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. 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 and comprised 35 questions. 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, adapted from a validated questionnaire 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. 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.\(^3\) \(k = 2\) 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\(^6\) 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.\(^3\) 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 |
|-----------------------------------------------|----------|-------|
| I Count | % within PAAC-ASA | % within ePAQ-ASA | % within PAAC-ASA | % within ePAQ-ASA |
| I | 47 | 12 | 0 | 59 |
| II | 11 | 42 | 2 | 55 |
| III | 19.0 | 75.0 | 18.2 | 44.0 |
| Total | 58 | 56 | 11 | 125 |

| % within PAAC-ASA | % within ePAQ-ASA |
|-------------------|-------------------|
| 46.4 | 44.8 |
| 100.0 | 100.0 |

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

| Table 2: Comparison of PEQ results between patients reviewed in PAAC | 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 (1.16) | 116.0 | 1.2 (1.124) | 3750 | 0.01* |
| I had a good talk with the anaesthetic doctor/nurse | 0.5 | 117 | 0.7 (136.5) | 4148 | 0.07 |
| 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) | 4218 | 0.17 |
| (2) Cheerful → Sad (7) | 2.6 (1-7) | 122.9 | 2.4 (1-5) | 4526 | 0.52 |
| (3) Worn out → Strengthened (7) | 5.3 (1-7) | 119.0 | 5.5 (2-7) | 4389 | 0.36 |
| (4) Tense → Relaxed (7) | 5.6 (2-7) | 120.6 | 5.8 (2-7) | 4471 | 0.38 |

PAAC: Pre-admission anaesthetic clinic; PEQ: Patient experience questionnaire
The ASA score obtained from the ePAQ and face-to-face consultation was compared for internal consistency using Cronbach’s alpha [6] [Table 1]. Reliability of ePAQ with PAAC-ASA using Cronbach’s alpha [6] 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
providers to focus resources on the patients in greatest need. In fact, studies have demonstrated efficacy and patient safety of telemedicine as patients may be more willing to interact with a computer than to reveal personal facts to a clinician.

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, 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 suggesting room for improvement with the ePAQ.

Strengths of this audit include the provision of longitudinal outcome measurements such as 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; nevertheless, telemedicine has redesigned health care services in coronavirus disease-19 times and its implementation is attributed to modern computer technology. 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 utility. 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. Issues may arise from the inability to conduct physical examination, particularly...
airway and cardiopulmonary assessment.\textsuperscript{[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.

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Nil.

**Conflicts of interest**

There are no conflicts of interest.

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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? | | |
| l) 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.
(i) In the past 4 weeks, how much of the time did your asthma keep you from getting as much done at work, school or at home?

| 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] |
|-------------------|---------------------|---------------------|-------------------------|---------------------|
| SCORE             |                     |                     |                         |                     |

2. During the past 4 weeks, how often have you had shortness of breath?

| More than | Once | 3 to 6 times | Once or | Not at all [5] |
|-----------|------|--------------|--------|---------------|
| Over 1 day [1] | a day [2] | a week [3] | twice a week [4] |               |

3. During the past 4 weeks, how often did your asthma symptoms (wheezing, coughing, shortness of breath, chest tightness or pain) wake you up at night or earlier than usual in the morning?

| 4 or more | 2 to 3 nights | Once a week | Once or twice | Not at all [5] |
|-----------|---------------|-------------|---------------|---------------|
| 4 nights a week [1] | 2 to 3 nights | Once a week [2] | twice a week [4] |               |

4. During the past 4 weeks, how often have you used your rescue inhaler or nebulizer medication (such as albuterol)?

| 3 or more | 1 to 2 times | 2 or 3 times | Once a week | Not at all [5] |
|-----------|--------------|-------------|------------|---------------|
| 3 times per day [1] | 1 to 2 times | 2 or 3 times | Once a week |               |

5. How would you rate your asthma control during the past 4 weeks?

| Not Controlled at All [1] | Poorly Controlled [2] | Somewhat Controlled [3] | Well Controlled [4] | Completely Controlled [5] |
|---------------------------|-----------------------|-------------------------|-------------------|--------------------------|

q) Any other breathing problems, apart from asthma e.g., bronchitis, emphysema?

r) Any breathing problems while you sleep e.g., Obstructive Sleep Apnoea (OSA)? If YES, proceed to (i), if NO proceed to s)

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

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.

**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?

**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

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

Are you pregnant?
Are you on the Oral Contraceptive Pill?

Q7) Drug Allergy History

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

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 provide a better service, we ask for your experience in this visit and what it felt like.

| 1) Do you know what to expect regarding your anaesthetic experience on the day of your operation? | Much more | Some more | A bit more | Not much more | No more |
|---|---|---|---|---|---|
| Agree completely | Agree | So-so | Disagree | Disagree completely |

| 2) I had a good talk with the anaesthetic 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 what was on my 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 difficult to connect with the doctor/nurse | Agree completely | Agree | So-so | Disagree | Disagree completely |
|---|---|---|---|---|---|

| 7) Too much time was spent on small talk | Agree completely | Agree | So-so | Disagree | Disagree completely |
|---|---|---|---|---|---|

| 8) It was a bit difficult to ask questions | Agree completely | Agree | So-so | Disagree | Disagree completely |
|---|---|---|---|---|---|

| 9) Important decisions were made over my head | Agree completely | Agree | So-so | Disagree | Disagree completely |
|---|---|---|---|---|---|

| 10) I sensed that other patients could listen in when I was talking to the staff | Agree completely | Agree | So-so | Disagree | Disagree completely |
|---|---|---|---|---|---|

| 11) I felt like one of the crowd and not important | Agree completely | Agree | So-so | Disagree | Disagree completely |
|---|---|---|---|---|---|

| 12) Emotions immediately after speaking to the doctor/nurse for my anaesthetic assessment | After this visit I felt (please circle one number for each line) | Relieved | Sad | Strengthened | Relaxed |
|---|---|---|---|---|---|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | Worried |
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | Cheerful |
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | Worn out |
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | Tense |