

A comparative review of obstetric anaesthesia training, supervision and experience of public sector doctors in the Free State, 2005 vs. 2019

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“Submitted in fulfilment of the requirements in respect of the Master’s Degree MMed in the Department of Anaesthesiology in the Faculty of Health Science at the University of the Free State.”

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DECLARATION

“I, Seta Liteboho Machai with student number 2002018964 declare that the coursework Master’s Degree **A comparative review of obstetric anaesthesia training, supervision and experience of public sector doctors in the Free State, 2005 vs. 2019** herewith submit in a publishable manuscript format for the Master’s Degree qualification Anesthesiology at the University of the Free State is my independent work, and that I have not previously submitted it for a qualification at another institution of higher education.”

Signature: 

Date: 10/03/21

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ABSTRACT

Introduction:

Obstetric anaesthesia is ranked first as a contributor to “potentially preventable deaths per underlying cause” of maternal death in South Africa. Lack of training, experience and supervision has been cited as the cause of these deaths. This study aimed to evaluate those public sector doctors administering obstetric anaesthesia in the Free State and compare training, experience and supervision findings with those of 14 years ago in a similar study by G Lamacraft.

Method:

This was a cross sectional analytical study carried out between the 11th and 19th December 2019. All caesarean section sites within the Free State were identified from a list obtained from the provincial government. Hospital CEOs and clinical managers were informed prior to the visit. On Arrival a list of doctors administering obstetric anaesthesia was obtained from the clinical manager. An audience with the doctors was requested and those that could not come were traced to their work areas and given the questionnaire. An implied consent was stated at the beginning of the questionnaire which was self-administered. The same questionnaire as by Lamacraft (with one added question) was handed over after a brief description of the study and collected into a box at the end of the session. The collected data was kept anonymous.

Results

A total of 124 medical doctors met the inclusion criteria with 103 of them completing the questionnaire, thus an overall response rate of 83%. Level 1 and level 2 hospital response rates were 78% and 91% respectively. This was an improvement from the 69% overall response rate of 2005. Exposure to obstetric anaesthesia during internship has improved: in 2005 12% of respondents lacked exposure but this dropped to 5% in 2019. The reported level of supervision also improved: In 2005 21% of supervision was by junior medical officers and only 25% by consultants compared to 2019 where junior medical officer's supervision contributed 15% and consultants 44%. A lack of exposure and training post internship was observed with only 1 doctor having a Diploma in anaesthesia in 2005 compared to 5 in 2019. Employment of a senior anaesthetist improved: 54% and 47% reported to have no senior anaesthetist employed by their hospital in 2005 and 2019 respectively. Unfortunately the added responsibility of neonatal resuscitation while administering anaesthesia to the mother increased slightly from 42% in 2005 to 47% in 2019

Conclusion:

Training, supervision and experience of doctors in level 1 and 2 hospitals in the Free State post internship has marginally improved in the last 14 years. Greater improvement has been noted during internship training.

KEYWORDS AND GLOSSARY OF TERMS

Anaesthetist: a physician trained in anaesthesia and perioperative medicine

Medical officer: independent general practitioner with no specialist registration

Community service doctor: a doctor post internship training doing 1 year community service and not yet an independent practitioner

Intern doctor: a recently qualified doctor still working under supervision

Level 1 Hospital: a hospital which receives referrals from and provides support to clinics and community health centers with health treatment administered by general health care practitioners or primary health care nurses.

Level 2 Hospital: a hospital which receives referrals from and provides specialist support to a district hospital and where health care users require the expertise of teams led by resident specialists.

Maternal death: the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes.

Institutional Maternal Mortality Ratio: number of maternal deaths among 100 000 deliveries in health facilities/institutions.

General anaesthesia: medically induced unconsciousness with loss of protective reflexes, resulting from administration of one or more general anaesthetic agents.

Spinal anaesthesia: a neuraxial regional anaesthesia involving the injection of a local anaesthetic or other drugs into the subarachnoid space, generally through a fine needle.

Obstetric anaesthesia: is a sub-specialty of anaesthesiology that provides peripartum pain relief for labour and anaesthesia for caesarean delivery.

LIST OF ABBREVIATIONS

ACLS: Advanced Cardiovascular Life Support

APLS: Advanced Paediatric Life Support

ATLS: Advanced Trauma Life Support

CFR-CD: Case Fatality Rate per Caesarian Delivery

C/S: Caesarean Section

DA: Diploma in Anaesthesia

DHIS: District Health Information System

DOH: Department of Health

FS: Free State

GDP: Gross Domestic Product

iMMR: institutional Maternal Mortality Rate

MDG: Millennium Development Goals

MMR: Maternal Mortality Rate

NCCEMD: National Committee of Confidential Enquiries into Maternal Death

SDG: Sustained Development Goals

WHO: World Health Organization

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CHAPTER 1

Critical and synthesized review of literature

Introduction:

The global burden of disease that needs surgical intervention has increased and so has the caesarean section rate¹. This means more and more women are being exposed to anaesthesia both on an elective and emergency basis. This calls for increased numbers of appropriately trained and experienced providers of anaesthesia.

Obstetric anaesthesia plays a critical part in emergency obstetric care. In order to avert maternal morbidity and death, the patient is often brought to theatre for further intervention. This is seen especially in the management of obstetric haemorrhage which is the leading cause of maternal mortality globally².

Indicators like “case fatality rates for bleeding during or after caesarean delivery” are important. They help to assess the contribution of peripartum haemorrhage to overall obstetric mortality. Anaesthesia care is integral in the safe performance of caesarean delivery and in mitigating this complication.

Safe anaesthesia is not only important in averting perioperative complications, but also in averting the devastating potentially preventable anaesthetic deaths. Appropriately trained, experienced and well supervised anaesthetic providers can ensure that the operative arm of obstetric care is safe but due to the small ratio of doctors: patients in the SA public service, relatively inexperienced doctors are expected to function as anaesthetic providers, whether they feel comfortable or not.

Anaesthesia is the leading cause of “potentially preventable obstetric deaths per underlying cause” in South Africa³. The Chairperson of The National Committee of Confidential Enquiries into Maternal deaths acknowledged in the 2018 report that despite improvements, challenges still remain in the knowledge and skills of health care professionals⁴. An estimated 57% of all maternal deaths are regarded as preventable in South Africa. The lack of appropriately trained doctors contributed 41.2% to the deaths⁴.

In 2005, a manpower study by Lamacraft et al revealed that within the Free State, major contributors to anaesthesia related maternal deaths were lack of skills and supervision of doctors⁵. She found that the majority of doctors administering obstetric anaesthesia had no prior anaesthetic training, were not being supervised or had no post graduate training

Perioperative Mortality Rate (POMR) is an indicator of access to and safety of surgery and anaesthesia⁶. It demonstrates health system improvement or failures. Perioperative deaths are mostly preventable and failure to bring about a significant decline in mortality is a big cause for concern.

Global Maternal health

Maternal Death or maternal mortality is defined by the World Health Organization (WHO) as the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes⁷. The Centre for Disease Control (CDC) has extended this definition to include deaths up to 1 year⁸.

In 2017, the WHO reported that about 810 women died daily due to preventable pregnancy-related deaths.⁹ In total, 295 000 pregnancy related deaths were estimated for that year, most of which were in low income and middle income countries⁸. The Global Maternal Mortality Ratio (MMR) has dropped by 38% from 342 in the year 2000 to 211 in 2017⁹. This reduction was mainly attributed to reduced HIV-related maternal deaths. Developing countries with the highest MMR saw the highest drop and contributed more significantly to this overall reduction. Concerted efforts to improve access and quality of sexual, reproductive, maternal and newborn healthcare proved pivotal.

While the global mortality reduction is encouraging, it is still far from achieving the United Nations Millennium Development Goal (MDG) 5A, which aimed to have reduced the maternal mortality ratio by 75% from 1990 to 2015².

One of the 13 health care-related Sustainable Development Goals (SDG) aim to reduce global MMR to less than 70 per 100 000 live births by 2030⁹. This 70% reduction in maternal deaths would translate into 1.4 million women's lives being saved⁹.

Low to middle income countries and maternal death:

Maternal mortality is viewed as an indicator of a country's overall Health wellbeing. A country that cannot take care of its pregnant women has a failing health system. There is a correlation between MMR and Gross Domestic Product (GDP)¹⁰. This is evidenced by the much lower maternal death in high income countries versus low income countries. However, some countries have relatively similar GDP but different health outcomes. The reason for this is multifactorial. Regional humanitarian conflict and natural disasters play a role and a Fragile States Index has been established to indicate a country's susceptibility to instability⁷. A government's commitment to drafting and implementing a good healthcare policy can also lead to protection of vulnerable groups.

Low and middle income countries contribute to 99% of global maternal deaths with an average MMR of 415 per 100 000 live births compared to Europe's 10 per 100 000 live births⁹. Sub Saharan Africa contributed to 66% of global maternal mortality^{9 10}. Tremendous commitment is needed to reduce MMR much faster than the current 2.9%

per annum In order to achieve the 2030 SDG.

Global causes of maternal death:

Maternal deaths can be either direct or indirect. “Direct” deaths occur as a consequence of woman being pregnant and results from complications of pregnancy or the puerperium, or the management of the pregnancy or puerperium. “Indirect” deaths result from previous existing disease or diseases that developed during pregnancy and were not due to direct obstetric causes².

The two most common causes of direct maternal deaths are hypertension and haemorrhage, with haemorrhagic disease being more prevalent during the postpartum period. In a 2014 WHO systemic analysis, the contributions of haemorrhage and hypertension to global MMR were 27.1% and 14% respectively².

Indirect causes contribute to a quarter of all global causes of MMR². The contribution of HIV in developing countries is significant and any strides in combatting this disease will lead to continued declines in indirect causes of maternal mortality.

South Africa

In South Africa the maternal mortality ratio was 134 per 100 000 live births in 2017⁴. The majority of deaths occurred in low resource settings where access to health care is a challenge¹⁰. The leading causes of death noted in the Saving Mothers’ report of 2014 to 2016 were: non pregnancy related infections (40.5 %), obstetric haemorrhage (22.8 %) and hypertension (21.6 %). Anaesthesia accounted for 3.15 % in the same year⁴.

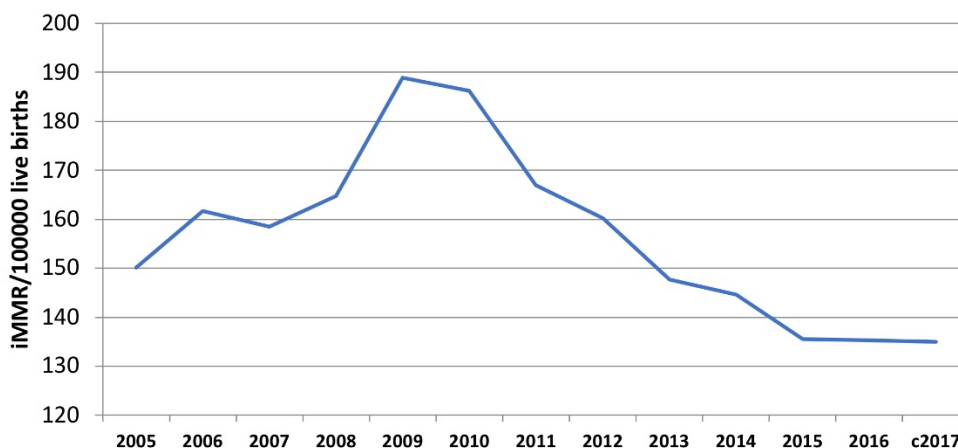


Figure 1: iMMR per year for South Africa 2005-2017⁴

South Africa has come far in reducing maternal mortality³. There is a downward trend in institutional maternal mortality ratio (iMMR) as reported by the National Committee on Confidential Enquiries into Maternal Deaths (NCCEMD) (figure 1)⁴. Focused efforts in the treatment programs of HIV has resulted in a 47 % reduction in non-pregnancy related infections since 2011. Deaths from maternal haemorrhage have also reduced. The number of deaths due to anaesthetic complications on the other hand has not shown significant reductions¹¹.

The Free State Province

South Africa has a population of over 59 million people with the Free State province contributing only 5.1% of the total population. Despite this low percentage the province has the third highest land area after Northern and Eastern Cape. This means that the population density is one of the lowest in the country with 22.3 people per square kilometer. The small economy of the Free State is largely supported by general government services with moderate contribution by other sectors.

The Free State province in 2017 had the second highest iMMR in South Africa as shown in the last published triennial report of the NCCEMD. Figure 2 below demonstrates that The Free State province was only second to Mpumalanga. Even though the ratio may be high the overall numbers that the province contributes to the countries maternal mortality is actually low. This however does not mean that we should find comfort in this. It actually means that the few mothers that enter the facilities are more at risk of death.

Province	Live births	NCCEMD	iMMR NCCEMD
Mpumalanga	75621	118	156.04
Free State	44559	69	154.85
Limpopo	119163	181	151.89
North West	55915	83	148.44
Eastern Cape	99927	142	142.10
Northern Cape	20475	28	136.75
KwaZulu Natal	180565	245	135.69
Gauteng	213955	275	128.53
Western Cape	95218	80	84.02
South Africa	905398	1222	134.97

Table 1: iMMR of provinces ranked from highest to lowest⁴

The highest number of deaths is seen at the more densely populated Mangaung metropolitan municipality as shown in figure 3⁴. All Municipalities have a Regional hospital or higher level except Xariep which refers to Mangaung metropolitan. The long distance for emergency referral from Xariep may influence their iMMR and that of Mangaung. The disparities in the availability of skilled human resources among the areas also mean non uniform quality of care.

Organisational Unit	Live births	DHIS MD	NCCE MD	iMMR DHIS	iMMR NCCEMD	2014-2016
Fezile Dabi District Municipality	6912	12	10	173.61	144.68	161.57
Lejweleputswa District municipality	9313	10	11	107.38	118.11	197.00
Mangaung Metropolitan	14689	29	30	197.43	204.23	183.67
Thabo Mofutsanyane District municipality	12853	14	17	108.92	132.26	166.25
Xhariep District Municipality	792	0	0	0.00	126.26	0
Free State	44559	65	69	145.87	154.85	174.63

Table 2: iMMR within the different municipalities of the Free State with different data capturing tools for 2017⁴

Anaesthesia related maternal mortality

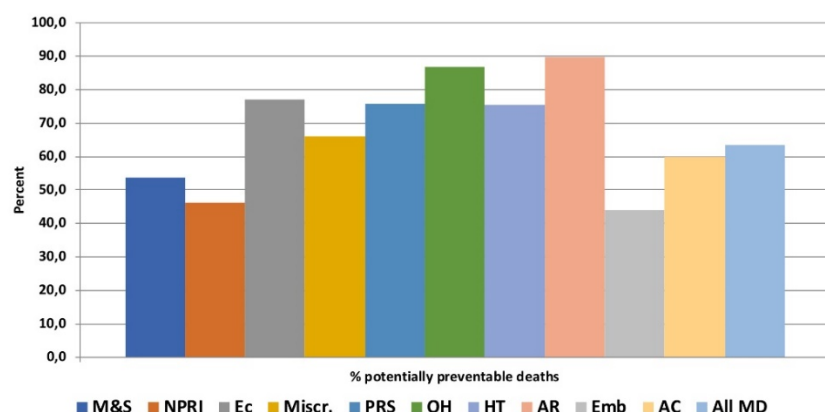
Procedures requiring anaesthesia have been noted to contribute to about a fifth of all direct maternal deaths¹¹. Of greatest concern is that these types of deaths are potentially preventable under the correct settings. This is best appreciated by the fact that anaesthesia related maternal mortality is highest in low and middle income countries where resources, skilled personnel and infrastructure is a concern.

A 2016 systematic review in the Lancet reported that 2.8% of all global maternal deaths were due to anaesthesia. It stated that anaesthesia contributed 13.8% of all global deaths occurring during or after caesarean section delivery with this number rising to 14.2% in low and middle income countries. Global average caesarean section rates increased from 6.7% in 1990 to 19.1% in 2014¹. Over 140 million caesarean section were done globally in 2015 with an upward trend despite it been shown that institutional caesarean section rates above 10- 15% did not reduce maternal or neonatal deaths.¹² This practice has led to women who are exposed to anaesthesia related complications and has placed a great demand on obstetric anaesthesiologists.

Exposure to general anesthesia carries an increased risk compared to regional anaesthesia, with 45% of all maternal deaths in a systematic review being due to airway complications⁹. These included failed tracheal intubation, bronchospasm and hypoxia from pulmonary aspiration. The same review noted that anaesthesia administration by those with no formal training also increased the risk of mortality. Issues related to poor pre assessment, intra operative monitoring and equipment failure led to 27% of deaths and only 6% were due to high spinal.

Case fatality rates for caesarean delivery is higher in low to middle income countries due to inadequate training and resources, poor general condition of the parturient and associated complications such as postpartum haemorrhage. Strategies implemented to address level of training, number of anaesthetic providers and improving available resources will aid in reducing anaesthesia related maternal deaths.

Anaesthesia related maternal mortality in South Africa



(M&S = pre-existing medical and surgical conditions; NPRI = non-pregnancy-related infections; EC = ectopic pregnancies; Miscr. = miscarriage; PRS = pregnancy-related sepsis; OH = obstetric haemorrhage; HT = complication of hypertension in pregnancy; AR = anaesthetic-related deaths; Emb. = embolism; AC = acute collapse, cause unknown; MDs = maternal deaths.)

Figure 2: Proportion of potentially preventable deaths per disease category⁴

Figure 2 shows the contribution of anaesthesia to potentially preventable maternal mortality in South Africa. This was noted in the last Saving Mothers report for the year 2017. Anaesthesia contributed only 3.15% of all IMMR but this number is still high because as shown above, the majority of deaths were preventable. In that period, avoidable factors were 85.5%, 75% and 100% in district, regional and tertiary hospitals respectively⁴. There were more anaesthesia related deaths at district hospitals than all the levels of care combined⁴

The caesarean section rate in South Africa was 27.4% in 2017- a 12.3% increase from the 2006 period¹¹.

The Free State province has the 3rd highest caesarian section rate in South Africa of 29.5%. Sadly, it has the highest CFR for CD with a value of 235.5 per 100 000 live births⁴. This is above the national average of 145.7 indicating that there is a problem that needs to be interrogated. The high CFR for CD might be attributed to:

1. The relationship between increased caesarian delivery and anaesthesia related mortality.
2. The fact that the Free State economy is among the smaller ones in the country and
3. The large total geographical area which means that you have multiple small towns which are not developed and thus have health safety problems.

The anaesthetic provider

The World Health Organization aims to achieve universal health coverage (UHC) by the year 2030¹². It is important to note that one third of the global burden of disease can be corrected surgically; thus making the shortage of anaesthetic providers a limiting factor for safe surgery.

The WHO programme for Emergency and Essential Surgical Care worked towards bringing surgery within the global health agenda by initiating the Lancet Commission on Global Surgery¹². This saw the collection of data on the number of licensed surgeons, obstetricians and anaesthesiologists. The commission recommended the escalation of specialist surgical workforce to at least 20 per 100 000 population in order to see dramatic surgical patient safety. The number of anesthesia providers will have to match the combined number of surgeons and obstetricians.

During the 2015 to 2016 period, the World Federation of Societies of Anaesthesiologists (WFSA) conducted a workforce survey that collected information on Physician anaesthesia provider (PAP) and non-physician anaesthesia provider (NPAP) numbers, distribution and training. The findings showed a global workforce density of 6.09 PAP per 100 000 population with a 90 fold difference between high income and low income countries. Countries that have low workforce density of PAP make use of NPAP and this is mostly in sub-Saharan Africa with South Africa being the exception. The rate of maternal deaths when a NPAP administered the anaesthetic was 9.8 per 1000 anaesthetics compared to 5.2 per 1000 anaesthetics when managed by a PAP¹³.

There are disparities in the distribution of PAP within countries and within regions with a correlation seen based on per capita income. Rural areas are underserved compared to large cities. In the South African context, only physicians administer anaesthesia. District hospitals are served by medical officers who seldom have postgraduate training in the form of the Diploma in Anaesthesia (DA). Anaesthesiology specialists are not part of the staff establishment of district hospitals leaving the more rural and remote areas of the country without specialist expertise¹⁴. In the Free State, even some Level 2 hospitals have no specialist supervision.

Anaesthesia Training

Studies have shown that there is a correlation between anaesthetic training, experience and maternal mortality¹⁵. Anaesthesia training in South Africa starts in the undergraduate years, but many countries have limited or no allocation for training with arguments having been raised that anaesthesia is a postgraduate specialty. The lack of anaesthetic training and exposure impedes on the invaluable knowledge of airway, circulation, ventilation and pain management that comes with the discipline of anaesthesia¹⁵.

In 2005 South Africa moved from a 1 year to a 2 year internship program which led to anaesthesia being a 2 month rotation for all newly qualified doctors. The aim was to ensure proper training and exposure under supervision of future clinicians concentrating on practical experience. There are clear training guidelines from the Health Professionals Council of

South Africa (HPCSA) internship booklet. These must be achieved and each student must be signed off demonstrating competency and acquisition of the stipulated outcomes.

The South African Society of Anesthesiologists (SASA) published guidelines in 2012, stipulated the scope of practice and required training for administering anaesthesia¹⁶. Intern doctors are to provide anaesthesia under on-site supervision. For the majority of doctors this may be the only training they may ever have before being expected to administer anaesthesia without supervision in a remote rural area during community service. Kusel et al. looked at intern anaesthesia rotation feedback and the findings included¹⁷:

- Interns wanted more autonomy in order to improve learning and improve confidence.
- Longer rotation beyond the 2 months that is allocated
- Placing anaesthesia in the second year of internship closer to community service
- Targeted training in skills required for community service

According to SASA, Community service doctors need 2 months of supervised training during this period and thereafter they can administer anaesthesia under remote supervision where the anaesthetist is not immediately present but can be called upon when needed. Training is not always possible due to lack of doctors in rural South Africa where community service doctors are based. Since the aim of community service is to provide a service in remote areas, it is of utmost importance to equip intern doctors with anaesthetic skills.

Physicians who last had anaesthesia training as interns or during the undergraduate period pose an even greater dilemma. According to SASA they can give anaesthesia if deemed a dire emergency or if they acquired further training. In South Africa and especially in the Free State, lack of post graduate anaesthetic training contributes to the high obstetric mortality recorded. In 2005 Lamacraft et al showed that only 1 medical officer had a DA in all the Free State hospitals that were providing obstetric anaesthesia. This unwillingness or lack of opportunity to further one's knowledge is concerning as it is at the expense of our mothers.

The Cuban trained medical doctor

South Africa has a challenge of shortage and maldistribution of doctors, with an estimated 35 out of 1200 annual medical graduates staying long-term in rural areas¹⁸. In 1996 Nelson Mandela and Fidel Castro initiated a programme devised to train disadvantaged black African medical students with the aim to close the gap in the growing health inequality. This initiative has seen its first fruits in the last few years but concerns have arisen about the difference in training between Cuban trained and locally trained doctors.

A mixed methods observational study comparing trainees from Cuba and locally trained, conceded that Cuban trained students lacked exposure to diseases common in South Africa including Obstetrics and Anaesthesia¹⁸. One of the benefits of the Cuban health system in the South African context is its focus on primary health care and its encouragement of doctors to work in rural areas which are poorly serviced.

The evaluation of the training of Cuban medical student needs to be done and assisted anywhere possible to cater for the South African context in areas of deficiency.

Gaps identified

Maternal death distribution, causes and preventative measures have been extensively studied both in the global context and locally. In South Africa, the NCCEMD is responsible for assimilating data regarding maternal health and makes recommendations as to how the gaps identified can be addressed. The implementation of these recommendations has played a big role in decreasing maternal deaths.

Assessment of training and experience in obstetric anaesthesia has also been studied. Theron et al evaluated and highlighted lack of training and experience of doctors in obstetric anaesthesia in district and regional hospitals in KwaZulu-Natal¹⁹. Kusel et al in 2010 looked at the experience of doctors providing anaesthesia during community service after finishing their internship at Pietermaritzburg¹⁷. It is important to study whether the valuable suggestions made in these studies were implemented and consequently improved clinical outcomes.

Big gaps in obstetric anaesthesia care in the Free State were identified in the landmark study by Lamacraft et al⁵. It is important to determine if the training, experience and supervision of doctors administering obstetric anaesthesia in Free State Level 1 and 2 hospitals had improved 15 years down the line, which is the aim of this study. Our hypothesis is that there had not been a significant change as evidenced by the high iMMR in the Free State compared to national average.

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CHAPTER 2 (Publishable manuscript)

A comparative review of obstetric anaesthesia training, supervision and experience of public sector doctors in the Free State, 2005 vs. 2019

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Background: Obstetric anaesthesia is ranked first as a contributor to “potentially preventable deaths per underlying cause” of maternal death in South Africa². Lack of training and experience has been cited as the cause. This study aimed to evaluate public sector doctors administering obstetric anaesthesia in the Free State and compare training, supervision and experience findings with those of 14 years ago in a similar study by Lamacraft³.

Methods: This was a cross sectional analytical study carried out between the 11th and 19th December 2019. Caesarean section sites within the Free State were identified by the provincial government. Hospital CEOs and clinical managers were informed prior to the visit. An audience with the doctors was requested and those that could not come were traced to their work areas and given the questionnaire. The same self-administered questionnaire as by Lamacraft was completed after a brief description of the study.

Results: The overall response rate was 83%, with level 1 and level 2 hospital response rates of 78% and 91% respectively. This was an improvement from the 69% overall response rate of 2005. Exposure to obstetric anaesthesia during internship has improved: in 2005 12% of respondents lacked exposure but this dropped to 5% in 2019. The reported level of supervision also improved: In 2005 21% of supervision was by junior medical officers and only 25% by consultants compared to 2019 where junior medical officers’ supervision contributed 15% and consultants 44%. A lack of exposure and training post internship was observed with only 1 doctor having a Diploma in anaesthesia in 2005 compared to 5 in 2019. 54% and 47% reported to have no senior anaesthetist employed by their hospital in 2005 and 2019 respectively. Unfortunately the added responsibility of neonatal resuscitation while administering anaesthesia to the mother increased slightly from 42% in 2005 to 47% in 2019.

Conclusion: Despite improved anaesthetic exposure in internship, better consultant supervision and more doctors acquiring their diploma in anaesthesia, there is still insufficient anaesthetic training, supervision and experience in level 1 and 2 hospitals in the Free State.

Keywords: Obstetric anaesthesia, training, supervision, experience, Free State, hospitals

Introduction

Maternal mortality is a serious problem globally. In 2015 the World Health Organization (WHO) estimated that about 830 women die every day in the world due to pregnancy related deaths.¹⁵. Between 1990 and 2015 global maternal mortality dropped by about 44%. This is encouraging but it is still far from achieving the WHO goal, which aimed to reduce the maternal mortality ratio to less than 70 per 100 000 births by 2030.

Ninety nine percent of maternal deaths occur in developing countries and the adolescent mother is most at risk¹⁰. In 2015, the maternal mortality rate in developing countries was reported as 235 per 100 000 live births. The millennium challenge goal to achieve a drop of 75% from 1991 to 2015 could not be met¹⁵.

In the latest saving mothers report, “Potentially preventable deaths per underlying cause 2014-2016”, anaesthesia related deaths was the leading causes of maternal mortality¹. The Chairperson of The National Committee of Confidential Enquiries into Maternal Deaths (NCCEMD) acknowledged in the 2018 report that despite improvements, challenges in the knowledge and skills of health care professionals still remained. An estimated 57% of all maternal deaths in South Africa were regarded as preventable with lack of appropriately trained doctors contributing 41.2%¹.

In 2005, a manpower study by Lamacraft et al revealed that within the Free State, major contributors to anaesthesia related maternal deaths were skills and supervision of doctors³. The study found that the majority of doctors administering obstetric anaesthesia had no prior anaesthetic training post internship, were not being supervised or had no post graduate qualification in anaesthesia.

Theron et al showed that the challenges in the Free State are not unique. A similar study to that of Lamacraft was conducted in KwaZulu Natal, and found lack of training and experience of doctors in obstetric anaesthesia at district hospitals and correlated this to 15 anaesthesia-related deaths at district hospitals compared to three at regional, and two at tertiary hospitals between 2008 to 2010¹⁶.

In the last 15 years, the Free State province has seen a decline in designated caesarean section site hospitals from 23 to 13. The idea behind this was to consolidate resources in specific areas thus ensuring quality care and to mitigate maternal deaths. The overall provincial iMMR dropped from 353.8 in 2005 to 154.85 in 2017 as indicated in the last triennial report. This represented the first 13 years of the 15 year interval between the study by Lamacraft et al and this study. Although there is a significant decline in iMMR, it still remains far above the national average of 129.22¹.

The Free State has the highest case fatality rate per caesarean delivery (235.5) compared to the national average (145.71). It has the 2nd highest percentage of lack of appropriately trained doctors after Limpopo. The Institutional Maternal Mortality Ratio due to anaesthesia increased from 2.77 in 2011-13 period to 6.73 in 2017¹. Lamacraft et al had already correlated training and experience to mortality. This study aimed to determine if the training, experience and supervision of doctors administering obstetric anaesthesia in Free State Level 1 and 2 hospitals had improved, since the last survey was done in 2005.

Methods

This was a cross sectional analytical study. It was approved by the Health Science Research Ethics Committee (HSREC) of the University of the Free State. (HSREC ref: UFS-HSD2019/1566/2611) and FSDoH. A list of all the hospitals registered as caesarean section sites was obtained from the Free State Department of Health. These were assessed as the only hospitals which met the criteria for delivering theatre services based on an audit done by the Department. The audit meant a hospital could lose or regain accreditation to be a caesarean section site. Tertiary hospitals were excluded from the study.

Thirteen hospitals were identified and visited between the 11th to the 19th of December 2019. The hospital management was informed about the visit of a University of the Free State consultant and registrar regarding a MMed research study. The best time for the visit which would yield the highest response was ascertained.

A questionnaire similar to the one posed by Lamacraft et al in 2005 was used with an addition of a question regarding maternal resuscitation skills. The questionnaire assessed training, supervision and experience of public sector medical doctors in administering obstetric anaesthesia. Interns, Community Service doctors and medical officers were included. Consultants, sessional doctors and doctors on leave at the time were not included.

A self-administered questionnaire with implied consent was issued which identified the hospital but not the participants. All the returned questionnaires were handed over to the biostatistics department of the University of the Free State for descriptive analysis.

Results

Of the 13 hospitals visited 124 medical doctors were identified by the respective hospital managers as administering obstetric anaesthesia. 103 doctors filled the questionnaire with a calculated response rate of 83%. This number constituted 61 (78%) and 42 (91%) doctors from district and regional hospitals respectively.

The majority of the doctors were between 20 and 30 years of age (57%) with the predominant job description of medical officer (48 %) and community service doctor (33%). The majority were less than 1 year in their present rank (48%) and within the hospital (46%).

Previous training and Experience

1. Internship

In 2019, out of all the interns trained in different parts of South Africa, 63% obtained training within the Free State. Internship training was obtained in a tertiary hospital in 53% of total respondents.. It has been 15 years now that internship is 2 years with an anaesthetic rotation of 2 months. This has led to some improvement regarding exposure to obstetric anaesthesia during internship: Doctors that had more than 8 weeks anaesthesia exposure were 16% in 2005 and 23% in 2019 with 12% and 5% reporting no exposure in 2005 and 2019 respectively.

Level of supervision	N (%) 2005 study	N (%) 2019 study
Consultant	25 (24.2)	44 (44.4)
Registrar	24 (23.2)	27 (27.3)
Senior medical officer	29 (28.2)	13 (13.1)
Junior medical officer	21 (20.4)	15 (15.1)
None	4 (3.9)	
Did not answer	2(2)	4(4)
Total respondents	103	99

Table 3: Supervision as an intern

Post internship, before present post

When excluding interns and community service doctors who had recently had anaesthesia training, medical officer experience prior to their current post did not vary greatly as shown in Table 4. Only 16% of the medical officers had more than 1 year supervised exposure to obstetric anaesthesia in 2005 compared to 14% in 2019.

Anaesthesia experience post internship	2005 study	2019 study
>1 year supervised	16%	14%
>1 year unsupervised	24%	19%

Table 4: Anaesthesia experience post internship

Obstetric Anaesthesia experience prior to current post

In 2005, 17.8% reported never having done a spinal prior to their current post versus 7.9% in 2019. Lack of experience in general anaesthetic administrations dropped with a smaller percentage from 24% to 20.4%. Highly experienced doctors (as defined by the performance of more than 100 anaesthetics) were 14.9% for general anaesthetics in 2005 compared to only 6.8% in 2019. Those that did more than 100 spinal anaesthetic procedures were 14.9% and 18.2% in 2005 and 2019 respectively.

No of caesarean sections	No of doctors having administered spinal anaesthesia for caesarean section (%)		No of doctors having administered general anaesthesia for caesarean section (%)	
	2005	2019	2005	2019
0	18 (17.8)	7 (7.9)	24 (24)	18 (20.4)
1-10	20 (19.8)	7 (7.9)	30 (30)	38 (43.2)
11-50	32 (31.7)	43 (48.8)	23 (23)	20 (22.7)
51-100	16 (15.9)	15 (17)	8 (8)	6 (6.8)
>100	15 (14.9)	16 (18.2)	15 (15)	6 (6.8)
No answer	4	15	5	15

Table 5: Obstetric anaesthesia experience prior to current post

Postgraduate qualification

Only 1 doctor had a Diploma in Anaesthesia in 2005 compared to 5 in 2019. Amongst these 5, two were in the same district hospital with the other three being in different regional hospitals. In one of the regional hospitals, the most experienced doctor was only one year post-community service with no DA and no senior or consultant cover. A significant number had other qualifications: 33% ACLS, 60% ATLS and 29% APLS.

Other duties required while administering anaesthesia

The practice of multitasking while performing anaesthesia showed only small changes in the last 14 years. In 2005, 12% always had to resuscitate the baby compared to 6% in 2019. Whereas 33% have previously had to perform both the anaesthetic and the surgery in 2005, 18% found themselves in this unfortunate situation in 2019.

	Resuscitation of baby N (%)		Performance of surgery N (%)	
Frequency	2005	2019	2005	2019
Never	3(2.9)	4(3.8)	70(66.7)	83(81.7)
Rarely	47(44.8)	46(44.6)	23(21.9)	10(9.8)
Frequently	42(40)	47(45.6)	11(10.5)	9(8.8)
Always	13(12.4)	6(5.8)	1(1)	none

Table 6: Other duties that doctors are required to perform while administering anaesthesia for caesarean section

Senior anaesthetic supervision

Table 7 shows the changes in supervision between the two study periods with 47.5% of respondents reporting to have no senior anaesthetist in 2019 compared to 54% in 2005. This is a marginal improvement when taking into account the time period. There were no anaesthesia consultants employed in the district hospitals and only 2 of the district hospitals had a doctor with a diploma in anaesthesia.

Level of supervision in current post	2005 N (%)	2019 N (%)
1. A senior anaesthetist is always in the theatre complex when I am administering anaesthesia	5(4.9)	5(4.8)
2. A senior anaesthetist comes to theatre when I think I might have a problem with a case. He /She is otherwise available to be called and is always in the hospital premises	3(2.9)	21(20.3)
3. A senior anaesthetist is available on the hospital premises, but they only assist me if a major emergency arises perioperatively	2(2)	8(7.7)
4. A senior anaesthetist is on call from their home and will come to theatre when I think I might have a problem with a case (intra-operative complication)	32 (31)	20(19.4)
5. There is no senior anaesthetist employed by this hospital	55(54)	49(47.5)
Other (specify)		

Table 7: Senior anaesthetic supervision in present hospital post

Suggestions made by respondents

To improve obstetric anaesthesia in their hospitals, 58% of the respondents had suggestions in three main categories. These included, outreach programs, training and supervision. Improved training by means of outreach from academic institution was a suggestion in both studies. Training could take the form of either outreach or inreach programs. Similar to 2005, the request to employ a qualified anaesthesiologist was echoed. Furthermore a suggestion to employ doctors with a DA was made. A new suggestion not documented in the 2005 study was: Doctors working in theatre during daytime must be the ones who do the overnight duty. Another suggestion was the employment of a dedicated anaesthetic nurse.

Perception of the level of competency

This category was not included in the 2005 study by Lamacraft et al. When asked about managing obstetric anaesthesia cases, there is a concerning 30% who are unsure of their capabilities in giving general anaesthesia to an obstetric patient with a difficult airway. 52%, 41% and 80% perceived themselves strongly capable to do CPR, give general anaesthesia and do spinal anaesthesia respectively.

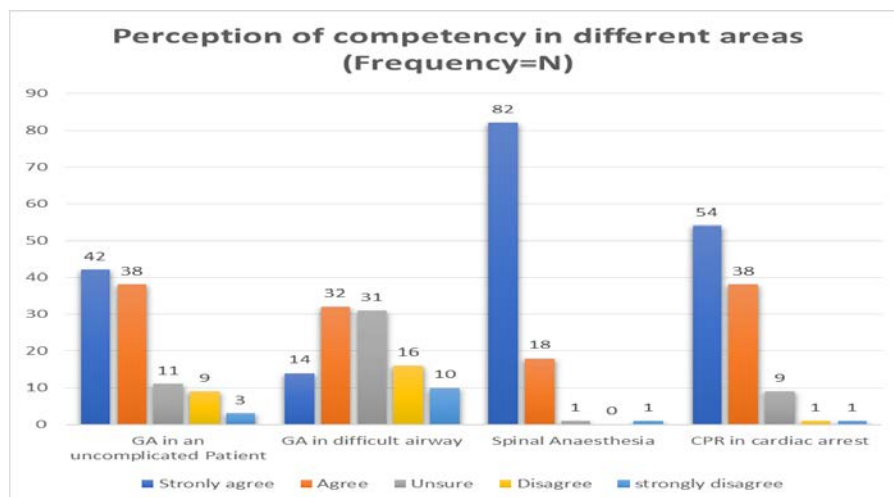


Figure 3: Perception of competency in different areas

Discussion

It has been almost 15 years since the last evaluation of obstetric anaesthesia training, supervision and experience in the Free State³. In 2005 Lamacraft et al gave a picture of the profile of obstetric anesthesia providers within the province. The study documented intern training and post internship exposure to anaesthesia. It also included supervision, post graduate anaesthetic qualification and multitasking while administering anaesthesia.

A lot of changes have happened since then. Internship training has been extended from 1 year to 2 years and the anaesthetic rotation from 2 weeks to 2 months. Spinal anaesthesia has become the preferred method for caesarian sections over general anaesthesia. There has been a consolidation of resources in order to identify well- equipped hospitals to become caesarean section sites. All these changes were among some of the recommendations of the 2005 study by G. Lamacraft. The aim of these was to improve health outcomes within hospitals and especially obstetric anaesthesia.

This study aimed to assess the changes over time that could or could not have brought about a positive change in obstetric anaesthesia within the province. Based on the last triennial report of 2017, the Free State's institutional Maternal Mortality rate (iMMR) had decreased from 353 in 2005 to 154 in 2017. Despite the drop, the Free State is the province with the 2nd highest iMMR, well above the national average of 134 deaths/100 000 live births⁵. The Free State has the highest Case Fatality Rate for caesarean delivery in South Africa reporting 235 deaths/100 000 live births in 2017 which is well above the country's average of 145. The small contribution of 6.7% due to anaesthesia related deaths should not be misleading as they are mostly preventable.

As expected, there are now more doctors being exposed to anaesthesia during internship for a longer period of time. An improved quality of training is also evidenced by more respondents being trained by consultants and registrars. This could be due to more training being done at tertiary hospitals or the presence of more consultants at regional hospitals.

There has not been any improvement regarding post-internship exposure to obstetric anaesthesia. In fact, there were slightly less doctors who had longer than 1 year supervised training in 2019 (14%) compared to 2005(16%). There are still 33% of respondents not exposed to obstetric anaesthesia post internship. Even though more doctors had obtained a DA since the last study, 5 are still inadequate to provide a quality service in the province. It seems that after the good exposure during internship, there is no system to ensure continued exposure and training.

Over time, spinal anaesthesia for caesarean delivery has become the standard of care unless there are contraindications. This change in practice has been at the detriment of experience in obstetric general anesthetics with 23 and 12 doctors reporting performance of more than 50 cases of general anaesthesia in 2005 and 2019 respectively. This is unfortunate, since a general anaesthetic still remains the favored option in women with emergency indications for delivery where time to delivery and haemodynamics are a concern¹⁷. Increased morbidity and mortality identified with general anaesthesia has been attributed to inadequate training, unavailability of equipment and the poor maternal condition.⁹ It may not always be possible to have done enough general anesthetics in order to be comfortable with the technique, but simulation training can prepare one for this eventuality. When asked about whether they could manage a difficult obstetric airway, 30% were unsure and 24% agreed that they could not.

It is concerning that less than half of the anaesthesia providers in the Province feel confident to intubate a parturient. Interns should not be “signed off” until they had shown competencies in these techniques. Doctors in peripheral hospitals must remain supervised by their seniors until they had done these types of anaesthetics and had enough experience to do these “solo”. Despite this, several doctors currently doing obstetric anaesthesia had never done a GA and or a spinal for caesarean section before taking up their present post.

The practice of multitasking while administering obstetric anaesthesia has decreased but should not be done at all. Unfortunately many hospitals are understaffed and to have a third doctor in theatre to look after the newborn may not be feasible.

While 47% of the 2019 group reported to have no senior anaesthetist in their hospital, this was a small drop from the 54% 15 years prior. Disappointingly, still only about 5% had in-theatre supervision with the presence of an anaesthetist in the theatre premises all the time. There is however a greater percentage in the current study (9.8% vs. 32.8%) who reported to have a senior anaesthetist on site who would come to assist if the need should arise.

The confidential nature of NCCEMD, does not allow one to fully interrogate the exact contribution of different causes of anaesthesia related maternal deaths. An inability to demonstrate which areas of training were lacking has been a limitation as this information with the knowledge of the exact cause would focus further intervention. The study was carried out in 2019 before the latest triennium report of 2019 was out which would have had the latest statistics. The unavailability of sessional doctors during the visit to the hospitals may also have excluded the most experienced doctors and could have maybe painted a different picture but their numbers were low and this should not discredit the finding of this study.

There is high (79%) suboptimal care that impacts on obstetric anaesthesia related deaths¹. This calls for further interrogation into why the care is so inadequate despite well documented studies that have shown that training and experience is the major culprit. Programmes like ESMOE have been introduced to partly address this issue but more still needs to be done.

Conclusion

There have been some improvements in obstetric anaesthesia training, experience and supervision, but some major problems still exist.. Doctors are still appointed to posts without the necessary experience. Skills in performing general anaesthesia for obstetric patients are lacking. The anesthetic provider is still often expected to tend to both the mother and the newborn. These deficiencies need to be addressed in order to reduce anaesthesia-related maternal deaths.

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Appendices

Appendix A: (Letter of approval from Research Ethics Committee)



Health Sciences Research Ethics Committee

14-Nov-2019

Dear **Dr Seta Machai**

Ethics Clearance: **A comparative review of obstetric anaesthesia training, supervision and experience of public sector doctors in the Free State, 2005 vs. 2019**

Principal Investigator: **Dr Seta Machai**

Department: **Anaesthesiology Department (Bloemfontein Campus)**

APPLICATION APPROVED

Please ensure that you read the whole document

With reference to your application for ethical clearance with the Faculty of Health Sciences, I am pleased to inform you on behalf of the Health Sciences Research Ethics Committee that you have been granted ethical clearance for your project.

Your ethical clearance number, to be used in all correspondence is: **UFS-HSD2019/1566/2611**

The ethical clearance number is valid for research conducted for one year from issuance. Should you require more time to complete this research, please apply for an extension.

We request that any changes that may take place during the course of your research project be submitted to the HSREC for approval to ensure we are kept up to date with your progress and any ethical implications that may arise. This includes any serious adverse events and/or termination of the study.

A progress report should be submitted within one year of approval, and annually for long term studies. A final report should be submitted at the completion of the study.

The HSREC functions in compliance with, but not limited to, the following documents and guidelines: The SA National Health Act, No. 61 of 2003; Ethics in Health Research: Principles, Structures and Processes (2015); SA GCP(2006); Declaration of Helsinki; The Belmont Report; The US Office of Human Research Protections 45 CFR 461 (for non-exempt research with human participants conducted or supported by the US Department of Health and Human Services- (HHS), 21 CFR 50, 21 CFR 56; CIOMS; ICH-GCP-E6 Sections 1-4; The International Conference on Harmonization and Technical Requirements for Registration of Pharmaceuticals for Human Use (ICH Tripartite), Guidelines of the SA Medicines Control Council as well as Laws and Regulations with regard to the Control of Medicines, Constitution of the HSREC of the Faculty of Health Sciences.

For any questions or concerns, please feel free to contact HSREC Administration: 051-4017794/5 or email EthicsFHS@ufs.ac.za.

Thank you for submitting this proposal for ethical clearance and we wish you every success with your research.

Yours Sincerely

Dr. SM Le Grange
Chair : Health Sciences Research Ethics Committee

Health Sciences Research Ethics Committee

Office of the Dean: Health Sciences

T: +27 (0)51 401 7795/7794 | E: ethicsfhs@ufs.ac.za

IRB 00006240; REC 230408-011; IORG0005187; FWA00012784

Block D, Dean's Division, Room D104 | P.O. Box/Posbus 339 (Internal Post Box G40) | Bloemfontein 9300 | South Africa



Appendix B: Participant information form on the questionnaire

A comparative review of obstetric anaesthesia training, supervision and experience of public sector doctors in the Free State, 2005 vs. 2019

Sample Questionnaire

PROVINCIAL OBSTETRIC ANAESTHESIA MANPOWER STUDY QUESTIONNAIRE

The aim of this study is to assess the training, experience and supervision of those doctors administering anaesthesia to obstetric patients in level 1 and 2 Hospitals in the Free State. If you never give anaesthesia to pregnant/obstetric patients, note this at the top of this page and return the incomplete form

Note: This is a voluntary questionnaire and you may withdraw at any time during the filling thereof. By completing this questionnaire it is implied that informed consent has been obtained from you. Any information derived from you (which will be anonymous) may be used for publication by the researcher.

Appendix C: (Permission from Department of Health)



health
Department of
Health
FREE STATE PROVINCE

28 October 2019

Dr S Machai
Dept. of Anaesthesiology
UFS

Dear Dr S Machai

Subject: A comparative review of obstetric anaesthesia, supervision an experience of public sector doctors in the Free State, 2005 vs. 2019.

- Please ensure that you read the whole document, Permission is hereby granted for the above – mentioned research on the following conditions:
- Participation in the study must be voluntary.
- A written consent by each participant must be obtained.
- Serious Adverse events to be reported to the Free State department of health and/ or termination of the study
- Ascertain that your data collection exercise neither interferes with the day to day running of Boitumelo, Metsimaholo, Parys, Tokollo, Bongani, Thusanong, Botshabelo, Dr JS Moroka, National, Diklabeng, Pekolong, Thebe & Mofumahadi Manapo Mopeli Hospital nor the performance of duties by the respondents or health care workers.
- Confidentiality of information will be ensured and please do not obtain information regarding the identity of the participants.
- **Research results and a complete report should be made available to the Free State Department of Health on completion of the study (a hard copy plus a soft copy).**
- Progress report must be presented not later than one year after approval of the project to the Ethics Committee of the University of the Free State and to Free State Department of Health.
- Any amendments, extension or other modifications to the protocol or investigators must be submitted to the Ethics Committee of the University of the Free State and to Free State Department of Health.
- **Conditions stated in your Ethical Approval letter should be adhered to and a final copy of the Ethics Clearance Certificate should be submitted to sebeelats@fshealth.gov.za / makenamr@fshealth.gov.za before you commence with the study**
- No financial liability will be placed on the Free State Department of Health
- **Please discuss your study with Institution Manager on commencement for logistical arrangements see 2nd page for contact details.**
- Department of Health to be fully indemnified from any harm that participants and staff experiences in the study
- Researchers will be required to enter in to a formal agreement with the Free State department of health regulating and formalizing the research relationship (document will follow)
- **As part of feedback you will be required to present your study findings/results at the Free State Provincial health research day**

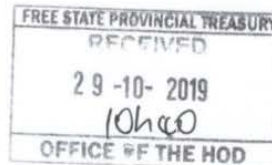
Trust you find the above in order.

Kind Regards

Dr D Motau

HEAD: HEALTH

Date: 4/11/2019



Appendix D: (Approval letter from Head of Department of Anaesthesiology)

09 August 2019

The Chair: Health Sciences Research Ethics Committee
Dr SM le Grange
For Attention: Mrs M Marais
Block D, Room 104,
Faculty of Health Sciences
University of the Free State
BLOEMFONTEIN
9300

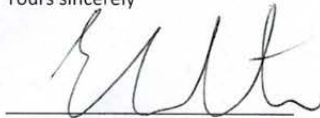
Dear Dr SM le Grange,

RE: SETA LITEBOHO MACHAI: STUDENT NUMBER 2002018964

PROJECT TITLE: Obstetric Anaesthesia training, supervision and experience of public sector doctors in the Free State in 2019: any improvement since 2005?

I, Dr Edwin Turton hereby grant Dr SL Machai permission to conduct the above-mentioned research project. The research will be completed in accordance with myself as Head of Department of Anaesthesiology, Dr J Lemmer-Malherbe as supervisor and Prof G Lamacraft as co supervisor of this study.

Yours sincerely



DR EW TURTON
HOD: ANAESTHESIOLOGY



Appendix E: (Research Protocol approved by HSREC)



A comparative review of obstetric anaesthesia training, supervision and experience of public sector doctors in the Free State, 2005 vs. 2019

(17/09/19 version 2)

Principal Investigator

Dr S.L Machai

Registrar Anaesthesiology (MMed)

Department of Anaesthesia

University of Free State

Supervisor

Dr J Lemmer-Malherbe

MBChB (Pret) MMed (Anaes)

Department of Anaesthesia

University of Free State

Co Supervisor

Prof G Lamacraft

MB BS, DA, MRCP (UK), FRCA (UK), PhD (UFS)

Professor Department of Anaesthesia

University of the Free State

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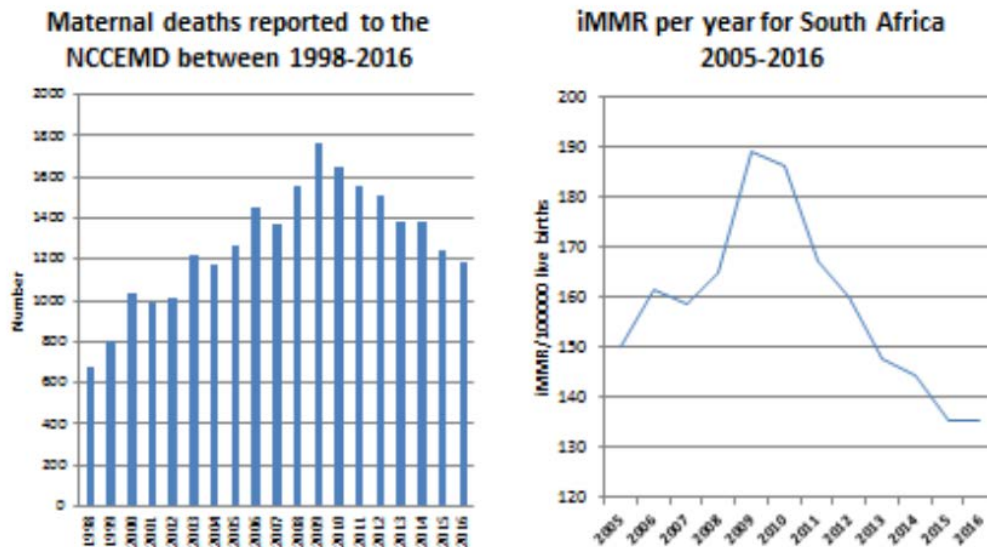
INTRODUCTION

Maternal mortality is a serious problem globally with the WHO estimating about 830 women dying every day in the world due to pregnancy related deaths in 2015¹⁸. Between 1990 and 2015 world maternal mortality dropped by about 44%¹⁸. This is encouraging but we are still far from achieving the WHO goal, which aims to reduce the maternal mortality ratio by less than 70 per 100 000 births by 2030¹⁸.

99% of maternal deaths occur in developing countries and the adolescent mother is most at risk. In 2015, the maternal mortality rate in developing countries was reported as 235 per 100 000 live births. The millennium challenge goal failed to achieve a drop of 75% from 1991 to 2015¹⁸.

Sub-Saharan Africa, with poor socioeconomic conditions, accounts for fifty percent of global maternal mortality¹⁰. These cases are mostly considered preventable. .

Changes in mortality over time

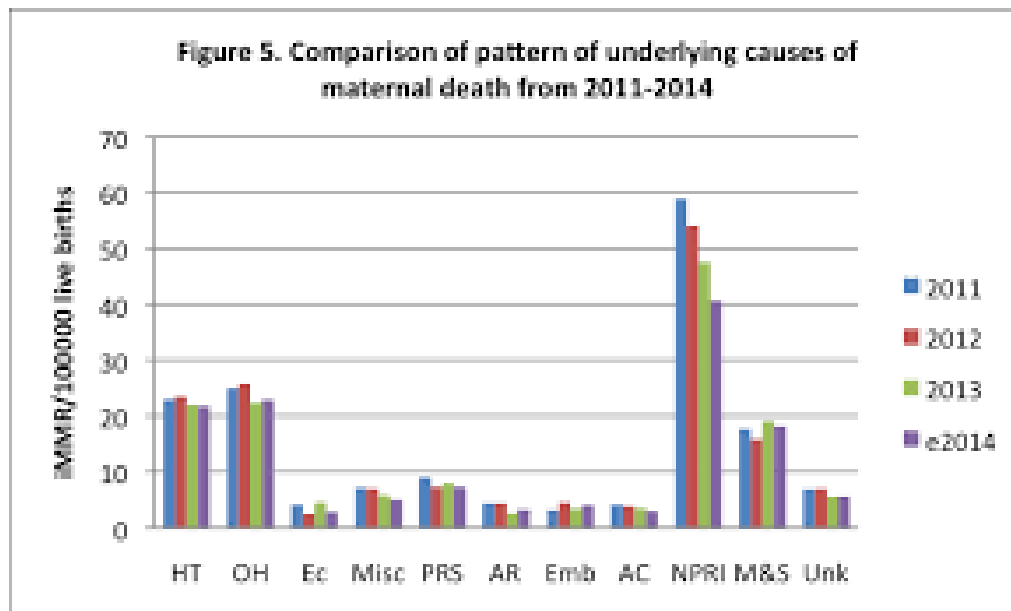


Institutional maternal mortality ratio (iMMR) graphs over time (Copy from Saving Mothers Report 2014-2016)

In South Africa maternal mortality is 134 per 100 00 live births. The majority of deaths occur in low resource settings where access to health care is a challenge¹⁰. The leading causes of death

noted in the saving mothers' report of 2014 to 2016 were: non pregnancy related infections (40.5 %), obstetric haemorrhage (22.8 %) and hypertension (21.6 %). Anaesthesia accounted for 3.15 % in the same year¹¹.

South Africa has come far in reducing maternal mortality². The above graph shows a downward trend in institutional maternal mortality ratio (iMMR) as reported by the National Committee on Confidential Enquiries into Maternal Deaths (NCCEMD)¹¹. Focused efforts in the treatment programs of HIV has resulted in a 47 % reduction in non-pregnancy related infections since 2011. Deaths from maternal haemorrhage have also reduced. The number of deaths due to anaesthetic complications on the other hand has not shown significant reductions as shown below by the same report¹¹.



Copy from Saving Mothers Report 2014-2016

“Potentially preventable deaths per underlying cause 2014-2016 report” reveals anaesthesia related deaths to be on top as the leading causes of maternal mortality². The chair of The National committee of confidential enquiries into maternal death acknowledges in the 2018 report that despite improvements, challenges still remain in the knowledge and skills of health care professionals. An estimated 57% of all maternal deaths are regarded as preventable. Lack of appropriately trained doctors contributes 41.2% of these deaths¹¹.

A lot of the causes of maternal deaths can be prevented. In 2005, a manpower study by Prof Lamacraft revealed that within the Free State, major contributors to anaesthesia related maternal deaths were skills and supervision of doctors³. She found that the majority of doctors administering obstetric anaesthesia had no prior anaesthetic training, were not being supervised or had no post graduate training.

Theron et al showed that the challenges in the Free State were not unique. A similar study to that of Prof G Lamacraft was conducted in KwaZulu Natal, and found increases in anaesthetic-related maternal deaths due to suboptimal treatment and lack of basic skills¹⁶. A Study carried out in Nigeria showed that general anaesthesia, difficult airway management, inadequate supervision and a lack of appropriate monitors were the major anaesthetic risk factors¹⁹.

Essential Steps in Managing Obstetric Emergencies (ESMOE) training has shown promise in improving knowledge and skills amongst interns²⁰. However, many practitioners administering obstetric anaesthesia have never been trained in ESMOE.

Motivation and/or justification for the study

Current statistics reveal a declining trend in maternal deaths but World Health Organization (WHO) and local desired targets have not been met²¹. Maternal deaths are common in sub-Saharan Africa for a variety of reasons including obstetric anaesthesia. Inadequate knowledge, skill and experience of doctors caring for this group of patients is a big contributing factor to mortality²². Anaesthesia in particular is a cause of preventable deaths and thus continued assessments, interventions and further studies have to be done to address its contribution to maternal deaths. The study will look at the profile of doctors administering obstetric anaesthesia in the Free State public sector with the hope that the findings can assist in policy making, improvements and strategic planning that will limit these unnecessary deaths.

AIMS AND OBJECTIVES

Aim

The aim of the study is to determine if the training, experience and supervision of doctors administering obstetric anaesthesia in Free State Level 1 and 2 hospitals has improved, since the last survey was done in 2005.

Objectives

1. To assess the obstetric anaesthesia *experience* of doctors administering obstetric anaesthesia in Level 1 and 2 hospitals, using the same questions as previously used in the questionnaire used in a similar 2005 manpower study.
2. To assess the *supervision* of doctors administering obstetric anaesthesia in Level 1 and 2 hospitals, using the same questions as previously used in the 2005 manpower study questionnaire.
3. To assess the *training* of doctors administering obstetric anaesthesia in Level 1 and 2 hospitals, using the same questions as previously used in the 2005 manpower study questionnaire.
4. To determine if there has been any improvement in the training, supervision and experience of these doctors, since 2005, by comparing the results of the above with those from 2005.
5. A secondary objective to assess perception of level of experience. This will be done by adding a question that was not there in the primary study of 2005.

- Hospital to be visited:
1. Bongani Hospital (Level 2)
 2. Boitumelo Hospital (Level 2)
 3. Dihlabeng Hospital (Level 2)
 4. Mofumahadi Manapo Mopeli Hospital (Level 2)
 5. National Hospital (Level 1)
 6. Botshabelo Hospital (Level 1)
 7. Fezi Ngumbentombi Hospital (Level 1)
 8. Thusanong Hospital (Level 1)
 9. Phekolong Hospital (Level 1)
 10. Dr JS Moroka Hospital (Level 1)
 11. Parys Hospital (Level 1)
 12. Thebe Hospital (Level 1)
 13. Tokollo Hospital (Level 1)

Level 1/District Hospital:

This is the third step in the provision of level 1 health care where step 1 is primary health care clinics and step 2 is the community healthcare center. Receive referral from and provide generalist support to community health centers and clinics such as diagnostic, treatment, care, counselling and rehabilitation services. Clinical services include Surgery, Obstetrics & Gynaecology, Out-Patients Department, Medicine, Paediatrics, Mental Health, Geriatrics, Casualty and Clinical Forensic Medical Services.

Level 2/Regional Hospital:

This is the second level of health care. These hospitals will normally receive referral from and provide specialist support to a number of district hospitals.

If the Regional Hospital cannot help they will refer to the Provincial Tertiary Hospital.

Population: Registered medical practitioners administering obstetric anaesthesia in the Free State Public sector

Sample size: All level 1 and 2 medical practitioners administering obstetric anaesthesia in caesarean section sites

Estimated population size of 85 doctors with an average of 10 doctors per regional hospital and 5 doctors per district hospital.

Data collection tool: pre-existing standard questionnaire (PROVINCIAL OBSTETRIC ANAESTHESIA MANPOWER STUDY QUESTIONNAIRE) will be physically handed out

Measurement: 13 hospitals will be visited by both the researcher and the supervisor. In an unforeseen event that the supervisor is unable to go the researcher will go alone.

Appointments will be made to meet the doctors during a pre-set hospital meeting or Morbidity and Mortality (M&M) meeting. Failure to meet in a structured way will warrant visitation to the specific work place of the doctors concerned with hospital management permission. A self-administered questionnaire will then be handed out and handed back after completion.

Inclusion Criteria

- Registered medical practitioners administering obstetric anaesthesia in level 1 and 2 hospitals within the Free State public sector
- Level 1 and 2 Hospital designated caesarean section sites

Exclusion Criteria

- Consultant specialists
- Doctors at academic hospitals (i.e. Pelonomi Hospital)

Pilot study: A self-administered pre-existing standard questionnaire (PROVINCIAL OBSTETRIC ANAESTHESIA MANPOWER STUDY QUESTIONNAIRE) will be handed out to 5 anaesthesia medical officers at Pelonomi Hospital. Information will then be gathered to evaluate the practicalities in filling and analysing the questionnaires and to see if any amendments need to be made prior to carrying out the study.

Analysis of Data

This data analysis will be performed by the biostatistician of the University of the Free State. Data from the questionnaires after being filled physically on site visitation, will be sorted and organised in Microsoft excel 2018. Descriptive statistics will be performed for continuous variables.

Information collected will include: The number of practitioners administering obstetric anaesthesia; Demography; Level of training; Experience in obstetric anaesthesia and Level of supervision. These will help in analysing the profile of doctors administering obstetric anaesthesia in level 1 and 2 hospitals in the Free State. This data will then be compared with that from 2005.

Limitations of the study

The cross sectional nature may not allow assessment of evolving factors such as hiring and planned training etc. A smaller number of hospitals will be assessed compared to the original study, due to fewer hospitals delivering a cesarean section service in 2019.

Ethical considerations

Confidentiality will be applied and participants will be provided a unique number to keep their information confidential. Participants will be allowed to withdraw at any time during the study. Ethics will be obtained from Health Science Research Ethics Committee (HSREC)

at the University of the Free State. Approval to carry out the study will be sort from the Free State Department of Health.

An information leaflet stating the following will be attached to the questionnaire:

"You have been asked to participate in a research study. Please note that by completing this questionnaire you are voluntarily agreeing to participate in this research study. You will remain anonymous and your data will be treated confidentially at all times. You may withdraw from this study at any given moment during the completion of the questionnaire. The results of The study may be published."

Budget

ITEM	COST (R)
Transport	R 5000,00
Printing	R 500,00
Communication	R 500,00
Total	R 6000,00

TIMELINE

The study will be conducted during the period 1st November 2019 to 31st December 2019

2019

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Literature review												
Protocol Preparation												
Protocol assessment												
Ethic application												
Data collection												
Data analysis												
Thesis Write Up												

2020

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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[illegible]

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Appendix F: (Data Collection tool)

A comparative review of obstetric anaesthesia training, supervision and experience of public sector doctors in the Free State, 2005 vs. 2019

Sample Questionnaire

PROVINCIAL OBSTETRIC ANAESTHESIA MANPOWER STUDY QUESTIONNAIRE

The aim of this study is to assess the training, experience and supervision of those doctors administering anaesthesia to obstetric patients in level 1 and 2 Hospitals in the Free State. If you never give

anaesthesia to pregnant/obstetric patients, note this at the top of this page and return the incomplete form

Note: This is a voluntary questionnaire and you may withdraw at any time during the filling thereof. By completing this questionnaire it is implied that informed consent has been obtained from you. Any information derived from you (which will be anonymous) may be used for publication by the researcher.

Level of Hospital:

Date:

{Please tick one box for each of the following questions}

1. Age (years)

1. 20-30	
2. 31-40	
3. 41-50	
4. >51	

2. Rank

1. Community service	
2. Medical officer	
3. General Practitioner	
4. Specialist	
5. Other	

3. Length of time in present Rank

1. 0-3 months	
2. 4-12 months	
3. 13 months- 5 years	
4. >5years	

4. How long have you been working in your current hospital?

1. 0-3months	
2. 4-12 months	
3. 13 months-5 yrs.	
4. >5 years	

5. Do you work full time or on a sessional basis?

1. Full time	
--------------	--

2. Sessions	
-------------	--

If sessions, how many sessions per week?

(A session= a morning, e.g.; 8am-1pm, afternoon, e.g.; 1pm-5pm or a night call e.g.; 5pm-8am)

1 session	
2-4 sessions	
5 or more sessions	

6. Are you a community service doctor on a rotation?

1. Yes (complete a –d of this question)	
2. No (go straight on to question 7)	

a) *In what level hospital did you do internship?*

1. Tertiary	
2. Regional	
3. District	

b) *In which province did you complete your internship? (If not in South Africa specify)*

Free State		N. Cape	
Limpopo		KZN	
North West		W. Cape	
Mpumalanga		E.Cape	
Gauteng		Other (specify)	

7. How long was your anaesthetic rotation as an intern?

2 weeks or less	
>2 weeks but <2 months	
>2 months	

8. Were you exposed to obstetric anaesthesia as an intern?

1. Yes		2. No	
--------	--	-------	--

9. What was your main level of supervision in your anaesthetic training as an intern?

Consultant	
Registrar	
Senior medical officer	
Medical officer	
no supervision	

10. How much experience in anaesthesia, excluding internship; did you have before starting this post?

a) Supervised

None	
up to 2 months	
2 months to 1 year	
>1 year	

b) Unsupervised

None	
up to 2 months	
2 months to 1 year	
>1 year	

Describe this unsupervised experience if it was on an irregular basis, i.e.; less than once a week. (Use an extra sheet of paper if needed)

--

10. What was your obstetric anaesthesia experience prior to your present hospital post?

a) Number of General anaesthesia for caesarean section

None	
1-10	
11-50	
51-100	

>100	
------	--

b) Number of spinal anaesthesia for Caesarean sections

None	
1-10	
11-50	
51-100	
>100	

11. What has been your obstetric anaesthesia experience since in your present hospital post?

a) Number of General anaesthesia for caesarean section

None	
1-10	
11-50	
51-100	
>100	

b) Number of spinal anaesthesia for caesarian section

None	
1-10	
11-50	
51-100	
>100	

12. Highest Anaesthesia qualification of the person training you in your present hospital post

None	
Diploma in Anaesthesia	
Consultant: FCA/ MMed	

12. Do you have any postgraduate qualifications in anaesthesia?

1. Yes		2. No	
--------	--	-------	--

If Yes;

D.A. (Diploma in Anaesthesia)	
MMed (Anaesthesia)	
FCA(SA) or equivalent	

13. Which non anaesthetic postgraduate qualifications do you have?

None	
ATLS	
ACLS	
APLS	
Other (specify)	

14. Highest Anaesthesia qualification of the person training you in your present hospital post

None	
Diploma in Anaesthesia	
Consultant: FCA/ MMed	

15. How often do you have to administer the anaesthesia for a Caesarean Section and resuscitate the baby?

Never (0%)	
Rarely (<5%)	
Frequently (6-99%)	
Always (100%)	

16. How often do you have to administer the anaesthesia for a Caesarean Section and perform the surgery?

Never (0%)	
Rarely (<5%)	
Frequently (6-99%)	
Always (100%)	

17. Anaesthetic Supervision in this Hospital Post:

In the event of a serious obstetric anaesthetic complication, in what way is a senior anaesthetist available to assist you?

(Choose only the one most applicable to your situation)

6. A senior anaesthetist is always in the theatre complex when I am administering anaesthesia	
7. A senior anaesthetist comes to theatre when I think I might have a problem with a case. He /She is otherwise available to be called and is always in the hospital premises	
8. A senior anaesthetist is available on the hospital premises, but they only assist me if a major emergency arises perioperatively	
9. A senior anaesthetist is on call from their home and will come to theatre when I think I might have a problem with a case	
10. There is no senior anaesthetist employed by this hospital	
Other (specify)	

18. With the following scale please choose the most appropriate answer in managing Obstetric anaesthesia patients

I perceive myself capable to manage:

	Strongly agree	Agree	Unsure	Disagree	Strongly disagree
General anaesthesia, in an uncomplicated patient					
Giving general anaesthesia, to a patient with difficult airway					
Spinal anaesthesia					
Cardiopulmonary resuscitation (CPR), in the event of a cardiac arrest					

19. Do you have any suggestions as to how the safety of obstetric anaesthesia can be improved in your hospital? (Attach sheet of paper if you wish to write more)

--

Thank you for your time taken in completing this form.

Appendix G:

Instruction to Author/ Full author guidelines for the South African Journal of Anaesthesia and Analgesia (SAJAA)

Author Guidelines

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 racial-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 authors 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 are 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 <) 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.

All references should be listed at the end of the article in numerical order of appearance in the **Vancouver style** (not alphabetical order). Approved abbreviations of journal titles must be used; see the List of Journals in Index Medicus. Names and initials of all authors should be given; if there are more than six authors, the first four names should be given followed by et

al. First and last page, volume and issue numbers should be given. **Wherever possible, references must be accompanied by a digital object identifier (DOI) link and PubMed ID (PMID)/PubMed Central ID (PMCID).** Authors are encouraged to use the DOI lookup service offered by [CrossRef](#). Crossref DOIs should always be displayed as a full URL link in the form <https://doi.org/10.xxxx/xxxxx>

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**A comparative review of obstetric anaesthesia training,
supervision and experience of public sector doctors in the
Free State, 2005 vs. 2019**

By Seta Liekeho Machai

"Submitted in fulfillment of the requirements in respect of the Master's Degree MEdid in the
Department of Anaesthesiology in the Faculty of Health Science at the University of the Free
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29 January 2021

A comparative review of obstetric anaesthesia training,
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