Imperial College London

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camo centre for antimicrobial optimisation

Machine learning based clinical decision support for antimicrobial stewardship

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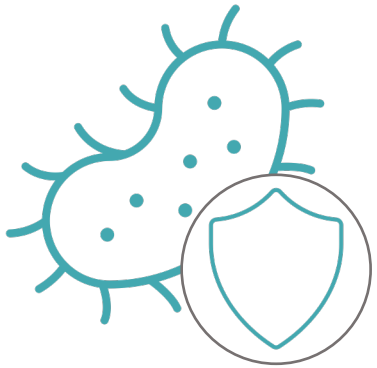
CAMO UK Data AI Meeting

21st June 2022

Machine learning can support optimised antibiotic decision making.



Antimicrobial resistance (AMR) is a global threat. One key strategy to tackle this is to undertake stewardship and optimise antimicrobial use

Clinical decision support systems (CDSSs) utilising machine learning (ML) have been developed to assist with managing infections

STAGES OF ANTIBIOTIC DECISION MAKING

1. Infection or not
2. Empiric treatment
3. Narrow therapy
4. Duration

- Cessation
- IV to oral switch
- Readmission
- Side effects

Fair interpretable machine learning for individualised IV to oral switch decision making.

CLINICAL GUIDELINES AND REAL-WORLD DATA

UK Health Security Agency

Guidance
National antimicrobial intravenous-to-oral switch (IVOS) criteria for early switch

make the switch
FROM IV TO ORAL ANTIBIOTICS

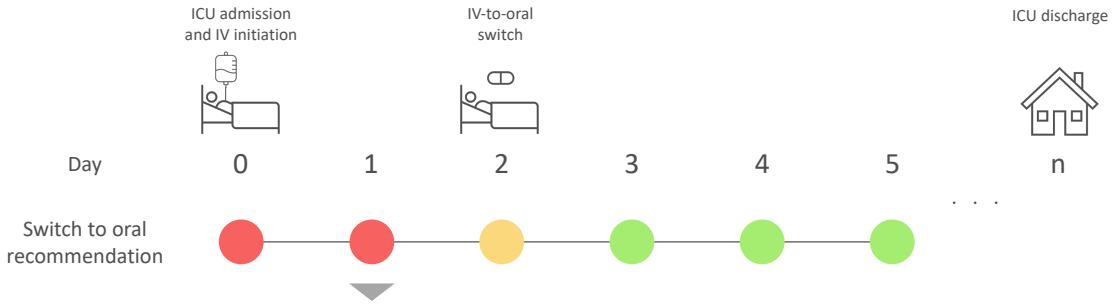
MIMIC n=8,694

eICU n=1,668

Short feature set n=5

Metric	1st threshold	2nd threshold
AUROC	0.78 (SD 0.02)	0.69 (SD 0.03)
Accuracy	0.76 (SD 0.01)	0.83 (SD 0.01)
TPR	0.80 (SD 0.05)	0.48 (SD 0.06)
FPR	0.25 (SD 0.02)	0.10 (SD 0.02)

INTERPRETABLE DECISION SUPPORT



Day 1

Highlights
- Both thresholds predict switching is **not appropriate** at this time
- Predictions were correct for **100%** of similar examples
- O2 saturation pulseoximetry (feature 4) was of particular interest for these predictions

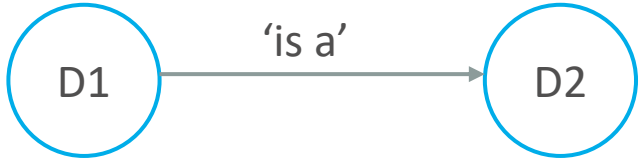
		Importance	Feature 1	2	3	4	5	Switch to oral label	Switch to oral prediction 1st threshold	2nd threshold
Patient		-	0.32	0.51	0.37	0.50	0.41	0	0	0
Example	1	0.28	0.38	0.54	0.29	0.48	0.46	0	0	0
	2	0.25	0.31	0.55	0.28	0.51	0.50	0	0	0
	3	0.21	0.29	0.52	0.45	0.52	0.46	0	0	0
	4	0.13	0.32	0.55	0.36	0.51	0.00	0	0	0

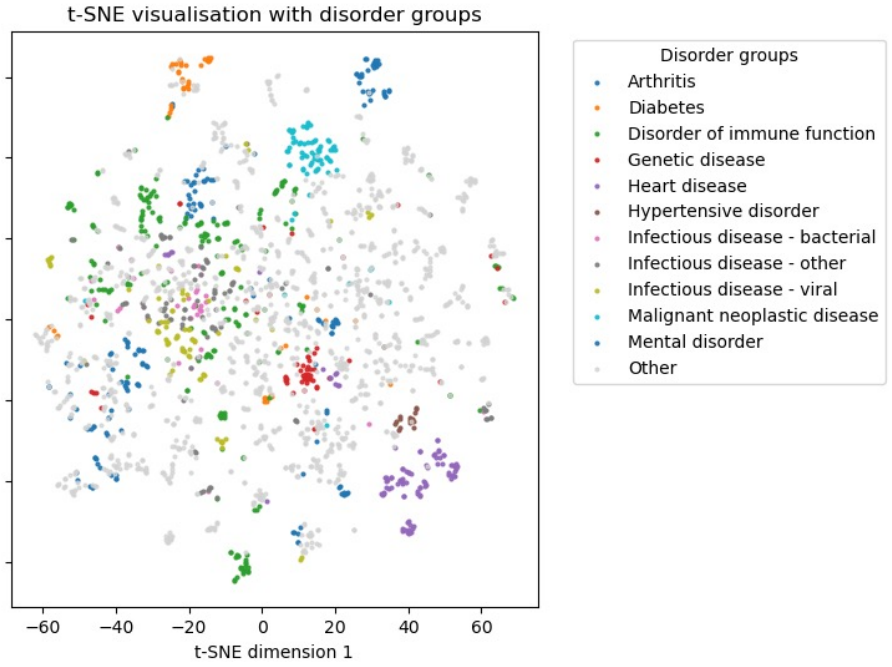
Negative feature contribution — Positive feature contribution
Prediction correct
Prediction incorrect
Switch
Potentially switch
Don't switch

Tapping into unused clinical knowledge for multi-morbidity in machine learning.

SNOMED EMBEDDINGS

SNOMED CT
The global language of healthcare





SIMILAR PATIENT RETRIEVAL TASK

Imperial Clinical Analytics, Research and Evaluation (iCARE)	SNOMED embeddings	Rocheteau method	One hot encodings
SNOMED similarity score	1.78	3.52	4.40

	Co-morbidities										
Patient A	Asthma	Hypertensive disorder	Osteo-arthritis	Type 2 diabetes	Hyper-cholesterol-emia	Anemia	Gastro-esophageal reflux disease	Hypo-thyroidism			
SNOMED Embedding	Asthma	Hypertensive disorder	Osteo-arthritis	Diabetes	Hyper-lipidemia	Anemia	Gastro-esophageal reflux disease	Obstructive sleep apnea			
Rocheteau score	Asthma	Hypertensive disorder	Rheumatoid arthritis	Diabetes	Hyper-cholesterol-emia	Anemia	Gastro-esophageal reflux disease	Hypo-thyroidism	Coronary arterio-sclerosis	Pulmonary embolism	Chronic kidney disease
One hot encodings	Asthma	Hypertensive disorder	Osteo-arthritis	Type 2 diabetes	Hyper-cholesterol-emia						
Patient B	Osteo-arthritis	Alcoholism									
SNOMED embedding	Osteo-arthritis	Alcohol dependence									
Rocheteau score	Osteo-arthritis	Alcoholism	Peripheral nerve entrapment								
One hot encodings	Osteo-arthritis	Alcoholism	Peripheral nerve entrapment								

Identical
Similar
Dissimilar

Patient, public and stakeholder views as well as ethical theories have been considered to ensure solutions are fair.

ETHICAL VIEWPOINT


Comment

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Developing moral AI to support decision-making about antimicrobial use

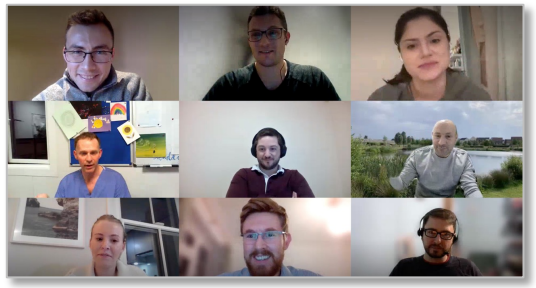
William J. Bolton, Cosmin Badea, Pantelis Georgiou, Alison Holmes and Timothy M. Rawson

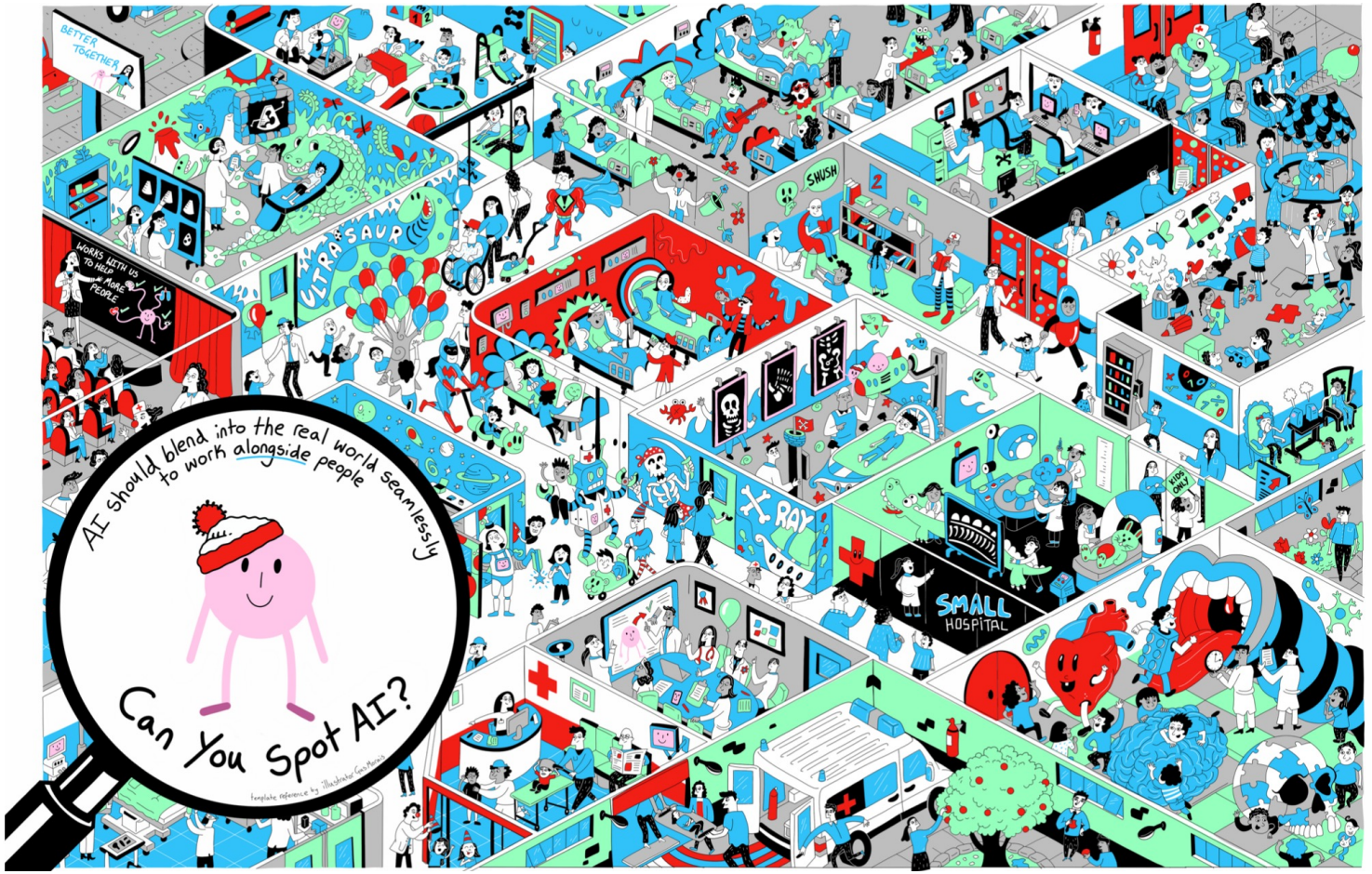
Check for updates

The use of decision-support systems based on artificial intelligence approaches in antimicrobial prescribing raises important moral questions. Adopting ethical frameworks alongside such systems can

decision is morally right is often unclear. Incorporating such concepts into AI systems is complex but may be supported by the development of a consensus on the optimal approach to decision-making in this context. In this article, we aim to explore potential ethical frameworks and nuances that may be applied to define what is ethical or not during the development of AI-based clinical decision-support systems (CDSSs)

PRIMARY RESEARCH





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Thank you!

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