OXFORD UNIVERSITY PRESS | BJA British Journal of Anaesthesia

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Journal:	*British Journal of Anaesthesia*
Manuscript ID	BJA-2016-00715-HH088.R2
Manuscript Type:	Clinical Investigation
Date Submitted by the Author:	n/a
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Mesh keywords:	anaesthesia, quality, patient reported outcome

Patient reported outcome of adult perioperative anaesthesia in the United Kingdom: a cross-sectional observational study

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Abstract

Background

Understanding the patient perspective on healthcare is central to the evaluation of quality. This study measured selected patient-reported outcomes following anaesthesia in order to identify targets for research and quality improvement.

Methods

This cross-sectional observational study in UK National Health Service hospitals recruited adults undergoing non-obstetric surgery requiring anaesthesia care over a 48 hour period. Within 24 hours of surgery, patients completed the Bauer questionnaire (measuring postoperative discomfort and satisfaction with anaesthesia care), and a modified Brice questionnaire to elicit symptoms suggestive of accidental awareness during general anaesthesia (AAGA). Patient, procedural and pharmacological data were recorded to enable exploration of risk factors for these poor outcomes.

Results

257 hospitals in 171 NHS Trusts participated (97% of eligible organisations). Baseline characteristics were collected on 16,222 patients; 15,040 (93%) completed postoperative questionnaires. Anxiety was most frequently cited as the worst aspect of the perioperative experience. Thirty-five per cent of patients reported severe discomfort in at least one domain: thirst (18.5%; 95%C.I 17.8-19.1), surgical pain (11.0%;10.5-11.5) and drowsiness (10.1%;9.6-10.5) were most common. Despite this,

only 5% reported dissatisfaction with any aspect of anaesthesia-related care. Regional anaesthesia was associated with a reduced burden of side-effects. The incidence of reported AAGA was one in 800 general anaesthetics (0.12%)

Conclusions

Anxiety and discomfort after surgery are common; despite this, satisfaction with anaesthesia care in the UK is high. The inconsistent relationship between patient-reported outcome, patient experience and patient satisfaction supports using all three of these domains to provide a comprehensive assessment of the quality of anaesthesia care.

Safety, effectiveness and patient-centeredness have been defined as three key domains of healthcare quality [1 2] and performance metrics may assess any of these. Each year, over 313 million operations take place globally (approximately 42 procedures per 1000 population), [3] the majority of which are supported by anaesthesia providers. In high-income countries, deaths directly attributable to anaesthesia are rare and intra-operative mortality in patients undergoing general anaesthesia (GA) is very low. [4] However, anaesthesia is associated with other important adverse outcomes including postoperative complications [5 6] and reduced long-term survival. [7 8 9] Furthermore, many postoperative symptoms – for example, acute surgical pain - are distressing to patients, [10, 11] may delay hospital discharge, [12] and can lead to chronic health problems, [13] thereby increasing health and social care costs. Thus, the measurement of quality in anaesthesia care provides an opportunity to drive improvement that may affect millions of patients each year and promote healthcare efficiency and productivity.

Patient-reported metrics are increasingly viewed as core quality indicators. [2] Measures specific to anaesthesia encompass the three aforementioned domains of quality: effectiveness, by assessing procedural-related discomfort which anaesthesia providers aim to alleviate (e.g. pain, drowsiness, nausea); patient-centeredness, by measuring patient satisfaction with care delivered; and safety, through estimating the incidence of events which may lead to significant or long-term harm, such as accidental awareness during general anaesthesia (AAGA). Using measures encompassing all three of these domains, this study describes the quality of

anaesthesia care from the patient perspective in a UK multi-centre sample, in order to identify risk factors for these adverse outcomes, characterise the relationship between patient reported outcome and patient satisfaction, identify targets for research and quality improvement, and to better inform the information given to future patients.

Methods:

This study is reported in accordance with the "Strengthening the Reporting of Observational Studies in Epidemiology" (STROBE) statement. [14]

We undertook a two-day multi-centre observational cross-sectional study in the UK's National Health Service (NHS). The protocol has been published previously. [15] Ethics approval was granted by the UK National Research Ethics Service (West Midlands Committee, 14/WM/0043). Hospital and investigator engagement was facilitated through the Quality Audit and Research Coordinator (QuARC) network, which was established by the National Institute of Academic Anaesthesia's Health Services Research Centre (NIAA-HSRC) to facilitate health services research in anaesthesia and perioperative care across the UK. All NHS hospitals were invited to participate. The full investigator list can be found in Supplementary document 2. Patient recruitment took place between 00:00 on 13th May 2014 and 23:59 on 14th May 2014. These days of the week were chosen to maximise opportunities for recruitment of patients, outside weekend working hours and potentially busier workloads on Mondays and Fridays. All adults (≥18 years) undergoing a non-obstetric surgical procedure requiring anaesthesia (local, regional or general) or sedation administered by an anaesthetist were eligible for inclusion; all were provided with information about the study prior to surgery (see supplementary documents).

Dataset

The case report form is presented in the supplementary documents. The anaesthetist responsible for each patient's perioperative care completed patient, personnel and process details at the time of surgery. Operation names were entered using free-text by anaesthetists, and subsequently coded by members of the central study team, using a UK-based objective categorisation of surgical procedure type and magnitude. [16] Patients subsequently completed the Bauer patient satisfaction questionnaire [17] and a Modified Brice Questionnaire for AAGA. The Bauer questionnaire was previously identified [18] as being a psychometrically developed and validated measure of patient satisfaction and discomfort. The modified Brice questionnaire uses closed-questions and was adapted from a previous study. [19] Two further questions were asked: the NHS "Friends and Family Test" (would you recommend this anesthetic service to friends and family?) and a question regarding whether the patient expected to be asleep during their procedure. Reasons for non-completion of patient questionnaires were noted. Obstetric and paediatric populations were excluded from this study as the Bauer questionnaire had not been previously validated in these settings.

Patient involvement

The Participant Information Sheet was reviewed and amended by a member of the Lay Committee of the Royal College of Anaesthetists; the lay committee were also invited to provide feedback on study design and conduct. The Bauer questionnaire was originally developed with patient involvement.

Analysis

Continuous variables are presented as mean (SD) when normally distributed and median (range) when not (normality was assessed using the Stata *"sktest"* for skewness and kurtosis in large sample sizes). Categorical variables are presented as n (%).Cases missing core variables (operation name, all demographic data or any outcome data) were excluded from all analyses. Baseline characteristics between patients who declined or were unable to complete follow-up questionnaires were compared against those who did consent and complete questionnaires. Our co-primary endpoints were the 10 domains of discomfort in the Bauer patient satisfaction questionnaire.

We explored the relationship between patient and process-related factors and a poor outcome in each of the 15 domains of the Bauer questionnaire. For each of the ten markers of anaesthesia-related discomfort, a poor outcome was defined as a response of "severe" on a 3-point Likert scale (none, moderate, severe); for each of the five patient satisfaction questions, a poor outcome was defined by a response of either 'Dissatisfied' or 'Very dissatisfied' on a 4-point Likert scale. Chi-squared tests were used to determine the univariate relationship between candidate categorical variables deemed to have plausible associations with poor outcomes in any of these 15 domains; chi-squared test for trend was used with variable with multiple categories. Variables significant at $p<0.1$ were then entered into separate

multivariable logistic regression models for poor outcome in each of the ten discomfort domains (backward-stepwise method) to calculate adjusted Odds Ratios (OR) with 95% Confidence Intervals (CI). Significance for multivariable models was set at $p<0.05$. In multiple regression analyses, we used Bonferroni's correction to adjust for multiple comparisons for different outcomes: 10 comparisons for domains of anaesthesia-related discomfort, and five domains of patient-satisfaction; adjusted p values are denoted p'.

A potential case of AAGA was flagged if a patient responded that they remembered something between going to sleep and waking up, or they answered "Awareness" to the question asking them to report the worst thing about their operation. Additionally, all free text responses were screened for responses that could signify AAGA. The local principle investigators for each of these cases were contacted and asked to give their opinion of the likelihood of AAGA for their cases as "probable", "possible", "unlikely" or "un-assessable" according to previously defined criteria, [20] (supplementary table 1) and using available local data. Two independent assessors (SRM and TMC) then reviewed each potential AAGA case and classified them again into one of these four likelihood categories. All cases classed by any of the three reviewers as probable or possible AAGA were then discussed in detail by the two independent assessors and a final classification agreed by consensus.

Data were analysed using STATA/IC 12.1 for Mac, StataCorp LP, Texas, USA and Microsoft Excel for Mac 2011, Version 14.4.9, Microsoft Corporation, Washington, USA.

Results:

Patients were recruited from 257 hospitals within 171 English and Scottish NHS Trusts, Welsh Health Boards and Northern Irish Health and Social Care Trusts – this represented 97% of NHS acute secondary care organisations providing adult services – 146 of 149 in England (98%), [21] 13 of 14 (93%) in Scotland, [22] six of seven (86%) in Wales [23] and six of six (100%) in Northern Ireland. [24] Following exclusions, patient characteristics were recorded for 16,222 patients; 15,040 patients answered postoperative questionnaires, giving a response rate of 93% (Figure 1). Baseline characteristics are shown in Table 1. The commonest reason for non-completion of postoperative questionnaires was that the patient had already been discharged from hospital (388 patients; 2.4%); consent was declined by 310 patients (1.9%) (Supplementary table 2). Excluding discharged patients, those who did not complete follow-up questionnaires were older and were more likely to have comorbidities or be undergoing urgent or immediate surgery. The median number of patient respondents per hospital was 78 (range 6 – 388). 12,674 (84%) received general anaesthesia. The commonest operations were cystoscopy (782 patients; 5%), cataract surgery (619; 4%) and hernia repair (594; 4%); however, the cohort included 2449 different procedure codes. Data describing perioperative care are summarised in Supplementary table 3.

Patient characteristics	**Respondents** (n = 15,040)	**Non-respondents** (n = 1,182)	**p value**
Gender (M/F) (% M)	6,696/ 8,344 (45)	551/631 (47)	0.163
Age, years (range)	55 (18 – 100)	57 (18-98)	**<0.001**
ASA *n* (%)			**<0.001**
1	4,995 (33)	305 (26)	
2	7,208 (48)	450 (38)	
3	2,646 (18)	345 (29)	
4	178 (1)	79 (7)	
5	3 (0.02)	3 (0.3)	
Surgical specialties, *n* (%)			**p' value**
Orthopaedics	4,000 (27)	251 (21)	**<0.002**
Gynaecology	1,946 (13)	122 (10)	0.12
Abdomen (gut)	1,818 (12)	144 (12)	0.96
Urology	1,802 (12)	143 (12)	0.94
Head and neck	1,251 (8)	102 (9)	0.75
Ophthalmology	984 (7)	105 (9)	**0.04**
Body surface (breast)	699 (5)	46 (4)	0.26
Abdomen (hepatobiliary)	496 (3)	41 (3)	0.99
Body surface (other)	438 (3)	28 (2)	0.8
Vascular	352 (2)	27 (2)	0.99
Dental	305 (2)	30 (3)	0.8
Neurosurgery	270 (2)	41 (3)	0.02
Cardiac	251 (2)	53 (4)	**<0.002**
Endoscopy	132 (0.9)	19 (2)	**<0.004**
Thoracic	131 (0.9)	17 (1)	0.18
Endocrine	55 (0.4)	1 (0.08)	0.36
Interventional radiology	43 (0.3)	24 (2)	**<0.002**
Abdomen (bariatric)	36 (0.2)	3 (0.3)	0.99

Transplant	22 (0.1)	3 (0.3)	0.89
Abdomen (endocrine)	9 (0.06)	1 (0.08)	0.74
Surgical urgency, *n* (%)			**<0.001**
Elective	12,008 (80)	809 (69)	
Expedited	1,436 (10)	129 (11)	
Urgent	1,532 (10)	222 (19)	
Immediate	64 (0.4)	22 (2)	
Surgical severity, *n* (%)			0.060
Minor	2,550 (17)	161 (14)	
Intermediate	5,709 (39)	458 (40)	
Major	4,476 (30)	356 (31)	
Complex	2,036 (14)	165 (14)	
Comorbidities, *n* (%)			
Congestive cardiac failure	320 (2)	54 (5)	**<0.001**
Previous stroke / TIA	572 (4)	84 (7)	**<0.001**
Cancer within past 5 years	1,816 (12)	166 (14)	**0.047**
Obesity (BMI ≥ 30)	3,258 (22)	229 (19)	0.065
Long-term medications, *n* (%)			
Opiates / opioids	1,514 (10)	131 (11)	0.261
NSAIDs / COX inhibitors	1,331 (9)	81 (7)	**0.019**
Benzodiazepines	433 (3)	39 (3)	0.405
Neuropathic pain medications	883 (6)	71 (6)	0.845

Table 1: Baseline patient characteristics comparing respondents and non-respondents (n=16,222) [p values corrected (p') for 20 comparisons between groups of surgical specialty]

Anaesthesia-related discomfort	None	Moderate	Severe
Thirst			
Number	4,358	7,711	2,776
Percentage (95% confidence intervals)	30.0 (28.3-29.7)	51.3 (50.5-52.1)	18.5 (17.8-19.1)
Drowsiness			
Number	5,193	8,131	1,513
Percentage (95% confidence intervals)	34.5 (33.8 – 35.4)	54.1 (53.3-54.9)	10.1 (9.6-10.5)
Pain at surgical site			
Number	7,600	5,600	1,652
Percentage (95% confidence intervals)	50.5 (49.7-51.3)	37.2 (36.5-38.0)	11.0 (10.5-11.5)
Hoarseness			
Number	9,769	4,418	526
Percentage (95% confidence intervals)	65.0 (64.2-65.7)	29.4 (28.7-30.1)	3.5 (3.2-3.8)
Sore Throat			
Number	10,353	3,955	495
Percentage (95% confidence intervals)	68.83 (68.1-69.6)	26.3 (26.6-27.0)	3.29 (3.0-3.58)
Cold			
Number	11,333	2,859	666
Percentage (95% confidence intervals)	75.4 (74.7-76.0)	19.0 (18.4-19.6)	4.43 (4.1-4.8)
Nausea and vomiting			
Number	12,357	1,996	476

Percentage (95% confidence intervals)	82.2 (81.6-82.8)	13.3 (12.7-13.8)	3.2 (2.9-3.4)
Confusion			
Number	12,409	2,174	189
Percentage (95% confidence intervals)	82.5 (82.0-83.1)	14.5 (13.9-15.0)	1.3 (1.1-1.4)
Shivering			
Number	12,782	1,635	410
Percentage (95% confidence intervals)	85.0 (84.4-85.6)	10.9 (10.4-11.4)	2.7 (2.5-3.0)
Pain at injection site			
Number	12,856	1,734	194
Percentage (95% confidence intervals)	85.5 (84.9-86.0)	11.5 (11.0-12.0)	1.3 (1.1-1.5)

Table 2: Anaesthesia related discomfort [n(%)]

Postoperative discomfort

5230 (34.8%; 95% C.I. 34.0-35.5%) patients reported severe discomfort in at least one domain. The three most prevalent types of severe discomfort were thirst (18.5%; 95% C.I. 17.8-19.1) pain at the surgical site (11.0%; 10.5-11.5)and drowsiness (10.1%; 9.6-10.5) (Table 2).

Univariate analyses of risk factors for each domain of severe discomfort are reported in Supplementary table 4. Independent risk factors for severe discomfort across the ten domains of inquiry are presented in Table 3. Non-modifiable risk factors for severe discomfort included younger age, female sex, obesity, previous stroke or transient ischaemic attack and long-term opioid, benzodiazepine or neuropathic pain therapy. Female gender was an independent risk factor for eight of the ten adverse outcomes. Independent of other factors, there was a significantly lower prevalence of severe postoperative pain, sore throat, drowsiness and shivering associated with using regional anaesthesia alone (that is, nerve block, spinal or epidural anaesthesia or a combination thereof, without general anaesthesia).

Risk factor	Thirst	Pain at surgical site	Drowsiness	Hoarseness	Sore throat	Cold	PONV	Confusion	Shivering	Pain at injection site
NON-MODIFIABLE FACTORS										
Female gender	1.32 (1.22-1.45)	1.73 (1.55-1.96)	1.70 (1.51-1.91)		1.52 (1.25-1.84)	2.69 (2.24-3.23)	2.77 (2.22-3.45)			
BMI>30						0.58 (0.47-0.72)	1.41 (1.15-1.72) *p'=0.01*		0.68 (0.52-0.88) *p'=0.04*	
Age 18-65		1.27 (1.12-1.43)	1.25 (1.10-1.41) *p'=0.01*			1.40 (1.17-1.68)	1.57 (1.27-1.94)		1.95 (1.53-2.49)	
Age>80	0.76 (0.63-0.90) *p'=0.02*									
Previous TIA/CVA						1.69 (1.17-2.44) *p'=0.05*				
Long-term opioids						1.48 (1.17-1.88)			1.52 (1.14-2.04)	

						p'=0.01			*p'=0.04*	
Long-term neuropathic agents	1.48 (1.25-1.74)									
ASA grade [Reference: ASA grade I]										
III	1.43 (1.25-1.63)									
IV or V	2.65 (1.89-3.71)									
Urgent/immediate surgery	1.22 (1.07-1.39) *p'=0.03*	1.35 (1.16-1.59)	1.35 (1.15-1.58)					3.49 (2.50-4.81)		
Surgical type										
Neurosurgery	0.61 (0.45-0.83) *p'=0.01*									
Urology	0.70 (0.59-0.81)	0.69 (0.55-0.87)	0.66 (0.53-0.82)	0.47 (0.30-0.75) *p'=0.01*						

Ophthalmology	0.45 (0.34-0.59)									
Cardiac		2.01 (1.45-2.80)	2.14 (1.53-3.01)							
Head and Neck				1.85 (1.44-2.38) *p'=0.01*	3.49 (2.80-4.36)					
Thoracic					3.38 (1.84-6.19)					
Magnitude of surgery [Reference variable: minor surgery]										
Major								2.75 (1.46-5.16) *p'=0.02*		
Complex								3.33 (1.69-6.55) *p'=0.01*		
Major or complex surgery		1	1.29 (1.12-1.48)	1.37 (1.12-1.66) *p'=0.02*		1.32 (1.10-1.57) *p'=0.02*	1.89 (1.48-2.43)		1.47 (1.20-1.81)	

Duration of surgery [Reference variable: <30minutes(m)]										
30-60m	1.26 (1.10-1.43) *p'=0.01*	1.68 (1.40-2.00)	1.54 (1.30-1.84)			1.47 (1.17-1.68)				
60-120m	1.31 (1.13-1.52)	2.63 (2.18-3.15)	2.47 (2.07-2.94)			1.48 (1.20-1.82)	2.23 (1.54-3.24)			
>120m	1.66 (1.40-1.98)	3.18 (2.58-3.92)	3.06 (2.52-3.70)				3.17 (2.13-4.72)			

MODIFIABLE FACTORS										
Anaesthetic technique										
Inhalational GA	1.42 (1.25-1.61)		1.95 (1.40-2.71)	3.10 (2.00-4.79)						
Total Intravenous GA			1.60 (1.16-2.22) p'=0.05	1.89 (1.21-2.92) *p'=0.05*		1.77 (1.30-2.41)				
Sole RA without GA		0.27 (0.19-0.37)	0.47 (0.31-0.73)							

Pharmacological agents administered during anaesthesia and surgery										
Neuromuscular blockade	1.85 (1.68-2.04)			3.38 (2.70-4.22)	2.96 (2.41-3.64)					
Morphine	1.20 (1.09-1.32)	1.44 (1.28-1.63)	1.46 (1.31-1.66)			0.69 (0.57-0.83)			0.71 (0.57-0.90) *p'=0.05*	
Alfentanil									0.50 (0.31-0.80) *p'=0.04*	
Cyclizine						1.49 (1.14-1.94) *p'=0.03*				

Table 3: Factors independently (on multivariable analysis) associated with severe postoperative discomfort. Odds ratios (95% confidence intervals); p'< 0.01 unless otherwise stated [p'= p corrected for 10 comparisons using Bonferroni's correction]

Patient experience and satisfaction

Patients most commonly reported anxiety to be the worst thing about their operation (33.3%), followed by pain (16.7%). Analysis of free-text responses identified a number of additional themes including the facilities, staff behaviours, communication, and non-clinical processes such as transport or discharge efficiency. (Table 4)

Response	Number of patients	Percentage	95% Confidence intervals
Anxiety	4,653	33.3	32.3-34.1
Pain	2,333	16.7	16.1-17.3
Unable to carry out usual activities	1,785	12.8	12.2-13.3
Recovery process	920	6.6	6.2-7.0
Awareness	136	1.0	0.8-1.1
Nothing	2,034	14.5	14.0-15.1
Other (thematic analysis) • Environment / facilities (waiting times/recovery) • Emotional wellbeing (anticipation/anxiety/circumstances of surgery) • Procedure specifics (cannulation/regional) • Symptoms (hunger, thirst, cold, pain) • Staff (professionalism/quality of care) • Communication (changes to planned surgery/pre-op discussion) • Process (transport, discharge)	2,124	15.6	14.6-15.8

TABLE 4: Responses to the question: "What was the worst thing about your operation?" (total responses: n=13,985)

Patient satisfaction levels were high with only 5.7% of patients reporting being dissatisfied or very dissatisfied with any aspect of their care (Table 5). 99% of the patients who responded to the NHS Friends and Family Test (FFT) stated they would recommend the anaesthesia service; 5% did not respond. Two patient or procedural risk factors independently predicted that a patient would not recommend the service to friends or family: long-term opioid use (11% of patients; odds ratio [O.R.] 1.98, 95% confidence interval [C.I.] 1.24-3.15; $p<0.004$), and a history of congestive cardiac failure (2% of patients; O.R. 2.80, 95% C.I. 1.29-6.05; $p<0.009$). Multivariable analysis adjusting for these non-modifiable risk factors found that the following types of severe discomfort predicted that the patient would not recommend the service to friends and family: pain (O.R. 2.73, 95% C.I. (1.81 - 4.13); $p'<0.0005$); PONV (O.R. 3.78, 95% C.I. 2.11-6.78; $p'<0.0005$.)

Domain	Very Satisfied	Satisfied	Dissatisfied	Very dissatisfied	Not applicable
Pain therapy (n=14,403)					
Number	8,879	4,986	414	108	16
Percentage (95% confidence intervals)	61.6 (60.9-62.4)	34.6 (33.8-35.4)	2.9 (2.6-3.1)	0.8 (0.6-0.9)	0.1
PONV therapy (n=12,161)					
Number	8,652	3,271	117	33	88
Percentage (95% confidence intervals)	71.1 (70.3-71.9)	26.9 (26.1 – 27.7)	0.8 (0.7-1.0)	0.3 (0.2-0.4)	0.7
Pre-operative information (n=14,943)					
Number	12,458	2,373	58	52	2
Percentage (95% confidence intervals)	83.4 (82.7-84.0)	15.9 (15.2-16.5)	0.4 (0.3-0.5)	0.4 (0.3-0.5)	0.01
Waking up (n=14,092)					
Number	9,416 (67)	4,360	194	78	44
Percentage (95% confidence intervals)	66.8 (66.0-68.7)	31.0 (30.1-31.8)	1.4 (1.2-1.6)	0.6 (0.4-0.7)	0.3
General care (n=14,922)					
Number	12,773	2,065	31	51	2
Percentage (95% confidence intervals)	85.6 (85.0-86.2)	13.8 (13.8-14.5)	0.2 (0.1-0.3)	0.3 (0.2-0.4)	0.013

Table 4: Satisfaction with care

Accidental Awareness during General Anaesthesia (AAGA)

3.6% (95% C.I. 3.3-3.9%) of patients undergoing GA were not expecting to be asleep for surgery; conversely, 4.0% (3.7-4.3%) of patients expecting to be asleep were not administered a GA. There was no association between receiving a different type of anesthetic to that expected, and reporting dissatisfaction with general care, waking or preoperative information sharing. 338 cases (2.7% of GAs; 95% C.I. 2.4-2.9%) were identified as potential cases of AAGA. Following the review process, 15 patients (0.12% of GAs; 95% C.I. 0.1-0.2%) were classified as having had either probable (one patient) or possible (14 patients) AAGA, an event rate of approximately 1 in 800. AAGA was related to emergence from anaesthesia (removal of tracheal tube) in six of these patients. One patient reported dissatisfaction with their wake-up from anaesthesia: they experienced pain, being unable to move or breathe and hearing voices during surgery. Two patients reported feeling the surgery but without pain. Regression analysis did not identify any independent risk factors for probable or certain AAGA from our dataset.

Discussion

This comprehensive national snapshot of patient-reported outcome shows high levels of satisfaction with anaesthesia care delivered by NHS hospitals. However, there is a striking disconnect between high levels of patient satisfaction and the substantial burden of perioperative symptoms. Severe discomfort in at least one domain was reported by 35% of respondents; the commonest symptom was severe thirst, but this did not predict patient dissatisfaction. Severe pain, drowsiness, sore throat and postoperative nausea and vomiting predicted dissatisfaction with anaesthesia services; however, 99% of patients who responded indicated that they would recommend the service to friends and family. Anxiety and pain were both common and had impact on patient experience, and provide important targets for research and quality improvement. These data may also be used to improve the information provided to patients prior to surgery and anaesthesia, hence helping to meet and manage patients' expectations of their perioperative outcomes and experience. AAGA was uncommon and when it did occur, in only one of 15 cases was it associated with short-term distress or dissatisfaction. Overall, these findings demonstrate the importance of measuring quality from several aspects (safety, experience, outcome) in order to contextualise findings and appropriately focus future efforts to improve care.

The inconsistent relationship we found between satisfaction, safety and effectiveness contradicts the findings of a recent systematic review. [25] There are several possible explanations for this. Our study has focussed on a particular aspect of hospital treatment – perioperative care evaluated within 24 hours of surgery – which has not previously been investigated in a comprehensive multi-centre cohort [18 25]; however, our findings are consistent with previous single centre studies in this setting. [17 26] While symptoms such as severe postoperative thirst are common, they may simply be less distressing than those linked with patient dissatisfaction such as pain, nausea and vomiting, or sore throat; it may also be that patients are more prepared for some symptoms than others, through better preoperative communication with healthcare professionals. [27] The discrepancy between the prevalence of different domains of discomfort and their impact on patient satisfaction highlights the importance of measuring both symptoms and experience when evaluating patient-centred outcomes for the purposes of quality improvement. It is notable that most patients who were categorised as potential AAGA cases did not report dissatisfaction with the care delivered. This may be because our estimate was inaccurate, because a low event rate meant that we missed a significant relationship between AAGA and other risk factors or outcomes, because the distressing consequences of AAGA may not become apparent until much later, [28] or

because dissatisfaction after an episode of AAGA is more likely to be associated with the manner in which complaints or concerns are later handled, than the event of AAGA itself. [29]

Analyses identifying risk factors for adverse outcomes should be interpreted with the same caution as in all observational studies: our data are hypothesis-generating rather than explanatory, and confounding by indication may be responsible for some reported associations – for example between the administration of morphine and severe postoperative pain. [30] Acknowledging these caveats, our findings nevertheless point towards opportunities for future research and improvement efforts. Low-risk interventions such as music therapy, which has been shown to reduce perioperative anxiety and pain, [31] may improve experience for substantial numbers of patients without incurring major cost. The most common type of postoperative discomfort reported was thirst; this may be locally investigated through evaluation of preoperative starvation times, intraoperative fluid and drug regimens and possibly addressed through rapid re-establishment of oral fluids after surgery where possible. [32] More than half of patients reported severe or moderate surgical pain: this is a particularly important target for research and quality improvement, as improving

acute pain management may also reduce the risk of chronic pain, [13] which is both distressing for patients and carries significant societal burden [33]; furthermore, this has recently been highlighted as a research priority by patients, public and healthcare professionals in the UK. [34] Although the incidence of suspected AAGA in this cohort is consistent with studies using similar methods to elicit explicit recall of intraoperative events, [35] in nearly half of these cases, the episode of awareness occurred during removal of a tracheal tube. However, recent reports have highlighted late psychological harm as a result of awareness during emergence from anaesthesia, [28] hence we have included these cases in our estimate of AAGA incidence, where older studies have not. [36]

The major strength of this study is the size and distribution of the sample. 97% of eligible NHS organisations contributed data, and the patient response rate was high. This comprehensive hospital participation is unusual compared with previous large-scale point-prevalence studies. [37 38] Professional engagement was facilitated by establishing a network of investigators to support research and quality improvement; furthermore, and following the example set by surgical trainee research networks, [39] junior doctors and students were encouraged to become

investigators for this study, hence supporting study delivery at local level. This networked approach to health services research delivery may provide a useful template which can be replicated in other settings. There are, however, also some limitations. Although comparison with previous NHS activity data [4] indicates that we have captured nearly all eligible cases during our recruitment window, a relatively small proportion of procedures (10%) were classified as either urgent or immediate, and non-respondents were also higher risk in terms of comorbidities and age: this is likely to reflect recruitment bias, and may have affected our findings. It is possible that we did not capture all patient or process-related risk factors for adverse outcomes: these are potential additional sources of confounding in our analyses. We did not include ethnicity in our dataset; other studies have found variation in patient satisfaction [40] or patient expectation [41] according to ethnicity; this may also be an important issue when considering the international generalizability of our findings. Finally, our methodology for determining whether patients experienced AAGA had limitations. It was clear from follow-up that for some patients, the term “awareness” carried a different meaning to that intended. This provides some explanation for the high false positive rate for the modified Brice questionnaire, and may indicate that its specificity is too poor to be used in routine clinical practice. We did not conduct three administrations of the Brice questionnaire as would normally be

recommended; nor did we specify the method of follow-up of suspected AAGA cases by local investigators: these factors may too have led to inaccuracy in our estimate of AAGA incidence.

In summary, this study is a robust multi-centre evaluation of patient perspectives on anaesthesia care in NHS hospitals. We have found that while patient satisfaction is high, one in three patients report severe discomfort within 24 hours of surgery. However, anxiety was most commonly reported as the worst aspect of the surgical episode: this finding supports the wider implementation and evaluation of simple, cost-effective, evidence-based interventions to alleviate it. Routinely reported quality data should cover all three aspects of safety, experience and outcome, so as to provide a comprehensive assessment of care from the patient perspective. International replication of our methodology would provide data supporting improved performance and outcome in different healthcare settings, and enable comparisons which may further elucidate the role of organisational and cultural factors on patients' perspective of quality in anesthesia care.

Declarations

Funding: National Institute for Academic Anaesthesia (Royal College of Anaesthetists), University College London Hospitals (UCLH) NHS Foundation Trust and UCLH National Institute for Health Research Biomedical Research Centre. The funders have had no role in the analysis or reporting of the results.

Study Sponsor: University College London Hospitals NHS Foundation Trust. The sponsor played no role in study conduct, analysis or reporting.

Author contributions: SRM conceived the study, wrote the study protocol, led design of the dataset and study documents, coordinated data acquisition, wrote the statistical analysis plan, supervised and contributed to the data analysis, drafted the manuscript and revisions, and approved the final version. She is the corresponding author and guarantor. EMKW wrote the study protocol, coordinated data acquisition, cleaned all study data, led the data analysis, drafted the manuscript, and approved the final version. MB contributed to the study protocol, coordinated data acquisition, provided critical input into the manuscript and approved the final version. TMC contributed to the data analysis, provided critical input into the revision of the manuscript and approved the final version. MPWG provided critical input into the data analysis, revision of the manuscript and approved the final version.

Acknowledgments: We are grateful to our collaborators, the SNAP-1 investigators; the full list of contributors can be found in supplementary document 2.

Declaration of Interests: All authors have completed the ICMJE uniform disclosure at www.icmje.org/coi_disclosure.pdf and declare: financial support for the submitted work from the National Institute for Academic Anaesthesia (NIAA) Royal College of Anaesthetists), University College London Hospitals (UCLH) NHS Foundation Trust and UCLH National Institute for Health Research Biomedical Research Centre. In addition, SRM has received other unrelated research grants from the NIAA, the UCLH NIHR Biomedical Research Centre and the Health Foundation. SRM (since May 2016) is the Associate National Director for Elective Care for NHS England. EMKW received salary support from the London Clinic Intensive Care Unit while analyzing this study. MPWG receives funding from the Southampton NIHR Biomedical Research Unit (Respiratory). There are no other relationships or activities that could appear to have influenced the submitted work.

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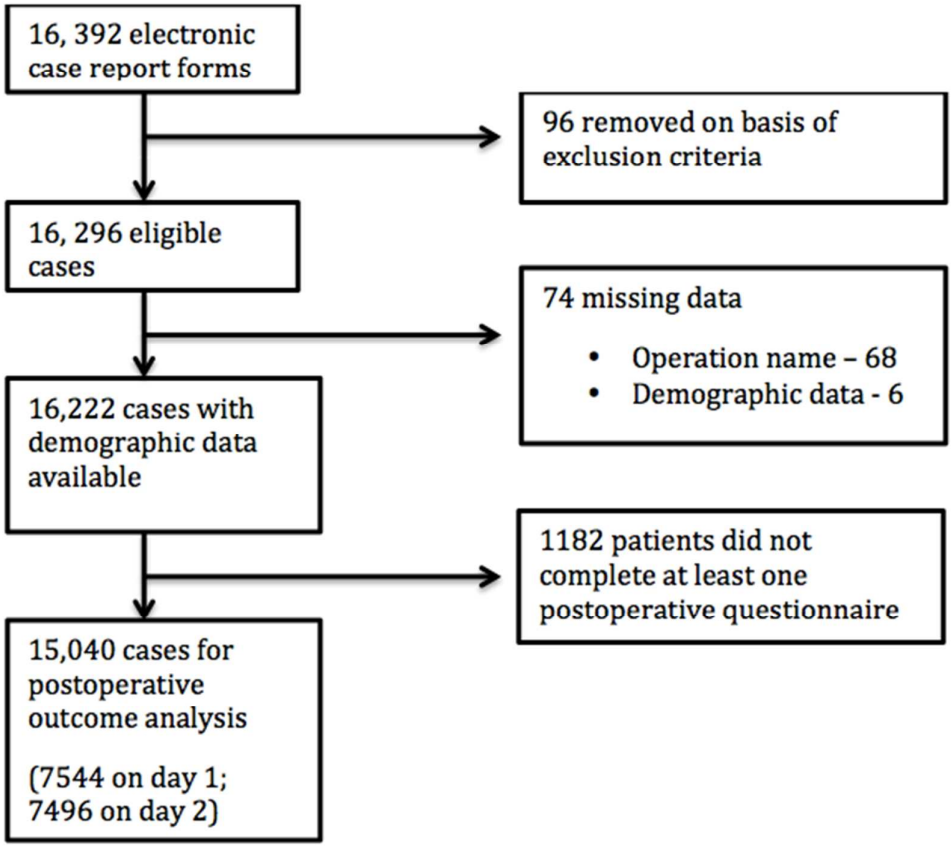

Figure 1: Study flow diagram