The State of UK anaesthesia: a survey of National Health Service activity in 2013†

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Editor’s key points

- The importance of this survey lies in describing anaesthetic activity at national level in the UK.
- A 100% response rate is commendable.
- The UK anaesthesia is mainly led by consultants, and is safe.
- Importantly, these unique data will be valuable to service planners, and serve as baseline to many further projects.

Background. Details of current UK anaesthetic practice are unknown and were needed for interpretation of reports of accidental awareness during general anaesthesia (GA) within the 5th National Audit Project.

Methods. We surveyed NHS anaesthetic activity to determine numbers of patients managed by anaesthetists and details of ‘who, when, what, and where’: activity included GA, local anaesthesia, sedation, or patients managed awake. Anaesthetists in NHS hospitals collected data on all patients for 2 days. Scaling enabled estimation of annual activity.

Results. Hospital response rate was 100% with 20 400 returns. The median return rate within departments was 98% (inter-quartile range 0.95–1). Annual numbers (% of total) of general anaesthetics, sedation, and awake cases were 2 766 600 (76.9%), 308 800 (8.6%), and 523 100 (14.5%), respectively. A consultant or career grade anaesthetist was present in more than 87% of cases. Emergency cases accounted for 23.1% of workload, 75% of which were undertaken out of hours. Specialties with the largest workload were orthopaedics/trauma (22.1%), general surgery (16.1%), and gynaecology (9.6%): 6.2% of cases were non-surgical. The survey data describe: who anaesthetized patients according to time of day, urgency, and ASA grade; when anaesthesia took place by day and by weekday; the distribution of patient types, techniques, and monitoring; where patients were anaesthetized. Nine patients out of 15 460 receiving GA died intraoperatively.

Conclusions. Anaesthesia in the UK is currently predominantly a consultant-delivered service. The low mortality rate supports the safety of UK anaesthetic care. The survey data should be valuable for planning and monitoring anaesthesia services.

Keywords: airway; anaesthesia; audit; level of consciousness; monitoring; sedation; technique

Accepted for publication: 1 July 2014

The 5th National Audit Project (NAP5) of the Royal College of Anaesthetists and Association of Anaesthetists of Great Britain and Ireland (AAGBI) is a large-scale service evaluation of reports of accidental awareness during general anaesthesia (AAGA). The main focus of the NAP5 project was the collection of new patient reports of AAGA over 1 yr in the UK, and separately in Ireland. This registry provides a numerator. In order to estimate the incidence of reports of AAGA, the denominator number of general anaesthetics administered was needed. Moreover, to best interpret the AAGA reports, an analysis of current anaesthetic practices was required. There are several potentially useful sources of estimates of anaesthesia-related activity available. In England and Wales, national data are collected by Hospital Episode Statistics (HES), but these lack detail of whether or not anaesthesia was involved. The number of procedures lasting > 30 min has been estimated by the National Institute of Health and Clinical Excellence (NICE), using HES data, to be just over 2 million yr−1. HES data also have details of anaesthesia for maternity services; there were an estimated 671 255 deliveries in NHS hospitals (in England) in 2012–3 (92% of all births), of which, a little less than two-thirds (63%) required anaesthetic intervention. In 2008, the census phase of the NAP4 project estimated the number of general anaesthetics administered over a 2 week period. Data were collected locally and then pooled centrally. The number of general anaesthetics per year was estimated to...
be just under 3 million (2 872 600). Although the NAP4 census had data on airway management, it did not provide details of anaesthetic practices or patient characteristics which would be pertinent to NAP5. NAP5 reports came from patients undergoing a wide range of techniques of anaesthesia care and we needed more detail to help interpret the reports rather than simply an estimation of the total number of general anaesthetics.

The National Enquiry into Perioperative Deaths (NCEPOD) surveyed the seniority of anaesthetists (and surgeons) and when operations were carried out; the so-called ‘Who Operates When?’ or ‘WOW’ studies. WOW1, in 1995/6, took data from hospitals over randomly allocated 24 h periods, and WOW2 in 2002 collected data over a whole week. Ninety-seven per cent of NHS hospitals participated, but only surgical cases were included (cases in radiology suites, and all others outside operating theatres were excluded). No scaling factor was applied to calculate an annual workload, and details of anaesthesia management were not obtained.

In 1988, more than 500 volunteer anaesthetists recorded data from ~25 consecutive anaesthetics for a Survey of Anaesthetic Practice (SOAP), organized by the AAGBI. Its output does not enable estimation of total workload, and no record of the surgical procedure was made, but it does contain data that estimate the proportion of patients who received specified anaesthetic techniques.

In the absence of relevant and recent data, a survey was designed to help interpret NAP5 AAGA reports. The survey aimed to not only determine the number of general and other anaesthetics conducted in the UK but also to provide detailed information about patient characteristics, the procedures they underwent, their management (including timing and seniority of the anaesthetist), the drugs and techniques used, and specifically for AAGA, the use of monitors of depth of anaesthesia (DOA).

Methods

All hospitals, Trusts, and Boards in the UK that took part in the NAP5 project were identified and represented by 267 local coordinators (LCs). Participating LCs coordinated a survey within their own hospital or hospital group on every patient who underwent a procedure under the care of an anaesthetist. Only NHS patients managed in NHS hospitals were included.

Anaesthesia activity was defined as any surgical, diagnostic, or interventional procedure where an anaesthetist (of any grade) was responsible for patient care. The type of care could be general anaesthesia (GA), sedation, local anaesthesia (LA), or with the patient awake and the anaesthetist providing monitoring only (‘managed anaesthesia care’). It included GA or central neuraxial block for Caesarean section or assisted delivery and epidurals performed for labour pain relief, but it did not include sedation delivered by non-anaesthetists or specialist interventional pain procedures where the anaesthetist undertook both sedation and the procedure.

It included patients on the intensive care unit (ICU) in whom unconsciousness was induced or maintained for any surgical procedure whether in theatre (e.g. transferred for laparotomy), at the bedside (e.g. tracheostomy), or for a diagnostic or interventional procedure (e.g. CT scan), but it did not include ICU management with sedation. It also included emergency department (ED) cases such as cases of trauma where an anaesthetist secured the airway and transferred the patient to a site of a procedure (e.g. CT scan or operating theatre).

The data were captured on a paper questionnaire designed to be read automatically by ‘optical character recognition’ technology (DRS Data & Research Services plc, Milton Keynes, Buckinghamshire, UK). The questionnaire was made up of 30 questions on one side of A4 paper (Supplementary Fig. S1). Each question could be answered by choosing only one option from a list which included the options ‘unknown’ and ‘other’. All LCs were asked to provide a ‘return rate’, that is, their estimate of the proportion of all cases which had been reported in their hospital(s).

The survey period chosen was Monday, September 9, 2013, to Monday, September 16, 2013. No bank holidays or school holidays fell between these dates. Data collection over a whole week was considered both too burdensome and too costly, and therefore, the activity during the week was sampled by randomizing each LC to two consecutive days within the chosen week. Specialist hospitals (Paediatric, Cardiothoracic, and Neurosurgery) were randomized separately to avoid unequal allocation of collection days.

A scaling factor was used to convert the number of forms returned from 2 days into the estimated number of cases for a whole year (annual workload). The scaling factor had three components: conversion of 2 days to a week (3.5), the number of working weeks in 2013 (50.59, see Supplementary Appendix), and the median return rate from LCs (0.98). The scaling factor was 180.68 \( \approx \frac{(3.5 \times 50.59)/0.98}{3.5} \). Annual caseload estimations were rounded to the nearest 100. All calculations were made using Microsoft Excel 2010 and the ‘PivotTable’ facility. In interpreting results, it is therefore notable that an estimated annual caseload of 200 or 400 represents one or two cases, respectively, and that, inevitably, such small numbers are less reliable than larger numbers.

Some responses were missing, and because question choices included ‘other’ or ‘unknown’, we combined all these uninterpretable answers (the sum of the missing, ‘other’, and ‘unknown’) and expressed them as a percentage. These uninterpretable answers were discarded when calculating proportional results, so all percentages quoted in results relate only to interpretable forms. For questions relating to GA (e.g. technique and monitoring), estimations of numbers and percentages were made only on forms indicating that GA was the prime mode of anaesthesia (i.e. answering ‘GA’ to Q9).

Results

Returns by LCs

All 267 LCs took part in the survey (100% response rate) and a total of 20 400 forms were returned. The median number of returned forms per LC was 60: 75% of LCs returned fewer than 100 forms (Supplementary Fig. S2). Three LCs reported that they had no cases in the reporting period. The median
return rate was 98% (IQR 0.95–1, Supplementary Fig. S3): 20 LCs did not estimate their return rates. The proportion of unanswered questions was <4% and only two questions had >20% of ‘unknown’ answers: Q20 (Which neuromuscular blocker was used?) and Q24 (Main depth monitor used?) (Supplementary Table S1). The estimated annual caseload was 3 685 800. The caseload was broadly similar for the weekdays except Monday and Tuesday, which had slightly lower rates of activity, and there was an appreciable nadir of activity over the weekend (Supplementary Fig. S4).

**Patient characteristics**

Figure 1 shows the distribution of caseload by specialty: the three specialties with the largest workload were orthopaedics and trauma (22.1%), general surgery (16.1%), and gynaecology (9.6%). Non-surgical specialties (Cardiology, Gastroenterology, Pain, Psychiatry, and Radiology) accounted for 6.2% of all activity. Obstetric cases accounted for 8.9% of all activity (326 500 yr⁻¹); of which, only 10% involved GA. Most ophthalmology cases (72.7%), managed by anaesthetists, were performed without GA.

The age group with the highest caseload was 26–35 yr (Fig. 2). In all subsequent figures and tables, the age groups have been combined into four broader age groups: children (<16 yr), adults (16–65 yr), elderly (>65 yr), and all patients. In respect of major sex differences, more young women than young men (75:25%, 16–25 yr), and more boys than girls (60:40%, 1–5 yr) had anaesthesia care (Fig. 2). Of all procedures in women, 15.5% were obstetric and 14.7% were gynaecological. Obstetric cases accounted for 60.4% of anaesthesia care in women aged 26–35 yr. Urological procedures accounted for 14% of anaesthetic activity in males and 3% in females.

Table 1 shows the spread of the urgency categories across ASA grades individually for both NCEPOD and Caesarean section categories. There were 91 600 Caesarean section...
cases and an estimated 3,236,300 non-Caesarean cases. Of the non-Caesarean cases 2.7% (n=87,400) were ASA IV and 0.3% (n=9,700) were ASAV. Of Caesarean sections 0.4% were ASA IV (n=400, which equates to two cases returned in the survey, neither GA), and no ASAV cases were reported.

In all patients more than 16 yr, the percentage of underweight, normal, overweight, obese, and morbidly obese patients were 2.5, 48.4, 26.9, 14.8, and 7.4, respectively (Supplementary Fig. S5).

Supplementary Figure S6 shows the distribution of ethnicity according to age group.

### Admission type, urgency, and timing of anaesthesia care

Across all specialties (Supplementary Table S2), 73.9% of admissions were elective (47.3% day case and 26.6% inpatient) and 23.1% were emergency. Ninety-one per cent of all NCEPOD classified cases started between 08:00 and 18:00 h, while 25% of ASA IV and V cases and 50% of immediate and 25% of urgent cases started between 18:00 and 08:00 h (Supplementary Fig. S7). Of all activity started between midnight and 08:00 h, 59.2% was obstetric (n=72,600), and of these cases, 88% were awake having neuraxial block (23% of these were Caesarean sections).

The estimated annual caseload was highest during the middle of the week and lowest at weekends (Fig. 3). The majority of weekend caseload was ASA I, II, and III patients (Fig. 3), but activity in ASA IV and V patients varied little across the week. ASA IV and V patients are combined because there were few ASAV returns: 530 and 61, respectively. Few elective cases were performed on weekend days (1.7% of elective caseload). The number of immediate cases was similar across the week (Fig. 4).

### Staffing

Overall, a consultant or career grade doctor was the most senior anaesthetist in 87.2% of cases (71.7% and 15.5%, respectively).

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**Table 1** ASA and urgency. Estimated annual caseload according to ASA\(^1\)\(^1\) status vs National Confidential Enquiry into Patient Outcome and Death (NCEPOD)\(^1\)\(^2\) and Caesarean Section\(^1\)\(^3\) categories

<table>
<thead>
<tr>
<th>ASA</th>
<th>NCEPOD category</th>
<th>Immediate</th>
<th>Urgent</th>
<th>Expedited</th>
<th>Elective</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td></td>
<td>33,600</td>
<td>281,900</td>
<td>68,500</td>
<td>845,900</td>
<td>1,229,900</td>
<td>38.00</td>
</tr>
<tr>
<td>II</td>
<td></td>
<td>17,000</td>
<td>199,600</td>
<td>66,300</td>
<td>1,019,000</td>
<td>1,302,000</td>
<td>40.23</td>
</tr>
<tr>
<td>III</td>
<td></td>
<td>9,400</td>
<td>156,600</td>
<td>51,900</td>
<td>386,500</td>
<td>604,400</td>
<td>18.67</td>
</tr>
<tr>
<td>IV</td>
<td></td>
<td>18,400</td>
<td>40,500</td>
<td>11,900</td>
<td>19,200</td>
<td>90,000</td>
<td>2.78</td>
</tr>
<tr>
<td>V</td>
<td></td>
<td>7,000</td>
<td>1800</td>
<td>400</td>
<td>400</td>
<td>9600</td>
<td>0.30</td>
</tr>
<tr>
<td>VI</td>
<td></td>
<td>400</td>
<td>—</td>
<td>—</td>
<td>200</td>
<td>500</td>
<td>0.02</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>85,800</td>
<td>680,400</td>
<td>198,900</td>
<td>2,271,100</td>
<td>3,236,300</td>
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<tr>
<td>%</td>
<td></td>
<td>2.65</td>
<td>21.03</td>
<td>6.15</td>
<td>70.18</td>
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<table>
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<th>3</th>
<th>4</th>
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<td>I</td>
<td>6100</td>
<td>25,500</td>
<td>8300</td>
<td>20,800</td>
</tr>
<tr>
<td>II</td>
<td>4000</td>
<td>11,400</td>
<td>2200</td>
<td>11,000</td>
</tr>
<tr>
<td>III</td>
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<td>500</td>
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</tr>
<tr>
<td>IV</td>
<td>—</td>
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<td>200</td>
<td>200</td>
</tr>
<tr>
<td>V</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>VI</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Total</td>
<td>10,700</td>
<td>37,800</td>
<td>11,200</td>
<td>32,000</td>
</tr>
<tr>
<td>%</td>
<td>11.64</td>
<td>41.22</td>
<td>12.23</td>
<td>34.51</td>
</tr>
</tbody>
</table>

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**Fig 3** ASA grade and day of the week. Estimated annual caseload across the week according to the ASA grade.\(^1\)\(^1\) See data in Supplementary Table S8.
respectively, see Supplementary Table S3), and whatever the ASA grade of the patient, either a consultant or a career grade anaesthetist, was present in more than 75% of cases (Supplementary Fig. S8). A trainee was the most senior anaesthetist present for a minority (28%) of immediate or urgent cases (Supplementary Fig. S9). However, in obstetrics, trainee-led activity was notably higher (41.7% of non-elective Caesarean sections, see Supplementary Fig. S10). For all ASA IV or V patients (obstetric and non-obstetric combined), a consultant was present for 80.6% of cases between 08:00 and 18:00 h and 51.4% of cases outside these hours (Supplementary Fig. S11), and more than 70% of cases during the week compared with 46.6% of weekend cases (Supplementary Fig. S12).

### Anaesthetic conduct

#### Conscious level

The estimated annual numbers (with percentage of all cases) of GA, sedation (of any level), and awake cases were 2,766,600 (76.9%), 308,800 (8.6%), and 523,100 (14.5%), respectively. The percentage of patients, by age range, managed according to the intended level of consciousness is shown in Figure 5. As patient age increased, there was a trend for sedation to be used more frequently. Of all sedation cases, 50% were orthopaedic and trauma cases (Fig. 6). A high number (970 of 1,028; 94%) of awake women aged 26–35 yr were having obstetric procedures.

#### Local anaesthesia (central neuraxial block)

The number and percentage of cases in which a central neuraxial block was used are shown in Table 2. Central neuraxial block was involved in 28.7% of non-obstetric cases compared with 93% of obstetric activity. In non-obstetric cases, GA was administered in 87% of patients having an epidural and 20% of those having a spinal technique. In contrast, GA was used in only 8% of obstetric cases having a central neuraxial block. Almost 90 (89.2%) of all Caesarean sections were performed with epidural or spinal anaesthesia without GA.

#### Location

The theatre anaesthetic room was the most common site of induction of GA (78.7% of all GA cases). Anaesthesia was induced in theatre in 17%, in radiology or catheter laboratory in 1.6%, in the ICU in 0.6%, and in the ED in 0.5% of all GA cases (Supplementary Fig. 13). For Caesarean sections, anaesthesia was induced in theatre in 87% cases. More than 50% of GA cases induced in the ICU or ED settings were ASA IV or V.
**Induction agent**

The main induction agents for GA cases were propofol (88%), sevoflurane (7.9%), and thiopental (2.9%). Etomidate (0.2%), midazolam (0.2%), and ketamine (0.25%) were used much less frequently. Halothane was not used. Almost 40% of children received sevoflurane induction and 97% of Caesarean section GA cases received thiopental (Supplementary Fig. S14).

**Rapid sequence induction**

Rapid sequence induction (RSI) was used in 7.4% of non-Caesarean section GA cases and, of these, propofol was used in 69.1%, thiopental in 27.9%, succinylcholine in 66.2%, and an opioid in 75.8% (Supplementary Fig. 15). Almost all (92.2%) Caesarean section GA cases included RSI, and of these, thiopental and succinylcholine were used in 100% and an opioid was in 23.4%. RSI accounted for 87.3% of all cases induced with thiopental.

**Maintenance agent**

A vapour was used in the maintenance phase of GA in 92% of all cases, and, irrespective of age (Supplementary Fig. S16), sevoflurane was the most common agent (58.5%). Propofol total i.v. anaesthesia (TIVA; including all infusion or intermittent bolus techniques) was used in 8% of all cases. Of all TIVA with propofol, 63% was by target-controlled infusion (TCI). The use of TCI varied according to location: 80% in theatre cases and 17% of cases induced in radiology or catheter lab, ICU, or ED.

**Nitrous oxide**

Nitrous oxide was used (during GA) in ~25% of adult and elderly patients, 45% of children, and 71.4% of Caesarean sections (Supplementary Fig. S17): overall use was 28.7%. Nitrous oxide was used in 4% of propofol TIVA cases.

**Opioids**

Remifentanil was used in 10.7% of all cases, 3.4% of children, 11.6% of adults, and 13.9% of elderly patients having GA: it was not used in any Caesarean sections. Opioids, other than remifentanil, were used in 86.7% of patients. 10.8% of GA cases received no opioids.

**Main airway device**

A tracheal tube was used in 44.6% (1 147 300 cases) and a supraglottic airway in 51.3% (n = 1 319 100) of all GA cases.

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**Table 2 Central neuraxial block techniques and intended level of consciousness.** Estimated annual caseload in which a central neuraxial block (CNB) was used, presented according to intended level of consciousness in non-obstetric and obstetric cases. Obstetric cases include Caesarean and non-Caesarean section activity. Epidural category includes caudal, lumbar, thoracic, or cervical techniques. ‘None’ includes cases in which only local infiltration or peripheral nerve block was used. Caseloads are to the nearest 100. NB: 200 represents only one report. Percentages are of the total number of cases having each technique.

<table>
<thead>
<tr>
<th></th>
<th>Epidural</th>
<th>Spinal</th>
<th>Combined spinal and epidural</th>
<th>CNB + other block</th>
<th>Any CNB technique</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-obstetric cases</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General anaesthesia</td>
<td>56 700 (87%)</td>
<td>43 200 (20%)</td>
<td>500 (10%)</td>
<td>7600 (38%)</td>
<td>108 000 (35%)</td>
<td>2 564 200 (89.1%)</td>
</tr>
<tr>
<td>Deep sedation</td>
<td>200 (0%)</td>
<td>12 800 (6%)</td>
<td>500 (10%)</td>
<td>1100 (5%)</td>
<td>14 600 (4.7%)</td>
<td>48 800 (1.7%)</td>
</tr>
<tr>
<td>Moderate sedation</td>
<td>500 (1%)</td>
<td>54 400 (25%)</td>
<td>2000 (38%)</td>
<td>6500 (32%)</td>
<td>63 400 (20.6%)</td>
<td>43 400 (1.5%)</td>
</tr>
<tr>
<td>Minimal sedation</td>
<td>900 (1%)</td>
<td>59 100 (27%)</td>
<td>1400 (28%)</td>
<td>3400 (17%)</td>
<td>64 900 (21%)</td>
<td>56 400 (2%)</td>
</tr>
<tr>
<td>Awake (no sedation)</td>
<td>7000 (11%)</td>
<td>48 200 (22%)</td>
<td>700 (14%)</td>
<td>1600 (8%)</td>
<td>57 600 (18.7%)</td>
<td>165 700 (5.7%)</td>
</tr>
<tr>
<td>Total</td>
<td>65 400</td>
<td>217 700</td>
<td>5200</td>
<td>20 200</td>
<td>308 500</td>
<td>2 878 400</td>
</tr>
<tr>
<td><strong>Obstetric cases</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General anaesthesia</td>
<td>3100 (8%)</td>
<td>1600 (1.5%)</td>
<td>400 (2.3%)</td>
<td>0</td>
<td>5100 (3%)</td>
<td>16 300 (75.6%)</td>
</tr>
<tr>
<td>Sedation (deep, moderate, or minimal)</td>
<td>700 (2%)</td>
<td>1100 (0.3%)</td>
<td>0</td>
<td>0</td>
<td>1800 (0.6%)</td>
<td>400 (1.7%)</td>
</tr>
<tr>
<td>Awake (no sedation)</td>
<td>121 600 (90%)</td>
<td>137 000 (98.2%)</td>
<td>17 900 (97.7%)</td>
<td>400 (100%)</td>
<td>276 800 (96.4%)</td>
<td>4900 (22.7%)</td>
</tr>
<tr>
<td>Total</td>
<td>125 400</td>
<td>139 700</td>
<td>18 200</td>
<td>400</td>
<td>283 700</td>
<td>21 500</td>
</tr>
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</table>
Neuromuscular block, monitoring, and reversal

Neuromuscular block (NMB) was used in 46% of all patients receiving GA. Within age groups, NMB was used in 24.7% of children, 47.6% of adults, and 57.3% of elderly patients (Fig. 7). Succinylcholine was used in almost all (92%) Caesarean section anaesthetics but only 13% of other cases in which an NMB was used. In cases involving a non-depolarizing NMB, a nerve stimulator was used in 38% and reversal was used in 68% (sugammadex in 1.5%).

Return of consciousness and perioperative death

Overall, only 1% of patients recovered in a high dependency unit or ICU setting (Supplementary Table S7). Twenty patients were reported to have died: nine deaths occurred during GA, two during deep sedation, and two during moderate sedation (in seven patients, the intended conscious level was unspecified). The cause of death was not captured in the survey, but of the nine GA patients, all were ASA III, IV, or V (three in each category) and aged more than 55 yr (three were aged 56–65 yr, three 66–75 yr, two 76–85 yr, and one >86 yr); the main procedure was general surgery in three, vascular in two, an unspecified major procedure in three, and unknown in one; three were elective and six emergencies. None were Caesarean sections. Three had GA induced in the anaesthetic room, one in theatre, one in ICU, three in ED, and in one in an unspecified location: the overall GA death rate was 0.06% (one in 1718). If all patients in whom the intended level of consciousness was unspecified received GA, the incidence would be 0.12%.

Discussion

This is not the first survey of its kind, but we believe that it is the most comprehensive national picture of anaesthesia practice to date. Clergue and colleagues\textsuperscript{17} conducted a national survey of anaesthesia activity in France in 1996. This had less detail than ours and was not intended to relate to AAGA or intended conscious level. Data were collected over three consecutive days from 98% of hospitals (public and private) and 62,415 cases were analysed. Their estimated annual national anaesthesia workload was 7,937,000; of which, 77% were GA or sedation cases. As part of NAP5, a similar survey to ours was undertaken in Ireland, and collected data from public and private hospitals.\textsuperscript{18}

We considered running the census over an entire week. However, we judged that it would present an unreasonable burden on staff and, ultimately, would lead to a lower response rate. Although the previous NAP4 survey\textsuperscript{7} was undertaken over 2 weeks, the data required of each case were much less and we did not think that the UK anaesthetic community could sustain a detailed survey over this period. A shorter sampling time yields smaller numbers and results in higher Poisson ‘noise’\textsuperscript{19}, but a longer sampling time, although giving larger numbers, could lead to a higher error in terms of incomplete reporting. On balance, it is more important to reduce the incomplete reporting error (\(\varepsilon\)) than it is to obtain a larger sample size, because the upper 95% confidence interval of the fractional error,\(\sqrt{\varepsilon^2 + 1/N}\), where \(N\) is the number of cases collected and \(\varepsilon\) is the reporting error (e.g. 0.1 for a 10% reporting error). Simple plots reveal that where \(N > \sim 10,000\), there is more gain by keeping \(\varepsilon\) lower than by further increasing \(N\) (see Supplementary Fig. S18). That 100% of NHS centres responded to the survey, and the median case return rate was 0.98, represents excellent compliance. However, even with a 2 day survey, some centres struggled to capture all their data, confirming to us that a longer survey period would only have increased the error rate.

Randomization of hospitals to 2 days had the potential problem of misrepresenting activity of specialist hospitals if their allocated days were skewed. We tried to minimize this problem by randomizing specialist hospitals separately. The
2 day collection period also meant that calculation of activity for individual days was not possible. The large size of our sample data set means that we can be confident that we have a true representation of the ‘big picture’ and that it is reasonable to scale-up the 2 day sample data to estimate the annual workload. However, where the sample size was small, variations in data captured or missed would have a proportionately larger impact on annual estimates, so these data should be treated more circumspectly.

Extrapolating sample data to annual activity is always at best an estimate, especially as a true annual figure takes into account seasonal variations. Our choice of a time period that avoided school holidays, bank holidays, or major conferences may have avoided skewing our data, but equally in some respects ‘maximized’ the returns since at other times, activity might be expected to be lower than we report—however, our scaling factor does account for the effect of bank holidays on activity, treating them as weekend days. Further, our results are broadly in line with estimates using other sources. Our reported estimate of 2 766 600 general anaesthetics is in very close agreement with the NAP4 estimate (using a 2 week-long survey in 2008) of 2 872 600. Our estimate of 308 800 cases of sedation and 523 100 awake cases (with or without LA) gives a total of 831 900 which is also in close agreement with an estimate of 700 000 cases. The distribution of uses of airway devices in this survey is also similar to that reported in NAP4: the proportion of cases managed with facemask/Hudson mask, supraglottic airway, or tracheal tube/tracheostomy for NAP5 were 3.4%, 51.3%, and 45% vs 5.3%, 56.2%, and 38.4% for NAP4. The estimated number of Caesarean sections, however, performed with GA was 9200, compared with an estimate of 11 278 by Murdoch and colleagues in 2011. Moreover, the HES data (corrected for the UK population) estimate the number of Caesarean sections with GA to be 11 687 yr⁻¹, which suggests that our data underestimates the true number.

An advantage of pivot tables is the ease with which large data sets can be analysed by their constituent factors, but one limitation is that the results of pivoting are influenced by the order of application of certain ‘filters’ that organize the data set. Therefore, some small variation in estimates is obtained depending upon the method of pivoting the same data set. For example in respect of Caesarean sections, if the only filter is ‘Caesarean Section category’, the annual estimate is 91 600. However, if the primary filter is ‘Obstetric procedure’, followed by a secondary filter of Caesarean section, then an estimate of 92 160 is obtained. Such a variation, however, is too small to affect the main conclusions.

This survey shows that NHS anaesthetists in the UK not only deliver ~2.8 million general anaesthetics in a year but also that there is a substantial additional workload with sedated and awake patients. Non-GA anaesthetic activity accounts for ~25% of all anaesthetic activity, and this figure is consistent with previous estimates in NAP4. Activity was spread over a wide range of surgical and non-surgical specialties. In respect of AAGA, for which the survey was primarily intended, the annual number of general anaesthetics of 2 766 600 will be used to estimate the incidence of reports of AAGA to the NAP5 project.

Our data show that the majority of patients are managed by consultants, irrespective of the patient’s ASA grade (Supplementary Fig. S8). In respect of urgent and immediate cases, consultants were present in fewer, but still a majority, 57% (Supplementary Fig. S9). However, consultant presence at category 1 and 2 Caesarean sections was low (26%; Supplementary Fig. S10) and consultant presence for ASA IV and V patients was ~50% outside daytime operating hours compared with 80% during the daytime (Supplementary Fig. S11), and 47% during weekends compared with 70% at other times of the week (Supplementary Fig. S12). Thus, while consultant anaesthetist presence is generally high, there is scope to increase the presence out of hours and at weekends, and for Caesarean sections. The nature of category 1 Caesarean sections and the quantity of such work performed out of hours makes this a particular challenge.

The survey data can be presented in many ways and used to answer many questions. For example, the data could be used as denominator data for a variety of calculations performed by research groups studying the incidence of various events or complications associated with anaesthesia care. We emphasize however that the data should be used to compare groups of patients cautiously and not to make inferences about causation. Instead, it could help to generate hypotheses and questions that should be answered by appropriately designed trials.

The survey provides important data relevant to the planning for, or impact of, 7 day working (Fig. 3). If it is planned that the workload at weekends is similar to that during weekdays, then we estimate that the NHS needs to find capacity for about 1 million extra surgical anaesthetic cases annually (an increase of ~33% on current figures). If, on the other hand, it is planned that existing caseload is simply redistributed to weekends, then each weekday’s work will need to reduce by ~200 000 cases annually to fill the weekend capacity. It is also possible that it is envisaged 7 day working will involve a smoother distribution of emergency cases across the working week, thereby releasing weekend capacity for elective cases. However, Figure 3 shows that, in fact, there is relatively little variation in the number of emergency surgical procedures across the week and certainly not to an extent that a reduction in weekend emergencies will free up spare capacity. Our data therefore bring into sharp focus the basis of planning for 7 day services in the NHS.

The low mortality rate of GA (~0.06%, or one in 1718) occurring during surgery is notable. Many patients are ‘scared of anaesthesia’ and this figure can only be reassuring for them. During the period of time when they are cared for by anaesthetists, the risk of death is low indeed. This low mortality rate is in marked contrast to the report by EuSOS of an overall 4% (one in 25) mortality rate for inpatient elective major surgery. These differences highlight the potential impact advances in perioperative care—by anaesthetists, surgeons, and intensivists—might have on overall mortality rates after surgery.

In planning an anaesthetic service for a large population, data sets such as ours are likely to be valuable. That there...
have been few such national surveys may relate to the practical difficulties in collecting data from large numbers of patients by busy clinicians. We hope that universal adoption of electronic records will help in future. If major changes in anaesthesia are planned, we propose that another census should be undertaken to determine its effects.

**Supplementary material**

Supplementary material is available at *British Journal of Anaesthesia* online.

**Authors’ contributions**


**Acknowledgements**

This project was a national survey by the 5th National Audit Project of the Royal College of Anaesthetists and the Association of Anaesthetists of Great Britain and Ireland. We are most grateful to all anaesthetists in the NHS who completed forms and to all Local Coordinators who provided the information necessary for this survey. We are also grateful for the administrative assistance from Ms Maddy Humphrey and Mrs Sharon Drake and their colleagues at the Royal College of Anaesthetists.

**Declaration of interest**

None declared.

**Requests for information**

The NAP program will consider working with researchers who would like to collaborate on further exploration of the database. Researchers with a project in mind should contact TMC at tcook@rcoa.ac.uk.

**Funding**

The 5th National Audit project, of which this forms part, is funded equally by the Royal College of Anaesthetists and the Association of Anaesthetists of Great Britain and Ireland.

**References**


Appendix

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Handling editor: R. P. Mahajan