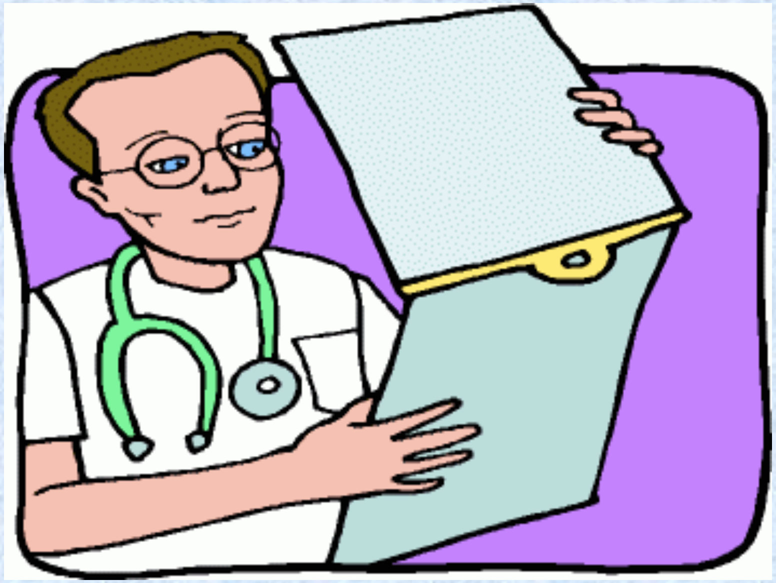
Clinical Decision Support Track Overview



Matthew Simpson

Ellen Voorhees

William Hersh

Motivation for CDS Track

- Major emphasis on Health IT
  - goal to improve patient outcomes and reduce costs
- Clinical decision support systems
  - one piece of the target infrastructure
  - aim to anticipate physicians' needs by linking health records to information needed for patient care
  - some of that info comes from biomedical literature
- Existing biomedical literature immense, and growth accelerating
  - difficult/impossible for clinicians to keep abreast

CDS Track Task

Given a case narrative, return biomedical articles that can be used to accomplish one of three generic clinical tasks:

- What is the diagnosis?
- What is the best treatment?
- What test should be run?

[Note: For the systems, this is an ad hoc document retrieval task, not a question answering task.]

CDS Track Task

- Documents:
  - open access subset of PubMed Central, a digital database of freely-available full-text biomedical literature
  - track used subset as defined on Jan 21, 2014
  - contains 733,138 articles in NXML
  - images and other supplementary material available, though not included in basic release

CDS Track Task

- 30 topics
  - case narratives plus label designating which basic clinical task the topic pertains to
  - developed by physicians at NIH
  - 10 topics for each clinical task type
  - each topic statement includes both a “description” of the problem and a shorter, more focused “summary”
  - case narratives used as an “idealized” medical record since no collections of actual medical records available for use

Sample Topics

```
<topic number="3" type="diagnosis">
  <description>A 58-year-old nonsmoker white female with mild exertional dyspnea
and occasional cough is found to have a left lung mass on chest x-ray. She is
otherwise asymptomatic. A neurologic examination is unremarkable, but a CT scan
of the head shows a solitary mass in the right frontal lobe.</description>
  <summary> 58-year-old female non-smoker with left lung mass on x-ray. Head
CT shows a solitary right frontal lobe mass.</summary>
</topic>

 <topic number="13" type="test">
  <description>A 30-year-old generally healthy woman presents with shortness of
breath that had started 2 hours before admission. She has had no health problems
in the past besides 2 natural abortions. She had given birth to a healthy child 3
weeks before. On examination, she is apprehensive, tachypneic and tachycardic,
her blood pressure is 110/70 and her oxygen saturation 92%. Otherwise, physical
examination is unremarkable. Her chest x-ray and CBC are normal.</description>
  <summary>30-year-old woman who is 3 weeks post-partum, presents with
shortness of breath, tachypnea, and hypoxia.</summary>
 </topic>
```

Runs

- Ranked list of up to 1000 docs per topic
- Standard two run types:
  - automatic: no human intervention from input of topic statement to output of ranked list
  - manual: everything else
- A given run must use the same topic type (summary vs. description) for all topics
- Max of 5 runs per participant

Participating Groups

26 groups participated in the track

Atigeo

Beijing U. of Posts and Telecommunications

BiTeM_SIBtex team, Geneva

The Chinese University of Hong Kong

CRP Henri Tudor

Dhirubhai Ambani Institute of Information & Communication Technology

East China Normal University

Georgetown University (2 groups)

Indian Institute of Technology, Varanasi

Institute of Medical Informatics, NCKU

JHU Human Language Technology CoE

Korea Institute of Science & Technology Information

LIMSI-CNRS

Medical Imaging Informatics, UCLA

Merck KGaA

Oregon Health & Science University

Philips

San Francisco State University

Seoul National University College of Medicine

University of Delaware

University of Michigan

Universidade Nova Lisboa

University of Texas at Dallas

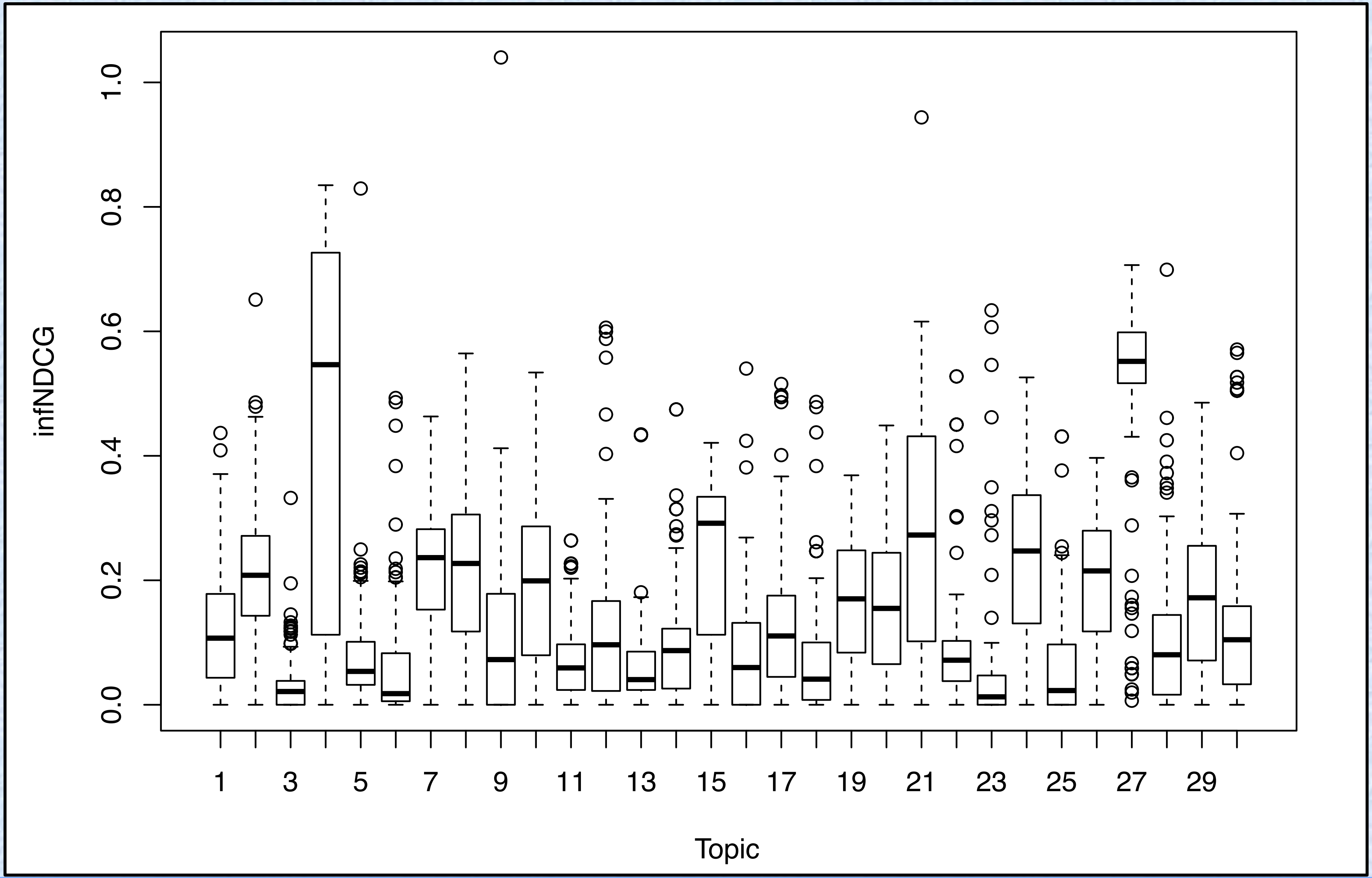
Vienna University of Technology

York University

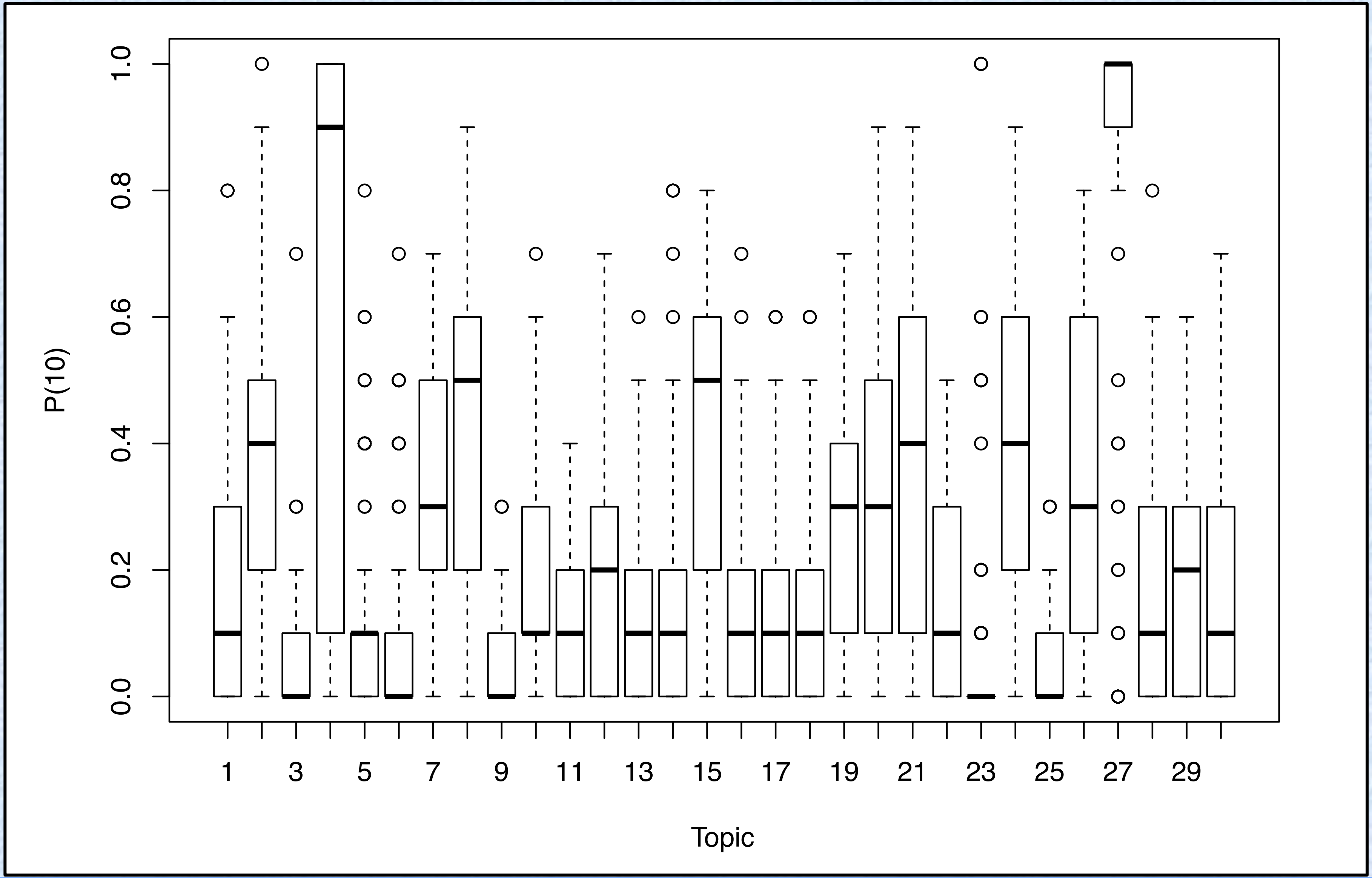
Relevance Judgments

- Judgments made by physicians
  - process overseen by OHSU
  - judge generally not topic author
- Judgment sets based on stratified samples
  - documents in top 20 ranks from all 102 runs, plus
  - 20% random sample of the set of docs retrieved between ranks 21—100 inclusive by some run
  - 37,949 topic-doc pairs to be judged (min: 908, max: 1669, mean: 1264.97 over topics)
- All docs in set judged on three-way scale
  - not relevant, possibly relevant, definitely relevant
- 8 topics fully double-judged

Per-Topic infNDCG(100) Scores



Per-Topic Prec(10) Scores



Notable Topics

Easiest (best median & best best infNDCG score)

4: *4-year-old boy with fever, conjunctivitis, strawberry tongue, desquamation of the fingers and toes* [diagnosis]
9: *soft, flesh-colored, pedunculated lesions on neck* [diagnosis]

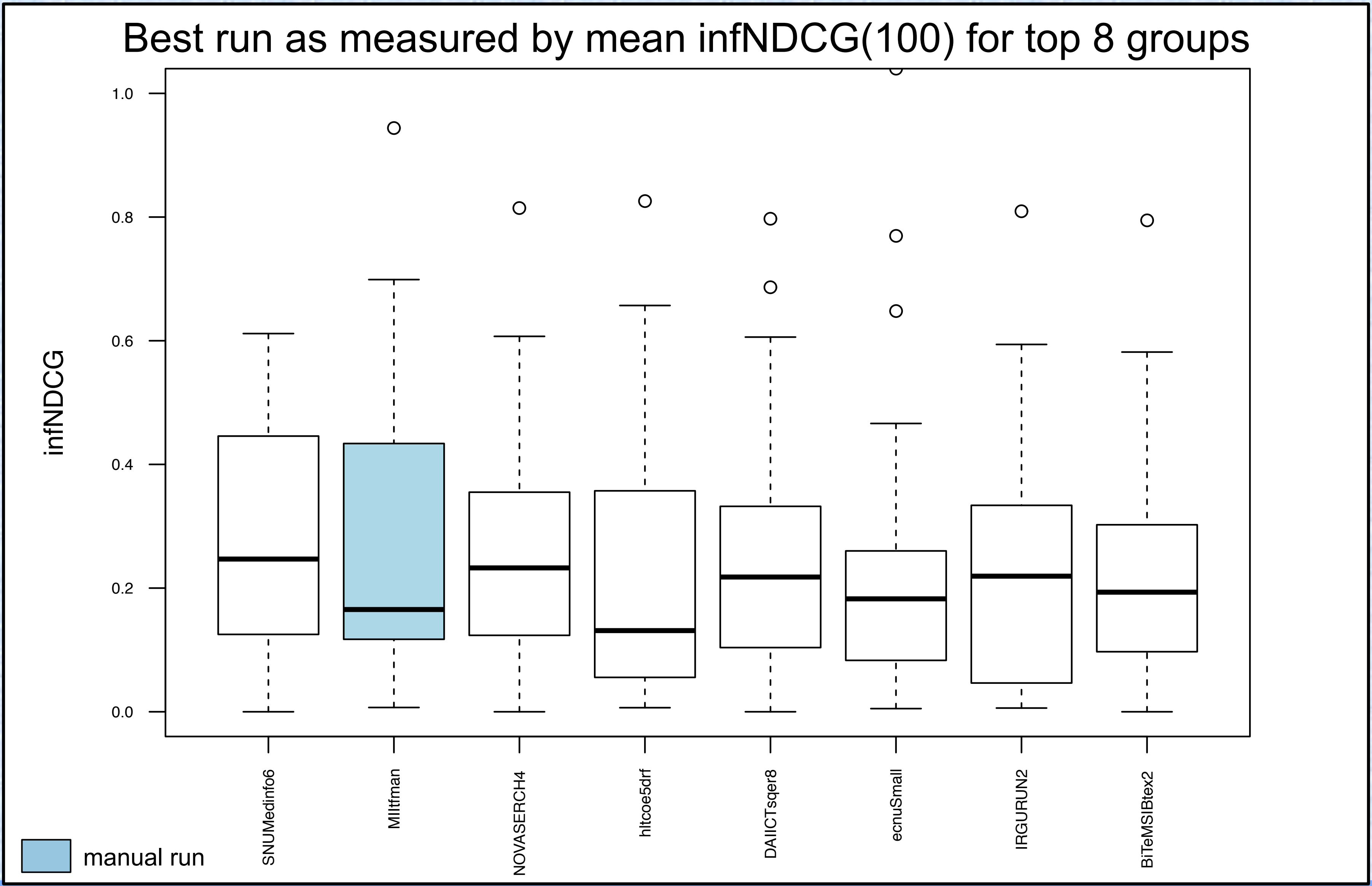
Hardest (worst median & worst best infNDCG score)

23: *heavy smoker with productive cough, shortness of breath, tachypnea, and oxygen requirement* [treatment]
11: *severe right arm pain and hypotension* [test]

Large differences between best & median infNDCG

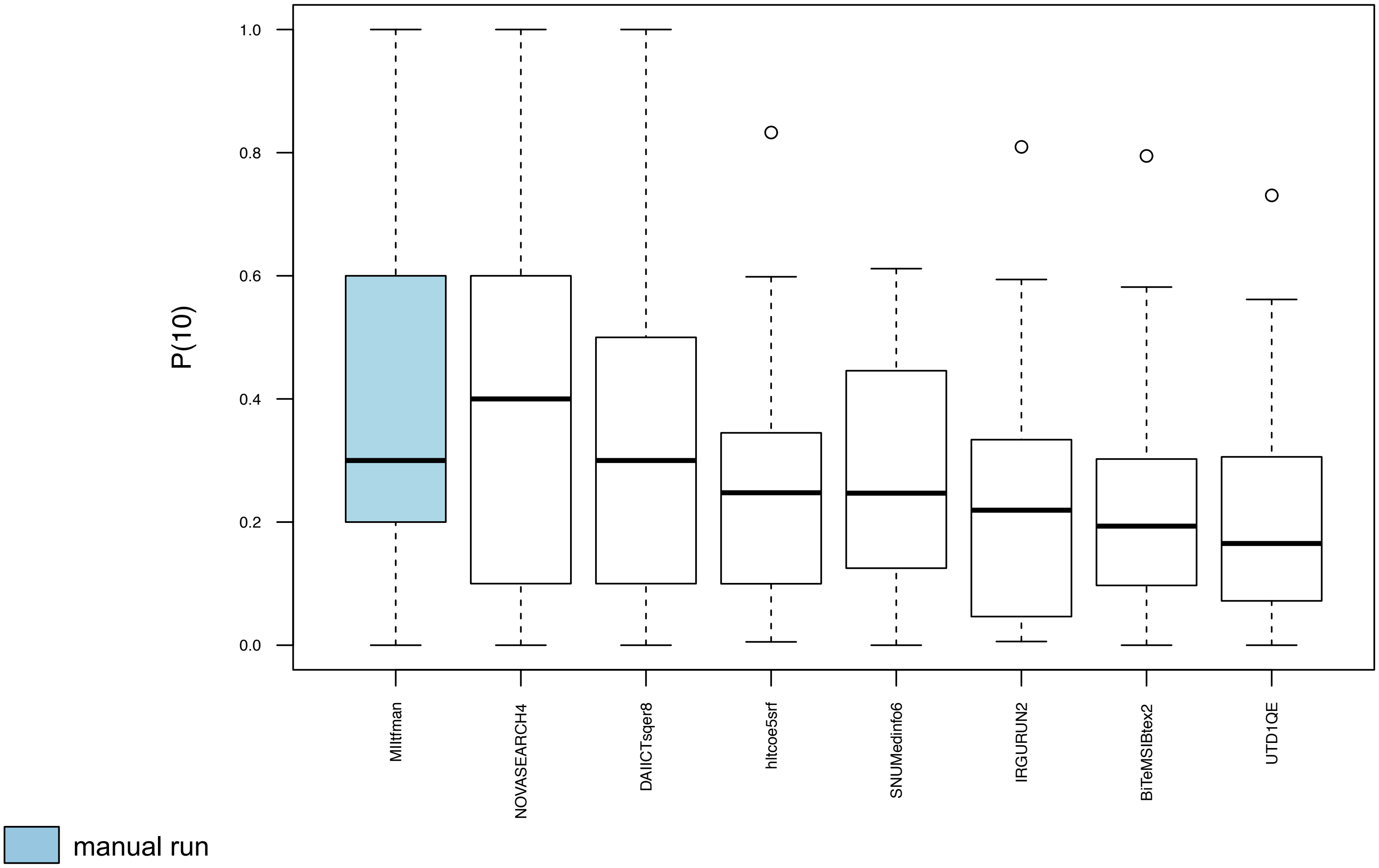
5: *shortness of breath 3 weeks after surgical mastectomy* [diagnosis]
21: *progressive arthralgias, fatigue, and butterfly-shaped facial rash* [treatment]

Evaluation of Top Runs

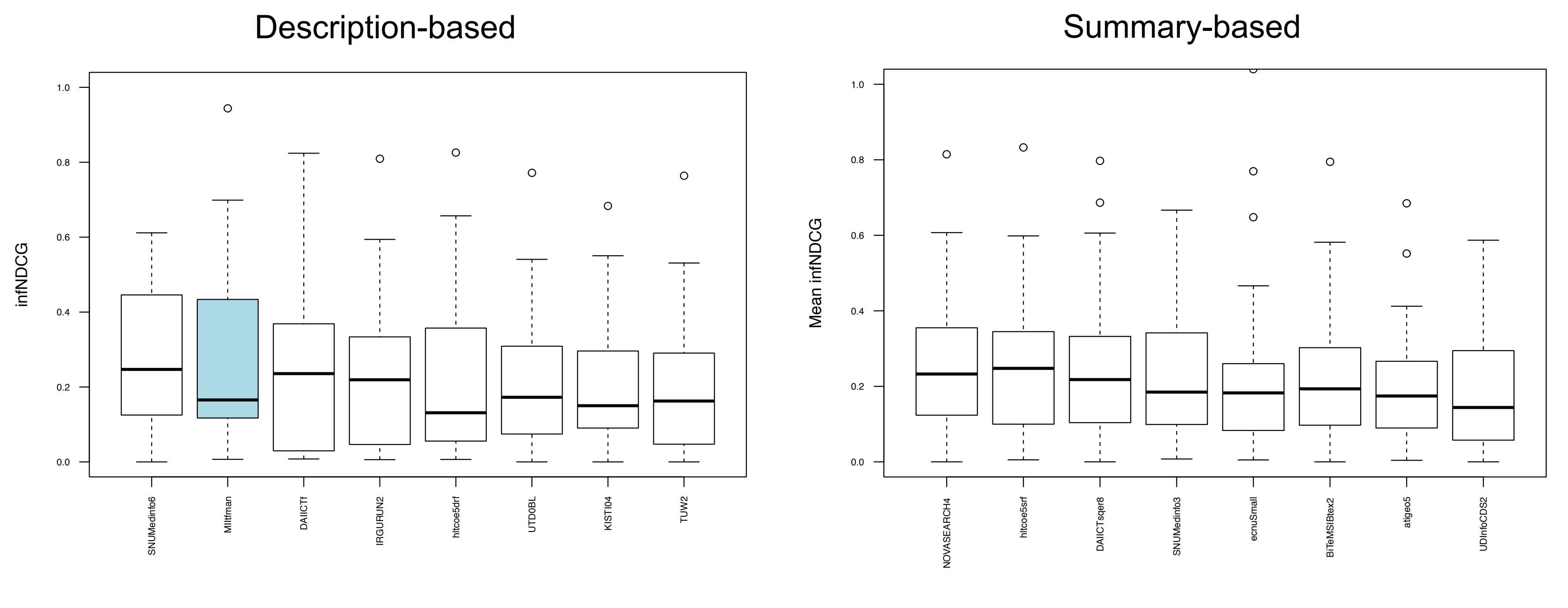


Evaluation of Top Runs

Best run as measured by mean Prec(10) for top 8 groups



Description vs. Summary



Description-based

Summary-based

Best run by infNDCG for top 8 teams over only description-based or only summary-based runs

For many teams, a summary run is better than the corresponding description run, but best mean infNDCG run overall is a description-based run

Dual-judged Topics

Topic	NN	NR	RR	RN	Overlap
1	1349	32	35	47	0.3070
5	1360	1	14	119	0.1045
12	838	17	114	508	0.1784
17	1040	53	13	6	0.1806
19	977	25	70	134	0.3057
25	1351	70	28	6	0.2692
27	437	17	296	158	0.6285
28	1070	10	35	17	0.5645
Mean					0.3173

- 8 topics independently judged by two assessors
- Overlap of relevance sets on low side
  - but not outside of bounds seen in previous studies
  - lack of high-overlap single topics, but sample is small
- Anecdotal evidence confirms clinicians vary in their opinions of salient facts

Conclusion

- First year of CDS track
    - retrieval results suggest retrieval task is challenging, but doable
- User model
    - some debate over realism of the user task
        - in any case, technology developed will have wider applicability than track's task
    - demonstration that clinical decisions at least as subjective as other relevance decisions