Local evaluation of an AI augmented surgical waiting list prioritisation tool

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INTRODUCTION

- In March 2024, 7.5 million patients were on waiting lists for treatment (1).
- Triaging patients at risk of deterioration before treatment could provide clinical benefits.
- C2-AI have developed software to support waiting list triage through scoring patients on a variety of parameters, including historical diagnoses.
- All hospital inpatient stays are coded for financial renumeration, healthcare analysis and service planning in the form of Hospital Episode Statistics (HES).

TECHNOLOGY

- C2-AI utilises inputs from HES and Referral to Treatment Time (RTT) waiting lists, both in CSV format, provided by the hospital on a weekly basis.
- C2-AI calculates scores from this data, using ICD-10 codes from previous admissions within the HES data as risk predictors.
- The software is currently pending registration as a Class IIb medical device.
- The UHBW present the scores as a dashboard within PowerBI (Fig3)

Fig. 1. Diagram depicting the data sources and output required for the triage software

WEIGHTED MATRIX SCORING SYSTEM for Triage

- Core product output
- Risk matrix score applied to each patient on outpatient surgical waiting list.
- Six Parameters
  - Allocated weighting according to consensus clinical opinion in organisation.
- Highlighted are the parts of the risk score which use a statistical model (the AI component)
  - Aims to prioritise patients based on a risk of increased harm should they deteriorate while waiting.
  - Up to 30 of the maximum total 100 Points

Risk Matrix Points Maximum 100 Points	
1. Waiting time	
>52 weeks	**20**
26 - 52 weeks	**15**
17 - 26 weeks	**10**
5 – 16 weeks	**5**
0 - 4 weeks	**1**
2. Surgeon priority	
Urgent / P2	**30**
Soon / P3	**15**
Routine / P4	**1**
3. Procedure priority	
P2	**20**
P2 / 3	**15**
P3	**10**
P3 / P4	**5**
P4	**1**
4. Deterioration possible	
Yes	**10**
No	**1**
5. Change in mortality	
>10.01%	**10**
5.01 - 10%	**7**
1.01 - 5%	**5**
0.01 - 1%	**3**
0%	**0**
6. Change in complication	
>20.01%	**10**
10.01 - 20%	**7**
5.01 - 10%	**5**
2.01 - 5%	**3**
0.01 - 2%	**1**
0%	**0**

Fig. 2. Table of the C2AI risk matrix points.

Fig. 3. Dashboard presenting the C2-AI scoring system.

AI COMPONENT

- The change in mortality and morbidity rates are based on a statistical model using previous coded patient co-morbidities collected from HES data.
- Two complication / mortality risk calculations are made:
  - Baseline risk for the patient and procedure when admitted electively.
  - Additional risk for the same patient and procedure when admitted and operated as an emergency .

LIMITATIONS

- The AI component of the model requires HES data for each patient. If this data is unavailable, the risk score cannot be personalised to the patient.
- The AI scoring component calculates increased mortality and morbidity for patients should the present as emergencies needing surgery, cannot not provide the probability of such an emergency admission occurring.
- The model generates a matrix of scores, with the aggregate score determined by a locally defined weighting system. This allows for the creation of millions of customized versions of the tool.

PREVIOUS ADMISSIONS

- A key limitation are outpatients with no previous inpatient admissions and therefore no coded past medical history in HES available.
- Using Python, Jupiter, Pandas packages the following process was followed to ascertain number of patients with hospital admissions.

Elective Procedure	Number of patients (2022 – 2024)	Proportion with no past medical history (2020-2024)
Aortic Valve replacement	1024	67.1%
All elective lower GI procedures	14704	36.2%
Colectomy	256	9%
Cholecystectomy	1124	20.8%

Table 1.Results of filtered patients undergoing specific procedures and counted admissions prior to their operation

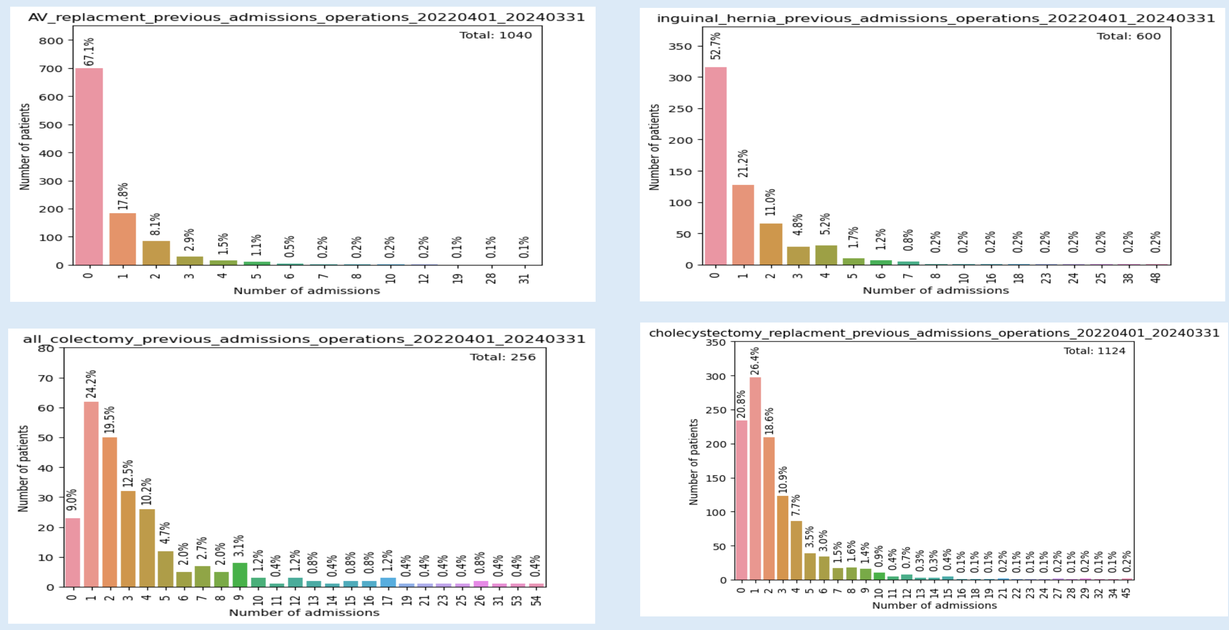

Fig. 4. Bar charts depicting the number of prior admissions within 2020-2024 for four operation groups.

DISCUSSION

- A significant minority of surgical patients cannot be accurately allocated a risk score due to missing medical history data.
- This could be due to:
  - Tertiary or Quarternary referral from their main medical center.
  - No previous admissions in the time period.
  - Patients moving to the area recently.
- A solution given to this could be all hospitals in a geographic locale buying and implementing the product.

PLAN FOR FURTHER EVALUATION

- In order to assess the model's predictions of post operative complications further work is being undertaken.
- Cholecystectomy had the greatest number of patients with a previous admission.
- HES data for their operative admission and 30 days afterwards was collected with analysis of post operative complications undertaken.

References:

1) www.england.nhs.uk. (n.d.). *Statistics» Consultant-led Referral to Treatment Waiting Times Data 2023-24*. [online] Available at: https://www.england.nhs.uk/statistics/statistical-work-areas/rtt-waiting-times/rtt-data-2023-24/.

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