

# PREDICTING PATIENT SEVERITY AND DISPOSITION FROM INTESTINAL ISCHEMIA: A GRADIENT BOOSTING FRAMEWORK

**BST 209**

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## PROBLEM: INTESTINAL ISCHAEMIA



- Case: Mr. X is a 70-year-old man who presented to ED with abdominal pain and bloody stools. He is diagnosed with ischemic colitis.
- How can we predict the appropriate level of care for Mr. X?

## PROBLEM: INTESTINAL ISCHEMIA

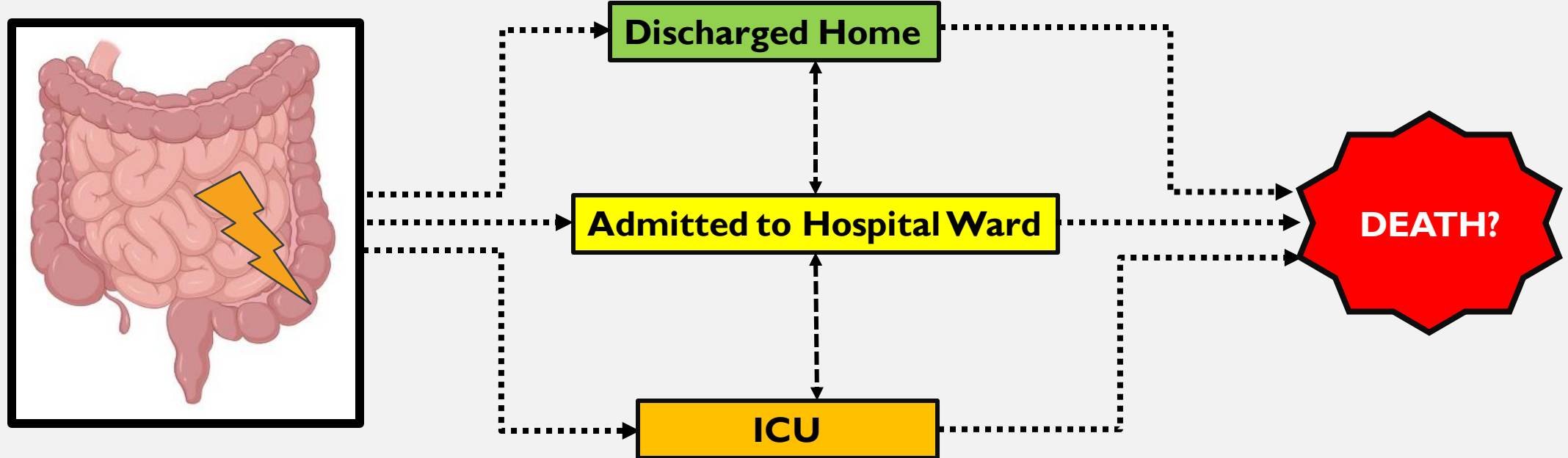
### **GOAL:**

Develop a prediction support tool for a hospital care pathway in patients with intestinal ischemia

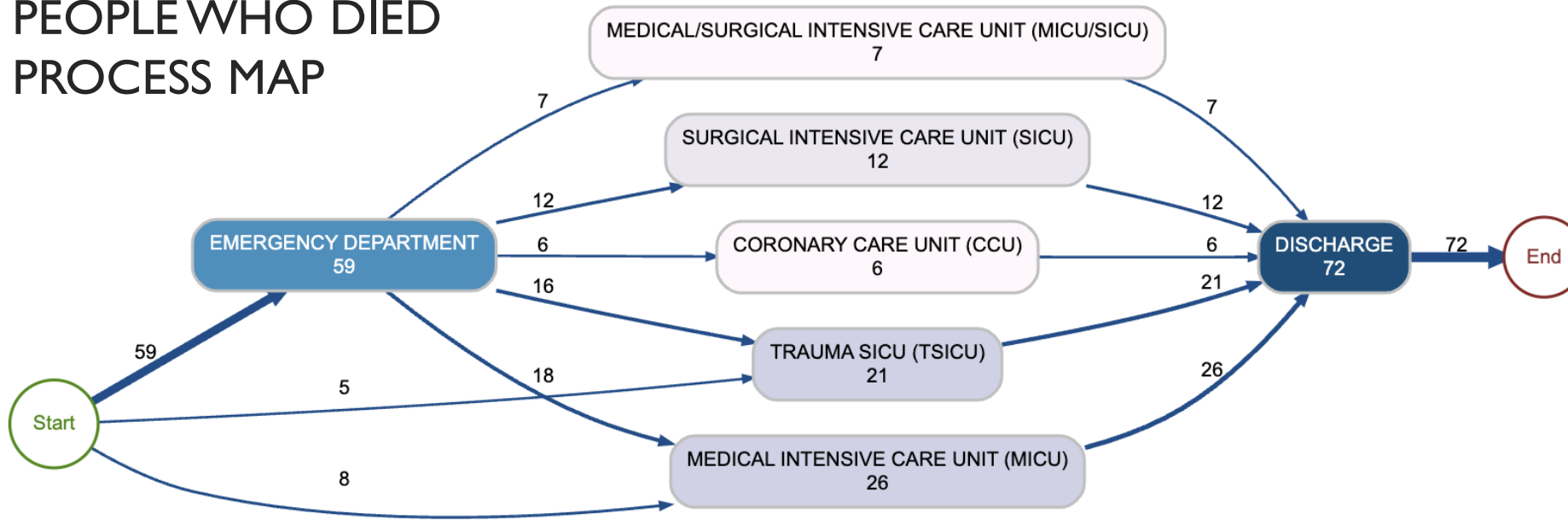
### **METHOD:**

Boosting

# PROBLEM: INTESTINAL ISCHEMIA

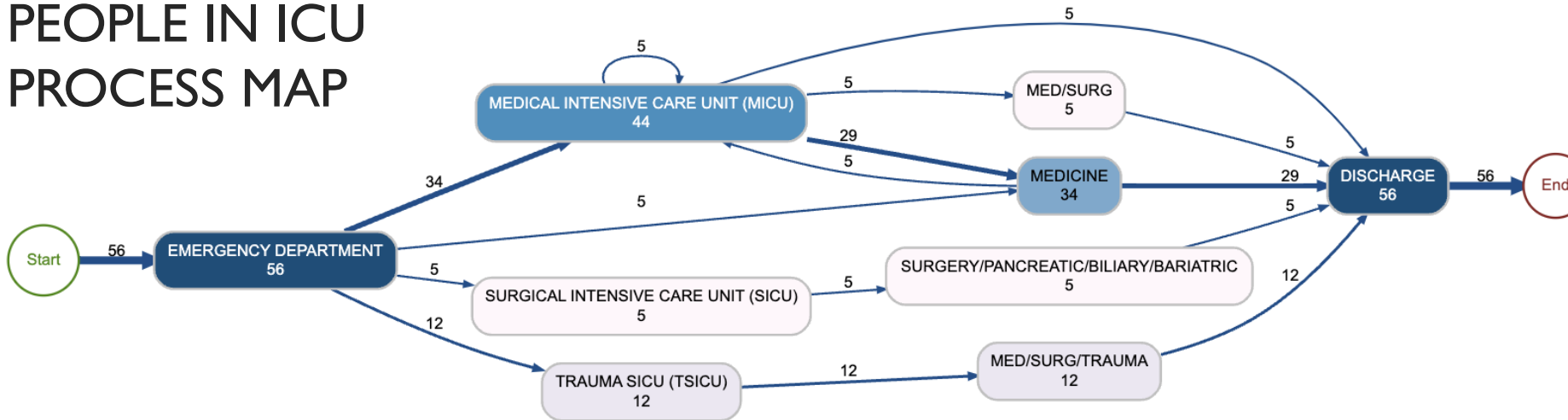


## PEOPLE WHO DIED PROCESS MAP



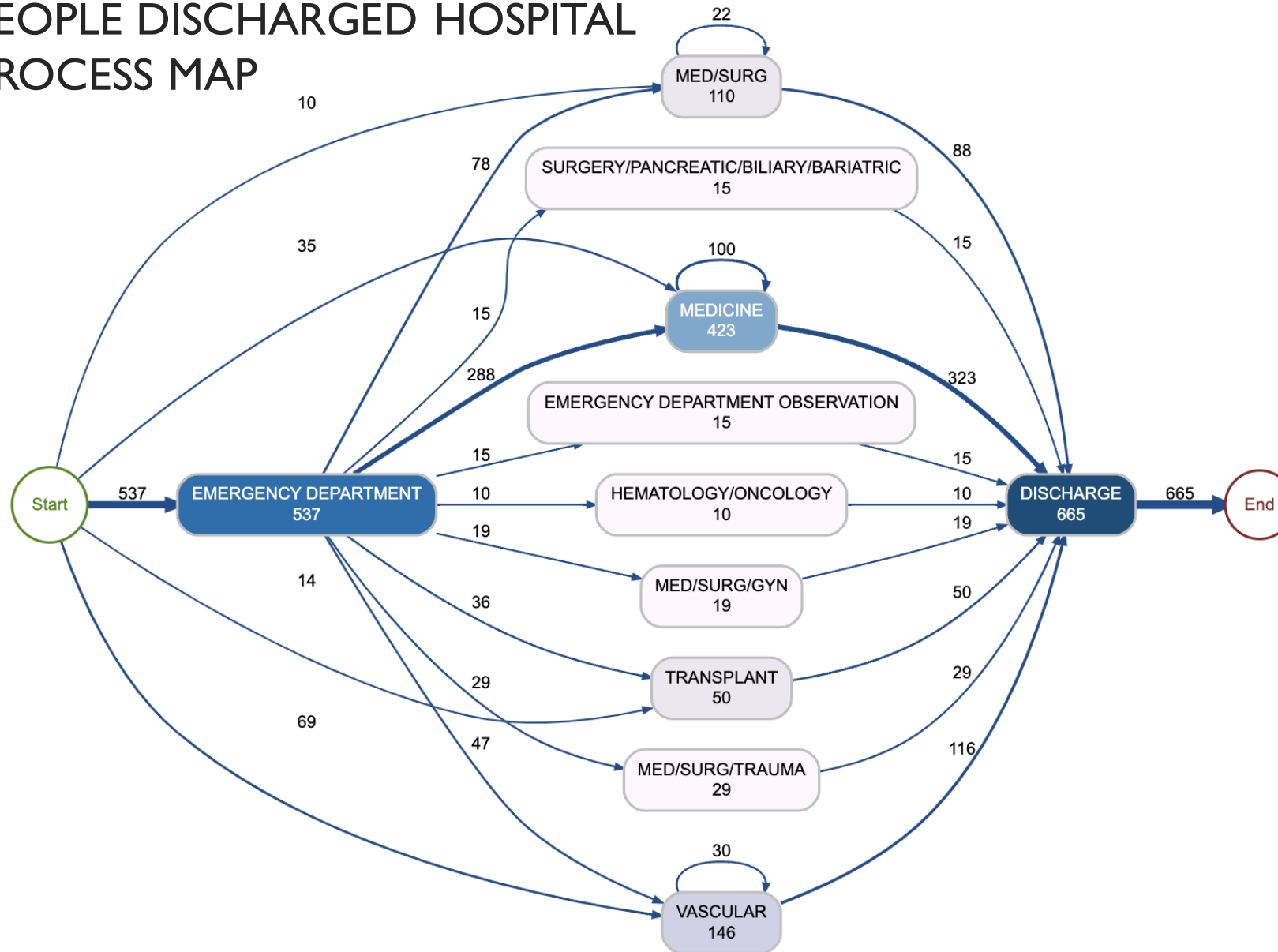
PEOPLE DIE IN  
INTENSIVE  
CARE UNITS

## PEOPLE IN ICU PROCESS MAP

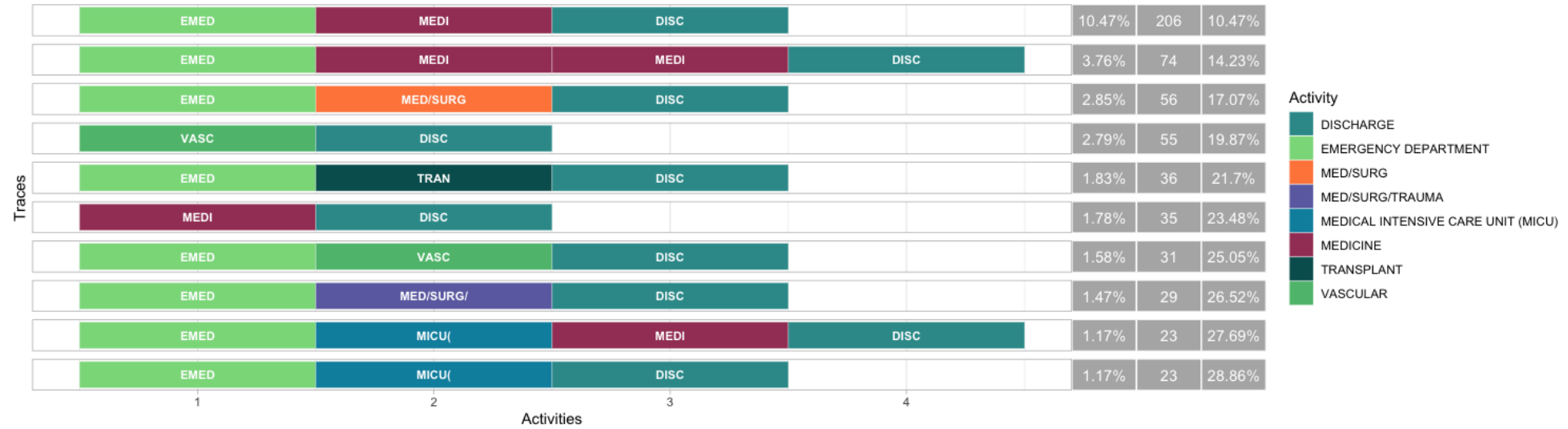


PEOPLE DIE IN  
INTENSIVE  
CARE UNITS

# PEOPLE DISCHARGED HOSPITAL PROCESS MAP



# PROBLEM: INTESTINAL ISCHAEMIA



# INCLUSION & EXCLUSION CRITERIA

- **Inclusion criteria**
- Patients from **MIMIC database** at BIDMC with a discharge diagnosis of intestinal ischaemia: 1968 individuals

## ICD 9 Codes

1. 557.0 Vascular insufficiency of the bowel
2. 557.1 Chronic vascular insufficiency of the bowel
3. 557.9 Unspecified vascular insufficiency of intestine

## ICD 10 Codes

- 1.K55.1 Chronic vascular disorders of intestine
2. K55.9 Vascular disorder of intestine unspecified

Risk of Ischemic Bowel Disease in Patients With Atrial Fibrillation Receiving Warfarin or Non-vitamin K Antagonist Oral Anticoagulants

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## SAMPLE SELECTION BIAS

1. Quaternary referral hospital – standard of care may be better/practices may be different and therefore not representative of other hospitals
2. Sample not representative of all races – predominantly white
3. Socioeconomic status of patients from New England not nationally representative
4. Only patients who are hospitalized at BIDC are evaluated, does not include patients who were discharged from the emergency department, presenting to other hospitals with a missed diagnosis - we are therefore unable to probe biases in inappropriate discharges
5. Using discharge ICD codes for intestinal ischemia – may be other patients admitted with abdominal pain/ischemic colitis who do not undergo diagnostic imaging/endoscopy - potential biases in who undergoes more thorough investigation

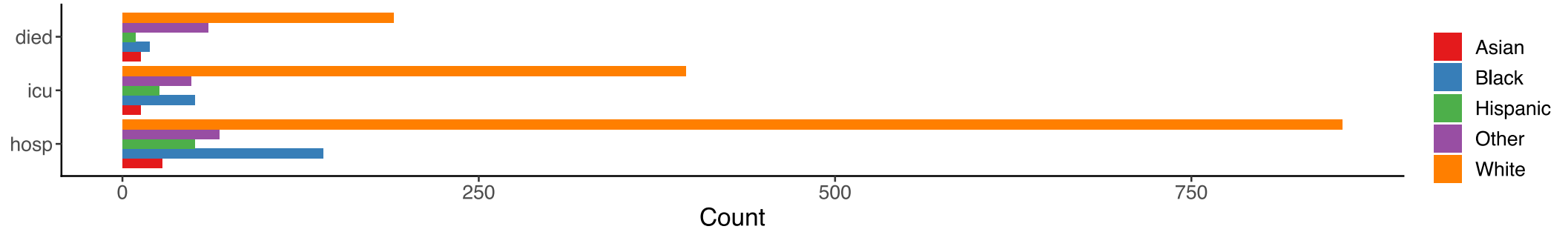
## COHORT DISTRIBUTION

	ICU	Death
Asian	24%	24%
Black	24%	9%
Hispanic	30%	10%
White	27%	13%

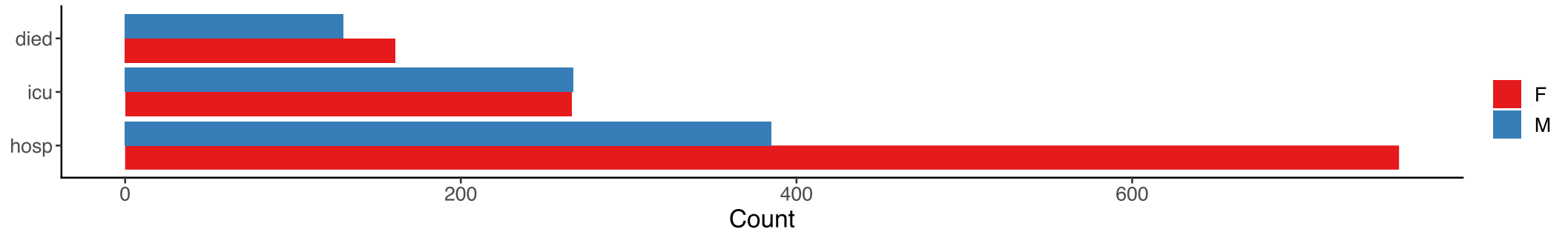
	Stratified by severity_class			p	test
n	hosp 1144	icu 533	died 291		
race (%)				<0.001	
asian	28 ( 2.4)	13 ( 2.4)	13 ( 4.5)		
black	141 (12.3)	51 ( 9.6)	19 ( 6.5)		
hispanic	51 ( 4.5)	26 ( 4.9)	9 ( 3.1)		
other	68 ( 5.9)	48 ( 9.0)	60 (20.6)		
white	856 (74.8)	395 (74.1)	190 (65.3)		
genders = M (%)	385 (33.7)	267 (50.1)	130 (44.7)	<0.001	
insurances (%)				0.144	
Medicaid	58 ( 5.1)	29 ( 5.4)	20 ( 6.9)		
Medicare	593 (51.8)	272 (51.0)	168 (57.7)		
Other	493 (43.1)	232 (43.5)	103 (35.4)		
max_anchor_age (mean (SD))	65.20 (15.86)	65.51 (15.24)	69.00 (15.37)	0.001	
max_temperature (mean (SD))	37.56 (0.70)	37.80 (0.77)	37.37 (1.13)	<0.001	
min_spo2 (mean (SD))	87.85 (13.93)	87.43 (13.00)	84.37 (14.72)	0.003	
max_wbc (mean (SD))	15.69 (8.35)	18.45 (9.88)	20.41 (13.91)	<0.001	
max_creatinine (mean (SD))	2.47 (2.63)	2.21 (2.11)	2.41 (1.71)	0.169	
max_sofa (mean (SD))	NaN (NA)	5.74 (3.67)	10.19 (4.22)	<0.001	
min_sbp (mean (SD))	83.30 (18.77)	81.55 (17.33)	72.81 (20.59)	<0.001	
max_resp_rate (mean (SD))	30.05 (7.04)	31.11 (7.11)	31.85 (6.95)	0.003	
max_inr (mean (SD))	2.44 (2.28)	2.22 (2.14)	2.63 (1.96)	0.041	
max_crp (mean (SD))	55.05 (65.55)	122.51 (75.61)	118.64 (96.48)	<0.001	

# DISTRIBUTIONS

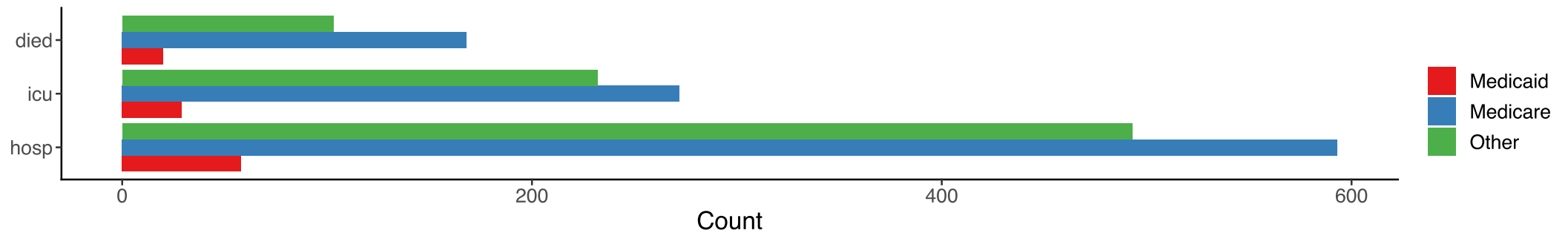
Distribution - race



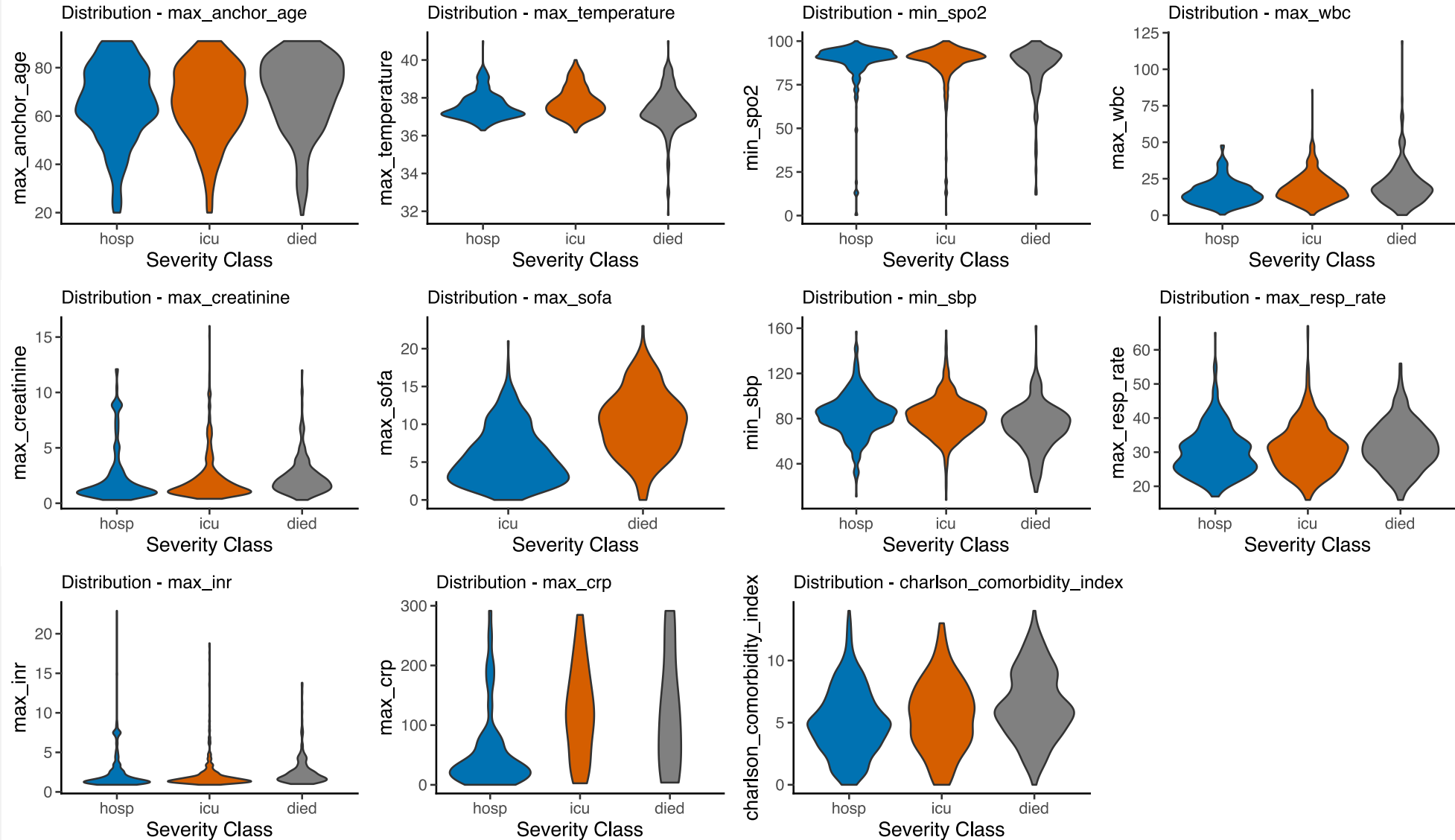
Distribution - genders



Distribution - insurances



# DISTRIBUTIONS



# PREDICTOR VARIABLES

1.Race

2.Gender

3.Insurance status

4.Age

5.Temperature

6.Respiratory rate

7.Blood pressure

8.Oxygen

9.WCC

10.CRP

11.SOFA score

12.Charlson comorbidity  
index

Future:

13.Lactate

14.Pain – location

15.Pain severity

16.Peritonism



# OUTCOMES

1. Ward admission
2. Intensive Care Unit (ICU) admission
3. Death

Bias: Only know the outcomes of patients who were admitted to hospital – misses those who were misdiagnosed and discharged who may have died outside of hospital or presented to another hospital

## EVALUATION OF *IN SILICO* MODEL PERFORMANCE

- A Leave One Out Cross Validation (LOOCV) will be utilized to assess the performance of the model and assess its generalizability to future data
  - A 70/30 split for test/train will be used
  - AUC and ROC curves will be generated and interpreted
- Unintended consequences may include:
  - Inherent bias from the parameters used within the severity score may misclassify appropriate disposition
    - Eg: CRP has been shown to vary amongst sex and race

## FUTURE WORK

1. Using natural language processing to identify signs in CT reports consistent with intestinal ischaemia/timing of diagnosis – this allows us to establish whether intestinal ischaemia was the presenting complaint
2. Predicting the need for surgery
3. Evaluating if any of the patient cohort had recent attendances to the emergency department and were misdiagnosed
4. Expanding predictor variables to include more detailed information about pain/duration of symptoms/specific comorbidities – through natural language processing
5. Better understanding patient course prior to ICU/death