12 NAP7 Activity Survey: serious complications during anaesthesia


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Key findings

- The Activity Survey identified 1,922 potentially serious complications during 1,337 of the 24,172 cases in NHS settings: a complication occurred in 1 in 18 cases (6%).
- Obstetric cases had a high reported major haemorrhage rate. This effect skewed the complication profile, and obstetric complications are considered separately in Chapter 34 Obstetrics.
- Of 20,996 non-obstetric cases, 1,705 complications were reported during 1150 (5%) cases.
- Circulatory events accounted for most complications (616 events, 36%), followed by airway (418, 24%), metabolic (264, 15%), breathing (259, 15%), 'other' (107, 6%) and neurological (41, 2%) events.
- Of these, a single complication was reported in 851 cases (4%), two complications in 166 cases (0.8%) and three or more complications in 133 cases (0.6%).
- In non-obstetric elective surgery (elective day case or planned admissions), all complications were 'uncommon' (between 10 and 100 per 10,000 cases) or less frequent.
- Most complication reports occurred in high-risk settings. Emergency surgery (urgent and immediate priority) accounted for 16% of the workload, but 42% of reported complications.
- During emergency surgery, severe hypotension, major haemorrhage, severe arrhythmias causing compromise, septic shock, new significant acidosis, and electrolyte disturbances were all 'common' (between 100 and 1,000 per 10,000 cases).
- The chance of any complication was associated with increasing age, higher ASA, male sex, increased frailty, the urgency and extent of surgery, the day of the week and time of day based on univariate analysis.

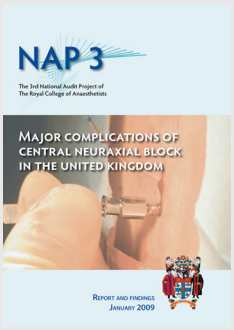
What we already know

Perioperative cardiac arrest is rare and, when it occurs, it is usually associated with an antecedent event or complication such as hypoxaemia or bleeding (Chapter 13 Reported cases summary). Knowing how often anaesthetic complications or events that could progress to cardiac arrest occur could help anaesthetists formulate strategies to decrease the risk of cardiac arrest and help inform patients about their perioperative risk. In addition, these data can help inform which complications progress to or are associated with severe patient harm, including cardiac arrest or death during anaesthesia (Kane 2022).

Previous National Audit Projects (NAPs) have focused on specific complications of anaesthesia, some of which could progress to a perioperative cardiac arrest. NAP3 reported that cardiovascular collapse leading to cardiac or respiratory arrest occurred after 1 in 101,000 central neuraxial blocks; NAP4 showed major complications of airway management occurred in 1 in 22,000 anaesthetics and NAP6 showed a perioperative incidence of anaphylaxis of 1 in 12,000 with about 1 in 7 cases progressing to cardiac arrest, and about 1 in 27 dying (Figure 12.1; Cook and Thomas 2016).

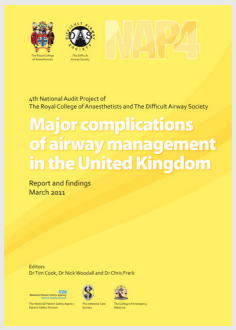
Describing the incidence of complications and communicating this incidence with patients can be challenging. In its patient information resources, the Royal College of Anaesthetists presents risks for healthy patients having routine surgery in terms of ten-fold differences in risk (Figure 12.2). These risk bands are anchored in common sense everyday language to aid communication (eg rare, common, very common; Table 12.1). We have used the same terminology to describe the risks of complications in NAP7.

Figure 12.1 Incidence of complications in previous NAPs



CVS collapse/ respiratory arrest

1 in 101,000

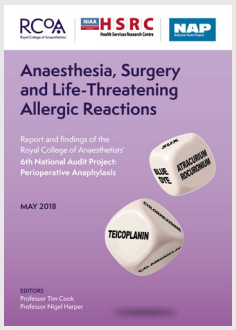


Complications

1 in 22,000

Death

1 in 180,000



Anaphylaxis

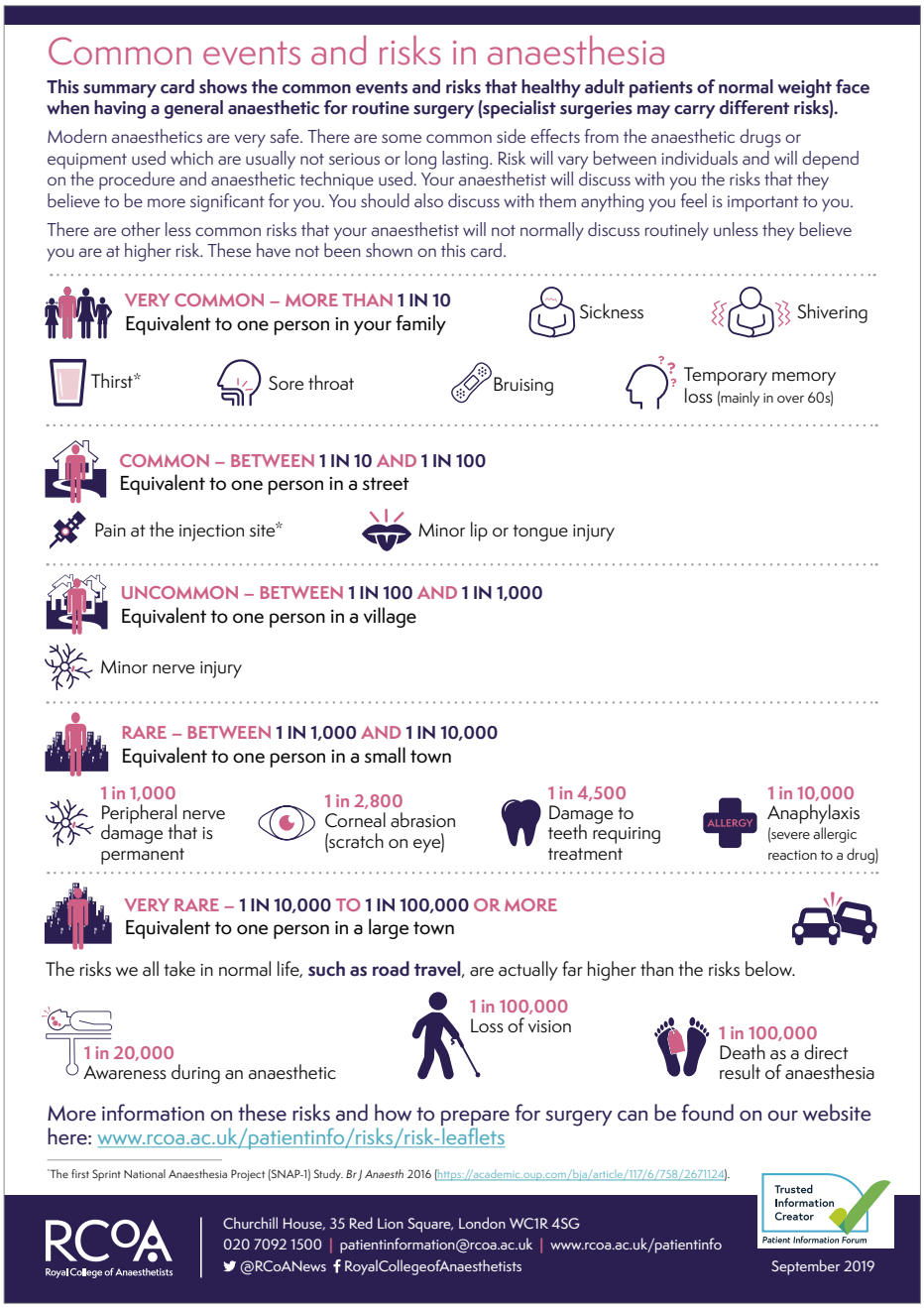
1 in 12,000

Cardiac arrest

1 in 78,000

Death

1 in 313,000



Common events and risks in anaesthesia

This summary card shows the common events and risks that healthy adult patients of normal weight face when having a general anaesthetic for routine surgery (specialist surgeries may carry different risks).

Modern anaesthetics are very safe. There are some common side effects from the anaesthetic drugs or equipment used which are usually not serious or long lasting. Risk will vary between individuals and will depend on the procedure and anaesthetic technique used. Your anaesthetist will discuss with you the risks that they believe to be more significant for you. You should also discuss with them anything you feel is important to you.

There are other less common risks that your anaesthetist will not normally discuss routinely unless they believe you are at higher risk. These have not been shown on this card.

VERY COMMON – MORE THAN 1 IN 10
Equivalent to one person in your family

Sickness · Shivering · Thirst* · Sore throat · Bruising · Temporary memory loss (mainly in over 60s)

COMMON – BETWEEN 1 IN 10 AND 1 IN 100
Equivalent to one person in a street

Pain at the injection site* · Minor lip or tongue injury

UNCOMMON – BETWEEN 1 IN 100 AND 1 IN 1,000
Equivalent to one person in a village

Minor nerve injury

RARE – BETWEEN 1 IN 1,000 AND 1 IN 10,000
Equivalent to one person in a small town

1 in 1,000 Peripheral nerve damage that is permanent

1 in 2,800 Corneal abrasion (scratch on eye)

1 in 4,500 Damage to teeth requiring treatment

1 in 10,000 Anaphylaxis (severe allergic reaction to a drug)

VERY RARE – 1 IN 10,000 TO 1 IN 100,000 OR MORE
Equivalent to one person in a large town

The risks we all take in normal life, **such as road travel**, are actually far higher than the risks below.

1 in 20,000 Awareness during an anaesthetic

1 in 100,000 Loss of vision

1 in 100,000 Death as a direct result of anaesthesia

More information on these risks and how to prepare for surgery can be found on our website here: www.rcoa.ac.uk/patientinfo/risks/risk-leaflets

*The first Sprint National Anaesthesia Project (SNAP-1) Study. *Br J Anaesth* 2016 (https://academic.oup.com/bja/article/117/6/758/2671124).

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September 2019

Figure 12.2 Risks in anaesthesia (Royal College of Anaesthetists 2019)
Source: https://www.rcoa.ac.uk/sites/default/files/documents/2021-12/Risk-infographics_2019web.pdf

Activity Survey methods

Categorisation of complications

Intraoperative complications were recorded for every case during the NAP7 Activity Survey (Chapter 6 Methods). In addition to details about the patient and anaesthetic, details of complications were reported by the anaesthetist performing the case. The data collection form was designed to collect complications that the review panel judged were likely to, or had the potential to, be associated with serious harm (Table 12.2). Complications were broadly categorised into airway, breathing, circulation, neurological, metabolic and other themes. Reporting anaesthetists could record zero, one or more complications for each case.

Table 12.1 Descriptors of complication frequency

Incidence	Definition	Per 10 000	Range (per 10 000)
Very common	1 in 10	1000 per 10 000	>1000
Common	1 in 100	100 per 10 000	100 to 1000
Uncommon	1 in 1000	10 per 10 000	10 to 100
Rare	1 in 10 000	1 per 10 000	1 to 10
Very rare	1 in 100 000	0.1 per 10 000	0.1 to 1
Extremely rare	1 in 1 000 000	0.01 per 10 000	0.01 to 0.1

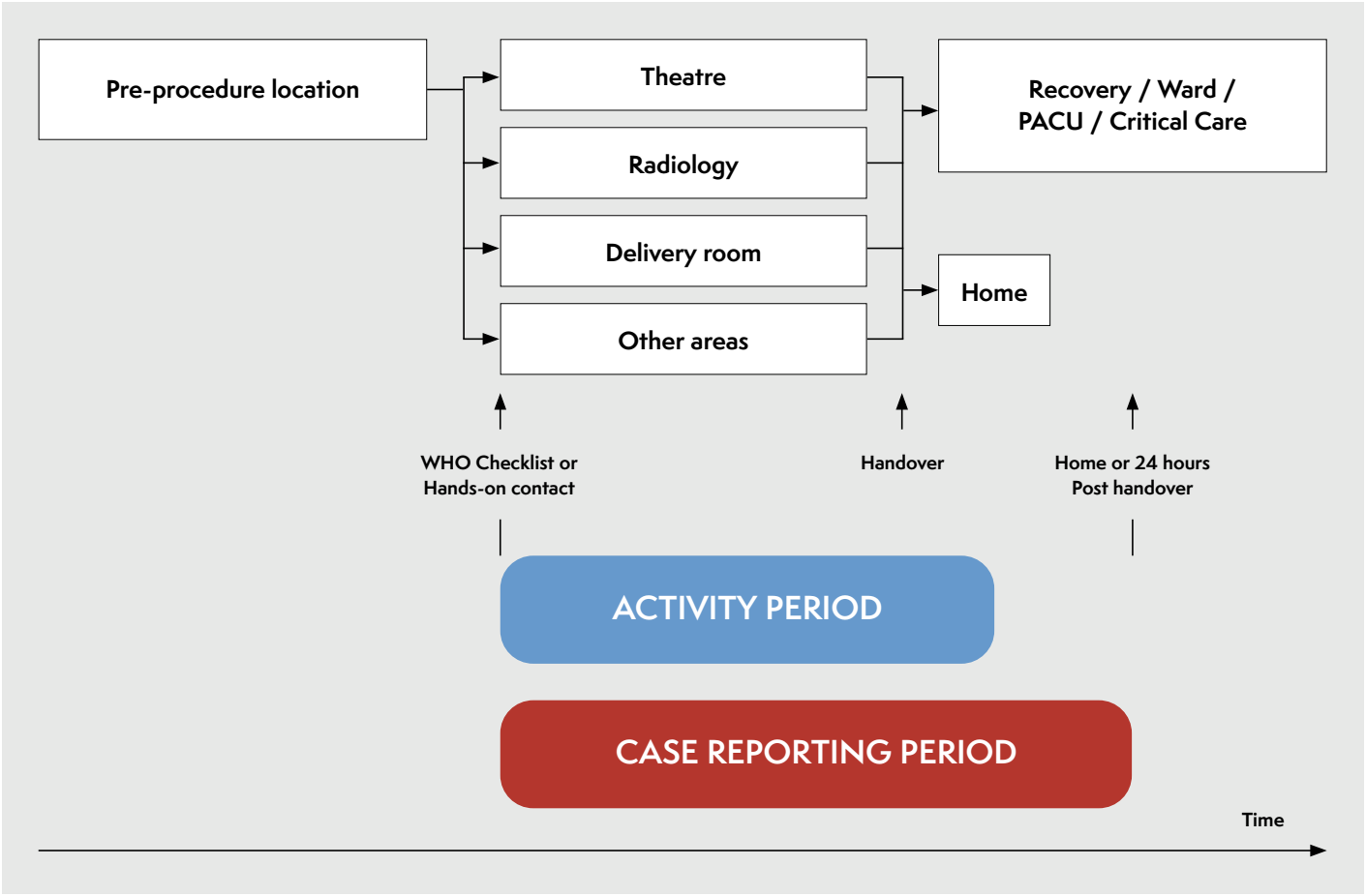
Table 12.2 List of complications which could be reported in the NAP7 Activity Survey

Theme	Complication
Airway	Failed mask ventilation, supraglottic airway placement or tracheal intubation
	Laryngospasm
	Can't intubate, can't oxygenate or emergency front of neck airway
	Unrecognised oesophageal intubation
	Wrong gas supplied, unintentional connection to air
	Airway haemorrhage
	Aspiration or regurgitation
	Other
Breathing	Severe hypoxaemia
	Ventilator disconnection
	Severe ventilation difficulties (eg bronchospasm, high airway pressure)
	Hyper- or hypo-capnia
	Endobronchial intubation
	Pneumothorax (simple or tension)
Circulation	Major haemorrhage
	Severe brady- or tachyarrhythmia causing compromise
	Severe hypotension (central vasopressors considered/started)
	Emergency DC cardioversion
	Cardiac ischaemia
	Cardiac tamponade
	New atrial fibrillation
	Embolic event (pulmonary embolism/fat/bone cement/amniotic fluid/air/CO_2)
	Septic shock
	Anaphylaxis
	Incompatible blood transfusion
	Suspected Addisonian crisis
	Cardiac arrest
Neurological	Stoke, intracranial and/or subarachnoid haemorrhage
	Intracranial hypertension (eg new fixed/dilated pupil or coning)
	Seizure
	Vagal outflow (eg pneumoperitoneum, oculocardiac reflex)
	Neurogenic shock
	Death
Metabolic	New significant acidosis/acidaemia
	Significant electrolyte disturbance (Ca^{2+}, Na^{+}, K^{+} or Mg^{2+})
	Hyper- or hypothermia
Other	Malignant hyperthermia
	Local anaesthetic toxicity
	Emergency call for anaesthesia assistance
	Drug error
	Equipment failure
	Intraoperative conversion of anaesthesia (eg local/regional anaesthesia or sedation to general anaesthesia

The Activity Survey inclusion period

The NAP7 Activity Survey was completed by anaesthetists and anaesthesia associates on the day of the procedure and collected information on 24,712 cases based on four days of reporting from each NAP7 site (Chapter 11 Activity Survey). The Activity Survey collected data from cases over a shorter period (start of anaesthesia until leaving recovery) than for NAP7 case reporting of perioperative cardiac arrests, which continued up to 24 hours after handover to recovery or a critical care unit (Figure 12.3).

Figure 12.3 NAP7 Activity Survey inclusion period. The Activity Survey and case reporting period began with the World Health Organization checklist or first hands-on contact. The Activity Survey period ended for most patients at the handover in recovery, while the case registry period lasted a further 24 hours following the handover of care to recovery or critical care. PACU, post-anaesthesia care unit.



What we found

Numbers of complications reported

We have only reported complications from NHS sites participating in the Activity Survey. Information from independent sector sites is discussed in Chapter 14 Independent sector.
In the Activity Survey cohort, 1,922 discrete complications were reported during 1,337 of 24,172 cases. The obstetric population was noted to have a different complication profile to the non-obstetric population (high rates of major haemorrhage in awake patients) and has therefore been excluded from analysis in this chapter. Full details can be found in Chapter 34 Obstetrics. This exclusion left 1,705 complications reported during 1,150 of the remaining 20,996 cases. Of these non-obstetric cases, a single complication was recorded in 851 cases (3.8%, 1 in 26 cases), two complications in 166 cases (0.8%, 1 in 127 cases), and three or more complications in 133 cases (0.63%, 1 in 158 cases; Figure 12.4).

Circulatory events accounted for most complications, followed by airway, metabolic, breathing and neurological events (Table 12.3).

Figure 12.4 Distribution of the number of complications reported during non-obstetric cases in the NAP7 Activity Survey (*n* = 1,705 complications during 20,996 cases)

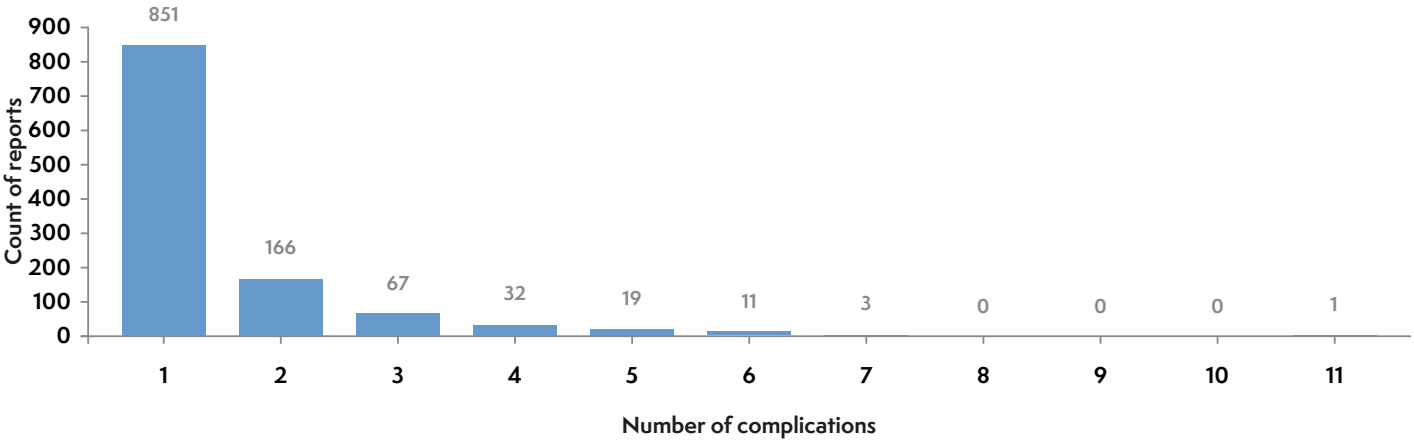


Table 12.3 Types of complications reported in the Activity Survey during non-obstetric cases

Type of complication	Complications reported (*n*)	All complications (%)
Airway	418	24
Breathing	259	15
Circulation	616	36
Neurological	41	2
Metabolic	264	15
Other	107	6
Total	**1,705**	**100**

Across all urgencies of surgery, only severe hypotension was 'common' (117 per 10,000). Of the other complications, 17 were categorised as 'uncommon', 17 as 'rare', two as 'very rare' and six as 'extremely rare' (Table 12.4).

In patients undergoing elective surgery, the rates of many complications were lower than in the overall population. The 14,136 elective cases (67% of activity) accounted for 705 (41%) of all complications, suggesting a lower risk of complications in this cohort (Table 12.5). Conversely, the emergency population (urgent and immediate surgery) accounted for 3,454 cases (16% of non-obstetric activity) and 714 (42%) complications (Table 12.6). In emergency surgery, severe hypotension, major haemorrhage, severe arrhythmias causing compromise, septic shock, new significant acidosis, and electrolyte disturbances were all 'common'.

Table 12.4 Rates of complications in all non-obstetric patients in the NAP7 Activity Survey across all levels of urgency. Data are the raw number and rate per 10,000 cases (95% CI, Wilson's method) of complications in all cases, general anaesthesia (GA), sedation and awake cases. Complications are ranked within 'airway', 'breathing' etc, by absolute number of cases. Colour coding shows frequency as per Table 12.1. Note that 708 cases did not record the intended level of consciousness. ■ Common; ■ Uncommon; ■ Rare; ■ Very rare; ■ Extremely rare (see Table 12.1). AF, atrial fibrillation; CICO, can't intubate can't oxygenate; eFONA, emergency front of neck airway; PE, pulmonary embolism.

	All cases (*n* = 20996)		GA (*n* = 16604)		Sedation (*n* = 2255)		Awake (*n* = 1429)	
	Events	Rates	Events	Rates	Events	Rates	Events	Rates
Airway								
Laryngospasm	157	74.8 (64.0 - 87.4)	154	92.7 (79.3 - 108.5)	3	13.3 (4.5 - 39.0)	0	0.0 (0.0 - 26.8)
Failed mask ventilation, supraglottic airway placement or intubation	125	59.5 (50.0 - 70.9)	117	70.5 (58.8 - 84.4)	8	35.5 (18.0 - 69.9)	0	0.0 (0.0 - 26.8)
Other	93	44.3 (36.2 - 54.2)	85	51.2 (41.4 - 63.3)	6	26.6 (12.2 - 57.9)	2	14.0 (3.8 - 50.9)
Aspiration or regurgitation	27	12.9 (8.8 - 18.7)	25	15.1 (10.2 - 22.2)	2	8.9 (2.4 - 32.3)	0	0.0 (0.0 - 26.8)
Airway haemorrhage	11	5.2 (2.9 - 9.4)	11	6.6 (3.7 - 11.9)	0	0.0 (0.0 - 17.0)	0	0.0 (0.0 - 26.8)
CICO or eFONA situation	3	1.4 (0.5 - 4.2)	3	1.8 (0.6 - 5.3)	0	0.0 (0.0 - 17.0)	0	0.0 (0.0 - 26.8)
Unrecognised oesophageal intubation	2	1.0 (0.3 - 3.5)	2	1.2 (0.3 - 4.4)	0	0.0 (0.0 - 17.0)	0	0.0 (0.0 - 26.8)
Wrong gas supplied / unintentional connection to air	0	0.0 (0.0 - 1.8)	0	0.0 (0.0 - 2.3)	0	0.0 (0.0 - 17.0)	0	0.0 (0.0 - 26.8)
Breathing								
Severe ventilation difficulties (eg bronchospasm / high airway pressure)	97	46.2 (37.9 - 56.3)	94	56.6 (46.3 - 69.2)	3	13.3 (4.5 - 39.0)	0	0.0 (0.0 - 26.8)
Severe hypoxaemia	62	29.5 (23.0 - 37.8)	54	32.5 (24.9 - 42.4)	5	22.2 (9.5 - 51.8)	3	21.0 (7.1 - 61.5)
Hypercapnia or hypocapnia	61	29.1 (22.6 - 37.3)	56	33.7 (26.0 - 43.8)	3	13.3 (4.5 - 39.0)	2	14.0 (3.8 - 50.9)
Ventilator disconnection	19	9.0 (5.8 - 14.1)	18	10.8 (6.9 - 17.1)	1	4.4 (0.8 - 25.1)	0	0.0 (0.0 - 26.8)
Endobronchial intubation	16	7.6 (4.7 - 12.4)	15	9.0 (5.5 - 14.9)	0	0.0 (0.0 - 17.0)	1	7.0 (1.2 - 39.5)
Pneumothorax (simple or tension)	4	1.9 (0.7 - 4.9)	2	1.2 (0.3 - 4.4)	2	8.9 (2.4 - 32.3)	0	0.0 (0.0 - 26.8)
Circulatory								
Severe hypotension (central vasopressors considered / started)	245	116.7 (103.0 - 132.1)	228	137.3 (120.7 - 156.2)	7	31.0 (15.0 - 63.9)	10	70.0 (38.1 - 128.3)
Severe brady- or tachyarrhythmia causing compromise	118	56.2 (47.0 - 67.3)	99	59.6 (49.0 - 72.5)	10	44.3 (24.1 - 81.4)	9	63.0 (33.2 - 119.3)
Major haemorrhage	110	52.4 (43.5 - 63.1)	102	61.4 (50.6 - 74.5)	7	31.0 (15.0 - 63.9)	1	7.0 (1.2 - 39.5)
Septic shock	41	19.5 (14.4 - 26.5)	40	24.1 (17.7 - 32.8)	0	0.0 (0.0 - 17.0)	1	7.0 (1.2 - 39.5)
Cardiac arrest	30	14.3 (10.0 - 20.4)	20	12.0 (7.8 - 18.6)	6	26.6 (12.2 - 57.9)	4	28.0 (10.9 - 71.8)
New AF	27	12.9 (8.8 - 18.7)	22	13.2 (8.8 - 20.1)	2	8.9 (2.4 - 32.3)	3	21.0 (7.1 - 61.5)
Cardiac ischaemia	16	7.6 (4.7 - 12.4)	13	7.8 (4.6 - 13.4)	3	13.3 (4.5 - 39.0)	0	0.0 (0.0 - 26.8)
Emergency DC cardioversion	10	4.8 (2.6 - 8.8)	8	4.8 (2.4 - 9.5)	1	4.4 (0.8 - 25.1)	1	7.0 (1.2 - 39.5)
Anaphylaxis	9	4.3 (2.3 - 8.1)	8	4.8 (2.4 - 9.5)	0	0.0 (0.0 - 17.0)	1	7.0 (1.2 - 39.5)
Cardiac tamponade	5	2.4 (1.0 - 5.6)	3	1.8 (0.6 - 5.3)	1	4.4 (0.8 - 25.1)	1	7.0 (1.2 - 39.5)
Embolic event (PE / fat / bone cement / amniotic fluid / air / CO_2)	4	1.9 (0.7 - 4.9)	2	1.2 (0.3 - 4.4)	2	8.9 (2.4 - 32.3)	0	0.0 (0.0 - 26.8)
Suspected Addisonian crisis	1	0.5 (0.1 - 2.7)	1	0.6 (0.1 - 3.4)	0	0.0 (0.0 - 17.0)	0	0.0 (0.0 - 26.8)
Incompatible blood transfusion	0	0.0 (0.0 - 1.8)	0	0.0 (0.0 - 2.3)	0	0.0 (0.0 - 17.0)	0	0.0 (0.0 - 26.8)
Neurological								
Stroke, intracranial haemorrhage and/or subarachnoid haemorrhage)	16	7.6 (4.7 - 12.4)	11	6.6 (3.7 - 11.9)	2	8.9 (2.4 - 32.3)	3	21.0 (7.1 - 61.5)
Intracranial hypertension (eg new fixed/dilated pupil or coning)	9	4.3 (2.3 - 8.1)	8	4.8 (2.4 - 9.5)	1	4.4 (0.8 - 25.1)	0	0.0 (0.0 - 26.8)
Seizure	7	3.3 (1.6 - 6.9)	7	4.2 (2.0 - 8.7)	0	0.0 (0.0 - 17.0)	0	0.0 (0.0 - 26.8)
Vagal outflow (eg pneumoperitoneum, oculo-cardiac reflex)	5	2.4 (1.0 - 5.6)	4	2.4 (0.9 - 6.2)	0	0.0 (0.0 - 17.0)	1	7.0 (1.2 - 39.5)
Death	4	1.9 (0.7 - 4.9)	2	1.2 (0.3 - 4.4)	2	8.9 (2.4 - 32.3)	0	0.0 (0.0 - 26.8)
High neuraxial block	0	0.0 (0.0 - 1.8)	0	0.0 (0.0 - 2.3)	0	0.0 (0.0 - 17.0)	0	0.0 (0.0 - 26.8)
Neurogenic shock	0	0.0 (0.0 - 1.8)	0	0.0 (0.0 - 2.3)	0	0.0 (0.0 - 17.0)	0	0.0 (0.0 - 26.8)
Metabolic								
New significant acidosis / acidaemia	126	60.0 (50.4 - 71.4)	119	71.7 (59.9 - 85.7)	3	13.3 (4.5 - 39.0)	4	28.0 (10.9 - 71.8)
Significant electrolyte disturbance (Ca^{2+}, Na^{+}, K^{+} or Mg^{2+})	97	46.2 (37.9 - 56.3)	92	55.4 (45.2 - 67.9)	2	8.9 (2.4 - 32.3)	3	21.0 (7.1 - 61.5)
Hyperthermia or hypothermia	41	19.5 (14.4 - 26.5)	39	23.5 (17.2 - 32.1)	2	8.9 (2.4 - 32.3)	0	0.0 (0.0 - 26.8)
Other								
Emergency call for anaesthesia assistance	43	20.5 (15.2 - 27.6)	34	20.5 (14.7 - 28.6)	5	22.2 (9.5 - 51.8)	4	28.0 (10.9 - 71.8)
Intraoperative conversion of anaesthesia (eg LA/RA/sedation to GA)	33	15.7 (11.2 - 22.1)	21	12.6 (8.3 - 19.3)	7	31.0 (15.0 - 63.9)	5	35.0 (15.0 - 81.6)
Equipment failure	22	10.5 (6.9 - 15.9)	21	12.6 (8.3 - 19.3)	1	4.4 (0.8 - 25.1)	0	0.0 (0.0 - 26.8)
Drug error	9	4.3 (2.3 - 8.1)	7	4.2 (2.0 - 8.7)	2	8.9 (2.4 - 32.3)	0	0.0 (0.0 - 26.8)
Local anaesthetic toxicity	0	0.0 (0.0 - 1.8)	0	0.0 (0.0 - 2.3)	0	0.0 (0.0 - 17.0)	0	0.0 (0.0 - 26.8)
Malignant hyperthermia	0	0.0 (0.0 - 1.8)	0	0.0 (0.0 - 2.3)	0	0.0 (0.0 - 17.0)	0	0.0 (0.0 - 26.8)
Total complications	1705		1547		99		59	

Table 12.5 Rates of complications in elective non-obstetric patients in the NAP7 Activity Survey (elective day surgery and planned admission). Data are the raw number and rate per 10,000 cases (95% CI, Wilson's method) of complications in all cases, general anaesthesia (GA), sedation and awake cases. Complications are ranked within 'airway', 'breathing' etc, by absolute number of cases. Colour coding shows frequency as per Table 12.1. ■ Common; ■ Uncommon; ■ Rare; ■ Very rare; ■ Extremely rare (see Table 12.1). AF, atrial fibrillation; CICO, can't intubate can't oxygenate; eFONA, emergency front of neck airway; PE, pulmonary embolism.

	All cases (*n* = 14136)		GA (*n* = 11194)		Sedation (*n* = 1679)		Awake (*n* = 1051)	
	Events	Rates	Events	Rates	Events	Rates	Events	Rates
Airway								
Laryngospasm	107	75.7 (62.7 - 91.4)	104	92.9 (76.7 - 112.4)	3	17.9 (6.1 - 52.4)	0	0.0 (0.0 - 36.4)
Failed mask ventilation, supraglottic airway placement or intubation	70	49.5 (39.2 - 62.5)	65	58.1 (45.6 - 73.9)	5	29.8 (12.7 - 69.5)	0	0.0 (0.0 - 36.4)
Other	53	37.5 (28.7 - 49.0)	48	42.9 (32.4 - 56.8)	4	23.8 (9.3 - 61.1)	1	9.5 (1.7 - 53.7)
Aspiration or regurgitation	15	10.6 (6.4 - 17.5)	13	11.6 (6.8 - 19.9)	2	11.9 (3.3 - 43.3)	0	0.0 (0.0 - 36.4)
Airway haemorrhage	4	2.8 (1.1 - 7.3)	4	3.6 (1.4 - 9.2)	0	0.0 (0.0 - 22.8)	0	0.0 (0.0 - 36.4)
CICO or eFONA situation	1	0.7 (0.1 - 4.0)	1	0.9 (0.2 - 5.1)	0	0.0 (0.0 - 22.8)	0	0.0 (0.0 - 36.4)
Unrecognised oesophageal intubation	1	0.7 (0.1 - 4.0)	1	0.9 (0.2 - 5.1)	0	0.0 (0.0 - 22.8)	0	0.0 (0.0 - 36.4)
Wrong gas supplied / unintentional connection to air	0	0.0 (0.0 - 2.7)	0	0.0 (0.0 - 3.4)	0	0.0 (0.0 - 22.8)	0	0.0 (0.0 - 36.4)
Breathing								
Severe ventilation difficulties (eg bronchospasm / high airway pressure)	48	34.0 (25.6 - 45.0)	46	41.1 (30.8 - 54.8)	2	11.9 (3.3 - 43.3)	0	0.0 (0.0 - 36.4)
Severe hypoxaemia	32	22.6 (16.0 - 31.9)	30	26.8 (18.8 - 38.2)	2	11.9 (3.3 - 43.3)	0	0.0 (0.0 - 36.4)
Hypercapnia or hypocapnia	22	15.6 (10.3 - 23.6)	20	17.9 (11.6 - 27.6)	2	11.9 (3.3 - 43.3)	0	0.0 (0.0 - 36.4)
Endobronchial intubation	11	7.8 (4.3 - 13.9)	10	8.9 (4.9 - 16.4)	0	0.0 (0.0 - 22.8)	1	9.5 (1.7 - 53.7)
Ventilator disconnection	8	5.7 (2.9 - 11.2)	8	7.1 (3.6 - 14.1)	0	0.0 (0.0 - 22.8)	0	0.0 (0.0 - 36.4)
Pneumothorax (simple or tension)	2	1.4 (0.4 - 5.2)	1	0.9 (0.2 - 5.1)	1	6.0 (1.1 - 33.7)	0	0.0 (0.0 - 36.4)
Circulatory								
Severe hypotension (central vasopressors considered / started)	74	52.3 (41.7 - 65.7)	72	64.3 (51.1 - 80.9)	1	6.0 (1.1 - 33.7)	1	9.5 (1.7 - 53.7)
Severe brady- or tachyarrhythmia causing compromise	63	44.6 (34.9 - 57.0)	54	48.2 (37.0 - 62.9)	6	35.7 (16.4 - 77.7)	3	28.5 (9.7 - 83.6)
Major haemorrhage	31	21.9 (15.5 - 31.1)	29	25.9 (18.0 - 37.2)	2	11.9 (3.3 - 43.3)	0	0.0 (0.0 - 36.4)
Cardiac arrest	12	8.5 (4.9 - 14.8)	10	8.9 (4.9 - 16.4)	1	6.0 (1.1 - 33.7)	1	9.5 (1.7 - 53.7)
New AF	12	8.5 (4.9 - 14.8)	10	8.9 (4.9 - 16.4)	2	11.9 (3.3 - 43.3)	0	0.0 (0.0 - 36.4)
Emergency DC cardioversion	6	4.2 (1.9 - 9.3)	4	3.6 (1.4 - 9.2)	1	6.0 (1.1 - 33.7)	1	9.5 (1.7 - 53.7)
Anaphylaxis	6	4.2 (1.9 - 9.3)	6	5.4 (2.5 - 11.7)	0	0.0 (0.0 - 22.8)	0	0.0 (0.0 - 36.4)
Cardiac ischaemia	5	3.5 (1.5 - 8.3)	4	3.6 (1.4 - 9.2)	1	6.0 (1.1 - 33.7)	0	0.0 (0.0 - 36.4)
Septic shock	2	1.4 (0.4 - 5.2)	2	1.8 (0.5 - 6.5)	0	0.0 (0.0 - 22.8)	0	0.0 (0.0 - 36.4)
Embolic event (PE / fat / bone cement / amniotic fluid / air / CO_2)	1	0.7 (0.1 - 4.0)	1	0.9 (0.2 - 5.1)	0	0.0 (0.0 - 22.8)	0	0.0 (0.0 - 36.4)
Cardiac tamponade	0	0.0 (0.0 - 2.7)	0	0.0 (0.0 - 3.4)	0	0.0 (0.0 - 22.8)	0	0.0 (0.0 - 36.4)
Suspected Addisonian crisis	0	0.0 (0.0 - 2.7)	0	0.0 (0.0 - 3.4)	0	0.0 (0.0 - 22.8)	0	0.0 (0.0 - 36.4)
Incompatible blood transfusion	0	0.0 (0.0 - 2.7)	0	0.0 (0.0 - 3.4)	0	0.0 (0.0 - 22.8)	0	0.0 (0.0 - 36.4)
Neurological								
Seizure	4	2.8 (1.1 - 7.3)	4	3.6 (1.4 - 9.2)	0	0.0 (0.0 - 22.8)	0	0.0 (0.0 - 36.4)
Vagal outflow (eg pneumoperitoneum, oculo-cardiac reflex)	2	1.4 (0.4 - 5.2)	1	0.9 (0.2 - 5.1)	0	0.0 (0.0 - 22.8)	1	9.5 (1.7 - 53.7)
Intracranial hypertension (eg new fixed/dilated pupil or coning)	2	1.4 (0.4 - 5.2)	1	0.9 (0.2 - 5.1)	1	6.0 (1.1 - 33.7)	0	0.0 (0.0 - 36.4)
Stroke, intracranial haemorrhage and/or subarachnoid haemorrhage)	1	0.7 (0.1 - 4.0)	0	0.0 (0.0 - 3.4)	1	6.0 (1.1 - 33.7)	0	0.0 (0.0 - 36.4)
High neuraxial block	0	0.0 (0.0 - 2.7)	0	0.0 (0.0 - 3.4)	0	0.0 (0.0 - 22.8)	0	0.0 (0.0 - 36.4)
Neurogenic shock	0	0.0 (0.0 - 2.7)	0	0.0 (0.0 - 3.4)	0	0.0 (0.0 - 22.8)	0	0.0 (0.0 - 36.4)
Death	0	0.0 (0.0 - 2.7)	0	0.0 (0.0 - 3.4)	0	0.0 (0.0 - 22.8)	0	0.0 (0.0 - 36.4)
Metabolic								
New significant acidosis / acidaemia	31	21.9 (15.5 - 31.1)	30	26.8 (18.8 - 38.2)	0	0.0 (0.0 - 22.8)	1	9.5 (1.7 - 53.7)
Hyperthermia or hypothermia	15	10.6 (6.4 - 17.5)	14	12.5 (7.5 - 21.0)	1	6.0 (1.1 - 33.7)	0	0.0 (0.0 - 36.4)
Significant electrolyte disturbance (Ca^{2+}, Na^{+}, K^{+} or Mg^{2+})	10	7.1 (3.8 - 13.0)	9	8.0 (4.2 - 15.3)	1	6.0 (1.1 - 33.7)	0	0.0 (0.0 - 36.4)
Other								
Intraoperative conversion of anaesthesia (eg LA/RA/sedation to GA)	23	16.3 (10.8 - 24.4)	14	12.5 (7.5 - 21.0)	5	29.8 (12.7 - 69.5)	4	38.1 (14.8 - 97.4)
Emergency call for anaesthesia assistance	18	12.7 (8.1 - 20.1)	14	12.5 (7.5 - 21.0)	3	17.9 (6.1 - 52.4)	1	9.5 (1.7 - 53.7)
Equipment failure	10	7.1 (3.8 - 13.0)	9	8.0 (4.2 - 15.3)	1	6.0 (1.1 - 33.7)	0	0.0 (0.0 - 36.4)
Drug error	3	2.1 (0.7 - 6.2)	3	2.7 (0.9 - 7.9)	0	0.0 (0.0 - 22.8)	0	0.0 (0.0 - 36.4)
Local anaesthetic toxicity	0	0.0 (0.0 - 2.7)	0	0.0 (0.0 - 3.4)	0	0.0 (0.0 - 22.8)	0	0.0 (0.0 - 36.4)
Malignant hyperthermia	0	0.0 (0.0 - 2.7)	0	0.0 (0.0 - 3.4)	0	0.0 (0.0 - 22.8)	0	0.0 (0.0 - 36.4)
Total complications	705		642		48		15	

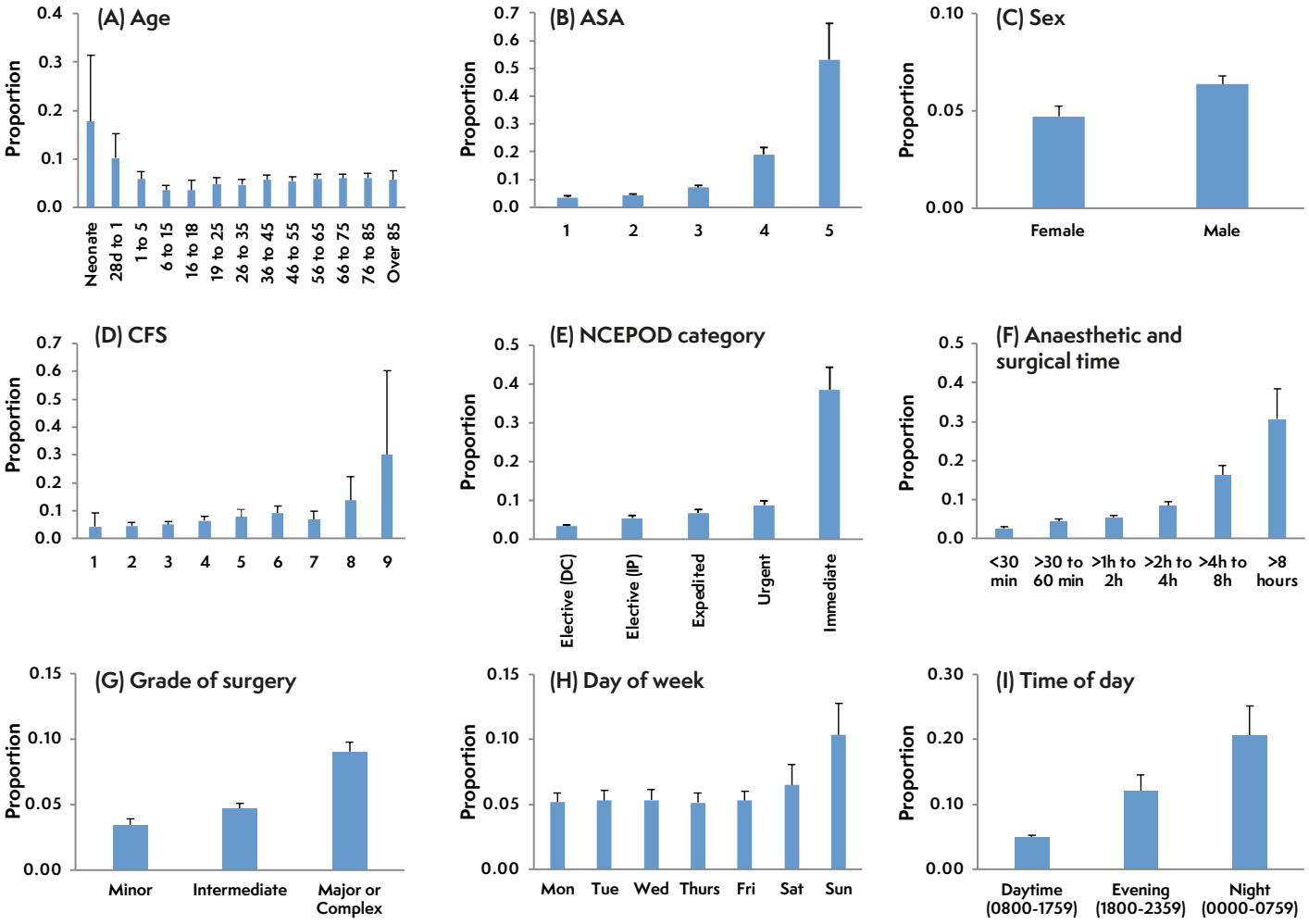
Table 12.6 Rates of complications in patients undergoing emergency (urgent and immediate) non-obstetric surgery in the NAP7 Activity Survey. Data are the raw number and rate per 10,000 cases (95% CI, Wilson's method) of complications in all cases, general anaesthesia (GA), sedation and awake cases. Complications are ranked within 'airway', 'breathing' etc, by absolute number of cases. Colour coding shows frequency as per Table 12.1. ■ Common; ■ Uncommon; ■ Rare; ■ Very rare; ■ Extremely rare (see Table 12.1). AF, atrial fibrillation; CICO, can't intubate can't oxygenate; eFONA, emergency front of neck airway; PE, pulmonary embolism.

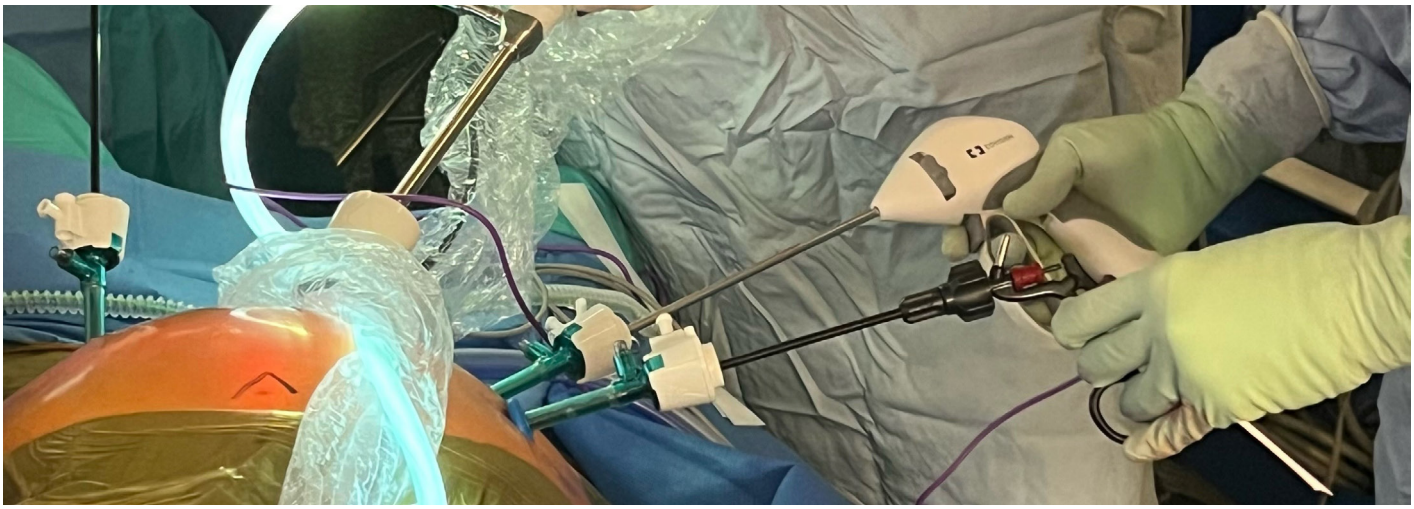
	All cases (*n* = 3454)		GA (*n* = 2906)		Sedation (*n* = 298)		Awake (*n* = 186)	
	Events	Rates	Events	Rates	Events	Rates	Events	Rates
Airway								
Other	23	66.6 (44.4 - 99.7)	21	72.3 (47.3 - 110.2)	2	67.1 (18.4 - 241.4)	0	0.0 (0.0 - 202.4)
Failed mask ventilation, supraglottic airway placement or intubation	22	63.7 (42.1 - 96.3)	19	65.4 (41.9 - 101.9)	3	100.7 (34.3 - 291.8)	0	0.0 (0.0 - 202.4)
Laryngospasm	20	57.9 (37.5 - 89.3)	20	68.8 (44.6 - 106.1)	0	0.0 (0.0 - 127.3)	0	0.0 (0.0 - 202.4)
Airway haemorrhage	6	17.4 (8.0 - 37.8)	6	20.6 (9.5 - 45.0)	0	0.0 (0.0 - 127.3)	0	0.0 (0.0 - 202.4)
Aspiration or regurgitation	5	14.5 (6.2 - 33.8)	5	17.2 (7.4 - 40.2)	0	0.0 (0.0 - 127.3)	0	0.0 (0.0 - 202.4)
CICO or eFONA situation	2	5.8 (1.6 - 21.1)	2	6.9 (1.9 - 25.1)	0	0.0 (0.0 - 127.3)	0	0.0 (0.0 - 202.4)
Unrecognised oesophageal intubation	1	2.9 (0.5 - 16.4)	1	3.4 (0.6 - 19.5)	0	0.0 (0.0 - 127.3)	0	0.0 (0.0 - 202.4)
Wrong gas supplied / unintentional connection to air	0	0.0 (0.0 - 11.1)	0	0.0 (0.0 - 13.2)	0	0.0 (0.0 - 127.3)	0	0.0 (0.0 - 202.4)
Breathing								
Severe ventilation difficulties (eg bronchospasm / high airway pressure)	30	86.9 (60.9 - 123.7)	29	99.8 (69.6 - 143.0)	1	33.6 (5.9 - 187.6)	0	0.0 (0.0 - 202.4)
Severe hypoxaemia	19	55.0 (35.2 - 85.8)	15	51.6 (31.3 - 85.0)	2	67.1 (18.4 - 241.4)	2	107.5 (29.5 - 383.5)
Hypercapnia or hypocapnia	17	49.2 (30.8 - 78.7)	16	55.1 (33.9 - 89.3)	0	0.0 (0.0 - 127.3)	1	53.8 (9.5 - 298.2)
Ventilator disconnection	5	14.5 (6.2 - 33.8)	5	17.2 (7.4 - 40.2)	0	0.0 (0.0 - 127.3)	0	0.0 (0.0 - 202.4)
Endobronchial intubation	3	8.7 (3.0 - 25.5)	3	10.3 (3.5 - 30.3)	0	0.0 (0.0 - 127.3)	0	0.0 (0.0 - 202.4)
Pneumothorax (simple or tension)	2	5.8 (1.6 - 21.1)	1	3.4 (0.6 - 19.5)	1	33.6 (5.9 - 187.6)	0	0.0 (0.0 - 202.4)
Circulatory								
Severe hypotension (central vasopressors considered / started)	141	408.2 (347.2 - 479.5)	128	440.5 (371.7 - 521.3)	5	167.8 (71.9 - 386.7)	8	430.1 (219.5 - 825.6)
Major haemorrhage	62	179.5 (140.3 - 229.4)	58	199.6 (154.7 - 257.1)	3	100.7 (34.3 - 291.8)	1	53.8 (9.5 - 298.2)
Severe brady- or tachyarrhythmia causing compromise	38	110.0 (80.3 - 150.6)	31	106.7 (75.3 - 151.0)	4	134.2 (52.3 - 340.0)	3	161.3 (55.0 - 463.4)
Septic shock	38	110.0 (80.3 - 150.6)	37	127.3 (92.5 - 175.0)	0	0.0 (0.0 - 127.3)	1	53.8 (9.5 - 298.2)
Cardiac arrest	15	43.4 (26.3 - 71.5)	9	31.0 (16.3 - 58.8)	4	134.2 (52.3 - 340.0)	2	107.5 (29.5 - 383.5)
New AF	13	37.6 (22.0 - 64.3)	11	37.9 (21.1 - 67.7)	0	0.0 (0.0 - 127.3)	2	107.5 (29.5 - 383.5)
Cardiac ischaemia	9	26.1 (13.7 - 49.5)	7	24.1 (11.7 - 49.6)	2	67.1 (18.4 - 241.4)	0	0.0 (0.0 - 202.4)
Cardiac tamponade	5	14.5 (6.2 - 33.8)	3	10.3 (3.5 - 30.3)	1	33.6 (5.9 - 187.6)	1	53.8 (9.5 - 298.2)
Emergency DC cardioversion	3	8.7 (3.0 - 25.5)	3	10.3 (3.5 - 30.3)	0	0.0 (0.0 - 127.3)	0	0.0 (0.0 - 202.4)
Anaphylaxis	1	2.9 (0.5 - 16.4)	1	3.4 (0.6 - 19.5)	0	0.0 (0.0 - 127.3)	0	0.0 (0.0 - 202.4)
Embolic event (PE / fat / bone cement / amniotic fluid / air / CO_2)	1	2.9 (0.5 - 16.4)	0	0.0 (0.0 - 13.2)	1	33.6 (5.9 - 187.6)	0	0.0 (0.0 - 202.4)
Suspected Addisonian crisis	0	0.0 (0.0 - 11.1)	0	0.0 (0.0 - 13.2)	0	0.0 (0.0 - 127.3)	0	0.0 (0.0 - 202.4)
Incompatible blood transfusion	0	0.0 (0.0 - 11.1)	0	0.0 (0.0 - 13.2)	0	0.0 (0.0 - 127.3)	0	0.0 (0.0 - 202.4)
Neurological								
Stroke, intracranial haemorrhage and/or subarachnoid haemorrhage)	11	31.8 (17.8 - 56.9)	8	27.5 (14.0 - 54.2)	1	33.6 (5.9 - 187.6)	2	107.5 (29.5 - 383.5)
Intracranial hypertension (eg new fixed/dilated pupil or coning)	6	17.4 (8.0 - 37.8)	6	20.6 (9.5 - 45.0)	0	0.0 (0.0 - 127.3)	0	0.0 (0.0 - 202.4)
Death	4	11.6 (4.5 - 29.7)	2	6.9 (1.9 - 25.1)	2	67.1 (18.4 - 241.4)	0	0.0 (0.0 - 202.4)
Seizure	2	5.8 (1.6 - 21.1)	2	6.9 (1.9 - 25.1)	0	0.0 (0.0 - 127.3)	0	0.0 (0.0 - 202.4)
Vagal outflow (eg pneumoperitoneum, oculo-cardiac reflex)	2	5.8 (1.6 - 21.1)	2	6.9 (1.9 - 25.1)	0	0.0 (0.0 - 127.3)	0	0.0 (0.0 - 202.4)
High neuraxial block	0	0.0 (0.0 - 11.1)	0	0.0 (0.0 - 13.2)	0	0.0 (0.0 - 127.3)	0	0.0 (0.0 - 202.4)
Neurogenic shock	0	0.0 (0.0 - 11.1)	0	0.0 (0.0 - 13.2)	0	0.0 (0.0 - 127.3)	0	0.0 (0.0 - 202.4)
Metabolic								
New significant acidosis / acidaemia	80	231.6 (186.5 - 287.3)	75	258.1 (206.4 - 322.3)	3	100.7 (34.3 - 291.8)	2	107.5 (29.5 - 383.5)
Significant electrolyte disturbance ($Ca2^+$, Na^+, K^+ or Mg^{2+})	77	222.9 (178.7 - 277.7)	73	251.2 (200.3 - 314.7)	1	33.6 (5.9 - 187.6)	3	161.3 (55.0 - 463.4)
Other								
Hyperthermia or hypothermia	20	57.9 (37.5 - 89.3)	19	65.4 (41.9 - 101.9)	1	33.6 (5.9 - 187.6)	0	0.0 (0.0 - 202.4)
Emergency call for anaesthesia assistance	19	55.0 (35.2 - 85.8)	16	55.1 (33.9 - 89.3)	2	67.1 (18.4 - 241.4)	1	53.8 (9.5 - 298.2)
Intraoperative conversion of anaesthesia (eg LA/RA/sedation to GA)	5	14.5 (6.2 - 33.8)	2	6.9 (1.9 - 25.1)	3	67.1 (18.4 - 241.4)	1	53.8 (9.5 - 298.2)
Equipment failure	4	11.6 (4.5 - 29.7)	4	13.8 (5.4 - 35.3)	0	0.0 (0.0 - 127.3)	0	0.0 (0.0 - 202.4)
Drug error	3	8.7 (3.0 - 25.5)	2	6.9 (1.9 - 25.1)	1	33.6 (5.9 - 187.6)	0	0.0 (0.0 - 202.4)
Local anaesthetic toxicity	0	0.0 (0.0 - 11.1)	0	0.0 (0.0 - 13.2)	0	0.0 (0.0 - 127.3)	0	0.0 (0.0 - 202.4)
Malignant hyperthermia	0	0.0 (0.0 - 11.1)	0	0.0 (0.0 - 13.2)	0	0.0 (0.0 - 127.3)	0	0.0 (0.0 - 202.4)
Total complications	714		642		42		30	

Demographics of cases with complications

Complications were more likely to occur in cases done at weekends, at night, during urgent or longer complex cases, in neonates, in patients with higher ASA scores, or in patients living with frailty (Figure 12.5).

Figure 12.5 Univariate analysis showing the effect of various factors on the chance of perioperative complication. Data show the proportion of cases reporting complications by: (A) age; (B) ASA; (C) sex; (D) clinical frailty scale; (E) NCEPOD category; (DC, day case; IP, planned inpatient stay); (F) combined anaesthetic and surgical time; (G) surgical complexity; (H) day of the week; (I) time of day. All variables $P < 0.001$, Chi-squared test. Error bars represent 95% confidence interval.





Perioperative cardiac arrest and death in the Activity Survey

In the cohort of non-obstetric patients, 30 cases included 'cardiac arrest' as a complication (14 per 10,000), of which 5 would not have reached the threshold for inclusion as a NAP7 case (5 or more chest compressions and/or defibrillation), bringing the overall rate for NAP7-type cases to 12 per 10,000 (Table 12.7). Of these 30 patients, 7 (23%) reported either 'no return of spontaneous circulation' (ROSC) or 'initial ROSC but not surviving to the postoperative area'. For elective patients, the rate of cardiac arrest was 8.4 per 10,000 cases, but this reduced to 7.7 per 10,000 when a case reporting less than 5 chest compressions was excluded. There were no deaths reported in elective patients in the Activity Survey.

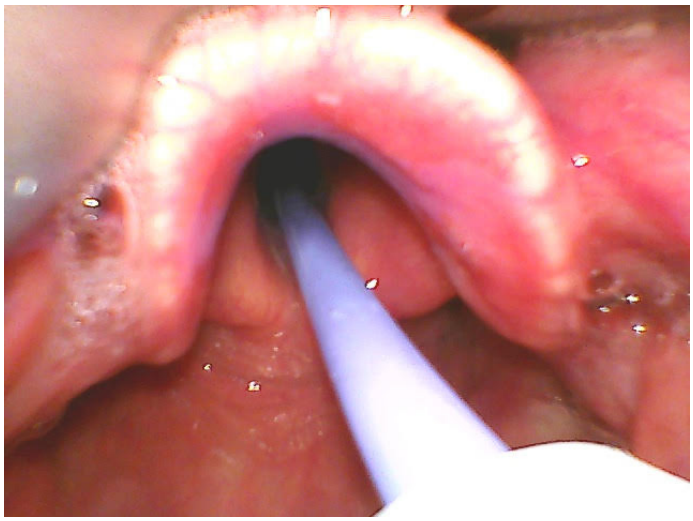


Table 12.7 Activity Survey cases in which 'cardiac arrest' was reported as a complication. Data show the frequency of events in non-obstetric patients by combinations of chest compressions and defibrillation. Only combinations reporting at least one event are shown. Events highlighted in light blue would not have been included to the NAP7 case registry.

Chest compressions	Defibrillation	Outcome	All	Elective	Emergency
No	No	No ROSC	1		1
No	Yes	ROSC with survival to postoperative area	1	1	
Yes < 5	No	No ROSC	1		1
Yes < 5	No	ROSC with survival to postoperative area	1	1	
Yes ≥5	No	No ROSC	3		3
Yes ≥5	No	ROSC with survival to postoperative area	15	7	7
Yes ≥5	Yes	Initial ROSC but did not survive to postoperative area	1		
Yes ≥5	Yes	ROSC with survival to postoperative area	4	3	1
Yes ≥5	Yes	No ROSC	1		1
Unknown	Unknown		2		1
		Total cases:	**30**	**12**	**15**
		Denominator	**20,996**	**14,316**	**3,454**
		Rate per 10 000 cases	**14.3**	**8.4**	**43.4**

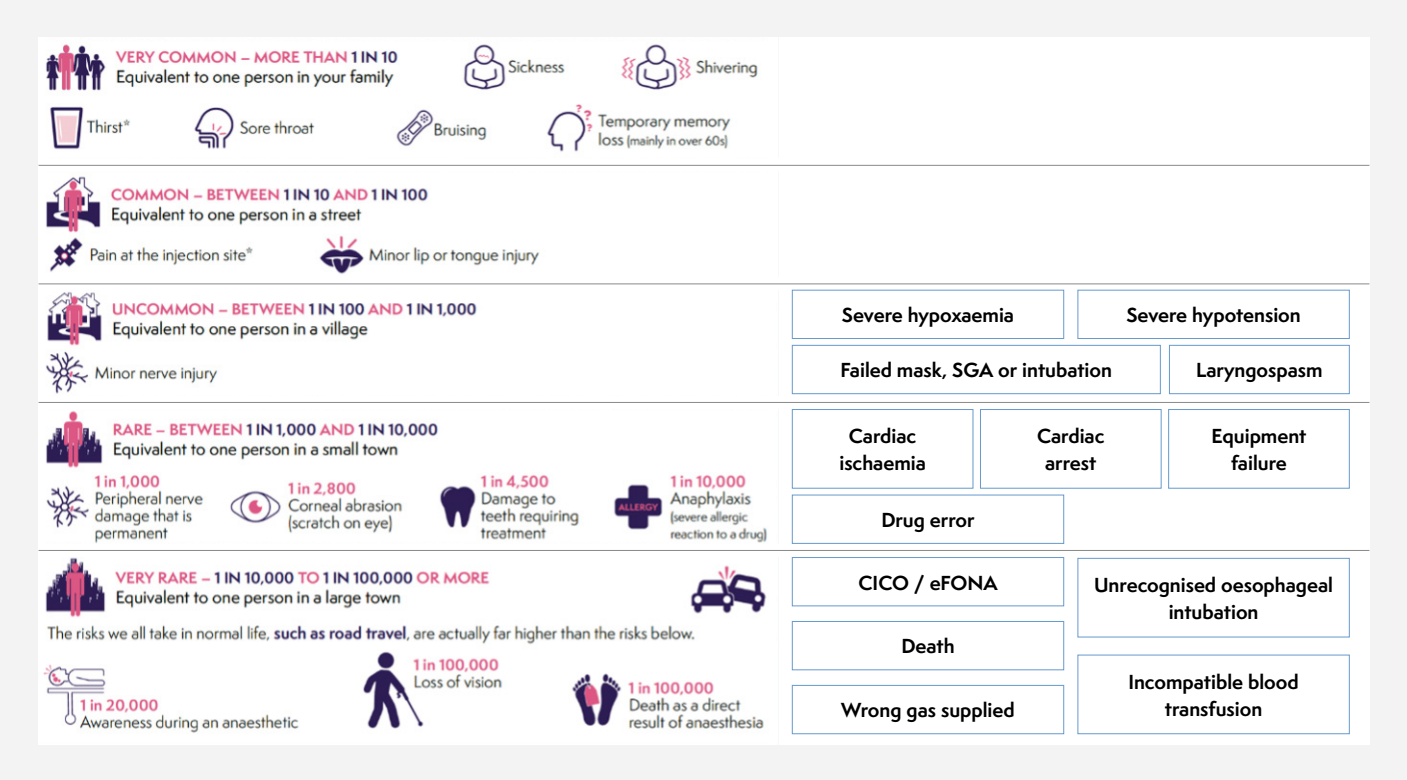
Discussion

While many studies have evaluated postoperative complications associated with anaesthesia and surgery, there are limited data about complications that occur during the procedure. Here, we show in non-obstetric patients that potentially serious complications occurred in 1 in 18 (6%) cases.

The distribution of types of complications merits discussion. A key finding is that circulatory complications are notably more frequent than others. In particular, severe hypotension and arrhythmias associated with compromise were notable for their frequency. Among airway problems, laryngospasm and airway failure were the most common, with almost all other complications rare. The most frequent breathing complications were problems with lung ventilation and severe hypoxaemia. Metabolic complications, most notably new acidaemia, were also relatively prominent. All these events were notably less common in elective cases and notably more common in emergency cases (the difference in rate being up to 10-fold). In emergency cases, profound hypotension, bradycardia, major haemorrhage and septic shock were the four most frequent complications and were all common. Complications were notably more frequent during general anaesthesia than in sedated or awake patients. However, it is likely at least some of this is a matter of case mix and, in emergency patients, complications became frequent across these domains. The relatively high rate of circulatory complications, including severe hypotension, bradycardia and haemorrhage (Chapter 13 Reported cases summary) has marked parallels with the case registry phase of NAP7 in which cardiac arrest due to haemorrhage, isolated hypotension and bradycardia were very prominent. The findings are important for communication with patients and for the awareness of anaesthetists but also offer potential targets for risk mitigation and prevention.

During consent for anaesthesia, the 'risks associated with anaesthesia should be discussed', according to the current *Guidelines for the Provision of Anaesthesia Services* (Royal College of Anaesthetists 2023). The College provides valuable patient information leaflets for common events and risks to aid this consent process. Thankfully, many anaesthetics occur without serious incidents (Chapter 18 Good care). Nonetheless, complications with a low likelihood of occurrence do occur, given the high number of cases performed annually in the UK. The current data add to our understanding and will help to refine the consent process (Figure 12.6).

Figure 12.6 Rates of events reported during the NAP7 Activity Survey in elective cases compared to current information for patients



A key strength of this study was capturing data from all anaesthetists during all cases, giving the data generalisability to the 'real world'. The survey was performed using an electronic survey link, and anaesthetists completed the survey after the end of a case. To balance the burden of the study on reporting anaesthetists' time and to improve the completion rate, we did not provide strict definitions of the criteria for each complication, leaving this to the discretion of the reporting anaesthetist. While some events are easy to recognise (eg new atrial fibrillation or 'emergency call for assistance'), others are more subjective, and there is likely to be variation in thresholds for reporting some events. That said, many of the event rates are comparable to the reported literature. For example, in their study, also conducted in November 2021, the AREOCOMP group found the aspiration rate to be 0.1% in adult patients compared with 0.13% in our survey (Table 12.4; Potter 2023). The same study also reports difficult facemask or supraglottic airway (SGA) insertion in 4.3% of cases. In our survey, the more extreme endpoint of a *failed* mask, SGA or tracheal intubation occurred in 0.7% of general anaesthesia cases and, again, this has face validity.

The reported rate of anaphylaxis was 4.3 per 10,000 cases, higher than the value in NAP6 (approximately 1 per 10,000; Harper 2018), but the lower end of our confidence interval (CI, 2.3 per 10,000) is not far from the NAP6 value. Confirming the diagnosis of anaphylaxis requires further investigation and this was not possible in the NAP7 Activity Survey reporting time window, which may have led to an overestimation as suspected cases of anaphylaxis were reported as opposed to confirmed cases. . Further, NAP6 only included life-threatening cases (ie severe hypotension, bronchospasm or airway compromise) or fatal- the NAP7 Activity Survey likely includes non-life-threatening cases. These issues were also observed during the review of the cardiac arrest cases in the registry phase of NAP7 and is discussed in Chapter 22 Anaphylaxis.

Two potential complications are on the current 'never events' list for England – unintended connection to air/wrong gas supplied and administration of an incompatible blood transfusion (NHS Improvement 2018). Reassuringly, there were no cases reported in the Activity Survey. During the year 1 April 2021 to 31 March 2022, which includes the period when the Activity Survey occurred, there were 13 cases of unintentional connection to air for a patient requiring oxygen and seven ABO incompatible blood transfusions (NHS England 2022). It is not possible to

determine whether these events occurred in perioperative settings, but anaesthetists should remain cautious about their possibility.

Unrecognised oesophageal intubation is currently suspended from the never event list (NHS Improvement 2018) but remains of considerable interest to anaesthetists owing to the potentially severe consequences and international consensus guidelines for its avoidance have recently been published (Chrimes 2022). Two cases of unrecognised oesophageal intubation were reported in the Activity Survey. Neither case was associated with cardiac arrest or death and no further details are available. These cases must have been detected before there was significant patient harm. Notably, instances of unrecognised oesophageal intubation were identified among NAP7 case reports; this remains a significant concern (Chapter 21 Airway and respiratory).

We assessed the chance of complications by various patient, surgical and anaesthetic factors. Age, ASA, sex and frailty score were statistically significant patient factors (Figure 12.5), whereas body mass index and ethnicity were not significant in this univariate analysis. Interestingly, very young age was associated with higher rates of complications, more than advancing age. While most neonates and infants tend to be healthy, those requiring anaesthesia for surgery in this age range are more likely to have comorbidities, and the distribution of ASA is shifted towards higher scores compared with older children. This increased rate of complications is associated with the observation that neonates and infants have high rates of perioperative cardiac arrest, particularly when associated with congenital heart disease (Chapter 27 Paediatrics).

Many studies have shown the association between ASA score and postoperative morbidity and mortality, but the link with intraoperative complications has been comparatively understudied. In this study, increasing ASA score was strongly associated with the risk of any complication, such that patients with a score of ASA 3 and 4 are twice and five times as likely to have an intraoperative complication, respectively. Within the 24-hour perioperative window, Tiret and colleagues (1988) assessed reported rates of 'any fatal or life-threatening accident, or any accident producing severe sequela'. They found ASA was strongly associated with these incidents: patients with ASA 3 and 4 scores were 14-fold and 88-fold more likely to have an event than those scoring ASA 1. Over the following 35 years, while the relationship is still evident, these extreme odds for ASA 3 and 4 appear to have been substantially reduced.

We found that the day of the week and time of day impacted the chance of an intraoperative complication. At their peak effect (ie a weekend night time), these effects were moderate compared with ASA, NCEPOD category and anaesthetic and surgical time. They are likely to be confounded by the relative proportion of emergency and complex cases occurring during these periods compared with daytime on a typical working day and should be viewed cautiously. In continuing work, we are performing multivariate analysis to control and adjust for these factors.

NAP7 has the opportunity to report cardiac arrest and death rates from the Activity Survey and cases reported to the registry phase of the project, using the Activity Survey as a denominator. The cardiac arrest rate (cases compliant with the NAP7 definition) from the Activity Survey is 12 per 10,000, notably higher than the 3.6 (3.4-3.9) per 10,000 in the case registry (non-obstetric cases, Chapter 13 Reported cases summary). Several factors may account for these differences. First, the Activity Survey only sampled over four days in each hospital, and there may be a random sampling effect. Second, the small number of events occurring in the Activity Survey leads to a relatively wide CI, and this effect is increased if subspecialty areas are examined. Third, it is possible some reports of cardiac arrest in the Activity Survey may have been due to 'mis-clicks' or spurious case entries. We reviewed the data to exclude obviously illogical cases, but this does not preclude the above, and identifying such cases among actual cases is not easy. A relatively small number of such cases in the Activity Survey would significantly alter incidences in the Activity Survey. Fourth, not all cases of cardiac arrest may have been reported to NAP7. Fifth, not all cases of cardiac arrest will have met the NAP7 inclusion criteria; for example, less than five chest compressions were performed, or patients with DNACPR recommendation who had a cardiac arrest but no chest compressions were performed. Indeed, five cases reporting 'cardiac arrest' to the Activity Survey would not have met the criteria to be included in the case registry (<5 chest compressions and no defibrillation, Table 12.7), bringing these rates closer together.

Reported death rates were more consistent between the Activity Survey and case registry phases of NAP7, with overlapping CIs. In non-obstetric patients, deaths occurred at a rate of 1.9 (95% CI 0.7–4.9) per 10,000 in the Activity Survey and 0.9 (95% CI 0.8–1.0) per 10,000 in the case registry; in both cases, this is 'rare'. Deaths in elective cases occurred 0 (95% CI 0.0–2.7) per 10,000 in the Activity Survey and 0.1 (95% CI 0.06–0.2) per 10,000 in the case registry. The evidence supports that, for the most part, elective surgery is safe, deaths are of the 'very rare' or 'extremely rare' order of magnitude. The same limitations to the incidence estimates in the Activity Survey described for cardiac arrest apply here too.

Within the full Activity Survey dataset, we observed a high rate of major haemorrhage in awake patients. Of the 106 major haemorrhages reported in awake patients, 105 were in obstetric cases. There were also eight cases of combined high neuraxial block and neurogenic shock in obstetrics, with none reported in non-obstetric cases. We therefore judged that the obstetric complication profile was not representative of the rest of the anaesthetic activity and chose to describe them separately (Chapter 34 Obstetrics).

In line with the other reported outcomes from the Activity Survey (Chapter 11 Activity Survey), the data have limitations and our findings should be interpreted carefully. We were conscious of the possibility of 'careless data' that may have entered the

database. As discussed above regarding cardiac arrest and deaths, the reporting rate could be significantly altered by a few cases for low-prevalence complications. We inspected the individual records to ensure that they were internally consistent and plausible; 5 cases were removed, and 12 probable single mis-clicks were edited. To ensure absolute confidentiality, the study team did not collect data on which hospital or anaesthetist reported each case. We hope that this will have enabled anaesthetists to report complications freely. However, it also prevented us from querying cases where the reported clinical events were not plausible or were missing fields. The ability to report complications with complete confidentiality is a strength of our data and may have led to higher reporting rates.

It is important to note what may not have been captured. Complications occurring at less than 1 in 24,000 cases in the survey may have a rate of 0 per 10,000 if they did not occur in the four-day survey period. However, this is accompanied by a CI range that reflects the uncertainty in these unobserved events. Also, we are likely to have missed events after the patient left recovery and maybe even after the patient had been handed over in recovery. It is also important to note that just because a complication has occurred this does not mean that the care provided was unreasonable.

Finally, we wish to thank all anaesthetists who entered data into this study. The data give up-to-date information on complications, but more than that, it should generally be reassuring to patients and anaesthetists that intraoperative complications, at least during elective surgery, are uncommon, rare or very rare.

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