# Telemedicine in COVID-19 pandemic: Anaesthetic assessment of elective surgical patients through mobile application-based questionnaire

### **INTRODUCTION**

The pre-anaesthetic assessment aims to assess and optimise patients to decrease perioperative morbidity and mortality. It also improves patient satisfaction by allaying anxiety; minimises operative cancellations by facilitating a tailored anaesthetic plan; and reduces postoperative complications.<sup>[1]</sup> In our institution, all patients are assessed by the Pre-admission anaesthetic clinic (PAAC) anaesthetist or nurse prior to surgery.

Infectious disease pandemics have spearheaded advancements in telemedicine to minimise nosocomial spread of infectious diseases. Leveraging on technological advances, we implemented an electronic Pre-anaesthetic questionnaire (ePAQ) to allow selected patients to be reviewed remotely. An ePAQ would ideally reduce contact time patients have in hospital, improve convenience as it can be done at out of business hours unlike a telephone consultation and minimise the possible risk of miscommunication or connectivity issues over the phone.

The primary aim of our study was to determine the reliability of ePAQ in identifying American Society of Anesthesiologists (ASA) physical status I patients presenting for elective surgery as compared to face-to-face. Our hypothesis was that ePAQ is as effective as face-to-face assessment in identifying ASA I patients. The secondary aim was to assess patient satisfaction after use of ePAQ by administering a Patient experience questionnaire (PEQ), and if it could similarly allay patients' fears like a face-to-face consult.

# **METHODS**

This was a single-centre, observational retrospective audit conducted between October 2019 and October 2020 at Changi General Hospital, a tertiary hospital in Singapore. Ethics approval and waiver of consent was obtained (CIRB 2020/3111).

Inclusion criteria were patients 18-44 years old, undergoing elective non-major surgery in orthopaedic surgery, ear, nose, throat surgery, general surgery, ophthalmology, urology or plastic surgery operation theatres; and were able to read and understand English.

The ePAQ was developed by the PAAC team from validated electronic pre-anaesthetic assessments<sup>[2,3]</sup> and comprised 35 questions [Appendix 1]. Patients answered the ePAQ using an unmanned touch-screen computer terminal known as the Self-Empowering and Enabling Kiosk (SEEK) at the PAAC. Patients were advised to use the alcohol dispenser before and after the SEEK. The SEEK was then wiped down with chemical disinfectant after every use. Thereafter, patients underwent a standard face-to-face pre-anaesthetic evaluation where they saw either the PAAC anaesthetist or nurse, who was blinded to the ePAQ evaluation. An ASA score was assigned to the patient (PAAC-ASA). An anaesthetist in the study team, blinded to the PAAC-ASA, then reviewed the ePAQ and assigned an ASA score to the patient (ePAQ-ASA).

Then, a PEQ survey [Appendix 2], adapted from a validated questionnaire<sup>[4]</sup> to measure patients' experience of interaction, was administered to specifically evaluate patients' experience of the face-to-face consultation.

Upon validation of the ePAQ, it was then launched on the Singhealth Health Buddy mobile application [Figure 1]. 201 patients listed for non-major surgery would have their height, weight, blood pressure and heart rate measured during the surgical consult. Patient information leaflets regarding the fasting instructions and the mode of anaesthesia was also provided. After filling in ePAQ remotely, it was reviewed by the PAAC anaesthetist or nurse who would then conduct a telephone consultation with the patient to verify the information collected. If the patient was deemed an ASA I patient, no face-to-face PAAC consultation would be required. Conversely, if the patient presented with medical comorbidities (ASA II and above), a face-to-face PAAC consultation was arranged.

On the day of surgery, a study team member administered a PEQ to assess the patient's satisfaction with ePAQ. Other outcomes collected included on-the-day cancellation.

The sample size was calculated using a formula used for estimating inter-class correlation between two scales.  $^{[5]}$  k = 2 was used as there were 2 raters – the ePAQ versus face-to-face anaesthetic consult. The intra-class correlation P/plan and width of confidence interval were assumed to be 0.7 and 0.2, respectively. Hence, for a two-sided test size with an alpha-error of 0.05 and power of 80%, a minimum sample of 101 patients was required. Taking into account a 20% dropout rate resulted in a sample size of 126.

To assess the reliability and internal consistency of ePAQ, Cronbach's alpha<sup>[6]</sup> was used to compare ASA scoring obtained from ePAQ and the standard face-to-face anaesthetic consult in PAAC. Cronbach's alpha is a measure of internal consistency and provides an overall reliability coefficient in comparing the ASA scores obtained from the ePAQ to a consultation visit. Internal

consistency describes the extent to which all the items in a test, the ePAQ in this instance, measures the same concept (ASA score) and hence the inter-relatedness of the items within the test. The interpretation of reliability is the correlation of the test to itself. $^{[5]}$  Mann–Whitney U test was used to compare patient satisfaction between those reviewed in PAAC against those who used the ePAQ. Statistical Package for the Social Sciences (SPSS) Statistics version 26 was used for statistical analysis.

### **RESULTS**

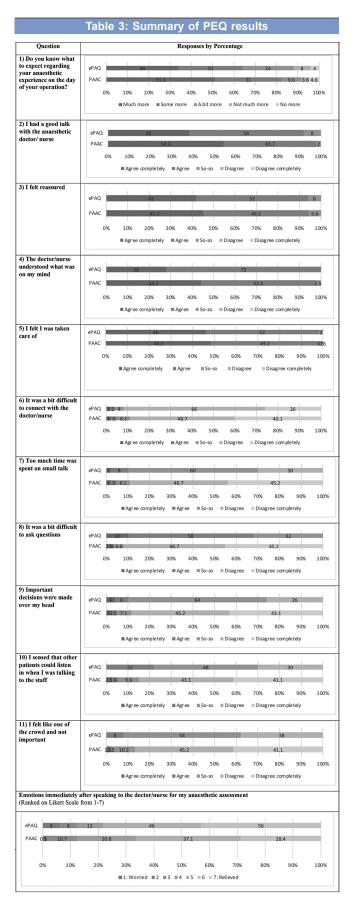
A total of 201 patients were recruited for ePAQ validation with a mean age of 20.6 years (Median of 27.5 years with interquartile range of 12). 50 patients were recruited for assessment of patient satisfaction with ePAQ.

	Table 1: Reliability of PAAC-ASA versus ePAQ-ASA					
				ePAQ-ASA		Total
			1	II	III	
ASA score	I	Count	47	12	0	59
(PAAC-ASA)		% within PAAC-ASA	79.7	20.3	0.0	100.0
		% within ePAQ-ASA	81.0	21.4	0.0	47.2
	II	Count	11	42	2	55
		% within PAAC-ASA	20.0	76.4	3.6	100.0
		% within ePAQ-ASA	19.0	75.0	18.2	44.0
	III	Count	0	2	9	11
		% within PAAC-ASA	0.0	18.2	81.8	100.0
		% within ePAQ-ASA	0.0	3.6	81.8	8.8
Total		Count	58	56	11	125
% within PAAC-ASA		46.4	44.8	8.8	100.0	
% within ePAQ-ASA		100.0	100.0	100.0	100.0	

ASA: American Society of Anesthesiologists; PAAC: Pre-admission anaesthetic clinic; ePAQ: electronic pre-anaesthetic questionnaire

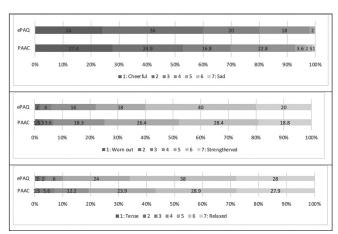
Question	PAAC mean (Range)	Mean rank	ePAQ mean (Range)	Mean Rank	Mann Whitney U	P
Do you know what to expect regarding your anaesthetic experience on the day of your operation?	0.8	116.0	1.2	142.5	3750	0.01*
I had a good talk with the anaesthetic doctor/nurse	0.5	117	0.7	140.9	3929	0.02*
I felt reassured	0.6	120.4	0.6	123.4	4656	0.76
The doctor/nurse understood what was on my mind	0.6	118.9	0.7	136.5	4148	0.07
I felt I was taken care of	0.5	121.3	0.6	124.8	4686	0.72
It was a bit difficult to connect with the doctor/nurse	3.2	125.0	3.1	112.8	4367	0.23
Too much time was spent on small talk	3.2	124.5	3.2	114.8	4466	0.34
It was a bit difficult to ask questions	3.3	125.7	3.2	110.0	4226	0.12
Important decisions were made over my head	3.2	126.0	3.1	108.8	4165	0.09
I sensed that other patients could listen in when I was talking to the staff	3.2	125.1	3.1	109.9	4219	0.14
I felt like one of the crowd and not important	3.2	122.2	3.3	121.4	4793	0.94
Emotions immediately after speaking to the doctor/nurse for my anaesthetic assessment						
(1) Worried → Relieved (7)	5.8 (1-7)	118.5	6.1 (4-7)	133.1	4218	0.17
(1) Cheerful → Sad (7)	2.6 (1-7)	122.9	2.4 (1-5)	116.0	4526	0.52
(1) Worn out → Strengthened (7)	5.3 (1-7)	119.0	5.5 (2-7)	128.7	4389	0.36
(1) Tense → Relaxed (7)	5.6 (2-7)	120.6	5.8 (2-7)	130.1	4471	0.38

PAAC: Pre-admission anaesthetic clinic; PEQ: Patient experience questionnaire



### Contd...





PEQ: Patient experience questionnaire; PAAC: Pre-admission anaesthetic clinic; ePAQ: electronic pre-anaesthetic questionnnaire

The ASA score obtained from the ePAQ and face-to-face consultation was compared for internal consistency using Cronbach's alpha<sup>[6]</sup> [Table 1]. Reliability of ePAQ with PAAC-ASA using Cronbach's alpha<sup>[6]</sup> was 0.849, which suggests that it has good reliability when assessed for internal consistency [Table 1].

A comparison of responses between PAAC and ePAQ Application cohort [Table 2] and summary of responses [Table 3] was tabulated.

Patient satisfaction was similar between both groups of patients in the PAAC and ePAQ Application cohort. For the following questions, "Do you know what to expect regarding your anaesthetic experience on the day of your operation" and "I had a good talk with the anaesthetic doctor/nurse", the PAAC group of patients scored better compared to the ePAQ group [Table 1].

When questioned about emotions, both the PAAC and ePAQ Application cohort felt relieved (as opposed to worried), cheerful (as opposed to sad), strengthened (as opposed to worn out) and relaxed (as opposed to tense).

Both the PAAC and ePAQ Application patient cohort felt reassured and well taken care of. Neither group felt that there was difficulty asking questions. There were no on-the-day cancellations in both patient cohorts.

### DISCUSSION

Our findings demonstrate that the ePAQ Application is as reliable as a face-to-face assessment and has brought about convenience and accessibility without compromising patient care, while allowing healthcare

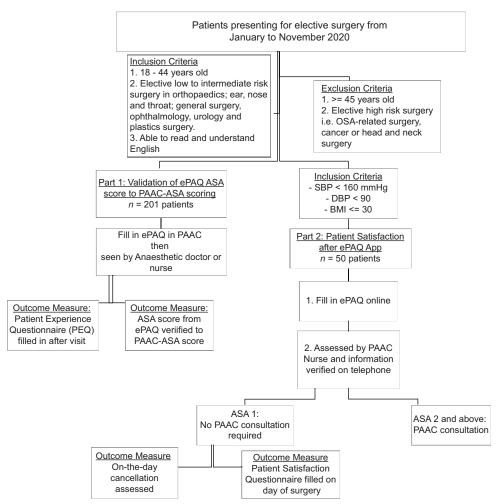


Figure 1: Study methodology. ASA: American Society of Anesthesiologists; PAAC: Pre-admission anaesthetic clinic; ePAQ: electronic pre-anaesthetic questionnaire; PEQ: Patient experience questionnaire

providers to focus resources on the patients in greatest need. [2] In fact, studies have demonstrated efficacy and patient safety of telemedicine [7] as patients may be more willing to interact with a computer than to reveal personal facts to a clinician. [2,7]

Patient satisfaction on ePAQ was similar to being seen face-to-face. In both groups, emotions after the anaesthetic assessment were similar, with no statistical significance. In addition, both patient groups felt 'taken care of' and 'reassured'. Potential barriers to telemedicine include hesitance to trust a clinician whom they have never encountered in person before, [7,8] which was not apparent in our findings.

On the other hand, patients assessed face-to-face scored better in terms of being able to anticipate their anaesthetic experience on the day of surgery ('knowledge acquisition') as compared to those who used the ePAQ Application. The preoperative assessment should educate and facilitate informed

decisions<sup>[9]</sup> suggesting room for improvement with the ePAQ.

Strengths of this audit include the provision of longitudinal outcome measurements on-the-day cancellations. In addition, these are novel findings as efficacy and safety of telemedicine has yet to be tested in the preoperative assessment of surgical patients<sup>[8]</sup>; nevertheless, telemedicine has redesigned health care services in coronavirus disease-19 times and its implementation is attributed to modern computer technology[10,11] Limitations include generalisability of results and selection bias. In this study, only patients proficient with mobile applications and the English language were eligible. Further large-scale studies are warranted to validate clinical efficacy and economic equity.[12] For the ePAQ to be effective, it requires good patient collaboration which may include remote patient-directed assessment of temperature, blood pressure and pulse rate.[8] Issues may arise from the inability to conduct physical examination, particularly airway and cardiopulmonary assessment. [1] Despite the inability to assess the airway prior to surgery with the ePAQ application, there were no on-the-day cancellations in relation to unanticipated difficult airway. Possible reasons for this include a formal anaesthetic assessment prior to surgery allowing tailoring of the anaesthetic technique as well as a well-equipped institution with appropriate airway devices such as video-laryngoscopes that are readily available.

### CONCLUSION

ePAQ provides a reliable assessment without compromising on medical care. Future studies evaluating the ePAQ with a more diverse group of patients can test its robustness.

# Financial support and sponsorship

### **Conflicts of interest**

There are no conflicts of interest.

# Yek J L Jacklyn, Yeo RY Joanne, Neo S H., Chan K. K., Avinash Gobindram

Department of Anaesthesiology, Changi General Hospital, 2 Simei Street 3, Singapore

### Address for correspondence:

Dr. Yek J L Jacklyn, Changi General Hospital, 2 Simei Street 3, 529889, Singapore. E-mail: Jacklyn.yek@mohh.com.sg

> Submitted: 05-Aug-2021 Revised: 05-Dec-2021 Accepted: 06-Dec-2021 Published: 22-Dec-2021

### **REFERENCES**

- Conway JB, Goldberg J, Chung F. Preadmission anaesthesia consultation clinic. Can J Anaesth 1992;39:1051-7.
- Goodhart IM, Andrzejowski JC, Jones GL, Berthoud M, Dennis A, Mills GH, et al. Patient-completed, preoperative web-based anaesthetic assessment questionnaire (electronic Personal Assessment Questionnaire PreOperative):

- Development and validation. Eur J Anaesthesiol 2017;34:221-8.
- Osman T, Lew E, Lum EP, van Galen L, Dabas R, Sng BL, et al. PreAnaesThesia computerized health (PATCH) assessment: Development and validation. BMC Anesthesiol 2020;20:286-96.
- Steine S, Finset A, Laerum E. A new, brief questionnaire (PEQ) developed in primary health care for measuring patients' experience of interaction, emotion and consultation outcome. Fam Pract 2001;18:410-8.
- Machin D, Campbell MJ, Tan SB, Tan SJ. Sample Size Tables for Clinical Studies. 3<sup>rd</sup> ed. Hong Kong: Wiley-Blackwell; 2009. p. 179-94.
- Taber KS. The use of Cronbach's alpha when developing and reporting research instruments in science education. Res Sci Educ 2018;48:1273-96.
- Flodgren G, Rachas A, Farmer AJ, Inzitari M, Shepperd S. Interactive telemedicine: Effects on professional practice and health care outcomes. Cochrane Database Syst Rev 2015;2015;CD002098.
- Chatrath V, Attri JP, Chatrath R. Telemedicine and anaesthesia. Indian J Anaesth 2010;54:199-204.
- 9. Mihalj M, Carrel T, Gregoric ID, Andereggen L, Zinn PO, Doll D, et al. Telemedicine for preoperative assessment during a COVID-19 pandemic: Recommendations for clinical care. Best Pract Res Clin Anaesthesiol 2020;34:345-51.
- Ghai B, Malhotra N, Bajwa SJS. Telemedicine for chronic pain management during COVID-19 pandemic. Indian J Anaesth 2020;64:456-62.
- Mehdiratta L, Bajwa SJS. Technology, engineering and innovations- Power buffers in the COVID driveline. Indian J Anaesth 2021;65:351-5.
- Gupta A, Gupta N. Setting up and functioning of a preanaesthetic clinic. Indian J Anaesth 2010;54:504-7.

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

Access this	article online
Quick response code	
	Website: www.ijaweb.org
	DOI: 10.4103/ija.ija_733_21

**How to cite this article:** Yek JL, Yeo RY, Neo SH, Chan KK, Gobindram A. Telemedicine in COVID-19 pandemic: Anaesthetic assessment of elective surgical patients through mobile application-based questionnaire. Indian J Anaesth 2021;65:892-900.

## APPENDIX 1: PREOPERATIVE ANAESTHESIA ASSESSMENT CLINIC (PAAC) SCREENING QUESTIONNAIRE

### **Opening statement**

The following questions will help us assess your anaesthetic risk for your operation.

Please answer the questions to the best of your knowledge. If you do not know or are unsure of the answer – Please click 'YES'.

It will take approximately 20 minutes to finish the questionnaire.

### Next section

General Statement about my health (please choose one)

Apart from the operation I am about to have,

- 1. I am in good health and my daily activities are not limited by my health (no problems walking around, climbing stairs or exercising).
- 2. I have some health problems but they DO NOT limit my daily activities (no problems walking around, climbing stairs or exercising).
- 3. I have some health problems and they LIMIT my daily activities (limitations on walking around, climbing stairs or exercising).

### Next section

Please tick 'YES' or 'NO'. If you are unsure, please click 'YES"

### Q1) General Health Questions

Apart from the current problem that you are awaiting surgery for, do you have any of the following symptoms or health problems?

YES NO

- a) High blood pressure (hypertension)?
- b) Chest pain that comes on at rest or when you exercise?
- c) Any heart disease (e.g. implantable pacemaker, previous heart attack, irregular heartbeat, heart valve problems or murmurs)?
- d) Any kidney disorder?
- e) Any thyroid disorder?
- f) Any liver disorder?
- g) Any blood disorder or low levels or blood (anaemia)?
- h) History of strokes or a bleed in the brain, either minor or major?
- i) Epilepsy (fits)?
- j) Diabetes (sugar intolerance)?
- k) Excessive bleeding/bruising?
- I) History of a blood clot in your lungs or blood vessels in your leg?
- m) Heart burn or acid reflux (Gastroesophageal reflux disease)?
- n) Any neck problem or joint/muscular disorder?
- o) Any psychological disorder e.g., depression?
- p) Currently suffer from asthma or had asthma when you were younger?
- If 'YES' proceed to (i), If NO, proceed to q.

Contd...

,		`	
1		١	
١	ı	1	

1.	<ol> <li>In the <u>past 4 weeks</u>, how much of the time did your <u>asthma</u> keep you from getting as much done at work, school or at home?</li> </ol>				SCORE	
	All of the time [1]	Most of the time [2]	Some of the time [3]	A little of the time [4]	None of the time [5]	
2.	During the past 4 week	s, how often have	e you had shortness of	of breath?		
	More than Once a day [1]	Once a day [2]	3 to 6 times a week [3]	Once or twice a week [4]	Not at all [5]	
3.	During the past 4 week of breath, chest tightne					
	4 or more nights a week [1]	2 to 3 nights a week [2]	Once a week [3]	Once or twice [4]	Not at all [5]	
4.	During the past 4 week (such as albuterol)?	s, how often have	e you used your rescu	ue inhaler or nebuli	zer medication	
	3 or more times per day [1]	1 to 2 times per day [2]	2 or 3 times per week [3]	Once a week or less [4]	Not at all [5]	
5.	How would you rate yo	ur asthma contro	during the past 4 we	eeks?		
	Not Controlled	Poorly	Somewhat	Well	Completely	
	at All [1]	Controlled [2]	Controlled [3]	Controlled [4]	Controlled [5]	•••••
17	y other breathing problems, a y breathing problems while yo				f NO proceed to s)	

Q2) Medications

	YES	NO
a) Are you on medication for any of the medical conditions listed above?		
b) Are you on any other medication/Traditional Medicine/Vitamins?		
If YES, to Q2b, proceed to (i) and (ii), if		
NO - proceed to Q3		
(i) Is it Traditional medicine?		
(ii) Is it nutrients/vitamins/health supplements?		

s) Any severe skin disorder (e.g. psoriasis, acne, eczema) for which you are on medication?

t) Any other condition that is not mentioned above? Please give details below.

(i) Do you use a CPAP machine while you sleep

# Q3) Smoking

	YES	NO
Do you smoke, or had stopped smoking only in the last 8 weeks?		
If 'YES', proceed to (i), if NO, proceed to Q4		
(i) No. of cigarette sticks/day: for		
of years (duration).		

# Q4) Previous Anaesthetics

	YES	NO
Have you had previous operations that required		
anaesthesia in which you were either awake or asleep		
(regional/general)?		
If 'YES', proceed to (i)&(ii); if 'NO', proceed to Q5.		

Contd...

- (i) Were you told of any problems or complication with the anaesthesia? (e.g. problems putting the tube into your lungs, reaction with the anaesthesia medicine, anaesthesia did not work)
- (ii) After the anaesthesia, did you have severe nausea and vomiting that lasted more than 12 hours?

# **Q5) Functional Capacity**

	YES	NO
Do you normally have difficulty climbing up 1 floor or walking from one bus stop to the next one?		
If 'YES', proceed to (i); if 'NO', proceed to Q6.		
(i) This difficulty is due to [please tick the appropriate box (es)]:		
Chest pain Shortness of Breath Arthritis (joint pain)		

Please indicate your gender. Option will be Male/Female. For female branch out to the below sub question.

### Q6) Only For Female Patients

	YES	NO
Are you pregnant?		_
Are you on the Oral Contraceptive Pill?		

# Q7) Drug Allergy History

	YES	NO
Are you allergic or sensitive to certain medications?		

# Q8) Drug history

Can you safely take Panadol/Paracetamol without any problems? NO – I CANNOT take it YES – I CAN take it NOT SURE Can you safely take either Aspirin, Voltaren or Ibuprofen without any problems? NO – I CANNOT take it YES – I CAN take it NOT SURE Can you safely take Arcoxia or Celebrex (COX 2 inhibitor) without any problems?

NO – I CANNOT take it YES – I CAN take it NOT SURE

### Q9) Dental Hygiene

	YES	NO
Do you have any loose or wiggle teeth?		

# Once completed

Thank you for completing the questionnaire. We will contact you within the next 3 working days with instructions regarding your operation.

# APPENDIX 2: PATIENT EXPERIENCE QUESTIONNAIRE (PEQ) FOR PATIENTS AGED 18 - 44 YEARS

In	order to pro	vide a better	service, we	ask for your	r experience in th	is visit a	nd what it f	elt like	
1) Do you know wha	t to expect re	garding your a	anaesthetic ex	perience on	the day of your or	peration?			
Much more	Some mor	е	A bit more		Not much more	Э	No more		
2) I had a good talk	with the anae	sthetic doctor	nurse/						
Agree completely	Agree		So-so		Disagree		Disagree	completely	
3) I felt reassured									
Agree completely	Agree		So-so		Disagree		Disagree	completely	
4) The doctor/nurse	understood w	hat was on m	y mind						
Agree completely	Agree		So-so		Disagree		Disagree	completely	
5) I felt I was taken	care of								
Agree completely	Agree		So-so		Disagree		Disagree completely		
6) It was a bit difficul	It to connect v	with the doctor	r/nurse						
Agree completely	Agree		So-so		Disagree		Disagree	completely	
7) Too much time wa	as spent on sr	mall talk							
Agree completely	Agree		So-so		Disagree		Disagree	completely	
8) It was a bit difficu	It to ask ques	tions							
Agree completely	Agree		So-so		Disagree		Disagree	completely	
9) Important decision	is were made	over my head	b						
Agree completely	Agree		So-so		Disagree		Disagree completely		
10) I sensed that oth	er patients co	ould listen in w	/hen I was tal	king to the s	taff				
Agree completely	Agree		So-so		Disagree		Disagree completely		
11) I felt like one of t	the crowd and	l not importan	t						
Agree completely	completely Agree			So-so		Disagree		Disagree completely	
12) Emotions immed	iately after sp	eaking to the	doctor/nurse	for my anaes	thetic assessment				
		After this	visit I felt (p	lease circle	one number for e	ach line)			
Relieved	7	6	5	4	3	2	1	Worried	
Sad	7	6	5	4	3	2	1	Cheerful	
Strengthened	7	6	5	4	3	2	1	Worn out	
Relaxed	7	6	5	4	3	2	1	Tense	