Efficiency changes in orthopaedic trauma surgery and implications for resource allocation

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Abstract

Background/Aims The trauma and orthopaedic surgery department needed to modify practices as a result of the COVID-19 pandemic. This study quantitatively assessed the effects of changes in resource allocation on the efficiency of trauma, specifically the number of operations performed per defined trauma session.

Methods Trauma lists were reviewed pre-COVID, at the peak and at the tail of the first wave of COVID-19 infections at a hospital in the UK. Efficiency was calculated before and after the reallocation of resources and this was defined as the number of cases per trauma session as well as turnaround times for each part of the surgical patient journey.

Results The mean trauma list efficiency was 1.73 cases per session in February 2020 compared to 1.89 in February 2019. It reduced to 1.21 during the COVID peak in April 2020 compared to 1.90 in April 2019 and improved to 1.48 per session in June 2020 vs 1.82 in June 2019.

Conclusions Measures introduced at the start of the pandemic are likely to continue for the foreseeable future. Increased allocation of resources would be needed to allow urgent trauma surgery to provide a timely and efficient service.

Key words: Efficiency; Resource allocation; Trauma lists; Trauma surgery

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Introduction

The COVID-19 pandemic has placed unprecedented demand on the entire healthcare system (Haffer et al, 2020). While the majority of elective orthopaedic surgery was halted, urgent orthopaedic trauma procedures continued (Casiraghi et al, 2020). Multiple challenges were encountered, such as reduced operative theatre time and space and reduced staff numbers as a result of symptoms of COVID-19, isolation periods or redeployment to other areas such as the intensive therapy unit.

This quality improvement project measured the trauma activity at the authors' centre throughout the first wave of the COVID-19 pandemic and compared it to previous seasonal activity. It also quantitatively assessed the efficiency of changes to resource allocation for trauma and orthopaedic surgery lists during this period and evaluated the potential impact of these changes going forward.

Methods

This quality improvement project took place at a UK district general hospital. The relevant factors recorded included the mean number of cases per session (4 hours or 240 minutes) and the gross time per case including anaesthetic and turnover time, the number of anaesthetic consultants supporting the lists and theatre space allocation. Trauma cases were subdivided into upper limb, lower limb and spinal cases.

Trauma lists for February (representing pre-COVID-19), April (first peak of COVID-19) and June 2020 (the tail of the first wave of COVID-19) were reviewed. The intervention took place in May 2020 and therefore February and April 2020 were considered as the first cycle and June 2020 was considered as the second cycle of the quality improvement project. Additional trauma lists carried out at nearby independent hospitals under the expanded NHS capacity were also included (UK Government, 2020a), as well as any operations performed on the hospital's emergency list.

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The intervention was centred around changes in resource allocation, specifically, extra anaesthetic consultant support in trauma theatre and extra theatre space provided to increase efficiency. The figures were compared to those from corresponding months for the previous year (2019) to account for seasonal variation.

All data was tabulated in Excel (Microsoft Corp. Redmond WA) and a statistical analysis was performed to determine significance. The project was approved as a quality improvement project by the Trust Clinical Audit Service.

Results

There were 57 trauma surgery sessions in February 2020 which increased to 66 in April 2020 and to 99 in June 2020 as the lockdown was relaxed. The number of sessions in the corresponding periods in 2019 were 55, 61 and 63 respectively (Figure 1).

The mean trauma list efficiency calculated on a case per session basis was 1.73 per session in February 2020 compared to 1.89 in February 2019 which was not statistically significant (P=0.010 assuming 99% confidence intervals) (Student's t-test). It reduced to 1.21 during the COVID peak in April 2020 compared to 1.90 in April 2019 (P<0.001). The mean efficiency improved to 1.48 per session in June 2020 against 1.82 in June 2019 (P<0.001). There was a rebound increase in the number of operations performed in June 2020 which was most pronounced for upper limb fractures (Figures 2 and 3).

About half of all lists in April 2020 were supported by two anaesthetic consultants which was increased to 75% of lists in June 2020 (Figure 4). In the pre-COVID period, almost all trauma was performed in a single theatre with a dedicated team. However, extra theatre space was used in about 20% of sessions during the COVID-19 peak, which was further

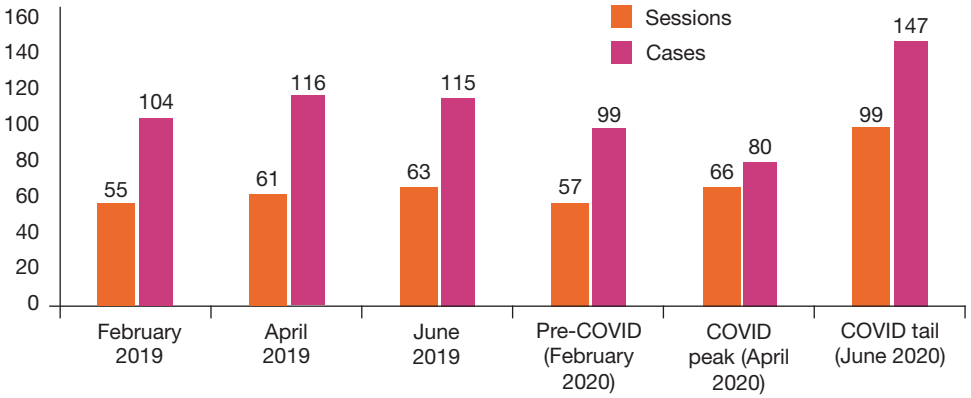

Figure 1. Volume of orthopaedic trauma surgery and the number of sessions required.

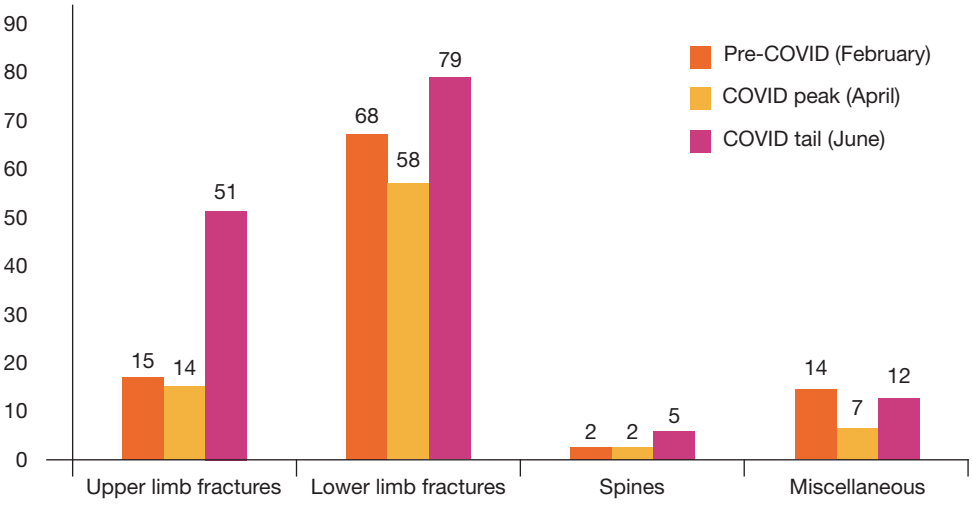

Figure 2. Distribution of trauma cases during the COVID-19 pandemic.

increased to 35% in June 2020 to ensure faster turnover (Figure 5). The mean gross time per case increased by more than 40% during the COVID peak (April 2020) compared to the pre-COVID averages (Figure 6).

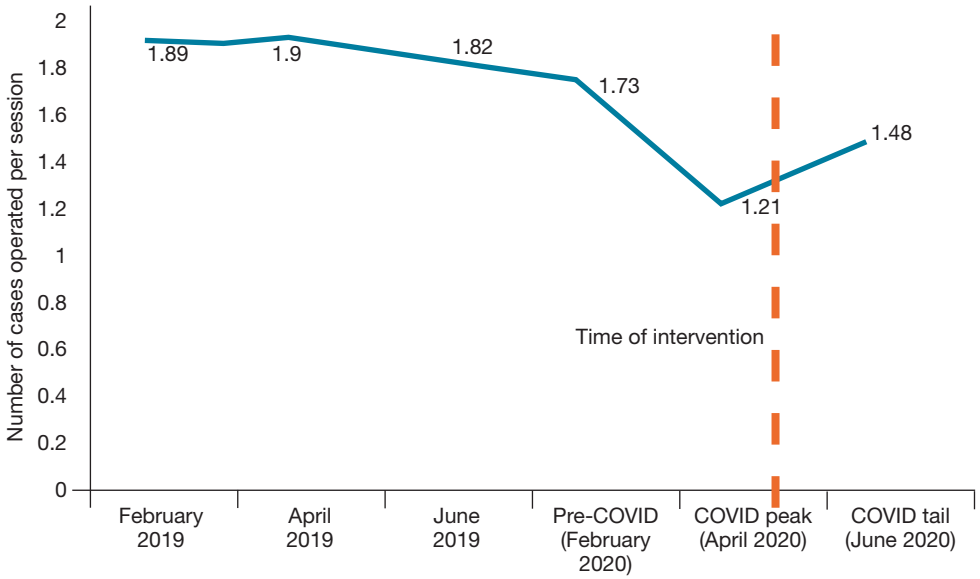

Figure 3. Trauma theatre efficiency quantified as number of cases operated per session.

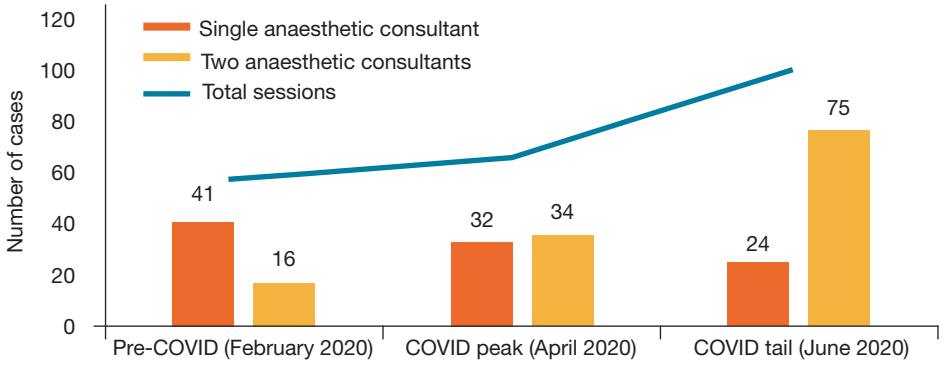

Figure 4. Anaesthetic consultant support to trauma lists.

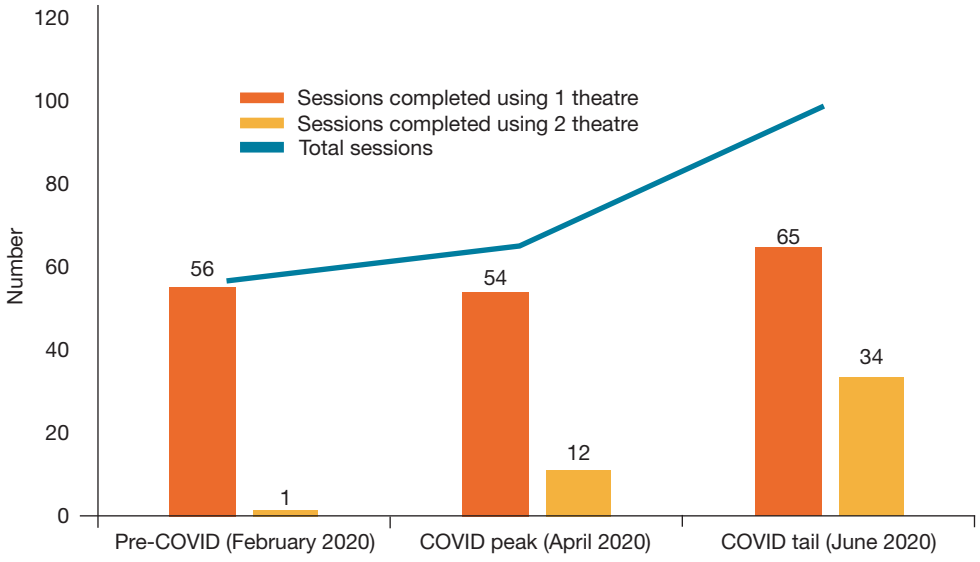

Figure 5. Distribution of the number of operating rooms used for trauma surgery sessions.

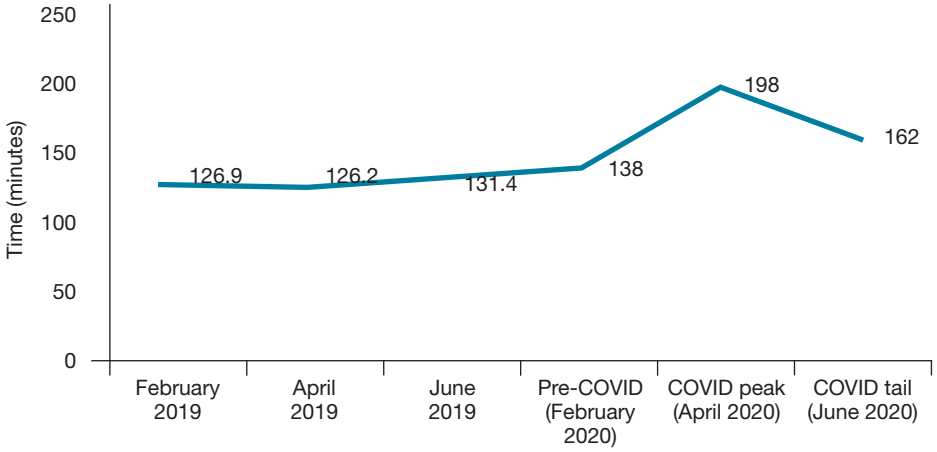

Figure 6. Gross time per operation, including surgical, anaesthetic and turnover time.

Discussion

A total of 335 trauma operations were performed from February–April 2019 while 326 were performed in the same months in 2020 (P=0.48; not statistically significant). Despite the trauma burden reducing during the peak of the pandemic, the efficiency of the remaining lists reduced by about 35%. The authors' trust implemented additional safety protocols based on national guidance (Wielogórska and Ekwobi, 2020) such as a deep clean after every procedure, a lockout period following an aerosol-generating procedure and use of enhanced personal protective equipment. This came with a learning curve for staff. The usual staff and equipment flow into and out of theatre was disrupted with minimum theatre equipment (such as surgical machines and orthopaedic implants) inside the theatre space. Instead they were kept in a 'clean space' outside the theatre, leading to delays when anything unexpected was required during surgery. Moreover, patients were routinely recovered in the operating theatre rather than recovery areas, which led to theatre lists becoming highly inefficient.

The introduction of the interventions led to efficiency increasing to within 80% of pre-COVID levels (Figure 7). The first measure included making a second theatre space available that the surgical, anaesthetic and scrub team could move into while the previous patient was recovered in the first theatre. This reduced delays while only using one team at a time when staffing levels were stretched. The second measure was to deploy a second anaesthetic consultant in about 75% of the lists. This increased efficiency by reducing the turnover time further, allowing the extra theatre space to be used to prepare the next patient as the previous surgery was concluding. If these changes (including extra theatre space and staff) were continued (Figure 8) (Ng et al, 2020), this would likely have an effect on the resumption of elective lists as the extra staff and space are currently drawn from the dormant elective capacity.

In 2015, the financial cost of an operating team in the NHS was calculated as about £800 per session (Chen et al, 2015). The cost of building and equipping an operating room is approximately £1.6 million (UK Government, 2010). The 10-year bond yields in the UK are at historic lows with the government borrowing via GILTS from the Bank of England at rates slashed to 0.1% per annum (UK Government, 2020b; 2020c). Extrapolating this expenditure to the building of an operating room, it would cost a hospital or government about £1600 to finance this loan for a year. This would provide a valuable asset at a very reasonable price. This could provide extra emergency theatre capacity for further COVID-19 peaks or any other extraordinary events that could impact the healthcare system. In times of austerity, it would mean less wear and tear and thereby a longer productive lifespan of these material assets.

The limitations of this quality improvement project include it being performed at a single centre (involvement of multiple centres would better validate the results), retrospective design and small time periods which may limit the generalisability of the outcomes. However, the authors believe that these measures can be adapted for use by other services as well such as emergency general surgery in order to provide extra operating capacity at a time of high demand.

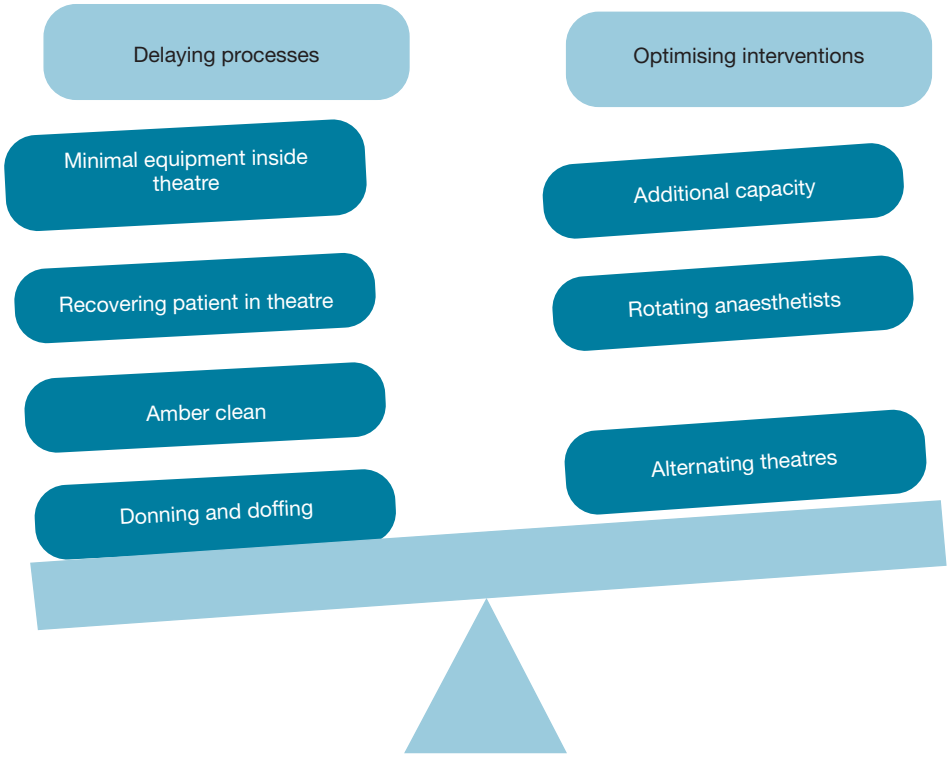

Figure 7. Processes affecting theatre efficiency as a result of the COVID-19 pandemic.

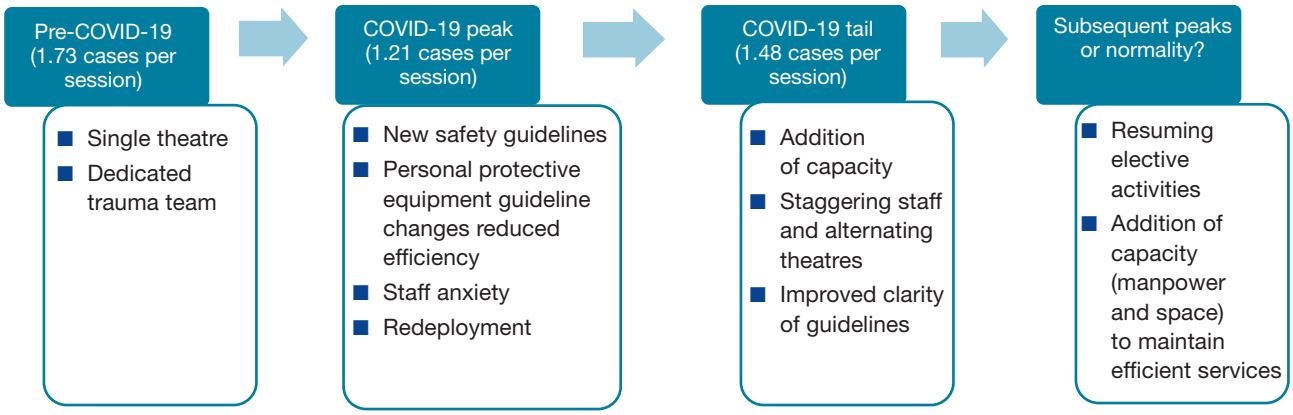

Figure 8. Flow of trauma surgery during the first wave of the COVID-19 pandemic and possible implications for future practice.

Conclusions

Urgent trauma surgery is a vital part of the provision of NHS healthcare. The measures introduced as a result of the COVID-19 pandemic are likely to continue in the foreseeable future, hence for timely trauma surgery to be maintained would require additional time, theatre space and anaesthetic staff. If additional theatre space is not made available, it is likely to impact on the volume of emergency and elective surgery undertaken. The capital cost of building additional theatre capacity is currently low and could represent an area for further exploration.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

Key points

- It has been important for centres to maintain an emergency orthopaedic service during the COVID-19 pandemic to treat urgent cases such as hip fractures and septic joints.
- There have been many challenges to this, such as a reduction in staff and theatre time, as well as disruption to normal operating practices, which have significantly reduced the orthopaedic operating capacity and efficiency during this time.
- This quality improvement project suggests that additional theatre time, theatre space and anaesthetic support would be needed to not only maintain efficiency of trauma lists, but also to allow efficient elective surgery to be undertaken.

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