_score_to_keep	1
once_per_patient	1
km_docs_to_send	74 (a list of highly relevant AMS resources)
email_subjectline	Altered Mental Status
email_header	You are getting this email as part of a project to improve your learning on altered mental status.
email_instruction	Key facts about Altered Mental Status: …

Summary

- EHR-linked DNA biobanks can be used for genomic and pharmacogenomic discovery. They can be cost efficient and fast.
- Best algorithms to find phenotypes include codes, labs, meds, and/or NLP through combination of Boolean and/or machine learning approaches – these algorithms are placed on PheKB
- NLP is often confirmatory for phenotypes
- NLP can also be used to improve cataloging of medical education content and tracking of trainee experiences