CHAPTER

27

The NAP5 Activity Survey


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HEADLINE

27.1 Details of current UK anaesthetic practice are unknown, and were needed for interpretation of reports of accidental awareness during general anaesthesia (AAGA) within NAP5. We surveyed NHS anaesthetic activity to determine numbers of patients managed by anaesthetists and details of 'who, when, what and where': activity included general anaesthesia, local anaesthesia, sedation or patients managed fully awake. Anaesthetists in NHS hospitals collected data on all patients for two days. Scaling enabled estimation of annual activity. Response rate was 100% with 20,400 returns. The median hospital return rate was 98% (IQR 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 a career grade anaesthetist was present in over 86% 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 anaesthetised 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 anaesthetised. Nine patients out of 15,460 receiving general anaesthesia died during the procedure. 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.

This chapter is reproduced, in part, as a summary paper and should be quoted or referred to as: Sury MRJ, Palmer JHMacG, Cook TM, Pandit JJ. The state of UK anaesthesia: a survey of National Health Service activity in 2013. *British Journal of Anaesthesia* 2014 doi: 10.1093/bja/aeu292. All figures in that paper are reproduced with permission of the Editor-in-Chief of the *British Journal of Anaesthesia*, Oxford University Press.

BACKGROUND

27.2 The main focus of the NAP5 project was the collection of new patient reports of AAGA over one year 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.

27.3 There are several potentially useful estimates of anaesthesia-related activity available. In England and Wales, national data are collected by Hospital

Episode Statistics (HES, 2013 a,b and c) 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 for Health and Care Excellence (NICE), using HES data, to be just over two million per year (NICE, 2014). HES data also has details of anaesthesia for maternity services; there were an estimated 671,255 deliveries in NHS hospitals (in England) in 2012–13 (92% of all births (Statistical Bulletin, 2012), of which a little less than two-thirds (63%) required anaesthetic intervention.

27.4 In 2008, the census phase of the NAP4 project estimated the number of general anaesthetics administered over a two-week period (Woodall & Cook, 2011). Data were collected locally and then pooled centrally. The number of general anaesthetics per year was estimated to be just under three million (2,872,600). Although the NAP4 census had data on airway management, it did not provide details of anaesthetic practices or patient demographic characteristics which would be pertinent to NAP5.

27.5 The National Enquiry into Peri-operative 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 (NCEPOD, 1995–6) took data from hospitals over randomly allocated 24h periods, and WOW2 in 2002 (Martin, 2013) collected data over a whole week. Ninety-seven percent of NHS hospitals participated, but only surgical cases were included (cases in radiology suites, and all others outside operating rooms were excluded). No scaling factor was applied to calculate an annual workload, and details of anaesthesia management were not obtained.

27.6 In 1988, more than 500 volunteer anaesthetists recorded data from approximately 25 consecutive anaesthetics for a Survey of Anaesthetic Practice (SOAP), organised by the Association of Anaesthetists (AAGBI, 1998). Its output does not enable estimation of total workload, and no record of the surgical procedure was made, but it does contain data that estimates the proportion of patients who received specified anaesthetic techniques.

27.7 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

27.8 All hospitals, Trusts and Boards in the UK that took part in the NAP5 project were identified and represented by 267 Local Co-ordinators (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.

27.9 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 general anaesthesia or central neuraxial blockade 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.

27.10 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) or 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).

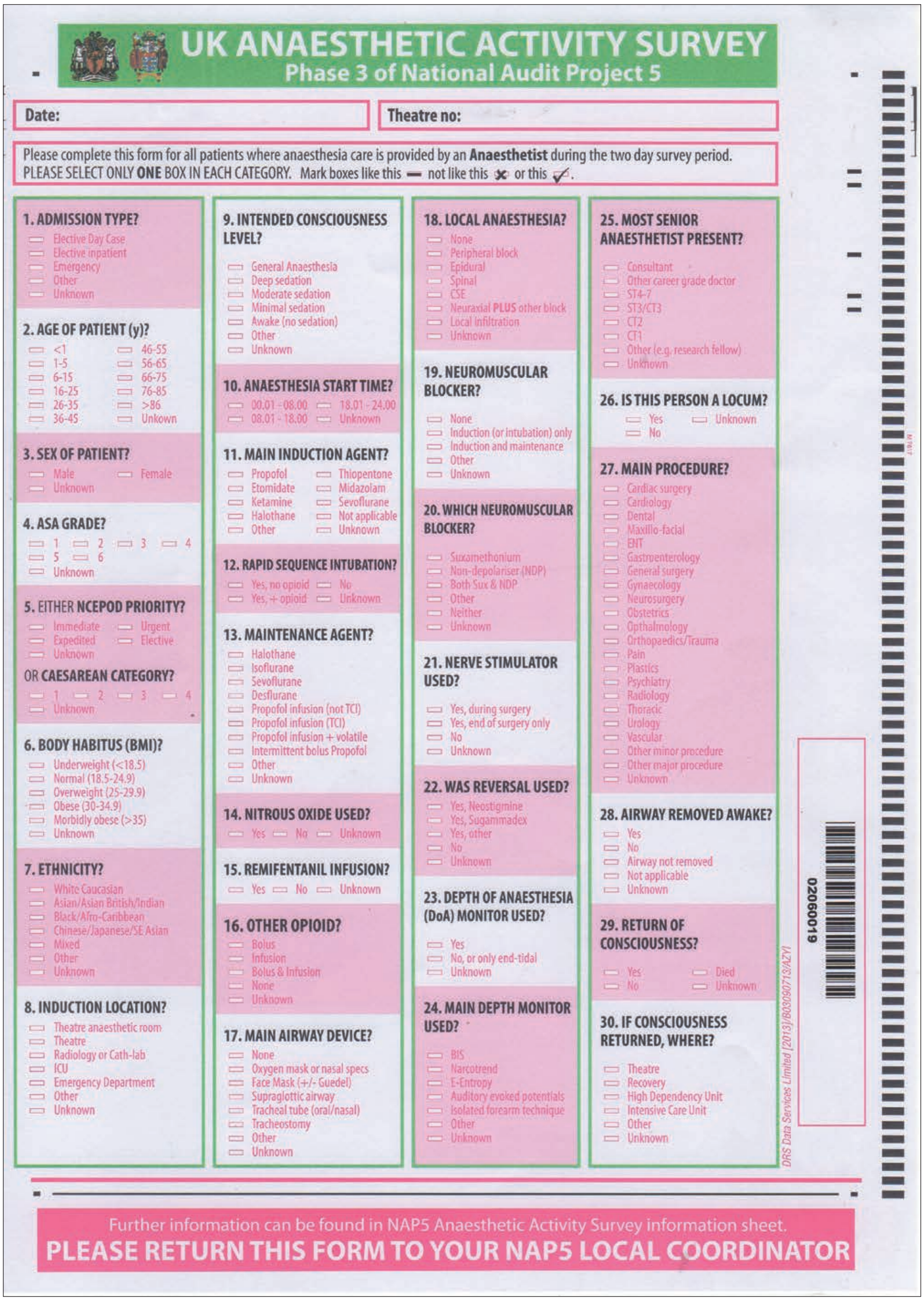
27.11 The data was captured on a paper questionnaire designed to be read automatically by 'optical character recognition' (OCR) technology (DRS Data & Research Services plc. Milton Keynes, Buckinghamshire, UK). The questionnaire was made up of 30 questions on one side of A4 paper (Figure 27.1). Each 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' i.e. their estimate of the proportion of all cases which had been reported in their hospital(s).

27.12 The survey period chosen was Monday 9 September 2013 to Monday 16 September 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 randomising each LC to two consecutive days within the chosen week. Specialist hospitals (Paediatric, Cardiothoracic and Neurosurgery) were randomised separately to avoid unequal allocation of collection days.

27.13 A scaling factor was used to convert the number of forms returned from two days into the estimated number of cases for a whole year (annual workload). The scaling factor had three components: conversion of two days to a week (3.5), the number of working weeks in 2013 (50.59, see Appendix) and the median return rate from LCs (0.98). The scaling factor was 180.68 (= (3.5 x 50.59)/0.98). 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 1 or 2 returns respectively, and that, inevitably, such small numbers are less reliable than larger numbers.

Figure 27.1. Survey questions



UK ANAESTHETIC ACTIVITY SURVEY
Phase 3 of National Audit Project 5

Date:
Theatre no:

Please complete this form for all patients where anaesthesia care is provided by an **Anaesthetist** during the two day survey period.
PLEASE SELECT ONLY **ONE** BOX IN EACH CATEGORY. Mark boxes like this — not like this ✗ or this ✓.

1. ADMISSION TYPE?
Elective Day Case; Elective inpatient; Emergency; Other; Unknown

2. AGE OF PATIENT (y)?
<1; 1-5; 6-15; 16-25; 26-35; 36-45; 46-55; 56-65; 66-75; 76-85; >86; Unkown

3. SEX OF PATIENT?
Male; Female; Unknown

4. ASA GRADE?
1; 2; 3; 4; 5; 6; Unknown

5. EITHER NCEPOD PRIORITY?
Immediate; Urgent; Expedited; Elective; Unknown

OR **CAESAREAN CATEGORY?**
1; 2; 3; 4; Unknown

6. BODY HABITUS (BMI)?
Underweight (<18.5); Normal (18.5-24.9); Overweight (25-29.9); Obese (30-34.9); Morbidly obese (>35); Unknown

7. ETHNICITY?
White Caucasian; Asian/Asian British/Indian; Black/Afro-Caribbean; Chinese/Japanese/SE Asian; Mixed; Other; Unknown

8. INDUCTION LOCATION?
Theatre anaesthetic room; Theatre; Radiology or Cath-lab; ICU; Emergency Department; Other; Unknown

9. INTENDED CONSCIOUSNESS LEVEL?
General Anaesthesia; Deep sedation; Moderate sedation; Minimal sedation; Awake (no sedation); Other; Unknown

10. ANAESTHESIA START TIME?
00.01 - 08.00; 18.01 - 24.00; 08.01 - 18.00; Unknown

11. MAIN INDUCTION AGENT?
Propofol; Thiopentone; Etomidate; Midazolam; Ketamine; Sevoflurane; Halothane; Not applicable; Other; Unknown

12. RAPID SEQUENCE INTUBATION?
Yes, no opioid; No; Yes, + opioid; Unknown

13. MAINTENANCE AGENT?
Halothane; Isoflurane; Sevoflurane; Desflurane; Propofol infusion (not TCI); Propofol infusion (TCI); Propofol infusion + volatile; Intermittent bolus Propofol; Other; Unknown

14. NITROUS OXIDE USED?
Yes; No; Unknown

15. REMIFENTANIL INFUSION?
Yes; No; Unknown

16. OTHER OPIOID?
Bolus; Infusion; Bolus & Infusion; None; Unknown

17. MAIN AIRWAY DEVICE?
None; Oxygen mask or nasal specs; Face Mask (+/- Guedel); Supraglottic airway; Tracheal tube (oral/nasal); Tracheostomy; Other; Unknown

18. LOCAL ANAESTHESIA?
None; Peripheral block; Epidural; Spinal; CSE; Neuraxial **PLUS** other block; Local infiltration; Unknown

19. NEUROMUSCULAR BLOCKER?
None; Induction (or intubation) only; Induction and maintenance; Other; Unknown

20. WHICH NEUROMUSCULAR BLOCKER?
Suxamethonium; Non-depolariser (NDP); Both Sux & NDP; Other; Neither; Unknown

21. NERVE STIMULATOR USED?
Yes, during surgery; Yes, end of surgery only; No; Unknown

22. WAS REVERSAL USED?
Yes, Neostigmine; Yes, Sugammadex; Yes, other; No; Unknown

23. DEPTH OF ANAESTHESIA (DoA) MONITOR USED?
Yes; No, or only end-tidal; Unknown

24. MAIN DEPTH MONITOR USED?
BIS; Narcotrend; E-Entropy; Auditory evoked potentials; Isolated forearm technique; Other; Unknown

25. MOST SENIOR ANAESTHETIST PRESENT?
Consultant; Other career grade doctor; ST4-7; ST3/CT3; CT2; CT1; Other (e.g. research fellow); Unknown

26. IS THIS PERSON A LOCUM?
Yes; Unknown; No

27. MAIN PROCEDURE?
Cardiac surgery; Cardiology; Dental; Maxillo-facial; ENT; Gastroenterology; General surgery; Gynaecology; Neurosurgery; Obstetrics; Opthalmology; Orthopaedics/Trauma; Pain; Plastics; Psychiatry; Radiology; Thoracic; Urology; Vascular; Other minor procedure; Other major procedure; Unknown

28. AIRWAY REMOVED AWAKE?
Yes; No; Airway not removed; Not applicable; Unknown

29. RETURN OF CONSCIOUSNESS?
Yes; Died; No; Unknown

30. IF CONSCIOUSNESS RETURNED, WHERE?
Theatre; Recovery; High Dependency Unit; Intensive Care Unit; Other; Unknown

02060019

DRS Data Services Limited [2013]/B03090713/AZYI

Further information can be found in NAP5 Anaesthetic Activity Survey information sheet.
PLEASE RETURN THIS FORM TO YOUR NAP5 LOCAL COORDINATOR

27.14 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 general anaesthesia (e.g. technique and monitoring), estimations of numbers and percentages were made only on forms indicating that general anaesthesia was the prime mode of anaesthesia (i.e. answering 'GA' to Q9).

NAP5 ACTIVITY SURVEY RESULTS AND NUMERICAL ANALYSIS

Returns by LCs

27.15 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 (Figure 27.2). Three LCs reported that their hospital had no cases in the reporting period. The median return rate was 98% (IQR 0.95 to 1, Figure 27.3): 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?) (Table 27.1). 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 (Figure 27.4).

Figure 27.2. Distribution of Local Co-ordinators (LCs) by number of returned forms

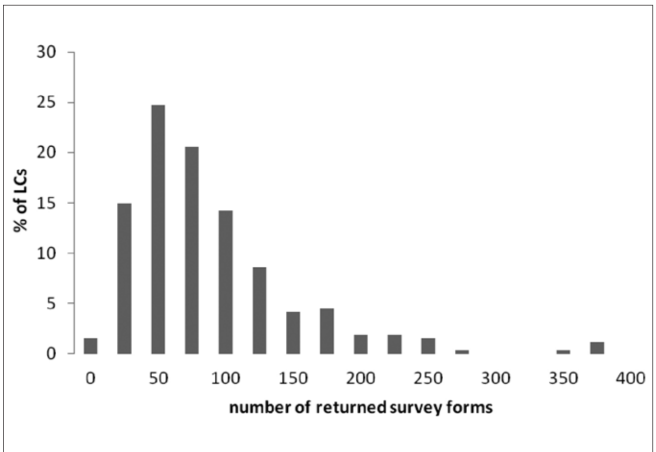


Figure 27.3. Distribution of Local Co-ordinators (LCs) by estimated percentage return rates. Completion rate = number of returned forms/estimated workload during the survey period

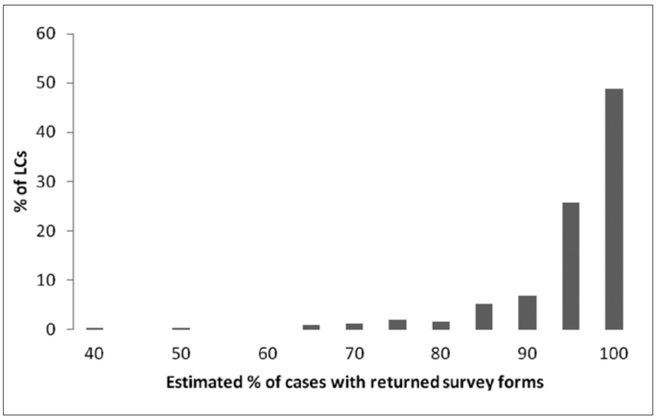
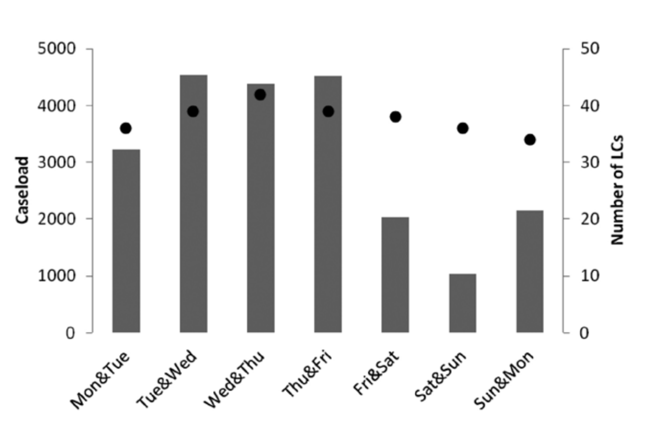


Table 27.1. Uninterpretable answers

	% of forms with answers:		
Questions	Unknown	Other	Blank
1. Admission type	0.75	3.02	0.71
2. Age of Patient	0.79		0.38
3. Sex Of Patient	1.29		0.14
4. ASA Category	1.81		0.27
5. NCEPOD Priority of Surgery	5.18		3.12
6. Body habitus	4.91		0.43
7. Ethnicity	1.39	0.93	0.13
8. Induction location	2.26	4.60	0.38
9. Intended conscious level	0.94	0.26	0.19
10. Anaesthesia start time	1.56		0.38
11. Main induction agent	4.53	14.26	1.59
12. Rapid sequence intubation	7.12		0.25
13. Maintenance agent	15.27	5.25	0.82
14. Nitrous oxide used?	7.80		1.31
15. Remifentanil infusion?	9.25		0.93
16. Opioid	7.24		0.61
17. Main airway device	3.04	0.61	0.77
18. Local anaesthesia	2.41		1.85
19. Neuromuscular blocker	4.10	0.61	0.69
20. Which neuromuscular blocker?	30.47	0.27	1.29
21. Nerve stimulator used	11.83		0.29
22. Was reversal used?	14.38		0.33
23. Depth of anaesthesia monitor?	7.74		0.49
24. Main depth monitor used?	86.22	11.48	0.13
25. Most senior anaesthetist present?	0.78		0.37
26. Is this person a locum?	2.33		0.23
27. Main procedure	0.99		0.35
28. Airway removed awake?	4.61		1.50
29. Return of consciousness?	12.64		0.30
30. If conscious returned, where?	13.27	2.52	0.85

Figure 27.4. Distribution of caseload and number of Local Co-ordinators (LCs) by two-day randomisation. Caseload and number of LCs according to allocation of two-day period of survey. Columns = caseload. ● = number of LCs



Patient characteristics

27.16 Figure 27.5 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 per year) of which only 10% involved GA. Most ophthalmology cases (72.7%), managed by anaesthetists, were performed without GA.

27.17 The patients age-group with the highest caseload was 26-35 years (Figure 27.6). In all subsequent figures and tables the age-groups have been combined into 4 broader age-groups: children (<16 years), adults (16 – 65 years), elderly (>65 years) and all patients. In respect of major sex differences, more young women than young men (75:25%, 16-25y), and more boys than girls (60:40%, 1-5y) had anaesthesia care (Figure 27.6). 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 years. Urological procedures accounted for 14% of anaesthetic activity in males and 3% in females.

Figure 27.6. Annual caseload according to age group: with sex ratio. Estimated annual caseload, according to age group (top chart) with percentage male (M ~ blue) or female (F ~ pink) (bottom chart)

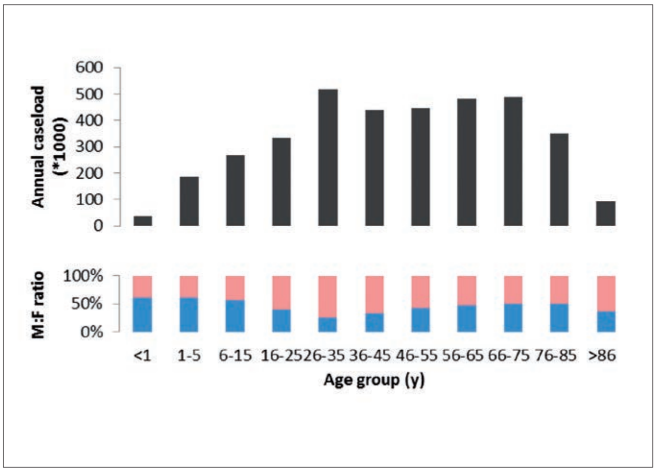
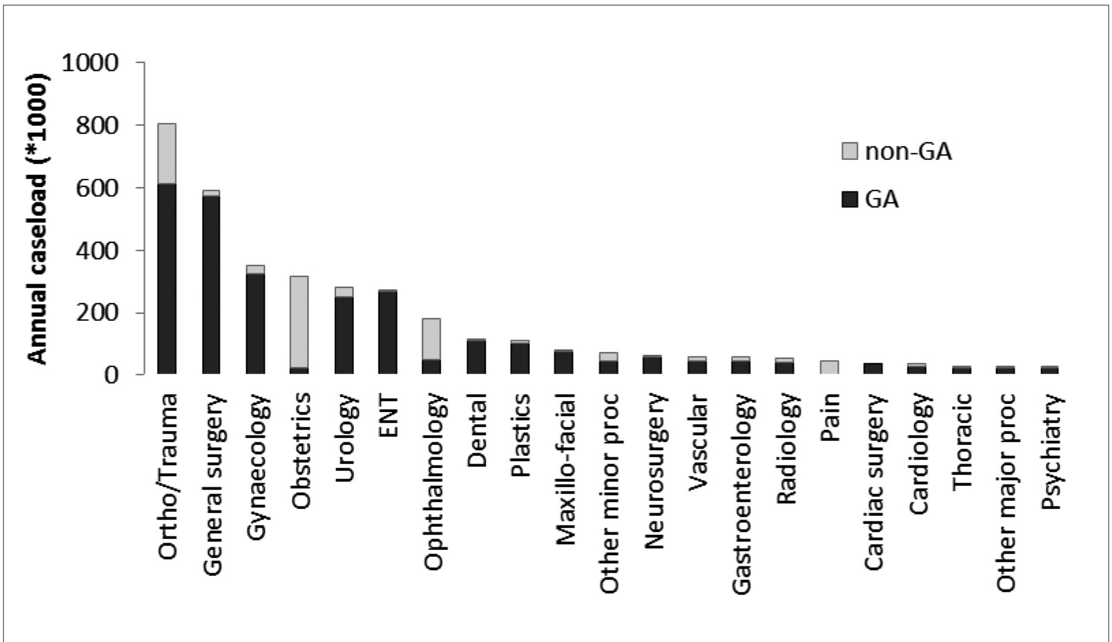


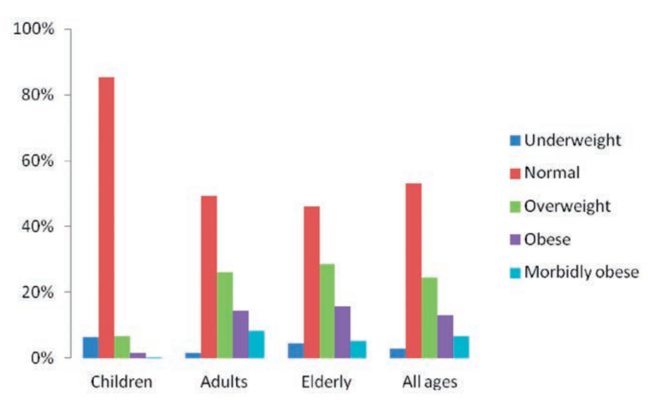
Figure 27.5. Estimated annual caseload according to specialty, and separated into general anaesthesia (GA) and non-GA activity



27.18 Table 27.2 shows the spread of the urgency categories across ASA grades separately for both NCEPOD (NCEPOD, 2004) and Caesarean section (RCOG, 2010; Lucas et al., 2000) categories.

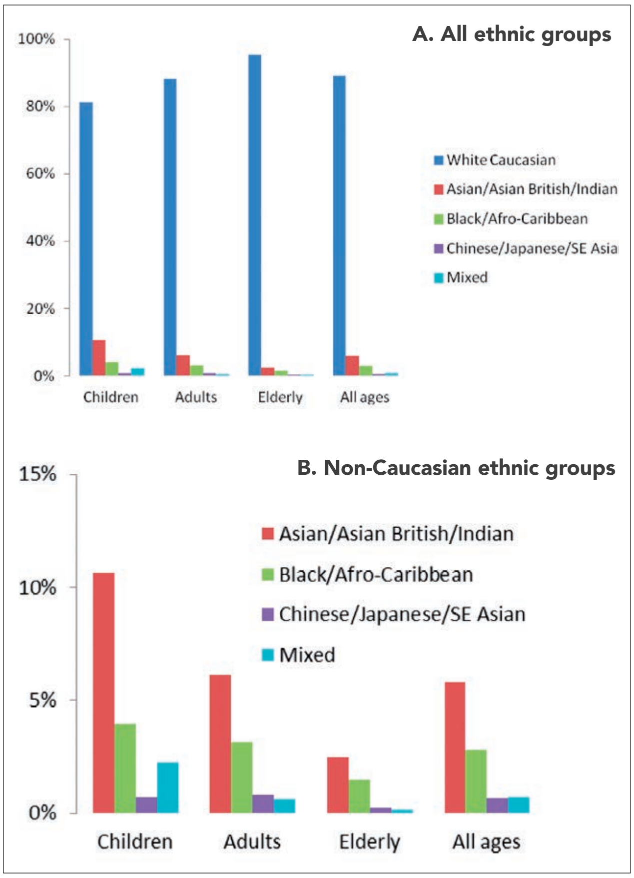
27.19 In all patients over 16 years, the percentage of underweight, normal, overweight, obese and morbidly obese patients were 2.5, 48.4, 26.9 , 14.8 and 7.4 respectively (Figure 27.7).

Figure 27.7. Body habitus and age. Percentage of patients, within age group, with body habitus



27.20 Figure 27.8 shows the distribution of ethnicity according to age group.

Figure 27.8. Ethnicity and age. Percentage of patients, within age group, according to ethnicity. Panel A: with all ethnic groups; panel B, with white Caucasian excluded, for clarity



NCEPOD category						
ASA	Immediate	Urgent	Expedited	Elective	Total	%
1	33,600	281,900	68,500	845,900	1,229,900	38.00
2	17,000	199,600	66,300	1,019,000	1,302,000	40.23
3	9,400	156,600	51,900	386,500	604,400	18.67
4	18,400	40,500	11,900	19,200	90,000	2.78
5	7,000	1,800	400	400	9,600	0.30
6	400	–	–	200	500	0.02
Total	85,800	680,400	198,900	2,271,100	3,236,300	
%	2.65	21.03	6.15	70.18		
Caesarean Section category						
ASA	1	2	3	4	Total	%
1	6,100	25,500	8,300	20,800	60,700	66.27
2	4,000	11,400	2,200	11,000	28,500	31.16
3	500	900	500	–	2,000	2.17
4	–	–	200	200	400	0.39
5	–	–	–	–	–	0.00
6	–	–	–	–	–	0.00
Total	10,700	37,800	11,200	32,000	91,600	
%	11.64	41.22	12.23	34.91		

Table 27.2 ASA and Urgency. Estimated annual caseload according to American Society of Anaesthesiologists (ASA) status versus National Confidential Enquiry into Patient Outcome and Death (NCEPOD, 2004) and Caesarean Section (RCOG, 2010) categories. Totals take into account unknowns

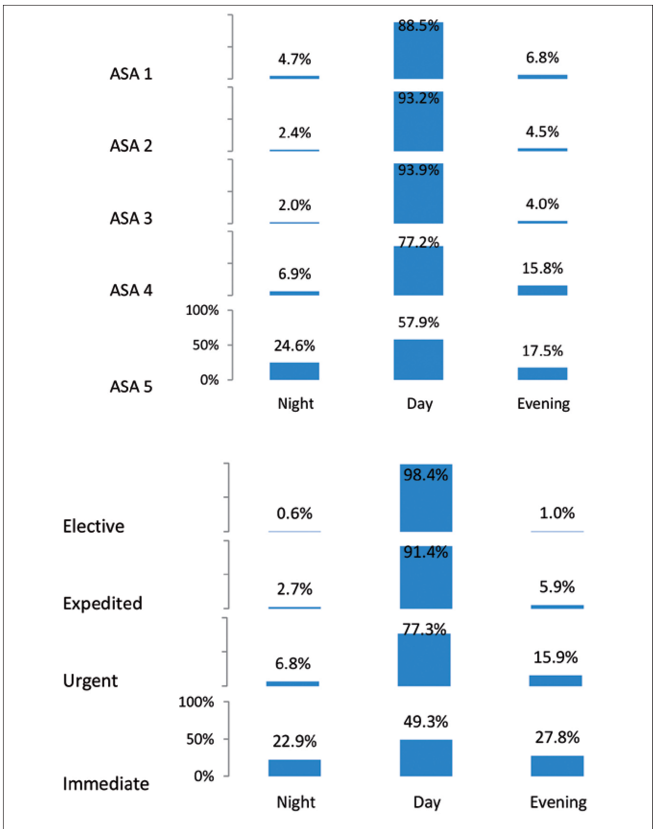
Admission type, urgency and timing of anaesthesia care

27.21 Across all specialties (Table 27.3), 73.9% of admissions were elective (47.4% day case and 26.6% inpatient), and 23.1% (n = 838,300) were emergency. Ninety one percent of all NCEPOD classified cases started between 08:00h and 18:00h but 25% of ASA 4 and 5 cases and 50% of immediate and 25% of urgent cases started between 18:00h and 08:00h (Figure 27.9). Of all activity started between midnight and 08:00h 59.2% were obstetric (n = 72,600), and of these cases 88% were awake, having had neuraxial blockade (23% of these were Caesarean sections).

Table 27.3. Admission type. Estimated annual caseload according to admission type

Admission type	Annual caseload	%
Elective Day Case	1,716,800	47.3
Elective inpatient	965,200	26.6
Emergency	838,300	23.1
Other	111,500	3.0

Figure 27.9. Time of start of anaesthesia care versus ASA grade and Urgency of procedure. Proportion of cases, within ASA grade (top panel A) or Urgency (bottom panel B), versus time of starting anaesthesia care. Each vertical axis represents percentage of cases within either ASA or NCEPOD class (tick marks 0, 50 and 100%). Night = 00:01-08:00. Day = 08:01-18:00. Evening = 18:01-24:00



27.22 The estimated annual caseload was highest during the middle of the week and lowest at weekends (Figure 27.10). The majority of weekend caseload was ASA 1, 2 and 3 patients but activity in ASA 4 and 5 patients varied little across the week. ASA 4 and 5 patients were combined because there were few ASA 5 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 (Figure 27.11).

Figure 27.10 ASA grade and day of the week. Estimated annual caseload across the week according to the ASA grade

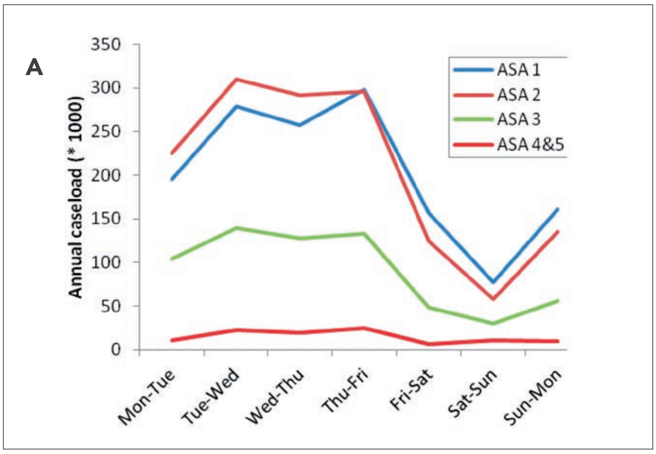
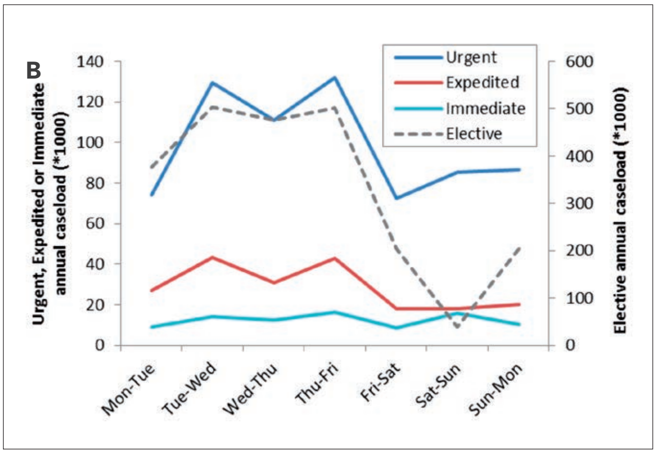


Figure 27.11. Urgency and day of the week (excluding Caesarean sections). Estimated annual caseload across the week according to NCEPOD category (NCEPOD, 2004). N.B the elective caseload (dashed line) is plotted against the right hand vertical axis



Staffing

27.23 Overall, a consultant or career grade doctor was the most senior anaesthetist in 86.2% of cases (71.7% and 15.5% respectively, see Table 27.4), and whatever the ASA grade of the patient, either a consultant or a career grade anaesthetist was present in over 75% of cases (Figure 27.12). A trainee was the most senior anaesthetist for a minority of ASA 4 and 5 patients (18.1%, and 23% respectively). A trainee was the most senior anaesthetist present for a minority (28%) of immediate or urgent cases (Figure 27.13). However, in obstetrics, trainee-led activity was notably higher (41.7% of non-elective Caesarean sections, see Figure 27.14). For all ASA 4 or 5 patients (obstetric and non-obstetric combined) a consultant was present for 80.6% of cases between 08:00h to 18:00h and 51.4% of cases outside these hours (Figure 27.12), and over 70% of cases during the week compared with 46.6% of weekend cases (Figure 27.15).

Table 27.4. Distribution of caseload according to most senior anaesthetist present. Estimated annual caseload according to the most senior anaesthetist present. Overall proportion of locum = 7.2%

Grade	Caseload	% of total	% locum
Consultant	2,562,900	71.65%	7.6%
Other career grade doctor	555,900	15.54%	
ST4-7	303,700	8.49%	3.9%
ST3/CT3	77,300	2.16%	
CT2	43,000	1.20%	
CT1	2,900	0.08%	
Other (e.g. research fellow)	31,400	0.88%	

Figure 27.12. ASA grade and most senior anaesthetist present. Top chart shows estimated annual caseload according to ASA grade. Bottom chart shows % of patients, within each ASA grade, according to most senior anaesthetist present

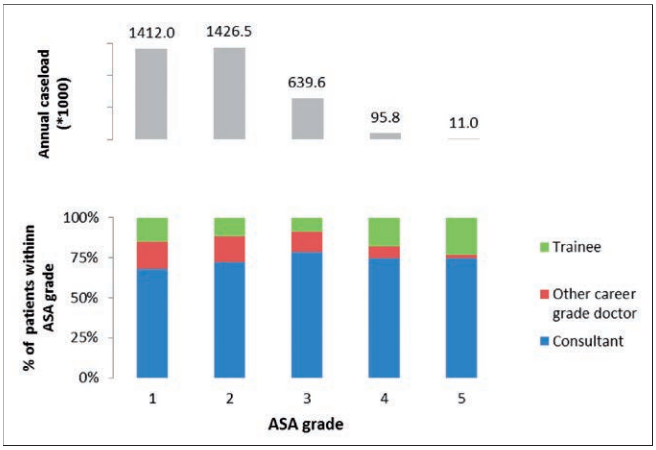


Figure 27.13. NCEPOD urgency and most senior anaesthetist present. Top chart shows estimated annual caseload according to NCEPOD urgency category. Bottom chart shows % of patients, within each category, according to most senior anaesthetist present

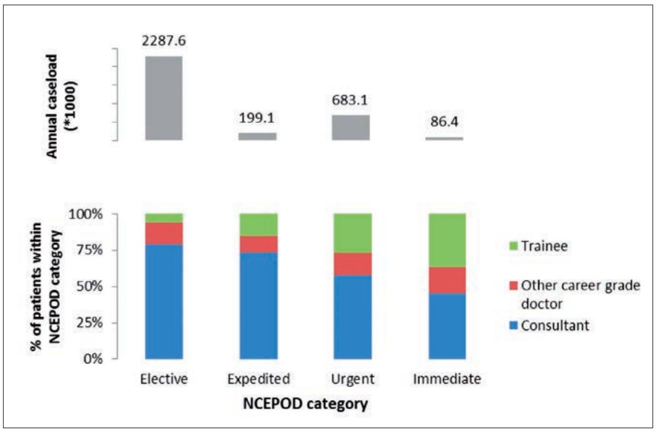


Figure 27.14. Caesarean section category and most senior anaesthetist present. Top chart shows estimated annual caseload according to Caesarean section category (RCOG, 2010). Bottom chart shows % of patients, within each category, according to most senior anaesthetist present

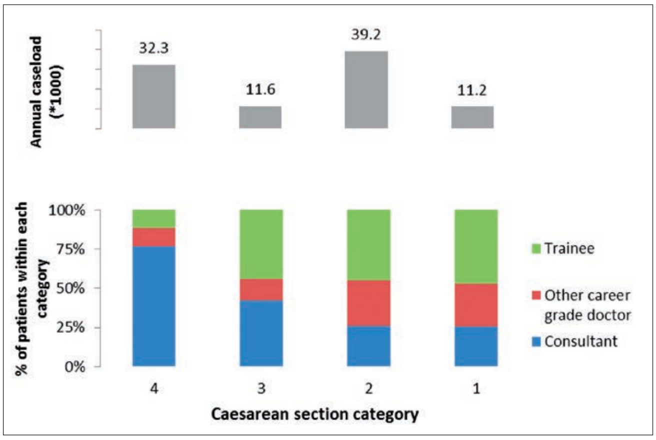
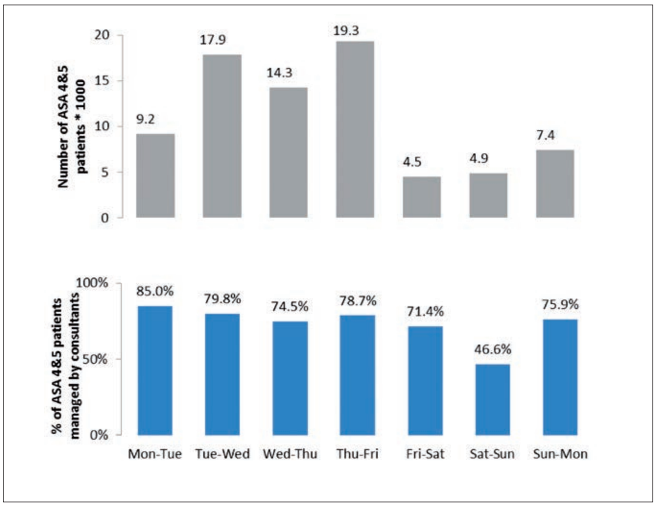


Figure 27.15. Sick patients: day of week and most senior anaesthetist present (non-obstetric and obstetric data combined).

Top chart shows number of ASA 4&5 patients versus days of week. Bottom chart shows proportion of patients, within each day category, managed by a consultant anaesthetist



Anaesthetic conduct

Conscious level

27.24 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 27.16. 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 (Figure 27.17). A high number (970 of 1,028; 94%) of awake women aged 26–35 years were having obstetric procedures.

Figure 27.16 Percentage of patients, within age range groups, according to intended level of consciousness

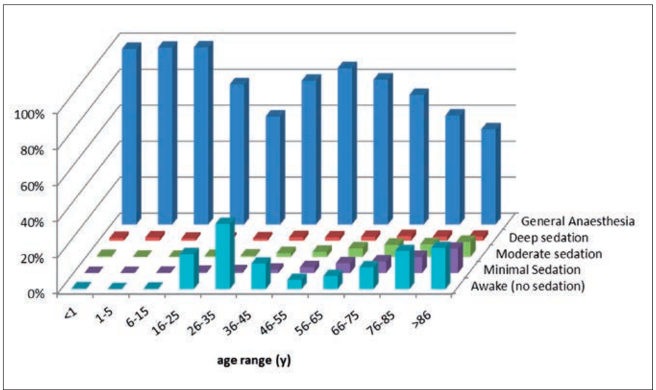
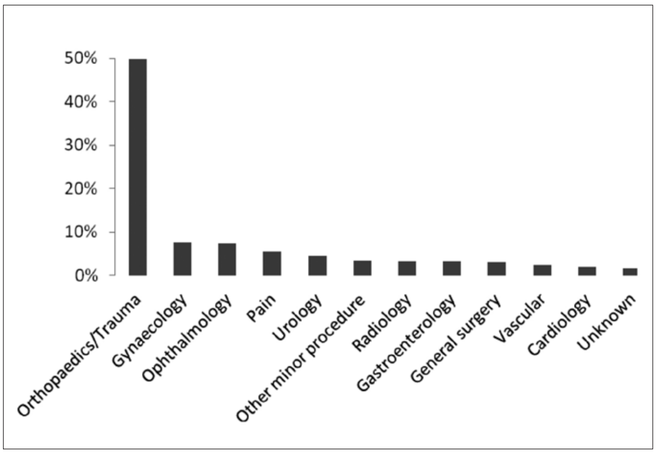


Figure 27.17. Sedation workload. Percentage of sedation cases by specialty; e.g. almost 50% of all sedation cases were in orthopaedics and trauma. Specialties contributing less than 2% of the total not included. All levels of sedation (deep, moderate or minimal) are combined



Local anaesthesia (central neuraxial block)

27.25 The number and percentage of cases in which a central neuraxial block was used are shown in Table 27.5. 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.

A: Non-obstetric cases

	Epidural	Spinal	Combined spinal and epidural	CNB + other block	Any CNB technique	None
General Anaesthesia	56,700 (87%)	43,200 (20%)	500 (10%)	7,600 (38%)	108,000 (35%)	2,564,200 (89.1%)
Deep sedation	200 (0%)	12,800 (6%)	500 (10%)	1,100 (5%)	14,600 (4.7%)	48,800 (1.7%)
Moderate sedation	500 (1%)	54,400 (25%)	2,000 (38%)	6,500 (32%)	63,400 (20.6%)	43,400 (1.5%)
Minimal Sedation	900 (1%)	59,100 (27%)	1,400 (28%)	3,400 (17%)	64,900 (21%)	56,400 (2%)
Awake (no sedation)	7,000 (11%)	48,200 (22%)	700 (14%)	1,600 (8%)	57,600 (18.7%)	165,700 (5.7%)
Total	65,400	217,700	5,200	20,200	308,500	2,878,400

B: Obstetric cases

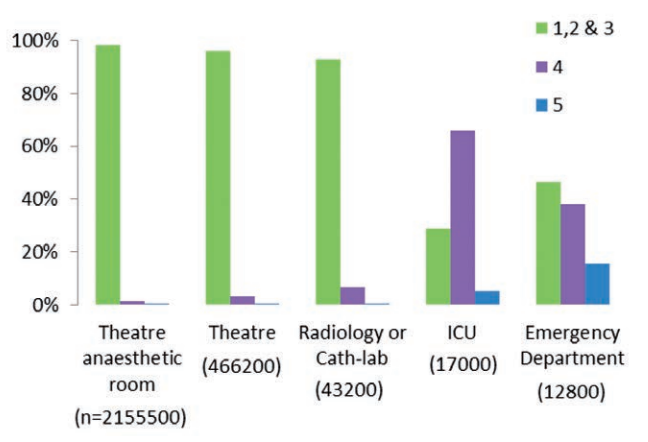
	Epidural	Spinal	Combined spinal and epidural	CNB + other block	Any CNB technique	None
General Anaesthesia	3,100 (8%)	1,600 (1.5%)	400 (2.3%)	0	5,100 (3%)	16,300 (75.6%)
Sedation (deep, moderate or minimal)	700 (2%)	1,100 (0.3%)	0	0	1,800 (0.6%)	400 (1.7%)
Awake (no sedation)	121,600 (90%)	137,000 (98.2%)	17,900 (97.7%)	400 (100%)	276,800 (96.4%)	4,900 (22.7%)
Total	125,400	139,700	18,200	400	283,700	21,500

Table 27.5. 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 (A) and obstetric cases (B). 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: n.b. 200 represents only one report. Percentages are of the total number of cases having each technique

Location

27.26 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 (Figure 27.18). 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 4 or 5.

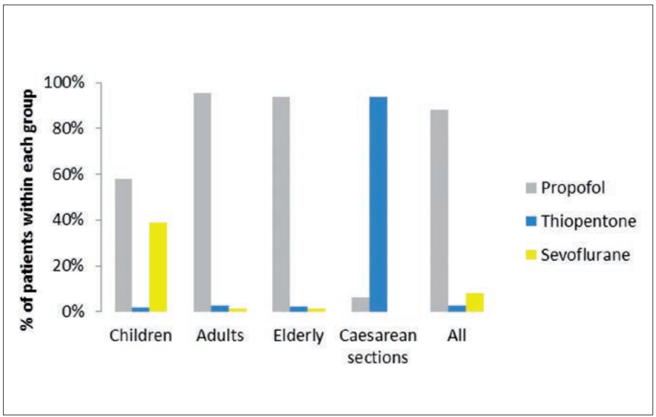
Figure 27.18. Induction location and ASA grade. Percentage of patients undergoing GA, by induction location, according to ASA grade. Number under location is the estimated annual GA caseload (all ASA grades) for the location



Induction agent

27.27 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 (Figure 27.19).

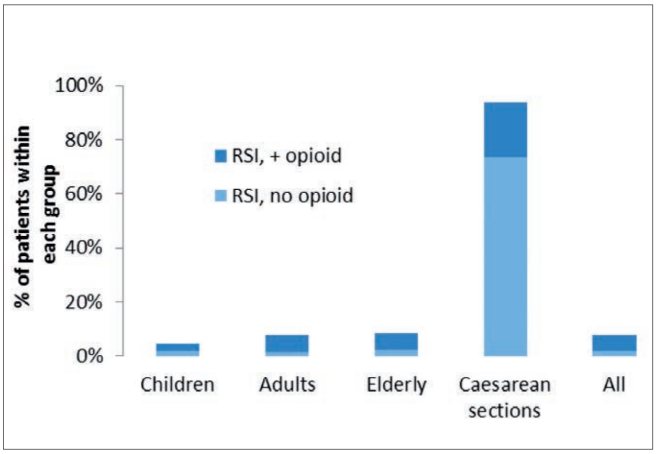
Figure 27.19. Induction agent. Percentage of patients undergoing anaesthesia receiving common induction agents



Rapid sequence induction

27.28 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%, suxamethonium in 66.2% and an opioid in 75.8% (Figure 27.20). Almost all (92.2%) Caesarean section GA cases included RSI, and of these, thiopental and suxamethonium were used in 100% and an opioid in 23.4%. RSI accounted for 87.3% of all cases induced with thiopental.

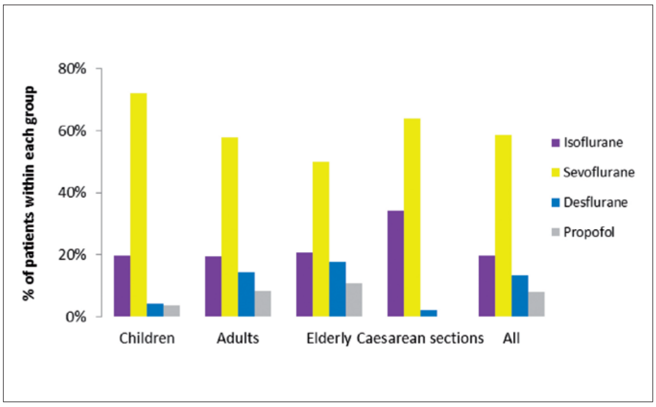
Figure 27.20. Rapid sequence induction. Percentage of patients undergoing anaesthesia receiving rapid-sequence induction



Maintenance agent

27.29 A vapour was used in the maintenance phase of GA in 92% of all cases, and, irrespective of age (Figure 27.21), sevoflurane was the most common agent (58.5%). Propofol Total Intravenous Anaesthesia (TIVA: including all infusion or intermittent bolus techniques) was used in 8% of all cases. 63% of all TIVA with propofol was by Target Controlled Infusion (TCI). Use of TCI varied according to location: 80% in theatre cases and 17% in cases induced in radiology, Cath-lab, ICU or ED.

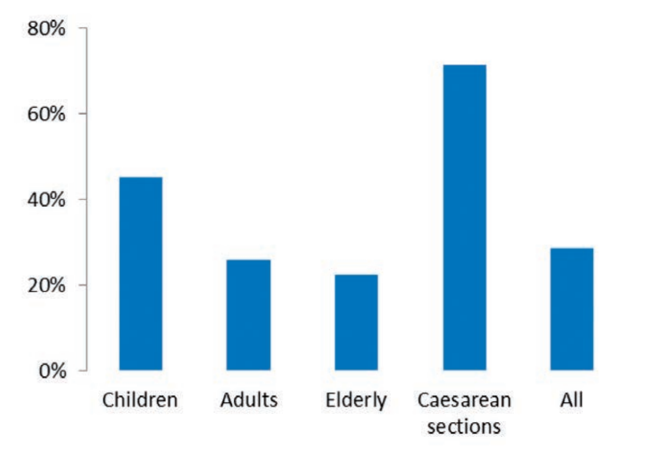
Figure 27.21. Maintenance agent. Proportion of patients undergoing anaesthesia receiving each maintenance agent. The propofol column represents any infusion or intermittent bolus technique



Nitrous oxide

27.30 Nitrous oxide was used (during GA) in approximately 25% of adult and elderly patients, 45% of children and 71.4% of Caesarean sections (Figure 27.22): overall use was 28.7%. Nitrous oxide was used in 4% of propofol TIVA cases.

Figure 27.22. Percentage of patients undergoing anaesthesia receiving nitrous oxide



Opioids

27.31 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

27.32 Airway management is summarised in Table 27.6. 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. Over 80% of these two devices were removed when the patient was awake.

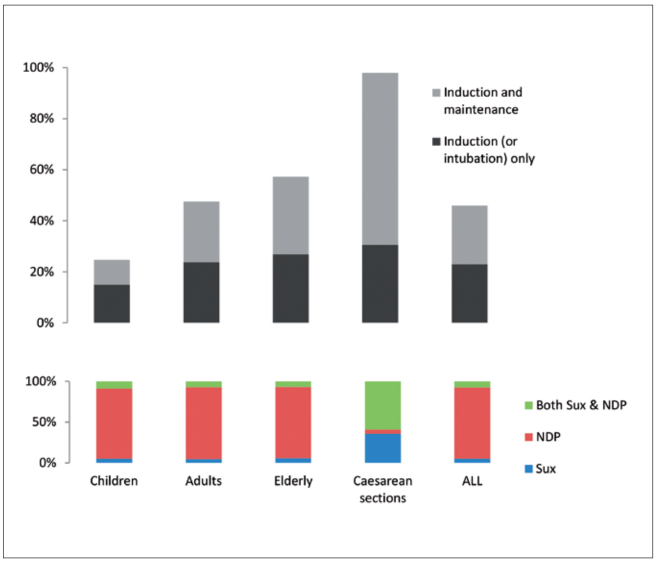
Table 27.6. Main airway device. Main airway device used during general anaesthesia

Airway device	Caseload	(%)	Removed awake
None	8,300	0.3%	
Oxygen mask or nasal specs	11,400	0.4%	
Face Mask (+/- Guedel airway)	77,300	3.0%	
Supraglottic airway	1,319,100	51.3%	84.5%
Tracheal tube	1,147,300	44.6%	83.2%
Tracheostomy	10,700	0.4%	

Neuromuscular blockade, monitoring and reversal

27.33 Neuromuscular blockade (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 (Figure 27.23). Suxamethonium was used in almost all (92%) Caesarean section anaesthetics but only 13% of other cases in which NMB was used. In cases involving a non-depolarising NMB a nerve stimulator was used in 38% and reversal was used 68% (Sugammadex in 1.5%).

Figure 27.23. Use of neuromuscular blocker. Percentage of patients, within each age group (and Caesarean section group) receiving neuromuscular blockade



Depth of Anaesthesia monitoring

27.34 DOA monitoring of any type was used in 2.8% of GA cases: processed EEG monitoring (including BIS, Narcotrend or E-Entropy) was used in 2.75% and Auditory Evoked Potentials was used in 0.03% (Table 27.7). The isolated forearm technique was reported in only five patients (0.03%). The use of DOA monitoring varied with the anaesthetic technique: DOA was used most often (23.4%) with TIVA anaesthetics in which NMB was used, and least often (1.1%) with volatile based anaesthetics without NMB (Table 27.8). DOA use was greatest in the elderly (5.5%) compared to adults (2.4%) and children (0.5%).

Table 27.7 Use of depth of anaesthesia monitors during general anaesthesia. Percentage of anaesthetised patients, according to age group, having depth of anaesthesia monitoring. * Processed EEG includes BIS, Narcotrend or E-Entropy

	BIS	Narcotrend	E-Entropy	Processed EEG *	Auditory evoked potentials	Isolated forearm technique
Children	0.42%	0.04%	0.04%	0.49%	0.00%	0.00%
Adults	2.01%	0.11%	0.29%	2.41%	0.00%	0.04%
Elderly	4.65%	0.18%	0.66%	5.48%	0.12%	0.03%
All ages	2.31%	0.11%	0.33%	2.75%	0.03%	0.03%

Table 27.8 Use of depth of anaesthesia monitoring (DOA) according to maintenance agent and neuromuscular blockade (NMB). Use of any dedicated DOA monitor in patients undergoing GA, according to maintenance anaesthetic technique and use of NMB. TIVA = propofol infusion (TCI and non-TCI combined) or intermittent propofol technique

	No NMB	% using DOA	NMB	% using DOA
Volatile agent	1,357,600	1.1%	1,095,100	3.5%
TIVA	95,200	7.8%	109,100	23.4%

Return of consciousness

27.35 Overall only 1% of patients recovered in a high dependency unit or ICU setting. 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 3, 4 or 5 (three in each category) and aged over 55 years (three were aged 56-65 years, three 66-75 years, two 76-85 years, and one >86y); 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 an ICU, three in an ED and one in an unspecified location: The overall GA death rate was 0.06% (1:1718). If all patients in whom the intended level of consciousness was unspecified received GA, the incidence would be 0.12%.

Table 27.9 Return of consciousness. A: % of patients undergoing GA according to the site of their return of consciousness. B: % of patients undergoing GA who did not regain consciousness (at the time of the completion of the survey form), according to age group. The number of deaths is of deaths reported during the anaesthetic procedure

A: Site of return of consciousness	
Theatre	35.2%
Recovery	63.6%
High Dependency Unit	0.3%
Intensive Care Unit	0.9%

B: Patient group	% who did not regain consciousness	% who died	Number of deaths
Children	1.9%	0.00%	0
Adults	1.6%	0.04%	3
Elderly	4.0 %	0.2%	6
All	2.2%	0.06%	9

DISCUSSION

27.36 This is not the first survey of its kind, but we believe it is the most comprehensive national picture of anaesthesia practice to date. Clergue and colleagues conducted a national survey of anaesthesia activity in France in 1996 (Clergue et al., 1999). This had less detail than ours and was not intended to relate to AAGA or intended conscious level. Data was 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 (Jonker et al., 2014).

27.37 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 (Woodall and Cook; 2011) was undertaken over two weeks, the data required for each case was much less, and we did not think 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' (Fried, 1974), 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 (Ɛ) 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 Ɛ 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 gained by keeping Ɛ lower than by further increasing *N*. That 100% of NHS centres responded to the survey, and the median return rate was 0.98, represents excellent compliance. However, even with a two-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.

27.38 Randomisation of hospitals to two-days had the potential problem of misrepresenting activity of specialist hospitals if their allocated days were skewed. We tried to minimise this problem by randomising specialist hospitals separately. The two-day collection period also meant that calculation of activity for individual days was not possible. The large size of our sample dataset 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 two-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.

27.39 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 'maximised' 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 two-week long survey in 2008) of 2,872,600 (Woodall & Cook, 2011). Our estimate of 308,800 cases of sedation and 523,100 awake cases (with or without local anaesthesia), gives a total of total of 831,900, which is also in close agreement with NAP4's estimate of 700,000 cases (Cook et al., 2011). 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 9,200, compared to an estimate of 11,278 by Murdoch et al., (2013). Moreover the HES data (corrected for the UK population) estimates the number of Caesarean sections with general anaesthesia to be 11,687 per year which suggests that our data underestimate the true number (HES, 2013). See also Chapter 16 Obstetrics.

27.40 An advantage of pivot tables is the ease with which large datasets 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 organise the dataset. Therefore, some small variation in estimates is obtained depending upon the method of pivoting the same dataset. 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.

27.41 This survey shows that NHS anaesthetists not only deliver approximately ~2.8 million general anaesthetics in a year, but also that there is a substantial additional workload when sedated and awake patients are added. Non-GA anaesthetic activity accounts for approximately 25% of all Anaesthetic activity, and this figure is consistent with previous estimates in NAP4 (Woodall & Cook, 2011). 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 has been used to estimate the incidence of reports of AAGA to NAP5.

27.42 Our data show that the majority of patients are managed by consultants, irrespective of the patient's ASA grade. In respect of urgent and immediate cases, consultants were present in fewer, but still a majority, 57%. However, consultant presence at category 1 and 2 Caesarean sections was low (26%) and Consultant presence for ASA 4 and 5 patients was approximately 50% outside daytime operating hours compared to 80% during the daytime, and 47% during weekends compared with 70% at other times of the week (see 'Staffing' section, above). 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.

27.43 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 emphasise 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.

27.44 The survey has important data regarding the planning for, or impact of, seven-day working (Figures 27.10 and 11). If it is planned that the caseload during weekend days becomes similar to weekday days, then we estimate that the NHS needs to find capacity for about one 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 approximately 200,000 cases annually to fill the weekend capacity. It is also possible that it is envisaged seven-day working will involve a smoother distribution of emergency cases across the working week, thereby releasing weekend capacity for elective cases. However, Figures 27.10 and 11 show 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 seven-day services in the NHS.

27.45 The low mortality rate (0.06% or 1 in 1,718) 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% (1 in 25) mortality rate for inpatient major elective surgery (Pearse et al., 2012). These differences highlight the potential impact that advances in peri-operative care – by anaesthetists, surgeons and intensivists – might have on overall mortality rates after surgery.

27.46 In planning an anaesthetic service for a large population, datasets 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.

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APPENDIX

Scaling factor

Number of weeks in the year

The weekly caseload may not be multiplied by 52 to estimate an annual caseload because several weeks have Bank Holidays. Assuming that the activity on a Bank Holiday is similar to a weekend day the 'effective' number of weeks can be calculated. For 2013, the number of weeks used as a scaling factor to estimate annual activity was 50.59 (see below).

There were 365 days in 2013, and 52.14 weeks (365/7 = 52.14).

Using the number of weekdays, a scaling factor x, and y as the number of 'effective' weeks in 2013:

$5/7 * x = 52.14$ and $253/365 * x = y$

Therefore $x = 7*52.14/5 = y*365/253$

And $y = (7*52.14*253) / (5 * 365) = 50.59$

Return rate

LCs were asked to estimate their site's return rate, either by using their own hospital data or by choosing one of the following ranges: <50%, 51–75%, 76–90%; 91–99%; 99-100%. The median return rate was 0.98 for the entire sample (where the LC quoted a range, the middle rate was used e.g. a rate of 95% was used instead of 91-99%).

Multiplication factor

Number of returns in a week = number of returned forms *3.5

Number of returns in a year (2013) = returned forms *3.5 * 50.59

Estimated annual caseload = (returned forms * 3.5 * 50.59) / 0.98

Multiplication factor = (3.5 * 50.59) / 0.98 = 180.6786