

# Knowledge, attitudes, and practices of South African anaesthesiology registrars towards perioperative point-of-care viscoelastic testing

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**Background:** Perioperative bleeding contributes significantly to patient morbidity and mortality while the cost of blood products is substantial. Viscoelastic testing (VET) forms part of the armamentarium for perioperative patient blood management. To date, there is a lack of published literature on the knowledge, attitudes, and practices (KAP) of medical practitioners regarding VET. The objective of this study was to describe the KAP of South African anaesthesiology registrars concerning perioperative point-of-care (POC) VET.

**Methods:** A descriptive, cross-sectional study design was performed using a novel, electronic self-administered questionnaire as the data collection instrument. The study population consisted of South African anaesthesiology registrars who were part of the South African Society of Anaesthesiologists' (SASA) electronic mailing list.

**Results:** A total of 71 completed questionnaires were received (response rate = 16.67%). Based on this, 69% of registrars were found to have adequate knowledge. Senior registrars were more likely to have adequate knowledge than junior registrars ( $p = 0.043$ ). Of the registrars, 64.7% had a positive attitude score towards perioperative VET. All registrars felt they would benefit from a formal education platform on VET. The overall median self-rated confidence score for interpreting VET results was 6/10. Senior registrars had a higher median self-rated confidence score (6 vs 5) compared to junior registrars ( $p = 0.005$ ). Registrars stated that a lack of VET consumables and trained technologists to administer the test was the greatest barrier to requesting VET for patients at their respective institutions.

**Conclusion:** Overall knowledge scores were encouraging, however, there is room for improvement, particularly at the junior registrar level. Targeted educational interventions should be implemented at both a local and national level. The lack of national guidelines should be addressed by a multidisciplinary team. Locally developed guidelines can serve as a tool for improving registrar knowledge on the subject of VET and can be used for improving uniformity in practices and standards across the various registrar training circuits in South Africa.

**Keywords:** knowledge, attitudes, practices, South African anaesthesiology registrars, perioperative point-of-care, viscoelastic testing, VET

## Introduction

South Africa is a resource-limited country where the cost of blood products is significant.<sup>1</sup> In addition to the direct costs involved in ordering blood products, the administration of blood products may also contribute to patient morbidity and mortality.<sup>2</sup> These direct and indirect costs underscore the importance of utilising blood products judiciously, and wherever possible, basing the decision to administer these products on empirical evidence/data.

Anaesthetists regularly encounter coagulopathic patients in a perioperative setting and are expected to make decisions on whether to administer a blood product or not to the patient. point-of-care (POC) viscoelastic testing (VET) has become an increasingly important modality in a perioperative setting for the management of clinically coagulopathic patients by elucidating the nature of coagulopathy and directing the administration of blood products.

A systematic review and cost-effectiveness analysis conducted by Whiting et al. found that patients undergoing cardiac or

trauma surgery received fewer allogenic blood products if their transfusion decisions were aided by VET data as opposed to standard laboratory test (SLT) data.<sup>3</sup> This translated into significant cost savings. The review wasn't able to comment definitively on the clinical effectiveness of VET versus SLT in trauma patients but found that cardiac surgery patients had shorter lengths of intensive care unit (ICU) stay without significant differences in reoperation, mortality, or overall length of stay between VET and SLT groups. Further studies have shown that the implementation of a goal-directed transfusion protocol informed by POC VET has led to significant reductions in the number of blood products administered to patients, including obstetric patients with postpartum haemorrhage, patients undergoing thoracolumbar spinal surgery, patients undergoing a living donor liver transplant, and patients who were being managed for acute coagulopathy of trauma/shock.<sup>4-7</sup>

There is currently no published literature that looks at the knowledge, attitudes, and practices (KAP) of anaesthesiology registrars/trainees with respect to the benefit and use of perioperative POC VET. A survey looking at the KAP of the current

cohort of South African anaesthesiology registrars regarding perioperative POC VET has the potential to provide useful insight into this subject. It may serve as a useful baseline to allow for the identification of trends, and potential areas of improvement, and can potentially provide useful information to relevant stakeholders for the development of registrar curricula and VET use within transfusion guidelines going forward.

## Methods

We conducted a prospective, cross-sectional study across South African university-affiliated hospitals. Ethical clearance was obtained from the Health Research Ethics Committee of Stellenbosch University (HREC Reference No: S21/07/123). Our primary objective was to empirically describe the KAP of South African anaesthesiology registrars towards perioperative POC VET by collecting data through an electronic self-administered questionnaire. Our study population consisted of South African anaesthesiology registrars who were registered members of the South African Society of Anaesthesiologists (SASA) at the time of distributing the questionnaire (September to October 2021).

### Data instrument and collection

The study questionnaire was created by the authors, drawing upon existing literature where applicable to keep its content evidence-based and valid. Face validity and content validity were carried out concurrently by distributing the questionnaire to eight consultant anaesthetists who regularly work with VET data in a perioperative setting. They had the opportunity to review the questionnaire in terms of its comprehensiveness and whether it covered the concepts it aimed to measure. Their feedback and suggested amendments were incorporated into the final version of the questionnaire that was distributed to registrars.

The questionnaire was electronically distributed via SASA's weekly email newsletter over a period of four weeks, commencing 23 September 2021. A total sampling method was employed by sending an invitation to participate to all eligible respondents (via a link in the SASA email newsletter) and those willing to participate accordingly responded. Participation was voluntary and responses were de-identified. An online questionnaire information leaflet was provided to all respondents as part of the informed consent. Respondents had to tick a checkbox confirming they understood the contents of the leaflet and that they agreed to participate in the study. The authors made extensive efforts to explicitly state in the questionnaire literature, disclaimer, header, and demographics section that it was only intended for completion by South African anaesthesiology registrars, hence the authors are satisfied that this would have minimised the risk and possibility that non-registrars may have completed the questionnaire. Participation was incentivised through a voucher mechanism that was approved by the university.

### Variables and outcomes

The questionnaire consisted of four sections. Section A captured respondents' demographic information and their main sources of

information regarding VET. Section B explored the respondents' knowledge about perioperative POC VET. Section B consisted of five single-best-answer questions. Each correct answer was worth one mark/point. The maximum score a respondent could obtain overall was five points, while the minimum score was zero. Respondents who scored a total knowledge score of  $\geq 3$  were adjudged to have "adequate" knowledge on the subject of perioperative VET. Knowledge Questions 1, 4 and 5 respectively were application based, i.e. they involved the interpretation of ROTEM/TEG values in the context of a clinical scenario. Knowledge Questions 2 and 3 respectively were recall based.

The memorandum for Section B's questions was derived from a British Journal of Anaesthesia article on the subject of VET, which formed part of the Royal College of Anaesthesia's "Continuing Education in Anaesthesia" curriculum and CPD revalidation matrix.<sup>8</sup> Reference data was also obtained from the Gold Coast University Hospital's (affiliated with Griffith University, Queensland, Australia) ROTEM Transfusion Algorithm.<sup>9,10</sup> The decision to base the memorandum on foreign literature was due to a lack of equivalent South African guidelines and algorithms (to the best of the authors' knowledge) on the subject at the time the questionnaire was developed.

Section C explored the respondents' practice/s regarding perioperative POC VET. Specifically their level of exposure to POC VET, the context in which they would use it, their perceived barriers towards using it perioperatively, and their confidence in interpreting VET data for patient management.

Section D focused on the respondents' attitudes and perspectives toward perioperative POC VET. It consisted of eight items/statements (Figure 3) regarding the use of perioperative POC VET, which the respondent could choose to agree or disagree with on a four-point Likert scale (1 – strongly disagree, 2 – disagree, 3 – agree, 4 – strongly agree). Statements 1, 5, 6, 7 and 8 respectively gauged the participants' attitudes towards the cost and clinical benefit of perioperative VET, as well as their attitude towards having formal education on VET interpretation. Statements 2 and 3 gauged the respondents' perspective regarding the logistical and financial feasibility of implementing perioperative VET in South Africa. Statement 4 gauged the likelihood that perioperative VET would form part of their clinical practice after their registrar training was complete.

Please refer to the supplementary document for a sample copy of the questionnaire.

### Data management and analysis

Responses were electronically captured into REDCap version 12.4 (Vanderbilt, Tennessee, USA), a data-capturing software tool licensed to Stellenbosch University and exported into a Microsoft Excel 2010 (Microsoft Corp, Washington, USA) spreadsheet. Data from the Excel spreadsheet was subsequently exported to Stata 14.2 (StataCorp, Texas, USA) for further analysis. The sociodemographic and professional profiles as well as the knowledge and practices of enrolled registrars included in

the analysis were described using descriptive statistics, namely frequencies and proportions for categorical data, as well as medians and interquartile ranges for continuous variables.

To determine positive attitudes towards perioperative POC VET, scores derived from the participants' responses to the statements for Section D were summed up to create an overall "positive attitude score". The internal reliability of the attitude score was determined using Cronbach  $\alpha$ , with a value of  $\alpha \geq 0.7$  considered good internal reliability.<sup>11</sup> The positive attitude score was described in terms of its median and interquartile range and categorised into a "high score" or "low score". A high score is defined as scoring the equivalent of 3 or 4 on all items on the scale – that is a total score  $\geq 24$  out of the highest possible score of 32 for the eight-item score. Or a total score  $\geq 16$  out of the highest possible score of 20 for the five-item score. Poisson regression with robust error variance was used to determine sociodemographic and professional characteristics associated with high positive scores. Variables with  $p$ -values  $< 0.2$  in the univariate analysis were included in the multivariable model. The strength of association between specified sociodemographic and professional factors from univariate regression analyses was presented as unadjusted prevalence rate ratios (PRR) with a 95% confidence interval (CI), while that from the multivariable regression analysis was presented as adjusted PRR (aPRR) with a 95% CI. A  $p$ -value  $< 0.05$  meant that the specified factor was independently associated with a high positive score in comparison to a reference group.

## Results

SASA had 426 registrars on its electronic mailing list during the period the questionnaire was distributed. A total of 101 electronic responses were returned. Of these 101 responses, 71 were complete (i.e. each question in sections A–D were answered) and were thus analysed (response rate = 16.67%), while the 30 incomplete responses were not included in the data analysis.

### Section A – description of participants

The demographic and professional characteristics of participants are summarised in Table I. Senior registrars were defined as registrars in their third or fourth year of registrar training, while junior registrars were defined as registrars in their first or second year of registrar training. Respondents were asked to select their main sources of information regarding VET (non-mutually exclusive). The four most commonly selected sources of information were: anaesthetic refresher courses (77.5% of respondents), textbooks (54.9% of respondents), miscellaneous online sources (49.3% of respondents), and taught about VET by senior colleagues (49.3% of respondents).

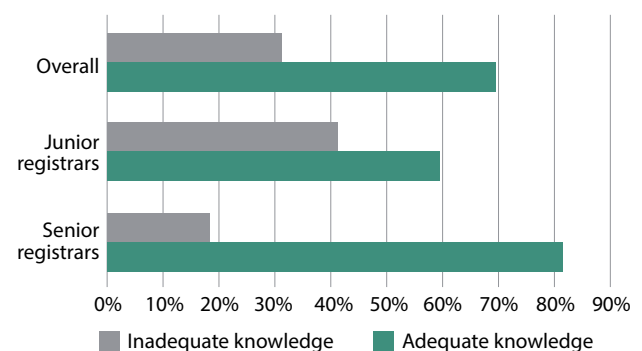
### Section B – POC VET knowledge

The proportion of registrars with adequate VET knowledge is summarised in Figure 1. The median (IQR) knowledge score for all respondents was 3 (2–4) out of a maximum of 5. Knowledge scores were lower among junior registrars than senior registrars (median, [IQR] 3 [2–3] versus 3 [3–4],  $p = 0.012$ ). Of

**Table I:** Sociodemographic and professional characteristics of enrolled registrars,  $n = 71$

Characteristic	Frequency (%)
Age (median, IQR)	33 (31–36)
Female	40 (56.3)
Year of study	
First	24 (33.8)
Second	15 (21.1)
Third	17 (23.9)
Fourth	15 (21.1)
University of training	
Sefako Makgatho Health Sciences University	2 (2.8)
Stellenbosch University	43 (60.6)
University of Cape Town	14 (19.7)
University of KwaZulu-Natal	5 (7.0)
University of Free State	2 (2.8)
University of the Witwatersrand	5 (7.0)
Level of care at training hospital	
National central hospital (i.e. Level 4 hospital – highest level of healthcare and normally receives referrals from a Level 3 provincial tertiary hospital)	26 (36.6)
Provincial tertiary hospital (i.e. Level 3 hospital – normally receives referrals from a Level 2 regional hospital)	45 (63.4)
Completed critical care rotation	52 (73.2)
Completed cardiothoracic anaesthesia rotation	28 (39.4)
Post-internship anaesthetic experience in years (median, IQR)	4 (3–6)

IQR – interquartile range



**Figure 1:** Proportion of registrars (overall and stratified into junior and senior cohorts respectively) found to have adequate knowledge on the subject of perioperative VET

the respondents, 49 (69%) had an adequate knowledge score. There was no difference in the likelihood of having adequate VET knowledge by the level of care provided by the hospital the respondent was primarily based in. Junior registrars were less likely to have adequate VET knowledge compared to senior registrars (23/39 [59%] vs 26/32 [81.3%] respectively,  $p = 0.043$ ).

### Section C – practices related to VET

Table II summarises registrars' responses for Section C of the questionnaire. All respondents worked in an institution that had facilities to perform perioperative VET. Of the respondents,

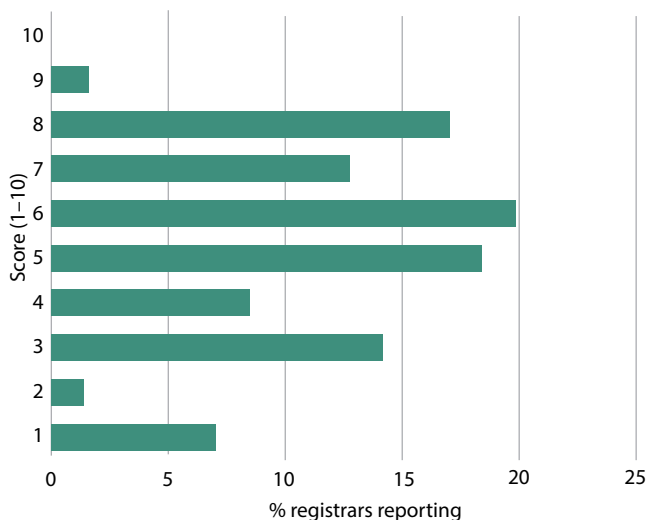


Figure 2: Self-rated confidence score for interpreting VET results

87.3% had been involved in a theatre case in which a VET was performed on a patient, while 78.9% of respondents had ordered a VET for a patient in the past year. Amongst respondents who had prior exposure to VET, it was most commonly requested for trauma surgical patients, followed by cardiothoracic and obstetrics and gynaecology patients. The majority of respondents (84.5%) stated that they would order perioperative VET after identifying coagulation abnormalities in their patients rather than establishing a baseline coagulation profile (4.2%) or measuring a response to administered blood products (9.9%). Factors discouraging VET use amongst respondents were the availability of technologists/trained staff to perform the test (54.9%), availability of VET facilities and consumables (43.7%), and turnaround time (36.6%). A lack of confidence in interpreting the results of the VET represented the greatest barrier for 15.5% of respondents, while 14.4% of respondents cited “uncertainty

Table II: Use of VET in clinical practice, n = 71

Variable	n	n (%)
Institution has facilities to do VET	71	71 (100)
Ever involved in case where VET was performed for a patient	71	62 (87.3)
Requested VET or involved in a case where VET was requested in the last 12 months of clinical practice	71	56 (78.9)
Surgical patient population for which most VET was requested*	62	
Cardiothoracic		12 (19.4)
General surgery (including burns)		3 (4.8)
Obstetrics and gynaecology		10 (16.1)
Orthopaedic surgery		1 (1.6)
Paediatric surgery		1 (1.6)
Trauma		35 (56.5)
Prefers ordering blood products before full VET result is available	62	28 (45.2)
Surgical population most likely to require VET perioperatively?+	9	
Cardiothoracic		3 (33.3)
Obstetrics and gynaecology		1 (11.1)
Trauma		5 (55.6)
Context in which perioperative VET would most frequently be ordered	71	
Academic exercise		1 (1.4)
Identifying coagulation abnormalities		60 (84.5)
Establishing baseline coagulation profile for the patient		3 (4.2)
Measuring response to administered blood products		7 (9.9)
Factors discouraging VET use <sup>‡</sup>	71	
Availability of VET facilities and consumables		31 (43.7)
Financial cost of the VET test		21 (29.6)
Availability of technologists/trained staff to perform the test		39 (54.9)
The turnaround time for the test itself		26 (36.6)
Uncertainty about whether patient would benefit from the test		18 (25.4)
Confidence in interpreting the results of the VET		19 (26.8)
The greatest barrier to VET use in practice	71	
Availability of VET facilities and consumables		17 (23.9)
Financial cost of the VET test		5 (7.0)
Availability of technologists/trained staff to perform the test		17 (23.9)
The turnaround time for the test itself		11 (15.5)
Uncertainty about whether patient would benefit from the test		10 (14.1)
Confidence in interpreting the results of the VET		11 (15.5)

\*Question posed to registrars who had previous perioperative POC VET experience

+Question posed to registrars with no previous perioperative POC VET experience

‡Registrars could choose up to three factors

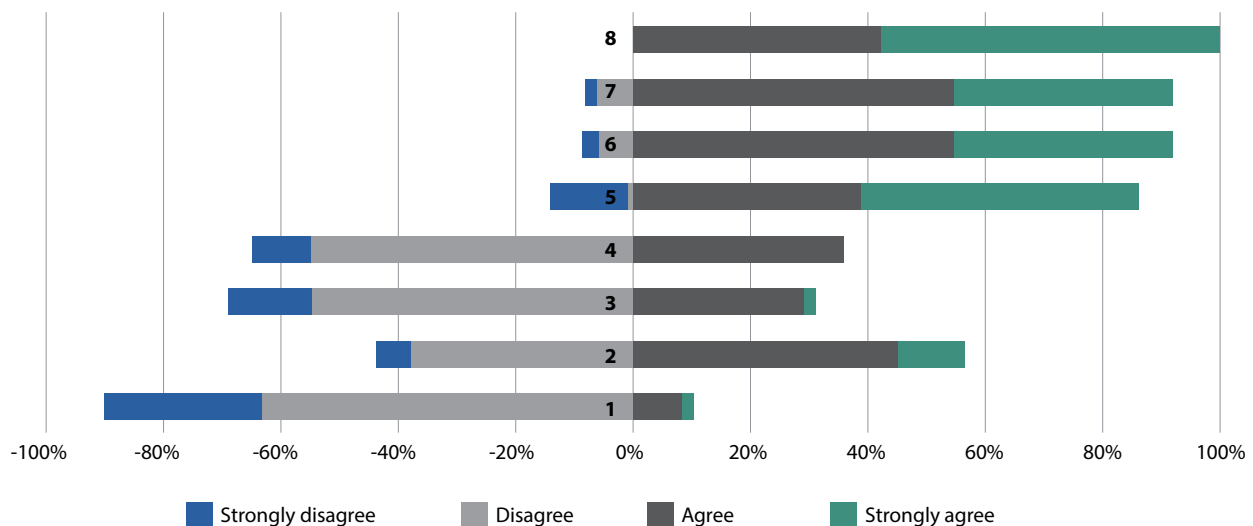


Figure 3: Divergent stacked bar graph summarising the breakdown of responses for each respective statement in Section D of the questionnaire

- 1 – Standardised laboratory tests provide me with enough information about a patient’s perioperative coagulation profile.<sup>a</sup>
  - 2 – VET can only be feasibly implemented in a tertiary/quaternary hospital setting in South Africa.
  - 3 – VET is too expensive for a resource-constrained country (such as South Africa) to have as part of standardised perioperative patient management protocol/s.
  - 4 – The likelihood that TEG/ROTEM tests will form part of my clinical practice after I complete my registrar training is low.
  - 5 – VET should become part of my institution’s/place of employment’s massive transfusion protocol.<sup>a</sup>
  - 6 – VET can lead to cost savings perioperatively at my institution/place of employment if implemented appropriately.<sup>a</sup>
  - 7 – VET can lead to improvements in morbidity/mortality for surgical patients at my institution/place of employment if implemented appropriately.<sup>a</sup>
  - 8 – I feel I would benefit from a formal education platform on the topic of ROTEM/TEG interpretation.<sup>a</sup>
- <sup>a</sup>Component of five-item positive attitude score

with respect to whether the patient would benefit from the test” as their greatest barrier to requesting a perioperative VET.

Respondents were asked to rate their confidence on a scale of 1–10 in independently interpreting a VET result and adjusting patient management accordingly (1 = very low confidence, 10 = extremely confident). The self-reported confidence scores

are summarised in Figure 2. The median (IQR) confidence score amongst all respondents was 6 (4–7).

### Section D – attitude towards POC VET

Figure 3 summarises the spectrum of responses to the statements (labelled 1–8) posed to participants in Section D of the questionnaire. All of the respondents believed they would benefit

Table III: Factors associated with a high positive attitude score based on a five-statement scale (≥ 16 out of the highest possible score of 20)

Variable	% with high positive attitude	Unadjusted PRR (95% CI)	p-value	aPRR (95% CI)	p-value
<b>Age &gt; 35 years</b>					
No	29/44 (65.9)	1.00			
Yes	17/27 (63.0)	0.96 (0.67–1.37)	0.804		
<b>Gender</b>					
Male	12/31 (38.7)	1.00		1.00	
Female	34/40 (85.0)	2.19 (1.38–3.50)	0.001	<b>1.97 (1.20–3.23)</b>	<b>0.008</b>
<b>Year of study</b>					
Third/fourth	21/32 (65.6)	1.00			
First/second	25/39 (64.1)	0.98 (0.69–1.38)	0.894		
<b>Post-internship experience</b>					
< 4 years	16/26 (61.5)	1.00			
≥ 4 years	30/45 (66.7)	1.08 (0.75–1.56)	0.672		
<b>Completed critical care rotation</b>					
No	12/19 (63.2)	1.00			
Yes	34/52 (65.4)	1.04 (0.69–1.54)	0.865		
<b>Passed knowledge test</b>					
No	14/22 (63.6)	1.00			
Yes	32/49 (65.3)	1.03 (0.70–1.50)	0.893		
<b>Confidence in interpreting VET results score</b>	71 (100)	0.86 (0.83–0.95)	0.001	<b>0.94 (0.88–1.01)</b>	<b>0.090</b>

from a formalised education platform on VET interpretation. The majority of respondents felt that perioperative VET should become part of their institution's massive transfusion protocol and that it can lead to improvements in patient outcomes and cost savings for the healthcare system if implemented appropriately.

The median (IQR) score on the eight-statement scale (Figure 3) was 25 (22–26). The Cronbach  $\alpha$  value for the positive attitude score was 0.62. The highest possible score was 32 and 44/71 (62%) participants had high scores – i.e. score  $\geq 24$  out of the highest possible score of 32. Because the value of Cronbach  $\alpha$  was lower than the threshold of good internal reliability, a five-statement scale (Figure 3) was also explored to determine positive attitudes towards VET. The median score on the five-statement scale was 16 (IQR 15–18) out of the highest possible score of 20. The proportion of registrars with scores  $\geq 16$  out of the highest possible score of 20, was 64.8% (46/71). The Cronbach  $\alpha$  for the five-statement scale was 0.71 and met the threshold for good internal reliability. Table III summarises the factors that were associated with a high positive attitude score using the five-statement scale following the regression analysis.

## Discussion

The main finding of our prospective questionnaire-based study on the KAP towards VET was that senior registrars were more likely to have adequate knowledge about POC VET as well as more confidence about interpreting POC VET data than junior registrars. A majority of respondents had a positive attitude towards perioperative VET concerning its utility and potential cost savings for patient care. The majority of respondents stated that structural/material factors were the main obstacles to utilising VET in their respective institutions (e.g. availability of consumables, technologists, etc.). Non-material factors (related to their lack of confidence and knowledge of which patients would likely benefit from perioperative VET) were additional obstacles in their clinical practice.

Respondents' main sources of information for VET varied. This may suggest that respondents consult multiple sources of information when trying to acquire knowledge on the subject, or may also be due to the lack of standardised national guidelines and literature on VET itself. This can be problematic because respondents may be consulting sources of information that aren't factually robust and appropriate to a South African healthcare context.

Knowledge scores were lower among junior registrars compared to senior registrars. A possible reason for this difference could be that senior registrars were likely exposed to a greater number of cases in which VET was performed compared to junior registrars, which may produce greater proficiency in interpreting VET data. Thus it would be beneficial to have educational interventions regarding the use and interpretation of VET, targeted particularly at junior registrars.

In addition to the finding that senior registrars had a higher median confidence score than junior registrars, the following findings were also noted:

1. Female registrars had a higher median confidence score than male registrars.
2. Registrars who had completed a rotation in critical care had a higher median confidence score than registrars who hadn't rotated in critical care.
3. Registrars who had an adequate knowledge score in Section B had a higher median confidence score than registrars who were found to have an inadequate knowledge score.

The authors were unable to account for the higher confidence score amongst female registrars. Regarding the higher median confidence scores for senior registrars and registrars that rotated in critical care, it is possible that exposure/formal education/guidance about VET in an ICU environment, and greater cumulative exposure to VET during a senior registrar's training (compared to junior registrars'), could result in greater familiarity and confidence in interpreting VET data.

Regression analysis found that females were more likely to have a higher positive attitude score when compared to their male counterparts ( $p < 0.05$ ). It was also found that lower self-reported confidence scores amongst registrars, in general, were associated with a higher positive attitude score ( $p < 0.05$ ). The reasons for these aforementioned relationships are unclear.

The results of our study are not dissimilar to the findings in the current literature. A qualitative study by Pearse et al. explored the barriers to implementing evidence-based bleeding management in Australian Cardiac Surgery Units.<sup>12</sup> Their study involved semi-structured interviews with anaesthetists, cardiac surgeons, and perfusionists. The majority of the interviewees expressed the following: that they received insufficient training about interpreting POC VET in their respective curricula; that knowledge about the management of a bleeding patient was predominantly obtained from disparate sources of information; that they would benefit from multidisciplinary teaching with regards to managing a bleeding patient; and that specialist training could be improved through a modernised curriculum that included a greater emphasis on VET. The similarities suggest that the barriers to utilising perioperative POC VET and the sentiments towards anaesthesia curriculum improvement are not unique to South Africa.

## Study strengths

The strengths of the study can be divided into methodological strengths and strengths related to potential quality improvement. Methodological strengths were its ease of distribution and the fact that it was multi-centred in terms of the sample population. Strengths related to potential quality improvement were: the fact that it found significant knowledge gaps in POC VET, particularly amongst junior registrars; the identification of both material and non-material barriers to requesting POC VET at registrars' teaching hospitals; and the fact that all respondents wanted a

formalised education platform on POC VET. These findings can be used by anaesthesia stakeholders as a basis for future quality-improvement projects at registrar training sites.

### Study limitations

Although the majority of respondents were affiliated with a single institution (Stellenbosch University), six medical schools were represented in the final sample population. No complete responses were obtained from respondents affiliated with the University of Pretoria, Walter Sisulu University, or the University of Limpopo. The comparatively high number of respondents from a single institution has the potential to affect overall data trends and observations. Our study had a relatively low response rate (16.67%). The questionnaire was distributed online. Online questionnaires tend to have lower response rates than other modes of distribution (e.g. face-to-face paper-based questionnaires).<sup>13</sup> While the decision to not pursue face-to-face/physical distribution of the survey may have adversely affected the overall response rate, the electronic route was chosen for the sake of efficient distribution and data collection. It also allowed for minimal physical contact against the milieu of COVID-19 in South Africa. The authors cannot exclude the possibility of self-selection bias amongst respondents (i.e. respondents who were familiar with POC VET may have been more likely to participate in the study than their colleagues who weren't familiar with POC VET). The fact that the questionnaire was self-administered may have also limited the respondents' opportunity to clarify potential misunderstanding/s of the questions posed to them. These aforementioned limitations restrict the generalisability of our findings.

### Recommendations

Presently there are no South African national guidelines regarding the use of POC VET in a perioperative setting. The Western Cape Blood Services (WCBS) acknowledge the benefit and promote the use of POC VET in the management of bleeding patients.<sup>14</sup> The authors recommend that a multi-stakeholder team consisting of (but not limited to) anaesthetists, surgeons, critical care specialists, as well as hospital managers/administrators develop a set of guidelines in this regard. These guidelines can be used as a tool for improving registrar POC VET knowledge and can be used for improving uniformity in practices and standards across the various registrar training circuits in South Africa.

### Conclusion

Overall knowledge of perioperative VET was found to be satisfactory, but there is still room for improvement particularly amongst the junior registrar cohort. While efforts should be made to reduce material barriers to the implementation of VET, addressing the non-material factors listed above represent potential low-risk, high-yield interventions to relevant stakeholders. Targeted educational interventions that can address these factors need not be resource-intensive and can be implemented comparatively quickly. These interventions

can be implemented on both a local level (e.g. through regular workshops, courses and on-the-job training and exposure to VET at respective training circuits) and at a national level.

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### Conflict of interest

The authors declare no conflict of interest.

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### Ethical approval

Ethical consent was granted by the Stellenbosch University Health Research Ethics Committee. HREC No S21/07/123

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