The development of a nurse-led preoperative anaesthesia screening tool by Delphi consensus

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Background. Low- and middle-income countries have a critical shortage of specialist anaesthetists. Most patients arriving for surgery are of low perioperative risk. Without immediate access to preoperative specialist care, an appropriate interim strategy may be to ensure that only high-risk patients are seen preoperatively by a specialist. Matching human resources to the burden of disease with a nurse-administered pre-operative screening tool to identify high-risk patients who might benefit from specialist review prior to the day of surgery may be an effective strategy.
Objective. To develop a nurse-administered preoperative anaesthesia screening tool to identify patients who would most likely benefit from a specialist review before the day of surgery, and those patients who could safely be seen by the anaesthetist on the day of surgery. This would ensure adequate time for optimisation of high-risk patients preoperatively and limit avoidable day-of-surgery cancellations.
Methods. A systematic review was conducted to identify preoperative screening questions for use in a three-round Delphi consensus process. A panel of 16 experienced full-time clinical anaesthetists representing all university-affiliated anaesthesia departments in South Africa participated to define a nurses' screening tool for preoperative assessment.
Results. Ninety-eight studies were identified, which generated 79 questions. An additional 14 items identified by the facilitators were added to create a list of 93 questions for the first round. The final screening tool consisted of 81 questions, of which 37 were deemed critical to identify patients who should be seen by a specialist prior to the day of surgery.
Conclusion. A structured nurse-administered preoperative screening tool is proposed to identify high-risk patients who are likely to benefit from a timely preoperative specialist anaesthetist review to avoid cancellation on the day of surgery.

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Low- and middle-income countries perform too few surgeries.[1] Access to theatre is partly limited by human resource constraints, which include a critical shortage of specialists.[2] Despite the limited number of surgeries in low-resource environments, not all high-risk patients are seen timeously prior to surgery to modify risk. This is partly due to the limited number of anaesthetists. Nearly 80% of patients presenting for surgery in low- and middle-income countries are of a low perioperative risk, yet not all of the remaining high-risk patients are seen by a specialist anaesthetist.[3]

Hypothesis

Low-risk patients are unlikely to be cancelled on the day of surgery because of health-related issues, and thus do not require assessment by an anaesthetist until the day of surgery. Patients with an elevated risk, and those with modifiable risk factors, are more likely to benefit from a specialist anaesthesia review and preoperative optimisation. A critical shortage of specialist anaesthetists leads to a significant proportion of high-risk patients not being timeously and appropriately assessed preoperatively. Additionally, a lack of a simple triage/

screening system to differentiate the low- and high-risk patients leads to an inappropriate review of low-risk patients by specialists.

Without immediate preoperative access to specialist anaesthesia care for all patients, an appropriate interim strategy may be to ensure that only high-risk patients are seen by a specialist. Task-sharing of the preoperative assessment process by nurses and anaesthetists could increase the effectiveness of the available human resources.

By matching human resources to the patient's burden of disease with a nurse-administered preoperative anaesthesia screening tool, we may be able to identify all high-risk patients who might benefit from specialist review prior to the day of surgery. This may be an effective strategy to ensure appropriate allocation of human resources.

Objectives

The primary objective of the study was to develop a nurse-administered preoperative anaesthaesia screening tool to identify patients who would most likely benefit from a specialist review before the day of surgery, and those patients who could safely be seen by the anaesthetist on the day of surgery. This would ensure adequate time for optimisation of high-risk patients preoperatively, and limit avoidable day-of-surgery cancellations.

Methods

Question generation for Delphi consensus process

A systematic review of published preoperative screening tools was conducted on 5 August 2017. The search is shown in the appendix (http://samedical.org/file/2160).

The search of PubMed, Scopus and EBSCOhost generated 899 references. These were screened to include only human studies, patients in the preoperative setting undergoing non-cardiac or non-obstetric surgery and studies involving a risk stratification tool or questionnaire. Review and duplicate articles were excluded. Ninety-eight studies were identified (appendix S2) and used to generate a list of 79 screening items which were then categorised into 10 domains (appendix S3).

The Delphi study was approved by the Human Research Ethics Committee of the Faculty of Health Sciences, University of Cape Town (ref. no. HREC 841/2019). All participants consented to participation in the process and were invited to be co-authors of the manuscript. The Conducting and REporting of DElphi Studies (CREDES) was used as a reporting guideline[4] (appendix S4).

Panel selection

Heads of anaesthesia departments (HODs) at all eight of the universities in South Africa (SA) were asked to nominate two members of their department to participate in the study who fulfilled the following criteria: (*i*) clinical experience of at least 5 years post specialist examinations; (*ii*) strong general clinical ability coupled with up-to-date academic knowledge; and (*iii*) a willingness to participate and communicate their point of view.

Delphi process

Stage 1: Establishing a preliminary list of questions to be included for round 1: A further 14 items were added by the facilitators (MN and BB) to the 79 items identified in the systematic review (Supplementary material S5,6).

Stage 2: Delphi round 1: The list of questions was recorded on an Excel for Mac (version 16.53; Microsoft, USA) spreadsheet and emailed to the participating anaesthetists for formal rating of the components. They were asked to rate the importance of a particular component on a 9-point Likert scale, where 1 was considered as least important and 9 most important. Guidance on categorising the items was given to the panel (Table 1).

The panel was instructed to provide comments related to any of the components, as well as propose any additional questions that they thought were important and not included.

Stage 3: Processing of round 1: The questions and responses were transcribed onto Google Sheets and categorised into one of three categories (unimportant, important or critical) based on the median response score calculated for each question. Consensus criteria for categorisation was set at 75%, 95% confidence interval 53.8 - 96.2 (12/16 panel members needed to agree on the categorisation). Items where consensus was reached for 'low importance' were removed from subsequent rounds and not included in the proposed tool. Items with consensus for 'important' and 'critical' would be included in the screening tool.

Stage 4: Delphi round 2: Each panel member received individual Google Sheets with the list of questions and their median scores. The panel were asked to consider re-ranking those items that did not reach the 75% majority, and also to score the newly suggested items.

Stage 5: Processing of round 2: Questions considered similar or duplicates by the panel were amalgamated. Questions achieving consensus for 'low importance' were removed. Following round 2, the facilitators prepared the remaining set of questions for round 3 panel discussion.

Stage 6: Delphi round 3 and final consensus: The list of 'important' and 'critical' questions where consensus was reached was circulated to the panel 3 days prior to the scheduled online Zoom meeting. The recorded meeting was chaired and facilitated by MN and BB, during which all the questions and their median score were presented for discussion. The facilitators' role was to move the group to a consensus position and categorise each item into one of the three categories. Panel members were able to raise their views verbally as well as via the chat forum. Categorisation of each question was concluded by majority decision (75%). If consensus was not reached, the default position was to adopt a more conservative strategy and include questions at the higher category. Thus, if a small cohort of panel members believed that the item was 'critical', but the view was not shared by 75% of the group, it would still have been included as a 'critical' item. The results of the final Delphi round were circulated by email to the panel for final approval to ensure that it reflected the views of all the panel members.

Table 1. Likert scale for categorising question

Low-importance item in decision-making			Important item			Critical item		
Item will be removed from screening tool			Patient can be seen on the day of surgery			Patient must be seen by an anaesthetist before the day of surgery		
1	2	3	4	5	6	7	8	9

Table 2. The Nurses' Preoperative Screening Tool

A positive response to a critical question indicates that the patient MUST be seen by an anaesthetist BEFORE the day of surgery	
A positive response to an important question indicates important information required to plan and execute an appropriate anaesthetic and perioperative journey but the patient can arrive ON THE DAY OF surgery	
Cardiovascular	
Have you ever had chest pain, angina or heart attack?	CRITICAL
Have you ever had heart failure or fluid in your lungs?	CRITICAL
Do you have a pacemaker or any heart implants?	CRITICAL
Have you ever been TREATED for an irregular heart beat?	CRITICAL
Do you have high blood pressure in the lungs (pulmonary hypertension)?	CRITICAL
Do you have a heart murmur?	CRITICAL
Have you ever had heart trouble?	CRITICAL
Have you seen a heart doctor (cardiologist) within the last 6 months for an unscheduled or urgent heart problem?	CRITICAL
Did you have rheumatic fever as a child?	IMPORTANT
Respiratory	
Do you use oxygen at home during the day or at night?	CRITICAL
Screening for obstructive sleep apnoea: CRITICAL if 1) YES to TIRED or SLEEPY during the day during the day AND 2) YES to two of the three below	
Do you feel TIRED or SLEEPY during the day?	IMPORTANT
Do you SNORE loudly?	IMPORTANT
Has anyone seen you STOP BREATHING or CHOKE during sleep?	IMPORTANT
Do you have high blood pressure?	IMPORTANT
Do you ever have difficulty with your breathing?	IMPORTANT
Do you have asthma, bronchitis, or emphysema?	IMPORTANT
Have you had a chest problem in the last 3 months for which you had to take oral steroids (e.g. prednisone) tablets or been admitted to hospital?	CRITICAL
Do you now or have you recently (within the last year) smoked cigarettes?	IMPORTANT
Do you cough frequently?	IMPORTANT
Have you had or been treated for TB (tuberculosis) before?	IMPORTANT
Nervous system	
Do you have myasthenia gravis or muscular dystrophy?	CRITICAL
Have you had a stroke in the last 3 months?	CRITICAL
Have you had or do you have Alzheimer's disease, dementia, multiple sclerosis, brain aneurysm or brain tumour?	IMPORTANT
Do you have numbness or weakness of your arms or legs?	IMPORTANT
Do you have epilepsy, blackouts or seizures? (If new onset or within the last month then CRITICAL)	IMPORTANT/CRITICAL
Blood disorders	
Have you ever had blood clots in the legs or lungs?	CRITICAL
Do you have haemophilia, sickle cell disease or blood cancer?	CRITICAL
Do you bruise easily or have bleeding problems?	CRITICAL
Would you REFUSE a blood transfusion if a doctor thought it was in your best interest or life-saving?	CRITICAL
Have you ever had a serious or life-threatening reaction to a blood transfusion?	IMPORTANT
Endocrine	
Do you have diabetes?	IMPORTANT
Have you been admitted to hospital in the last 6 months because of a diabetic complication?	CRITICAL
Do you have a history of thyroid problems?	IMPORTANT
If you are on thyroid medication, has it been more than a year since your last thyroid test?	CRITICAL
Gastrointestinal	
Do you have liver disease, or a history of jaundice or hepatitis as an adult?	CRITICAL
Do you have indigestion, heartburn, or a hiatus hernia?	IMPORTANT
Renal	
Do you have a kidney problem?	IMPORTANT
Are you on dialysis?	CRITICAL

...continued

Table 2. The Nurses' Preoperative Screening Tool (continued)

Medical	
Have you had an organ transplant?	CRITICAL
Is the patient going for intermediate or high-risk surgery?	IMPORTANT
Have you got a cancer that has spread?	IMPORTANT
Have you lost weight unintentionally in the last 3 months?	IMPORTANT
Have you spent a night in hospital (been hospitalised) in the last 6 months?	IMPORTANT
Have you had an intensive care unit admission because of COVID-19?	IMPORTANT
Have you had COVID-19 in the last 6 weeks?	IMPORTANT
Are you HIV positive?	IMPORTANT
Do you drink more than three drinks of alcohol per day?	IMPORTANT
Do you think you may be pregnant?	IMPORTANT
Clinical parameters	
Is the saturation on room air after 5 deep breaths <90%?	CRITICAL
Is the sodium (Na) <126 mmol/L or >150 mmol/L?	CRITICAL
Is the potassium (K) <2.9 or >5.9 mmol/L?	CRITICAL
Is the respiratory rate >24 breaths per minute?	CRITICAL
Is the heart rate <50 or >120 per minute?	CRITICAL
Is the systolic blood pressure >180 mmHg or the diastolic blood pressure >110 mmHg?	CRITICAL
Is the systolic pressure <90 mmHg?	CRITICAL
Is the creatinine >177 micromol/L?	IMPORTANT
Is the urea >15 mmol/L?	CRITICAL
Is the haemoglobin between 7 and 10 g/dL?	IMPORTANT
Is the haemoglobin (Hb) <7 g/dL?	CRITICAL
Is the white cell count <3 or >20×10^9 /L?	CRITICAL
Is the platelet count <100×10^9 /L	CRITICAL
Is the HbA1c >8 mmol/L?	IMPORTANT
Calculated body mass index (weight (kg)/height(m)^2)	IMPORTANT
Anaesthetic	
Can you climb one flight of stairs or walk uphill without stopping? Do not answer 'yes' if the only reason that you are unable to do this is because of an orthopaedic condition (If UNABLE then mark as CRITICAL)	CRITICAL
Do you need assistance with getting dressed or washing yourself?	CRITICAL
Is the patient frail (scores ≥5 on the clinical frailty scale)?*	IMPORTANT
In any of your operations was there any difficulty in placing a (breathing) tube into your airway?	CRITICAL
Have you or a blood relative been put to sleep for an operation and experienced any serious anaesthetic problems?	CRITICAL
Did you experience any major nausea or vomiting after any operation?	IMPORTANT
Do you have any allergies to food, medication or latex?	IMPORTANT
Do you have any problems with pain, stiffness or arthritis in your neck or jaw?	IMPORTANT
Do you have any difficulty in opening your mouth?	IMPORTANT
Do you have dentures, capped or loose teeth?	IMPORTANT
Do you wear contact lenses or a hearing aid?	IMPORTANT
Are you taking blood thinners now?	CRITICAL
Are you taking any over-the-counter (garlic, ginseng, echinacea) medicine?	IMPORTANT
Are you taking any traditional medicine?	IMPORTANT
Do you take narcotic medication not prescribed for you or street (illicit) drugs?	IMPORTANT
Have you taken prednisone, steroid medication, or cortisone-like drugs in the past year?	IMPORTANT
List ALL the medication you are currently taking	IMPORTANT
Is there anything else that your anaesthetist or surgeon should know?	IMPORTANT

* See appendix S6.

Results

Ninety-eight studies identified in the systematic review generated 79 questions. An additional 14 questions were added by the facilitators to create a list of 93 items (appendix S6) for round 1 of the Delphi process. New panel-proposed items from rounds 1 and 2 are included in appendix S7. The results of the individual questions for rounds 1 and 2 are listed in appendix S8.

The selected panel for the Delphi process included 16 anaesthetists with a mean (standard deviation) specialist work experience of 14.9 (6.5) years. Five of the eight university HODs were part of the panel.

The summary of the Delphi rounds is shown in Fig. 1.

Fourteen of the 16 panel members attended the round 3 online meeting. The other two members subsequently made comments, reviewed the final questions and agreed with the consensus reached.

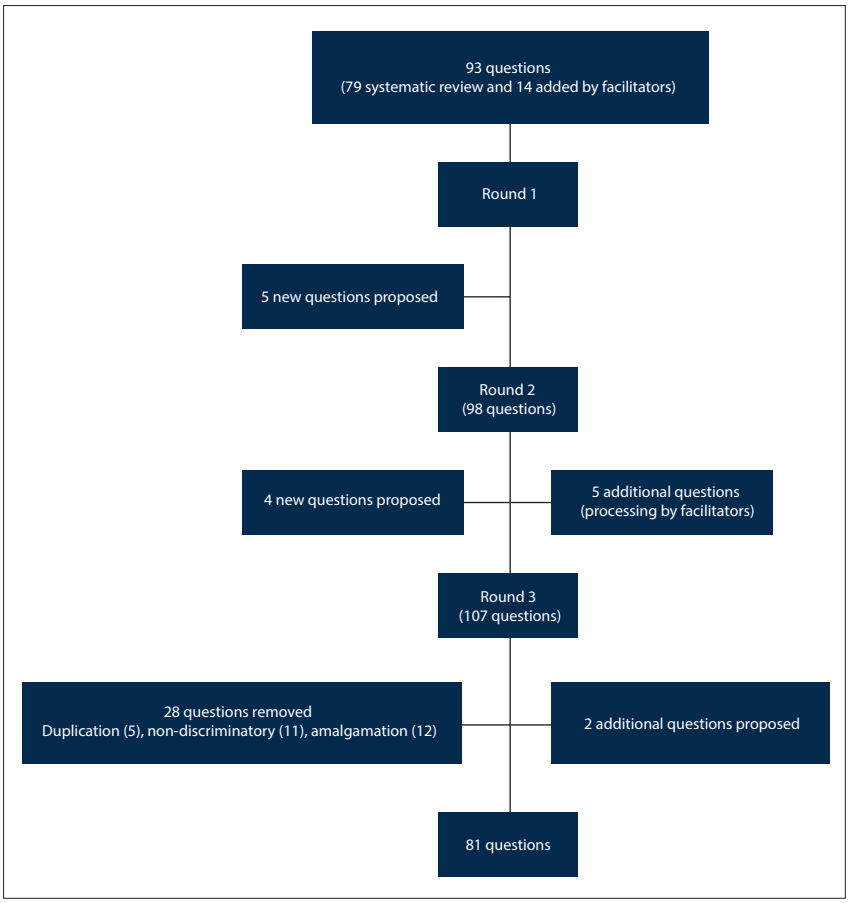

Fig. 1. Summary of Delphi process.

The facilitators' role during round 3 was to move the panel towards consensus on items not reached during round 2. Importantly, the aim of the final round was to create a questionnaire that would identify only the high-risk patients needing review before the day of surgery. To avoid inclusion of low-risk patients needing review before the day of surgery, the facilitators also proposed that certain questions despite consensus categorisation as 'critical' during round 2 be discussed and be possibly recategorised as 'important' (appendix S9).

At the conclusion of the Delphi process, the Nurses' Preoperative Screening Tool included 81 items, of which 37 were critical, which identified patients who should be seen by a specialist prior to the day of surgery, and 44 important questions were also identified. The final Nurses' Preoperative Screening Tool is shown in Table 2.

Discussion

The principal outcome of the study is an agreed-upon structured preoperative screening tool that can be administered by a nurse to identify high-risk patients who may benefit from a specialist review prior to the day of surgery. The tool also identifies clinically important information that may affect perioperative care but would be unlikely to result in a cancellation on the day of surgery.

The study had several strengths. The proposed questions for inclusion in the Delphi consensus process were derived from a systematic review. The Delphi panel was experienced, with an individual average of 15 years as a specialist anaesthetist. Importantly, there was strong national support for the study, with five HODs on the panel and all eight academic anaesthesia departments in SA represented. The specialists on the panel care for patients across SA, which includes a population spectrum of diverse health literacy and economic status. It is therefore likely that the tool may have utility across all levels of healthcare. Its use in remote rural settings where access to healthcare resources is often limited would need to be tested.

The following limitations of the study were identified. Nurses for whom the tool is intended were not included in the Delphi process. Testing the clinical applicability and nurse acceptability will be explored in subsequent studies, but nurse-led pre-operative assessment clinics are not novel.[5,6] Another limitation was the absence of specialist anaesthetists from private practice on the Delphi panel. Although the motivation behind the study was the extreme shortage of anaesthetists in the state sector, and identifying strategies to optimise specialist time through task-sharing of screening by nurses, and even though the majority of the panel has some degree of private practice experience, the authors acknowledge that colleagues in private practice could have contributed intellectual and sector-specific information. This may well have enhanced the validity and possible uptake of the questionnaire. Future work with the private sector through the SA Society of Anaesthesiologists may attract participation in the testing, refinement and validation of the tool for a broader SA context.

The risk of a bandwagon effect with Delphi participants going along with the majority opinion was not assessed. Pursuing group consensus through the display of median scores and group categorisation increases the tradeoff between accuracy and consensus.[7] The study mitigated the risk through: (*i*) anonymity in the first two rounds; (*ii*) intermediate cohesiveness of the group (panel of expert with some degree of heterogeneity influenced by their local factors); (*iii*) online meeting, which may be associated with less social pressure than a face-to-face meeting (speculative); and (*iv*) filtered feedback by facilitators in exploring minority/divergent points of view in the final round. Amalgamation of questions, directing of discussions and drive toward consensus with the aim of finding a practical and appropriate tool may have been subject to facilitator bias. However, to limit facilitator bias, we used two facilitators, who were sensitive in exploring every individual opinion and searching for a group consensus during the online meeting. The online meeting was recorded and reviewed, and results of the final round were circulated to all members, with unanimous approval of the final document. This may support the view that the facilitators did not have undue influence on the process, although this was not objectively assessed.

The tool has many questions, which may detract from its use. Some questions may not be easily and consistently interpretable. One such question, about the level of surgical risk, may be difficult to quantify for doctors as well as nurses for whom the tool was intended. Adding a list of surgeries that accompanies the questionnaire where the risk of major adverse cardiac events (MACE) is low (<1%), intermediate (1 - 5%) and high (>5%) could assist in answering the question.

The study does not offer any new paradigm shifts or novel screening strategies. Its intention was to identify and formalise a set of screening items, through a process of consensus, to identify high-risk patients who may likely benefit from a specialist review prior to the day of surgery.

The study has several potential positive consequences that need to be tested. These include the appropriate referral of high-risk patients and subsequent decrease in cancellation rates, better resource allocation of specialist services by avoiding unnecessary review of low-risk patients, and nurse empowerment and upskilling to improve the level of perioperative care. Finally, the screening tool may become an adaptable foundation for use in a preoperative assessment clinic and a bridge to education and treatment strategies in targeting chronic conditions such as diabetes, hypertension and anaemia.

Future work will focus on prospective validation of the tool and contextual adaptation into different health systems. Poorly performing questions with low predictive value for cancellation can be identified and removed to streamline the screening process.

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