

# Is out of hours ICU care in sepsis dangerous?

## Ngā Rourou Raraunga



"Nau te rourou, naku te rourou, ka ora te manuhiri"

*(With your food basket and my food basket, the visitors will be fed)*



**HACK AOTEAROA**  
ARTIFICIAL INTELLIGENCE IN HEALTHCARE  
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# Reproducibility

- Github repo (Jupyter notebooks and Rmarkdown):

<https://github.com/nga-rourou-raraunga/sepsis-icu-time-of-day-analysis>

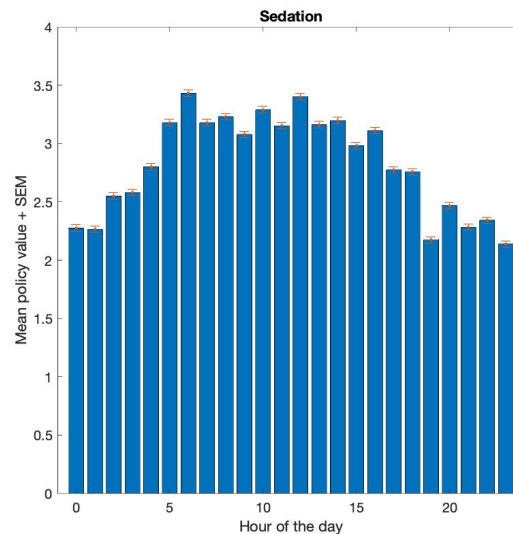
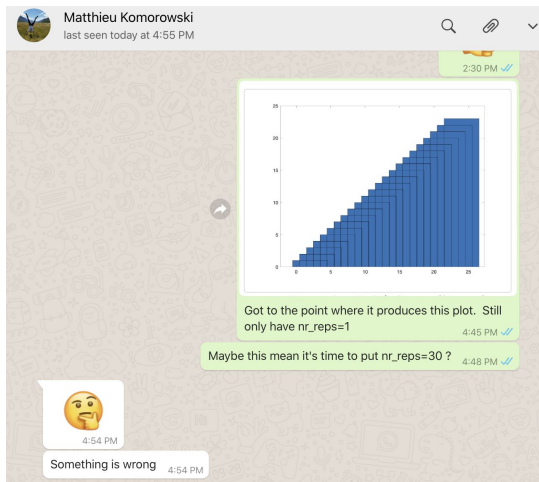
- HTML from Rmarkdown ->



# The Problem

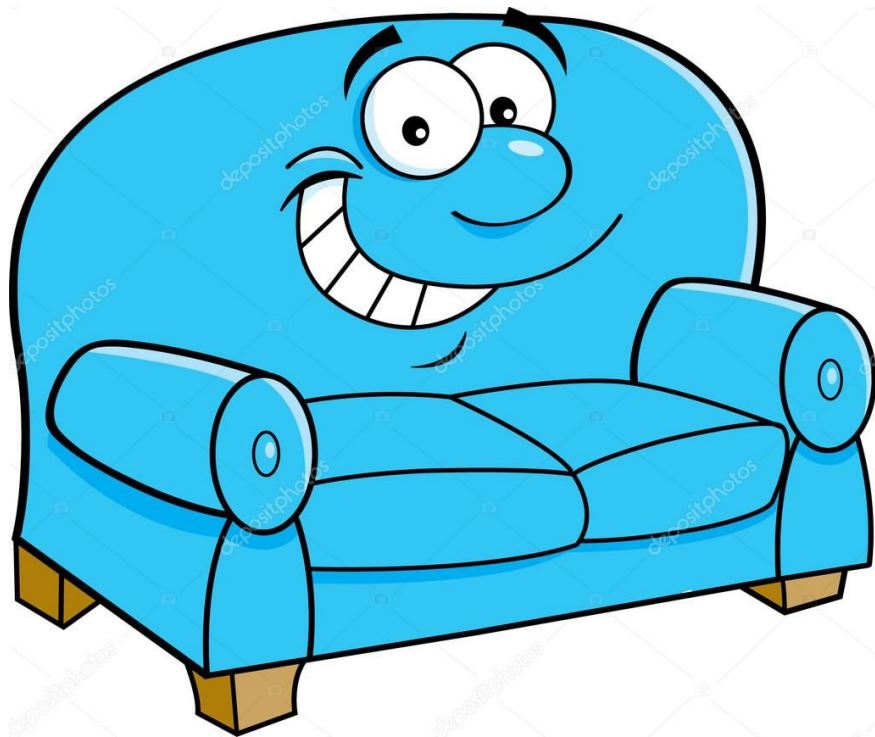
- Hospitals have less staff on site 'out of hours' for cost and morale reasons
- Care may be worse. This has never been quantified.

# Method: Reinforcement Learning



# Method: Data Exploration

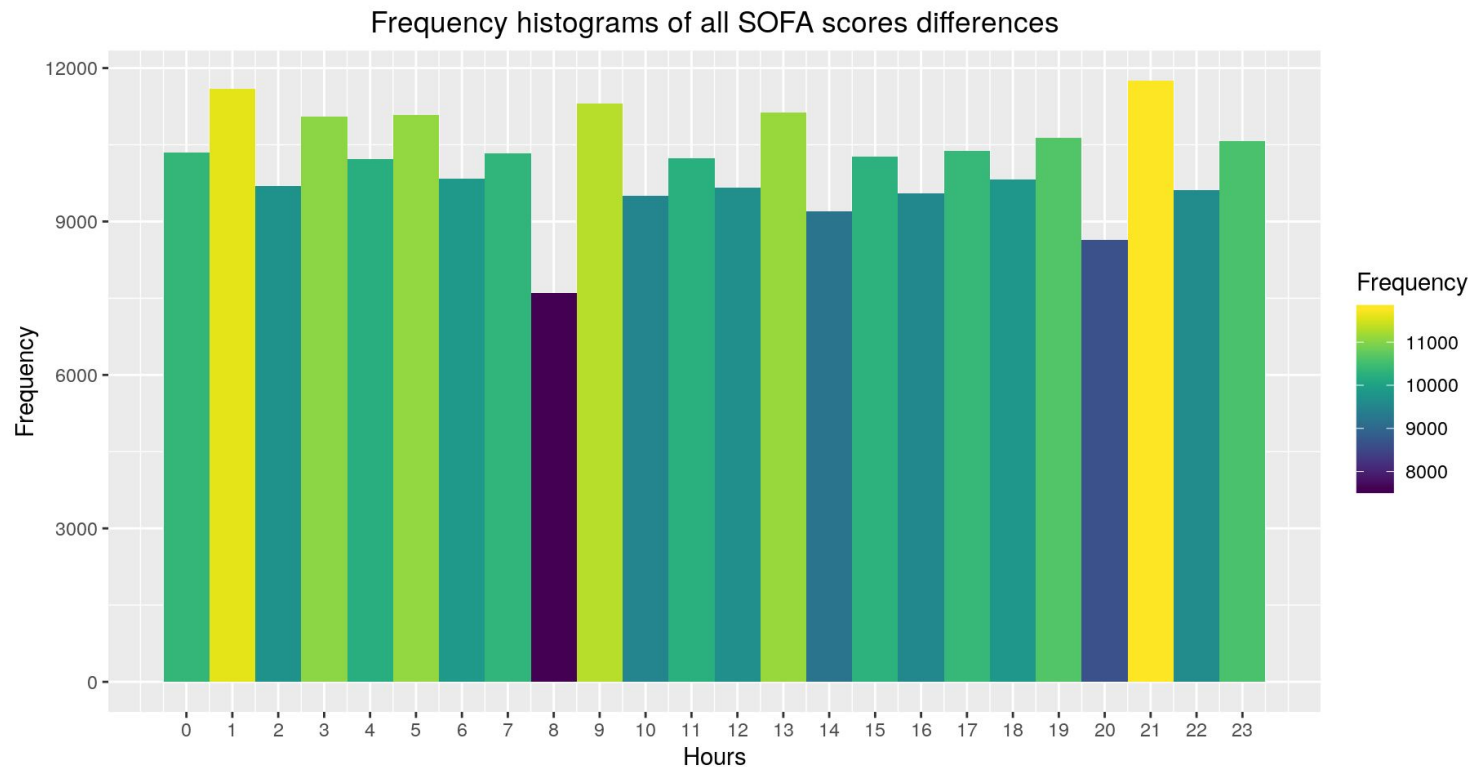
- Using sepsis subset of MIMIC III;
- Outcome of interest:
  - SOFA  $\geq 9$
  - Delta SOFA
  - Time of death



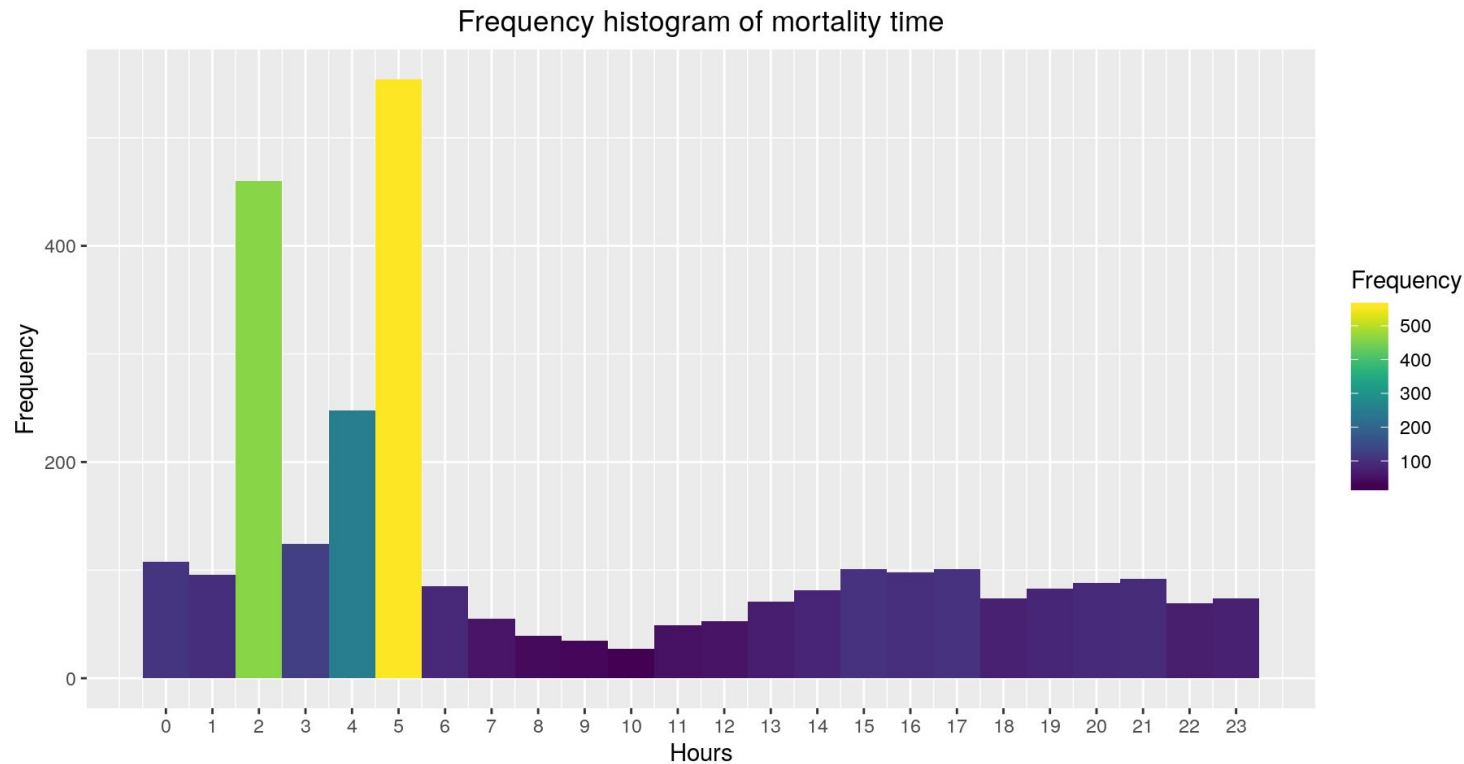
# Sequential [Sepsis-Related] Organ Failure Assessment (SOFA) Score

System	0	1	2	3	4
Respiration PaO <sub>2</sub> /FiO <sub>2</sub> , mmHg (kPa)	≥400 (53.3)	<400 (53.3)	<300 (40)	<200 (26.7) with respiratory support	<100 (13.3) with respiratory support
Coagulation Platelets, x10 <sup>3</sup> /uL	≥150	<150	<100	<50	<20
Liver Bilirubin, mg/dL (umol/L)	<1.2 (20)	1.2 - 1.9 (20 - 32)	2.0 - 5.9 (33 - 101)	6.0 - 11.9 (102 - 204)	>12.0 (204)
Cardiovascular	MAP ≥70mmHg	MAP <70mmHg	Dopamine <5 or Dobutamine (any dose)	Dopamine 5.1 - 15 or Epinephrine ≤0.1 or Norepinephrine ≤0.1	Dopamine >15 or Epinephrine >0.1 or Norepinephrine >0.1
CNS GCS Score	15	13 - 14	10 -12	6 - 9	<6
Renal Creatinine, mg/dL (umol/L) Urine Output, mL/d	<1.2 (110)	1.2 - 1.9 (110 - 170)	2.0 - 3.4 (171 - 299)	3.5 - 4.9 (300 - 440)  <500	>5.0 (440)  <200
*Catecholamine Doses = ug/kg/min for at least 1hr					

# Data Exploration with clinicians



# Data Exploration with clinicians





# Next Steps

Reinforcement learning:

- Matlab → Python (easier reproducibility)
- Broader actions than just Sedation
- Reward: delta-SOFA (current model just terminal reward on 90-day mortality)

Data interpolation of SOFA

- Multiple SOFA scores for one patient in a hour

**Thank you**

Ngā mihi