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A survey of anaesthesia registrars' experience and perspectives on epidural training in the WITS Anaesthesia circuit, Johannesburg

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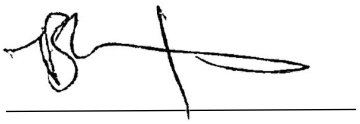
Brett R Hosking

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

Johannesburg, 2022

Declaration

I, Brett R Hosking, herewith declare that this research report is my own, unaided work. It is being submitted for the degree of Master of Medicine at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.



Signed

On this 17th day of February 2023

Abstract

Background

Insertion of epidurals, in particular thoracic epidurals, is a challenging procedure that is considered one of the most difficult technical skills in which to develop proficiency. Internationally, there is a lack of objective recommendations pertaining to epidural insertion education and skill acquisition. The aim of this study was to describe anaesthetic registrars' experience and perspectives of epidural training at the University of Witwaterstrand.

Method

A cross-sectional, contextual, descriptive study was performed using a self-administered electronic questionnaire. A validated questionnaire on this topic developed by Isaacs et al was used with permission as a guide for the development of our questionnaire, which was then adapted to ensure its relevance to the local environment.

Results

Eighty-nine participants responded to the survey giving a response rate of 80.9%. Despite disagreement with respect to observation and feedback on enough cases to feel confident when performing the procedure alone (47, 52.8%), most participants still perceived they had a good understanding of spinal anatomy (73, 82%) and complications of epidural insertion (70, 78.7%). Participants could easily call for help if struggling (53, 59.5%), and knew when it was appropriate to do so (54, 60.7%). Almost all the participants (87, 97.8%) had never used an epidural simulator before, yet 67 (75.3%) participants indicated that it should be recommended to teach junior colleagues. Regarding the use of ultrasound pre-puncture, a large number of participants (75, 84.3%) had never used it, however, 55 (61.8%) participants recommend it being used as part of a teaching strategy.

Conclusion

Our study found that a more formal teaching program, as well as a minimum number of supervised epidural insertions has been recommended to improve the current training program, as registrars continue to face challenges in developing the skill of epidural insertion. Simulators and ultrasound skills should also be incorporated into the training of epidural insertions.

Words: 299

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List of Abbreviations

WITS	University of Witwatersrand
MASTER Trial	Multicentre Australian Study of Epidural Anaesthesia in high risk surgery
NICE	National Institute for Health and Care Excellence
UK	United Kingdom
USA	United States of America
ANZCA	Australian and New Zealand College of Anaesthetists
CMSA	Colleges of Medicine South Africa
HPCSA	Health Professions Council of South Africa
CanMEDS	Canadian Medical Education Directives
SASA	South African Society of Anaesthetists
CUSUM	Cumulative Sum
PDPH	Post Dural Puncture Headache
ADP	Accidental Dural Puncture
CNS	Central Nervous System
TAP blocks	Transversus Abdominus Plane blocks
QL blocks	Quadratus Lumborum blocks
ICU	Intensive Care Unit

Section 1: Review of the Literature

Background

Insertion of epidurals, in particular thoracic epidurals, is a challenging procedure that is considered to be one of the most difficult technical skills to develop proficiency in as an anaesthetic registrar (1-3). Despite this, it is an essential tool for the specialist anaesthetist to manage acute pain effectively, which leads not only to improved patient satisfaction and decreasing pain scores, but may also improve clinical outcomes of patients (4).

Training systems for teaching skill acquisition in anaesthesia, such as epidural insertion, are complex yet poorly structured. They generally appear to be specific to which region or country, and institution a registrar is training in; as well as under which individual specialist-supervisor they are training. Not only are teaching programs variable, but assessment of competency varies from country to country, and even within different institutions in the same country. Despite published recommendations for assessment of competency of epidural insertion, these are not standardised or practised globally. (1, 3, 5-7)

The role of epidurals

The indications for epidural blocks include anaesthesia, intra-operative and postoperative analgesia, treatment of chronic pain, analgesia for trauma, in particular chest trauma with fractured ribs , and obstetric anaesthesia and analgesia.(1, 8-10) Thoracic epidurals, in particular, are useful in treating acute pain and reducing pain scores in patients undergoing major upper abdominal and thoracic surgery (4). Manion et al (4) suggest that thoracic epidurals allow patients with significant comorbid diseases to have their procedures when previously they may have been assessed as too high risk for surgery (4). Epidurals in general are more effective in providing postoperative analgesia when compared to parenteral opioids, regardless of site of epidural catheter insertion, type of analgesic used, type of pain assessment used, or day of postoperative assessment (11). In addition to the analgesic benefits of epidurals, there is also a decrease in the perioperative physiological stress response (12).

Other benefits of epidurals include reduced pulmonary complications, decreased duration of mechanical ventilation, decreased duration of postoperative ileus, decreased mortality in rib fractures (especially multiple rib fractures), decreased postoperative catabolism, and better

patient related outcomes including restored functional exercise capacity, reduced Intensive Care Unit (ICU) stay, and better health-related quality of life (4, 12-15).

Rigg et al (16), in the Australasian MASTER trial, concluded that the use of an epidural combined with a general anaesthetic did not reduce the incidence of most morbidities in high risk patients. There was, however, a reduction in respiratory failure postoperatively, as well as reduced pain scores (better analgesia) in those patients who received epidurals, suggesting that patients may still derive significant benefit from use of an epidural perioperatively. (16)

Stoneham and Quinlan (3) commented on the significant decrease in the number of epidurals inserted for patients having major surgery in Australasian hospitals in the years following the MASTER trial, as anaesthetists and perioperative physicians were not convinced of the clinical benefit of epidurals. There are however, criticisms relating to the study analysis of the group of patients receiving epidurals, in that almost fifty percent of patients did not receive effective epidurals, and yet were analysed within that group. (3)

Park et al (17), in the United States (US) Veteran's Administration trial, showed that the insertion of epidurals showed a benefit for patients undergoing aortic surgery, but not for patients undergoing gastric, biliary, or colonic surgical procedures. However, the study did show that patients with epidurals had better postoperative analgesia with less analgesic medication requirements. Patients undergoing aortic surgery showed overall outcomes to be improved, including death and major complications, shorter intensive care stay, and shorter intubation times postoperatively. (17)

Alternatives to epidurals are becoming popular, including wound infiltration techniques and truncal blocks, although there are benefits, many believe that these techniques are not as effective as thoracic epidurals for major abdominal and thoraco-abdominal surgery. (3, 18-20)

Despite there being a decrease in the number of patients receiving thoracic epidurals for perioperative analgesia, they remain an important part of managing high risk patients undergoing abdominal and thoraco-abdominal surgery and have a significant role to play in pathways for enhanced recovery after surgery. (3, 18, 21-26)

International training standards

Internationally, there is a lack of objective and standardised recommendations pertaining to education of how to insert an epidural and the acquisition of skills necessary to do so, due largely to a lack of evidence as to what constitutes best practise for how to insert an epidural (3). The NICE guidelines for best practise management of epidurals from the United Kingdom (UK) states that "there should be formal, documented training for doctors and nurses who are responsible for supervising patients receiving epidural analgesia" and that these "training programs should include induction and regular update sessions" (27). They also ensure that those doctors who are inserting epidurals need to demonstrate their competencies are appropriate before being permitted to insert epidural catheters and initiate infusions unsupervised by a consultant or senior colleague (27). A five point plan was established by Stoneham et al (3) in Oxford, UK, as a program for how to teach insertion of thoracic epidurals to registrars, as teaching programs are Hospital and University based. It is a systematic approach, where patients will receive fewer overall attempts at epidural insertion and theatre efficiency improved (3). Although this program suggests benefit, it is not standardised in the UK, and programs for training are institution dependant.

A study in Australia by Waterson et al (7), suggests that current training practices for registrars are not adequate, and vary significantly between hospitals. The recommendation is for a more structured learning program, with better assessment activities. There may also be benefit from enhanced supervision, structured feedback tools and use of simulations for improving registrar training and competency. Ultimately, there is currently no standard program for teaching epidural insertion in Australia, and programs and supervision are institution dependant. (7)

In the United States of America (USA), despite thoracic epidurals being widely taught, little was known about how it was taught. Saied et al (28) surveyed all the American board of Anaesthesiology-accredited programs, and showed a significant variation in strategy for how epidural training was performed. Variance included the order of which site was learned first (lumbar or thoracic), which approach was predominantly taught (midline, paramedian, or both), and which medium was used for loss of resistance identification (saline or air). This highlights the lack of any standardised teaching or training program for epidural insertion. (28)

Curricula for anaesthesia pertaining to epidural insertion from different, international anaesthesia councils are globally based on a number needed to have performed before being acknowledged as competent (28-30). ANZCA requires that seventy epidurals are inserted by registrars during their training, with a specification that 50 labour epidurals need to be inserted (which may count towards the total number of 70) (29). During Graduate Medical Education in the USA, registrars are required to have done 50 epidurals during their training to receive their accreditation from the council (28).

South African training standards

In South Africa, no curricula include any recommended teaching program nor strategy for skill acquisition. The current training recommendations from the South African College of Medicine (CMSA), and the University of the Witwatersrand (Wits), with regards to the suggested number of labour epidurals to insert during registrar training are forty (31). This number may be difficult to achieve as a result numerous infrastructural and staffing limitations (1, 6). There is no specified number of non-obstetric epidurals that registrars are required to perform to demonstrate competency, however, it is recommended that registrars be exposed to a one month regional rotation, during which it is anticipated that they will insert epidurals for surgical procedures. There are currently no requirements with respect to the minimum number of epidural insertions required by the Health Professions Council of South Africa (HPCSA) for registration as a specialist anaesthetist, nor CMSA for registration to sit for the final Anaesthesia College Fellowship examinations, only that the academic head of institute signs each registrar off as competent (32).

A brief survey of literature revealed no central reporting, data collection systems or audits done within South Africa, that keeps any record of the number, site, technique, or indication of epidurals inserted, nor failure nor complication rates. Audits collecting similar data in the United Kingdom and Australia have been performed (1, 9, 10, 33). This sort of data collection and assessment is necessary for research and analysis, as well as to improve epidural services and training (34).

Curriculum development

Training and Transfer of training

Literature in other fields (namely management and social sciences, and the industrial sector), provides interesting insights into the generic "training process". Training has essentially been defined as a process of learning a sequence of programmed behaviour, through increasing knowledge and skill to perform a specified task (35). It has also been suggested that the effectiveness of any training program is influenced by many factors, including the degree of managerial support, the departmental climate, emotional and psychological states of trainees and trainers, and what strategy was used for training. Ultimately any training has the purpose of a term called training transfer, which essentially means that the skills and knowledge are thus transferred back to be used either directly or indirectly "on the job" (35, 36). The factors effecting the transfer of knowledge and skills to the workplace can be categorised into three distinct categories: The trainees characteristics (personal motivation, perception of opportunities to apply new skills, personal career goals), the training design (methods and extent of training with relevance to the job), and organisational characteristics (the working environment to which a trainee will return) (36). This way of thinking about training and training programs alludes to a competency-based assessment of any training program, which may be extrapolated to the medical field.

Medical education curriculum and structure

The principles of medical education for most of the last century were guided largely by Abraham Flexner and William Osler (37). The two pillars of medical education pioneered by these two included a combination of university or didactic lecture-based teaching focussing on "applied laboratory and clinical science content" including ongoing research, recommended by Flexner; and a clinical component focused on bedside teaching and clinical experience under the supervision of educator-clinicians (37). South Africa has largely adopted these forms of medical education curricula from high income countries (38). Due to contextual challenges, the current medical education curricula have largely lagged behind international trends (38).

There is a move towards a different strategy for medical education in both the undergraduate and postgraduate phases, and the move is towards a competency-based construct for demonstrating skills and knowledge (37). This is based on recommendations from Frenk et al (39). This is also in keeping with another competency-based medical training structure called the CanMEDS Physician Competency Framework (40). There are even those promoting a time-variable undergraduate and postgraduate training period, provided competencies are met, thus allowing for an accelerated program. (37)

Medical education focuses on producing physicians who are professional and ethical and who have the highest level of functionality within their field, because of training aimed at developing core competencies, knowledge and skills. Postgraduate medical education programs (registrar training), incorporates educational experiences and interactions to achieve said training within the trainees'/registrars' specialty. (41)

This training should be a combination of teaching strategies, including didactic teaching and curriculum, and clinical activity, and a registrar program needs to ensure that an adequate number of cases are seen (skills performed) to gain knowledge and competence. This necessitates a balance between service delivery (clinical work), educational needs and input, and personal life. A registrar training program also needs to include opportunities for improving scientific and critical thinking and ongoing learning practise. The conceptual structure of this strategy is what translates into many current models of undergraduate medical education programs namely a preclinical phase focused on "basic or foundational sciences" and the clinical phase focusing on application and "clinical sciences". (41)

Development and implementation

The current curriculum in South Africa was designed by a committee of anaesthesia specialists in 2014 and was based largely on syllabi from international associations (European and Australian/New Zealand). It is designed to be used in conjunction with other documents from the CMSA, South African Society of Anaesthetists (SASA) and the HPCSA. The curriculum specifies under domain 2 requirements, that registrars are to be competent in the technical skill of both thoracic and lumbar epidural anaesthesia. (30)

Domain three of the curriculum covers obstetric anaesthesia and analgesia. Under this domain, registrars learn principles and apply knowledge to clinical management of obstetric patients in labour, and those presenting for caesarean section. It is in these specific areas that registrars need to demonstrate this knowledge and their abilities to perform (competence) epidural, spinal and combined spinal-epidural anaesthesia and analgesia, alternatives to regional analgesia and anaesthesia, and all complications of regional anaesthesia and management thereof. (30)

Although it is very clearly defined what registrars ought to know and what they must be able to do, there is no structured form of teaching or training program for registrars on how to become competent, as previously suggested by Stoneham et al (3). The curriculum and logbook requirements and portfolio recommendations only state that registrars must have the skills and knowledge pertaining to epidurals and have performed a certain number of epidurals (30).

Factors affecting trainees' perspectives of training programs

It is important to realise that an individual's perspective can significantly differ from the objective reality. It is the process by which individuals receive information from the environment around them and organise and interpret this information so that they have meaning to the experiences and environment in which they live. They are thus able to respond to the information accordingly. The perceptions of an individual are influenced substantially by the personal characteristics of the individual (including their personality, motivation, interests, past experiences and expectations of an experience or environment). (42)

The aforementioned factors affecting the transfer of training, namely the trainees' characteristics, the training design and the organisational characteristics all contribute to the sensory information received by trainees and may affect their perception of the training process. (36)

Giangreco et al (43) state that assessing a training program encompasses four levels of assessment, initially described by Kirkpatrick in 1967 as a hierarchical model of training outcomes. The first level is the assessment of a trainee's perception, otherwise defined as the "Immediate reaction". Level two is an assessment of learning, what was actually learned at the training. Level three is an assessment of behaviour, specifically has there been any

transfer of training back to the workplace, and level four is an assessment of results, has the training improved individual and organizational performance and outcomes. Level one assessments of training are by far the commonest form of assessment of training programs. Each level has a sequential effect to the next, for example the experience of the trainees and their satisfaction with training influences their likelihood to study further and retain knowledge gained, ultimately modifying behaviour leading to improved outcomes. Thus, an assessment of a trainee's initial experience and perception of training is a useful starting tool. (43)

Simulation based training programs

During the insertion of an epidural, the anaesthetist relies on haptic feedback, which is described as the perception of the epidural needle passing through different tissue layers by assessing the resistance of these said tissues to the epidural needle (6). Simulators can help with the visuospatial awareness of the operator in learning how to determine which tissue layers have been passed and where the epidural needle is situated. They are becoming progressively more important on the training of anaesthetic registrars, particularly in high income countries, where limitations on working hours are decreasing the numbers and exposure to such skills, and there is an emphasis on minimising patient harm (despite informed consent), thereby necessitating realistic simulators for this psychomotor skill development. (6)

Vaughan et al (26) compared over thirty simulators, from manikin-based models with rubber or plastic layers representing the tissue layers passed, and with physically palpable landmarks, to computer-based, mechanical and electronic simulators which often incorporate haptic devices, computer-controlled components and virtual reality; ultimately simulators can be used for both training and assessing skills. Although multiple simulators are available for commercial use, their cost and availability limit their use, especially in resource limited settings, and where simulators may not be available for the teaching and learning of all techniques described for the insertion of epidurals (44). Raj et al (44) have shown that something as cheap and accessible as fruit, namely bananas, can be used to create a fairly realistic simulator "for the purpose of teaching the feel of loss of resistance for epidural insertion" (44). Another simple and cheap fruit-based simulator is a lemon, as described by van den Berg in a letter to the editor of Anaesthesia and Analgesia in August 2013. Using the

anterior skin of the lemon to simulate skin puncture, the flesh of the lemon representing the supraspinous and interspinous ligaments, and the lemon skin on the posterior side of the lemon giving the feel of the firm resistance of the ligamentum flavum, piercing the skin of the lemon gives the sensation of loss of resistance upon entering the epidural space (45). With the complication rate of epidural insertions being higher with registrar attempts, any technique of learning the tactile skill of loss of resistance is beneficial (44). According to personal communications with current specialist anaesthetists within the department (Purbhoo, K. Email. 7th Dec 2021; Kleyenstuber, T. Email. 28th January 2022; Nel, D. Email. 29th January 2022), current epidural simulator training for registrars in the Anaesthetic Department at the University of Witwatersrand is rare. Although simulators are available at several training sites within the department, they are predominantly used for the teaching and training of interns on how to do spinal blocks.

Assessing registrar competency

Currently in anaesthesia in South Africa there are no objective and standardised methods of assessing the competency of registrars technical skills (46, 47). Cumulative sum analysis (CUSUM) is a statistical strategy to assess the trends of successive events, the results of which can also be represented graphically and may assist with assessing anaesthetists' technical skills (46). Naik et al (46) in Toronto, Canada performed a CUSUM on 11 registrars over a six month period and using an "accepted" failure rate of ten percent, revealed that registrars may need to perform as many as 75 epidural attempts before they achieve competency.

Learning and developing new skills is dependent on a vast array of factors (5). A study by Konrad et al (5) was performed to define learning curves and number of procedures to reach competency for epidurals, spinals, intubations, peripheral nerve blocks, and arterial line insertions. Most procedures show some level of skill and ability by 20 attempts, followed by variable learning curves thereafter. Epidural insertion being considered the most difficult of all the skills assessed, has shown a success rate of 60% at 20 attempts, and 78% at 90 attempts, with a continued increase in the learning curve still noted thereafter (5). Kopacz et al (48) have shown a similar graph of success for procedures (namely spinal insertion, epidural insertion, and intubation), and concluded that registrars show significant

improvement after 25 attempts at epidurals, and that a 90% success rate is only achieved after 60 attempts.

Over a period of sixteen years (1996-2011) Drake et al (8) assessed a retrospective cohort of 104 “novice registrars” on the success rates of their obstetric epidural insertions. The researchers employed CUSUM analysis, and although their defined success and failure rates were much lower than previously mentioned studies, the criteria for assessing success and failure were far more stringent than self-reporting from registrars. The findings of the study were in keeping with other studies in that a success rate more than 75% was found after 10 attempts, with competence reached after a mean of 46 insertions. (8)

Watterson et al (7) in Australia, have found that the median number of supervised epidurals performed among trainees was three, with a total number of 20 epidurals being performed within 6 months. A study conducted in 2016 in Gauteng South Africa showed that the median number of epidurals inserted by anaesthetists was between 21 and 30 (49). Subsequently, educational interventions have been initiated in the department. However, the number of epidurals inserted by trainees has not subsequently been assessed (49).

Core difficulties related to epidural training programs

Practice of epidurals

When it comes to the technicality of practical skills developed by an anaesthetic registrar, there is a rapid learning curve initially, with success rates increasing significantly over the first 20 attempts of any procedure or skill. Epidural insertion is considered the most challenging anaesthetic technique to learn. The complexity is multi-faceted, with numerous contributing causes including individual registrar variation, institutional protocols and the environment, and exposure to sufficient numbers. (5)

There is no standardised approach to the insertion of epidurals resulting in increased complexity to learn and teach epidurals. However, the midline approach, paramedian approach, or both are the most common techniques utilised (14, 28). There are also different techniques for identifying the epidural space, which is essential for developing the skill of epidural insertion, and this too adds to the difficulty of learning the skill (3, 50). Tran et al (50) acknowledge three different categories of strategies for identifying the epidural space: “loss of resistance (tactile end point), negative-pressure recognition (visual end point), and

acoustic fall in tonal pitch (auditory end point)". The tactile strategy of loss of resistance still remains the most commonly used (3, 50).

There is no clear evidence defining best practice for epidural insertion relating to approach (midline or paramedian), method employed for loss of resistance (air or saline), or optimal patient positioning during insertion (seated or lying down). This lack of evidence further contributes to the difficulty in learning the skill of epidural insertion. (3)

Epidural anatomy

The anatomy of the thoracic spine in particular makes developing the skill of epidural insertion particularly difficult, due to characteristics like the significantly angulated spinous processes, and the narrow inter-laminar spaces (3, 15). However, Saied et al (28) have shown that the order in which registrars learn the skill of epidural insertion at different sites (thoracic or lumbar), did not relate to changes in competency or complications.

Ultrasound guided regional anaesthesia techniques

Ultrasound assisted and ultrasound guided epidural insertion has been shown to have numerous benefits with respect to patient care as well as registrar learning (51-55). Studies have shown a clinically and statistically significant reduction in failed epidurals (and lumber punctures) when ultrasound in used, and have also described a decrease in traumatic experiences, a decrease in the number of attempts, and a decrease in the number of re-directions of the needle, number of puncture levels, patient satisfaction, pain scores, and side effects/complications (51-55). However, in contrast to all the supporting evidence for ultrasound improving the ease of epidural insertion, Arzola et al (56) have found that preprocedural spinal ultrasound performed by a cohort of anaesthesia trainees does not improve the ease of insertion of labour epidural catheters in patients with easily palpable lumbar spines. This may be the result of differing study methodology. In light of the multiple different techniques available for epidural insertion, and the different ultrasound methods for assisting visualisation of the spine and inserting epidurals, the process of learning and the medical training environment in which the skill of epidural insertion is complex (1, 7). Further research is advised before recommendations of generalisation can be made with regards to ultrasound use (54).

Quality of supervision, and supervisor experience

In 2003, Grau et al (52) identified two teaching options, the first being direct supervision for the first 30-50 epidurals, or secondly, an "on demand" method of supervision (i.e. when a registrar calls for help). They concluded that the learning curves and success rates of obstetric epidurals increased substantially and that the role of a supervisor is one of the most emotionally challenging roles that a specialist has (45). A lack of adequate supervision is noted to be a particular limitation to successful training programs (7). Teaching practices differ worldwide as well as within institutions (3, 7, 28). It has been seen that supervision in tertiary institutions is much greater than in other non-academic centres (7).

Trainees' perceptions of the quality and amount of supervision required also differs widely (7). Isaacs et al (1) observed increased confidence in registrars that were observed for a minimum of 10 epidural insertions before they are allowed to perform them independently. The registrars perceived that they knew when to call for supervisor assistance, and they also felt like they could (1). This sentiment was shared by the registrars surveyed by Watterson et al (7), who found that "a number of registrars training in rural and district metropolitan hospitals emphasised that the commitment, or lack thereof, of one or two individual senior staff members made a large impact on the effectiveness of their learning" (7). Watterson et al (7) suggest that by assessing registrars' technique within the first 10-20 epidurals, it may be possible to identify those who are learning at a slower rate and may need further supervision and training (7). This suggestion is in keeping with a statement by Isaacs et al (1), that registrars should be supervised for a minimum of 10 epidurals before being allowed to perform them independently (1).

Effects of inadequate training programs

Although the causes of medical errors are multifactorial, the majority of individuals perceive that inadequate experience and inadequate supervision are the two most common causes of medical errors of any type (major, minor, or near misses) (57).

Increased complications

Complications can be grouped into those pertaining to the insertion of the epidural catheter, and those caused by administration of anaesthetic agents (local anaesthetics, opioids) (12). Complications of epidural insertion such as epidural haematoma (with subsequent paraplegia) are rare, and the evidence for their occurrence results largely from case studies and descriptive reports (12, 14, 58). The nature of their occurrence, along with the exceptionally low incidence, precludes any randomised, prospective research (14, 58). Other rare complications include infection (superficial and deep e.g. epidural abscess, and meningitis), nerve and spinal cord injury, and the most common complication of accidental dural puncture, with an associated post dural puncture headache (PDPH) (12).

Failure of epidurals (in particular thoracic epidurals) is not an uncommon occurrence especially in teaching institutions, yet it occurs more frequently than is generally acknowledged or recognised (15, 59). Tran et al (15) classified failure into primary and secondary causes; primary failure being incorrect initial placement of the epidural catheter, and secondary failure referring to one of two causes, namely epidural catheter migration or anaesthetic agent under dosing (15). Generally, an accepted failure rate for epidurals is 10%. However, this may depend on the anaesthetic technique practised. Administration of a test dose after insertion has been found to decrease failure rate (60).

Failure rates in other studies have been described to be between 3-30% (60). Some studies suggest failure rates as high as 32% in thoracic epidurals and 27% in lumbar epidurals (59). Other studies have shown primary failure rates in the range of 22-24% (15). Larson et al (60) studied 100 patients who were scheduled for major abdominal surgery, and who were planned to have epidural catheters inserted prior to induction of general anaesthesia, and showed that 80% of the patients could have their epidural catheter placement correctly identified in as little as eight minutes after an epidural bolus dose (60). This percentage may be as high as 95% if 10 minutes is allowed for assessment after the epidural bolus dose, and may allow for a decrease in the primary failure rate (60).

There is no national audit program in South Africa for assessing success or failure rates of epidurals or for recording the incidence of complications. Statistics in the United Kingdom (UK) based on their National Audit Project three found that the incidence of permanent harm from epidurals ranged between 3.1 and 6.1 per 100 000, and the incidence of paraplegia or death from epidurals ranged between 0.3 to 2.0 per 100 000 (1, 33). Jenkins (9) states that

lumbar epidurals are considered a safe option for providing analgesia in labour and anaesthesia, however, inadvertent intravascular, intrathecal, and subdural injection of local anaesthetic (as well as total or high spinal blocks) although rare, are significant and immediate life-threatening complications of epidurals (9, 10).

Paech et al (10) had similar findings in Australia, revealing the incidence of potentially life-threatening morbidity to be 0.02% (10). The more common, but less serious, complication of accidental dural puncture (ADP), commonly associated with a headache (PDPH), has been found to have an incidence of 0.6- 1% (1, 10, 61) but may be affected by under-reporting, and exposure (61, 62).

Gupta et al (62) identified an increasing incidence of PDPH from 1.1% in 2001/2002 to 2.8% in 2005/2006, at a tertiary hospital in the UK, attributed to a change in working hours and decreased exposure to epidural insertion.

Intravascular injection can lead to local anaesthetic toxicity, including depressed level of consciousness, seizures and cardiac arrest (9). The incidence of intravascular injection quoted by Jenkins et al (9) was 1 in 5 000, and that being based on the occurrence of pre-cursor signs of the central nervous system (CNS), including auditory and visual disturbances and experiencing a metallic taste. This is in keeping with their quoted incidence from prior studies, ranging between 1 in 1 350 to as low as 1 in 54 000 depending on definitions (i.e. only including those experiencing seizures, cardiotoxicity, or cardiac arrest) (9). Regardless of that, local anaesthetic toxicity is a seemingly rare complication, as evidenced by Paech et al (10) reporting a low incidence of local anaesthetic toxicity of 1 in 3 500 epidurals. Their definition includes CNS symptoms such as tinnitus, visual disturbance, slurred speech, and an altered level of consciousness. No seizures/convulsions, nor cardiotoxicity were noted in their study (10).

Other effects

Selecting appropriate and qualified trainers and educators is a significant part of "scaling up and transformation of the education of health professionals", according to a guideline published by the World Health Organization in 2013 of a similar name (63). That being said, registrars can hardly be expected to be a part of this teaching transformation if upon

graduation, they themselves have not been equipped with adequate skills and undergone sufficient training to perform epidurals confidently (15).

The effects of a lack of training in general, borrowed largely from alternative sectors like business, suggest some significantly negative impacts to both the individual and the organisation. These are applicable to the health care setting, and in particular anaesthesia. Some of the negative effects include (but are not limited to), weakened performance and unsafe work environments (as already covered by the extensive section on risks and side effects), a lack of employee (doctor) ongoing development, legal consequences, low staff morale with dissatisfied employees (doctors), and inadequate documentation. (64-67)

Conclusion

There is a paucity of data with respect to the experience and perception of registrars with respect to epidural training (obstetric and non-obstetric). Although educational programs have been incorporated into the Wits registrar training program, their effect has not been assessed. The purpose of this survey is to describe registrars' perspectives on epidural training and to gain an understanding of the training and education process, including supervision, patient outcomes, and exposure to simulators and ultrasound assisted techniques.

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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 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.

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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.

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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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COVERING LETTER

A covering letter to the editor is mandatory and must include statements that the manuscript has not been published previously and is not under review elsewhere. It should state details of any prior publication of the research in abstract form or in Congress proceedings. The letter must declare if any of the authors have a conflict of interest and that the requirements for

submission, including ethics approval and patient permission for case reports have been fulfilled. All authors must sign the covering letter.

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A PDF proof of an article may be sent to the corresponding author before publication to resolve remaining queries. At that stage, **only** typographical changes are permitted; the corresponding author is required, having conferred with his/her co-authors, to reply within 2 working days in order for the article to be published in the issue for which it has been scheduled.

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Section 3: Draft Article

A survey of anaesthesia registrars' experience and perspectives on epidural training in the WITS Anaesthesia circuit, Johannesburg

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Background

Insertion of epidurals, in particular thoracic epidurals, is a challenging procedure that is considered one of the most difficult technical skills to develop proficiency in as an anaesthetic registrar.[1-3] Despite this, it is an essential tool for the specialist anaesthetist to manage acute pain effectively, which leads not only to improved patient satisfaction and decreasing pain scores, but may also improve clinical outcomes of patients.[4]

Internationally, there is a lack of objective and standardised recommendations pertaining to education of how to insert an epidural and the acquisition of skills necessary to do so, due largely to a lack of evidence as to what constitutes best practice for how to insert an epidural.[3] The NICE guidelines for best practice management of epidurals from the UK state that 'there should be formal documented training for doctors and nurses who are responsible for supervising patients receiving epidural analgesia', and that these 'training programs should include induction and regular update sessions'.[5] In the United States of America (USA), despite thoracic epidurals being widely taught, little was known about how it is being taught.[6] Saied et al[6] surveyed all the American Board of Anaesthesiology-accredited programs. The results showed a significant variation in strategy for how epidural training was performed, highlighting a lack of standardisation.[6] A study in Australia by Waterson et al,[7] suggests that current training practices for registrars are not adequate, and vary significantly between hospitals.

Training of registrars is a dynamic process, constantly evolving, and there is a move towards a competency-based construct for demonstrating skills and knowledge for medical education in both the undergraduate and postgraduate phases.[8] To add to this, there is a constant attempt at balancing educational requirements and service delivery, in the background of personal circumstances and challenges faced by registrars.[7]

When it comes to the technicality of practical skills developed by an anaesthetic registrar, there is a rapid learning curve initially, with success rates increasing significantly over the first 20 attempts of any procedure or skill. Epidural insertion is considered the most challenging anaesthetic technique to learn. The complexity is multi-faceted, with numerous contributing causes including individual registrar variation, institutional protocols and the environment, and exposure to sufficient numbers.[9]

There is a paucity of data with respect to the experience and perspectives of registrars regarding epidural training (obstetric and non-obstetric). The aim of this study is to describe

anaesthetic registrars' experience and perspectives of epidural training at the University of Witwaterstrand.

Methods

Ethics approval to conduct the study was obtained from the Human Research Ethics Committee (Medical) (M220208), along with permission from other relevant authorities for this study. A cross-sectional, contextual, descriptive study was performed using a self-administered electronic (Google forms ™) questionnaire. A validated questionnaire on this topic developed by Isaacs et al[1] was used with permission as a guide for the development of our questionnaire, together with a review of the literature. The questionnaire was adapted to ensure its relevance to the local environment and was then reviewed by three senior anaesthesiologists with a special interest in obstetric anaesthesia, regional anaesthesia and education and training, to ensure content and face validity.

The study population consisted of all 110 anaesthetic registrars working within the Department of Anaesthesia at the University of Witwaterstrand, and a minimum sample size of 86 was calculated with the Raosoft ® sample size calculator, using a confidence interval of 95%, an error of 5%, and a response distribution of 50%. The questionnaire was distributed electronically to all registrars within the department. Participation in the survey was voluntary and anonymity was maintained. Data were analysed according to descriptive statistics, reporting frequencies and percentages of responses, with comments on open ended questions.

Results

Demographics

Eighty-nine participants responded to the survey giving a response rate of 80.9%. All responses were included in the study. Of the participants included in the survey 47 (53%) were female, and 41 (46.5%) were male.

Years of Anaesthetics Experience

The distribution of participants through their respective years of anaesthesia training was diverse with 23 (25.8%), 17 (19.1%), 14 (15.7%) and 28 (31.5%) in their first, second, third

and fourth and final year of anaesthesia registrar time respectively. Seven participants (7.9%) were doing extended registrar time. The level of anaesthetic experience our participants have also varied, with 44 (49.4%) participants having between one and four years, 39 (43.8%) participants having five to eight years, and six (6.8%) of our participants having more than eight years of anaesthetics experience.

First Epidural Insertion and Supervision

Most participants inserted their first epidural in the lumbar region: 35 (39.3%) of which in the labour ward and 42 (47.2%) in the operating theatre. Only 12 participants (13.5%) inserted their first epidural in the thoracic region in the operating theatre. Almost all first insertions were supervised (77, 86.5%). The total number of labour and non-labour epidurals participants had inserted is represented in Figure 1.

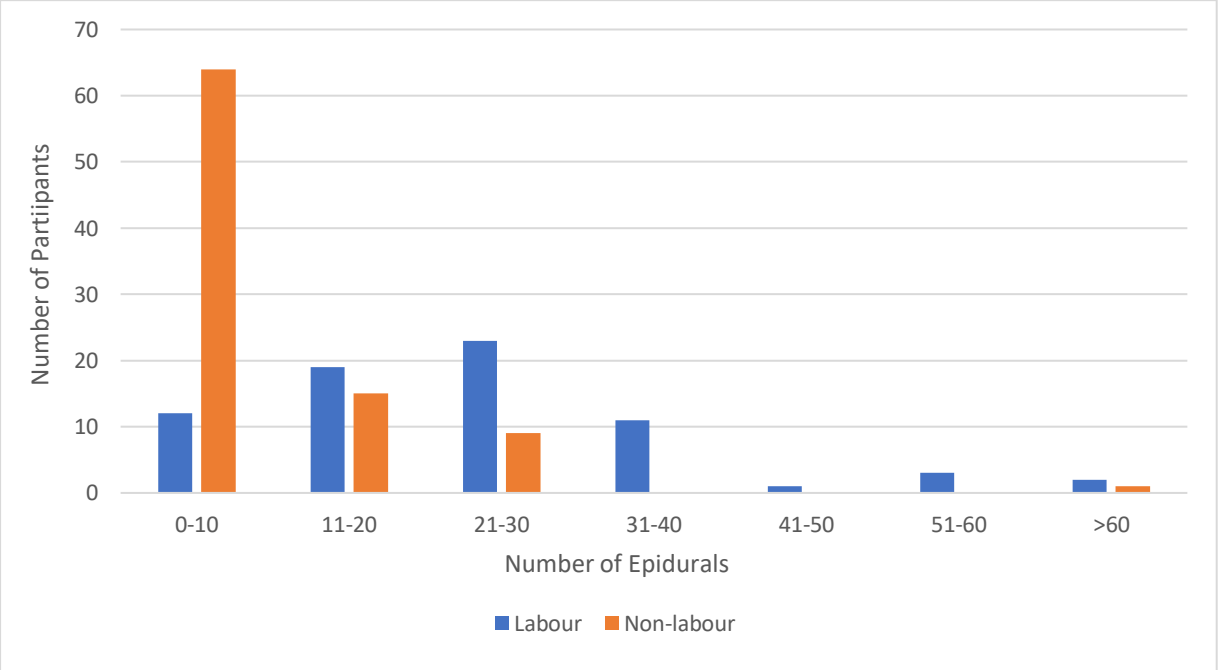


Figure 1. Number of labour and non-labour epidurals inserted

Experience and perspective on epidural training

Despite disagreement with respect to observation and feedback on enough cases to feel confident when performing the procedure alone, the vast majority still perceived they had a good understanding of spinal anatomy (73, 82%) and complications of epidural insertion (70, 78.7%). Participants' responses with respect to first several epidural insertions, supervision, and teaching are presented in Table 1.

Table 1. Experience and perspectives on supervision and teaching

Statement	**Agree n (%)**	**Neutral n (%)**	**Disagree n (%)**
I was observed and given feedback on enough cases to feel confident to perform the procedure alone	29 (32.6%)	13 (14.6%)	47 (52.8%)
I had a thorough understanding of spinal anatomy	73 (82%)	12 (13.5%)	4 (4.5%)
I knew how to troubleshoot when having difficulty	43 (48.3%)	18 (20.2%)	28 (31.5%)
I felt uncertain a lot of the time	44 (49.4%)	17 (19.1%)	28 (31.5%)
I could easily call for help if I was struggling to site an epidural	53 (59.5%)	15 (16.9%)	21 (23.6%)
I felt uncertain about when I should call for help	18 (20.2)	17 (19.1%)	54 (60.7%)
I had a good understanding of the risks and complications involved	70 (78.7%)	5 (5.6%)	14 (15.7%)
Performing epidurals was very stressful	46 (51.7%)	21 (23.6%)	22 (24.7%)

Most of the participants perceived that alternative anaesthetic techniques like plane blocks and morphine spinals (55, 61.8%) and minimally invasive surgical techniques (56, 62.9%) make the skill acquisition of epidural insertion difficult. Two clear challenges registrars face are pressure from surgical colleagues with regards to time constraints, and resistance from

midwives in labour ward. Participants' perception of factors influencing skill acquisition are presented in Table 2.

Table 2. Factors influencing the acquisition of technical skills

Statement	**Agree n (%)**	**Neutral n (%)**	**Disagree n (%)**
Increased use of Rectus Sheath blocks, TAP blocks, QL blocks, Erector Spinae Plane blocks, morphine spinals or other blocks or anaesthetic techniques	55 (61.8%)	21 (23.6%)	13 (14.6%)
More minimally invasive surgery (e.g., laparoscopic procedures)	56 (62.9%)	14 (15.7%)	19 (21.3%)
Not all registrars are afforded the opportunity of the obstetric epidural rotation	52 (58.4%)	17 (19.1%)	20 (22.5%)
There is an increased emphasis on patient safety, leading to seniors being less likely to allow registrars to attempt or perform epidurals	21 (23.6%)	16 (18%)	52 (58.4%)
More challenging patients requiring experienced operators	40 (44.9%)	24 (27%)	25 (28.1%)
Too many registrars looking for opportunities to site an epidural	31 (34.8%)	17 (19.1%)	41 (46.1%)
There is significant time pressure from surgical disciplines to be efficient with theatre time, hence they resist the use of epidurals	66 (74.2%)	6 (6.7%)	17 (19.1%)
There is considerable resistance from midwives in labour ward for registrars to site labour epidurals, for various reasons	66 (74.2%)	13 (14.6%)	10 (11.2%)

Supervising others and formal assessment

Only 42 (47.2%) of the participants had previously supervised a junior colleague inserting an epidural. Although most participants (46, 51.36%) stated that they would be prepared to supervise a junior colleague, 53 (59.5%) of the participants stated that they would prefer a consultant to supervise junior colleagues. Most participants (63, 70.8%) agreed that there should be a formal assessment of the technical skills and ability to insert an epidural.

Comments on epidural training

Some of the open-ended comments of participants explain some of the challenges experienced with epidural training in general. Issues with *'resource limitations'* (P73), and the lack of availability of both disposable and non-disposable *'stock'* (P36) and *'monitoring equipment'* (P81) required to perform an epidural was repeatedly reported.

'Limited ICU bed availability' (P4) for postoperative care for major surgical cases and thus postoperative use of a preoperatively placed epidural is a challenge. Participants indicated that a *'Lack of high care areas where patients can keep epidurals postop leads to less epidurals being inserted as sometimes their use intraoperatively alone cannot justify their use'* (P28). Participants also indicated that the lack of *'postoperative monitoring or follow up may be a concern'* (P87).

Participants indicated that there were issues relating to staff shortages and that *'Often on epidural rotations you (the anaesthetic registrar) are needed to replace registrars on other lists who didn't come to work'* (P2). Participants perceived that '*Shortages of appropriate epidural sets, logistics, patients not going to ICU, or inability of ICU staff to use the epidural decreases it's rank of consideration for analgesia'* (P42). Participants also perceived that *'Postoperative high dependency or afterhours monitoring and nursing not always (being) available'* (P88) were limitations to service delivery.

Participants indicated that registrars were often *'Shown how to do an epidural for the first time by a fellow registrar. It was the whole "see one, do one, teach one" mantra. It's not the best way to be taught'* (P44) and that they often received only *'one to two days of supervision by a senior registrar on (the) pain rotation in the beginning'* (P8). Participants indicated that there was often *'No consultant present to educate or supervise,'* and that they perceived that their training was like the *'blind leading the blind'* (P1). Some participants indicated that the

'Epidural rotation was almost completely unsupervised' (P39), and that registrars received '*Minimal teaching regarding epidurals'* (P60). Participants stated that training is a *'loophole needing attention'* (P62).

Participants stated that ~~more~~ *'More supervision is needed'* (P25) especially *'More support in supervision for the first few'* (P11), and that *'More exposure to epidural siting is needed'* (P58). Participants indicated that *'More consultant presence should be available to also ally patient concerns'* (P72), and that at least the *'first day of epidural rotation should be supervised'* (P89), and that *'A formal short course with lectures and videos, especially trouble shooting, should be introduced'* (P28).

Experience and perspectives on epidural simulators

Almost all the participants (87, 97.8%) had never used an epidural simulator before, yet 67 (75.3%) participants indicated that it should be recommended to teach junior colleagues. Many participants (57, 64%) would only allow junior registrars to attempt epidurals on patients once they had demonstrated competency on an epidural simulator. Simulator training is seemingly deemed a very important aspect of training of junior registrars, as 69 (77.5%) participants thought it should be compulsory, while only five (5.6%) did not.

Experience and perspectives on ultrasound

Regarding the use of ultrasound pre-puncture, a large number of participants (75, 84.3%) had never used it. However, 55 (61.8%) participants recommend it being used as part of a teaching strategy when junior registrars are being trained, and 71 (79.8%) indicated that ultrasound skills and use should be considered a compulsory element of training.

Discussion

Our study found there was a lack of training and supervision in the placement of epidurals. Despite participants dismissing an increased emphasis on safety as a challenge, the risk of complications was the impetus for the study by Isaacs et al.[1] Participants recognised the risks involved with epidural insertion and were able to call for help when appropriate. The opportunity to learn epidural placement is limited in our low-middle income setting due to

time, staff and consumable related reasons. The suggestion of increased supervision by consultants is in keeping with international trends.[1,3,7]

Globally, teaching practises differ significantly, with individual institutions in the UK having their own specific curricula and training programs.[3] A survey from Australia revealed inadequate training and suggestions were made to enhance supervision, have structured feedback tools and make use of simulators,[7] and a survey in the USA also revealed non-standardised teaching practises across institutions.[3,6,7] It is not surprising that our results reveal a perception of a similar lack of structure and a need for a more formal training session. more supervision.

Although teaching practises are not standardised internationally, learning curves and skill success rates increase substantially with supervision. [4,6,7,10] The lack thereof can just as easily be a limitation to a successful training program.[7] Selecting appropriate and qualified trainers and educators is a significant part of 'scaling up and transformation of the education of health professionals', according to a guideline published by the World Health Organization in 2013 of a similar name.[11] In spite of the overall impression being that of a lack of training and supervision, registrars' confidence in performing the procedure alone, as well as their basic knowledge of the anatomy and complications does not seem to mirror this perceived lack of training. This might be an example of the Dunning Kruger effect of over-confidence, and perhaps an actual assessment of knowledge and skill might be able to quantify their knowledge and skills on a more objective level.

Assessing training programs encompasses four levels, the first of which is assessing the perception or 'immediate reaction' of registrars,[12] and this survey of registrars' experience and perceptions is a useful starting tool for assessing the training program in in our setting. Further evaluation of what is actually taught and how this changes practise in the form of assessing competence and use of epidurals going forward are also part of assessing the training program and are considerations for a full assessment thereof.

Several studies using Cumulative Sum (CUSUM) Analysis to assist with assessing competency of epidural insertion suggest that this is one of the most difficult skills for anaesthetists to develop, with success rates of 75% requiring at least ten epidural insertions, improvement with 20 to 25 procedures and that registrars may need to perform between 46 and 75 epidural insertions before they reach competence.[9, 13-16] An Australian study found the median number of supervised epidurals performed by registrars was three,[7] while in a region

in the UK, registrars perform a minimum of ten epidurals with supervision.[1] Comparing this to the number of epidurals our respondents have reported to have performed (on average between 10-30 non-labour, and less than 10 labour epidurals), it seems registrars in our setting may be getting too little exposure to develop competency in this important skill. Registrars can hardly be expected to be a part of the training team upon graduation if they themselves have not been equipped with adequate skills and undergone sufficient training to perform epidurals confidently.[17]

The exact number of supervised epidurals was not questioned in this survey, although participants' responses indicate that a minimum number of supervised insertions and formal assessment of technical ability should become a mandatory training requirement. Currently, formal assessment of technical skills is not part of the registrar training program nor the College of Medicines South Africa (CMSA) examinations, which may be something to consider implementing going forward.

We know from other research done in South Africa, that implementing a dedicated labour epidural service increases the labour epidural rate,[18] and although this has been implemented in our setting with registrars performing a significant number of labour epidurals when they rotate through the epidural service, the degree of supervision is still less than what is desired based on international comparisons.

It is interesting to note that very few participants performed their first epidural in the thoracic region in the operating theatre. Exposure to thoracic and major abdominal surgery is usually seen as a senior rotation, so this would be expected as registrars are getting exposure to epidurals as part of junior rotations, however these are more likely in the form of labour epidurals, or lumbar epidurals for non-thoracic and non-major surgery cases in theatre. The lack of any standardised approach to epidural training seen in the literature is evident in our setting and highlighted by this result alone.[3,6,7]

Other factors which registrars felt hindered their ability to learn the skill of epidural insertion such as interference from our surgical colleagues in the operating theatre applying time pressure, and resistance from midwives in labour wards for various reasons, seems to be in contrast to what Isaacs et al[1] found in the UK where only a quarter of participants reported these pressures. Surgical disciplines do not always perceive the benefit of an epidural, and neither do most of our respondents who perceive alternative anaesthetics techniques like plane blocks and morphine spinals to be contributing to the difficulty of acquiring the skill of

epidural insertion. This perception may be influenced by the Australasian MASTER trial, showing no reduction the incidence of most morbidities in high risk patients. There was, however, a reduction in respiratory failure postoperatively, as well as reduced pain scores in those patients who received epidurals, suggesting that patients may still derive significant benefit from use of an epidural perioperatively.[19] There are criticisms regarding who was included in the epidural arm of the study, suggesting that ineffective epidurals were included in the epidural group, which may have skewed the results.[3] Park et al[20] also showed that there were morbidity benefits in some but not all surgeries which may also influence perceptions of the role of epidurals, however, again overall pain scores were better with an epidural regardless of type of surgery, implying benefit.[20] Although alternative techniques are gaining popularity, many believe that these techniques are not as effective as thoracic epidurals for major abdominal and thoraco-abdominal surgery.[3, 21-23] To what degree these challenges of interference from surgical disciplines and midwives are a unique finding in our setting is not clear and further research will be required to assess whether this is a growing trend.

The findings of limited prior simulator use in our setting, yet simulators still being recommended by participants for the benefits in teaching and training junior registrars, mirror findings in the UK.[1] In any setting where limited exposure to skills is experienced, and an emphasis on minimising patient harm is desired, simulators should be considered for operator development of haptic feedback and visuospatial awareness of the epidural needle in determining adequate depth, while limiting complications.[24] Although multiple simulators are available for commercial use, their cost and availability limit their use, especially in resource limited settings.[25] Simple and cheap alternatives, as basic and accessible as using fruit to simulate the loss of resistance tactile sensation, may provide some benefit to registrars in training programs.[25]

The use of ultrasound to assist with epidural insertion has been shown to have numerous benefits with respect to patient care as well as registrar learning.[10, 14, 26-28] It is thus reassuring that most of the participants think it prudent to develop the skill of using ultrasound to assist with epidural insertion, as well as its use as a teaching strategy for junior registrars who are learning, despite many having never used it. The equipment needed to perform ultrasound is readily available in all the training hospitals in which respondents are working. The responses regarding ultrasound use to assist with epidural insertion suggest that continuing professional education regarding ultrasound use for epidurals may be required, in order to ensure this skill is taught and developed appropriately.

This study is limited in that it was a subjective questionnaire with responses based largely on opinion and perception and hence may not be a true reflection of the actual training program. It was also limited to a single university with specific training practices and is therefore not generalisable to other training institutions.

Conclusion

Our study found that a more formal teaching program, as well as a minimum number of supervised epidural insertions has been recommended to improve the current training program, as registrars continue to face challenges in developing the skill of epidural insertion. Simulators and ultrasound skills should also be incorporated into the training of epidural insertions. Improved staffing of registrars, specialists and nurses alike would improve the supervision and opportunities available for epidural training. Further study into success and complication rates in our setting, and patient satisfaction, as well as studies to objectively evaluate and thereby improve the process of epidural training are needed.

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Declaration conflict of interest

The authors declare no conflict of interest.

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Ethics Declaration

This research was performed as partial fulfilment of a master's in medicine (Anaesthesiology) at the University of Witwatersrand, with approval obtained from the Human Research Ethics Committee (Medical) (M220208).

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Section 4: Proposal

A survey of anaesthesia registrars' experience and perspectives on epidural training in the WITS Anaesthesia circuit, Johannesburg

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1. Introduction/Background

Insertion of epidurals, in particular thoracic epidurals, is a challenging procedure that is considered to be one of the most difficult technical skills to develop proficiency in as an anaesthetic registrar (1-3). Despite this, it is an essential tool for the specialist anaesthetist to manage acute pain effectively, which leads not only to improved patient satisfaction and decreasing pain scores, but may also improve clinical outcomes of patients (4).

Training systems for teaching skill acquisition in anaesthesia, such as epidural insertion, are complex yet poorly structured. They generally appear to be specific to which region or country and institution a registrar is training in; as well as under which individual specialist-supervisor they are training. Not only are teaching programs variable, but assessment of competency varies from country to country, and even within different institutions in the same country. Despite published recommendations for assessment of competency of epidural insertion, these are not standardised or practised globally. (1, 3, 5-7)

Training of registrars is a dynamic process, constantly evolving, and there is a move towards a competency-based construct for demonstrating skills and knowledge for medical education in both the undergraduate and postgraduate phases (8). To add to this, there is a constant attempt at balancing educational requirements and service delivery, in the background of personal circumstances and challenges faced by registrars (7).

When it comes to the technicality of practical skills developed by an anaesthetic registrar, there is a rapid learning curve initially, with success rates increasing significantly over the first 20 attempts of any procedure or skill. Epidural insertion is considered the most challenging anaesthetic technique to learn. The complexity is multi-faceted, with numerous contributing causes including individual registrar variation, institutional protocols and the environment, and exposure to sufficient numbers. (5)

There is no standardised approach to the insertion of epidurals resulting in increased complexity to learn and teach epidurals. However, the midline approach, paramedian approach, or both are the most common techniques utilised (9, 10).

There are also different techniques for identifying the epidural space, which is essential for developing the skill of epidural insertion, and this too adds to the difficulty of learning the technique (3, 11). Tran et al (11) acknowledge three different categories of strategies for identifying the epidural space: "loss of resistance (tactile end point), negative-pressure recognition (visual end point), and acoustic fall in tonal pitch (auditory end point)". The tactile strategy of loss of resistance still remains the most commonly used (3, 11).

There is no clear evidence defining best practice for epidural insertion relating to approach (midline or paramedian), method employed for loss of resistance (air or saline), or optimal patient positioning during insertion (seated or lying down). This lack of evidence further contributes to the difficulty in learning the skill of epidural insertion. (3)

During the insertion of an epidural, the anaesthetist relies on haptic feedback, which is described as the perception of the epidural needle passing through different tissue layers by assessing the resistance of these said tissues to the epidural needle (6). Simulators can help with the visuospatial awareness of the operator in learning how to determine which tissue layers have been passed and where the epidural needle is situated, and are becoming progressively more important on the training of anaesthetic registrars, particularly in high income countries, where limitations on working hours are decreasing the numbers and exposure to such skills, and there is an emphasis on minimizing patient harm (despite informed consent), thereby necessitating realistic simulators for this psychomotor skill development (6).

Although multiple simulators are available for commercial use, their cost and availability limit their use, especially in resource limited settings, and where simulators may not be available for the teaching and learning of all techniques described for the insertion of epidurals (12). Raj et al (12) have shown that something as cheap and accessible as fruit, namely bananas, can be used to create a fairly realistic simulator "for the purpose of teaching the feel of loss of resistance for epidural insertion" (12). Another simple and cheap fruit-based simulator is a lemon, as described by van den Berg (13) in 2013.

Using the anterior skin of the lemon to simulate skin puncture, the flesh of the lemon representing the supraspinous and interspinous ligaments, and the lemon skin on the posterior side of the lemon giving the feel of the firm resistance of the ligamentum flavum, piercing the skin of the lemon gives the sensation of loss of resistance upon entering the epidural space

(13). With the complication rate of epidural insertions being higher with registrar attempts, any technique of learning the tactile skill of loss of resistance is beneficial (12).

Current epidural simulator training for registrars in the Anaesthetic Department at the University of Witwatersrand is rare. Although simulators are available at several training sites within the department, they are predominantly used for the teaching and training of interns on how to do spinal blocks.

The use of ultrasound to assist epidural insertion has been shown to have numerous benefits with respect to patient care as well as registrar learning, and can be divided into distinct techniques depending on the timing of ultrasound use (i.e. pre-puncture, or during the procedure with real-time visualisation of the epidural needle, although the latter is largely still a developing technique) (14-18). Studies have shown a clinically and statistically significant reduction in failed epidurals (and lumbar punctures) when ultrasound is used (predominantly pre-puncture), and have also described a decrease in traumatic experiences, the number of attempts, number of re-directions of the needle, and number of puncture levels, and side effects and complications. These studies have also shown increased patient satisfaction, and improved pain scores (14-18).

However, in contrast to all the supporting evidence for ultrasound improving the ease of epidural insertion, Arzola et al (19) have found that preprocedural spinal ultrasound performed by a cohort of anaesthesia trainees does not improve the ease of insertion of labour epidural catheters in patients with easily palpable lumbar spines. This may be the result of differing study methodology. In light of the multiple different techniques available for epidural insertion, and the different ultrasound methods for assisting visualisation of the spine and inserting epidurals, the process of learning and the medical training environment in which the skill of epidural insertion is complex (1, 7). Further research is advised before recommendations of generalisation can be made with regards to ultrasound use (17).

Internationally, there is a lack of clear standardised recommendations for education and skill acquisition, due largely to a lack of evidence as to what constitutes best practise for how to insert an epidural (3).

The NICE guidelines for best practise management of epidurals from the UK state that “there should be formal documented training for doctors and nurses who are responsible for supervising patients receiving epidural analgesia”, and that these “training programs should include induction and regular update sessions” (20). They also recommend that those doctors

who are inserting epidurals need to demonstrate their competencies are appropriate before being permitted to insert epidural catheters and initiate infusions unsupervised by a consultant or senior colleague (20). A five point plan has been established by Stoneham et al (3) in Oxford, to teach insertion of thoracic epidurals to registrars to decrease the number of attempts at epidural insertion, and improve theatre efficiency (3). Although this program suggests benefit, it is not standardised in the UK, and programs for training still remain institution dependant.

A study in Australia by Watterson et al (7), suggests that current training practices for registrars are not adequate, and vary significantly between hospitals. The authors state that that currently there is no standard program for teaching epidural insertion in Australia, and programs and supervision are institution dependant. They recommend more structured learning programs, with better assessment activities, enhanced supervision, structured feedback tools, and the use of simulations for improving registrar training and competency. (7)

In the United States of America (USA), despite thoracic epidurals being widely taught, little was known about how it is being taught. Saied et al (9) surveyed all the American Board of Anaesthesiology-accredited programs. The results showed a significant variation in strategy for how epidural training was performed. Variance included the order of which site was learned first (lumbar or thoracic), which approach was predominantly taught (midline, paramedian, or both), and which medium was used for loss of resistance identification (saline or air). This highlights the lack of any standardised teaching or training program for epidural insertion. (9)

Curricula for anaesthesia pertaining to epidural insertion from different, international anaesthesia councils are globally based on a number needed to have performed before being acknowledged as competent (9, 21, 22). ANZCA requires that 70 epidurals are inserted by registrars during their training, with a specification that 50 labour epidurals need to be inserted (which may count towards the total number of 70) (22). During Graduate Medical Education in the USA, registrars are required to have done 50 epidurals during their training to receive their accreditation from the council (9).

In South Africa, no curricula include recommendations with respect to teaching or strategies for skill acquisition. The current training recommendations from the South African College of Medicine (CMSA), and the University of the Witwatersrand (Wits), with regards to the

suggested number of labour epidurals to insert during registrar training are 40 (21). This number may be difficult to achieve as a result numerous infrastructural and staffing limitations (1, 6). There is no specified number of non-obstetric epidurals that registrars are required to perform to demonstrate competency, however, it is recommended that registrars gain experience with epidural insertion for appropriate surgical procedures. There are currently no requirements with respect to the minimum number of epidural insertions required by the Health Professions Council of South Africa (HPCSA) for registration as a specialist anaesthetist (23).

In 2003, Grau et al (15) identified two teaching options, the first being direct supervision for the first 30-50 epidurals, or secondly, an "on demand" method of supervision (i.e. when a registrar calls for help). They concluded that the learning curves and success rates of obstetric epidurals increased substantially and that the role of supervisor is one of the most emotionally challenging roles that a specialist performs (13). A lack of adequate supervision is noted to be a particular limitation to successful training programs (7).

Teaching practices differ worldwide as well as within institutions (3, 7, 9). It has been seen that supervision in tertiary institutions is much greater than in other non-academic centres (7). Trainees' perceptions of the quality and amount of supervision required also differs widely (7). Isaacs et al (1) observed increased confidence in registrars that were observed for a minimum of 10 epidural insertions before they are allowed to perform them independently. The registrars perceived that they knew when to call for supervisor assistance, and they also felt like they could (1).

This sentiment was shared by the registrars surveyed by Watterson et al. (7) , who found that "a number of registrars training in rural and district metropolitan hospitals emphasised that the commitment, or lack thereof, of one or two individual senior staff members made a large impact on the effectiveness of their learning" (7). Watterson et al (7) suggest that by assessing registrars' technique within the first 10-20 epidurals, it may be possible to identify those who are learning at a slower rate and may need further supervision and training (7). This suggestion is in keeping with a statement by Isaacs et al (1), that registrars should be supervised for a minimum of 10 epidurals before being allowed to perform them independently (1).

Cumulative sum analysis (CUSUM) is a statistical strategy to assess the trends of successive events, the results of which can also be represented graphically and may assist with assessing

anaesthetists' technical skills (24). Naik et al (24) in Toronto, Canada performed a CUSUM on 11 registrars over a six month period and using an "accepted" failure rate of ten percent, revealed that registrars may need to perform as many as 75 epidural attempts before they achieve competence. Locally there are no objective, standardised methods of assessing the competency of registrars' technical skills (24, 25).

Learning and developing new skills is dependent on a vast array of factors (5). A study by Konrad et al (5) was performed to define learning curves and number of procedures to reach competency for epidurals, spinals, intubations, peripheral nerve blocks, and arterial line insertions. Most procedures show some level of skill and ability by 20 attempts, followed by variable learning curves thereafter. Epidural insertion being considered the most difficult of all the skills assessed, has shown a success rate of 60% at 20 attempts, and 78% at 90 attempts, with a continued increase in the learning curve still noted thereafter (5). Kopacz et al (26) have shown a similar graph of success for procedures (namely spinal insertion, epidural insertion, and intubation), and concluded that registrars show significant improvement after 25 attempts at epidurals, and that a 90% success rate is only achieved after 60 attempts.

Over a period of sixteen years (1996-2011) Drake et al (27) assessed a retrospective cohort of 104 "novice registrars" on the success rates of their obstetric epidural insertions. The researchers employed CUSUM analysis, and although their defined success and failure rates were much lower than previously mentioned studies, the criteria for assessing success and failure were far more stringent than self-reporting from registrars. The findings of the study were in keeping with other studies in that a success rate more than 75% was found after 10 attempts, with competence reached after a mean of 46 insertions. (27)

Watterson et al (7) in Australia, have found that the median number of supervised epidurals performed among trainees was two and a half, with a total number of 20 epidurals being performed within six months. A study conducted in 2016 in Gauteng, South Africa showed that the median number of epidurals inserted by anaesthetists was between 21 and 30 (28). Subsequently, educational interventions have been initiated relating to the optional one month epidural rotation available at Rahima Moosa Mother and Child Hospital, and the optional one week rotation per annum available at Chris Hani Baragwanath Academic Hospital, both part of the University of Witwatersrand Department of Anaesthesia. However, the number of epidurals inserted by trainees has not subsequently been assessed.

There is a paucity of data with respect to the experience and perspectives of registrars regarding epidural training (obstetric and non-obstetric). The purpose of this survey is to describe registrars learning experience and to gain an understanding of the training and education process, including supervision, and exposure to simulators and ultrasound assisted techniques.

2. Aim

The aim of this study is to describe anaesthetic registrars' experience and perspectives of epidural training at the University of Witwaterstrand.

3. Objectives

The primary objectives of this study are to:

- Describe anaesthetic registrars' experience and perspectives on epidural analgesia/anaesthesia training for obstetric and non-obstetric use
- Describe anaesthetic registrars' experience and perspectives on epidural simulator training
- Describe anaesthetic registrars' experience and perspectives on ultrasound assisted epidurals and the use of ultrasound pre-puncture.

The secondary objective of this study is to describe the challenges faced by anaesthetic registrars in developing the skill of epidural insertion.

4. Research assumptions

The following definitions will be used in the study**:**

Anaesthetic Registrar: a medical doctor currently in a training program to become a specialist in anaesthesiology.

Experience: gaining practical knowledge and skill through participating in or observing a particular situation or action, such situations affecting the individuals in a subjective manner

related to their personal character and personality; something an individual has encountered or lived through.

Perspective: a particular way of regarding or attitude towards something. It is a point of view, is individual and is subjective.

Epidural Insertion: the process of placing an epidural catheter inside the epidural space using an array of techniques and skills best suited to accomplish the process.

Training: in this study refers to teaching or developing skills and knowledge, and fitness which relates to the specific use of competencies to perform a task, in this case, epidural insertion.

Epidural Simulator: a device used to facilitate the training of epidural insertion, specifically the sensation of loss of resistance, and some allow for catheter insertion, and ultra-sound guided and assisted procedures.

Ultrasound Assisted Epidural Insertion: the use of ultrasound pre-puncture to better identify landmarks and the depth of the epidural space prior to epidural insertion.

Ultrasound Guided Epidural Insertion: the real-time use of ultrasound to visualise the advancement of the epidural needle to the epidural space.

5. Demarcation of study field

The study will be conducted within the Department of Anaesthesia, affiliated to the Faculty of Health Sciences of the University of the Witwaterstrand. The registrars within the department number 110, and are employed across the following hospitals:

- Charlotte Maxeke Johannesburg Academic Hospital a 1200-bed tertiary hospital.
- Chris Hani Baragwanath Hospital a 2888-bed tertiary hospital.
- Helen Joseph Hospital a 500-bed tertiary hospital.
- Rahima Moosa Mother and Child Hospital a 338-bed regional hospital.
- Wits Donald Gordon Medical Centre a public-private hospital with 190 beds.
- Thelle Mogoerane Hospital an 821-bed regional hospital
- Klerksdorp Hospital an 829-bed regional hospital.

6. Ethical considerations

6.1 Permission

Approval from the Academic Head of Department of Anaesthesia at the University of Witwaterstrand (Prof Motshabi) will be obtained (Appendix A). Permission has also been obtained from Isaacs et al, to make use of the validated survey questionnaire used in their study conducted un the United Kingdom in May 2012, published in 2015 (Appendix B). Approval from the Human Research Ethics Committee (Medical) and the Graduate Studies Committee of the University of Witwaterstrand is currently pending.

6.2 Confidentiality and anonymity

Anaesthetic registrars will be emailed a link to a survey, with a participant information sheet (Appendix C) and an offer to voluntarily participate in the survey and consent will be implied by submission of survey. Data will be collected via an electronic survey system (Google forms - Appendix D), without any identifying information being linked to each survey. Confidentiality will thus be maintained, and only the researcher and supervisors will have access to the raw data. The academic head of the Anaesthesia department of the University of Witwaterstrand will be made aware of the findings.

Should the study show the experience and perspective of registrars reveals inadequate training and exposure, and a need for further training in epidural insertion, the heads of departments at all training hospitals will be contacted so that the need to develop and implement initiatives to address training be evaluated.

6.3 Data storage

Raw data will be stored securely for six years after the completion of the study, on a password protected electronic database.

This study will be conducted in accordance with the principles outlined in the Declaration of Helsinki (29), and the South African Guidelines for Good Clinical Practice (30).

7. Research Methodology

7.1 Research design

In this study, a cross-sectional study design will be employed. The study is contextual and descriptive in nature and aims to describe the perspectives of registrars but does not attempt to test a hypothesis or establish causal relationships between variables. The study is cross-sectional as it aims to collect data from registrars at a single point in time, without influencing variables.

7.2 Study population

The study population consists of all 110 anaesthetic registrars working within the Department of Anaesthesia at the University of Witwaterstrand.

7.3 Study sample

7.3.1 Sample size

The sample size has been determined with the use of the Raosoft ® sample size calculator. The entire complement of registrars is 110. A minimum sample size of 86 was calculated, using a confidence level of 95%, an acceptable margin of error of 5% and a response distribution of 50%.

7.3.2 Sampling method

Non-probability convenience sampling will be used in this study. Surveys will be emailed to all registrars within the department and participation in the survey is based on voluntary response.

7.3.3 Inclusion criteria

All registrars within the Department of Anaesthesia, affiliated to the Faculty of Health Sciences of the University of the Witwaterstrand are considered eligible for inclusion.

7.3.4 Exclusion criteria

Medical Officers, and Specialist Anaesthetists working within the Department of Anaesthesia, affiliated to the Faculty of Health Sciences of the University of the Witwaterstrand.

7.4 Data collection

A self-administered, electronic questionnaire will be used to collect data. The development of this questionnaire was guided by a literature review performed and based on a validated questionnaire developed by Isaacs et al (1) in the United Kingdom. Their study which was designed because becoming proficient in the skill of epidural insertion is known to be one of the most difficult technical skills to master in anaesthesia, as well as in response to audits and studies done looking at complication rates pertaining to epidural insertion (1, 31-33). The questionnaire has been modified to ensure its relevance to the local environment, and this adapted questionnaire has been reviewed by three senior anaesthesiologists with a special interest in obstetric anaesthesia, regional anaesthesia and education and training, to ensure content and face validity.

The electronic questionnaire will be emailed to the registrar body, with follow up email reminders one week, two weeks, and four weeks after the initial email was sent. The study will be concluded once the sample size calculated is attained. Participants will be sent an information letter introducing the study and inviting participation. The participants will be asked to complete the questionnaires and submit the completed surveys electronically on completion.

7.5 Data analysis

The use of standard descriptive statistics will be made to summarize, analyse, and express the data. Categorical data will be described as frequencies and percentages, and continuous numerical data will be described using means and standard deviations, or medians and interquartile ranges depending on the distribution of the data.

7.6 Significance of the study

Epidural insertion is one of the most difficult technical skills to develop proficiency in as an anaesthetic registrar. (1-3) Training systems for skill acquisition, being complex yet poorly understood, vary significantly from country, to region, to institution, to individual specialist-supervisor. (1, 3, 5-7) This study will allude to the effectiveness of the current epidural training program in the University of Witwaterstrand Anaesthesia department, thereby allowing for recommendations to be made with regards to the need for further improvements if it is seemingly inadequate, or if the program currently employed can be recommended for use in other institutions.

8. Validity and reliability of the study

To ensure content and face validity of the study, an appropriate study design has been chosen. This study has also been based on the study by Isaacs et al (1) within this field. The modified questionnaire (data collection tool) was based on the questionnaire used by Isaacs et al (1) and has been reviewed by three specialist anaesthetists affiliated to the University of the Witwaterstrand, and who have an interest in Obstetric Anaesthesia, Regional Anaesthesia and education and training. Feedback and recommendations from these specialists were used to refine the survey. A single researcher will be responsible for data collection. The results will also be analysed with the assistance of a biostatistician.

9. Potential limitations of the study

This is a subjective questionnaire, based largely on opinion, and may not be a true reflection of the training program itself. It is also limited to a single university with specific training practises, which might not be generalisable to all training institutions.

10. Project outline

10.1 Time frame

Year	2021-2022										
Month	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct
Proposal											
Ethics Approval											
Post-Grad Approval											
Data Collection											
Data Analysis											
Submission											

10.2 Financial plan

Description	Price per item	Number of items	Total
Printing proposal	R1/page	30	R30
Printing research report	R1/page	160	R160
Binding final research report	R50/copy	2	R100
Total			R290

These costs, and any others that arise during the conduct of this project will be borne by the primary researcher.

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Section 5: Appendices

Appendix A: Permission Letter from the Academic Head of Anaesthesiology

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FACULTY OF HEALTH SCIENCES
WITS SCHOOL OF CLINICAL MEDICINE
DEPARTMENT OF ANAESTHESIOLOGY
Tel.(011)488 4344

03 February 2021

Postgrad Office

School of Clinical Medicine

Faculty of Health Sciences

University of the Witwatersrand

To Whom It May Concern

Permission To Conduct Research: Dr Brett R Hosking

This is to confirm that I have read and given permission for Dr Brett R Hosking to conduct research at Wits Anaesthesia towards his Mmed project titled "***"A Survey of Anaesthesia Registrars' experience and perspectives on epidural training in the Department of Anaesthesia at the University of Witwatersrand, Johannesburg***".

Thank you.

Assoc. Prof. P Motshabi Chakane

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FACULTY OF HEALTH SCIENCES
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Appendix B: Permission from original author (Isaacs) to use and modify questionnaire

NHS
University Hospital Southampton
NHS Foundation Trust

To Whom It May Concern,

Re: Survey of trainees' perspectives on epidural training in the United Kingdom

After discussion with Dr Brett Hosking and his wish to conduct a similar survey at his own institution, I can confirm that I, as lead author, would be happy to grant permission for our original questionnaire to be used and modified as required. I can confirm that I have also consulted the other co-authors. Our only requirement would be acknowledgement in any future presentation, written or oral, but this has already been assured by Dr Hosking.

I hope this meets with your requirements.

Kind regards

R Isaacs

Dr Richard Isaacs
Consultant Anaesthetist
University Hospital Southampton NHS Foundation Trust

Appendix C: Participant Information Sheet

Study: A Survey of Anaesthesia registrars' experience and perspectives on epidural training in the Department of Anaesthesia at the University of Witwatersrand

Dear Colleagues,

My name is Brett Hosking, and I am currently a second year registrar in the Department of Anaesthesia at the University of Witwatersrand. This survey forms part of my completion of an MMed degree in Anaesthesia, and I hereby invite you to participate in the survey with the above-mentioned title. Describing your experience of epidural training within the Department will allude to the quality of training received and recommendations can be made to either emulate the training received within this department or make adjustments to the said training program.

Participation is entirely voluntary, and consent is implied by submission of a completed questionnaire. Confidentiality is maintained in that no identifying data is being connected to your responses, and only the researcher and supervisors will have access to the raw data.

The questionnaire should not take you longer than 10 Minutes to complete, and you are encouraged to keep your responses private. Please ensure you understand the above information before completing the questionnaire.

Should you have any questions regarding this study, or should you need access to the final report, please contact me at 072 574 3687, or brhosking@gmail.com; alternatively my supervisors can be contacted at: Zainub Jooma zainub.jooma@gmail.com; and Janine Wagner drjaninewagner@gmail.com .

This study has been approved by the Human Research Ethics Committee (Medical) of the University of the Witwatersrand, Johannesburg ("Committee"). A principal function of this Committee is to safeguard the rights and dignity of all human subjects who agree to participate in a research project and the integrity of the research.

If you have any concern over the way the study is being conducted, please contact the Chairperson of this Committee who is Professor Clement Penny, who may be contacted on telephone number 011 717 2301, or by e-mail on Clement.Penny@wits.ac.za. The telephone numbers for the Committee secretariat are 011 717 2700/1234 and the e-mail addresses are Zanele.Ndlovu@wits.ac.za and Rhulani.Mukansi@wits.ac.za .

Thank you for taking the time to read this letter and participate in the study, your assistance is greatly appreciated.

Yours Sincerely,
Brett Hosking
Anaesthesia Registrar
Department of Anaesthesia
University of Witwatersrand
February 2022

Appendix D: Survey Questionnaire

Study: A Survey of Anaesthesia registrars' experience and perspectives on epidural training in the Department of Anaesthesia at the University of Witwatersrand

Dear Colleagues,

My name is Brett Hosking, and I am currently a second year registrar in the Department of Anaesthesia at the University of Witwatersrand. This survey forms part of my completion of an MMed degree in Anaesthesia, and I hereby invite you to participate in the survey with the above-mentioned title. Describing your experience of epidural training within the Department will allude to the quality of training received and recommendations can be made to either emulate the training received within this department or make adjustments to the said training programme.

Participation is entirely voluntary, and consent is implied by submission of a completed questionnaire. Confidentiality is maintained in that only an email address is connected to your responses, and only the researcher and supervisors will have access to the raw data.

The questionnaire should not take you longer than 10 Minutes to complete, and you are encouraged to keep your responses private. Please ensure you understand the above information before completing the questionnaire.
Should you have any questions regarding this study, or should you need access to the final report, please contact me at 072 574 3687, or brhosking@gmail.com; alternatively my supervisors can be contacted at: Zainub Jooma zainub.jooma@gmail.com; and Janine Wagner drjaninewagner@gmail.com .

This study has been approved by the Human Research Ethics Committee (Medical) of the University of the Witwatersrand, Johannesburg ("Committee"). A principal function of this Committee is to safeguard the rights and dignity of all human subjects who agree to participate in a research project and the integrity of the research.

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Thank you for taking the time to read this letter and participate in the study, your assistance is greatly appreciated.

Yours Sincerely,
Brett Hosking
Anaesthesia Registrar
Department of Anaesthesia
University of Witwatersrand
February 2022

Demographics and Epidural Experience

1. Gender *

Mark only one oval.

- ◯ Male
- ◯ Female
- ◯ Prefer not to say

2. Year of Registrar Training *

Mark only one oval.

- ◯ First Year
- ◯ Second year
- ◯ Third Year
- ◯ Fourth Year
- ◯ Extended Time

3. Years of Anaesthetic experience post internship *

_____

4. How many Labour epidurals have you performed in your anaesthetic career thus far? *

- ◯ 0
- ◯ 1-10
- ◯ 11-20
- ◯ 21-30
- ◯ 31-40
- ◯ 41-50
- ◯ 51-60
- ◯ >60

5. How many Non-Labour epidurals have you performed in your anaesthetic career thus far? *

Mark only one oval.

- 0
- 1-10
- 11-20
- 21-30
- 31-40
- 41-50
- 51-60
- >60

6. Where did you perform your first epidural (if other, please specify) *

Mark only one oval.

- Labour ward
- Operating theatre (Thoracic Epidural)
- Operating theatre (Lumbar Epidural)
- Other: _____

7. Were you supervised? *

Mark only one oval.

- Yes
- No

Acquiring the technical skills necessary for epidural insertion

To what level do you agree or disagree with the following statements: Trying to acquire the technical skills necessary for epidural insertion are becoming increasingly more difficult because of:

8. Increased use of Rectus sheath blocks, TAP blocks, QL Blocks, Erector Spinous Plane blocks, Morphine spinals or other blocks or anaesthetic techniques *

Mark only one oval.

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

9. More minimally invasive surgery (eg laparoscopic procedures) *

Mark only one oval.

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

10. Not all registrars are afforded the opportunity of the obstetric epidural rotation *

Mark only one oval.

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

11. There is an increased emphasis on patient safety, leading to seniors being less likely to allow registrars to attempt or perform epidurals *

Mark only one oval.

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

12. More challenging patients requiring experienced operators *

Mark only one oval.

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

13. Too many registrars looking for opportunities to site an epidural *

Mark only one oval.

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

14. There is significant time pressure from surgical disciplines to be efficient with theatre time, hence they resist the use of epidurals *

Mark only one oval.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

15. There is considerable resistance from midwives in labour ward for registrars to site labour epidurals, for various reasons *

Mark only one oval.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

16. Please comment on any other challenges you may have faced in acquiring the technical skills necessary for epidural insertion not mentioned in any of the above questions. *

Supervision and Teaching

In general, considering your first few solo epidural insertions ever performed, to what extent do you agree or disagree with the following statements:

17. I was observed and given feedback on enough cases to feel confident to perform the procedure alone *

Mark only one oval.

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

18. I had a thorough understanding of spinal anatomy *

Mark only one oval.

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

19. I knew how to troubleshoot when having difficulty *

Mark only one oval.

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

20. I felt uncertain a lot of the time *

Mark only one oval.

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

21. I could easily call for help if I was struggling to site an epidural *

Mark only one oval.

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

22. I felt uncertain about when I should call for help *

Mark only one oval.

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

23. I had a good understanding of the risks and complications involved *

Mark only one oval.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

24. Performing epidurals was very stressful *

Mark only one oval.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

25. Do you think there should be a formal assessment of the technical skills and ability to insert an epidural? *

Mark only one oval.

- Yes
- No
- Undecided

26. Do you have any other comments regarding supervision and training? *

Supervising others

When you are supervising junior colleagues inserting/learning to insert epidurals:

27. Have you supervised junior colleagues? *

Mark only one oval.

- ◯ Yes
- ◯ No

28. I usually let the junior colleague have one try and then step in if any problems *

Mark only one oval.

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree
- ◯ I have not supervised a junior colleague

29. I'd be happy to supervise a junior colleague even if they may not be so familiar with the equipment or anatomy *

Mark only one oval.

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

30. I would prefer the consultant to supervise juniors *

Mark only one oval.

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

31. Do you have any other comments about supervising junior colleagues? *

_____

_____

_____

_____

_____

Epidural Simulators

With regards to epidural simulators:

32. Have you ever used an epidural simulator for training purposes (either yourself or to teach others)? *

Mark only one oval.

- ◯ Yes
- ◯ No

33. If you have used a simulator, did you find it useful? *

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ I have not used a simulator

34. Would you recommend simulator use in teaching epidural insertion to junior registrars/colleagues? *

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Undecided

35. Would you only allow a junior registrar/colleague to attempt epidurals on patients if they could demonstrate competency on an epidural simulator (provided epidural simulators were available)? *

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Undecided

36. Do you think simulator training should be a compulsory element in the training of junior registrars/colleagues? *

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Undecided

37. Do you have any other comments regarding epidural simulators? *

Ultrasound

With regards to Ultrasound and epidural insertion

38. Have you ever used ultrasound pre-puncture to assist with epidural insertion? *

Mark only one oval.

- Yes
- No

39. Did you find the use of ultrasound to be useful? *

Mark only one oval.

- Yes
- No
- I have not used ultrasound to assist with epidural insertion

40. Would you recommend using ultrasound as part of a teaching strategy when training junior registrars/colleagues? *

Mark only one oval.

- Yes
- No
- Undecided

41. Do you think ultrasound skills and use should be considered a compulsory element in the training of junior registrars/colleagues? *

Mark only one oval.

- Yes
- No
- Undecided

42. Do you have any other comments with regards to ultrasound use and epidurals? *

Appendix E: Postgraduate Approval Letter

UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

Private Bag 3 Wits, 2050
Fax: 027117172119
Tel: 02711 7172076

Reference: Mrs Sandra Benn
E-mail: sandra.benn@wits.ac.za

18 March 2022
Person No: 2497667
PAG

Dr BR Hosking
29 Sagewood Way
Glen Anil
4051
South Africa

Dear Dr Brett Hosking

Master of Medicine in Anaesthesia: Approval of Title

We have pleasure in advising that your proposal entitled *A Survey of Anaesthesia registrars' experience and perspectives on epidural training in the WITS Anaesthesia circuit, Johannesburg* 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

Appendix F: Human Research Ethics Committee (Human) Approval Letter

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Dr Brett Hosking

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M220208

NAME: (Principal Investigator)	Dr Brett Hosking
DEPARTMENT:	Anaesthesia
PROJECT TITLE:	A Survey of Anaesthesia registrars' experience and perspectives on epidural training in the WITS Anaesthesia circuit, Johannesburg
DATE CONSIDERED:	25/02/2022
DECISION:	Approved unconditionally
CONDITIONS:	
NOTE:	If contact information regarding student study participants is required, please contact the University Registrar's office <Nicoleen.Potgieter@wits.ac.za>
SUPERVISOR:	Dr J Wagner and Dr Z Jooma
APPROVED BY:	CB Penny Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	08/04/2022

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

DECLARATION OF INVESTIGATORS

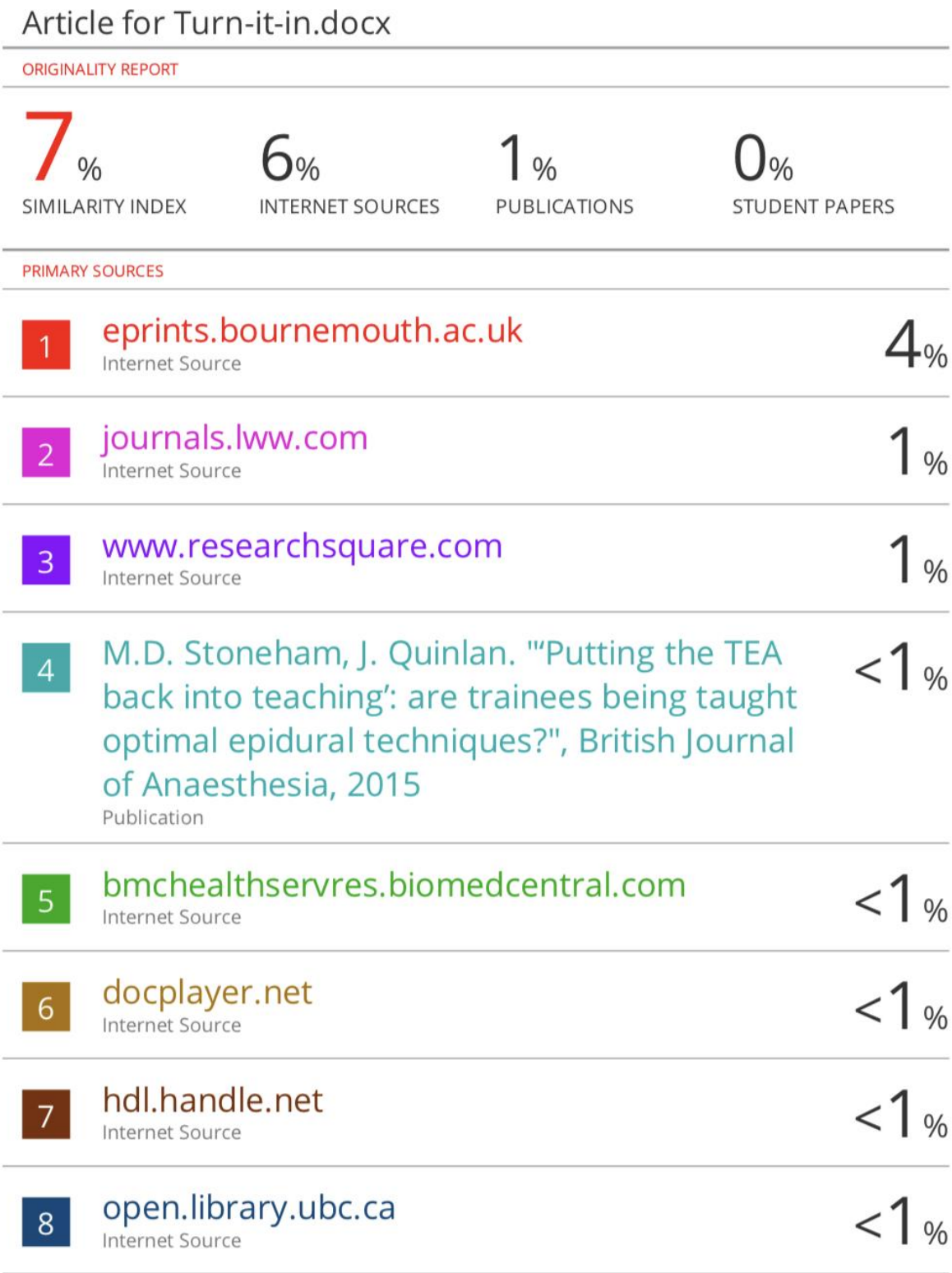
To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on the Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are 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 resubmit the application to the Committee. I **agree to submit a yearly progress report.** The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in **February** and will therefore be due in the month of **February** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature

12/04/2022
Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix G: Plaguiarism/Turnit in Report cover page



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