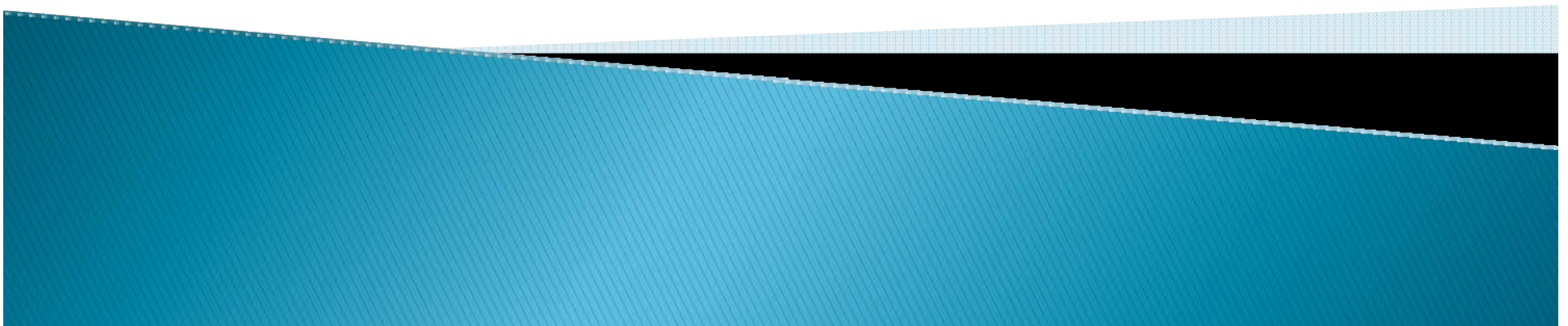


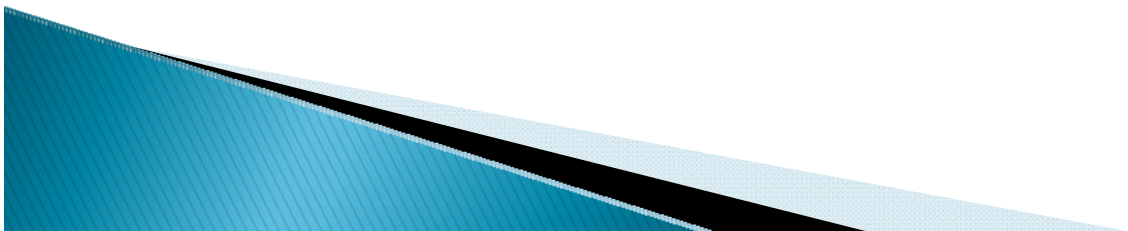
Information Value in Computerized Patient Care Documentation

Kenric Hammond MD
VA Puget Sound
University of Washington



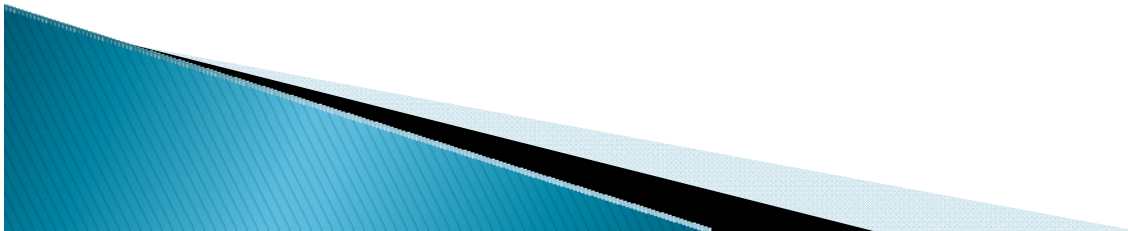
CPD

- ▶ Computerized Patient Care Documentation
- ▶ Emerging capability in the EMR
- ▶ VA has had CPD since 1996
- ▶ Rich experience, lots of documentation



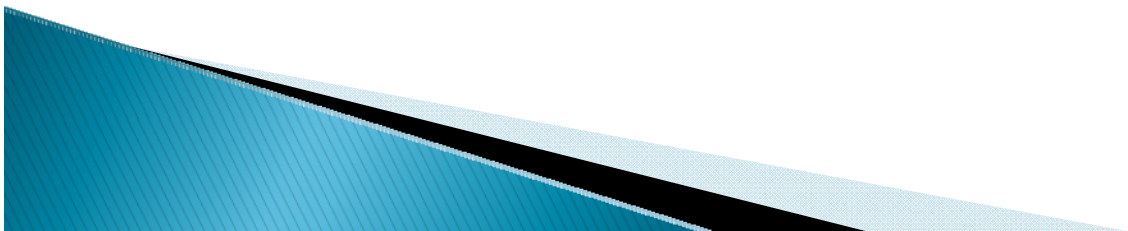
Research Goals

- ▶ Improve the documentation processes
- ▶ Find incremental improvements that add up
- ▶ Make documentation more effective



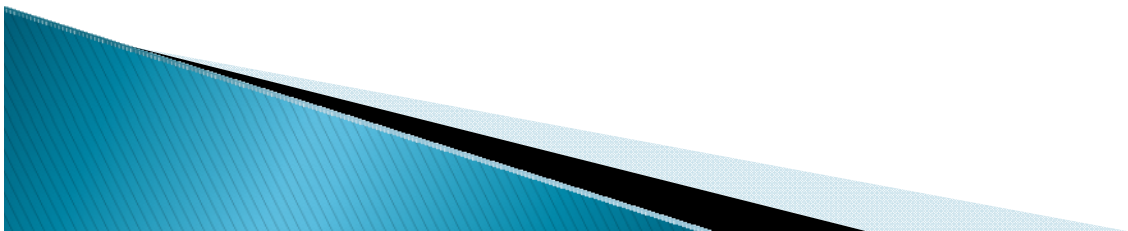
Research Methods

- ▶ Triangulate the problem with qualitative and quantitative methods
- ▶ Work task and user focus
 - ▶ In the effort to understand
 - ▶ In the effort to measure and validate








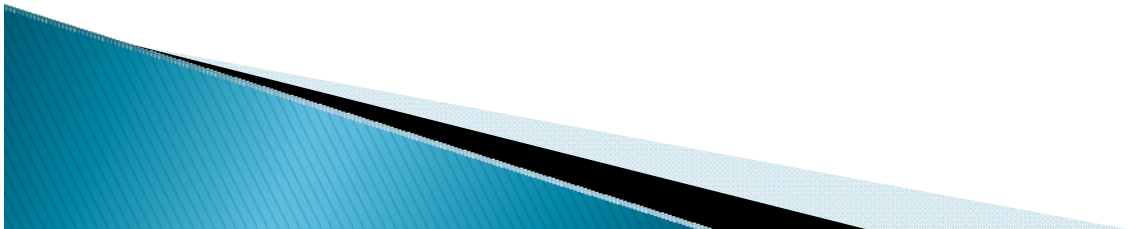
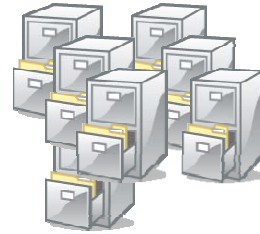
Quantitative Research

- ▶ Originally, 18 million document corpus
 - 8 VA sites, 3 years, all documents
- ▶ Changing IRB rules narrowed scope
 - 3 sites, 3 years, ~8M documents
- ▶ Preliminary data from Puget Sound

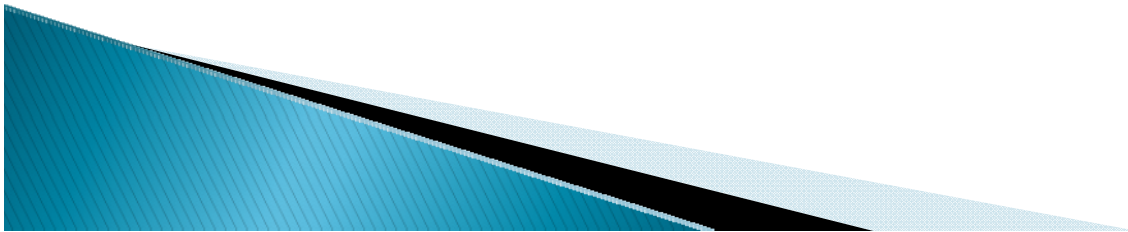


VA Puget Sound Corpus

- ▶ 4,66,359 documents
- ▶ 1395 titles 
- ▶ 5935 authors 
- ▶ 98,139 patients 
- ▶ 536,122 distinct terms 
- ▶ 534,309,839 total words 



Anatomy of VA Documents



Vista CPRS in use by: Hammond, Kenric W (vista.puget-sound.med.va.gov)

File Edit View Action Options Tools Help

ZZTEST,ACPRS PATIENT FOURTEEN Visit Not Selected WOMENS KUO-JC
 000-00-9876 Feb 14,1910 (99) Provider: HAMMOND,KENRIC W Flag ? VistaWeb Postings
 Remote Data WA

Last 100 Signed Notes Visit: 04/03/09 PSYCHIATRY EMERGENCY DEPARTMENT NOTE, MHS S ATC CHAUDHRY IN

- Apr 09,09 NURSING PROGRESS
- Apr 09,09 NURSE PRACTITIONE
- Apr 07,09 NURSE PRACTITIONE
- Apr 07,09 STUDENT NURSE, MF
- Apr 07,09 STUDENT NURSE, MF
- Apr 06,09 STUDENT NURSE, DF
- Apr 06,09 PSYCHIATRY EME**
- Apr 03,09 PRIMARY CARE PROC
- Apr 03,09 PSYCHIATRY INPT
- Apr 03,09 ADDICTION TREATME
- Apr 02,09 NURSE PRACTITIONE
- Apr 01,09 STUDENT NURSE, DF
- Mar 31,09 STUDENT NURSE, MI
- Mar 31,09 STUDENT NURSE, MI
- Mar 30,09 NURSE PRACTITIONE
- Mar 23,09 PRIMARY CARE PROC
- Mar 23,09 PRIMARY CARE OUTI
- Mar 13,09 CORRESPONDENCE-
- Mar 13,09 CORRESPONDENCE-
- Mar 13,09 OCCUPATIONAL THE
- Mar 12,09 STUDENT NURSE, Ur
- Mar 09,09 STUDENT NURSE, ZZ
- Mar 03,09 SOCIAL WORK NOTE
- Feb 26,09 PRIMARY CARE PRO

LOCAL TITLE: PSYCHIATRY EMERGENCY DEPARTMENT NOTE
 STANDARD TITLE: PSYCHIATRY EMERGENCY DEPT NOTE
 DATE OF NOTE: APR 06, 2009@10:17 ENTRY DATE: APR 06, 2009@10:17:36
 AUTHOR: 1 EXP COSIGNER:
 URGENCY: STATUS: COMPLETED

*** PSYCHIATRY EMERGENCY DEPARTMENT NOTE Has ADDENDA ***

Psychiatrist Emergency Room Progress Note

Time spent with patient: 25 minutes

Chief Complaint (Reason for evaluation today):

Pertinent Symptoms and History:

Mental Status Exam:

Assessment:

Plan:

Active Inpatient and Outpatient Medications (including supplies):

Non-VA Medications	Status
1) Non-VA ACARBOSE 50MG TAB 50 MG BY MOUTH THREE TIMES A DAY BEFORE MEALS	ACTIVE

Templates
 Encounter
 New Note

Cover Sheet Problems Meds Orders Notes Consults Surgery D/C Summ Labs Reports

Text goes here

Vista CPRS in use by: Hammond, Kenric W (vista.puget-sound.med.va.gov)

File Edit View Action Options Tools Help

ZZTEST, ACPRS PATIENT FOURTEEN Visit Not Selected WOMENS KUO-JK VistaWeb Postings
 000-00-9876 Feb 14, 1910 (99) Provider: HAMMOND, KENRIC W Flag ? Remote Data WA

Last 100 Signed Notes Visit: 04/03/09 PSYCHIATRY EMERGENCY DEPARTMENT NOTE, MHS S ATC CHAUDHRY IN

- Apr 09,09 NURSING PROGRESS
- Apr 09,09 NURSE PRACTITIONE
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- Mar 13,09 OCCUPATIONAL THE
- Mar 12,09 STUDENT NURSE, Ur
- Mar 09,09 STUDENT NURSE, ZZ
- Mar 03,09 SOCIAL WORK NOTE
- Feb 26,09 PRIMARY CARE PRO

Active Inpatient and Outpatient Medications (including Supplies):

Non-VA Medications	Status
1) Non-VA ACARBOSE 50MG TAB 50 MG BY MOUTH THREE TIMES A DAY BEFORE MEALS	ACTIVE
2) Non-VA ALBUTEROL 90MCG (CFC-F) 200D ORAL INHL 2 PUFFS BY MOUTH EVERY SIX HOURS AS NEEDED	ACTIVE
3) Non-VA LISINOPRIL 2.5MG TAB 2.5MG BY MOUTH EVERY DAY	ACTIVE
4) Non-VA LISINOPRIL 10MG TAB 10MG BY MOUTH EVERY DAY	ACTIVE
5) Non-VA METOPROLOL TARTRATE 25MG TAB 25 MG BY MOUTH TWICE A DAY	ACTIVE
6) Non-VA MILK OF MAGNESIA 1 TEASPOON BY MOUTH EVERY TWO HOURS AS NEEDED	ACTIVE
7) Non-VA OXYCODONE 5MG TAB 1 TABLET BY MOUTH THREE TIMES A DAY AS NEEDED	ACTIVE
8) Non-VA RASAGALINE 2 MG BY MOUTH FIVE TIMES A DAY	ACTIVE

LAB WORK FOR TODAY
 --- No results to report.

ACTIVE PROBLEMS:

- Co-managed, Dr. Garlick, Onset 01/11/09
- Pulmonary Fibrosis, Onset 09/30/08 secondary to medication
- Morbid Obesity
bmi of 42
- Hemorrhoids/Fissure
- Hypertension, Onset 09/15/08
- Peripheral Vascular Disease
- Personal History of Colonic Polyps
colonoscopy done 6-2000, follow-up due 2005
- MDD, Recur, Moderate
- Diabetes Mellitus Type I, Onset 10/11/07
- Dizziness
- Inguinal hernia, without mention of obstruction or gangrene, Onset 02/02/07

Templates
 Encounter
 New Note

Cover Sheet Problems Meds Orders Notes Consults Surgery D/C Summ Labs Reports

Inserted
 Patient
 Data

Vista CPRS in use by: Hammond, Kenric W (vista.puget-sound.med.va.gov)

File Edit View Action Options Tools Help

ZZTEST.ACPRS PATIENT FOURTEEN Visit Not Selected WOMENS KUO-JOHNSON / Johnson, Ka
 000-00-9876 Feb 14, 1910 (99) Provider: HAMMOND.KENRIC W Flag ? VistaWeb Postings
 Remote Data WA

Last 100 Signed Notes Visit: 04/03/09 PSYCHIATRY EMERGENCY DEPARTMENT NOTE, MHS S ATC CHAUDHRY IND, TUSHAR M KUMAR (Apr

- Apr 28.09 STUDENT NUF
- Apr 17.09 STUDENT NUF
- Apr 15.09 STUDENT NUF
- Apr 15.09 STUDENT NUF
- Apr 13.09 STUDENT NUF
- Apr 13.09 NUCLEAR ME
- Apr 09.09 NURSING PRC
- Apr 09.09 NURSE PRAC
- Apr 07.09 NURSE PRAC
- Apr 07.09 STUDENT NUF
- Apr 07.09 STUDENT NUF
- Apr 06.09 STUDENT NUF
- Apr 06.09 PSYCHIAT**
- Apr 03.09 PRIMARY CAF
- Apr 03.09 PSYCHIAT**
- Apr 03.09 ADDICTION TF
- Apr 02.09 NURSE PRAC
- Apr 01.09 STUDENT NUF
- Mar 31.09 STUDENT NUF
- Mar 31.09 STUDENT NUF
- Mar 30.09 NURSE PRAC
- Mar 23.09 PRIMARY CAF
- Mar 23.09 PRIMARY CAF
- Mar 13.09 CORRESPON
- Mar 13.09 CORRESPON
- Mar 13.09 OCCUPATION
- Mar 12.09 STUDENT NUF
- Mar 09.09 STUDENT NUF
- Mar 03.09 SOCIAL WOR
- Feb 26.09 PRIMARY CAF

HOURS AS NEEDED

7) Non-VA OXYCODONE 5MG TAB 1 TABLET BY MOUTH THREE TIMES A DAY AS NEEDED ACTIVE

8) Non-VA RASAGALINE 2 MG BY MOUTH FIVE TIMES A DAY ACTIVE

LAB WORK FOR TODAY
 --- No results to report.

ACTIVE PROBLEMS:

- Co-managed, Dr. Garlick, Onset 01/11/09
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colonoscopy done 6-2000, follow-up due 2005
- MDD, Recur, Moderate
- Diabetes Mellitus Type I, Onset 10/11/07
- Dizziness
- Inguinal hernia, without mention of obstruction or gangrene, Onset 02/02/07
Left
- PTSD, Onset 07/11/05
- Obesity * (ICD-9-CM 278.00)
- Congestive Heart Failure * (ICD-9-CM 428.0)
- CAD * (ICD-9-CM 414.9)
- Aortic Aneurysm, thoracic

/es/ T AR
 Resident, PGY-1
 Signed: 04/06/2009 11:54

/es/ Mol M.D.
 Staff Psychiatrist
 Cosigned: 04/07/2009 08:35

04/15/2009 ADDENDUM STATUS: COMPLETED
 THIS NOTE ON WRONG PATIENT
 Medical records notified.

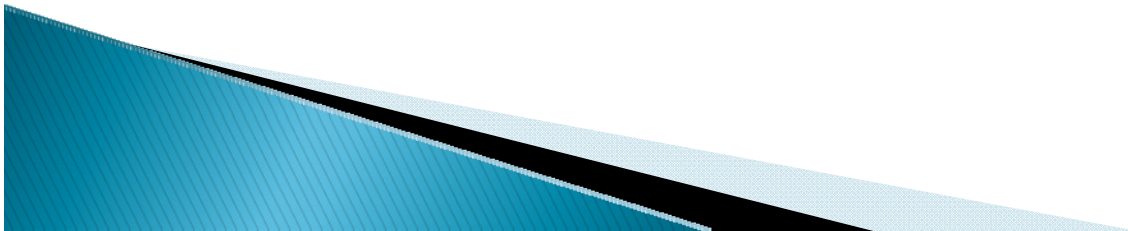
/es/ s :SE

Cover Sheet Problems Meds Orders Notes Consults Surgery D/C Summ Labs Reports

Addendum

Information Retrieval Approach

- ▶ Index text in corpus, using Lucene
- ▶ Look at distribution of statistics

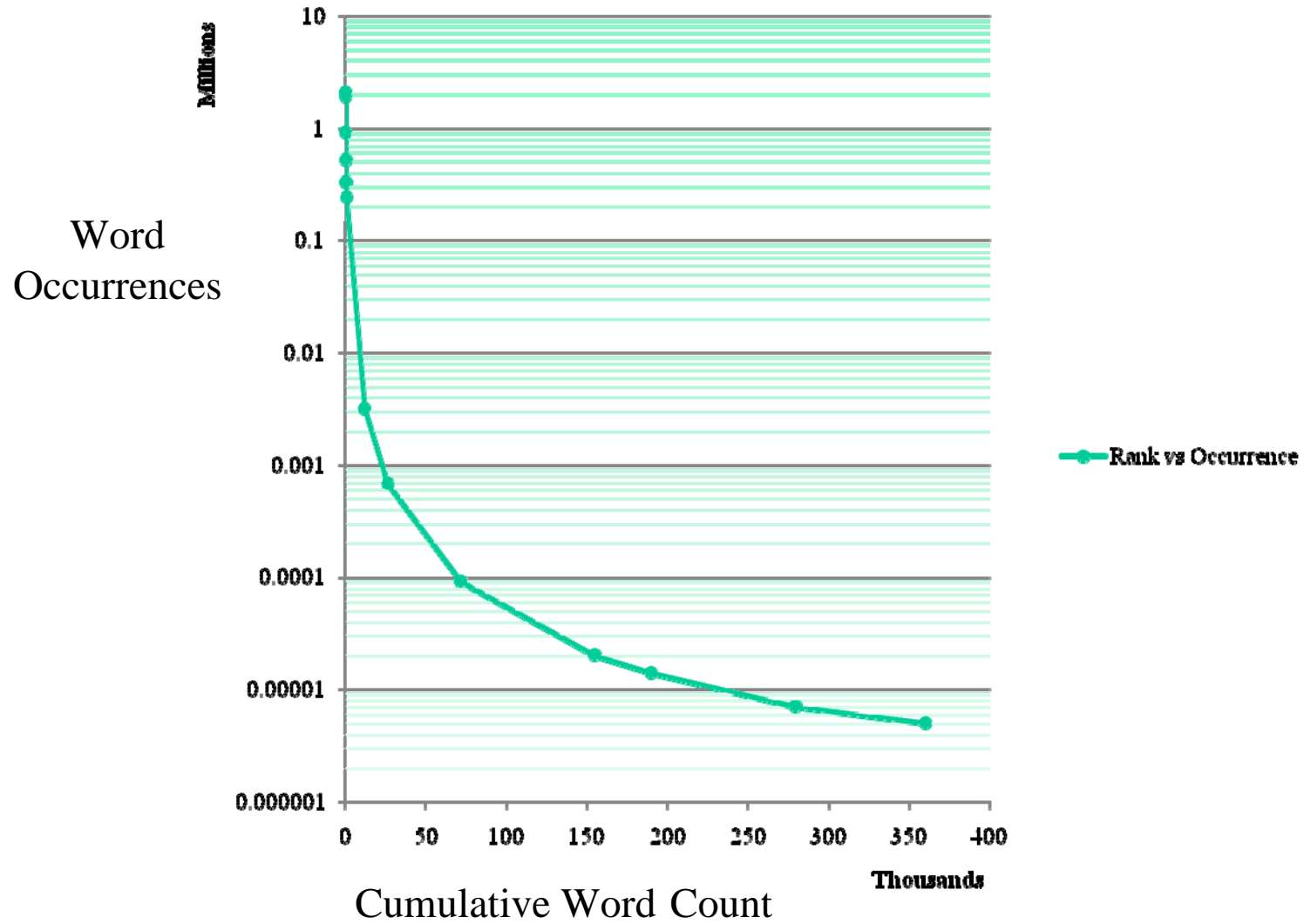


Top 15 terms

Rank	Term	Occurrence in Corpus
1	patient	2089581
2	has	1936767
3	he	1772287
4	pt	1738253
5	1	1651608
6	2	1641596
7	his	1525721
8	pain	1445055
9	from	1437254
10	s	1424016
11	3	1408644
12	plan	1304706
13	o	1271527
14	time	1266124
15	care	1254825

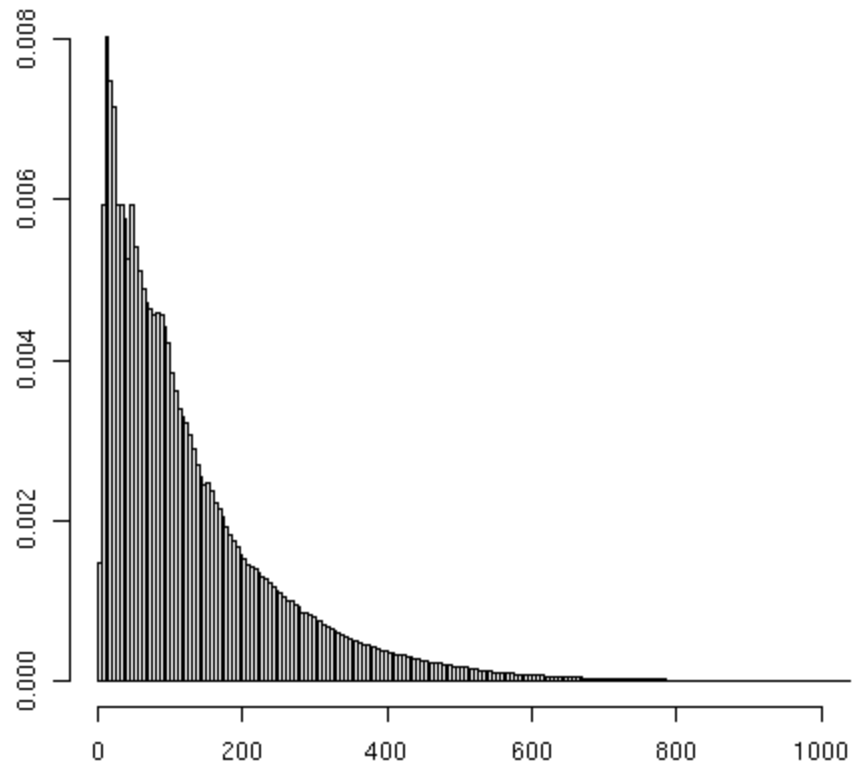


Rank vs Occurrence



Document Length Distribution

Proportion of documents

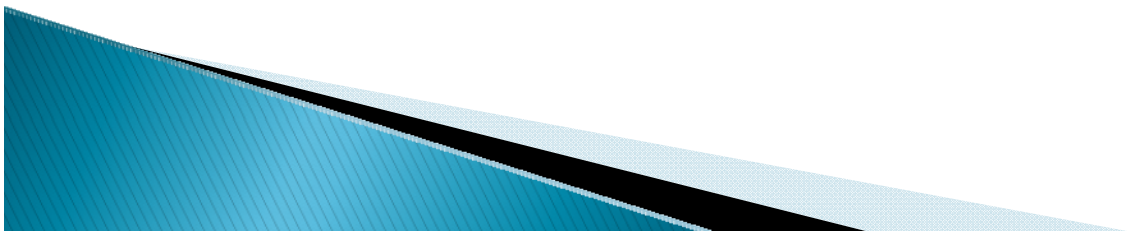


Document Length (words)

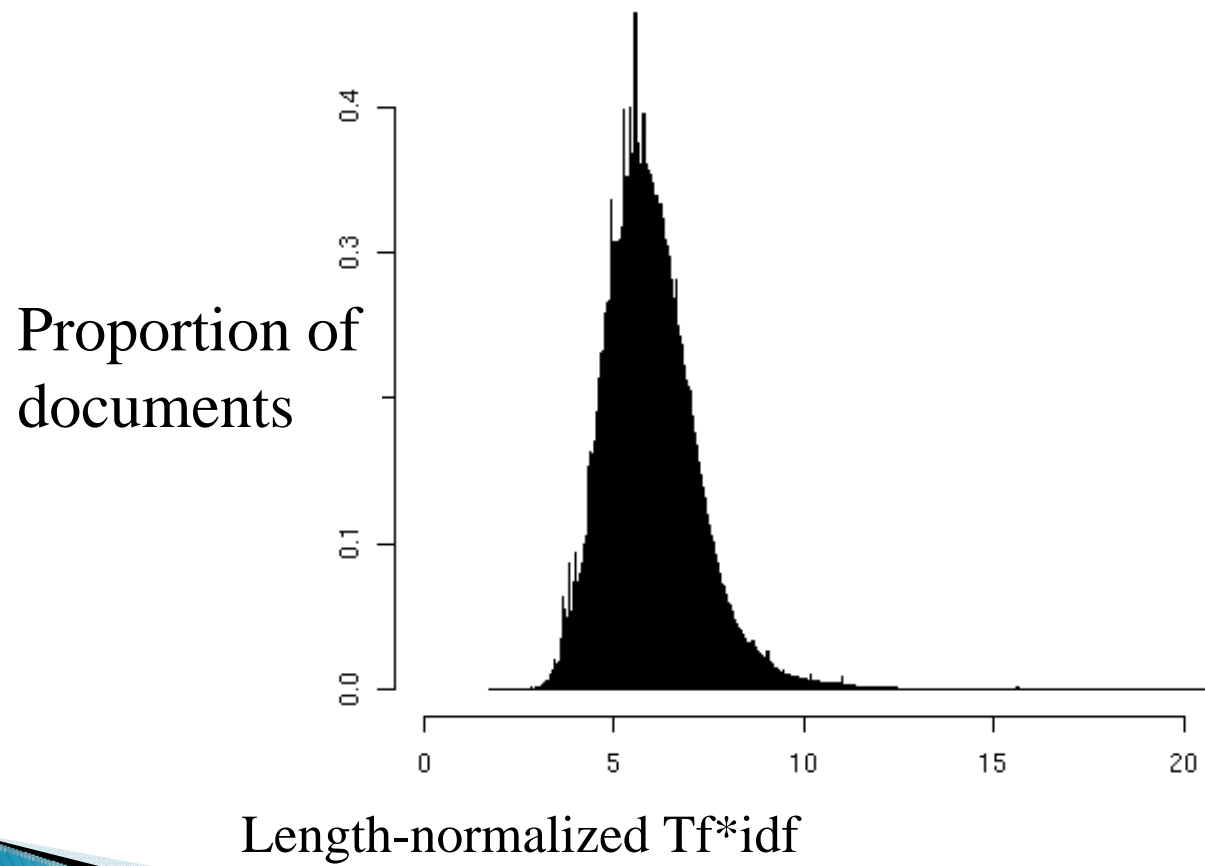


Relevance Statistics

- ▶ “Relevance” expressed as $Tf*idf$
(term frequency * inverse document frequency)
 - scores documents with clusters of “unusual” terms higher
- ▶ Okapi BM25 – another version of $Tf*idf$

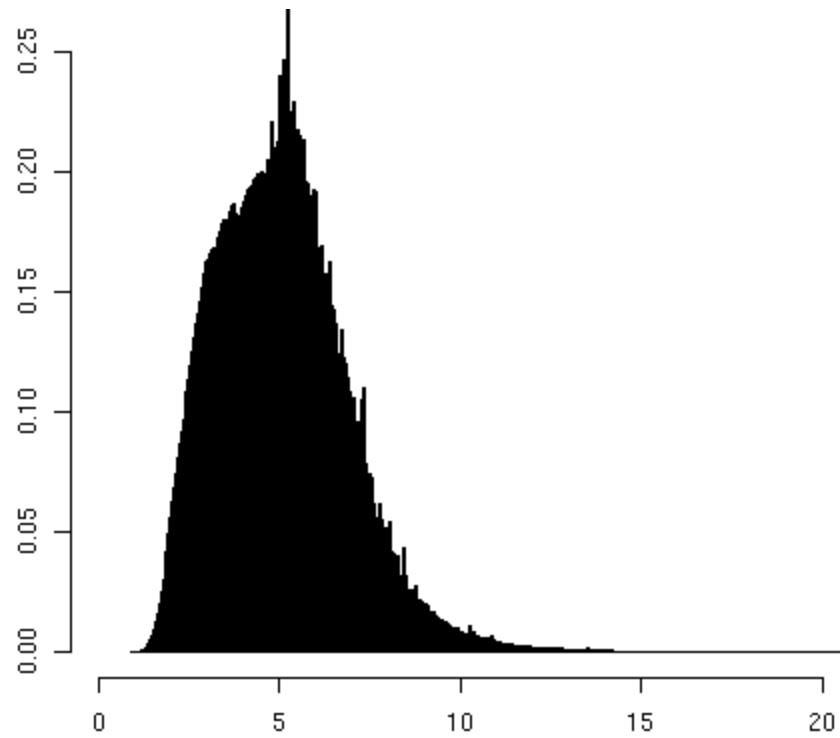


Tf*idf distribution

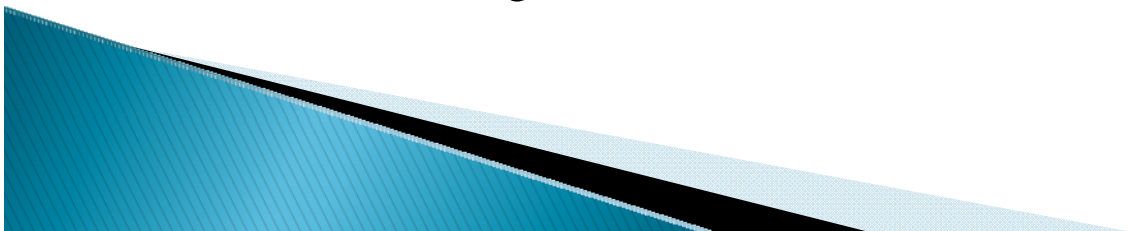


Okapi BM25

Proportion of documents

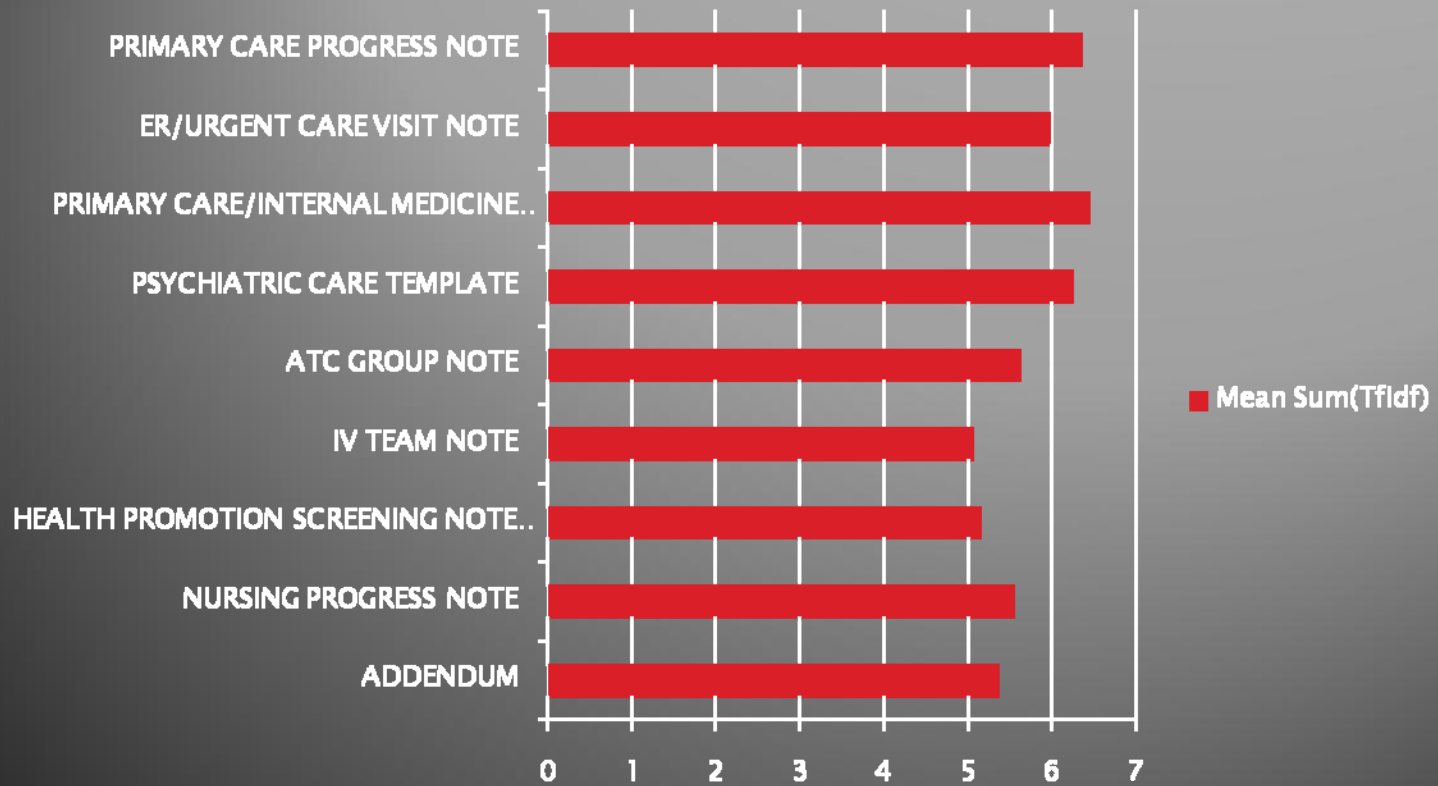


Length-normalized BM25 relevance

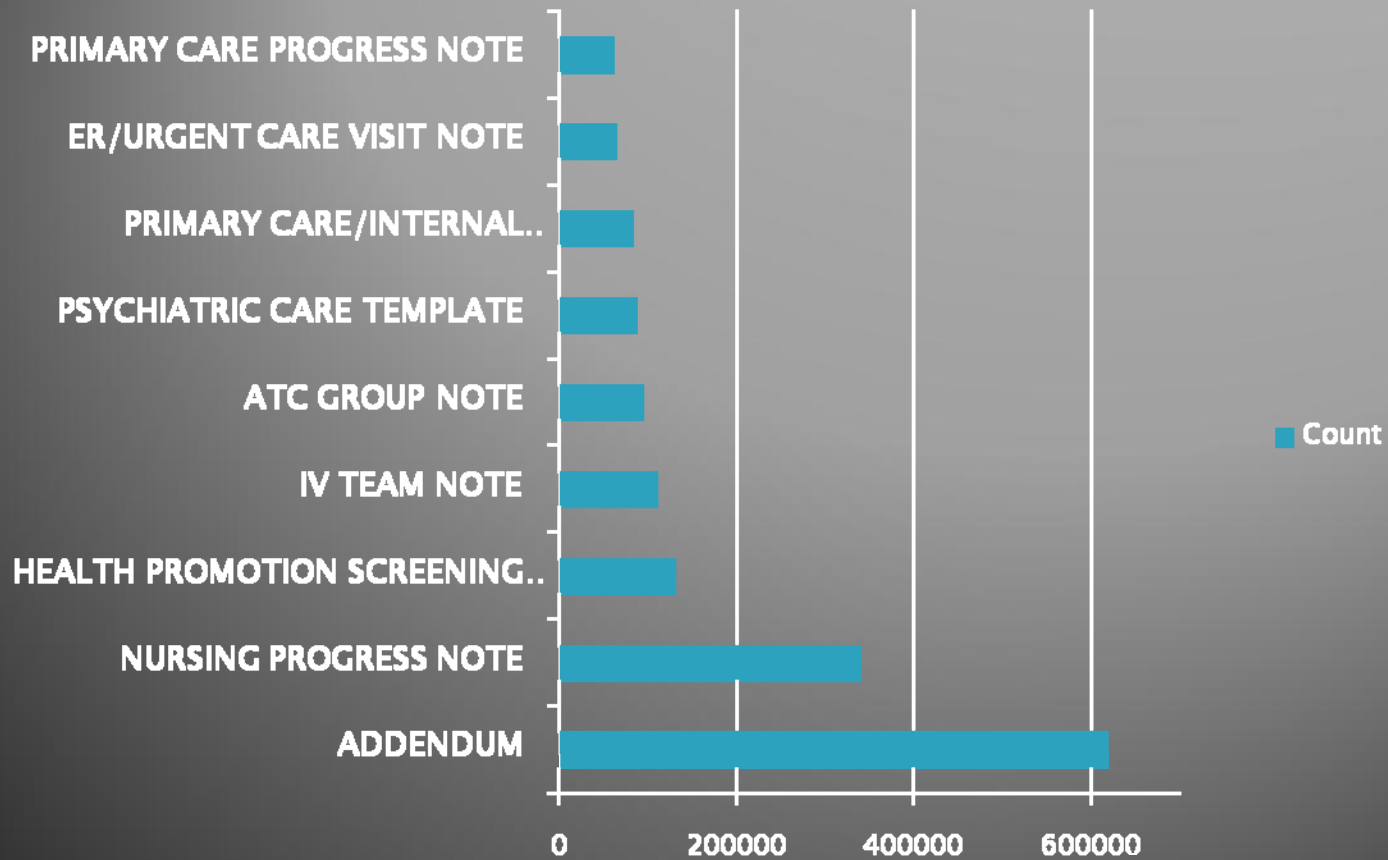


Tf*Idf vs. Title

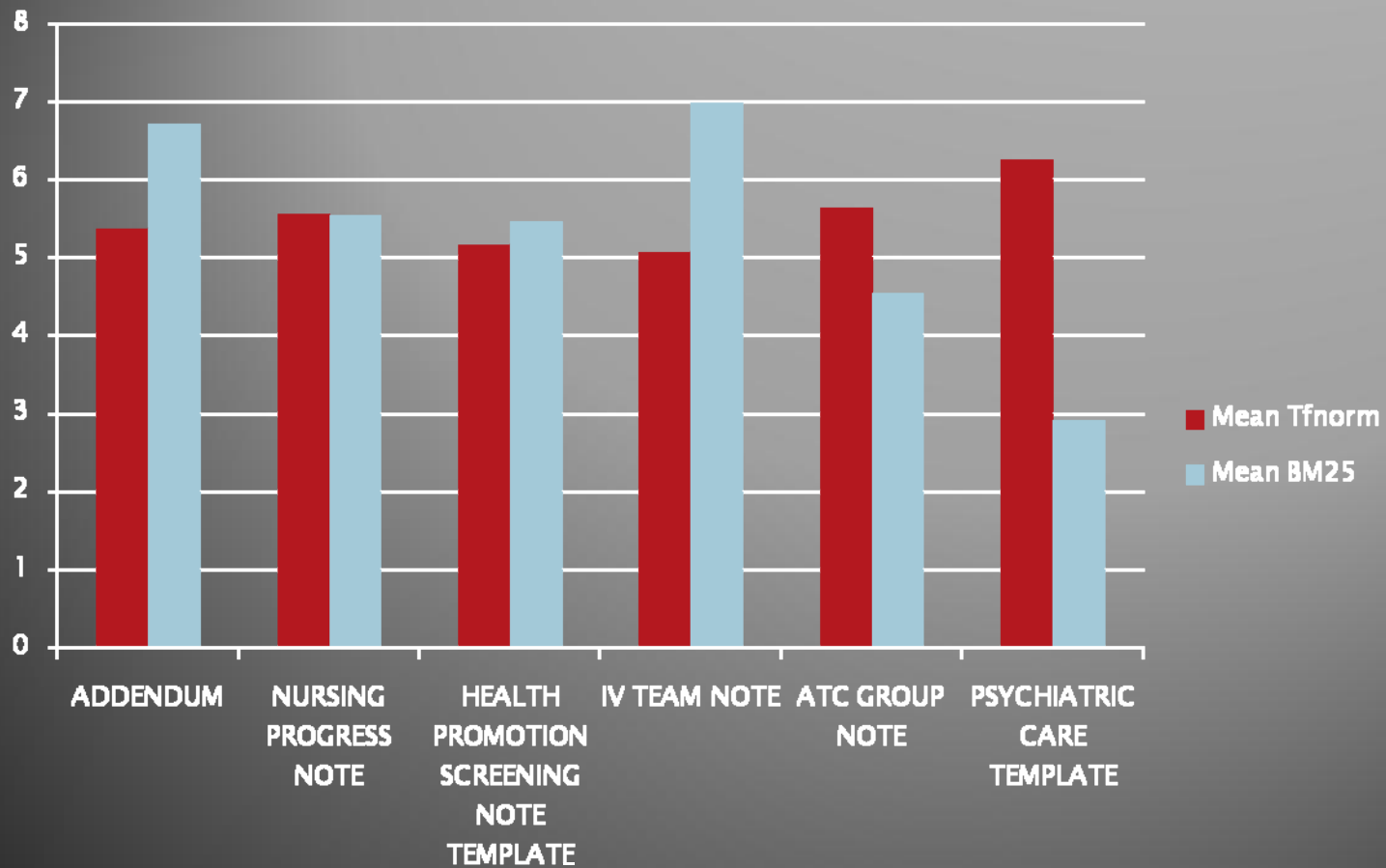
Mean Summed Tf*Idf



Document Count by Title

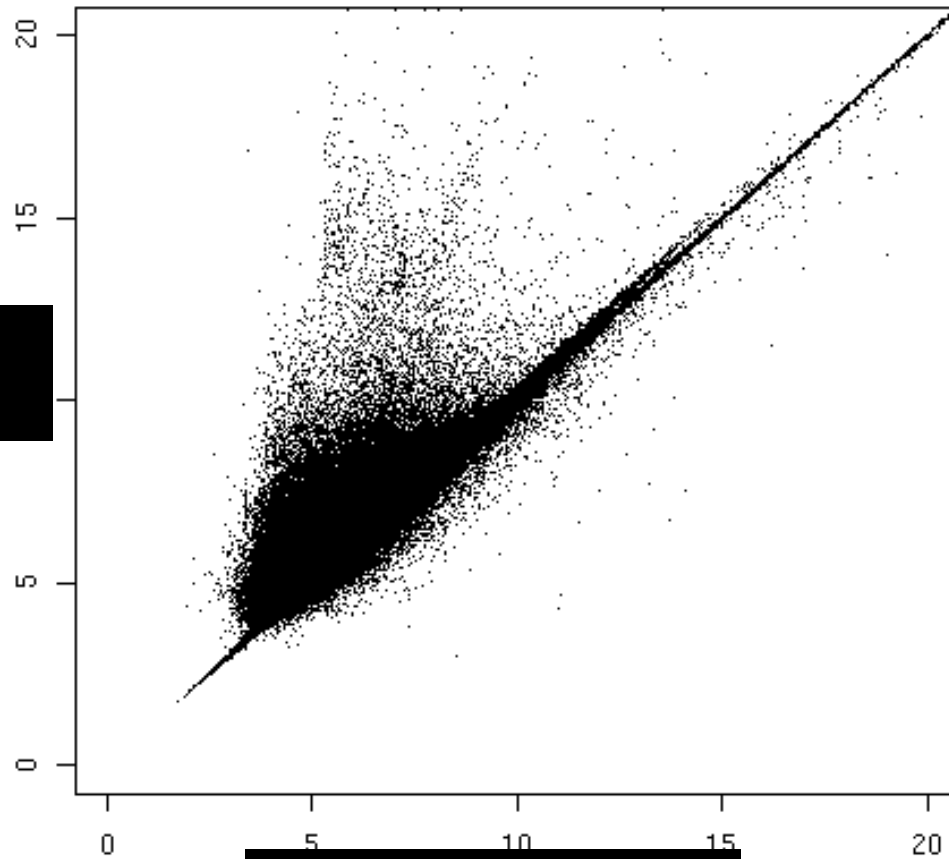


Tf*Idf vs BM25



Tf*Idf after combining Addenda with Parent

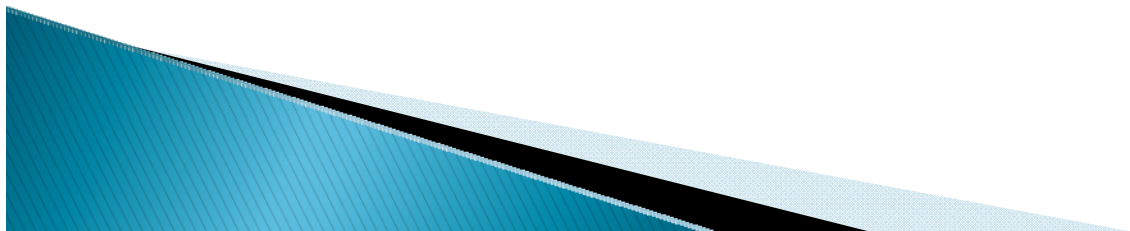
Tf*Idf concat



Tf*Idf original

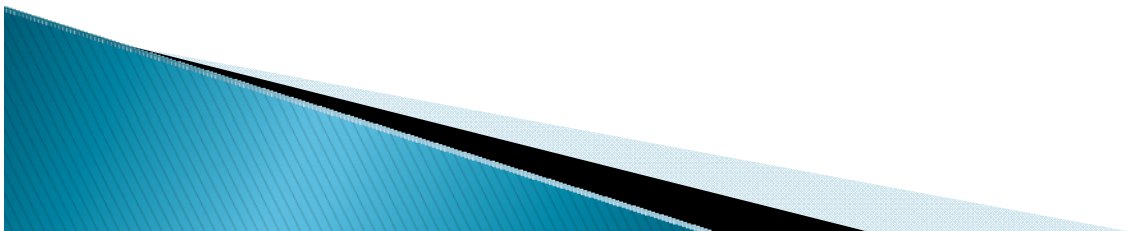
Other “value” features suggested by qualitative research

- ▶ Addendum Count
 - A measure of how often the document is “visited”
- ▶ Order Count
 - A measure of “decision intensity”
- ▶ Proportion of *Human-Authored Text*
 - “What was *that mind* thinking”
- ▶ How recent is the document?



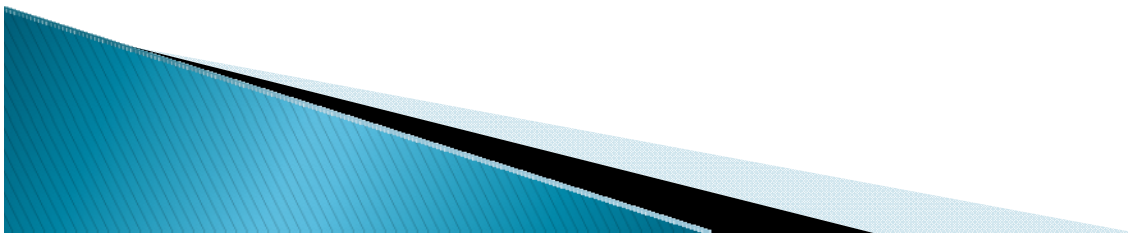
Qualitative Research

- ▶ Focus groups
 - 4 VA sites: Sea, Tac, Salt Lake, Cincinnati
 - Separate interviews with:
 - Administrative Staff who work with CPD
 - Nurses
 - Practitioners (MD, NP, PA)
 - 129 VA staff interviewed



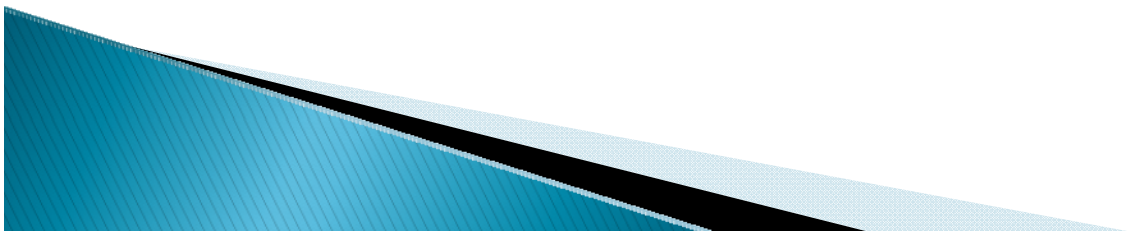
Theme Analysis

- ▶ Read, re-read transcripts
 - Collaborators: Charlene Weir, Peter Embi, Efthimis Efhimiadis, Stephen Thielke, Ashley Hedeem



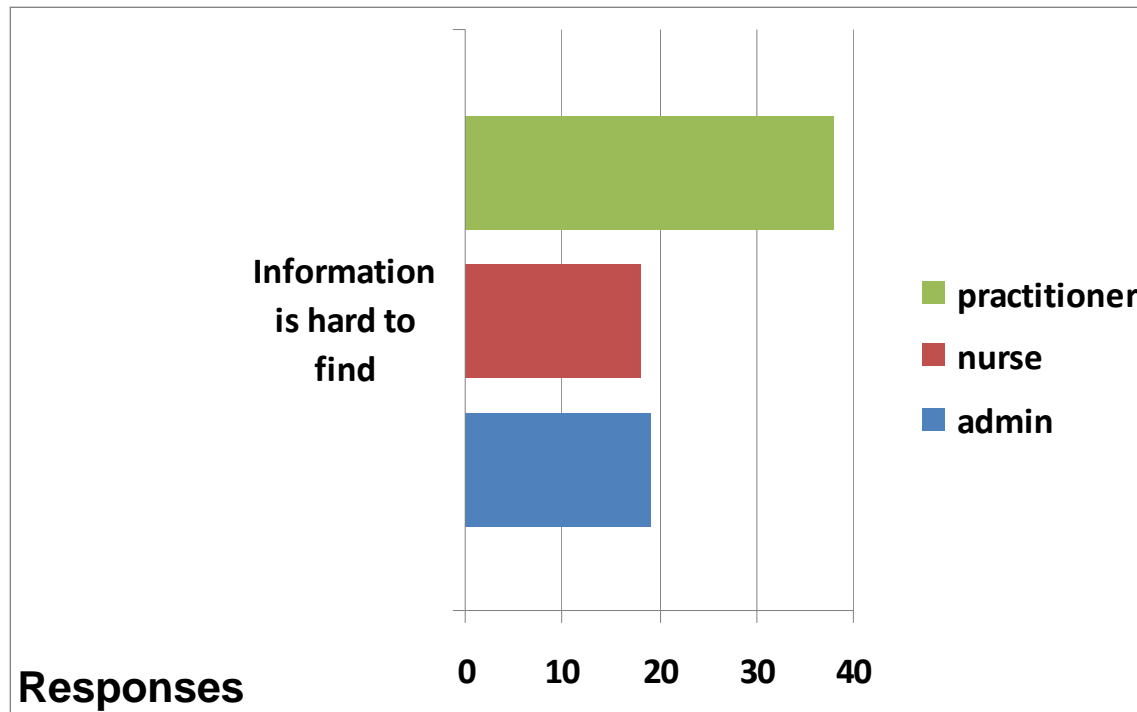
Emergent Themes

- ▶ CPD improves on paper
- ▶ Records are more accessible
- ▶ Managing information volume
- ▶ Data entry burden for authors
- ▶ Finding relevant information can be hard
- ▶ Integrating documentation with workflow
- ▶ Documentation is used to support communication but wasn't designed to do so
 - Ambiguous use of “additional signature” to flag importance to a co-worker

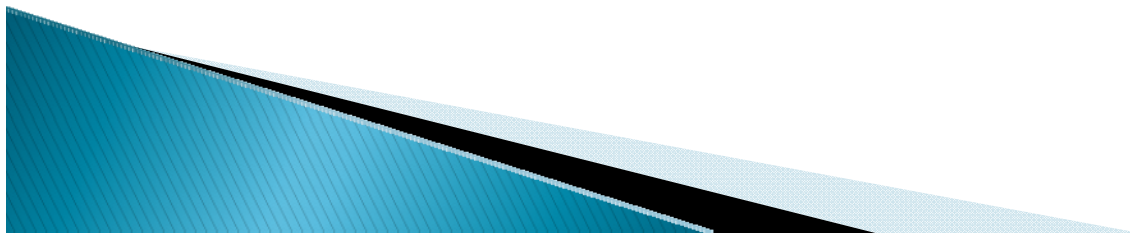
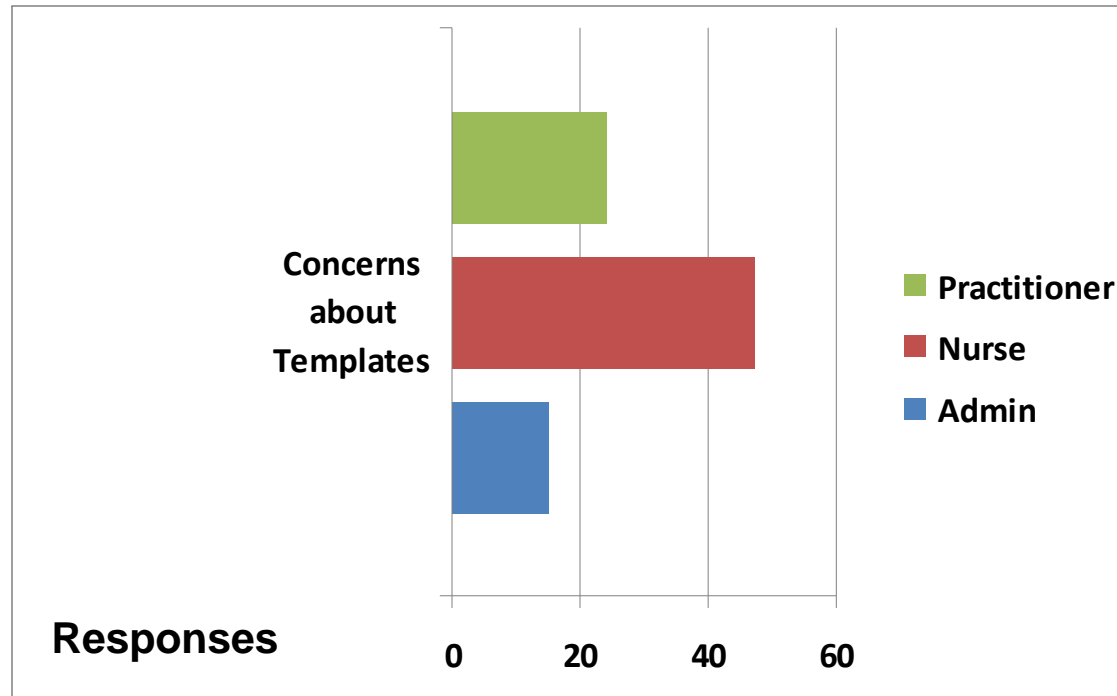


Differing Stakeholder Perspectives

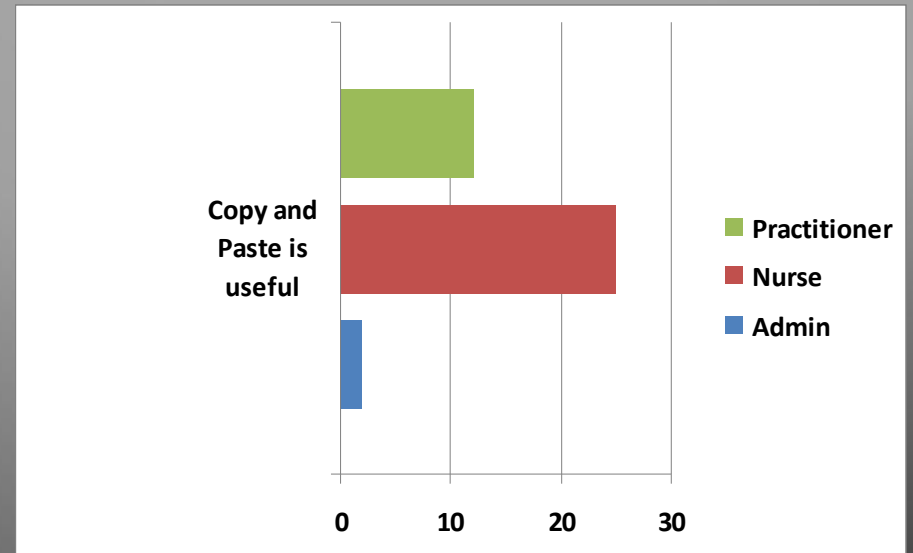
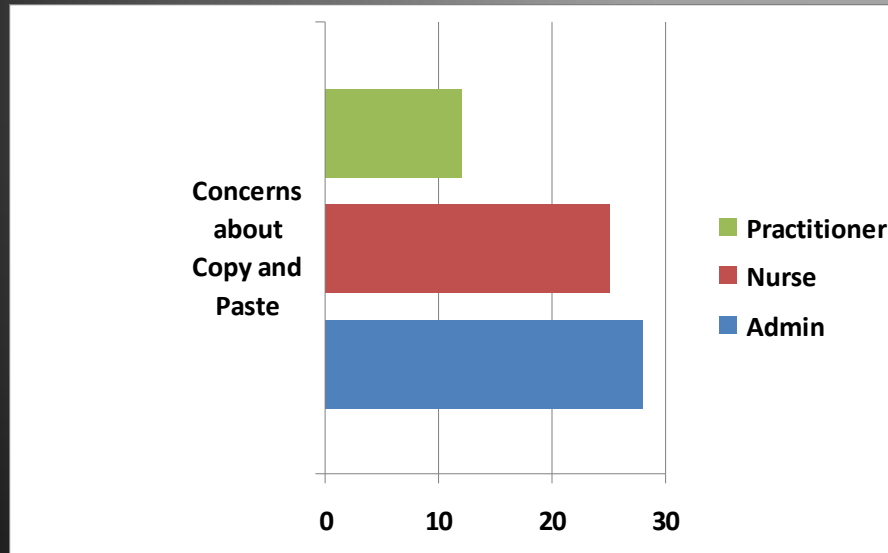
▶ Finding Information



Concerns about Templates



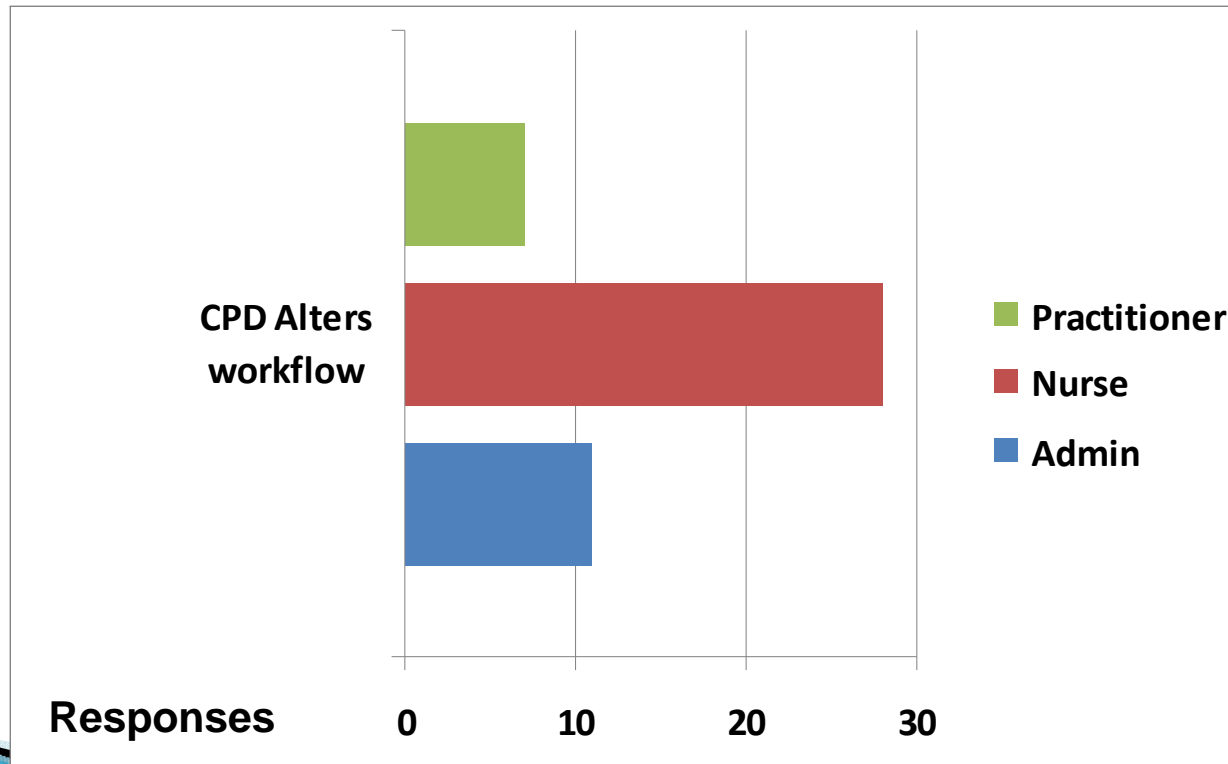
Copy and Paste



Responses

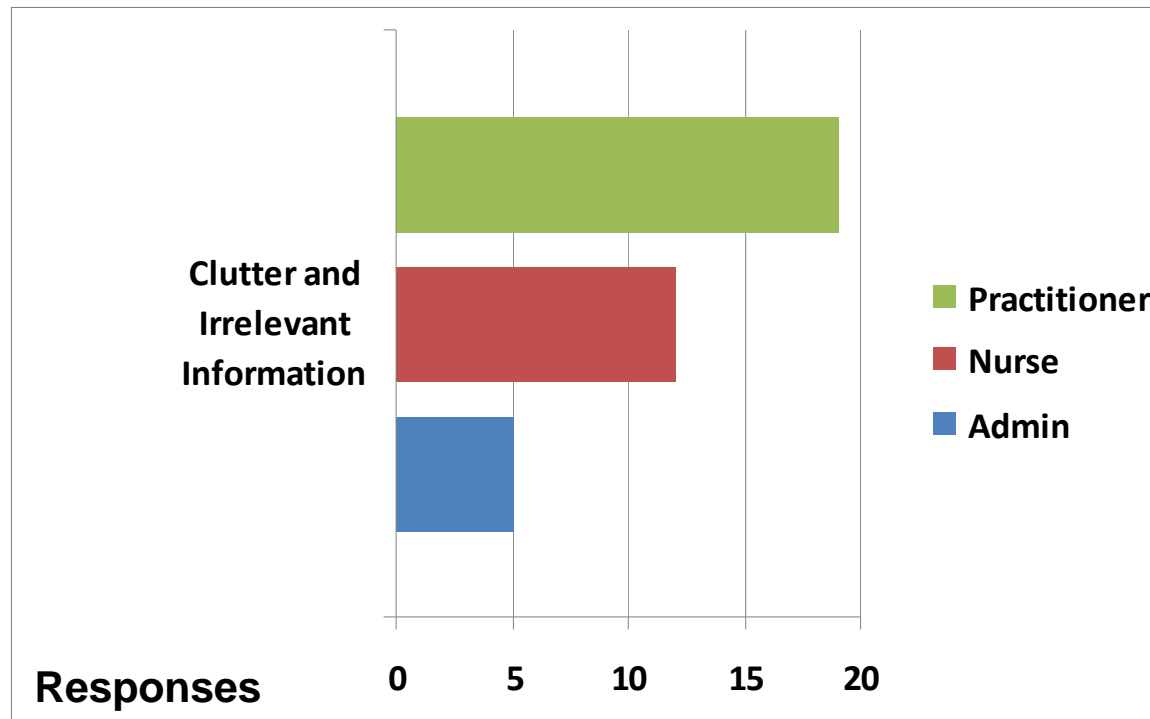
Workflow

- ▶ A major nursing concern



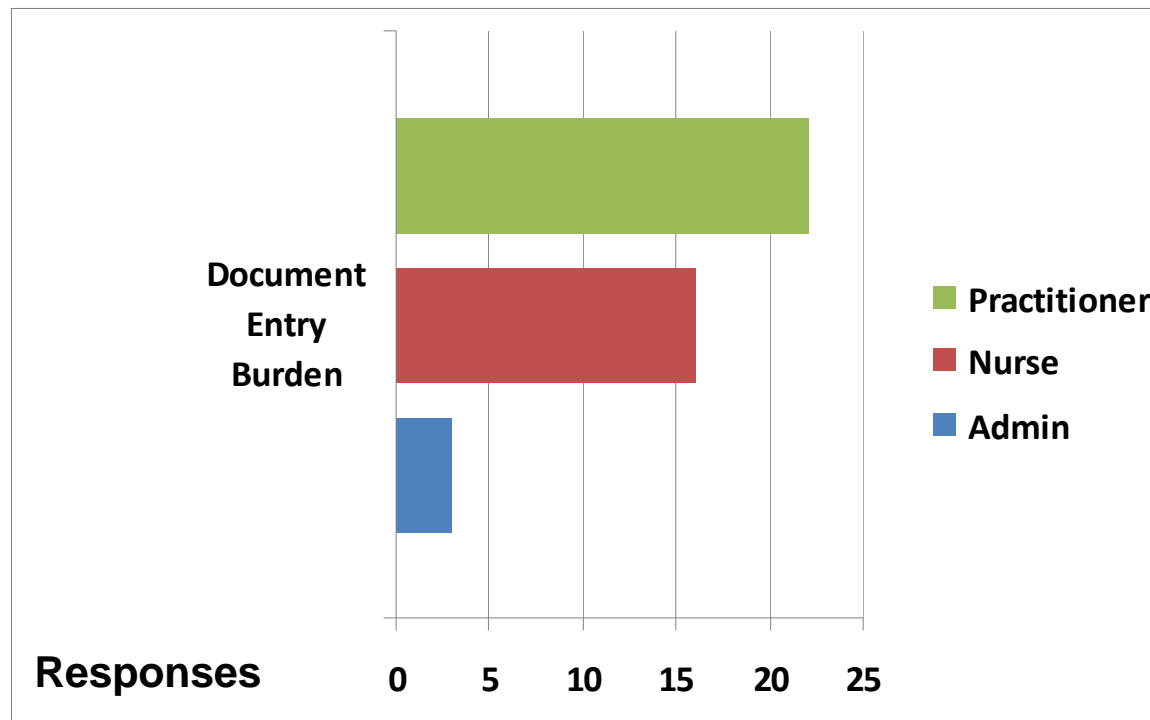
Clutter and Irrelevant Information

- ▶ A major practitioner concern

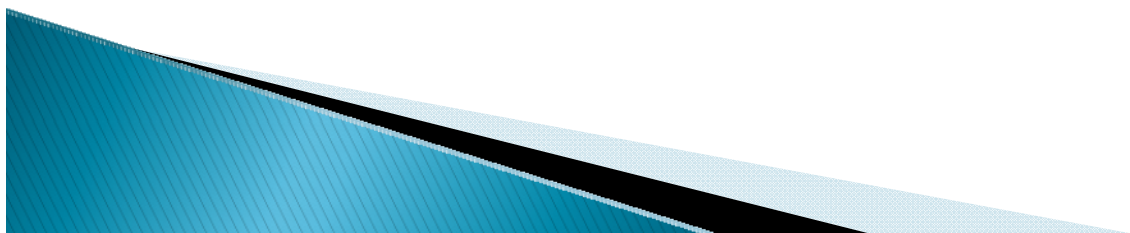
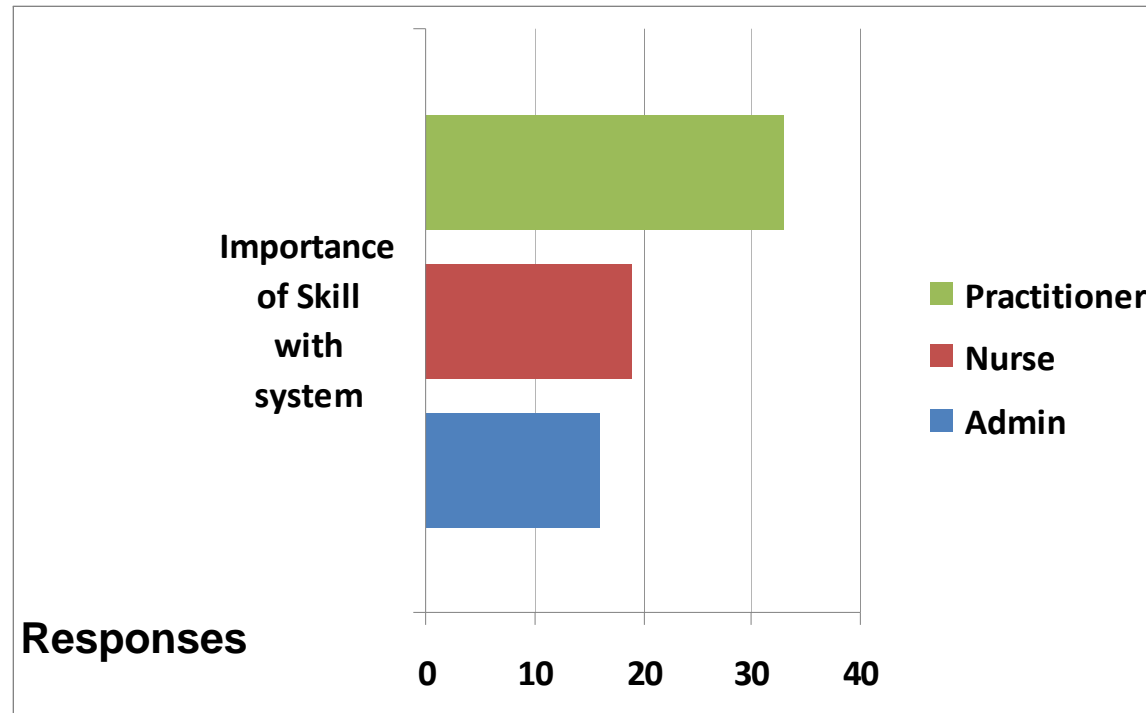


Document Entry

- ▶ Mainly affects the authors

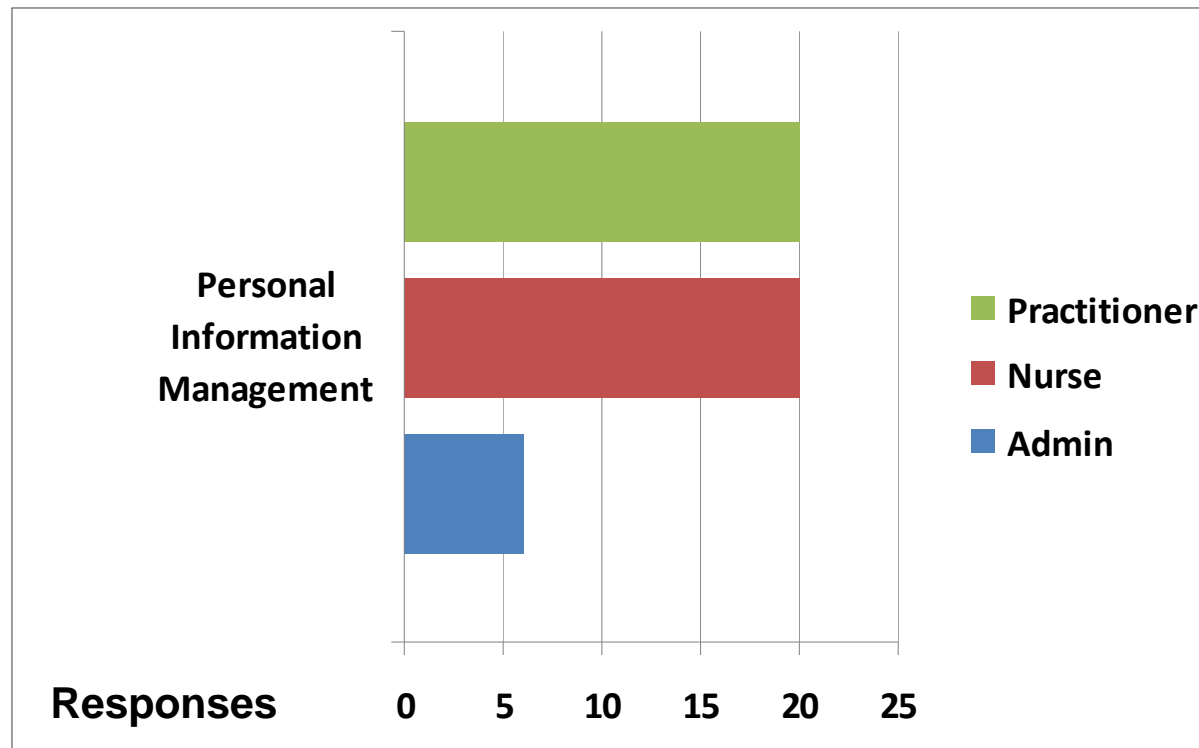


Need for skill and training

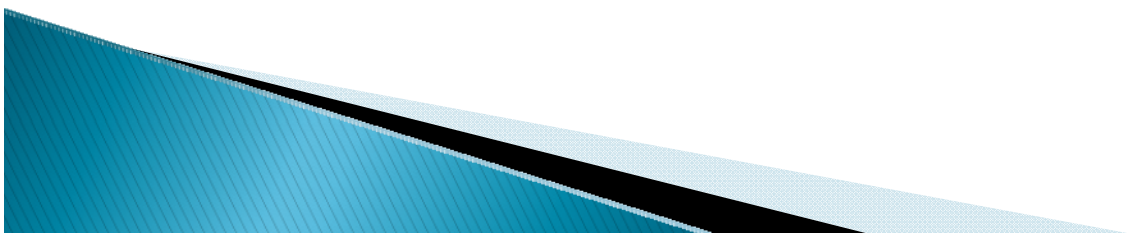
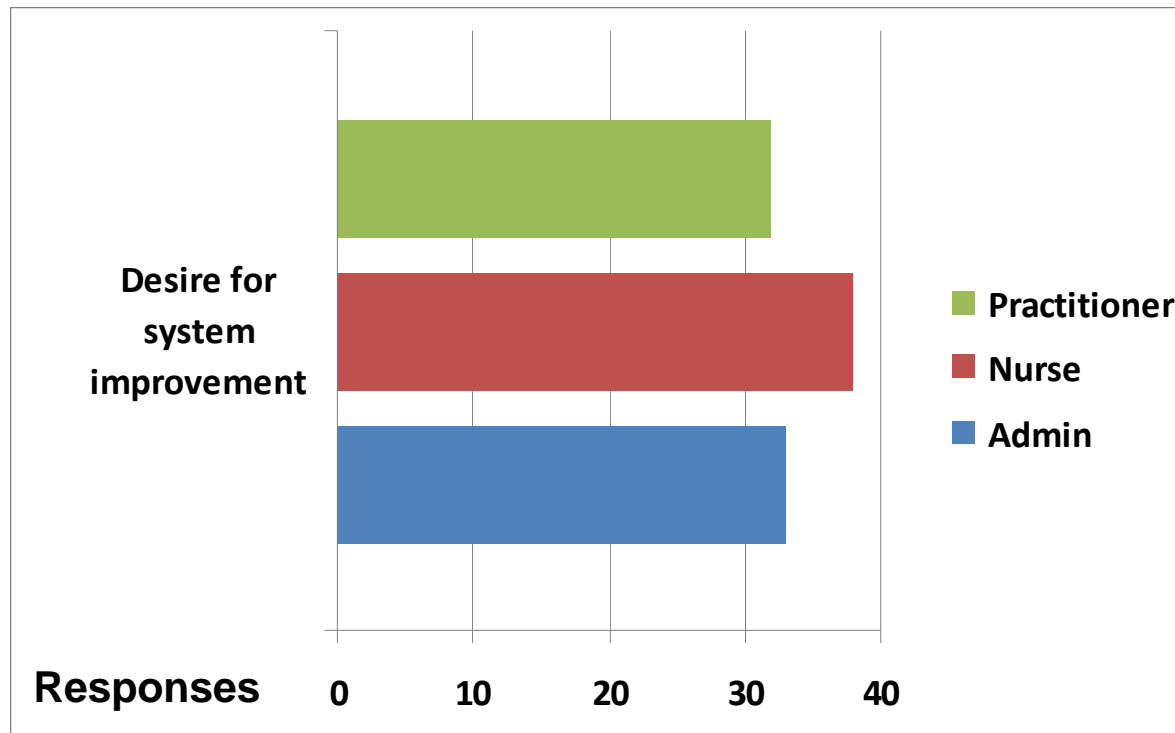


Personal Information Management

- ▶ Support needed



Everyone wants improvements

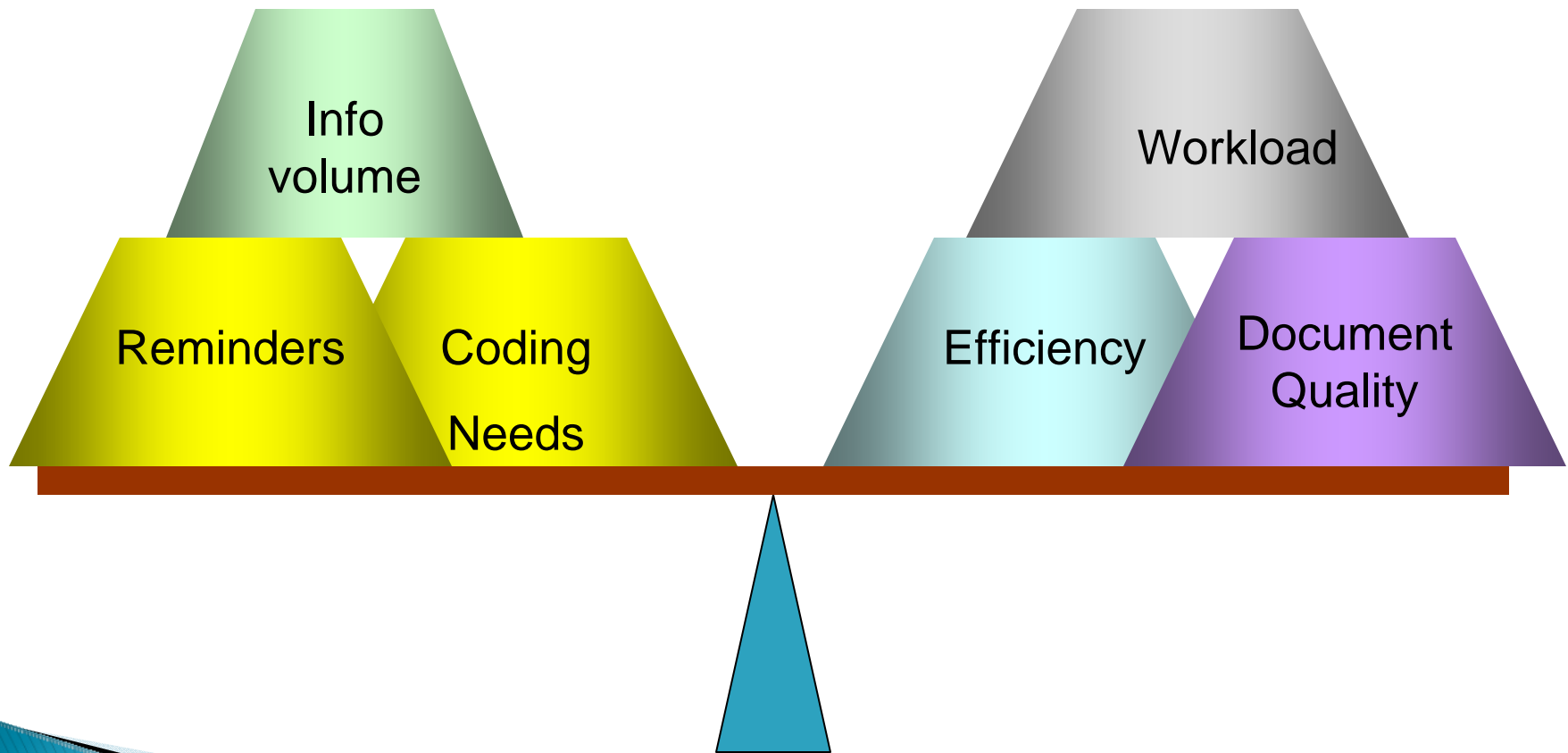


Interim conclusions

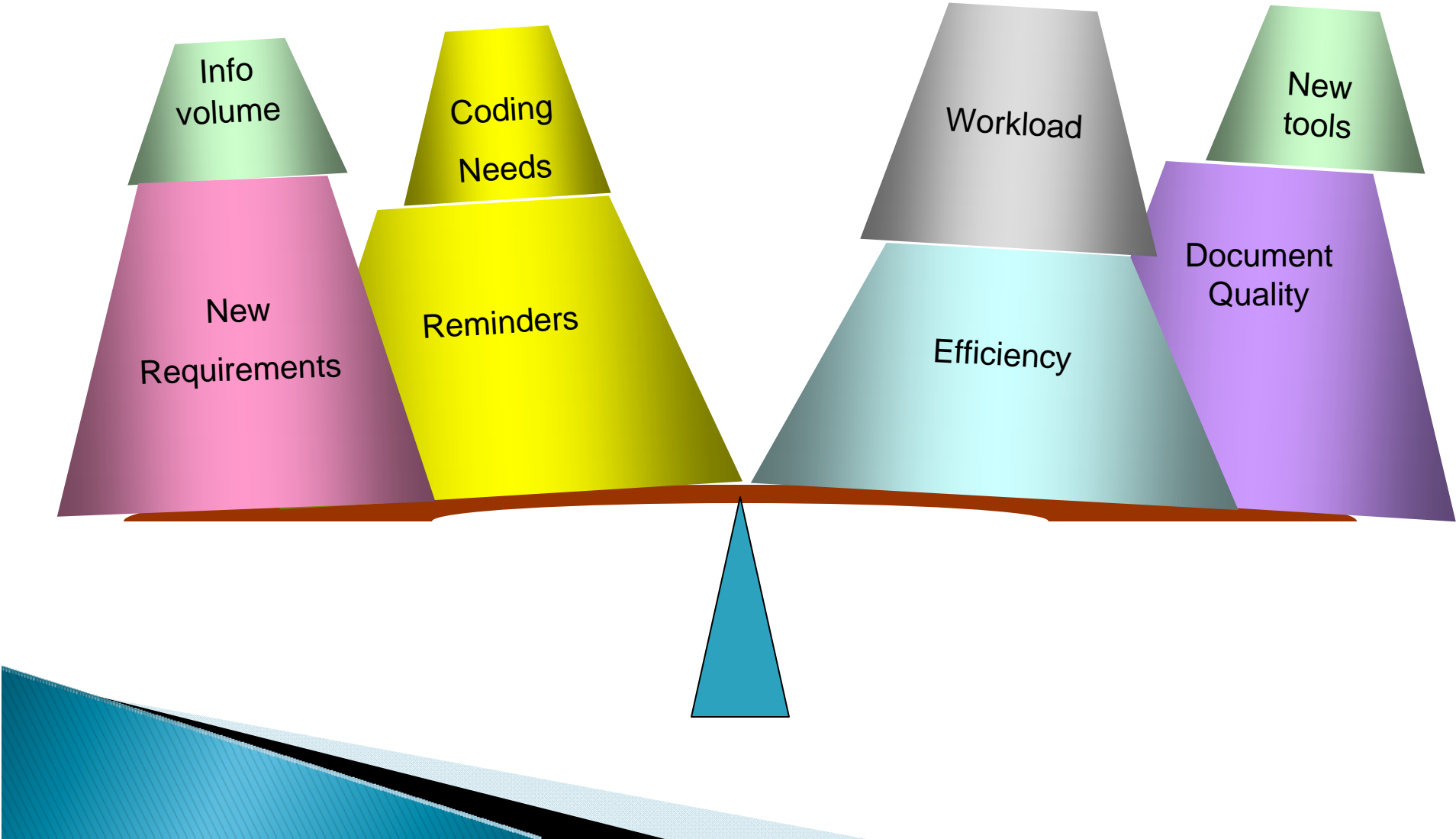
- ▶ Cognitive work analysis approach enriches understanding of the documentation process
- ▶ Communication is a key *undocumented* feature of documentation
- ▶ Need to balance administrative requirements for control and user requirements for flexibility
- ▶ Voice recognition may help reduce some of the “time-savers” that result in difficult text



Striking a balance

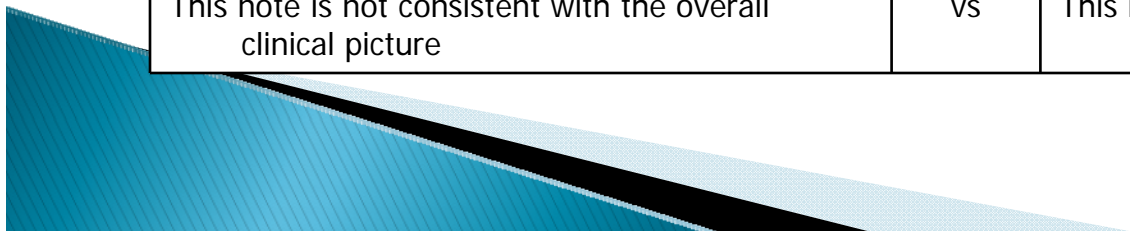


Strategies



Grounded Dimensions of Document Quality

This note doesn't tell me what's going on with the patient	vs	This note tells me what's going on with the patient
It's very difficult to skim to important information in this note	vs	It's very easy to skim to important information in this note
It's very difficult to distinguish the author's text from template text	vs	It's very easy to distinguish the author's text from template text
This note doesn't help me anticipate the needs of the patient	vs	This note helps me anticipate the needs of the patient
I always skip over this sort of note	vs	I always read this sort of note
I can't follow what the author was really thinking in this note	vs	I can follow what the author was really thinking in this note
I have to wade through this note to get what's important to me	vs	I don't have to wade through this note to get what's important to me
I doubt that this note is current	vs	I am sure this note is up to date
I don't trust the information in this note	vs	I trust the information in this note
This note is not consistent with the overall clinical picture	vs	This note is consistent with the overall clinical picture



Validation using a simulated EMR

- ▶ Web-based
- ▶ Realistic data

The screenshot displays a simulated EMR interface. At the top, a header bar includes patient information (Patient: Bren, 000-00-0000, 1941/11/22), provider information (7A GM 722-D, PROVIDER, NINE), a disclaimer, and navigation links (Flag, Remote Data, Postings CAD, Department of Veterans Affairs). The main content area is titled 'APR 04,07 PHYSICIAN DISCHARGE NOTE, RESIDENTONE,ORVA J'. On the left, a sidebar lists various medical notes. The central panel features a 'Quality Ratings' section with a 'neutral' rating and a series of Likert-scale questions with radio button options. Below this, a text box contains clinical data including admission and discharge dates, diagnoses, and a brief description of hospitalization.

Patient: Bren
000-00-0000
1941/11/22

7A GM 722-D
Provider:
PROVIDER, NINE

The disguised health care information displayed on these screens is based on actual data and is classified as sensitive. It is to be used only for the purposes of this research. Do not copy, print or otherwise disclose this information.

Flag Remote Data Postings CAD Department of Veterans Affairs

APR 04,07 PHYSICIAN DISCHARGE NOTE, RESIDENTONE,ORVA J

Quality Ratings

Click [Help](#) for instructions

neutral

This note doesn't at all tell me what's going on with the patient This note fully tells me what's going on with the patient

It's very difficult to skim to important information in this note It's very easy to skim to important information in this note

It's very difficult to distinguish the author's text from template text It's very easy to distinguish the author's text from template text

This note doesn't at all help me anticipate the needs of the patient This note fully helps me anticipate the needs of the patient

I always skip over this sort of note I always read this sort of note

I can't at all follow what the author was really thinking in this note I can fully follow what the author was really thinking in this note

I have to wade through this note to get what's important to me I don't have to wade through this note to get what's important to me

This note is incomplete (for this type of note) This note is complete (for this type of note)

I don't at all trust the information in this note I fully trust the information in this note

This note is not at all consistent with the overall clinical picture This note is fully consistent with the overall clinical picture

Date of Admission: MAR 28, 2007@01:00

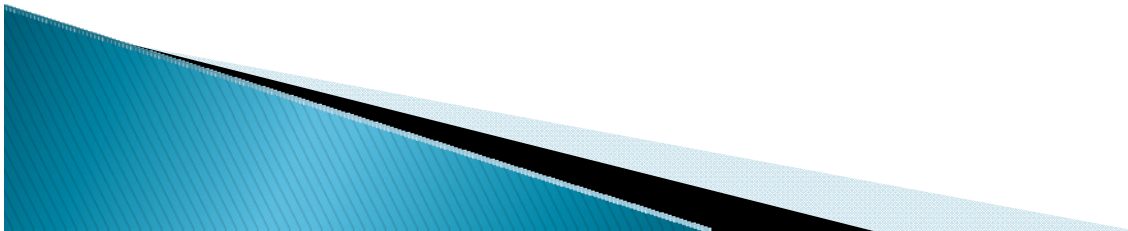
Date of Discharge: APR 04, 2007

Discharge Diagnoses: partial small bowel obstruction, GERD, septic right knee, anxiety

Brief Description of Hospitalization: 65 yo admitted for LUQ abdominal pain, nausea, emesis x1, and diarrhea. Abd xrays consistent with partial SBO, with dilated bowel and gas in distal colon. Pt kept NPO and continued to have loose BMs. Advanced to clear then regular diet and tolerated well. Abdominal pain has declined. Diarrhea has improved, and was negative for clostridium difficile x2. Had an RBC on 4/4 which

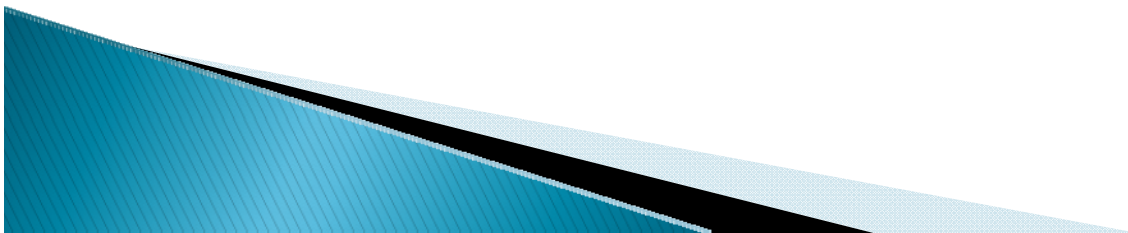
Design of simulation study

- ▶ Balanced incomplete block design
- ▶ 1 / 3 of users see 1 / 3 of documents in one of 3 forms:
 - “Native”
 - “Expanded”
 - “Short”
- ▶ Powered to detect a “main effect” between Native, Expanded and Long forms as measured by the quality dimensions elicited from the focus groups and literature



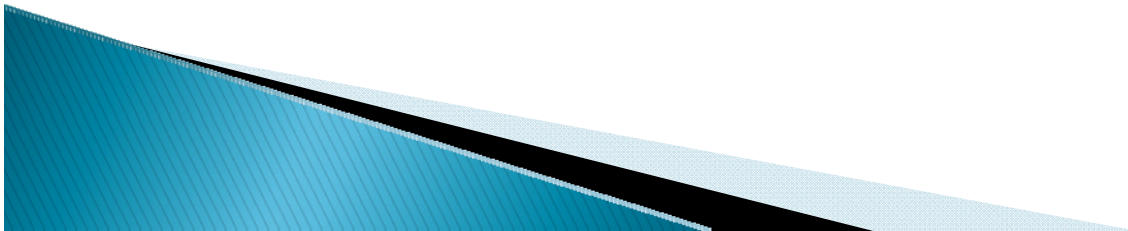
Native

- ▶ De-identified documents as they appear in CPRS



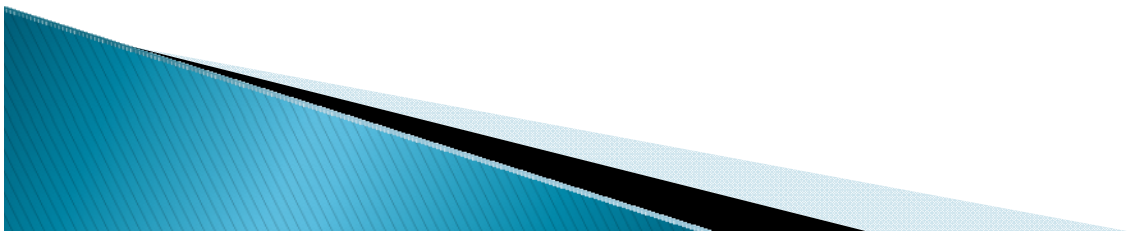
Expanded

- ▶ Based on Native Document
- ▶ Maximal insertion of
 - Medication lists
 - Problem lists
 - Lab values
 - Longest form of vital signs
 - All reminders and signature blocks



Short Form

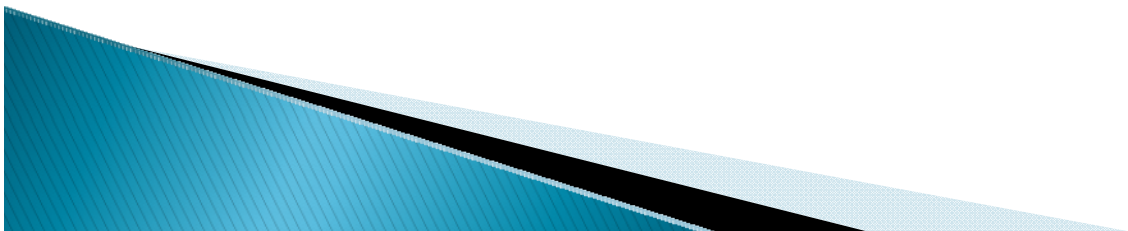
- ▶ Omit information available elsewhere in the EMR:
 - No title and signature blocks
 - Only abnormal lab values
 - Suppress medication and problem lists
 - Suppress boilerplate



Block design

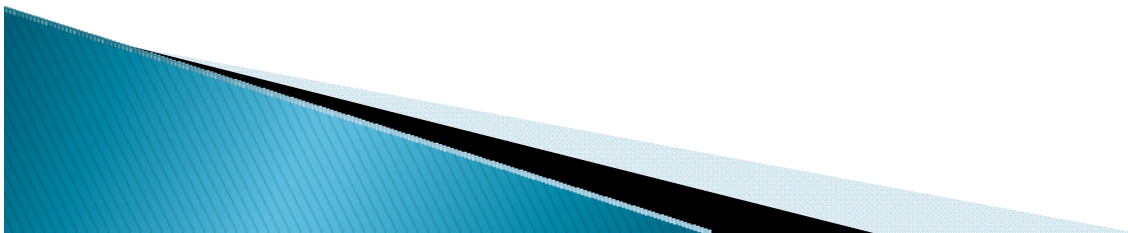
For each subject within a role (practitioner, nurse, administrator), a Latin square determines the form of the note to be presented in a balanced design. One third of the subjects in a role are in group A, 1/3 in group B, 1/3 in group C

Note	User Group A	User Group B	User Group C
1	Native version	Short Version	Expanded Version
2	Expanded Version	Native version	Short Version
3	Short Version	Expanded Version	Native version



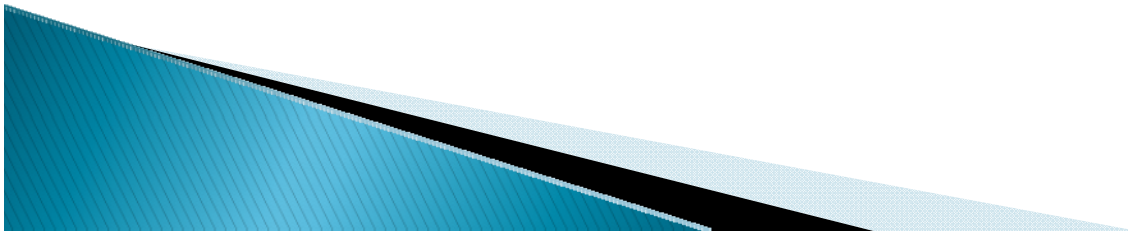
Response Rates

- ▶ 3 months at Puget Sound:
 - 20 nurses completed: 74% of those asked
 - 19 admin: 69% of those asked
 - 15 practitioners: 25% of those asked
- Harder to recruit practitioners



Current Research Direction

- ▶ Compare relevance statistics with user ratings
- ▶ Compare relevance statistics with systematic alterations of base documents
- ▶ Assess feasibility of a relevance filter
- ▶ Add other “features” to relevance score:
 - Number of addenda
 - Number of orders associated with a document



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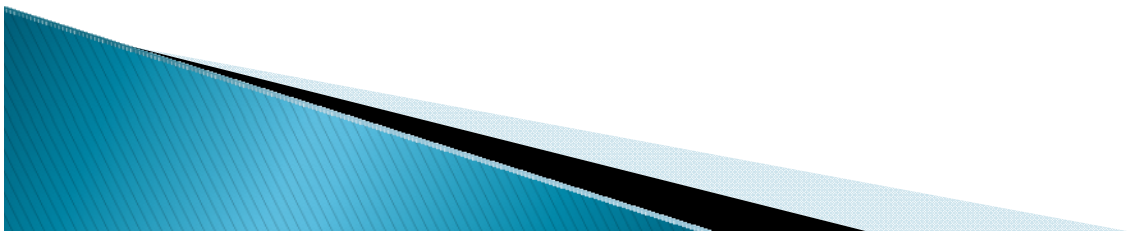
Ryan Laundry, UW i-School

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