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Development of a list of essential obstetric anaesthetic knowledge and skills for interns in a department of anaesthesiology

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Development of a list of essential obstetric anaesthetic knowledge and skills for interns in a department of anaesthesiology

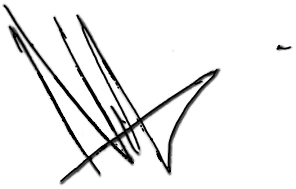
Zibele Nibe

A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg in partial fulfilment of the requirements for the degree of Master of Medicine in the branch of Anaesthesiology.

Johannesburg, 2021

Declaration

I, Zibele Nibe, declare that this research report is my own unaided work. It is being submitted for the Degree of Master of Medicine in the branch of Anaesthesiology at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.



12 November 2021

Abstract

Background

Community service medical officers often practice obstetric anaesthesia without supervision, and complications can occur if they are not adequately equipped with the necessary knowledge and skills. This study aims to develop a list of essential obstetric anaesthetic knowledge and skills for interns in a department of anaesthesiology.

Methods and results

A prospective, exploratory, and instrumental study design using Lynn's Model of determination and quantification of content validity was followed. The Developmental Stage involved an extensive literature review, followed by a peer group discussion with expert local anesthesiologists with a special interest in obstetric anaesthesia. Each item on the list was debated until consensus was reached. This stage resulted in a list with 59 items. In the Judgement - Quantification Stage, this list was sent to expert anaesthesiologists with a special interest in obstetric anaesthesia nationally for validation. The anaesthesiologists used a four-point Likert scale ranging from unnecessary to essential information to grade each item. Fifty-seven of the 59 items were deemed essential and retained. This entire list was quantified using the content validity index (CVI). Lynn suggests that a content list should have a CVI of at least 0.8. The list was content valid with a CVI of 0.98.

Conclusion

This study presents a comprehensive list of essential knowledge and skills for interns in obstetric anaesthesia in the Wits Department of Anaesthesiology that may contribute to interns practising obstetric anaesthesia more safely.

Acknowledgements

I would like to thank my supervisors Prof Juan Scribante, Ms Helen Perrie and Dr Thomas Kleyenstuber for their guidance and patience throughout this study.

I would also like to thank all local and national experts who took part in both the Development and the Judgement-Quantification Stages of this study.

A special thank you to Dr Palesa Motshabi for allowing me to conduct my study in the Wits department of anaesthesiology

Thank you to my mother Nokuzola Nibe for your support throughout this journey.

Lastly and most important, to Mrs Helen Perrie “there can be no greater gift than that of giving ones time and energy to help others”, happy retirement.

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Abbreviations

ABG	Arterial blood gas
CV	Content validity
CVI	Content validity index
DA	Diploma in Anaesthetics of the College of Anaesthetists of South Africa
DAS	Difficult Airway Society
ESMOE	Essential Steps in the Management of Obstetric Emergencies
Hb	Hemoglobin
HPCSA	Health Professions Council of South Africa
SAFE-OB	Safer Anaesthesia from Education Obstetric Anaesthesia

Statement

The Research Report consists of a literature review, draft article, study proposal and appendices. The study proposal is included for background reference and is not for examination.

The formatting of this Research Report complies with the University of the Witwatersrand's Style Guide for Theses, Dissertations and Research Reports. The formatting of the draft article may differ from the author guidelines of the Southern African Journal of Anaesthesia and Analgesia, the journal to which it is intended to be submitted, in order to comply with the University's style guide.

Section 1: Review of the literature

1.1 Introduction

In this section, a brief overview of the Health Professionals Council of South Africa (HPCSA) internship programme is given. Obstetric anaesthesia internship training is explored. Selected documents used to develop a list of essential knowledge and skill for obstetric anaesthesia internsip training and the content validity of such a list is briefly described.

1.2 Brief overview of the HPCSA internship programme

In 1950, the South African Medical and Dental Council (renamed in 1974 to the HPCSA) instituted a one-year internship program to provide newly qualified graduates with practical experiences to accompany their theoretical knowledge (1). In 2005, the one-year internship program was extended by the HPCSA to two years because the level of competency among doctors completing the one-year program was deemed inadequate. This was after deficits were identified in the knowledge and clinical skill among these doctors (1). The anaesthesiology rotation was increased from two weeks to two months (2).

The Health Professions Act No. 56 of 1974 (3) informs the regulations related to the registration and training of medical interns in South Africa. The Act (3) has outlined the following domains as compulsory rotations during internship training with durations varying per domain as follows: four months rotation in general medicine, general surgery, obstetrics and gynaecology and paediatrics, three months rotation in family medicine encompassing primary care, two months rotation in anaesthesiology and orthopaedics respectively and a one-month rotation in psychiatry (3). An examination is not undertaken at the end of the 24 months of training. However, a logbook is used to assess the interns' progress after each rotation in all domains (2).

The Act (3) further states that the internship rotation is to be completed within three years of registration as a medical intern with the HPCSA. If the intern fails to complete their training in the allocated 24 months or extended three-year period, registration as a medical intern may be cancelled by the HPCSA unless the intern

can provide substantial evidence as to why their registration should not be cancelled (3).

1.3 Obstetric anaesthesia internship training

The adequacy of internship training has been questioned. According to Nkabinde et al (2), community service medical officers recognised that they lacked essential knowledge and skills, particularly in an emergency setting, after 24 months of internship training. Some of these knowledge and skills are indispensable, particularly in an emergency setting. The authors also highlighted that a lack of core skills required in obstetric anaesthesia (the focus of this review) could endanger a parturient (2).

Lamacraft et al (4) stated that community service doctors in the Free State frequently administer obstetric anaesthesia unsupervised in district hospitals that can potentially be unsafe should complications occur. According to the authors, these community service doctors are inadequately trained to manage the parturient. This statement by Lamacraft et al (4) is echoed in the Savings Mother Report 2017 – 2019 technical report (5). In most of the 921 anaesthetic deaths for the 2017 – 2019 triennium, the anaesthetic was administered by medical officers, community service doctors and unsupervised interns and clinical associates. Poor conduct of anaesthesia in the face of complications such as hypotension and haemorrhage led to 22% of these deaths (5).

The 2017 – 2019 Saving Mothers Technical Report (5) noted that the institutional maternal mortality ratio had dropped to less than 100 per 100 000 live births for the first time in 2019 since the inception of the National Committee on Confidential Enquiries into Maternal Deaths in 1998. However, the report also noted that there was a marked increase in the rate of caesarean deliveries from 25.7% in the previous triennia to 28.1%. A total of 800 065 caesarean deliveries were performed in the public sector during 2017 – 2019. The report highlights that caesarean deliveries were associated with a three-times higher mortality rate than vaginal deliveries. Of the women who died during this period, 40.2% had an anaesthetic, and 16.7% were in district hospitals. Of the overall maternal deaths, 62.4% were classified as being preventable, of which 93.3% were anaesthetic

related. The high percentage of preventable anaesthetic deaths remains unchanged from the previous triennia (5). This emphasises the need for comprehensive obstetric anaesthesia internship training. No literature on the internship training regarding obstetric anaesthesia at respective training facilities in South Africa could be identified. Anecdotally, it appears that training varies. For example, Chris Hani Baragwanath Academic Hospital and Pietermaritzburg Training Complex have their own obstetric logbooks, additional to the HPCSA intern logbook.

There is value in a focused obstetric anaesthetic training programme. Noting the increasing maternal mortality in low- and middle-income countries, the Safer Anaesthesia from Education (SAFE) project was established in 2007 as a joint initiative by the Association of Anaesthetists of Great Britain and Ireland and the World Federation of Societies of Anaesthesia (6). The initiative aims to bring obstetric and paediatric anaesthesia practitioners (mostly non-physician anaesthetists) to a level of practice to deliver vigilant, competent, and safe anaesthesia in settings with inadequate resources. The SAFE-Obstetric Anaesthesia (SAFE-OB) course (7) appears to have a more comprehensive logbook than the HPCSA intern logbook. Participation in a SAFE-OB course in the Republic of Congo and Madagascar was associated with organisational changes in practice and sustained improvements in participants' knowledge and skill at 12 – 18 months (8). A follow-up study in Rwanda and Uganda has similarly found retention of the knowledge and skills taught on the SAFE-OB course and its translation into practice (9).

To prevent the high rate of maternal deaths, the Essential Steps in Management Obstetric Emergencies (ESMOE) guidelines (10) were developed in 2008 and are a "skills and drills" programme to train all South African health care workers managing obstetric patients. The ESMOE guidelines have an anaesthetic module giving guidance in the management of obstetric emergencies (10). The South African Society of Anaesthesiologists Practice Guidelines (11) consider it mandatory for the intern to be trained in the obstetric anaesthesia module of the ESMOE guidelines (10) during the two-month anaesthesia rotation. The ESMOE guidelines are currently not included in the HPCSA intern logbook. Although the

ESMOE guidelines offer valuable guidance, on their own they are not comprehensive enough to direct obstetric anaesthesia internship training.

In order to develop a list of essential knowledge and skills for obstetric anaesthesia internship training the following documents were reviewed:

- HPSCA intern logbook (12)
- ESMOE guidelines anaesthetic module (10)
- Difficult Airway Society (DAS) guidelines for the management of unanticipated difficult intubation (13)
- Diploma in Anaesthetics (DA) of the College of Anaesthetist of South Africa curriculum (14)
- SAFE-OB pocket handbook (7)
- Saving Mothers triennial reports on confidential enquiries into maternal deaths in South Africa (5, 15).

1.4 Documents reviewed

HPCSA intern logbook

According to the HPCSA logbook (12), interns are required to meet objectives during the two-month rotation in anaesthesia. The interlinked aspects of internship training in anaesthesia are centred around the perioperative management of patients. They include perioperative risk assessment and basic anaesthesia. Skills in obstetric anaesthesia, management of trauma patients and cardiopulmonary resuscitation are listed as critical objectives to be met during the rotation. The HPCSA intern logbook also states that an intern should have core skills and knowledge in the patient's pre-operative evaluation, focusing on history, examination, patient classification, planning, preparing for administering anaesthesia, physiological homeostasis, and airway management. The intern must also have intricate knowledge of the equipment needed to manage an airway, the pharmacology of anaesthetic drugs, and medication used by the patient population . The intern must predict, identify, and manage intra-operative complications associated with specific patient populations such as obstetric, trauma and paediatric patients. Furthermore, interns must possess knowledge of the

management of intra-operative complications related to regional anaesthesia. Fundamental administrative aspects of anaesthesia such as consent, anaesthetic record and post-operative instructions are listed as core skills and knowledge (12).

Regarding the obstetric patient, interns must know about the physiological changes of pregnancy that affect anaesthesia management, especially airway management, the respiratory system, the cardiovascular system, and aortocaval compression (12). Interns are also required to possess an in-depth knowledge of the 2004 article by Dyer et al (16). This article discusses critical components for the safe performance of spinal anaesthesia in the obstetric patient. It is important to note that Gibbs et al (17) published an update to this article in 2018 that has not been included in HPCSA intern logbook.

ESMOE guidelines

The obstetric anaesthesia module of the ESMOE guidelines (10) aims to establish appropriate patient risk assessment, correct choices of anaesthetic intervention and appropriate referral protocols. The knowledge component of the ESMOE guidelines encompasses the safe administration of spinal anaesthesia and the management of post-spinal hypotension, the safe administration of general anaesthesia and the management of a haemodynamically unstable patient and the use of uterotonics in managing post-partum haemorrhage. The skills component encompasses airway management by concentrating on patient assessment, drug and equipment preparation and a failed intubation drill. In addition, the module has a specific protocol on safe post-operative care including recovery, subsequent discharge, and written post-operative instructions to the ward (10).

DAS guidelines

The DAS has published a guideline for unanticipated difficult intubation in 2015 (13). The DAS guidelines (13) have maintained the model of having a "Plan A, B, C or D" approach to airway management in the face of unexpected difficulty. This guarantees that the practitioner has other alternatives to oxygenating the patient by using different devices and techniques for intubation when managing a difficult airway. The mainstay of this approach relies on patients being adequately

assessed pre-operatively. This assists with planning alternative approaches if the standard approach is not feasible (13).

According to Kiwalabye et al (18), the ESMOE and DAS guidelines have similarities. However, the DAS guidelines place greater emphasis on preplanning, use of nasal oxygen or gentle mask ventilation during induction, use of a second-generation laryngeal mask airway and limiting airway manipulation to two attempts (18).

DA curriculum

The DA was instituted in 1974 to equip doctors with the necessary knowledge and skills to administer safe anaesthesia and quality care to patients (14). The learning objectives are structured around 10 domains. Domain 3 encompasses the clinical application of knowledge of physiology, pharmacology, clinical measurement and monitoring to the perioperative care of obstetric patients and the provision of safe general and regional anaesthesia. Professional practice and ethical considerations relating to the local requirements for notification of maternal mortality and termination of pregnancy are listed, along with consent for all surgical procedures and the administration of anaesthesia (14).

According to Domain 3 (14), doctors must know how to safely administer spinal, epidural and general anaesthesia, manage a difficult airway for obstetric patients and manage any resultant complications. Regarding the anaesthesia management of high-risk obstetric patients, doctors should identify them and refer them to hospitals where appropriate care can be given. A list of high-risk obstetric patients is shown in Table 1. Interns must have pre-anaesthetic assessment skills, including taking a relevant history and performing an appropriate physical examination (14).

Table 1: List of high-risk obstetric patients (14)

Morbid obesity	Thyroid disease
Difficult airway	Intra-cranial pathology
Thromboembolic disease	Coagulation abnormalities
Bleeding disorders	Renal disease
Hypertension	Neuromuscular disease
Sepsis	Obstetric haemorrhage
Respiratory disease	Amniotic fluid embolism
Diabetes	Septic abortion
Cardiovascular collapse	Molar pregnancy
Pre-eclampsia and its complications	
Diseases common in South Africa, for example, HIV/AIDS and tuberculosis.	

Domain 3 (14) further specifies that doctors need to be aware of neonatal and adult resuscitation differences. Regarding the obstetric patient, doctors must have advanced life support resuscitation skills. They must specifically be skilled at managing an obstetric haemorrhage, complicated pre-eclampsia, and all causes of maternal cardiovascular collapse. Doctors must be competent in using the failure to intubate and failure to ventilate algorithm in obstetrics and manage pulmonary aspiration during general anaesthesia (14).

SAFE-OB pocket handbook

The SAFE-OB pocket handbook (7) has a comprehensive list of topics to be covered by those administering obstetric anaesthesia. These include physiological changes in pregnancy, pre-operative assessment, spinal anaesthesia and its complications, general anaesthesia, maternal life support, failed spinal anaesthesia, high spinal and total spinal, major obstetric haemorrhage, pre-eclampsia, and eclampsia (7).

Saving Mothers Reports

The anaesthetic-related causes of death noted in the 2014 – 2016 Saving Mothers Report (15) were hypoxia which was postulated to be a direct result of high spinal

anaesthesia respiratory failure which resulted from poor airway management, inadequate cardiopulmonary resuscitation and hypovolaemic shock.

According to 2017-2019 Saving Mothers Report (5) the avoidable factors that lead to maternal deaths were spinal hypotension, obstetric haemorrhage, hypertension, poor and delayed resuscitation, delay in the recognition of the onset of complications, failure of post-operative care and inappropriate method of anaesthesia.

1.5 Validating the list

Validity, especially content validity, is an important factor in developing an instrument or list (19), such as the list of essential obstetric anaesthetic knowledge and skills for interns. Polit and Beck (20) define content validity as “the degree to which an instrument had an appropriate sample of items for the construct being measured and adequately cover the construct domain”. There are no completely objective methods to ensure content validity as it is largely based on judgement. A panel of experts is often used to determine content validity (20). The most commonly used measure of content validity is the content validity index (CVI), where experts evaluate individual items and the new instrument overall (20). There are different approaches to determine CVI, but Lynn’s seminal work has been particularly influential (19).

Lynn’s Model (21) consists of the Developmental and the Judgement and Quantification Stages. The development stage comprises three steps, domain identification, item generation and instrument formation. Domain identification entails conducting a comprehensive literature review. In the second step, a list of items identified from the literature review is generated. Lastly, the items are refined and arranged in a suitable sequence; this can be done by means of a peer group discussion where items are debated until consensus is reached (21).

The Judgement and Quantification Stage comprises two steps (21). The steps include assertion by a specific number of experts that the items and the entire instrument are content valid. A minimum of five experts should negate chance agreement. Maximum number of experts has not been established and may vary according to the field of study (21).

Regardless of the number of experts participating in the validation process, a structured procedure for the evaluation of the content validity of the instrument must be presented to the experts (21). The experts must be given a set of instructions to determine the content relevance of the items. A 4-point ordinal rating scale is suggested, where 1 implies an irrelevant item and 4 a highly relevant item. The CVI is first calculated for each individual item and then for the list as a whole. Thus, the CVI for the item is calculated by using the proportion of items that receive a rating of three or four by the experts. This is then used to calculate the CVI of the list as a whole. Once the requirements for the Developmental and Judgement/Quantification Stages have been fulfilled, the CVI of the instrument is established (21).

1.6 Summary

This section gave a brief overview of the Health Professionals Council of South Africa (HPCSA) internship programme. Obstetric anaesthesia internship training is explored. Selected documents used to develop a list of essential knowledge and skill for obstetric anaesthesia internship training, and the content validity of such a list was briefly described.

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Section 2: Author guidelines

Southern African Journal of Anaesthesia and Analgesia (SAJAA)

Submitted manuscripts that are not in the correct format and without the required supporting documentation specified in these guidelines will be returned to the author(s) for correction and will delay publication.

AUTHORSHIP

Named authors must consent to publication **by signing a covering letter** which should be submitted as a supplementary file. Authorship should be based on substantial contribution to:

(i) conception, design, analysis and interpretation of data;

(ii) drafting or critical revision for important intellectual content; and

(iii) approval of the version to be published. These conditions must all be met (uniform requirements for manuscripts submitted to biomedical journals; refer to www.icmje.org); and

(iv) exact contribution of each author must be stated.

DECLARATION OF CONFLICT OF INTEREST

Authors must declare all sources of support for the research and any association with a product or subject that may constitute a conflict of interest. If there is no conflict of interest to declare please include the following statement: The authors declare no conflict of interest.

FUNDING SOURCE

All sources of funding should be declared. Also define the involvement of study sponsors in the study design, collection, analysis and interpretation of data; the writing of the manuscript; the decision to submit the manuscript for publication. If the study sponsors had no such involvement, this should be stated as follows: No funding source to be declared.

RESEARCH ETHICS COMMITTEE APPROVAL

The submitting author must provide written confirmation of Research Ethics Committee approval for all studies including case reports. The ethics committee as well as the approval number should be included.

STATISTICAL ANALYSIS

Authors are advised to involve medical statisticians at the protocol stage of their research project: to plan sample size, and the selection of appropriate statistical tests for analysis and presentation.

PROTECTION OF PATIENT'S RIGHTS TO PRIVACY

Identifying information should not be published in written descriptions, photographs, and pedigrees unless the information is essential for scientific purposes and the patient (or parent or guardian) gives informed written consent for publication. The patient should be shown the manuscript to be published. Refer to www.icmje.org.

ETHNIC CLASSIFICATION

The rationale for analysis based on racio-ethnic-cultural categorisation should be indicated.

CATEGORIES OF SUBMISSIONS

Shorter items are more likely to be accepted for publication, owing to space constraints and reader preferences.

Original articles

Original articles on research relevant to anaesthesia and analgesia should not exceed 3 200 words, no more than 30 references, with up to 6 tables or figures. A structured abstract under the following headings, Background, Methods, Results, and Conclusions is a requirement and should not exceed 300 words.

Clinical Review articles

Review articles relevant to anaesthesia and analgesia should not exceed 2 400 words, with a maximum of 20 references and no more than 6 tables or figures. A summary of 300 words or less is required.

Case reports

Case reports should not exceed 1 800 words with no more than 10 references. Figures are limited to 2 figures and may include images or photographs. The case report should have three headings: Summary (not exceeding 100 words), Case report (with no introduction) and Discussion. Case reports will be published online only. The summary and the URL will appear in the printed version.

Scientific Letters

Scientific Letters should not exceed 2 400 words with a maximum of 10 references. Only one table or illustration is permissible. A structured abstract under the following headings, Background, Methods, Results, and Conclusions, is a requirement and should not exceed 250 words.

Letters to the editor

Letters to the editor should be 800 words or less with only one image or table.

MANUSCRIPT PREPARATION

Refer to articles in recent issues for the presentation of headings and subheadings. If in doubt, refer to 'uniform requirements' - www.icmje.org. Manuscripts must be provided in **UK English**.

Qualification, affiliation and contact details

This information must be provided for ALL authors and must be submitted as a supplementary file.

Email addresses of all author must be provided.

ORCID number of **ALL** authors must be provided – if authors do not have ORCID, please register at https://orcid.org/

Abbreviations

All abbreviations should be spelt out when first used and thereafter used consistently, e.g. ‘intravenous (IV)’ or ‘Department of Health (DoH)’.

Scientific measurements

Scientific measurements must be expressed in SI units except blood pressure (mmHg) and haemoglobin (g/dl). Litres is denoted with a lowercase ‘l’ e.g. ‘ml’ for millilitres). Units should be preceded by a space (except for %), e.g. ‘40 kg’ and ‘20 cm’ but ‘50%’. Greater/smaller than signs (> and 40 years of age) should also be preceded by a space e.g. > 20 years. No spaces should precede ± and °, i.e. ‘35±6’ and ‘19°C’.

Numbers should be written as grouped per thousand-units, i.e. 4 000, 22 160…

Quotes should be placed in single quotation marks: i.e. The respondent stated: ‘…’ Round **brackets** (parentheses) should be used, as opposed to square brackets, which are reserved for denoting concentrations or insertions in direct quotes.

General formatting

The manuscript must be in Microsoft Word or RTF document format. Text must be 1,5-spaced, in 12-point Times New Roman font, and contain no unnecessary formatting (such as text in boxes, except for Tables). *The manuscript must be free of track changes.*

Disclaimers should follow the Conclusion and it should be in the following order: Acknowledgements, Declaration conflict of interest, Funding source, Ethics declaration and ORCID.

ILLUSTRATIONS AND TABLES

If tables or illustrations submitted have been published elsewhere, the author(s) should provide consent to republication obtained from the copyright holder.

Tables may be embedded in the manuscript file **and** provided as **'supplementary files'**. They must be numbered in Arabic numerals (1,2,3…) and referred to consecutively in the text (e.g. 'Table 1'). Tables should be constructed carefully and simply for intelligible data representation. Unnecessarily complicated tables are strongly discouraged. Tables must be cell-based (i.e. not constructed with text boxes, tabs or enters) and accompanied by a concise title and column headings. Footnotes must be indicated with consecutive use of the following symbols: * † ‡ § ¶ || then ** †† ‡‡ etc.

Figures must be numbered in Arabic numerals and referred to in the text e.g. '(Figure 1)'. Figure legends: Figure 1: 'Title…'. All illustrations/figures/graphs must be of **high resolution/quality**: 300 dpi or more is preferable, but images must not be resized to increase resolution. Unformatted and uncompressed images must be attached as '**supplementary files**' upon submission (not embedded in the accompanying manuscript). TIFF and PNG formats are preferable; JPEG and PDF formats are accepted, but authors must be wary of image compression. Illustrations and graphs prepared in Microsoft PowerPoint or Excel must be accompanied by the original workbook.

REFERENCES

Authors must verify references from the original sources. *Only complete, correctly formatted reference lists will be accepted.* Reference lists may be generated with the use of reference manager software, but the final document must be delinked from the reference database or otherwise generated manually. Citations should be inserted in the text as superscript, e.g. These regulations are endorsed by the World Health Organization,[2] and others.[3,4-6] The superscript reference number should come after the punctuation mark and should not be in brackets.

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Section 3: Draft article

Development of a list of essential obstetric anaesthetic knowledge and skills for interns in a department of anaesthesiology

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Keywords: Interns, knowledge and skills in obstetric anaesthesia, Lynn's model, content validity

Abstract

Background

Community service medical officers often practice obstetric anaesthesia without supervision, and complications can occur if they are not adequately equipped with the necessary knowledge and skills. This study aims to develop a list of essential obstetric anaesthetic knowledge and skills for interns in a department of anaesthesiology.

Methods and results

A prospective, exploratory, and instrumental study design using Lynn's Model of determination and quantification of content validity was followed. The Developmental Stage involved an extensive literature review, followed by a peer group discussion with expert local anesthesiologists with a special interest in obstetric anaesthesia. Each item on the list was debated until consensus was reached. This stage resulted in a list with 59 items. In the Judgement - Quantification Stage, this list was sent to expert anaesthesiologists with a special interest in obstetric anaesthesia nationally for validation. The anaesthesiologists used a four-point Likert scale ranging from unnecessary to essential information to grade each item. Fifty-seven of the 59 items were deemed essential and retained. This entire list was quantified using the content validity index (CVI). Lynn suggests that a content list should have a CVI of at least 0.8. The list was content valid with a CVI of 0.98.

Conclusion

This study presents a comprehensive list of essential knowledge and skills for interns in obstetric anaesthesia in the Wits Department of Anaesthesiology that may contribute to interns practising obstetric anaesthesia more safely.

Introduction

In 1950, the South African Medical and Dental Council – renamed in 1974 to the Health Professions Council of South Africa (HPCSA) instituted a one-year internship program to provide newly qualified graduates with practical experiences to accompany their theoretical knowledge (1). In 2005, the one-year internship program was extended by the HPCSA to two years because the level of competency among doctors completing the one-year program was deemed inadequate. This was after deficits were identified in the knowledge and clinical skill among these doctors (1). The anaesthesiology rotation was increased from two weeks to two months (2).

The adequacy of internsip training has been questioned. According to Nkabinde et al (2), community service medical officers recognised that they lacked essential knowledge and skills, particularly in an emergencies setting, after 24 months of internship training. The authors also highlighted that a lack of core skills required in obstetric anaesthesia (the focus of this review) could endanger a parturient (2).

Lamacraft et al (3) stated that community service doctors in the Free State frequently administer obstetric anaesthesia unsupervised in district hospitals. This can potentially be unsafe should complications occur. According to the authors, these community service doctors are inadequately trained to manage the parturient. This statement by Lamacraft et al (3) is echoed in the Savings Mother Report 2017 – 2019 Technical Report (4). In most of the 921 anaesthetic deaths for the 2017 – 2019 triennium, the anaesthetic was administered by medical officers, community service doctors and unsupervised interns and clinical associates. Poor conduct of anaesthesia in the face of complications such as hypotension and haemorrhage led to 22% of these deaths (4).

The 2017 – 2019 Saving Mothers Technical Report (4) noted that the institutional maternal mortality ratio had dropped to less than 100 per 100 000 live births for the first time in 2019 since the inception of the National Committee on Confidential Enquiries into Maternal Deaths in 1998. However, the report also noted a marked increase in the rate of caesarean deliveries from 25.7% in the previous triennia to 28.1%. A total of 800 065 caesarean deliveries were performed in the public sector

during 2017 – 2019. The report highlights that caesarean deliveries were associated with a three-times higher mortality rate than vaginal deliveries. Of the women who died during this period, 40.2% had an anaesthetic, and 16.7% were in district hospitals. Of the overall maternal deaths, 62.4% were classified as preventable, of which 93.3% were anaesthetic related. The high percentage of preventable anaesthetic deaths remains unchanged from the previous triennia (4). This emphasises the need for comprehensive obstetric anaesthesia internship training.

No literature on the internship training regarding obstetric anaesthesia at respective training facilities in South Africa could be identified. Anecdotally, it appears that training varies. For example, Chris Hani Baragwanath Academic Hospital and Pietermaritzburg Training Complex have their own obstetric logbooks, additional to the HPCSA intern logbook (5).

The obstetric anaesthesia internship training programme in the Department of Anaesthesiology at the University of the Witwatersrand (Wits) is centred around the obstetric anaesthesia module of the Essential Steps in Management of Obstetric Emergencies (ESMOE) guidelines (6). One of the hospitals in the department has a separate logbook with a strong focus on obstetric anaesthesia and includes spinal and general anaesthesia. This logbook complements the HPCSA intern logbook (5). Despite the logbooks and the obstetric anaesthesia module of the ESMOE guidelines (6), there still appears to be a lack of knowledge and skills among community service doctors allowing them to practice obstetric anaesthesia safely. In the Department of Anaesthesia at Wits, there is a need to develop a validated, comprehensive list of the knowledge and skills that an intern needs to acquire during the anaesthetic rotation to equip them to administer safe obstetric anaesthesia as a community service officer.

Method and results

Lynn's Model (11) consists of the Developmental and the Judgement and Quantification Stages. The development stage comprises three steps, domain identification, item generation and instrument formation. Domain identification entails conducting a comprehensive literature review. In the second step, a list of

items identified from the literature review is generated. Lastly, the items are refined and arranged in a suitable sequence; this can be done by means of a peer group discussion where items are debated until consensus is reached (11).

The Judgement and Quantification Stage comprises two steps. The steps include assertion by a specific number of experts that the items and the entire instrument are content valid. A minimum of five experts should negate chance agreement. The maximum number of experts has not been established and may vary according to the field of study (11).

Approval was obtained from the Wits Human Research Ethics Committee (Medical) (M200873) and other relevant authorities. A prospective, exploratory and instrumental study design was followed. As anaesthesiologists with an interest and expertise in obstetric anaesthesia were required for the validation process, purposive sampling was used in both stages. The methodology, data analysis, and results for each stage are discussed together as they are interlinked. The stages and a summary of the methodology are shown in Figure 1.

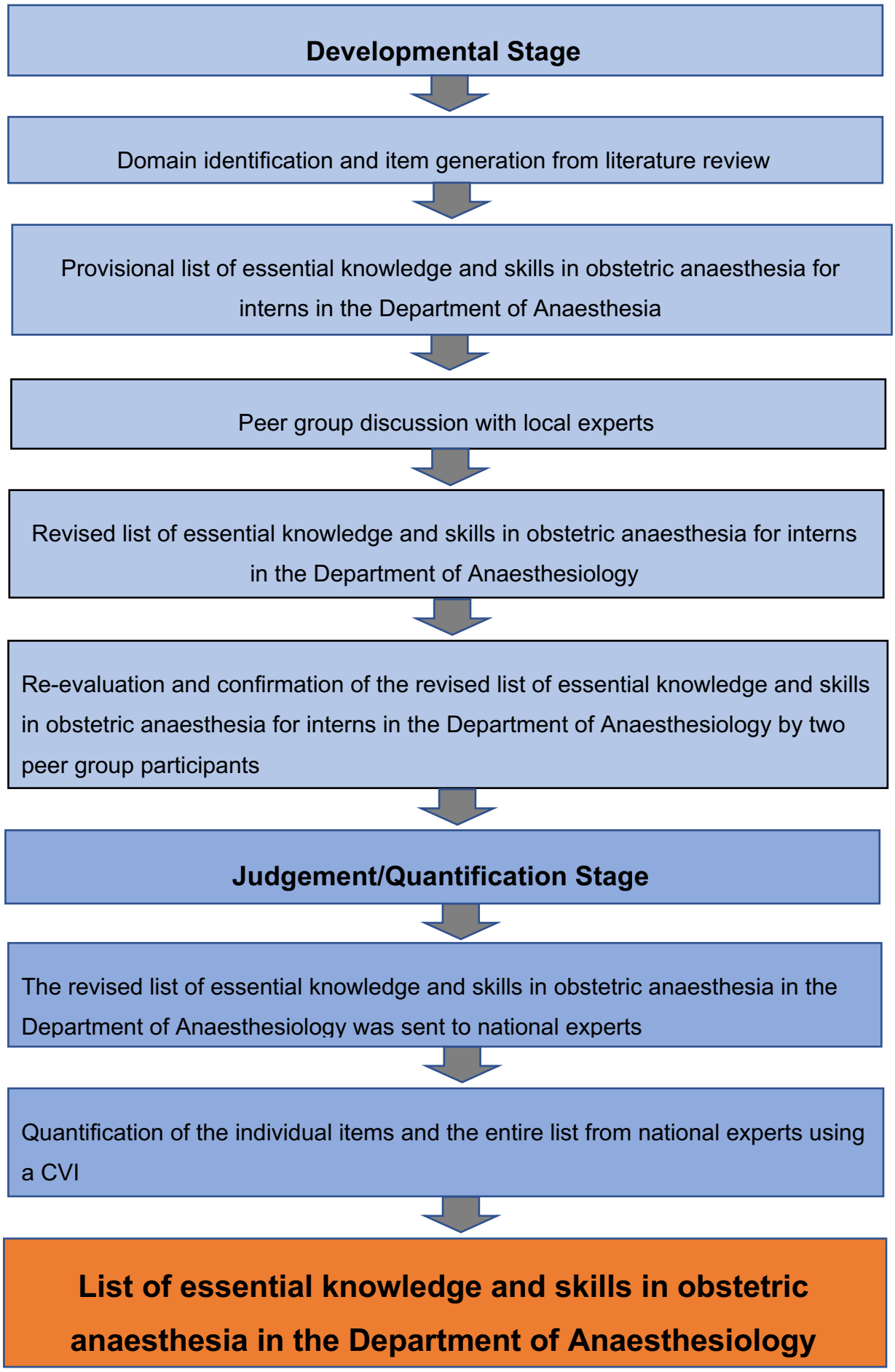


Figure 1: Stages and summary of methodology

Stage 1: Developmental Stage

Domain identification and item generation, the first two steps of the Developmental Stage, were done by reviewing the following documents:

- HPCSA internship logbook (5)
- ESMOE guidelines (6)
- Difficult Airway Society (DAS) guidelines (7)
- Diploma in Anaesthesia of the College of Anaesthetists of South Africa curriculum (8)
- SAFE-obstetrics (SAFE-OBS) pocket handbook (9)
- Saving Mothers 2014 – 2016 (10) and 2017 – 2019 (4): Triennial Reports on Confidential Enquiries into Maternal Deaths in South Africa (Saving Mothers)

A provisional list of essential knowledge and skills in obstetric anaesthesia for interns in the Department of Anaesthesiology with 12 domains and 58 items was then generated. Item formation, the third step, was achieved by holding a peer group discussion to debate the items on the list and to make refinements, additions, and deletions. An invitation requesting participation in a discussion group, an information letter, and the provisional list of essential knowledge and skills in obstetric anaesthesia for interns was e-mailed to 10 local experts from the Wits Department of Anaesthesiology. Seven experts attended the peer group discussion facilitated by two authors (ZN, TK). During the peer group discussion, the participants were asked to review and grade each item on the provisional list according to the following Likert scale:

- 1 = do not need to know
- 2 = nice to know but not necessary
- 3 = should know
- 4 = must know.

Each item on the provisional list was debated until 100% consensus was reached. No items were removed from the list, and one item, “patient referral process” was added. Refinements to existing items were made where deemed necessary. The

revised list, with 43 knowledge and 16 skills items, was reviewed by two discussion group experts to confirm accuracy. The revised list is shown in Table 1.

Table 1: Revised list of knowledge and skills

	Knowledge items	**Item in intern logbook**	**In obstetric section**
A	**General**	**Yes/No**	**Yes/No**
1	Anaesthesia machine check	Yes	No
2	Emergency drugs	Yes	No
3	Anaesthetic chart and medicolegal implications	Yes	No
4	Pregnancy physiology and aortocaval compression	Yes	Yes
5	Obstetric patients' pre-operative assessment	Yes	No
6	Aspiration prevention and management	Yes	No
7	Airway anatomy and management	No	No
8	Post-operative care (Aldrete score)	No	No
9	Recognition of high-risk patients	No	No
10	Causes of anaesthetic maternal death in South Africa	Yes	Yes
B	**Spinal anaesthesia**		
11	Indications and contraindications	No	No
12	Equipment, monitoring and consumables	Yes	No
13	Relevant anatomy	No	No
14	Patient positioning	No	No
15	Bupivacaine; dose and toxicity	Yes	Yes
16	Recognition and treatment of high spinal	Yes	No
17	Spinal hypotension and management	Yes	Yes
18	Recognition of other complications	No	No
C	**General anaesthesia**		
19	Rapid sequence induction	Yes	No
20	Drugs and dosages	No	No
21	Treatment of intra-operative and post-operative nausea and vomiting	No	No
D	**Difficult airway**		
22	Equipment	Yes	No
23	Guidelines	No	No
E	**Drugs commonly used**		
24	Use of local anaesthetics	Yes	No
25	Use of magnesium sulphate	No	No

26	Use of antihypertensives	No	No
27	Use of sympathomimetics	Yes	No
28	Use of uterotonics	No	No
29	Use of prophylactic antibiotics	Yes	No
30	Use of antiemetics	No	No
31	Side effects of tocolytic agents	No	No
F	**Blood and blood product transfusion and fluid therapy**		
32	Indications	Yes	No
33	Trigger factors	No	No
34	Complications	Yes	No
35	Point-of-care testing (for example, arterial and venous blood gas and haemoglobin)	No	No
36	Pre-operative and intra-operative fluid management	Yes	No
G	**Medical conditions in pregnancy**		
37	Hypertension	No	No
38	Pre-eclampsia	Yes	Yes
39	Eclampsia	No	No
40	Human immune deficiency virus	No	No
41	Sepsis	No	No
42	Anti-partum haemorrhage	No	No
43	Post-partum haemorrhage	No	No
	Skills items		
H	**General**		
44	Patient referral process	No	No
J	**Spinal anaesthesia**		
45	Technique (10 spinals for caesarean section)	No	No
46	Management of spinal hypotension (highlight aortocaval compression) and high spinal	Yes	No
K	**General anaesthesia**		
47	Anaesthesia machine check	Yes	No
48	Rapid sequence induction (minimum of two)	Yes	No
49	Immediate management of pulmonary aspiration	Yes	No
50	Management of obstetric haemorrhage	No	No
I	**Airway management**		
51	Airway maintenance	Yes	No
52	Basic airway manoeuvres	Yes	No
53	Simple airway devices	Yes	No
54	Supraglottic airway devices	Yes	No
55	Video-assisted laryngoscopy	No	No

56	Front of neck access	No	No
57	Difficult airway management according to DAS guidelines	No	No
L	**Resuscitation**		
58	Basic neonatal resuscitation	No	No
59	Cardiopulmonary resuscitation in pregnant patients	No	No

Stage 2: Judgement/Quantification Stage

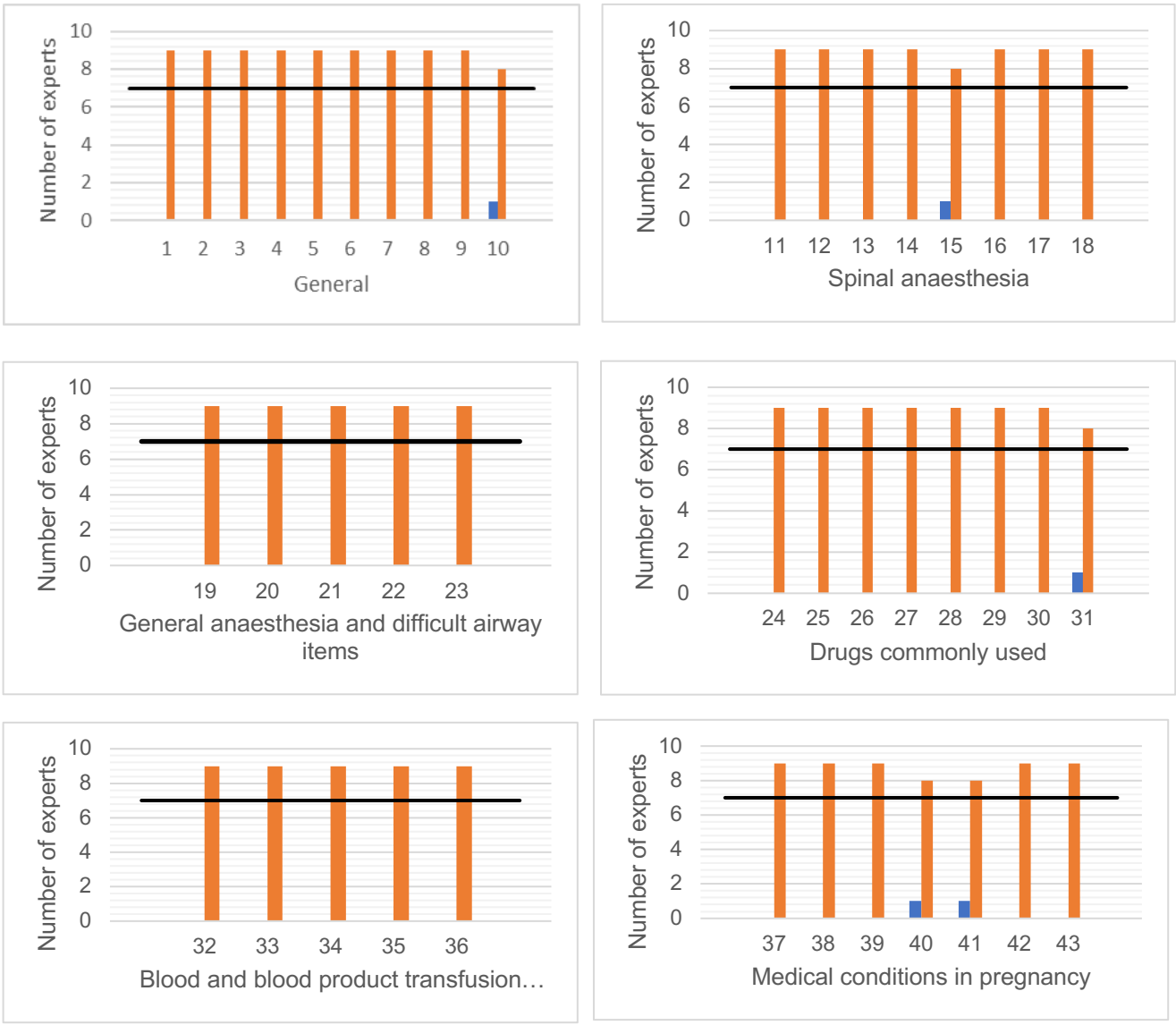
National experts in obstetric anaesthesia, excluding those that had participated in the Developmental Stage, were identified. An e-mail containing an invitation to participate in the Judgement/Quantification Stage, an information letter, a consent form, and the revised list were e-mailed to 13 national experts, and nine responded. The province and sector of the responders are shown in Table 2.

Table 2: Characteristics of responders

Province	**Public or private**	**`Respondents n (%)**
Gauteng	Public	1 (11)
	Private	2 (22)
Eastern Cape	Public	1 (11)
Western Cape	Public	2 (22)
Kwazulu Natal	Public	2 (22)
Free State	Public	1 (11)

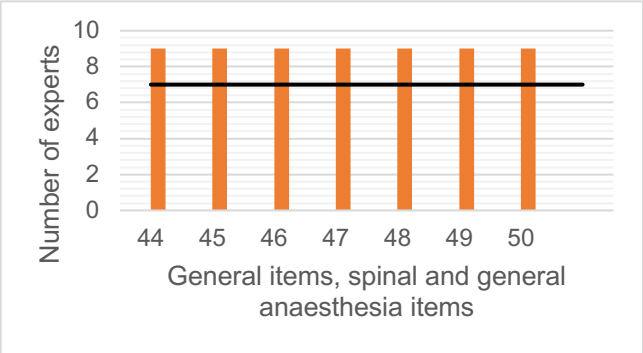
The ratings from the national experts were used to determine the CVI using the Likert scale used in the Developmental Stage. The CVI is first calculated for each individual item and then for the list as a whole. Lynn (11) uses published cumulative binomial distribution norms to determine the proportion of experts needed to rate an item as valid. Thus, for an item on the list to be regarded as content valid in this study, 7 out of the 9 national experts were required to rate an item as either 3 or 4 on the Likert scale giving a CVI of 0.78. Any new instrument as a whole should have a CVI of at least 0.80 (11).

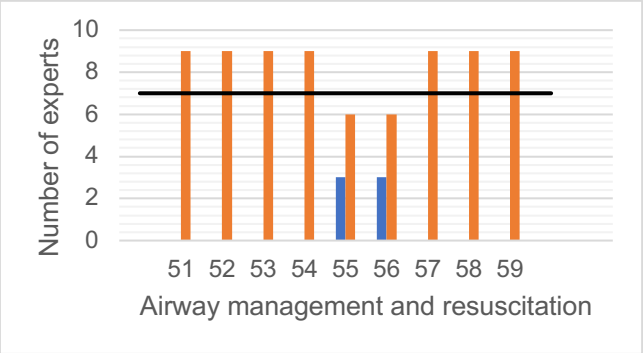
The ratings of the national experts for the knowledge section are shown in Figure 2 and for the skill items in Figure 3. The black line indicates the cut-off for validating the items (7 of 9 experts). The item numbers in the figures match the revised item list (Table 1). Only two items (55 and 56) were not rated as valid, therefore items 55 and 56 were excluded from the final developed list.



Key: Likert 1/2 Likert 3/4

Figure 2: Rating of knowledge items





Key: Likert 1/2 Likert 3/4

Figure 3: Rating of item skills

The CVI of items that did not receive a CVI of 1 (9 out of 9) is shown in Table 3.

Table 3: CVI of items not scoring 1

No.	Item	Out of 9	CVI
10	Causes of anaesthetic maternal deaths	8	0.89
15	Bupivacaine; dose and toxicity	8	0.89
31	Side effects of tocolytic agents	8	0.89
40	Human immune deficiency virus	8	0.89
41	Sepsis	8	0.89
55	Video-assisted laryngoscopy	6	0.67
56	Front of neck access	6	0.67

The list overall received a CVI of 0.98 and, therefore, it can be considered content valid.

Discussion

A total of 57 items are included in the list of essential obstetric anaesthetic knowledge and skills for the Wits Department of Anaesthesiology. Of these items, 39 knowledge and 12 skills items are not incorporated in the obstetric anaesthesia section of the HPCSA intern logbook. The discussion will focus on the more pertinent items not included in the logbook.

Pre-operative assessment forms the basis of managing any patient in obstetric anaesthesia. It allows the anaesthetist to build rapport with the patient and acquire informed consent. Spinal anaesthesia is the most common technique for caesarean delivery (12), and it is essential to determine if any contraindications exist. However, even if a patient is receiving spinal anaesthesia there is always a possibility of needing to convert to general anaesthesia. Therefore, all patients should be assessed pre-operatively for a general anaesthetic, focusing on airway assessment and determining the risk of aspiration (13). Assessment of comorbidities is essential. For example, in South Africa, hypertensive disease, mainly in the form of pre-eclampsia and eclampsia, accounts for almost 18% of all maternal deaths (14). During the pre-operative assessment, high-risk patients that may need referral can be identified, and the interns should be familiar with the referral criteria and procedure to avoid unnecessary delays.

Spinal anaesthesia has been adopted as a preferred method of administering anaesthesia for caesarean delivery due to its favourable safety profile (12). However, potentially detrimental complications such as spinal hypotension and high spinal anaesthesia may still occur (12). According to the 2011 – 2013 Saving Mothers Report (17), 71% of the 105 recorded deaths resulted from spinal anaesthesia and were completely avoidable. The HPCSA intern logbook refers to the Dyer et al. (15) 2004 article regarding spinal hypotension. Updated recommendations to the article have been published by Gibbs et al (16), however, the HPCSA intern logbook does not include this update. The 2014 – 2016 Saving Mothers Report (10) highlighted high spinal as one of the leading causes of mortality. According to the HPCSA intern logbook, the intern is required to perform 10 spinal anaesthetics. They do not specifically have to be performed on obstetric patients. Due to the high complication and mortality rate mentioned in the 2011 –

2013 Saving Mother Report (17) as well as the altered physiology and anatomy of pregnant patients, the experts in this study recommended that interns perform an additional 10 spinal anaesthetics on obstetric patients.

In current obstetric anaesthesia practice, general anaesthesia is reserved for patients in whom spinal anaesthesia is contraindicated. According to Delgado et al (13), failed tracheal intubation and the risk of aspiration pneumonitis are the most feared complications of general anaesthesia. Term obstetric patients are at high risk of regurgitation and rapid desaturation (18). Direct laryngoscopy is often technically more difficult due to engorged breasts, poorer visualisation of the vocal cords and an increased risk of bleeding from airway manipulation (18). In the triennium of 2014 – 2016 (10), there were 87 reported anaesthetic-related deaths; 18% were attributed to complications of general anaesthesia. Interns are required to perform ten rapid sequence inductions and intubations in non-obstetric patients. Performing routine rapid sequence inductions in this group of patients does not equip interns with skills necessary for managing the airway of an obstetric patient. The experts recommended that interns perform a minimum of two rapid sequence inductions and intubations in obstetric patients. This study highlights the importance of including essential information about general anaesthesia such as drugs and dosages and rapid sequence induction specific to obstetrics, that are not included in the logbook.

Obstetric haemorrhage is ranked as one of the leading causes of maternal death in the 2017 – 2019 Saving Mothers Technical Report (4). Sixty-nine of the 921 anaesthetic related deaths were attributed to poor delayed resuscitation, inappropriate risk stratification and delayed recognition of complications. There are no specific guidelines in the HPCSA intern logbook for managing obstetric haemorrhage, yet community service doctors are required to manage this in district hospitals with limited resources. It is therefore paramount that interns receive training to improve their knowledge and skills.

Maternal arrest is a rare event. However, a prompt, well-coordinated response by anaesthetists and obstetricians is essential. (19). Aetiologies of maternal mortality differ significantly in different parts of the world (20). According to the Saving Mothers 2017 – 2019 technical Report (4) haemorrhage is one of the leading

causes of cardiac arrest in South Africa. Madden and Meng (21) state that the inability to save patients in cardiac arrest caused by haemorrhage and hypovolaemia in low- and middle-income countries is of great concern. According to the World Health Organization, in 2017, the mortality rate was 462 per 100 000 live births in low-income countries (21). Cardiopulmonary resuscitation in obstetric patients differs significantly from non-obstetric patients because the gravid uterus impairs venous return and reduces the effectiveness of chest compressions. The HPCSA intern logbook does not require the interns to learn how they should adapt cardiopulmonary resuscitation when resuscitating a pregnant woman. Assessing an intern's competency in performing CPR is challenging, however the experts in this study have deemed it necessary for internship training.

A limitation of this study is that doctors who recently completed community service were not included in the validation process. Such a doctor was invited to the peer group discussion but withdrew due to last-minute clinical commitments. It is recommended doctors who recently completed their community service evaluate the appropriateness of the list of essential knowledge and skills for interns in obstetric anaesthesia.

Conclusion

The HPCSA intern logbook is not comprehensive enough to prepare interns to safely practice obstetric anaesthesia during community service (2, 3). This study presents a comprehensive list of essential knowledge and skills for interns in obstetric anaesthesia in the Wits Department of Anaesthesiology that may contribute to interns practising obstetric anaesthesia more safely.

Conflict of interest

The authors declare that we have no financial or personal relationships, which may have inappropriately influenced us in writing this paper.

Acknowledgement

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Section 4: Proposal

Development of a list of essential obstetric anaesthetic knowledge and skills for interns in a department of anaesthesiology

Zibele Nibe

2260324

Supervisor	Juan Scribante Department of Anaesthesiology
Co-supervisor	Helen Perrie Department of Anaesthesiology
Co-supervisor	Thomas Kleyenstuber Department of Anaesthesiology

4.1 Introduction and problem statement

The deaths of women during pregnancy, childbirth and puerperium remain a major public health issue, particularly in low- and middle-income countries such as South Africa (1). Sobhy et al (2) noted that anaesthesia contributed to 13.8% of all maternal deaths post caesarean section in a systematic review of anaesthesia related maternal mortality in low- and middle-income countries. The authors further concluded that the death rate was higher for non-physician anaesthesia providers than physician anaesthesia providers, 9.8 per 1 000 and 5.2 per 1 000, respectively (2).

According to the Saving Mothers triennial report (1), 87 anaesthetic-related maternal deaths occurred between 2014 and 2016. The same report retrospectively notes that 105 anaesthetic related maternal deaths occurred in the previous triennial period between 2011 – 2013. District hospitals recorded 53% of those deaths; noteworthy is that the majority of community service doctors are deployed to these hospitals (1). The report states that 93% of the anaesthetic deaths occurred were due to avoidable complications from high spinal anaesthesia, respiratory failure and hypovolaemic shock, which are core skills in obstetric anaesthesia (1). The National Committee on the Confidential Enquiries into Maternal Deaths continues to publish the Saving Mothers Reports, which indicate that anaesthesia related maternal deaths are occurring predominantly in district hospitals and that these deaths are a direct result of poor levels of competency in obstetric anaesthesia (1). District Hospitals recorded 41% of all maternal mortalities from 2011 – 2017. Of the 1 059 maternal deaths in 2017, 268 were in district hospitals. Of the 29 anaesthetic related maternal deaths which were recorded, 19 occurred in district hospitals (1).

Lamacraft et al (3) noted that community service medical officers and interns training in the Free State at district hospitals that performed caesarean sections were not directly supervised and that community service medical officers administered anaesthesia without onsite senior support. Theron and Rout (4) concluded that there is a lack of basic skills in anaesthesia, particularly the resuscitation of obstetric patients at district hospitals in KwaZulu Natal. Community

service medical officers, similarly, are expected to administer anaesthesia without senior supervision at district hospitals.

Medical training in South Africa involves six years of undergraduate teaching, followed by two years of practical training in a Health Professions Council of South Africa (HPCSA) accredited facility (5-7). Previously interns were only required to complete one year of internship; however, due to concerns high rates of mortality and incompetency in the anaesthetic domain among community service doctors, the duration of internship training was changed from a one-year to a two-year programme (5-7). Medical interns are required to rotate through all the medical specialities (surgery, medicine, paediatrics, family medicine, orthopaedics and anaesthesiology) to ensure that they have adequate knowledge and the skills necessary for community service (5-7).

The HPCSA intern logbook forms an essential part of the assessment of knowledge and skills of interns in their two-year training, and interns are signed off after completion of time allocated to each domain (8). The 2020 intern logbook (9) states that obstetric anaesthesia is one of three critical skills that interns must obtain during their anaesthesia rotation. In obstetric anaesthesia, the intern logbook requires interns to have knowledge of the physiological changes of pregnancy that affect the management of obstetric patients, pre-eclampsia and anaesthesia and the causes of anaesthesia related maternal death emanating from the Confidential Enquiry into Maternal Deaths. The administration of spinal anaesthesia is considered a core competency for interns. The intern logbook states that interns are to possess a detailed knowledge of the 2004 article by Dyer et al (10) on the safe performance of spinal anaesthesia for obstetric patients. However, it is important to note that this article was updated in 2018 (11). Gibbs et al (11) recommend that best practice includes the use of alpha1-agonist boluses or infusions, crystalloid co-loading or colloid pre-loading and left lateral uterine displacement for the prevention and treatment of spinal hypotension. The authors further state that it is now well accepted that the best approach to spinal hypotension is combined intravenous crystalloid co-load and phenylephrine (11). The authors refer to a meta-analysis by Melchor et al (12) that demonstrated that

the of colloids either as a pre-load or a co-load is associated with significantly reduced rates of hypotension compared to crystalloids (11).

The intern logbook also requires the interns to perform 10 spinal anaesthetics, of which five are to be performed on caesarean section patients. Interns are also required to perform 10 rapid sequence induction and intubations for patients requiring general anaesthesia. However, there is no requirement in the logbook for any of these patients to be obstetric patients (9). This implies that an intern may be signed off as having completed their two months in anaesthesia without administering general anaesthesia to any obstetric patients. The question arises as to whether the interns are sufficiently prepared to practice obstetric anaesthesia following the two-month anaesthetic rotation. According to Nkabinde et al. (8), community service medical officers recognised that they lacked a number of knowledge and skill entities at the end of their two-year internship training. Many of these entities being essential, particularly in an emergency setting. The authors also highlighted that a lack of core skills required in obstetric anaesthesia could endanger a parturient (8).

The South African Society of Anaesthesiologists Practice Guidelines (13) considered it mandatory for the intern to be trained in the obstetric anaesthesia module of the Essential Steps in the Management of Obstetric Emergencies (ESMOE) guidelines (14) during the two-month anaesthesia rotation. However, this guideline is not included in the intern logbook. The obstetric anaesthesia module of the ESMOE guidelines (14) aims to establish appropriate patient risk assessment, correct choices of anaesthetic intervention and appropriate referral protocols. It also includes preparing the necessary equipment, drugs and human resources at various hospital levels. The module has a specific protocol on how to give a safe spinal and general anaesthesia with the recognition and management of complications, safe post-operative care with recovery and subsequent discharge and instructions to the ward (14).

Noting the increasing maternal mortality ratio in low- and middle-income countries, the Safer Anaesthesia from Education (SAFE) was established in 2007 as a joint initiative by the Association of Anaesthetists of Great Britain and Ireland and the World Federation Of Societies of Anaesthesia (15). The initiative aims to bring

practitioners of obstetric and paediatric anaesthesia (mostly non-physician anaesthetists) to a level of practice where they can deliver vigilant, competent and safe anaesthesia even in settings with poor resources. The SAFE-Obstetric Anaesthesia (SAFE-OB) course (15) appears to have a more comprehensive logbook than the HPCSA intern logbook. The long-term impact of the SAFE-OB course on maternal mortality in low- and middle-income countries is yet to be established (16). However, participation in a SAFE-OB course in the Republic of Congo and Madagascar was associated with organisational changes in practice and sustained improvements in knowledge and skill of participants at 12 – 18 months (17). A follow-up in Rwanda and Uganda has demonstrated significant retention of the knowledge and skills taught on the SAFE-OB course and translation of these into practice (16).

The obstetric anaesthesia internship training programme in the Department of Anaesthesiology at the University of the Witwatersrand (Wits) is centred around the obstetric anaesthesia module of the ESMOE guidelines (14). One of the hospitals in the department has a separate logbook with a strong focus on obstetric anaesthesia and includes spinal and general anaesthesia. This logbook complements the HPCSA intern logbook. Despite the logbooks and the obstetric anaesthesia module of the ESMOE guidelines, there still appears to be a lack of knowledge and skills among community service doctors allowing them to practice obstetric anaesthesia safely. In the Department of Anaesthesia at Wits, there is a need to develop a validated, comprehensive list of the knowledge and skills that an intern needs to acquire during the anaesthetic rotation to equip them to administer safe obstetric anaesthesia as a community service officer.

4.2 Aim and objectives

4.2.1 Aim

The aim of this study is to develop a list of the essential obstetric anaesthetic knowledge and skills for interns in the Department of Anaesthesiology at Wits using Lynn’s Model (18).

4.2.2 Objectives

The objectives of this study are to**:**

- develop a provisional list of essential obstetric anaesthetic knowledge and skills from the literature using Lynn's Development Stage (domain identification and item generation)
- develop a revised list of essential obstetric anaesthetic knowledge and skills using Lynn's Development Stage (item formation)
- determine the content validity of the items and the entire revised list of essential obstetric anaesthetic knowledge and skills using Lynn's Judgement/Quantification Stage (18).

4.3 Research assumptions

Intern: refers to a medical doctor in training who has completed medical school and has a medical degree but does not yet have a license to practice medicine unsupervised.

Community service medical officer: refers to a doctor who has completed two years of internship but does not yet have a license to practice medicine unsupervised.

Anaesthesiologist: refers to a doctor who has undergone post-graduate training and examination in anaesthesiology and is registered as a specialist in anaesthesiology with the HPCSA.

Expert: refers to local and national anaesthesiologists who have an interest in obstetric anaesthesiology.

Lynn's Model: is a two-stage process to develop an instrument and achieve content validity (18). The Development Stage entails identification of the full content domain, sampling and item generation and assimilation of items into a usable form. The Judgement/Quantification Stage entails the judgement and quantification of content validity for both the items generated and of the entire instrument.

4.4 Ethical considerations

Ethical approval will be acquired from the Human Research Ethics Committee (Medical) and the Graduate Studies Committee at Wits. Approval to conduct this study will be obtained from the Head of Department of Anaesthesiology at Wits before the commencement of data collection (Appendix 1).

In both stages of the study, identified experts will be approached in person or telephonically, the study will be explained, and they will be invited to participate. Those who agree will receive an information letter for the respective stage (Appendix 2 or 3), will be asked to give written consent (Appendix 4) and will receive the provisional list of essential knowledge for the specific stage, which will be generated after receiving clearance from the Human Research Ethics Committee.

Anonymity is not possible in either of the stages as a purposive sampling method will be used. However, the compiled data will not contain any identifying data of the participants. Only the researcher and supervisors will have access to the raw data so that confidentiality is safeguarded.

All data will be stored securely on a password-protected database for six years after the study's conclusion. The study will be executed according to the principles of the Declaration of Helsinki (19) and the South African Guidelines for Good Clinical Practice (20).

4.5 Research methodology

4.5.1 Research design

This study will follow a prospective, exploratory and instrumental research design. In a prospective study, the population is identified and tracked over time and variables are measured when conducting the study (21). This is a prospective study as the population will be identified, and data will be gathered as the study progresses. This research is exploratory as it intends to explore and describe phenomena (22). A list of essential obstetric anaesthesia knowledge and skills will be explored and generated. This study is instrumental since specific rules, as

proposed by Lynn's Model (18), will be applied to develop a list of essential obstetric anaesthetic knowledge and skills to prepare interns for community service.

4.5.2 Study method

The study method will employ Lynn's Model (18), a two-stage process to ensure the content validity of a list of essential obstetric anaesthetic knowledge and skills for interns. The two stages are the Development Stage and the Judgement/Quantification Stage.

4.5.3 Study population

The study population will comprise of South African expert anaesthesiologists who have an interest in obstetric anaesthesia.

4.5.4 Study sample

A purposive sampling method will be employed in this study. Purposive sampling is a type of non-probability sampling (21). The researcher and supervisors will identify experts with an interest in obstetric anaesthesia.

The sample size relies on the number of accessible, available and agreeable experts that the researcher and supervisors can identify (18). According to Lynn (19), a minimum of five experts is needed to provide control for chance agreement. The maximum number of experts has not been established, but it is unlikely to exceed 10.

The Development Stage sample will comprise at least five local experts from Johannesburg. The sample for the Judgement/Quantification Stage will consist of a minimum of eight national anaesthesiology experts, excluding those who were involved in the Development Stage. Recruitment of experts will continue until a minimum of eight completed ratings is received.

4.5.4 Data collection

Development Stage

The Development Stage consists of three steps, namely domain identification, item generation and item formation (18). Domain identification will be conducted by carrying out a literature review. Based on the literature review and the researcher and clinical supervisor's experience, a provisional list of items will be generated after receiving clearance from the Human Research Ethics Committee. Item formation will be achieved during a peer group discussion.

A minimum of five experts will be invited (Appendix 2) to participate in the peer group discussion. Those who agree will be asked to sign a consent form (Appendix 4). Experts who participate in the Development Stage of the study will not participate in the Judgement/Quantification Stage. The peer group discussion will be held in the Department of Anaesthesiology Research Office on a Wednesday afternoon after the academic meeting. A Zoom platform will be created pre-emptively to facilitate the meeting should face to face gatherings continue to be prohibited because of the COVID-19 pandemic. The meeting will last approximately two hours.

The peer group discussion will aim to refine the provisional list and, if necessary, make recommendations for changes, additions or deletions to the list to augment content validity. The experts will be expected to review and grade the items on the list during the peer group discussion according to the following scale:

- 1. Do not need to know
- 2. Nice to know but not necessary
- 3. Should know
- 4. Must know.

A four-point rating scale is preferable because it does not include the ambivalent middle rating common in odd number rating scales.

The peer group discussion will be facilitated by the researcher. Each item on the list will be debated until 100% consensus is reached; therefore, no analysis will be

needed. On completion of the peer group discussion, the required modification to the list will be made, and the list will be prepared for the Judgement/Quantification Stage. The revised list will be submitted to two of the experts from the peer discussion group to confirm that the recommended alterations have been made.

Judgement/Quantification Stage

The Judgemental/Quantification Stage of Lynn's Model has two steps. The first is the assertion by a specific number of experts that the items on the list are content valid. The second step is the assertion by experts that the entire list is content valid (18). Experts in this phase can make recommendations, but they will not add items to the list.

Lynn (18) states that content validity can be quantified with the content validity index (CVI). The CVI is derived from rating the content importance of the items using an ordinal rating scale. The same rating scale that was used in the Development Stage will be used.

National experts will be invited (Appendix 3) to take part in the study. After agreeing to participate, a consent form (Appendix 4) and the revised list with instructions will be e-mailed to the national experts. The experts will be asked to rate the items using the same scale as in the Development Stage.

Data collected during this stage will be captured on a Microsoft Office Excel® spreadsheet. Data analysis will entail that the CVI for each item is determined by the proportion of experts who rated it as content valid with a rating of three or four on the rating scale. Lynn (6) utilises a cumulative binomial distribution to establish the proportion of experts required to rate an item as valid. The cumulative binomial distribution is published as standard norms. The CVI of the entire list is the total proportion of items judged as content valid.

4.6 Significance of the study

Community service medical officers frequently administer obstetric anaesthesia unsupervised in district hospitals which can potentially be unsafe should complications occur. The list of essential anaesthesia knowledge and skills that

this study aims to develop may ensure that interns rotating at the Department of Anaesthesiology at Wits are better equipped to practice safe obstetric anaesthesia as community service medical officers.

4.7 Validity and reliability of the study

The validity of a study is the degree to which it represents a true value, and reliability is the consistency of the measure achieved (18).

The validity and reliability of this study will be maintained by:

- using an appropriate study design
- using a validated model to ensure content validity of the list
- giving participants specifics written instructions.

4.8 Potential limitations

This study will depend on the response and involvement of the experts who are invited to participate in the research. A poor response to the invitation may “place the instrument developer at great risk of an erroneous conclusion that content validity has not been achieved when it actually has” (18).

4.9 Project outline

4.9.1 Time frame

Activity	Feb-Jun 2020	Jul 2020	Aug 2020	Sep 2020	Oct 2020	Nov 2021	Dec 2021	Jan-Mar 2021	Apr-Nov 2021
Proposal preparation									
Literature review									
Proposal submission									
Ethics approval									
Postgraduate approval									
Data collection									
Data analysis									
Draft article									
Submission									

4.9.2 Budget

Item	Price per item	Number of items	Total
Printing	R 1	1000	R 1000
Binding	R 45	6	R 270
Refreshments	R 100	6	R 600
Grand total			**R 1870**

The Department of Anaesthesiology will bear the cost of printing and paper for the proposal and postgraduate applications, information letters and consent forms. The researcher will provide light refreshments for the peer discussion group meeting.

4.10 References

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4.11 Appendices

Appendix 1: Approval Head of Department of Anaesthesiology

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG | FACULTY OF HEALTH SCIENCES | WITS SCHOOL OF CLINICAL MEDICINE | DEPARTMENT OF ANAESTHESIOLOGY Tel.(011)488 4344

15 June 2020

School of Clinical Medicine

Faculty of Health Sciences

University of the Witwatersrand

Permission to conduct a study: Dr Nibe Zibele - Student Number 2260324

This is to confirm that I have read and give permission to Dr Nibe Zibele's to conduct a study in the Department of Anaesthesiology towards an Mmed project titled "**Development of a list of essential obstetric anaesthetic knowledge and skills for interns in a Department of Anaesthesiology.**"

Thank you.

Dr P Motshabi



Appendix 2: Information letter for the experts in the Developmental Stage

Zibele Nibe
Anaesthesiology Registrar
University of the Witwatersrand

To: Dr/Prof

Dear Colleague

Hello, my name is Zibele Nibe. I am a registrar in the Department of Anaesthesiology at the University of the Witwatersrand. I am conducting a research study titled: **Development of a list of essential obstetric anaesthetic knowledge and skills for interns in a department of anaesthesiology** as part of my M Med degree. This study is motivated by the fact that community service medical officers are not always adequately prepared to deliver safe obstetric anaesthesia. Community service medical officers frequently administer obstetric anaesthesia unsupervised in district hospitals which can potentially be unsafe should complications occur.

I will be using Lynn's Stage Model to develop and validate this essential knowledge and skills in obstetric anaesthesia list. This is a two-stage (Development and Judgement/Quantification) process that is used to determine content validity.

I hereby invite you as an expert with an interest in obstetric anaesthesia to be part of the peer group discussion for the Development Stage of this list on **DATE** in the Department of Anaesthesia Research Office. The discussion will take place after the Wednesday afternoon academic meeting and should last approximately two hours. Light refreshments will be provided. A zoom platform will be created pre-emptively to facilitate the meeting should face-to-face gatherings continue to be prohibited because of the COVID 19 global pandemic. An e-mail containing the login details for the zoom meeting will be sent to you on the morning of **DATE**.

An e-mail containing documentation pertaining to the study will be sent to you prior to the peer group discussion should you consent to participate. This will include the provisional list with items that I have developed from reviewing the literature after receiving clearance from HREC for you to refine to ultimately enhance the content validity. During the peer group discussion, I will ask you to make recommendations for changes, additions or deletions to the provisional list and to grade the items on a four-point scale:

- 1. Do not need to know
- 2. Nice to know but not necessary

- 3. Should know
- 4. Must know.

We will debate each item, and items that reach a 100% consensus will be prepared for the Judgment/Quantification Stage.

Participation in this process is entirely voluntary. I appreciate that you will not benefit from participation in this study. However, the development of a list of essential obstetric anaesthesia knowledge and skills for interns may ensure that interns rotating at the Department of Anaesthesiology at the University of the Witwatersrand are better equipped to practice safe obstetric anaesthesia as community service medical officers.

The study has been approved by the Human Research Ethics Committee (Medical) (Approval number) and the Graduate Studies Committee, University of the Witwatersrand.

Should you require any further information, you can contact:

Dr Zibele Nibe, Researcher in the Department of Anaesthesiology at the University of the Witwatersrand, on cell-phone number 0726475246, or by e-mail at nibezibele1@gmail.com

Professor CB Penny, Chairperson of the Human Research Ethics Committee (Medical) at the University of the Witwatersrand, on telephone no. 011 717 2301, or by e-mail at Clement.Penny@wits.ac.za.

Ms Z Ndlovu or Mr Rhulani Mkansi, Committee Secretariat, telephone nos.: 011 717 2700 or 1234, or by e-mail at Zanele.Ndlovu@wits.ac.za or Rhulani.Mkansi@wits.ac.za

Thank you for taking the time to read this information letter.

Yours sincerely,

Zibele Nibe

Appendix 3: Information letter for experts invited to the Judgement/Quantification Stage

Dr Zibele Nibe
Anaesthesiology registrar
University of the Witwatersrand

To: Dr/Prof

Dear Colleague

Hello, my name is Zibele Nibe. I am a registrar in the Department of Anaesthesiology at the University of the Witwatersrand. I am conducting a research study titled: **Development of a list of essential obstetric anaesthetic knowledge and skills for interns in a department of anaesthesiology** as part of my M Med degree. This study is motivated by the fact that community service medical officers are not always adequately prepared to deliver obstetric anaesthesia. Community service medical officers frequently administer obstetric anaesthesia unsupervised in district hospitals which can potentially be unsafe should complications occur.

I will be using Lynn's Model to develop and validate this essential knowledge and skills in obstetric anaesthesia list. This is a two-stage (Development and Judgement/Quantification) process that is used to determine content validity.

The Developmental Stage has already taken place. Documentation pertaining to the study was sent to participants in preparation for the peer group discussion. The provided documentation included the provisional list with items, which I developed, with the assistance of my clinical supervisor, from reviewing the literature and was refined to ultimately enhance the content validity. During the peer group discussion, I asked participants to make recommendations for changes, additions or deletions to the provisional list and to grade the items on the same four-point scale I will ask you to use if you consent to take part in the study. Each item was debated, and items that reached a 100% consensus were then prepared for the Judgement/Quantification Stage.

I hereby invite you as an expert in obstetric anaesthesia to be part of the Judgement/Qualification Stage of this study. Should you consent, I would like you to rate each item on this list and then the entire list on the following four-point scale:

- 1. Do not need to know
- 2. Nice to know but not necessary
- 3. Should know
- 4. Must know.

Participation in this process is entirely voluntary. I appreciate that you will not benefit from participation in this study. However, developing a list of essential obstetric anaesthesia knowledge and skills for interns may ensure that interns rotating at the Department of Anaesthesiology at Wits are better equipped to practice safe obstetric anaesthesia as community service medical officers.

The study has been approved by the Human Research Ethics Committee (HREC) (Approval number) and the Graduate Studies Committee, University of the Witwatersrand.

Should you require any further information, you may contact:

Dr Zibele Nibe, Researcher in the department of anaesthesiology at the University of the Witwatersrand, on cell-phone number 0726475246, or by e-mail at nibezibele1@gmail.com

Professor CB Penny, Chairperson of the Human Research Ethics Committee (Medical) at the University of the Witwatersrand, on telephone no. 011 717 2301, or by e-mail at Clement.Penny@wits.ac.za.

Ms Z Ndlovu or Mr Rhulani Mkansi, Committee Secretariat, telephone nos.: 011 717 2700 or 1234, or by e-mail at Zanele.Ndlovu@wits.ac.za or Rhulani.Mkansi@wits.ac.za

Thank you for taking the time to read this information letter.

Yours sincerely,

Zibele Nibe

Appendix 4: Consent form for experts

Development of a list of essential obstetric anaesthetic knowledge and skills for interns in a department of anaesthesiology

I,_____ (full name), fully understand the contents of the information letter detailing the purpose of the study and how the study will be performed.

I hereby consent to participate in this study.

_____ _____

Participant Signature Date:

_____ _____

Researcher Signature Date:

Section 5: Annexures

5.1 Ethics approval

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

R14/49 Dr Z Nibe

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M200873

NAME: (Principal Investigator)	Dr Z Nibe
DEPARTMENT:	School of Clinical Medicine Department of Anaesthesiology Medical School University
PROJECT TITLE:	Development of a list of essential obstetric anaesthetic knowledge and skills for interns in a department of anaesthesiology
DATE CONSIDERED:	2020/08/28
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Professor J Scribante
APPROVED BY:	Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	2020/10/20

This clearance certificate is valid for 5 years from the date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on the 3rd Floor, Phillip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.
I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to submit details to the Committee. **I agree to submit a yearly progress report**. When a funder requires annual re-certification, the application date will be one year after the date when the study was initially reviewed. In this case, the study was initially reviewed in **August** and will therefore reports and re-certification will be due early in the month of **August** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature

10 · 11 · 21
Date

5.2 Graduate studies approval

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Private Bag 3 Wits, 2050
Fax: 027117172119
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Reference: Mrs Sandra Benn
E-mail: sandra.benn@wits.ac.za

03 February 2021
Person No: 2260324
PAG

Dr Z Nibe
Unit 116
Richmond Park
Oakdene
2190
South Africa

Dear Dr Zibele Nibe

Master of Medicine in Anaesthesia: Approval of Title

We have pleasure in advising that your proposal entitled *Development of a list of essential obstetric anaesthetic knowledge and skills for interns in a department of anaesthesiology*. has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

5.3 Turnitin report

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG | FACULTY OF HEALTH SCIENCES

11 November 2021

The Chairperson
Graduate Studies Committee
Faculty of Health Sciences
University of the Witwatersrand

Dear Professor Papathanasopoulos

Re: M Med: **Development of a list of essential obstetric anaesthetic knowledge and skills for interns in a department of anaesthesiology**

Dr Zibele Nibe, student number: 2260324, has submitted his research report to Turnitin, which revealed a similarity index of 9%. These similarities appear not to be plagiarism but mainly the use of common terminology and phrases specific to the research topic.

Yours sincerely,

Juan Scribante
Supervisor

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2260324:turnitin.docx

ORIGINALITY REPORT

9%	4%	6%	3%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to University of Witwatersrand Student Paper	1%
2	I Kiwalabye, L Cronjé, S Schoeman, T Sommerville. "A simulation-based study evaluating the preparedness of interns' post-anaesthesia rotation in managing a failed obstetric intubation scenario: Is our training good enough?", South African Medical Journal, 2021 Publication	1%
3	Jolene N Moore, Wayne W Morriss, Gebrehiwot Asfaw, Gosa Tesfaye, Aaliya R Ahmed, Isabeau A Walker. "The impact of the Safer Anaesthesia from Education (SAFE) Obstetric Anaesthesia training course in Ethiopia: A mixed methods longitudinal cohort study", Anaesthesia and Intensive Care, 2020 Publication	1%
4	F K Orr, C Keyes, A Alli. "Development and validation of an instrument for procedure-	1%