Situation Report - Elective care - long waiters modelling (Inpatient)

v1.0.1

WWL DAA: Data Science

2023-05-24

Methodology

The subsequent work was produced by creating four separate forecasting algorithms, each of which produce models forecasting a horizon period of 365 days, using the last six months of waiting list size data (start and end dates of the training period are described below).

Subsequently the average of these four models was calculated to produce a *combinatorial* model. Combinatorial models reliably perform better than individual forecasts in many situations, particularly for long forecast horizons.

The final combinatorial model was then *positively biased* to the most recent month training data. This bias is a simple weighting calculation: using the last 30 days mean values for *demand*, *capacity*, and *error (ROTT - removals over than treatment)*, the combinatorial model is adjusted to reflect these characteristics. In addition, this calculation includes an exponent function that reduces the positive bias the further into the future we are predicting, producing a more realistic forecast.

Overall forecasts were produced by firstly running the model individually for each speciality, and each waiting list; the outputs of these models were simulated 50 times and 80% prediction intervals calculated from these results. Lists were grouped together and then specialities were concatenated and summed to produce the overall figures. Additionally, any individual forecast that was predicted to reach a forecast list size of 0 at any horizon day was adjusted to ensure that all subsequent horizon days were given a list size of 0.

For the long waiter tables, the variable "Date list cleared" is the *first date the lower boundary of the 80% prediction interval touches 0 waiters*. Thus, these dates are the "best case scenario" of expected list clearance date. In contrast, the long waiter list graphs show the median forecast position *and* the 80% prediction intervals - as such, a more conservative forecast is displayed.

- AI Training period is from 2022-11-13 to 2023-05-12.
- Positive weighting estimated from 2023-04-12 to 2023-05-12
- Figures horizon lines depict median predicted list size
- Figures shaded regions depict 80% prediction interval

How these results should be interpreted

All forecasts include uncertainty, and long-term forecasts such as this, have significantly more. Thus, how these results are interpreted requires care.

These results project the expected 80% prediction interval, which includes the range of predicted list sizes that we are 80% confident the true future position will sit within, *so long as the variables underpinning the model remain the same as they have been over the last six months.* These results should be used as early warning signals for specialities that are seeing rising numbers of long waiters, so that root cause analysis may occur, and strategies put in place to relieve pressure.

This necessarily means that any attempt to retrospectively assess the forecasts will be challenging due to real-life variable alteration in response to the forecasts predictions. If the variables that underpin this combinatorial model are altered in the future then any historical prediction becomes less reliable; the further a speciality's variables deviate from those fed into the model, the less the prediction will accurately model reality. Yet this is the purpose of this model, it advises that alterations to speciality variables should occur, and when they do the prior predictions become obsolete. Thus, a once monthly situation report is considered necessary to account for changes in the operation of the Trust.

Long waiters forecast clearance dates

- *If a speciality has "Date list cleared" field = NA then this means the list does not reach zero by the horizon end date.*
- *"Difference from [date]" field = negligible is assigned to specialities with <=10 in field "List size at [date]".*

Over 52 week waiters

Speciality	Date list cleared	List size at 2023-05-12	Predicted list size in 1 year	Predicted change
Vascular Surgery	NA	38	75	+97.37 %
ENT	NA	69	73	+5.8 %
Urology	NA	40	42	+5 %
Gastroenterology	NA	51	53	+3.92 %
General Surgery	NA	30	31	+3.33 %
Colorectal Surgery	NA	30	25	-16.67 %
Breast Surgery	2023-05-12	1	0	NA
Cardiology	2023-06-04	3	0	NA
Gynaecology	2023-10-14	17	0	NA
Ophthalmology	2023-07-27	13	0	NA
Oral Surgery	2023-08-29	6	0	NA
Paediatric Dentistry	2023-06-16	6	0	NA
Pain Management	2024-04-05	9	0	NA
Plastic Surgery	2023-06-01	6	0	NA
Thoracic Medicine	2023-05-15	2	0	NA
Trauma & Orthopaedics	2024-02-01	183	0	NA

Table 1.

Over 65 week waiters

Speciality	Date list cleared	List size at 2023-05-12	Predicted list size in 1 year	Predicted change
Thoracic Medicine	NA	12	12	+0 %
Gastroenterology	NA	44	40	-9.09 %
Breast Surgery	2023-05-12	1	0	NA
Cardiology	2023-09-23	4	0	NA
Colorectal Surgery	2023-11-07	11	0	NA
ENT	2023-10-23	21	0	NA
General Medicine	2023-11-13	2	0	NA
General Surgery	2023-05-31	14	0	NA
Gynaecology	2023-06-06	16	0	NA
Haematology	2022-12-06	NA	0	NA
Ophthalmology	2023-06-19	8	0	NA
Oral Surgery	2023-05-12	0	0	NA
Paediatric Dentistry	2023-05-12	0	0	NA
Pain Management	2023-11-04	4	0	NA
Plastic Surgery	2023-05-03	NA	0	NA
Rheumatology	2023-05-27	2	0	NA
Trauma & Orthopaedics	2023-08-15	53	0	NA
Urology	2023-08-03	19	0	NA
Vascular Surgery	2023-08-20	9	0	NA

Table 2.

Overall inpatient elective lists forecast

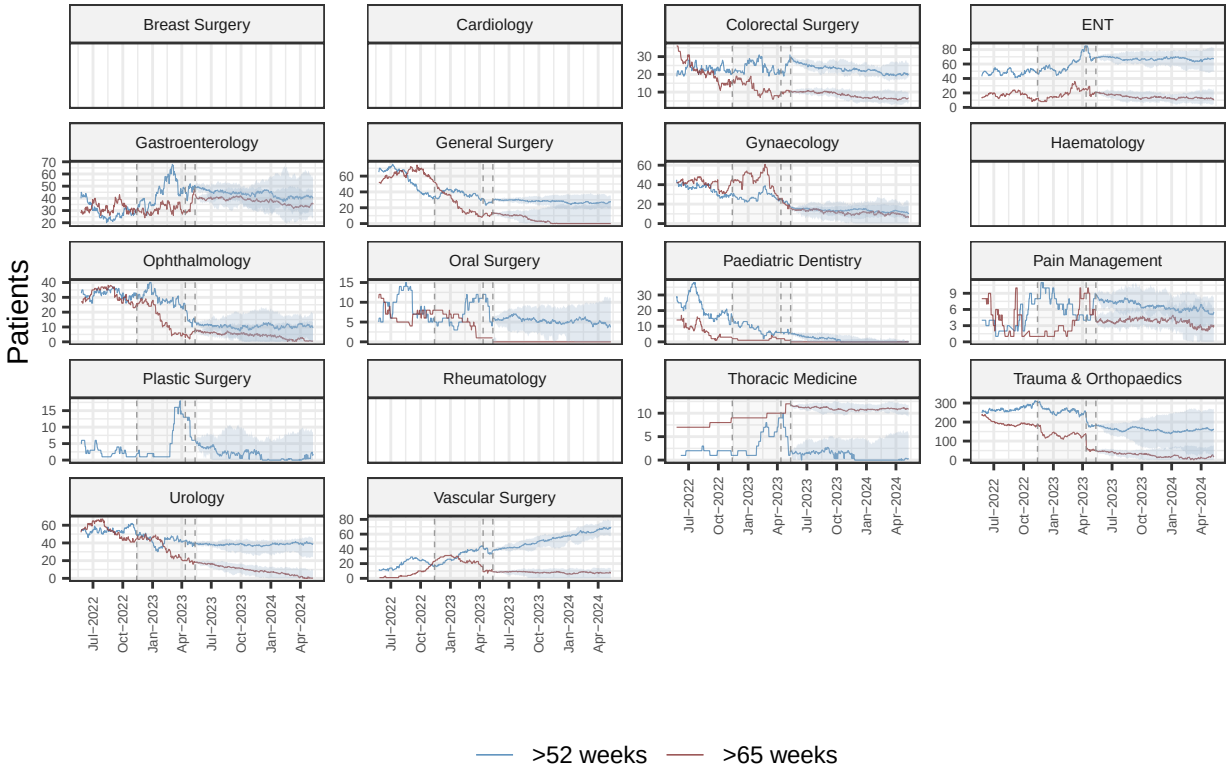

Figure 1. Long waiters forecast.
Specialities shown are those that have >5 long waiters at horizon start date

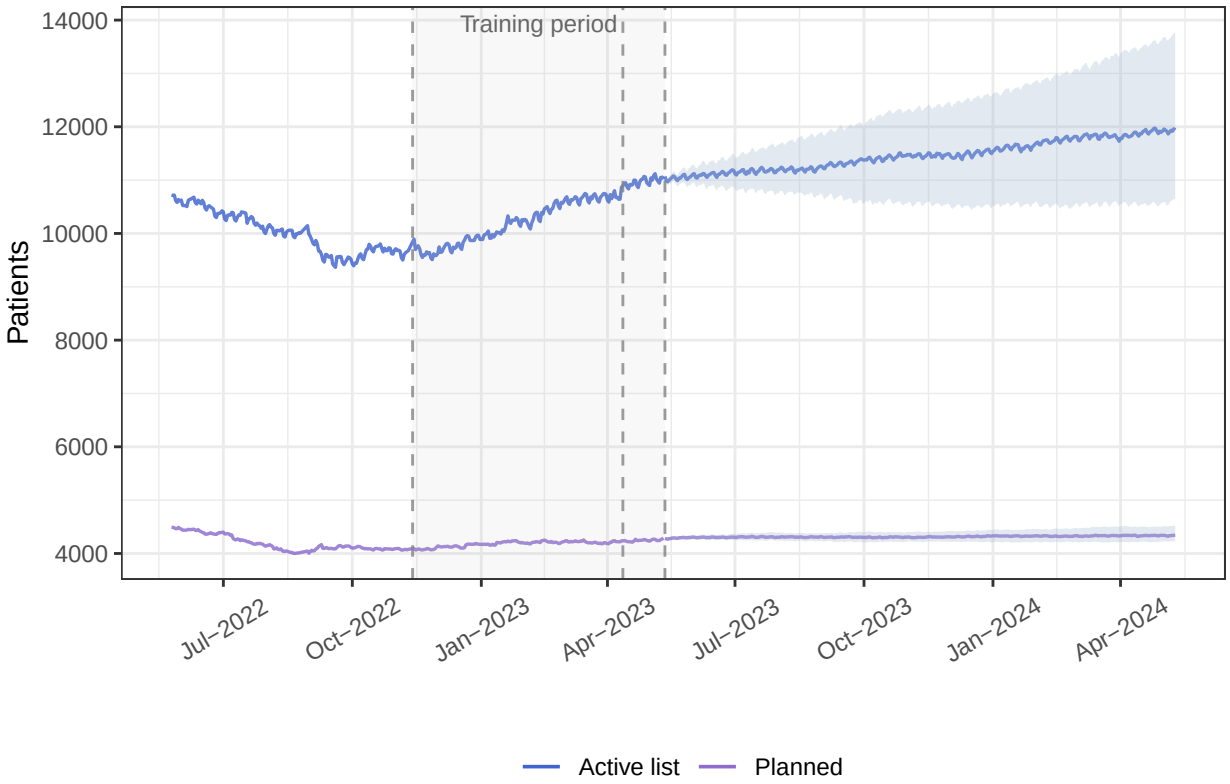
Training period
Patients
14000
12000
10000
8000
6000
4000
Jul–2022
Oct–2022
Jan–2023
Apr–2023
Jul–2023
Oct–2023
Jan–2024
Apr–2024
Active list
Planned

Figure 2

Planned updates for later SitRep versions:

- *Improve sense and readability of methodology*
- *Add outpatient and diagnostic lists*
- *Add the completed non-elective bed modelling demand work*

Change log

21/04/2023 - *Added new column to Table 1 and 2: List size at [training halt date]. This is our list starting size. - Altered Table 1 and 2 column headers for clarity. - Added text to "How these results should be interpreted"*