

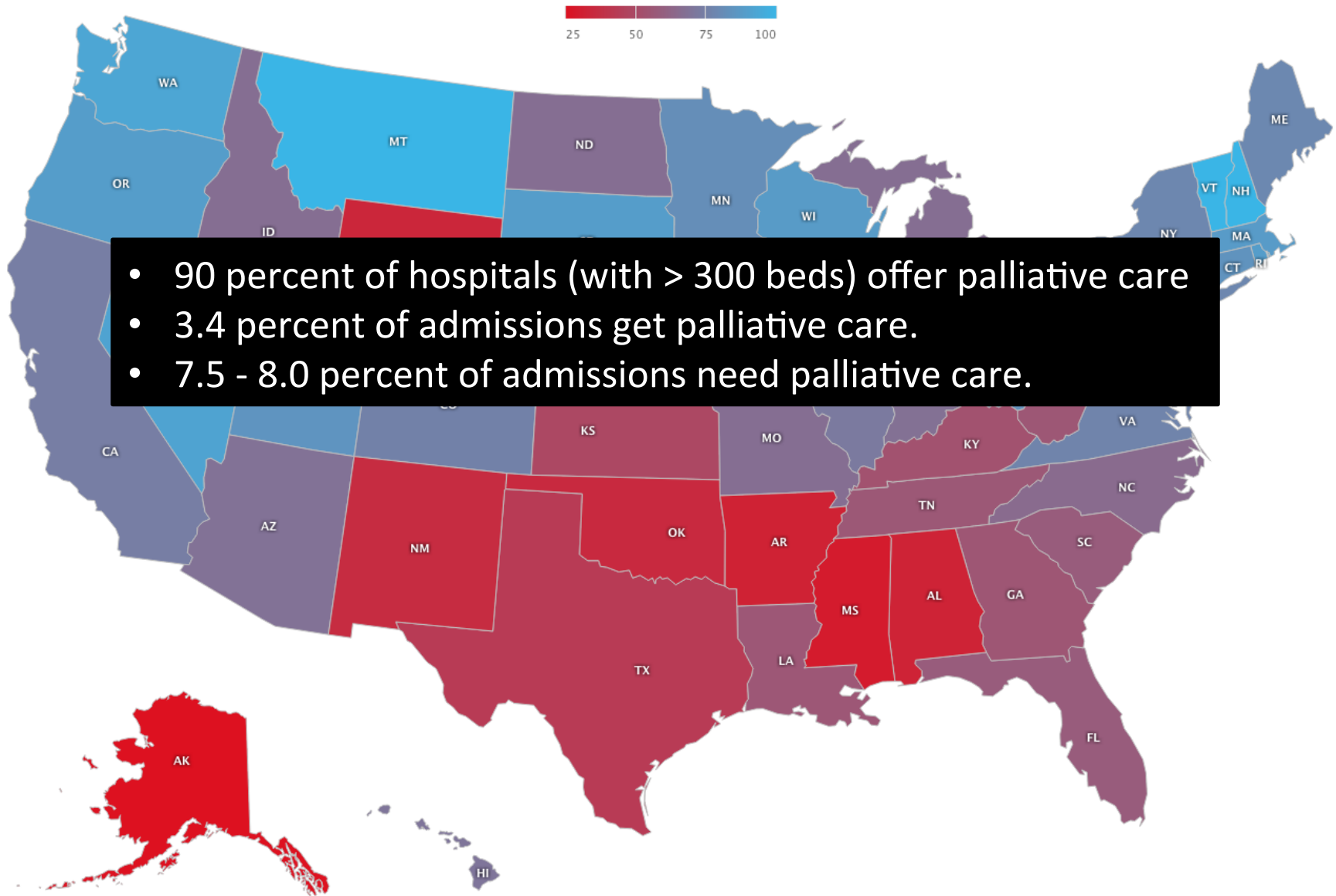


# Improving Palliative Care Using Patient Level Prediction

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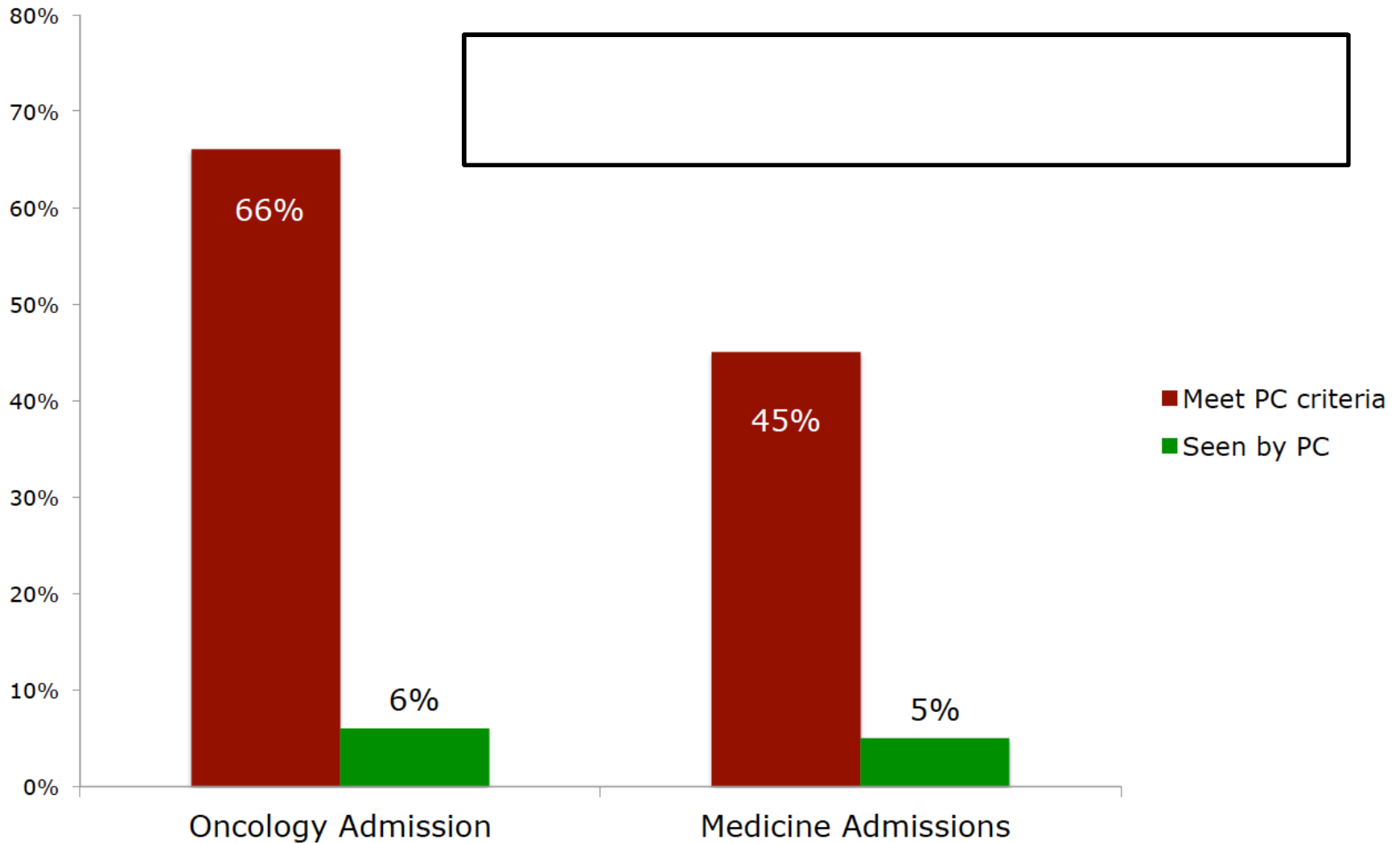


# Palliative care in the USA





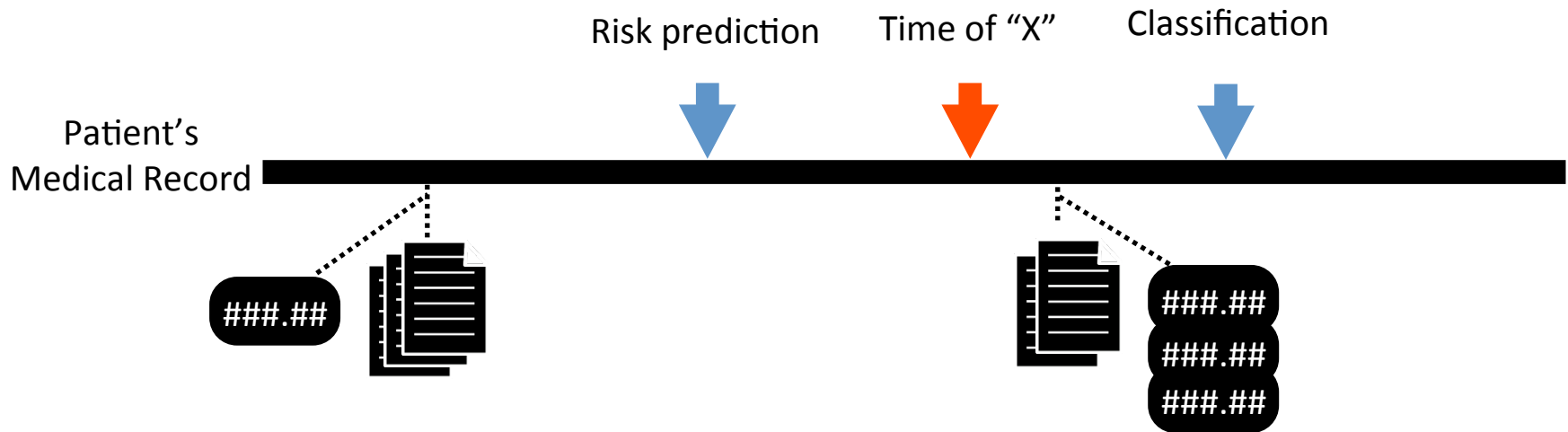
# Palliative care at Stanford



\*Screening admissions over 2 weeks using the INOVA palliative care tool



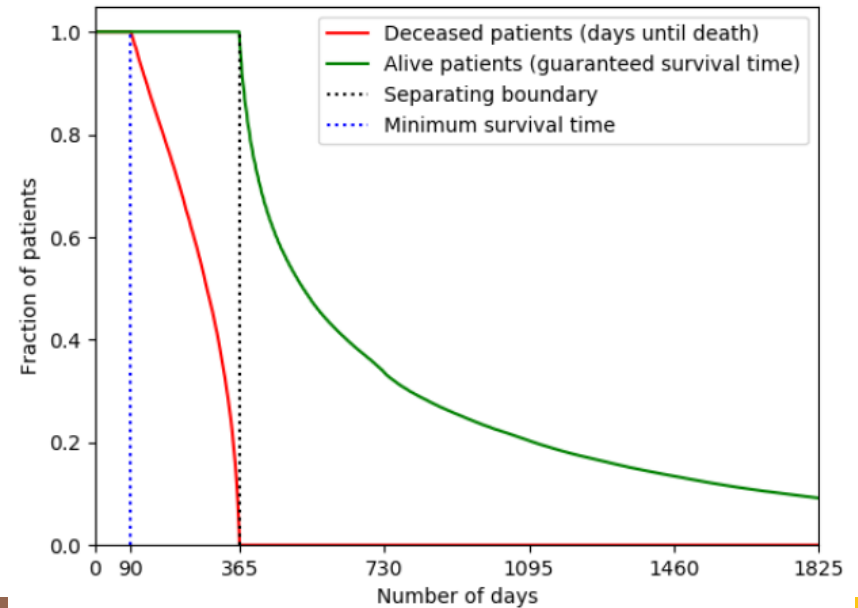
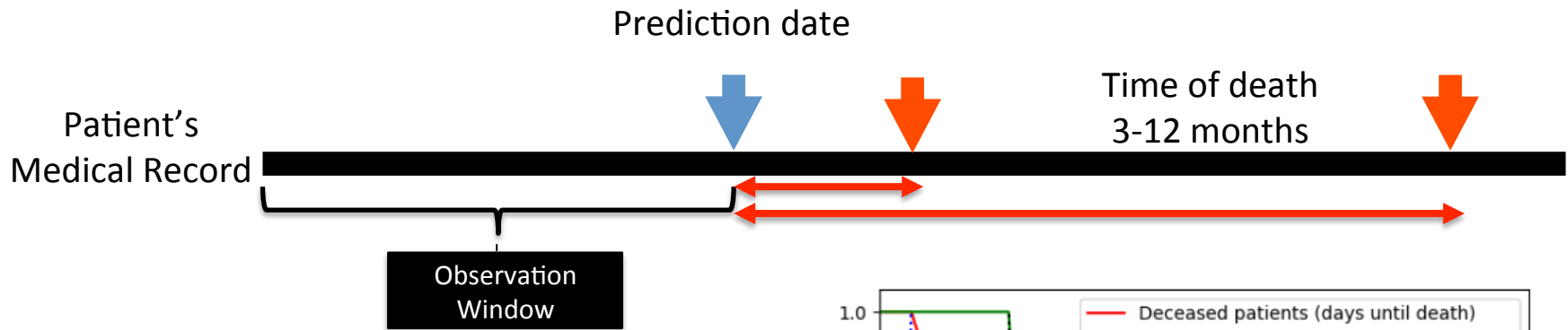
# Mortality as a surrogate for need



<b>Deceased</b>	131,006	
<b>with V66.7</b>	4,657	3.55%
<b>with V66.7 at least 6 mon prior to death</b>	105	0.08%

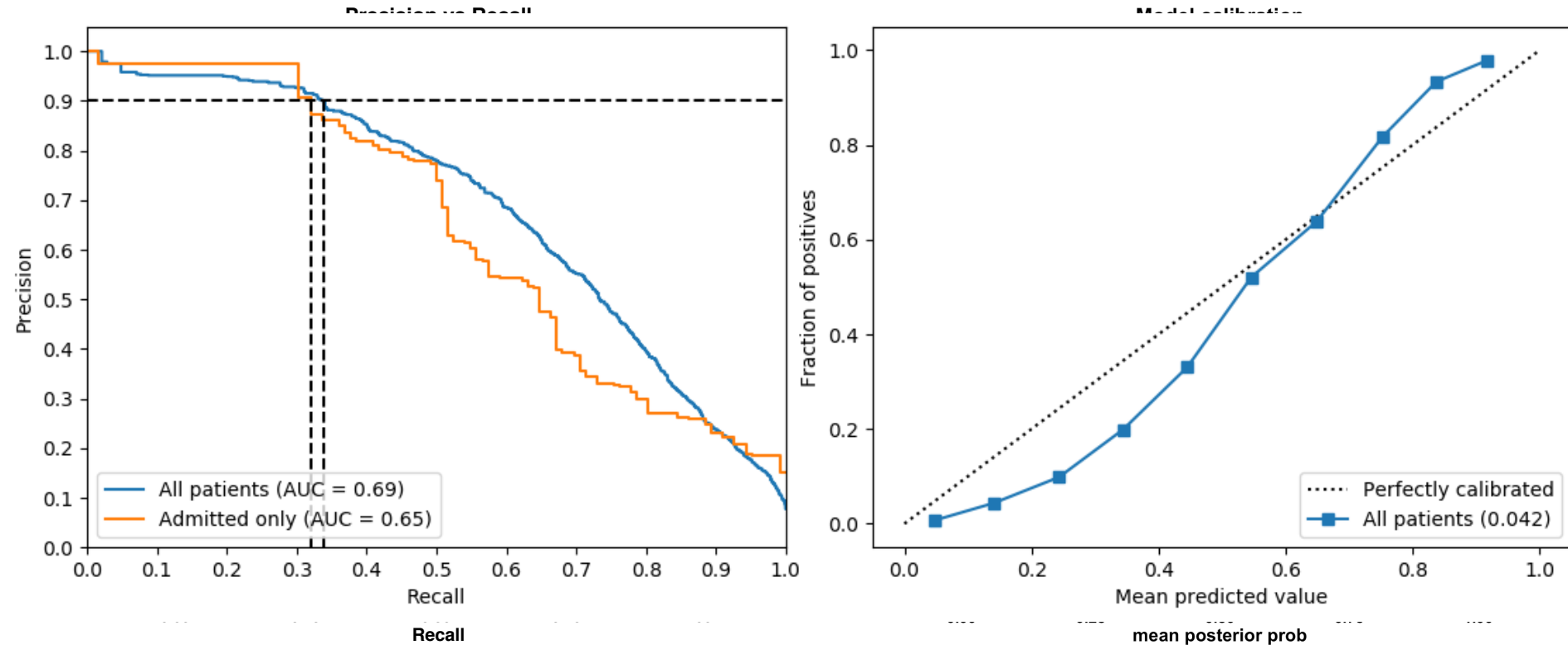


# Problem set up





# A predictive model for mortality



Avati et al, IEEE International Conference on Bioinformatics and Biomedicine  
Kansas City, MO, USA, November 13 - 16, 2017



# We have a model, what next?

- Can we explain the predictions?
- What would the intervention be?
- Who dispenses the intervention?
- What are the mechanics of dispensing the intervention?
  - What is the capacity to intervene?
- What is the threshold for action?
  - How many false positives can there be in the top k predictions?
- What performance measure do we use?
  - Physician agreement | useful consult | or accuracy (F1 etc.)
- What are the outcomes we track?
  - Consult rates | time between AD setup and death | Rate of AD set up | Increase in no. of in home deaths | ?
- Where would we deploy the model (in SHC, or SOM)?



# Explaining the predictions

Patient MRN	XXXXXXXX
Probability score	0.946

Factors	Code	Value	Influence	Description
Top Diagnostic factors	V10.51	4	0.0051	Personal history of malignant neoplasm of bladder
	V10.46	5	0.0019	Personal history of malignant neoplasm of prostate
	518.5	1	0.0012	Pulmonary insufficiency following trauma and surgery
	518.82	1	0.0008	Other pulmonary insufficiency
	88.75	1	0.0006	Diagnostic ultrasound of urinary system
Top Procedural factors	88331	1	0.0017	Pathology consultation during surgery with FS
	75984	1	0.0014	Transcatheter Diagnostic Radiology Procedure
	72158	1	0.0013	MRI and CT Scans of the Spine
	Code_Type_Count	76	0.0011	Summary statistic (count of all ICD/CPT codes)
	76005	1	0.0007	Fluoroscopic guidance and localization of needle or catheter tip for spine
Top Medication factors				
Top Encounter factors	Hx Scan	21	0.0012	Number of scan encounters of all types
	Inpatient	60	0.0004	Number of days patient was admitted
	Var_Codes_per_Day	8	0.0002	Summary statistic (variance in number of codes assigned per day)
	Code_Day_Count	88	0.0001	Number of days any encounter code was assigned
Top Demographic factors	Age	81	0.0010	Age of patient in years at <i>prediction time</i>





# Taking prediction models into practice

- Ask what would you do with the prediction in hand?
- Look for situations where the NNT for an action is 1-3 : 100 and a model can get it to 3-5 : 10
- Think of the model output as a ranking metric
- Think of the model as a screening test
  - Don't get hung up on AUROC, AUPRC, the exact probabilities.
- Understand your capacity for action
  - Focus on precision @ K.
- Explanation of the prediction is over-rated
  - Separate prediction from action



# Pilot project participants

- People
  - Stephani Harman, Medical director of Palliative Care services at SHC
  - Yohan Vetteth, VP of Analytics at SHC
  - Topher Sharp, CMIO at SHC
  - Kenneth Jung, Dept of Medicine
  - Lance Downing, Dept of Medicine
  - Anand Avati, Dept of Computer Science
  - Andrew Ng, Dept of Computer Science
- Funding
  - Seed funding from Dept.
  - Stanford Data Science Institute