

Using Artificial Intelligence to improve theatre scheduling at South Tees NHS Foundation Trust

Edge Health and South Tees NHS FT

Summary: Like many NHS trusts, South Tees NHS FT, a major tertiary hospital in the Tees Valley, faced the challenge of increased waiting times and low theatre utilisation in late 2016. To help improve operational performance, they implemented an artificial intelligence software which predicted theatre times of operations and allowed for more optimal scheduling of theatre lists. This initiative improved theatre productivity, resulting in an end to weekend theatre lists, as well as increased within-list throughput by ~10%. This allowed the trust to save £4m in 2017/18.

Background: South Tees NHS FT is a large tertiary hospital that provides general hospital services for a population of c.435,000 people and specialist services to c.1.5million people in Tees Valley, North Yorkshire and parts of Durham and Cumbria. It works from two main hospitals and 4 community-based sites. They provide more than 80,000 day-case and planned procedures per year.

Problem: To meet RTT targets and manage increased elective waits, the trust started additional weekend theatre working. This created capacity for an additional ~60 weekend cases per week, but at significant extra cost. At the same time, theatre utilisation hovered around c. 75%. South Tees' goal was to increase the number of cases completed within core hours and reduce weekend working. This would tackle both their financial challenges and reduce elective waiting times.

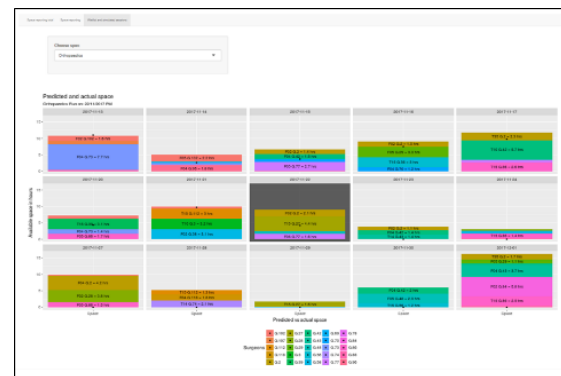
Intervention: South Tees undertook a programme of work to improve its theatre productivity. This was led internally by the Chief Executive. In keeping with many trusts, challenges included late starts, long turnover time as well as inefficient booking of operating lists. Routinely lists would sit empty at the end of the day even though space and staff were available. To address this, the team at South

Tees NHS FT started to look at how they could safely fit more operations into their theatres without 'overbooking' operating lists.

Software: To support this initiative, the trust used Space Finder, an artificial intelligence software designed by Edge Health. Using predictive analytics, Space Finder tackles two issues:

- 1) It proposes optimal lists for booking managers considering surgeon ability, theatre, site, case-length, urgency and RTT.
- 2) Secondly it monitors the lists and alerts service managers and booking staff to under or over-runs before they happen. It can send out reports to facilitate this process and identify specific cases from the waitlist to fill any spots that arise to ensure the full use of capacity.

Figure 1: Space Finder reports and interface



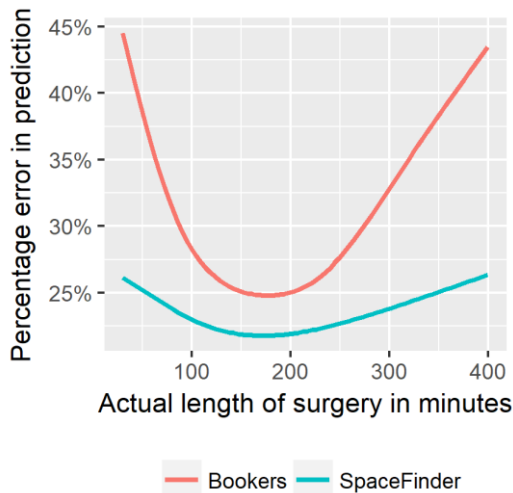
Note: the first of the two figures show free space available by surgeon and day (forward and backward looking), the second figure allows to dive into particular days to see booked cases and their predicted lengths as well as cases that could be booked.

As Space Finder is based on machine learning it improves on its own with continued use.

Accuracy: Space Finder predicts case length more accurately than booking managers can. This

means more cases can be booked than traditionally the case. The Space Finder predictions are c. 30% more accurate relative to the estimates of the booking team (see Figure 1.)

Figure 1: Accuracy of Space Finder relative to booking manager

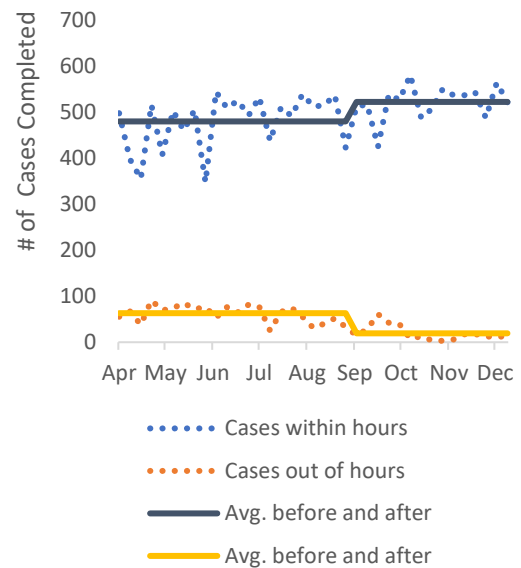


This means that when the software is used to build and scrutinise theatre lists ahead of time it allows for more cases to safely be put on to existing lists.

As part of the implementation process, the trust worked closely with the booking team and clinicians to build confidence in the approach and in the ability of the software to give reliable predictions. The software provides reports on actual versus predicted theatre use on an ongoing basis, to allow clinicians, bookers and managers to track improvements. Importantly, the software continuously updates, based on experience, to improve the accuracy of its predictions.

Results: The programme was provisionally started in January 2017 with selected specialties and fully rolled out in September 2017. By December it has led to an average increase of c.60 cases within hours which allowed the trust to reduce weekend working almost completely.

Figure 2: Elective cases completed in and out of hours at ST NHS FT 2017 (weekly)



Note: Intervention from September 2017 onwards. Out of hours cases on right axes.

In terms of financial performance, the reduction of out of hours working alone will save South Tees c. c£4m in out of hours staff cost.

“Space Finder allowed us to prospectively view real time case opportunity across our scheduled lists to drive up performance and utilise our theatre plant more efficiently”
Director of strategy at ST NHSFT