The first Super-Sprint National Anaesthesia Project: (SuperSNAP1) Cancellations, efficiency and productivity in perioperative care: a 2-day national service evaluation

Report prepared for NHS England and NHS Improvement

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Executive Summary

- **74% of UK NHS Trusts and Health Boards participated in this 2-day study of surgical and interventional procedural activity, which took place on 11 and 12 January.**
- **87% of participating organisations were located in England.**

Key findings

1. **During the two days of the study, there was a 27% reduction in elective sessions and a 2% reduction in emergency sessions compared with usual activity** (based on a typical day in the past 1 year)

2. **At least one entire session was cancelled on 313 of 457 reported theatre days (68%).**

- Staff shortages led to the greatest number of theatre days affected (44.4%), followed by hospital bed availability (29.1%) and critical or enhanced care bed availability (6.8%).

3. **Staffing constraints accounted for the majority of whole session cancellations.**

- 39.4% of theatre days had reduced activity because of Covid-related absences – this might have been for Covid illness, self-isolation or carer responsibilities related to Covid, or because of staff redeployment to other hospital areas.
- 19.7% of theatre days had reduced sessions because of non-Covid related reasons including non-Covid sickness, chronic staff shortages, or leave / double bookings of staff which had not been anticipated and covered.
- The differential impact of different types of staff absence was consistent whether or not the absence was Covid related or not.
    - The staff groups which had greatest impact on theatre activity were scrub staff and anaesthetic assistants (encompassing anaesthetic nurses and Operating Department Practitioners).
    - 30.9% of 'theatre days' reported reduced activity as a result of scrub staff shortages (including 14.9% for non-Covid related absence) and 27.4% as a result of anaesthetic assistance (13.3% for non-Covid reasons). Thus, approximately half of all scrub / anaesthetic practitioner absence is NOT directly Covid-related.

4. **71.8% of lists started on time, 79.6% ended on time and in the opinion of the theatre team, 1713 (64.5%) lists were used as efficiently as possible.**

5. **603 P1 (emergency) procedures took place on elective lists** (8.0% of total procedures on elective lists)

6. **43% of cases on elective lists were P2 prioritisation; 49% were P3 and P4**

7. **In addition to 7498 procedures which took place, 1246 patients were cancelled on the day or day before surgery**

- 34.2% of cancelled patients were undergoing P2 surgery.

- 16.5% of cancelled patients were having cancer-related procedures

8. **The overall cancellation rate was 15.3%.** The overall cancellation rate was broadly similar between adults and children, and ambulatory vs inpatient care, although reasons for cancellation varied by procedural and patient characteristics (see key finding 11).

9. **Acute clinical reasons led to cancellation of 416 patients (33.4% of cancellations and 5.1% of all elective procedures)**

- 264 patients (21.2% of cancellations; 3% of planned elective procedures) were cancelled for medical reasons related to Covid-19
    - Some of these patients may have had acute Covid infection; others may have had recent infection (within 7 weeks) and therefore postponed on the basis of clinical guidance.
- 153 patients (12.3% of cancellations; 1.8% of planned elective procedures) were cancelled for other acute conditions.

10. **Capacity reasons led to cancellation of 400 patients (32.1% of all cancellations; 4.9% of all elective procedures)**

- 216 patients (17.3% of cancellations, 2.7% of planned elective procedures) were cancelled because of lack of physical hospital capacity (either ward beds, critical/enhanced care beds or because emergency activity displaced elective work)
- 112 patients (9.0% of cancellations, 1.4% of planned elective procedures) were cancelled because of staffing constraints.

11. **Potentially avoidable reasons relating to preoperative information, assessment and preparation led to cancellation of 285 patients (22.9% of cancellations, 3.5% of elective procedures).**

- These included**:**
    - Long-term conditions (100 patients, 8% of cancellations; 1.2% planned elective procedures)
    - Patients not attending on day of surgery (94 patients, 7.5% of cancellations; 1.2% planned elective procedures)
    - Procedure no longer indicated or patient chose not to go ahead on the day (91 patients (7.3% cancellations; 1.1% planned elective procedures)
- While we cannot be sure of the reasons why patients did not attend on the day, long-term condition management and change in clinical priorities are unlikely to be directly Covid-related and therefore will be a continued issue even when Covid numbers fall.

12. **Reasons for cancellation varied by indication for surgery, and magnitude and urgency of surgery**

- Patients having cardiac or vascular surgery were most likely to be cancelled for capacity reasons.
- Patients having surgery for any other indication, including cancer, were most likely to be cancelled for acute medical reasons.
- Long-term condition management was most likely to lead to cancellation of more urgent (P2) and more complex (major/major+/complex) procedures.

Recommendations

Operationally prioritise the most clinically urgent patients

1. Particularly at times of high staff absences, consideration should be given to further operationally prioritising P2 patients. Prioritisation and service planning should be considered at system rather than Trust level.

2. Ring-fenced resources should be provided on the basis of clinical need rather than reducing waiting list numbers, in keeping with the declaration in the NHSEI elective recovery plan.

3. Consideration should be given to advanced planned seasonal operational delivery models which reduce P3 and P4 activity at times of predictable high pressure within the NHS (e.g. Winter). This will have significant workforce and training implications which will require modelling and consultation – e.g. opportunity for annualised contracts for consultant surgeons and/or promoting job plans which flex different types of clinical activity (e.g. inpatient vs. outpatient work) at particular times of the year.

4. Enhanced perioperative care services and ring-fenced high turnover level 3 facilities should be prioritised within main NHS estates to reduce cancellations because of critical care pressures.

Improve system efficiency through safe delivery of high volume low complexity surgical hubs

5. Surgical hubs for high volume low complexity work will directly reduce waiting times and improve efficiency for some services, and indirectly improve efficiency (through reduction in secondary care pressures) for others. These are therefore supported but with important caveats and considerations, for example:

    - **Patient safety**, particularly if considering hubs outside the main NHS estate. While rare, the absolute number of serious critical incidents in anaesthesia such as death or severe morbidity from airway management is higher in younger (<60 years), fitter (ASA 1 and 2) patients, [1] highlighting the importance of senior anaesthetic cover in all sites.
    - **Equality of access**: Perioperative risk increases with age, [2] frailty [3] and socioeconomic deprivation. [4, 5] Patients at higher risk of generic perioperative and postoperative complications will need to remain within main NHS estates with access to critical care and appropriate specialist services, and should not be disadvantaged by capacity issues.

Aim for zero tolerance of avoidable last-minute cancellations through strengthening perioperative pathways.

6. Further investment is required in perioperative care coordinators and preoperative assessment processes so that **all** patients waiting for surgery can be screened, optimised and have regular check-ins with perioperative services to ensure that their needs and health

have not changed. While current NHSEI plans to focus on inpatient surgery appropriately target the group at highest risk of cancellation due to failure of preoperative processes, substantial numbers of avoidable cancellations are occurring in ambulatory and lower risk surgery as well.

Develop and evaluate disruptive innovations through coproduction with staff and patients

7. **Piloting of "over-establishment" workforce models which include booking surplus staff** for work each day, who can be deployed in the event of staff sickness or other unexpected absence. Trusts will need to examine their own absence data to understand the incidence and impact of different staff group absences in order to plan cover appropriately. This should reduce cancellations and improve efficiency, productivity and reduce costs; it will also potentially improve staff satisfaction; however, it will require a sea-change in rostering culture.

8. **Changing preoperative processes to include a 'final check' 48h before surgery** to reduce the risk of last minute cancellation due to a change in patient condition, including acute illness. A digital self-assessment checklist for patients can be developed which will be supported by perioperative care coordinators (particularly to support non-digitally enabled patients). Senior medical and/or nursing advice can then determine if a patient may need to be postponed or cancelled and arrangements made for rebooking the available theatre time.

9. **Consider how to safely implement 'reserve lists' for elective surgical patients**. If listed patients are identified 24-48h preoperatively who are not ready for surgery, reserve list patients can be contacted to fill gaps in operating lists. This will require significant planning and patient consultation given the need to reduce the risk of perioperative Covid infection and nosocomial transmission. It will also need health inequalities assessment to ensure that those with carer or work responsibilities, particularly if working in the gig economy, are not systematically disadvantaged by such a system.

10. **Investment in administrative functions** and support to improve list planning and coordination and improve productivity. This should include piloting and evaluation of new methodologies including machine learning methods using routine data; on-the-day systems such as waiting lounges and time-in-motion analyses of how interdependent services (e.g. radiography, laboratory services) impact on theatre efficiency.

11. **Reducing pressure on hospital beds through further innovation in reducing length of stay initiatives:** in particular, consideration should be given to how virtual ward support can be extended to perioperative pathways.

Background

There has been a well-documented and significant growth in waiting lists for elective care, including both treatment and diagnostic pathways, as a result of the Covid-19 pandemic. As a result, an elective recovery plan has been developed and published by NHS England and Improvement (NHSEI) which sets out measures to deal with this challenge.

The plan has four key themes: increasing capacity; clinical prioritisation of individual patients rather than waiting list numbers; service transformation including establishing elective surgical hubs; and improving information and support for patients while they wait.

Approximately 20% of waiting list patients are awaiting surgical / other interventional procedures. Last minute cancellation of planned procedures leads to disruption and potential harm to patients (both physical and psychological) and reduction in efficiency and productivity of hospital services. Previously, mandatory data returns on last minute cancellations were provided by NHS trusts in England, but these were paused during the Covid pandemic to reduce pressure on clinical and operational teams. There were also limitations to these previous returns, including that they only collected information on patients cancelled for non-clinical reasons, and did not provide detail about the reasons for cancellation, for the purpose of future service improvement.

Previous research[6] evaluated rates and reasons for cancellation in patients undergoing major surgery (defined as that requiring the care of an anaesthetist, and an overnight stay in hospital).

- A hospital-level census found that clinical reasons accounted for around a third of last-minute cancellations, although this did not differentiate between acute and long-term conditions.
- A patient-level study of those having surgery, found that one in 10 had been previously cancelled at least once, and that the requirement for a postoperative critical care bed, and having surgery in a hospital with an emergency department, were the two biggest single risk factors for cancellation.

Both sub-optimal theatre efficiency and productivity, and last minute cancellation, are risks to elective recovery and to patients that are potentially modifiable. This pragmatic snapshot study aimed to provide additional information to that available via routine NHS data, on last minute cancellation of interventions, theatre efficiency, and the factors which affect these metrics. The purpose is to support policy makers and operational teams in decision-making around how to innovate to improve service delivery.

Methods

SuperSNAP1 was a pragmatic, national study of elective interventions / surgery cancellation and efficiency and of emergency surgery timeliness. It aimed to support policy makers and operational and clinical leads at every level of the system in understanding the contemporary reasons underpinning service pressures and inefficiencies, in order to support development of targeted solutions. This report does not cover the methods or results of the emergency surgery timeliness part of this study, which will be reported separately.

SuperSNAP1 took place over 48h starting at 08:00 on Tuesday 11 January 2022 and finishing at 07:59 on Thursday 13 January 2022. The study was deemed a service evaluation by the Health Research Authority's self-assessment tool. Patient consent was not required and no patient identifiable data were collected.

The study was led and coordinated by a team from the Centre for Perioperative Medicine at UCL, and the Health Services Research Centre (HSRC) at the Royal College of Anaesthetists (RCoA). Funding was provided by NHS England and NHS Improvement.

All acute Trusts in England, Wales, Scotland, Northern Ireland and the Crown Administrations were invited to participate in December 2021. An invitation to participate with an explanation of the study and the timelines was sent to clinician investigators who were already registered as HSRC leads for other active studies. Trusts / sites were invited to register and a webinar and supporting materials were provided to support site initiation and study delivery. Registration details included listing individual sites within Trusts, and whether or not these sites had an emergency department and/or a dedicated emergency operating theatre.

All adult and paediatric lists which required the support of an anaesthetist were eligible for inclusion Exclusion criteria were obstetric procedures and lists with minor procedures/interventions that did not require anaesthetic support.

Study documents are in appendix 1; data were captured electronically using online case report forms (CRFs) generated using Form Assembly software (Form Assembly Inc., Bloomington, Indiana, US - formassembly.com) and accessible via website links and QR codes.

The four CRFs were:

1. **Hospital-level daily activity survey:** one CRF completed by local principal investigators (PIs) for each site on each day of the study which detailed the number of sessions taking place, the number of sessions cancelled, and information about reasons for cancellation. PIs were asked to compare the activity taking place on the days of the study with equivalent days of 'usual' activity during the past 1 year.
2. **List-level activity survey:** one CRF completed by the anaesthetist responsible for each interventional or operating list detailing the number and types of patients receiving treatment on each list

3. **Last minute cancellations:** completed by the anaesthetist responsible for each operating list; one CRF for each patient which was cancelled on the day or the day before surgery detailing basic information about the patient and the procedure and the reasons for cancellation
4. **Emergency surgery timeliness:** one CRF completed for each procedure taking place on emergency lists over the 48h period, providing basic information about the procedure and the timeliness of it taking place, compared with the ideal timeline dictated in the clinical notes; completed by the anaesthetist in charge of each case.

Only the first three of these CRFs are reported in the analysis presented here. Piloting took place in one NHS trust and feedback led to minor modifications to the CRFs.

Results

253 sites within 119 Trusts/Health Boards submitted data (of a total of 161 Trusts invited to participate). UK Trust participation rate was therefore 74%, distributed as follows:

- England – 103 of 136: 76% participation rate
- Wales – 4 of 7: 57%
- Scotland – 10 of 14: 71%
- Northern Ireland – 1 of 3: 33%
- Crown Dependencies – 2 of 2: 100%

Trusts/Health Boards which did and did not participate are listed in appendix 2.

Hospital level activity

- 457 "working days" were reported by principal investigators at 253 sites in 119 Trusts/Boards
- During these 457 working days, 5563 elective and 2119 emergency **sessions**[1] were reported.
- Elective session activity was distributed as follows:
  - morning: 2783 (50%);
  - afternoon: 2539 (46%);
  - evening: 241 (4%)
- There was less variation in the number of **emergency** sessions according to time of day:
  - 706 (33%) in the morning;
  - 755 (36%) in the afternoon;
  - 368 (17%) in the evening and 290 (14%) at night. (Table 1)

[1] **Sessions** could be either am, pm, evening or night. **Lists** might have covered more than one session.

Type of activity	Number
Morning	
Usual Number of elective sessions	3739
Actual Number of elective sessions	2783
Change in **elective** activity (%)	- 956 (↓25.6%)
Usual Number of emergency sessions	703
Actual Number of emergency sessions	706
Change in **emergency** activity (%)	+3 (↑0.4(%))
Number of elective theatre sessions converted to emergency surgery	93
Afternoon	
Usual Number of elective sessions	3680
Actual Number of elective sessions	2539
Change in **elective** activity (%)	- 111 (↓31.0%)
Usual Number of emergency sessions	741
Actual Number of emergency sessions	755
Change in **emergency** activity (%)	+14 (↑1.9%)
Number of elective theatre sessions converted to emergency surgery	128
Evening	
Usual Number of elective sessions	238
Actual Number of elective sessions	241
Change in **elective** activity (%)	+ 3 (↑1.3%)
Usual Number of emergency sessions	404
Actual Number of emergency sessions	368
Change in **emergency** activity (%)	- 36 (↓8.9%)
Number of elective theatre sessions converted to emergency surgery	14
Night	
Usual Number of emergency sessions:	312
Actual Number of emergency sessions	290
Change in **emergency** activity (%)	- 22 (↓7.1%)

Table 1: Total number of sessions taking place during the 48h of the study

Key Finding 1

There was a 27% reduction in potential elective activity and a 2% reduction in emergency session activity compared with usual activity (table 2).

- The usual number of sessions (based on a typical day in the past 1 year) were 7657 and 2160 for elective and emergency work respectively

	n
Elective sessional activity	
Usual number of elective sessions	7657
Actual number of elective sessions	5563
Shortfall between usual and actual elective sessional activity (%)	- 2094 (-27% potential activity)
▪ Planned empty sessions	238 (↓3.1% potential activity)
▪ Unplanned empty sessions due to acute pressures	1065 (↓13.9% potential activity)
▪ Unknown if empty lists were planned or unplanned	791 (↓10.3% potential activity)
Elective lists converted to emergency[2]	248 (4.5% of elective session activity)
Emergency sessional activity	
Usual number of emergency sessions	2160
Actual number of emergency sessions during study window	2119
Shortfall in emergency sessions	-41 (↓2% of emergency session activity)

Table 2: Summary of sessional activity

Key Finding 2

At least one entire session was cancelled on 313 of 457 reported theatre days (68%).

- Reasons for sessional cancellation are provided in table 3.
- Staff shortages led to the greatest number of theatre days affected (44.4%), followed by hospital bed availability (29.1%) and critical or enhanced care bed availability (6.8%).

	Theatre days affected [n, (%)]
Covid-related	**128 (28)**
Not Covid-related	**201 (44)**
Covid-impact uncertain (e.g. bed shortages)	**128 (28)**
Specific reasons for cancellation of whole sessions	
Staff shortages (table 4)	203 (44.4)
Lack of hospital bed	133 (29.1)
Lack of critical or enhanced care bed	31 (6.8)
Trust-level decision to close theatres	24 (5.3)
Administrative issues	23 (5.0)
Avoidable patient factors (e.g. not starved)	16 (3.5)
Educational or governance meetings	13 (2.8)
COVID clinical process	13 (2.8)
Reconfiguration of services to support emergency work	11 (2.4)
Theatre maintenance	10 (2.2)
Equipment missing or failed	4 (0.9)
Unclear or no reasons given	5 (1.1)

Table 3: Reasons for whole sessions being cancelled

[2] National data for the same week in January indicate 1.6% of elective lists were converted to emergency

Sessional cancellations due to staff shortages

Where staff shortages were cited as a reason for whole sessions being cancelled, further information was provided on the staff groups associated with cancellation and the reasons for their absence (table 4).

Key Finding 3

Staffing constraints accounted for the majority of whole session cancellations.

- 39.4% of theatre days had reduced activity because of Covid-related absences – this might have been for Covid illness, self-isolation or carer responsibilities related to Covid, or because of staff redeployment to other hospital areas.
- 19.7% of theatre days had reduced sessions because of non-Covid related reasons including non-Covid sickness, chronic staff shortages, or leave / double bookings of staff which had not been anticipated and covered.
- The differential impact of different types of staff absence was consistent whether or not the absence was Covid related or not.
    - The staff groups which had greatest impact on theatre activity were scrub staff and anaesthetic assistants (encompassing Operating Department Practitioners (ODPs) and Anaesthetic Nurses).
    - 30.9% of 'theatre days' reported reduced activity as a result of scrub staff shortages (including 14.9% for non-Covid related absence) and 27.4% as a result of anaesthetic practitioner shortages (including 13.3% for non-Covid reasons). Thus, approximately half of all scrub / anaesthetic practitioner absence was NOT directly Covid-related.
    - Healthcare assistants were reported as being a limiting factor on 14.7% of theatre days, although their absences were usually (>98%) accompanied by more senior staff absences and therefore in and of themselves unlikely to have led to lists being cancelled.

	Scrub staff	Anaesthetic assistants	HCAs	Ward or critical care staff	Senior surgeon	Recovery staff	Senior anaesthetist	Porters	Middle grade anaesthetist	Middle grade surgeon	Not specified	Total number of theatre days affected by each type of absence [n,(%)]
Covid-related leave [n]	132	118	64	49	38	41	28	13	10	4	4	176 (38.6)
Non-Covid sickness [n]	59	53	34	21	16	14	10	4	5	1	1	72 (15.8)
Redeployment [n]	48	46	31	25	9	22	12	6	4	2	1	57 (12.5)
Chronic staff shortages [n]	12	12	4	2	2	0	3	1	1	0	0	15 (3.3)
Leave / double booked [n]	1	0	1	0	7	0	1	0	1	1	0	8 (1.8)
Other [n]	0	0	0	0	1	0	0	0	0	0	0	2 (0.44)
Summary of theatre days affected by Covid-related reasons incl. sickness + redeployment [n, (%)]	133 (29.1)	118 (25.8)	64 (14.0)	50 (10.9)	39 (8.5)	40 (8.8)	28 (6.1)	13 (2.8)	9 (2.0)	4 (0.9)	4 (0.9)	180 (39.4)
Summary of theatre days affected by non-Covid related (incl. non-Covid sickness, chronic staff shortages, leave etc) [n, (%)]	68 (14.9)	61 (13.3)	36 (7.9)	22 (4.8)	25 (5.5)	16 (3.5)	12 (2.6)	4 (0.9)	5 (1.1)	2 (0.5)	1 (0.3)	90 (19.7)
Total theatre days affected by each staff group [n, (%)]	141 (30.9)	125 (27.4)	67 (14.7)	51 (11.2)	50 (10.9)	40 (8.7)	30 (6.6)	13 (2.8)	10 (2.2)	6 (1.3)	4 (0.88)	

Table 4: Staff groups leading to whole lists being cancelled

Theatre efficiency

2658 theatre lists were reported from 253 sites, 1416 taking place on day 1 and 1242 taking place on day 2.

Key finding 4

71.8% of lists started on time, 79.6% ended on time and in the opinion of the theatre team, 1713 (64.5%) lists were used as efficiently as possible.

- For 606 of the 945 lists which did **not** run efficiently, reasons were provided (table 5)

	Number	%age of all lists (n=2658)
Total number of lists which did not run efficiently	**945**	**35.6**
Administrative / organisational / system inefficiencies (n=343; 12.9%)		
Administrative issues: e.g. underbooked lists	235	8.8
Organisational issues in theatre e.g. equipment	89	3.34
Late arrival of staff	20	0.75
Organisational challenges with other teams (e.g. radiographers)	11	0.41
Hospital flow challenges (n=182; 6.9%)		
Delays in Patients arriving in theatre	144	5.42
Delays in patients being able to leave theatre	30	1.13
Uncertainty over ward, critical care or enhanced care bed availability	12	0.45
Clinical or patient choice reasons (potentially avoidable) (n=79; 3.0%)		
Failure of routine systems involved in getting patients to theatre. e.g. unavailable investigations, patients not starved etc.	37	1.4
Patient factors e.g. lack of capacity, refusal, distressed, change in wishes, re-evaluating update procedure / DNA	23	0.86
Change in clinical status (long wait times, surgery no longer indicated or possible; change of decision-making re: surgical/anaesthetic plan or status	12	0.45
COVID screening pathways limited finding alternative patients	11	0.41
Workforce related (n=64; 2.4%)		
Staffing	46	1.73
Staff redeployment	19	0.71
IPC or Covid-related (n=50; 1.9%)		
Covid-19 related clinical reasons e.g. awaiting results/ positive/ recent Covid	36	1.4
Infection Prevention and control issues	20	0.75
Unavoidable other general reasons (n=98; 3.7%)		
Non-Covid-19 related clinical reasons	78	2.93
Complication on list leading to cancellation of other patients or decreased efficiency (clinical complexity from surgical or anaesthetic side)	9	0.34
Over run of morning lists/inefficiencies earlier in the day	8	0.3
Trust decision to cancel or reduce total number of lists	5	0.19
Reasons not specified	**339**	**12.8**

Table 5: Reasons for poor theatre efficiency

Procedure level elective activity and cancellations

Detailed information was submitted on 2658 elective procedure **lists**[3] over the two days of the study. 7498 procedures were reported:

- 4793 procedures (64%) were undertaken as ambulatory surgery
    - 3922 (52.3%) in adults
    - 871 (11.6%) in children
- 2705 (36%) were undertaken as inpatient surgery.
    - 2408 (32.1%) in adults
    - 297 (3.4%) in children

Key Finding 5

603 cases (8.0% of total workload) were P1 (emergency) cases taking place on elective lists.

- These cases were excluded from denominators when calculating elective cancellation rates.

Key Finding 6

43% of cases on elective lists were P2 prioritisation; 49% were P3 and P4

Prioritisation categories	Number of procedures (proportion of all procedures)		
	Ambulatory	Inpatient	Total
Adult P1	232 (3.1)	287 (3.8)	519 (6.9)
Adult P2 cancer	932 (12.4)	793 (10.6)	1,725 (23.0)
Adult P2 non-cancer	697 (9.3)	461 (6.1)	1,158 (15.4)
Total Adult P2	1629 (21.7)	1254 (16.7)	2,883 (38.4)
Adult P3	663 (8.8)	340 (4.5)	1,003 (13.3)
Adult P4	1398 (18.6)	527 (7.0)	1,925 (25.6)
Paediatric P1	40 (0.5)	44 (0.6)	84 (1.1)
Paediatric P2 cancer	65 (0.9)	21 (0.3)	86 (1.2)
Paediatric P2 non-cancer	162 (2.2)	88 (1.2)	250 (3.4)
Total Paediatric P2	227 (3.1)	109 (1.5)	336 (4.6)
Paediatric P3	212 (2.8)	64 (0.9)	276 (3.7)
Paediatric P4	392 (5.3)	80 (1.1)	472 (6.4)
Totals	**4,793 (63.9)**	**2,705 (36.1)**	**7,498 (100)**

Table 6: Number of procedures by Prioritisation category, ambulatory vs. inpatient and age group

Key Finding 7

In addition to the 7498 procedures which took place, 1246 patients were cancelled on the day or day before surgery (table 6)

- 34.2% of cancelled patients were undergoing P2 surgery.
- 16.5% of cancelled patients were having cancer-related procedures
- Characteristics of cancelled cancer patients are described in table 7.

[3] Lists may have included one or more four-hour sessions.

	Adults [n=1050] [n, (%) adults]	Children [n= 196] [n, (%) children]	Total [n, (%) total]
Ambulatory vs inpatient surgery			
Ambulatory	641 (61)	154 (79)	795 (63.8)
Inpatient	409 (39)	42 (21)	451 (36.2)
Surgical magnitude			
Minor	372 (35.4)	125 (64)	497 (40.0)
Intermediate	397 (37.8)	43 (22)	440 (35.3)
Major	281 (26.8)	27 (14)	308 (24.7)
Surgical Prioritisation			
P2	359 (34.2)	67 (34)	426 (34.2)
P3	257 (24.5)	50 (26)	307 (24.6)
P4	434 (41.3)	79 (40)	513 (41.2)
Indication for surgery			
Cancer	194 (18.5)	12 (6)	206 (16.5)
Cardiac	64 (6.1)	9 (5)	73 (5.9)
Vascular	29 (2.8)	0	29 (2.3)
Other	763 (72.7)	175 (89)	938 (75.3)

Table 7: Characteristics of cancelled patients (n=1246)

	Minor [n, (% all cancer cancellations)]	Intermediate [n, (% all cancer cancellations)]	Major/Major+/Complex [n, (% all cancer cancellations)
Adults	60 (29.1)	64 (31.1)	70 (34.0)
Children	9 (4.5)	1 (0.5)	2 (1.0)
P2	54 (26.2)	50 (24.3)	55 (26.7)
P3	15 (7.3)	14 (6.8)	16 (7.8)
P4	0	1 (0.5)	1 (0.5)
Capacity cancellation	11 (5.3)	22 (10.7)	29 (14.1)

Table 8: Characteristics of cancer cancellations

Cancellation rates

Key Finding 8

The overall cancellation rate was 15.3%.[4] (table 9)

- Cancellation rates were similar across broad patient-subgroups (table 8): e.g.
    - adults (15.3%) vs. children (15.3%)
    - ambulatory (15.0%) vs. inpatient surgery (16.0%)
- Adult P2 patients were less likely to be cancelled than P3 or P4
    - Adult ambulatory cancellation rates: overall – 17.4%
        - P2: 9.2%
        - P3: 19.3%
        - P4: 18.5%
    - Adult Inpatient cancellation rates: overall – 19.3%
        - P2: 14%
        - P3: 22.4%
        - P4: 18.2%

Reasons for elective (P2,3,4) cancellation (tables 10, 11, 12, 13)

Key Finding 9

Acute clinical reasons led to cancellation of 416 patients (33.4% of cancellations and 5.1% of all elective procedures)

- 264 patients (21.2% of cancellations; 3% of planned elective procedures) were cancelled for medical reasons related to Covid-19
    - Some of these patients may have had acute Covid infection; others may have had recent infection (within 7 weeks) and therefore postponed on the basis of clinical guidance.
- 153 patients (12.3% of cancellations; 1.8% of planned elective procedures) were cancelled for other acute conditions.

Key Finding 10

Capacity reasons led to cancellation of 400 patients (32.1% of all cancellations; 4.9% of all elective procedures)

- 216 patients (17.3% of cancellations, 2.7% of elective procedures) were cancelled because of lack of physical hospital capacity (either ward beds, critical/enhanced care beds or because emergency activity displaced elective work)
- 112 patients (9.0% of cancellations, 1.4% of elective procedures) were cancelled because of staffing constraints.

[4] Denominators used for cancellation calculations: adults: 5811; paediatrics: 1084; overall 8141 (based on total of procedures which took place + procedures which were cancelled)

Key Finding 11

Potentially avoidable reasons relating to preoperative information, assessment and preparation led to cancellation of 285 patients (22.9% of cancellations, 3.5% of elective procedures).

- These included**:**
    - Long-term conditions (100 patients, 8% of cancellations; 1.2% elective procedures)
    - Patients not attending on day of surgery (94 patients, 7.5% of cancellations; 1.2% elective procedures)
    - Procedure no longer indicated or patient chose not to go ahead on the day (91 patients (7.3% cancellations; 1.1% elective procedures)
- While we cannot be sure of the reasons why patients did not attend on the day, long-term condition management and change in clinical priorities are unlikely to be Covid-related and therefore likely to be a continued issue even when Covid numbers fall.

Prioritisation categories	Number of procedures (proportion of all procedures)	Number cancelled	Cancellations as a proportion of all listed elective procedures within category
Ambulatory			
Adult P1	232 (3.1)	-	-
Adult P2 cancer	932 (12.4)	72	-
Adult P2 non-cancer	697 (9.3)	93	-
Total P2	1629 (24.8)	165	9.2
Adult P3	663 (8.8)	159	19.3
Adult P4	1398 (18.6)	317	18.5
Total adult ambulatory	**3922 (52.3)**	**641**	**-**
Total excluding P1	**3690 (49.2)**	**641**	**17.4**
Paediatric P1	40 (0.53)	-	-
Paediatric P2 cancer	65 (0.87)	7	-
Paediatric P2 non-cancer	162 (2.2)	40	-
Total Paediatric P2	227 (3.6)	47	17.2
Paediatric P3	212 (2.8)	41	16.2
Paediatric P4	392 (5.3)	66	14.4
Total paediatric ambulatory	**871 (11.6)**	**154**	
Total excluding P1	**831 (11.1)**	**154**	**18.5**
Inpatient			
Adult P1	287 (3.8)	-	-
Adult P2 cancer	793 (10.6)	76	-
Adult P2 non-cancer	461 (6.1)	118	-
Total Adult P2	1254 (20.5)	194	14.0
Adult P3	340 (4.5)	98	22.4
Adult P4	527 (7.0)	117	18.2
Total adult inpatient	**2408 (32.1)**	**409**	**-**
Total adult inpatient excluding P1	**2121 (28.2)**	**409**	**19.3**
Paediatric P1	44 (0.6)	-	
Paediatric P2 cancer	21 (0.3)	4	-
Paediatric P2 non-cancer	88 (1.2)	16	-
Total P2	109 (2.1)	20	15.5
Paediatric P3	64 (0.9)	9	12.3
Paediatric P4	80 (1.1)	13	14.0
Total paediatric inpatient	**297 (4.0)**	**42**	**-**
Total paediatric inpatient excluding P1	**253 (3.4)**	**42**	**16.6**
Total adult	6330 (84.4)	1050	-
Total adult excluding P1	5811		15.3
Total paediatric	1168 (15.6)	196	-
Total paediatric excluding P1	1084		15.3
Total ambulatory	4793 (63.9)	795	-
Total ambulatory excluding P1	4521		15.0
Total inpatient	2705 (36.1)	451	-
Total inpatient excluding P1	2374		16.0
Total (8744)	**7498 (100)**	**1246**	**-**
Total excluding P1 patients (8141)	**6895 (92)**	**1246**	**15.3**

Table 9: Characteristics of patients who had surgery on elective operating lists during the 48h study window

Reason for cancellation	Number	%age of cancelled patients (n=1246)	%age of all patients listed for surgery during the study window (n=8141)
Overall cancellations	**1246**	**100**	**14.3**
Non-Covid related cancellations	628	50.4	7.7
Covid-related cancellations	306	24.6	3.8
Uncertain if Covid or not Covid-related (e.g. workforce and bed capacity)	312	25.0	3.8
Acute medical reason	**416**	**33.4**	**5.1**
Medical: Acute/recent Covid infection or complication	264	21.2	3.0
Medical: Acute NOT Covid related	153	12.3	1.8
COVID (not direct clinical reasons): Screening issues, contact or carer positive, IPC, Covid on ward	47	3.8	0.5
Positive pregnancy test on day of surgery	4	0.32	0.05
Avoidable through improving hospital capacity or flow	**400**	**32.1**	**4.9**
Lack of hospital bed	154	12.4	1.8
Staffing	112	9.0	1.3
List over-run or insufficient capacity	90	7.2	1.0
Lack of critical or enhanced care bed	41	3.3	0.5
Emergency surgery displaced elective activity	21	1.7	0.2
Avoidable through improved preoperative processes	**285**	**22.9**	**3.5**
Medical: Long term condition or medication related	100	8.0	1.1
Patient factors e.g. lack of capacity, change in wishes, re-evaluating update procedure; change in clinical status/surgical decision over indication/anaesthetic	91	7.3	1.0
Patient DNA	94	7.5	1.1
Avoidable through systems improvements	**114**	**9.1**	**1.4**
Administrative e.g. overbooked list, inappropriate booking, communication failure	57	4.6	0.7
Equipment problem	24	1.9	0.3
Failure of routine systems involved in getting patients to theatre e.g. patients not starved	35	2.8	0.4
Unknown	**12**	**1.0**	**0.1**
TOTAL REASONS FOR 1246 PATIENT CANCELLATIONS	**1301**	**-**	**-**

Table 10: Reasons for individual patient cancellation as a proportion of surgical activity over 48h of elective activity

*** Denominator: 1246 cancelled + 6895 elective patients who did have surgery = 8141**

Key finding 12:

Reasons for cancellation varied by indication for surgery, and magnitude and urgency of surgery

- Patients having cardiac or vascular surgery were most likely to be cancelled for capacity reasons.
- Patients having surgery for any other indication, including cancer, were most likely to be cancelled for acute medical reasons.
- Failures of preoperative processes including long-term condition management were much less likely to account for cancellation in cardiac surgical patients. (table 10).
- Long-term condition management was most likely to lead to cancellation of more urgent (P2) and more complex (major/major+/complex) procedures.

	Cancer (n, % all cancer cancellations, n=206)	Cardiac (n, % all cardiac cancellations; n=73)	Vascular (n, % all vascular cancellations; n=29)	Other (n, % all cancellations other surgery; n=938)
Acute medical condition	78 (37.9)	14 (19.2)	6 (20.7)	318 (33.9)
Capacity	62 (30.1)	48 (65.8)	14 (48.3)	276 (29.4)
Preoperative processes	51 (24.8)	7 (9.6)	8 (27.6)	219 (23.3)
Long term condition	27 (13.1)	4 (5.5)	4 (13.8)	65 (6.9)

Table 11: Reasons for cancellation by indication for surgery

	Minor [n, (% all minor procedure cancellations)] n=497	Intermediate [n, (% all intermediate cancellations)] n=440	Major/Major+/Complex [n, (% all major procedure cancellations)] n=308
Acute medical condition	175 (35.2)	151 (34.3)	90 (29.2)
Capacity	115 (23.1)	149 (33.9)	135 (43.8)
Preoperative processes	128 (25.8)	99 (22.5)	58 (18.8)
Long-term condition	21 (4.2)	36 (8.2)	43 (14.0)

Table 12: Reasons for cancellation by surgical magnitude

	P2 [n, (% all P2; n=426)]	P3 [n, (% all P3; n=307)]	P4 [n, (% all P4; n=513)]
Acute medical condition	141 (33.1)	121 (39.4)	151 (29.4)
Capacity	140 (32.9)	77 (25.1)	183 (35.7)
Preoperative processes	98 (23.0)	69 (22.5)	118 (23.0)
Long-term condition	43 (10.1)	27 (8.8)	30 (5.8)

Table 13: Reasons for cancellation by clinical prioritisation category

Discussion

Summary

While the NHS routinely collects data on theatre efficiency, productivity and patient cancellations, such statistics provide few insights into the underpinning reasons for these challenges.

This study describes the impact on patients and services of limitations in NHS physical and workforce capacity, service efficiency, and clinical pathways.

There are four themes to the findings:

1: NHS pressures and elective recovery

NHS pressures are high, not just related to Covid, and lead to thousands of last minute cancellations each week

- Cancellation rates were higher than anticipated (including multiple cancellations of entire sessions) and substantial variation in theatre efficiency
- Extrapolating the data on individual patient cancellations, a conservative estimate of last-minute cancellations would be 422,000 per year.
- Although some of the challenges may improve with falling Covid infection rates, the main challenges related to workforce, hospital capacity and preoperative pathways will remain.

2: Theatre efficiency

Theatre inefficiency is predominantly due to organisational and administrative issues rather than workforce or patient issues

- If theatre lists do take place, the greatest source of inefficiencies relate to organisational and administrative issues: both in advance of the day of activity (booking and scheduling) and on the day (timely and reliable availability of equipment and staff).
- Hospital 'flow' challenges also remain significant, with delays in patients arriving in or leaving interventional areas and lack of availability of ward beds both leading to list inefficiencies.

3: Cancellation rates

Cancellation rates are high, and due to three main reasons: acute or recent patient illness; hospital capacity; and inadequate preoperative preparation, communication and/or optimisation

- In addition to the substantial problems already described with sessions being cancelled or suspended, or not running as efficiently as possible, over 14% of patients who expect to have elective surgery are cancelled on the day or the day before.
- One-third of last minute cancellations were because of acute conditions, another third due to hospital capacity (ward or critical/enhanced care bed availability and staffing) and more than 20% were related to inadequate preoperative assessment, optimisation and/or patient preparation (including whether or not the procedure was still indicated or wanted).

- One in 8 cancellations, representing almost 2% of patients listed for surgery, were due to acute clinical conditions not related to Covid.

4: Workforce

Workforce is the key challenge to elective recovery

- Workforce challenges are most likely to lead to entire lists being cancelled or suspended, and therefore the largest reduction in overall productivity.
- Within the workforce, shortages of scrub staff and anaesthetic assistance have the greatest impact.
- The opportunity cost of cancelling surgery because of shortages in a particular staff group, include poor utilisation of the remaining workforce and the impact on patients of last minute cancellation. Dealing with this challenge requires better auditing of staff absences and disruptive solutions.

1. NHS pressures and elective recovery

This study took place in mid-January when Omicron infection in the population was very high. However, serial measures of NHS activity from routinely available data (table 13) show that activity was only a little lower than mid-February (by which time community Omicron prevalence had substantially reduced). Therefore, although Covid may have been more likely to account for staff absences or general system pressures,

	week ending 9.1.22	week ending 16.1.22	week ending 23.1.22	week ending 30.1.22	week ending 6.2.22	week ending 13.2.22
Hospital pressures						
Hospital beds occupied by Covid19 patients (Tuesday of each week)	14,926	16,858	16,102	14,017	12,867	11,444
Critical care % occupied by Covid19 (or suspected) patients (Tuesday of each week)	30	26	22	18	16	11
Critical care % occupancy	82.8	83.6	82.7	79.2	81.3	89.4
Theatre data						
Number of sessions (7 days)	7,156	9,374	9,560	9,810	9,457	9,585
Planned number of 4-hour sessions (7 days)	10,848	13,970	14,194	14,775	14,211	14,253

Table 14: Hospital and theatre statistics during 2022. Source: NHS England and NHS Improvement National Theatres Productivity Dashboard

Surgical / interventional activity

- It is stated in the NHS recovery plan that patients will be prioritised on need rather than waiting time. It is reassuring therefore to see that P2 category patients accounted for the highest proportions of elective activity in both adults and children, and in both ambulatory and inpatient settings.

- However, 49% of elective surgery was in the P3 or P4 category.

- Over a third of cancellations were in P2 patient, although adult P2 patients were substantially less likely to be cancelled than adult P3 or P4 patients. Over a third of P2 cancellations were due to capacity reasons and another quarter due to failures of preoperative preparation and assessment (including 10% because of poor long-term condition management).

- While any cancellation is upsetting for patients and disruptive for systems, P2 cancellations are perhaps even more so than others.

2. Theatre efficiency

- If an operating list did take place, general organisational and administrative issues were the most common reasons for poor efficiency: for example, lists being under or over-booked, staff not arriving on time, or problems with equipment.

- Challenges with hospital flow are well known and were the second most likely reason for poor efficiency, including difficulties with transitioning patients in and out of theatre, and uncertainty over bed availability, both leading to pauses in activity.

- Workforce constraints had a much lower impact on efficiency than on whole session or individual patient cancellations.

- Almost 30% of theatre lists did not start on time; national data indicate a mean start-time delay of 40min and a median start-time delay of 63min in the same week as data capture.

Local quality improvement efforts including initiatives such as 'golden patients' and process analysis to understand causes of late starts should again be a focus of local efforts.

3. Cancellation Rates

Capacity considerations

- Hospital capacity, including availability of inpatient and critical or enhanced care beds, and workforce constraints, accounted for the highest proportion of whole list cancellations and apart from acute medical conditions, the highest proportion of individual patient cancellations.

- Elective hubs may provide some solutions to bed capacity problems by ring-fencing resources for elective surgery.

- Similarly, innovations in critical care, to support development of enhanced perioperative care facilities which are ring-fenced for elective surgical activity, should also be prioritised to reduce the risk of cancellation for higher acuity patients.

- However, hospital capacity depends on more than absolute numbers of beds: prioritising reduction in hospital length of stay on surgical pathways is also important.

Innovations such as the new CQUIN for Drinking Eating and Mobilising are aimed at reducing LOS and variation between providers. In addition, consideration may be given to other innovations aimed at reducing length of stay, such as extending virtual ward environments and home monitoring to postoperative surgical patients.

Preoperative preparation and optimisation

- Almost a quarter of cancellations might have been avoided through improved preoperative processes, including physical preparation and optimisation of long-term conditions and communication with patients to ensure that they were both prepared for surgery, and also willing and available to attend.

- The study did not allow for differentiation by age, but other evidence suggests that this predominantly affects older people having surgery.

- From a patient perspective, this presents perhaps the greatest lost opportunity: many patients may be more understanding of being cancelled because a bed is unavailable, than if their own health had not been optimised to the point that surgery could proceed.

- Patients having more complex surgery were more likely to be cancelled because long-term conditions had not been optimised, an observation which makes clinical sense.

Plans to improve preoperative pathways should be prioritised, including earlier screening and starting of the optimisation process, and improved communication between hospital services and patients. These efforts should facilitate continued shared decision making, offering patients the opportunity to opt out of surgery if they feel it is no longer indicated, and ensuring that responsible clinicians know about patients who have had a significant change in their general health.

4. Workforce

- The success of the elective recovery plan depends heavily on expansion or better utilisation of the workforce, including theatre staff, anaesthetists and surgeons. These data demonstrate the fragility of the workforce and therefore potential limitations of the elective recovery strategy.

- It is evident that the staff groups with the least resilience in terms of workforce availability are scrub staff and anaesthetic assistance.

- The data gathered also represent only the tip of the iceberg of the potential impact: skilled assistance for both surgeons and anaesthetists are crucial to patient care, and teams which work together regularly are likely to be safer, achieve better patient outcomes and have better team dynamics, health and wellbeing.

- Almost 20% of theatre days were affected by non-Covid related staff shortages, so the most optimistic assessment would suggest that this is the likely long-term workforce gap impact.

- Absences unrelated to Covid led to 15% of theatre days having lists cancelled for lack of scrub staff and 13.3% for lack of anaesthetic assistance. These data confirm the critical importance of focusing on increasing the workforce for these staff groups in order to maintain theatre productivity.

- Last minute absences due to staff sickness have the potential to cause significant disruption. It is notable that substantially fewer lists were affected by surgeon unavailability (despite their unique role in perioperative care) and anaesthetist unavailability (despite known workforce gaps in anaesthesia).
    - One potential explanation for this, is that surgeons and anaesthetists are more likely to 'step up' to cover short-term absences, as they have better working conditions and higher rewards.
    - Furthermore, there may be more inbuilt resilience within those workforces with rotas including 'doubled up' trainees and consultants, and the buffer of outpatient clinics and non-direct clinical care sessions that allow consultant surgeons to fill theatre gaps.

- The workforce gap in theatre staff is already recognised, although the impact on elective services has not previously been described in this way. NHSEI and HEE are developing a number of proposed solutions: these include measures to:
    - increase recruitment and retention including developing more attractive career development pathways;
    - improve flexibility of the workforce (i.e. skill-mix of individual practitioners so that they might fulfil different roles according to service need);
    - electronic-rostering to support better workforce planning at local level

In addition to current efforts to address workforce gaps, consideration may be given to "over-establishment" staffing models, to ensure that there is a backup pool of staff available in at-risk professional groups. This may be a more reliable and cost-effective approach than relying on bank or agency staff, and should reduce last minute cancellations due to staff shortages. It will potentially also improve staff wellbeing by enabling better rostering and reducing emergency requests to work which may lead to moral injury if refused.

Generalisability and limitations of the data

- This study included 74%of NHS Trusts and Health Boards (119 of 161) including 76% (103 of 136) Trusts in England. Therefore, it provides detailed information from a large and diverse sample of organisations.

- There may yet however be some sampling bias which could affect the overall findings in an unpredictable manner. The 2-day snapshot methodology also has limitations: efficiency and service pressures may vary by day of week; we were unable to capture information about elective work taking place at weekends and the general NHS and environmental context in January was substantially influenced by high levels of Omicron infection in the population, including NHS staff.

- Nonetheless, even if a very optimistic view is taken of the likely reduction in impact of Covid-19 over time, it is evident that there are still substantial opportunities for improvement. Only 25% of individual cancellations were directly attributable to Covid-19 disease or induced pressures, and publicly accessible data (table 12) indicate that while hospital and critical care occupancy with Covid patients has fallen substantially since the week of the study, theatre productivity does not appear to have risen proportionately.

Recommendations

Operationally prioritise the most clinically urgent patients

1. Particularly at times of high staff absences, consideration should be given to further operationally prioritising P2 patients. Prioritisation and service planning should be considered at system rather than Trust level.

2. Ring-fencing resources should be provided on the basis of clinical need rather than reducing waiting list numbers, in keeping with the declaration in the elective recovery plan.

3. Consideration should be given to seasonal operational delivery models which reduce P3 and P4 activity at times of predictable high pressure (e.g. Winter). This may have significant workforce implications which will require modelling and consultation – e.g. opportunity for annualised contracts for consultant surgeons and/or promoting job plans which flex different types of clinical activity (e.g. inpatient vs. outpatient work) at particular times of the year.

4. Enhanced perioperative care services and ring-fenced high turnover level 3 facilities should be prioritised within main NHS estates to reduce cancellations because of critical care pressures.

Improve system efficiency through safe delivery of high volume low complexity surgical hubs

5. Surgical hubs for high volume low complexity work will directly reduce waiting times and improve efficiency for some services, and indirectly (through reduction in secondary care pressures) for others. These are therefore supported but with important caveats and considerations, for example:

    - **Patient safety**, particularly if considering hubs outside the main NHS estate. While rare, the absolute number of serious critical incidents in anaesthesia such as death or severe morbidity from airway management is higher in younger (<60 years), fitter (ASA 1 and 2) patients, [1] highlighting the importance of senior anaesthetic cover in all sites.
    - **Equality of access**: Perioperative risk increases with age, [2] frailty [3] and socioeconomic deprivation. [4, 5] Patients at higher risk of generic perioperative and postoperative complications will need to remain within main NHS estates with access to critical care and appropriate specialist services, and should not be disadvantaged by capacity issues.

Aim for zero tolerance of avoidable last-minute cancellations through strengthening perioperative pathways.

6. Further investment is required in perioperative care coordinators and preoperative assessment processes so that **all** patients waiting for surgery can be screened, optimised and

have regular check-ins with perioperative services to ensure that their needs and health have not changed. While current NHSEI plans to focus on inpatient surgery appropriately target the group at highest risk of cancellation due to failure of preoperative processes, substantial numbers of avoidable cancellations are occurring in ambulatory and lower risk surgery as well.

Develop and evaluate disruptive innovations through coproduction with staff and patients

7. **Piloting of "over-establishment" workforce models which include booking surplus staff** for work each day, who can be deployed in the event of staff sickness or other unexpected absence. Trusts will need to examine their own absence data to understand the incidence and impact of different staff group absences in order to plan cover appropriately. This should reduce cancellations and improve efficiency, productivity and reduce costs; it will also potentially improve staff satisfaction; however, it will require a sea-change in rostering culture.

8. **Changing preoperative processes to include a 'final check' 48h before surgery** to reduce the risk of last minute cancellation due to a change in patient condition, including acute illness. A digital self-assessment checklist for patients can be developed which will be supported by perioperative care coordinators (particularly to support non-digitally enabled patients). Senior medical and/or nursing advice can then determine if a patient may need to be postponed or cancelled and arrangements made for rebooking the available theatre time.

9. **Consider how to safely implement 'reserve lists' for elective surgical patients**. If listed patients are identified 24-48h preoperatively who are not ready for surgery, reserve list patients can be contacted to fill gaps in operating lists. This will require significant planning and patient consultation given the need to reduce the risk of perioperative Covid infection and nosocomial transmission. It will also need health inequalities assessment to ensure that those with carer or work responsibilities, particularly if working in the gig economy, are not systematically disadvantaged by such a system.

10. **Investment in administrative functions** and support to improve list planning and coordination and improve productivity. This should include piloting and evaluation of new methodologies including machine learning methods using routine data; on-the-day systems such as waiting lounges and time-in-motion analyses of how interdependent services (e.g. radiography, laboratory services) impact on theatre efficiency.

11. **Reducing pressure on hospital beds through further innovation in reducing length of stay initiatives:** in particular, consideration should be given to how virtual ward support can be extended to perioperative pathways.

Declarations / conflicts of interest

Professor Moonesinghe (report lead author and chief investigator) is National Clinical Director for Critical and Perioperative Care at NHS England and NHS Improvement (NHSEI) and therefore has supported development of the elective recovery plan, and will support delivery at national level. She receives funding (salary backfill for secondment) from NHSEI for this role.

References

1. Cook TM, Woodall N, Frerk C. Major complications of airway management in the UK: results of the Fourth National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society. Part 1: anaesthesia. Br J Anaesth. 2011;106:617-631.
2. Wong DJN, Harris S, Sahni A et al. Developing and validating subjective and objective risk-assessment measures for predicting mortality after major surgery: An international prospective cohort study. PLoS Med. 2020;17:e1003253.
3. Han B, Li Q, Chen X. Effects of the frailty phenotype on post-operative complications in older surgical patients: a systematic review and meta-analysis. BMC Geriatr. 2019;19:141.
4. Poulton TE, Salih T, Martin P, Rojas-Garcia A, Raine R, Moonesinghe SR. Systematic review of the influence of socioeconomic deprivation on mortality after colorectal surgery. Br J Surg. 2018;105:959-970.
5. Poulton TE, Moonesinghe SR, Raine R, Martin P, National Emergency Laparotomy Audit Project Team. Socioeconomic deprivation and mortality after emergency laparotomy: an observational epidemiological study. Br J Anaesth. 2020;124:73-83.
6. Wong DJN, Harris SK, Moonesinghe SR et al. Cancelled operations: a 7-day cohort study of planned adult inpatient surgery in 245 UK National Health Service hospitals. Br J Anaesth. 2018;121:730-738.

Appendix 1: Case Report Forms

Daily Activity Overview: one form per site per day

Trust Name:				
Hospital name:				
Site name:				
Date of completion (11th or 12th January 2022):				
	am	pm	eve	night
Normal number of **elective** sessions in theatre / interventional suites involving an anaesthetist (consider a typical day within the past year)				
Today: Number of **elective** sessions in theatre/interventional suites involving an anaesthetist				
Normal number of **emergency or trauma** sessions in theatre/interventional suites involving an anaesthetist (consider a typical day within the past year)				
Today: Number of emergency or trauma sessions in theatre / interventional suites involving an anaesthetist				
Today: Number of **elective theatres** doing **emergency** surgery (i.e., theatres converted from elective work to support emergency surgery)				
Today: Number of empty sessions in theatres or interventional suites involving an anaesthetist				

If there were empty sessions: how many were usual empty sessions and how many were unplanned empty sessions because of service pressures (tick/circle)					
Were there empty sessions?	Y / N	Number of usually empty sessions		Number of unplanned empty sessions	

If fewer sessions occurred than usual, what were the reasons for this? (tick all that apply)			
Lack of ward beds		Staff shortages (please see below)	
Lack of critical care beds		Administrative errors	
Other, please specify:			

If staffing was contributing factor to unexpected empty sessions, please indicate which staff groups contributed (tick all that apply)			
Scrub staff		Middle grade anaesthetist	
HCAs		Senior surgeons	
Porters		Middle grade surgeons	
ODP/ODA/anaesthetic nurses		Recovery staff (i.e. not all recovery beds open)	
Senior anaesthetists		Ward staff (discharge delays from recovery)	
Other, please specify:			

If staffing was contributing factor to unexpected empty sessions, please indicate reasons why (tick all that apply)			
Covid related absences (sickness, isolation etc)		Non-Covid related sickness	
Staff redeployment to other services		Other, please specify:	

Elective list cancellations and efficiency: one form per operating / interventional list

Trust Name:						
Hospital Name:						
Hospital Site:						
Date of List:						
Total number of patients who underwent anaesthetic intervention on the list today						
…… patients				Please fill out the table below to indicate **the number of patients** treated in each category of urgency and day case vs, inpatient care.		
	P1	P2 Cancer	P2 Non-cancer	P3	P4	
Adult day case						
Adult inpatient						
Paediatric day case						
Paediatric inpatient						
Did the list start on time? (tick)						
Yes			No			
Did the list end on time? (tick)						
Yes			No			
In the opinion of the surgical / anaesthetic team, was the full time allocated for surgery and anaesthesia on this list used as efficiently as possible? (tick)						
Yes			No			
If the list was not used as efficiently as possible, please select all reasons why this was						
Uncertainty over hospital bed availability				Delays in patients arriving in theatres		
Uncertainty over critical or enhanced bed availability				Delays in patients being able to leave theatres (e.g., recovery full /no ICU bed available/removal of all airway devices mandated in theatre)		
Infection Prevention Control issues (e.g., cleaning theatres; mandated delays between patients)				Organisational issue in theatres (e.g., equipment not available)		
COVID-19 related clinical reasons (e.g. patient awaiting COVID result)				Administrative issues: over or under booked list		
Non COVID-19 related clinical reasons				Staffing		
Other, please specify:						
If you feel staff shortages have affected capacity today, has one staff group been affected more than others? (tick)						
Yes			No			***Please turn over for the final question.***

If staffing was contributing factor, please indicate which staff groups contributed (tick all that apply)			
Scrub staff		Middle grade anaesthetist	
HCAs		Senior surgeon	
Porters		Middle grade surgeon	
ODP/ODA/anaesthetic nurse		Recovery staff (i.e. not all recovery beds open)	
Senior anaesthetist		Ward staff (discharge delays from recovery)	
Other, please specify:			

Individual patient cancellations: one per cancelled patient

Trust Name:											
Hospital Name:											
Hospital Site:											
Date of planned procedure:											
Patient age? (tick)											
<18 years			≥18 years								
Planned as day-case or inpatient? (tick)											
Day-case			Inpatient								
Surgical magnitude? (tick)											
Minor			Intermediate			Major, major+/complex					
Surgical urgency? (tick/circle)											
P2 (<1 month)			P3 (<3 months)			P4 (>3 months)					
Indication for treatment (tick/circle)											
Cancer		Cardiac		Vascular		Other					
Reason for cancellation (please tick all that apply)											
Medical: long-term condition or medication related		Equipment Problem									
Medical: acute condition NOT COVID 19 related (e.g., acute infection)		Patient DNA									
Medical: acute/recent COVID 19 Infection or complication		Administrative e.g. overbooked list									
Lack of hospital bed		Unknown									
Lack of critical or enhanced care bed		Staffing *(see next section)*									
List overrun / insufficient operating theatre capacity											
Other, please specify:											
If staffing was contributing factor, please indicate which staff groups contributed (tick all that apply)											
Scrub staff		Middle grade anaesthetist									
HCAs		Senior surgeon									
Porters		Middle grade surgeon									
ODP/ODA/anaesthetic nurse		Recovery staff (i.e. not all recovery beds open)									
Senior anaesthetist		Ward staff (discharge delays from recovery)									
Other, please specify:											

Appendix 2: Participating and non-participating Trusts and Health Boards

Participating Trusts and Health Boards

England and Crown Dependencies (n=104)

Airedale NHS Foundation Trust
Alder Hey Children's NHS Foundation Trust
Ashford & St Peters NHS Foundation Trust
Barnsley Hospital NHS Foundation Trust
Barts Health NHS Trust
Bedfordshire Hospitals NHS Foundation Trust
Birmingham Women's and Children's NHS Foundation Trust
Blackpool Teaching Hospitals NHS Foundation Trust
Bolton NHS Foundation Trust
Bradford Teaching Hospitals NHS Foundation Trust
Buckinghamshire Healthcare NHS Trust
Calderdale and Huddersfield NHS Foundation Trust
Cambridge University Hospitals NHS Foundation Trust
Chelsea and Westminster Hospital NHS Foundation Trust
Countess of Chester Hospital NHS Foundation Trust
County Durham and Darlington NHS Foundation Trust
Croydon Health Services NHS Foundation Trust
Doncaster and Bassetlaw Teaching Hospitals NHS Foundation Trust
East and North Hertfordshire NHS Trust
East Kent Hospitals University NHS Foundation Trust
East Lancashire Hospitals NHS Trust
East Suffolk and North Essex NHS Foundation Trust
Epsom and St Helier University Hospitals NHS Trust
Frimley Health NHS Foundation Trust
Great Ormond Street Hospital for Children NHS Foundation Trust
Great Western Hospitals NHS Foundation Trust
Guy's and St Thomas' NHS Foundation Trust
Hampshire Hospitals NHS Foundation Trust
Harrogate and District NHS Foundation Trust
Imperial College Healthcare NHS Trust
Isle of Man Department of Health and Social Services
Isle of Wight NHS Trust
James Paget University Hospital NHS Trust
Kettering General Hospital NHS Foundation Trust
King's College Hospital NHS Foundation Trust
Leeds Teaching Hospitals NHS Trust
Lewisham and Greenwich NHS Trust

Liverpool University Hospitals NHS Foundation Trust
London North West Healthcare NHS Trust
Maidstone and Tunbridge Wells NHS Trust
Manchester University NHS Foundation Trust
Manx Care (Isle of Man)
Medway NHS Foundation Trust
Mid Essex Hospital Services NHS Trust
Mid Yorkshire Hospitals NHS Trust
Milton Keynes University Hospital NHS Trust
Moorfields Eye Hospital NHS Foundation Trust
North Bristol NHS Trust
Norfolk and Norwich University Hospitals NHS Foundation Trust
North Devon Healthcare NHS Trust
North Middlesex University Hospital NHS Trust
North Tees and Hartlepool Hospitals NHS Foundation Trust
North West Anglia NHS Foundation Trust
Northampton General Hospital NHS Trust
Nottingham University Hospitals NHS Trust
Oxford University Hospitals NHS Foundation Trust
Portsmouth Hospitals NHS Trust
Queen Victoria Hospital NHS Foundation Trust
Royal Devon and Exeter NHS Foundation Trust
Royal Free London NHS Foundation Trust
Royal Orthopaedic Hospital NHS Foundation Trust (Midlands)
Royal National Orthopaedic Hospital NHS Trust (London)
Royal Papworth Hospital NHS Foundation Trust
Royal United Hospitals Bath NHS Foundation Trust
Salisbury NHS Foundation Trust
Sandwell and West Birmingham Hospitals NHS Trust
Sheffield Children's NHS Foundation Trust
Sheffield Teaching Hospitals NHS Foundation Trust
Sherwood Forest Hospitals NHS Foundation Trust
Shrewsbury and Telford Hospital NHS Trust
South Eastern Health and Social Care Trust
South Tees Hospitals NHS Foundation Trust
South Tyneside and Sunderland NHS Foundation Trust
South Warwickshire Foundation Trust
Mid and South Essex NHS Foundation Trust
Southern Health and Social Care Trust
South West Yorkshire Partnership NHS Foundation Trust
Southport and Ormskirk Hospital NHS Trust
St George's Hospitals NHS Foundation Trust
St Helens and Knowsley Teaching Hospitals NHS Trust
States of Jersey
Taunton and Somerset NHS Foundation Trust

The Christie NHS Foundation Trust
The Dudley Group NHS Foundation Trust
Hillingdon Hospitals NHS Foundation Trust
Newcastle Upon Tyne Hospitals NHS Foundation Trust
Rotherham NHS Foundation Trust
The Royal Wolverhampton NHS Trust
Torbay and South Devon NHS Foundation Trust
University College London Hospitals NHS Foundation Trust
University Hospitals Birmingham NHS Foundation Trust
University Hospitals Bristol and Weston NHS Foundation Trust
University Hospitals Dorset NHS Foundation Trust
University Hospitals of Derby and Burton NHS Foundation Trust
University Hospitals of Leicester NHS Trust
University Hospitals of North Midlands NHS Trust
University Hospitals Plymouth NHS Trust
University Sussex NHS Foundation Trust
Walsall Healthcare NHS Trust
Warrington and Halton Hospitals NHS Foundation Trust
West Suffolk NHS Foundation Trust
Whittington Health NHS Trust
Worcestershire Acute Hospitals NHS Trust
York Teaching Hospital NHS Foundation Trust

Wales (n=4)

Betsi Cadwaladr University Health Board
Cwm Taf Morgannwg University Health Board
Hywel Dda University Health Board
Swansea Bay University Health Board

Scotland (n=10)

NHS Borders
NHS Dumfries and Galloway
NHS Fife
NHS Forth Valley
NHS Grampian
NHS Greater Glasgow and Clyde
NHS Highland
NHS Lothian
NHS Scotland Special Board/ NHS Golden Jubilee
NHS Tayside

Northern Ireland (n=1)

Belfast Health and Social Care Trust

Appendix 3: Proposed cancellations and efficiency daily dataset

Individual patient cancellations: all patients cancelled on the day or day before surgery

Patient prioritisation code (P2, 3 or 4)

Clinical cancellation

1. Acute medical condition – related to Covid
2. Acute medical condition - all other
3. Long-term condition
4. Procedure no longer indicated (clinician decision)
5. Procedure no longer wanted (patient decision)
6. Other clinical reason (please state)

Non-clinical cancellation

7. Ward bed unavailable
8. Critical or enhanced care bed unavailable
9. Staff unavailable:
    a. Surgeon
    b. Anaesthetist
    c. Scrub staff
    d. Anaesthetic assistance
    e. Other
10. Emergency displacement
11. List overrun:
    a. booking error
    b. complexity of procedures
    c. theatre inefficiencies
    d. other reason
12. Equipment unavailable or failed
13. Patient did not attend
14. Patient not starved

15. Administrative error

16. Essential support unavailable e.g. blood, radiographer

17. Other non-clinical reason (please state)

Theatre productivity dataset: daily dataset

1. Planned number of elective sessions

2. Actual number of elective sessions

3. Reason for sessional cancellation

Ward bed unavailable
- Number of sessions affected

Critical or enhanced care bed unavailable
- Number of sessions affected

Staff unavailable:
a. Surgeon
   - Number of sessions affected
b. Anaesthetist
   - Number of sessions affected
c. Scrub staff
   - Number of sessions affected
d. Anaesthetic assistance
   - Number of sessions affected
e. Other
   - Number of sessions affected

Emergency displacement
- Number of sessions affected

Structural failure requiring maintenance work
- Number of sessions affected

Other (please state)