AN INVESTIGATION TO DETERMINE IF THE THEATRE TIME ALLOCATED TO THE OBSTETRIC THEATRE AT PELONOMI HOSPITAL IS BEING UTILISED APPROPRIATELY

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DECLARATION

I, Matthys Lourens Swart, declare that this research report represents my own independent work. It is being submitted for the degree Master of Medicine (MMed) in the Department of Anaesthesiology, Faculty of Health Sciences, University of the Free State. It has not been submitted before for any degree or examination at any other university, neither has any part of it been published before.

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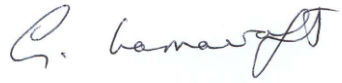
Matthys L. Swart

16 March 2021



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DEDICATION

I dedicate this dissertation to my wife, Elisia Swart, for all the support while doing this research, and my children, Elan, Johan and Matthys, for missing out on many hours with their dad.

ABBREVIATIONS

AACD	American Association of Clinical Directors
ASA	American Society of Anesthesiologists
CPSWT	Canadian Paediatric Surgical Wait Times
C-section	Caesarean section
ERAS	Enhanced recovery after surgery
FCOTS	First case on-time starts
FCST	First case start time
HSREC	Health Sciences Research Ethics Committee
ICU	Intensive care unit
LSS	Lean and Six Sigma
MMed	Master of Medicine
NHS	National Health Service
NICE	National Institute for Health and Care Excellence
OR	Operating room
UFS	University of the Free State

ABSTRACT

Background. Operating theatre efficiency is a priority from both a financial and patient care perspective. Optimal theatre efficiency is required to prevent prolonged waiting time for surgery, which can lead to deterioration of a patient's health, prolonged hospitalisation, anxiety, inconvenience, staff frustration and increased costs.

Objectives. The aim of this study was to determine if theatre time was being used efficiently in the obstetric theatre at Pelonomi Tertiary Hospital, Bloemfontein, by investigating the amount of time the theatre was not in use during working hours and after hours, and to determine whether when an elective case was done after hours, if there was time available during working hours when it could have been done.

Methods. The study design involved a retrospective investigation. The obstetric theatre register was used to collect the data. The data collected from this register included the type of surgery, start and end times of the operation, and whether it was an emergency or elective procedure.

Results. The study period was 01/07/2019 and 31/12/2019. In total, 1 048 caesarean sections were performed; 1 020 (97.3%) were emergency cases. Of the 28 elective cases, nine (32.1%) were done after hours. The amount of time the theatre was not in use during working hours ranged from a minimum of 1 hour and 35 minutes (1h 35m) to a maximum of 8h 40m, with a median of 5h 20m. The median theatre utilisation during working hours was 44%. The amount of time the theatre was not in use after hours on a week day ranged from a minimum of 45 minutes to a maximum of 12h 15m, with a median of 7h 40m, which was equal to median theatre utilisation of 47%. The median amount of time the theatre was not in use on public holidays and weekends combined was 10h 25m per 24-hour day (range 1h 15m to 17h 40m), which was equal to median theatre utilisation of 57%. First case start times (FCSTs) on normal work days, after 7h30, were a median of 2 hours, ranging from 5 minutes to 8h 40m.

Conclusions. This study showed inefficient use of obstetric theatre time, at Pelonomi Tertiary Hospital, as some elective C-sections were done after hours when enough time were available during working hours. Remarkably few cases were classified as elective cases and needs further investigation. The possibility exists of calling most cases an emergency to justify doing it after hours.

Keywords: operating theatre efficiency; theatre utilisation; first case start time; obstetric; caesarean section; emergency; elective

CHAPTER 1
LITERATURE REVIEW

1. INTRODUCTION

1.1 Problem statement

An informal in-house investigation conducted at Pelonomi Tertiary Hospital in Bloemfontein, South Africa, has shown that the obstetric theatre at this hospital may not be being used efficiently, potentially compromising maternal and child health. Results from this informal investigation indicated that frequent episodes may occur during normal working hours that the theatre is not utilised. This situation may have led to elective cases being done after hours. Most after hour cases are done by relatively less experienced anaesthesiology medical officers and junior anaesthesiology registrars. Consequently, these elective cases after hours result in having a less experienced anaesthetist administering the anaesthetic, which would not have been the situation is the procedure was performed during working hours. Apart from potential anaesthesia-related complications, the opportunity for the less experienced anaesthetists to be taught obstetric anaesthesia during working hours when the Consultant Anaesthetist can provide direct supervision, has been forfeited.

Normally, there are no anaesthesiology consultants in the obstetric theatre after hours as these consultants have to cover emergencies at both Pelonomi and Universitas Hospitals, although they always endeavour to attend if a complicated case that requires senior anaesthetic care would occur. Furthermore, limited theatre nursing staff are available after hours. Therefore, when an elective case that has been scheduled to be done earlier that day during working hours, but has not been done and is subsequently in progress after hours and an emergency obstetric case (such as a caesarean section) occurs, it may not be possible to open another theatre after hours to attend to this emergency case. These circumstances can lead to a delay in performing the emergency obstetric case and result in maternal and foetal compromise.

The purpose of the investigation was to determine whether the obstetric theatre utilisation time is adequate, or whether interventions are required to improve theatre time utilisation and thereby improve maternal and child health.

1.2 Operating theatre cost

The value of medical care is determined by both the quality and cost of care. To improve value, quality must improve and cost must be limited. Knowing the costs involved in perioperative care will assist hospital managers in improved planning of usage of healthcare resources.[1]

A theatre complex can be an expense centre or a profit centre. If it is an expense centre, the goal should be to reduce cost. If it is a profit centre, the main focus should be the margin between costs and revenue to maximise profit.[2] Costs can be variable or fixed, and direct or indirect. Variable direct costs will include labour and supplies used to perform a service to a patient, which can be managed by the clinical decision-making of a doctor. Variable indirect costs, for example, are the salaries of food service workers or filing personnel working in medical records. Fixed costs are the costs of production of a patient service.[1]

There is a difference between costs and charges. Costs are all the variable and fixed, direct and indirect costs associated with the perioperative care of a patient. Charges are the profit that is added to costs in a profit driven centre. Theatre cost per minute is calculated by dividing the total costs (direct costs plus indirect costs) by the total number of minutes in use. Due to different hospital models, no benchmark for the cost of operation theatre time per minute is availbale.[3]

Raft et al.[4] found that two thirds of direct costs were allocated to surgery and one third to anaesthesiology. The largest proportion of direct cost was allocated to staff, which comprised 65% of the total cost, while 20% of the total cost was contributed to cover indirect expenses.[4]

Healthcare in South African consists of public and private healthcare systems. The public sector is funded from the national budget, which means that these hospitals are expense centres. Healthcare utilisation in South Africa is increasing due to a growing population and

increased disease burden. Despite these increasing demands, the public health sector remains chronically underfunded.[5] In developing countries, healthcare receives 5% to 10% of the national budget, of which 50% to 80% is allocated to hospitals.[6]

Between 2011 and 2014, the rate of caesarean sections performed in South Africa has increased from 22% to 25%.[5] Operating theatres is a large expenditure, financial hub, as well as a resource-intensive area for all major hospitals. It consumes up to 40% of a hospital's budget.[7] Optimal theatre time utilisation is therefore a priority from both a financial and patient care perspective.

1.3 Theatre utilisation

Utilisation of operating theatre time is regarded as the principle marker of theatre performance and guides the management of a theatre complex.[8] It involves the proportion of scheduled theatre list time used for surgery and anaesthesia.[9] Under-utilisation occurs when scheduled work hours are not used, while over-utilisation is experienced when a scheduled case continues beyond scheduled hours, also referred to as over-running.[10]

Both high and low utilisation rates have disadvantages. High utilisation rates can cause difficulty in scheduling a new elective case, increased waiting times and a dissatisfied patient and surgeon. Low utilisation rates, on the other hand, cause loss of income for a specific hospital model. Utilisation is the usage of resources and is not equal to how efficiently a theatre is operating. Efficiency relates to the economic side of the matter.[2]

Utilisation of theatre time can give a value of more than 100% by way of over-running a list, and under-utilisation, by way of cancellations, can still imply utilisation of more than 80%. Over-running of a theatre list and cancellations are both inefficient. A utilisation percentage of 80% to 90% has been suggested.[8–10]

In order to show efficiency, it must be measured. To measure operating theatre efficiency, a hospital needs a scoring system that tracks and displays key performance indicators. However, which indicators to consider to determine theatre efficiency remains a matter of uncertainty.[11] Multiple measures of theatre efficiency have been proposed. The Canadian Paediatric Wait Times project identified metrics of efficiency that include off-hours surgery,

same-day cancellation rate, first case start-time accuracy, operating room use, percentage of unplanned closures, case duration accuracy, turnover time and excess staffing costs.[12]

Nevertheless, no universally accepted concept of efficiency has yet been formulated. Van As et al.[13] described pre-operative performance indicators related to efficiency. These indicators include admission time to procedure start time, elective/emergency cases ratio, cancellations and availability of surgical beds. Intra-operative performance indicators included the average procedure time, change-over time and time utilisation.[13]

Measurement of efficiency should be universally applicable and easy to calculate. Pandit et al.[9] proposed a formula to describe the efficiency of theatre utilisation expressed as a percentage. The following formula has been developed:

Efficiency = [(fraction of scheduled time utilised) – (fraction of scheduled time over-running)] x [fraction of scheduled operations completed].[9]

According to their formula, an efficiency of 85% would imply cancellation of one out of five patients, and an efficiency of 90% would mean cancellation of one out of ten patients. They suggested an efficiency of 85% as an acceptable minimum and more than 90% as desirable.[9]

In the United Kingdom, it has been recommended by the National Health Service (NHS) Management Executive that hospitals should aim for 90% efficiency utilisation.[14] According to the NHS, cited by Hartmann and Sunjka,[15] the global benchmark is between 70% and 80%.

1.4 Factors influencing efficiency

1.4.1 Scheduling

Scheduling of surgery is an important part of theatre management. Improvement of theatre scheduling will lead to theatre efficiency and patient and staff satisfaction. Scheduling can be done manually or can be computerised.

The three stages of scheduled surgery management are the strategic, tactical and operational stages. The strategic stage considers the number and type of operating rooms available, hours of operation of each operating room and the overall capacity of operating rooms. The tactical stage includes the master surgical schedule and block assignments. The operational stage involves the booking of elective cases.[16]

Accurate prediction of surgical case duration is necessary to determine optimal schedules and reduce over-running and under-utilisation. Inaccurate scheduling has an economic impact on other areas such as the recovery area, intensive care unit, radiology department and laboratories.[17] Different software models can be used to calculate procedure duration based on historical data.[18] Three types of statistical models are used to predict procedure duration, namely normal or linear models, lognormal models and three-parameter lognormal models.[19]

Wright et al.[17] reported that a large difference between calculated and actual procedure duration. In their study, surgeons had a low accurate prediction of the average procedure time, but still made a better outcome compared to the software calculated predictions. Computerised estimates were worse than the estimates of 60% of the surgeons.[17] Procedure time variability complicates the prediction of the amount of time necessary to perform procedure, with the most important sources of variability being the surgeon work rate, type of anaesthesia and the American Society of Anesthesiologists (ASA) classification.[19]

Block time is the amount of theatre time allocated to a specific surgical group, service or individual surgeon. A hospital will have to turn away surgery demand if too little block time is allocated, while excessive unused block time will not be cost-effective. Block adjustments are an ongoing process due to demand variability. In a case study by Hosseini and Taaffe,[20] it was found that using data of the preceding twelve months for block adjustments resulted in the lowest inefficiency cost.

If a hospital wants to expand its surgical services, additional block time should be scheduled for specialities that meet the following criteria: (i) high contribution margin per operating room (OR) time; (ii) no constraints such as limited ICU beds; (iii) appropriateness of the procedure; (iv) a surgeon who wants to grow his practice; and (v) potential for growth

according to community need. Utilisation of block time is not a good measure to use for tactical planning of adding block time.[21]

An elective surgery is a planned procedure that is scheduled in advance. An emergency surgery needs to be performed as soon as possible. Scheduling becomes complicated when an operating room is needed to be immediately available for emergency cases. If the same theatre is used for elective and emergency cases, there is a trade-off between cancellation or postponement of an elective case and responsiveness to an emergency case. This can lead to over-running of an elective case. It is costly when an operating room is dedicated for emergency cases and not in use at a specific time. Both scenarios contribute to inefficiency. There must be a balance between efficiency and responsiveness.[22]

An operating theatre can be dedicated either to only emergency cases or only elective cases. An operating theatre is flexible when used for both emergency and elective cases. There are three different flexible models: (i) decide how many elective cases to book to allow a fraction of OR time for emergency cases; (ii) schedule elective cases and leave time available between cases; and (iii) do not leave open time for emergencies, but schedule cases in such a way that the waiting time for emergency cases can be reduced.[23] In this study, Ferrand et al.[23] compared two models. Model 1 was a mixed model with dedicated and flexible operating theatres. Model 2 consisted of only dedicated or only flexible operating theatres. For a patient wait time objective, the first model performed better than the second.[23]

1.4.2 On-time starts

First case on-time start is a performance parameter for operating theatre efficiency. One could argue that gaining 15 minutes by starting earlier will still not allow for an additional procedure to be performed at the end of the day, but it will allow for less rushing and therefore a more pleasant environment,[24] and avoid inefficiency related to overrunning.

The definition of start time could differ between nursing staff, anaesthesiologists and surgeons. The American Association of Clinical Directors(AACD) published the Procedural Times Glossary. "Anaesthesia start" time is when the anaesthetist starts to prepare the patient for anaesthesia, "anaesthesia ready" is the time when the patient has reached a sufficient level of anaesthesia to begin surgical preparation, and "procedure/surgery start time" is when

the first incision is made. The start time that is referred to should be communicated between team members to avoid misclassified late starts.[25] Shelver et al.[26] identified some of the most common reasons for late starts. They classified it as surgeon late, anaesthesia late, no history and physical examination, insufficient transportation, nursing delays and others.[26] If no medical history was obtained and a thorough physical examination was not done on the day of surgery, a new medical problem can arise on the day of surgery, which might require additional tests and cause a delay in surgery. Insufficient transportation can occur in the hospital between the ward and the OR, which can be porter-related, or the patient's transportation to the hospital.

Improvement in first case on-time starts (FCOTS) can be achieved in two ways; firstly, by improvement of the process to get the patient in theatre, and secondly by starting the process earlier. Tiwari et al.[27] investigated the FCOTS initiative at a hospital and found that the over-all FCOTS improved by improvement of the process and not by starting the process earlier. Better process performance resulted from better process control due to better communication between team members and training of administrative staff. Their final observation was that to succeed in a sustainable FCOTS initiative, improvement in the process was the key and not starting the process earlier.[27]

1.4.3 Turnover time

According to the Procedural Times Glossary of the AACD,[25] the definition of turnover time is the amount of time that elapsed between the prior patient moved out of the room and the succeeding patient received in the room for sequentially scheduled cases.

Turnover time is of financial and clinical benefit to both the hospital and the patient. In 31 operating hospitals in the USA, the turnover time was less than 25 minutes. Gottschalk et al.[28] did a study on turnover time in hand surgery theatres and identified the factors that had a significant change in turnover time, which included (i) surgeon presence and surgeon incentives, such as buying lunch for staff members; (ii) the time of the day, e.g. shift changes between staff prolonged turnover time; and (iii) ambulatory or specialised hospital. In an ambulatory hospital, the turnover time was on average 19 minutes shorter than in a specialised hospital. Turnover time was shorter with ASA classification 1 compared to ASA 3. Prior and current case types also had an effect on turnover time. For example, when the

prior case was only a soft tissue procedure the turnover time was shorter. Turnover time between last cases of the day was also longer compared to earlier cases in the day.[28]

The implications of prolonged turnover time are cost-related, not performing all the scheduled elective cases on the day, added costs of over-time, erosion of work-life balance and a missed opportunity to do an urgent procedure waiting in the emergency room.[29]

1.4.4 Factors to improve on-time starts and decreasing turnover times

1.4.4.1 Improve on-time starts

The following aspects may contribute to improve on-time starts:[2]

- do not require the surgeon to be present before the patient enters the OR;
- use guaranteed block time;
- use speciality teams dedicated to complex cases;
- standardise preoperative orders and testing; and
- preoperative visits.

1.4.4.2 Improve turnover times

Turnover times can be improved by taking the following factors into consideration:[2]

- organise a turnover team to clean and prepare the OR;
- have the same surgeon working in one OR;
- use speciality-specific nurses and anaesthesiologists;
- reduce changes on the scheduled list;
- streamline the preoperative process; and
- communicate in a timely manner.

1.4.4.3 Preoperative clinics

Preoperative clinics improve hospital resource utilisation by reducing preoperative consultations and laboratory testing. In addition, they have been shown to improve patient safety and satisfaction and reduce hospital stay. Furthermore, it reduces the amount of cancellations and reduce delays on the day of surgery.[30]

1.4.5 Cancellations

Cancellations are a performance indicator of operating room efficiency and leads to financial loss for a hospital. Substantial variability may occur in the cancellation rates of different hospitals due to different financial systems and work culture. According to Turunen et al.,[31] 50% to 60% of cancellations are avoidable. They found that 60% of all cancellations occurred on the day of surgery and days 1, 3 or 14 before surgery. These specific days could be due to institutional protocols. Day-of-surgery cancellations accounted for 20% of all cancellations. Factors contributing to cancellations were patient- or organisation-related. Patient-related factors included sudden illness (34%), no further need for surgery, did not suit the patient's schedule, the patient did not want the surgery anymore, or a lack of important information in the consent. Organisation-related factors included no surgeon available, a more important case needs to be performed, and shortage of staff or equipment.[31]

International cancellation rates are between 5.6% and 25%, although it should be less than 5% if efficient.[32] In a study conducted in a regional state hospital in Durban, South Africa, some of the most important reasons for day-of-surgery cancellations included lack of available operating time (41%), surgeon unavailable (5%), lack of surgical or anaesthesia work up (3%), and change in the patient's medical condition (2%). The cancellation rate could have been reduced by 14%, as 42% of the cancellations in this study were avoidable.[32]

1.5 Effects on patients

Increased waiting time for surgery can lead to deterioration of a patient's health, prolonged hospitalisation, anxiety, inconvenience, staff frustration and increased costs.[33] A delay in performing a caesarean section (CS) can also lead to foetal morbidity and mortality.

The degree of urgency of a CS is classified into the following 4 categories:

1. maternal or foetal compromise immediate life threatening;
2. maternal or foetal compromise not immediate life threatening;
3. need early delivery but no maternal or foetal compromise; and
4. elective CS.

The standard of care for obstetric patients undergoing an emergency CS adopted by the American and Royal Colleges of Obstetrics and Gynaecology is 30 minutes from decision-to-incision time. Tolcher et al.[34] reported in a meta-analysis of the literature that delivery was not achieved in 79% of category 1 cases and the clinical significance of failure to achieve this goal was still unsure.[34]

Enhanced recovery after surgery (ERAS) improve perioperative care, shorten recovery time to normal physiology and decrease length of hospital stay. ERAS after elective CS also holds the same benefits. According to the National Institute for Health and Care Excellence (NICE) guidelines, a woman who had an uncomplicated delivery and is low risk, should be offered to be discharged 24 hours after delivery with home follow-up. Bowden et al.[35] demonstrated that such an ERAS fast track pathway after elective CS is safe for low-risk women. Added advantages include open beds and patient satisfaction.[35] Inefficient theatre time usage can potentially jeopardise any attempts of implementing ERAS after elective CS. If an elective CS was scheduled to be done as the first case for the day and due to inefficient theatre utilisation is only performed early that evening, it will mean that the patient will have to stay in hospital for two nights instead of one night.

1.6 Improvement of operating theatre efficiency

Lean and Six Sigma (LSS) are two different methodologies that were developed by the manufacturing industry to manage and improve efficiency of a manufacturing system to improve production. LSS consists of management tools to reduce wasteful steps in the production pathway. The aim of Lean is too get rid of steps that do not add value. The aim of Six Sigma is to reduce variation in a process. LSS can also be used to improve the efficiency of an operating theatre complex. It can be applied globally over the entire surgical pathway from surgery scheduling through to discharge of a patient. When LSS is

implemented, measurable outcomes can include on-time start, theatre utilisation and cancellations. It has been proven in previous studies that by applying LSS does improve the efficiency of OR utilisation.[36,37]

From the literature review, it became evident that OR utilisation inefficiency is a global occurrence to varying degrees. No study in this regard has been conducted previously to determine OR utilisation at Pelonomi Tertiary Hospital, which prompted the research presented here.

2. AIM AND OBJECTIVES OF THE STUDY

2.1 Aim

The aim of this study was to determine if theatre time was being used efficiently in the obstetric theatre at Pelonomi Tertiary Hospital in Bloemfontein, South Africa.

2.2 Objectives

The primary objectives were to determine the following:

(i) the amount of time the theatre was not in use during working hours versus after hours;
(ii) first case starting time (FCST) on each normal working day during the study period;
(iii) whether an elective case was performed after hours; and
(iv) whether there was time available during working hours during which the procedure identified in (ii) could have been performed.

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CHAPTER 2
PUBLISHABLE ARTICLE

Title

An investigation to determine if the theatre time allocated to the obstetric theatre at Pelonomi Tertiary Hospital is being utilised efficiently

Authors

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Title

An investigation to determine if the theatre time allocated to the obstetric theatre at Pelonomi Tertiary Hospital is being utilised efficiently

Abstract

Background. Operating theatre efficiency is a priority from both a financial and patient care perspective. Optimal theatre efficiency prevents prolonged waiting time for surgery, which can lead to deterioration of a patient's health, lengthy hospitalisation, anxiety, inconvenience, staff frustration and increased costs.

Objectives. The aim of this study was to determine if theatre time was being used efficiently in the obstetric theatre at Pelonomi Tertiary Hospital, Bloemfontein, by investigating the amount of time the theatre was not in use during working hours and after hours, and to determine if, when an elective case was done after hours, there was time available during working hours when it could have been done.

Methods. The study design involved a retrospective investigation. The obstetric theatre register was used to collect the data. The data collected from this register included the type of surgery, start and end times of the operation, and whether it was an emergency or elective procedure.

Results. The study period was 01/07/2019 and 31/12/2019. In total, 1 048 caesarean sections were performed; 1 020 (97.3%) were emergency cases. Of the 28 elective cases, nine (32.1%) were done after hours. The amount of time the theatre was not in use during working hours ranged from a minimum of 1 hour and 35 minutes (1h 35m) to a maximum of 8h 40m, with a median of 5h 20m. The median theatre utilisation during working hours was 44%. The amount of time the theatre was not in use after hours on a week day ranged from a minimum of 45 minutes to a maximum of 12h 15m, with a median of 7h 40m, which was equal to median theatre utilisation of 47%. The median amount of time the theatre was not in use on public holidays and weekends combined was 10h 25m per 24-hour day (range 1h 15m to 17h 40m), which was equal to median theatre utilisation of 57%. First case start times (FCSTs) on normal work days were delayed for a median of 2 hours, ranging from 5 minutes to 8h 40m.

Conclusions. This study showed inefficient use of obstetric theatre time at Pelonomi Tertiary Hospital, as some elective C-sections were done after hours when sufficient time was available during working hours. Remarkably few cases were classified as elective cases and needs further investigation. The possibility of calling most cases an emergency to justify doing it after hours could not be excluded.

Keywords: operating theatre efficiency; theatre utilisation; first case start time; obstetric; caesarean section; emergency; elective

Introduction

Theatre efficiency is a priority from both a financial and patient care perspective. The value of medical care is determined by both the quality and cost of care. To improve the value, quality must improve and cost must be limited.[1] Healthcare in South Africa consists of public and private systems. The public sector is funded from the national budget, which means that these hospitals are expense centers.[2] Operation theatres represent a large expenditure, financial hub and a resource-intensive area for all major hospitals, consuming up to 40% of a hospital's budget.[3]

Optimal theatre efficiency is required to prevent prolonged waiting time for surgery, which can lead to deterioration of a patient's health, extended hospitalisation, anxiety, inconvenience, staff frustration and increased costs.[4] This may in particular occur among obstetric patients where a delay in surgery may lead to maternal and foetal morbidity and mortality. The economic results in such cases may include costly medico-legal lawsuits to care for a severely handicapped child.

If an elective case that had been scheduled to be done earlier that day during working hours, but was not done and is subsequently in progress after hours, and an emergency obstetric case (e.g., caesarean section) arises, it may not be possible to open another theatre after hours to attend to this emergency case. At Pelonomi Tertiary Hospital in Bloemfontein, South Africa, only one theatre is available after hours for obstetric cases due to the limited availability of theatre staff. This can lead to a delay in performing an emergency obstetric procedure, which may result in maternal and foetal compromise.

Most after-hour cases are done by relatively less experienced anaesthesiology medical officers and junior anaesthesiology registrars. Performing elective cases after hours by a less experienced anaesthetist could lead to anaesthesia-related complications. Furthermore, it is also a lost opportunity for the less experienced anaesthetists to be taught obstetric anaesthesia during working hours when the consultant anaesthetist can directly supervise the colleague in training.

An informal in-house investigation had previously indicated that the obstetric theatre at Pelonomi Hospital might not be used efficiently, thereby potentially compromising

maternal and child health, and also wasting vital public healthcare resources. The aim of this study was to determine if theatre time was being used efficiently in the obstetric theatre in Pelonomi Hospital. The primary objectives were to determine the amount of time the theatre was not in use during working hours and after hours. A secondary objective was to determine when an elective case has been done after hours, if there was time available during working hours during which it could have been done.

Methods

This retrospective investigation was conducted at Pelonomi Tertiary Hospital in Bloemfontein, South Africa. The obstetric theatre at Pelonomi Hospital is being used for elective and emergency obstetric cases. The study was conducted during the six-month period from 1 July 2019 to 31 December 2019. Ethics approval was obtained from the Health Sciences Research Ethics Committee (HSREC) of the Faulty of Health Sciences, University of the Free State (ethics approval number UFS-HSD2019/1967/2801), the Free State Province Department of Health and the Head of the Department of Anesthesiology.

The obstetric theatre register was used to collect the data. The data were collected from this register and entered on an Excel spreadsheet and included the type of surgery, start and end times of the operation, and if it was an emergency or elective operation.

The data were collected by the principal researcher (MLS) and the data sheet was stored on a laptop to which access was protected by a password. Patient confidentiality was also protected by not documenting the patient's name, date of birth and hospital number. Statistical analysis was performed by the Department of Biostatistics, Faculty of Health Sciences, UFS, using the statistical analysis software package SAS/STAT© Version 9.4 (SAS Institute Inc.; Cary, NC, USA). Results were summarised by frequencies and percentages for categorical variables, and means, medians and standard deviations or percentiles for numerical variables.

All the procedures performed in the obstetric theatre at Pelonomi Hospital from 7:30 am on 1 July 2019, to midnight 31 December 2019 were included in the study. Records that were incomplete and illegible were excluded.

Working hours were defined as being between 7:30 am to 17:00 pm, Monday to Friday, excluding public holidays. After hours were defined as all other times and days. If a time period of 90 minutes or more occurred between cases during working hours, it was considered as sufficient time to have performed an elective case if it had been postponed and later that same day been performed after hours.

Results

The study period was from 1 July 2019 to 31 December 2019, which included a total of 184 days. Figure 1 summarises the number of days and cases included in the study. Due to incomplete data, 32 days had to be excluded from the calculations, resulting in 152 days that were included for data analysis.

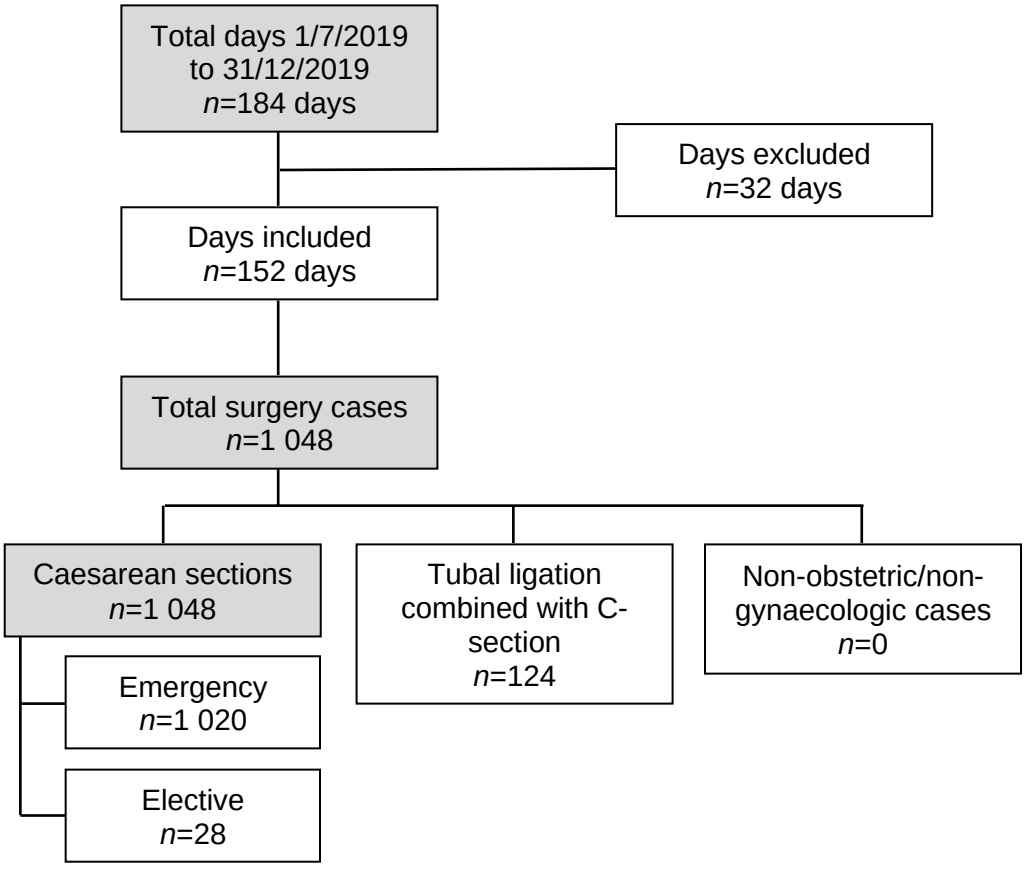

Figure 1. Number of days and cases performed in the obstetric theatre included in the six-month study period 1 July 2019 to 31 December 2019.

During the 152 days of the study period, a total of 1 048 C-sections were performed, of which 1 020 were emergency cases and 28 were elective cases. Of the elective cases, 9 (32.1%) were performed after hours. For 6 of the elective cases performed after hours, sufficient time had been available to have performed these cases during working hours. Figure 2 illustrates the distribution of C-sections during working hours and after hours.

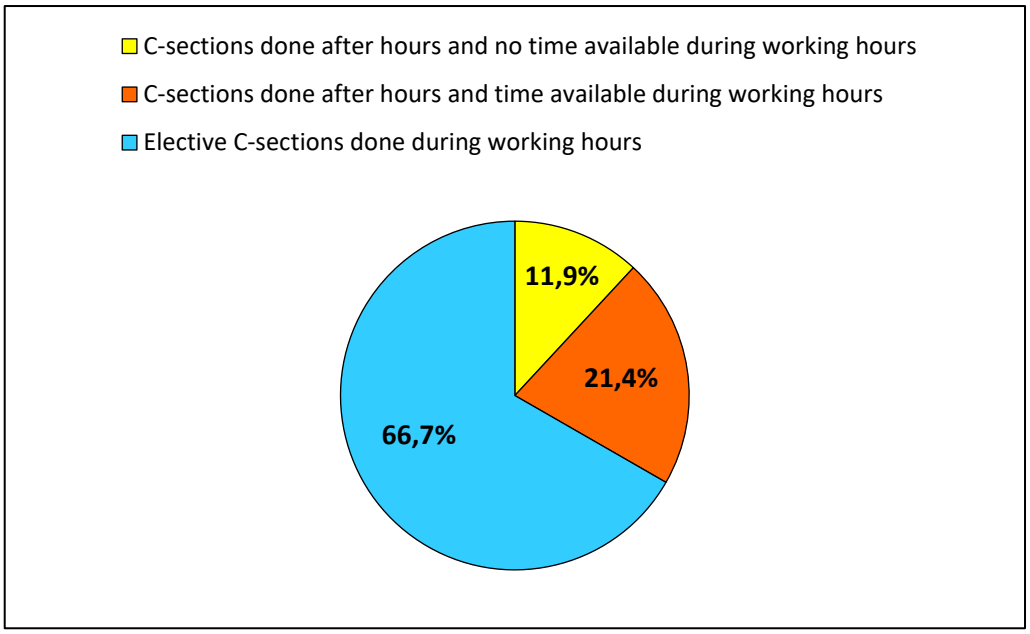

Figure 2. Distribution of C-sections during working hours and after hours.

A total of 124 other procedures were done in the obstetric theatre during the study period. All 124 cases were tubal ligations and all were done at the same time a C-section was performed, which prolonged surgery time only minimally. This extended time was included in the total theatre utilisation. No ectopic pregnancy, uterine evacuation or isolated tubal ligation was documented during the study period. No non-obstetric and non-gynaecologic surgical procedures were performed in this theatre during the study period.

The amount of time the theatre was not in use during working hours ranged from a minimum of 1 hour and 35 minutes (1h 35m) to a maximum of 8h 40m, with a median of 5h 20m. The median theatre utilisation during working hours was 44%.

The amount of time the theatre was not in use after hours on a week day ranged from a minimum of 45 minutes to a maximum of 12h 15m, with a median of 7h 40m, which was equal to median theatre utilisation of 47%.

The amount of time the theatre was not in use on public holidays and weekends combined was a median of 10h 25m (range 1h 15m to 17h 40m), which was equals to median theatre utilisation of 57%.

The time the first case for that day was started is referred to as "first case start time (FCST)" and is the duration of time after 7:30 am on working days. The median FCST was 2h 00m, with a range of 0h 00m to 8h 40m. Figure 3 illustrates the delay in FCSTs on normal working days during the study period. The FCST included emergency and elective cases. If an emergency case was the first case for the day, it did not indicate a delay in start time, but the amount of time available in the morning to do an elective C-Section.

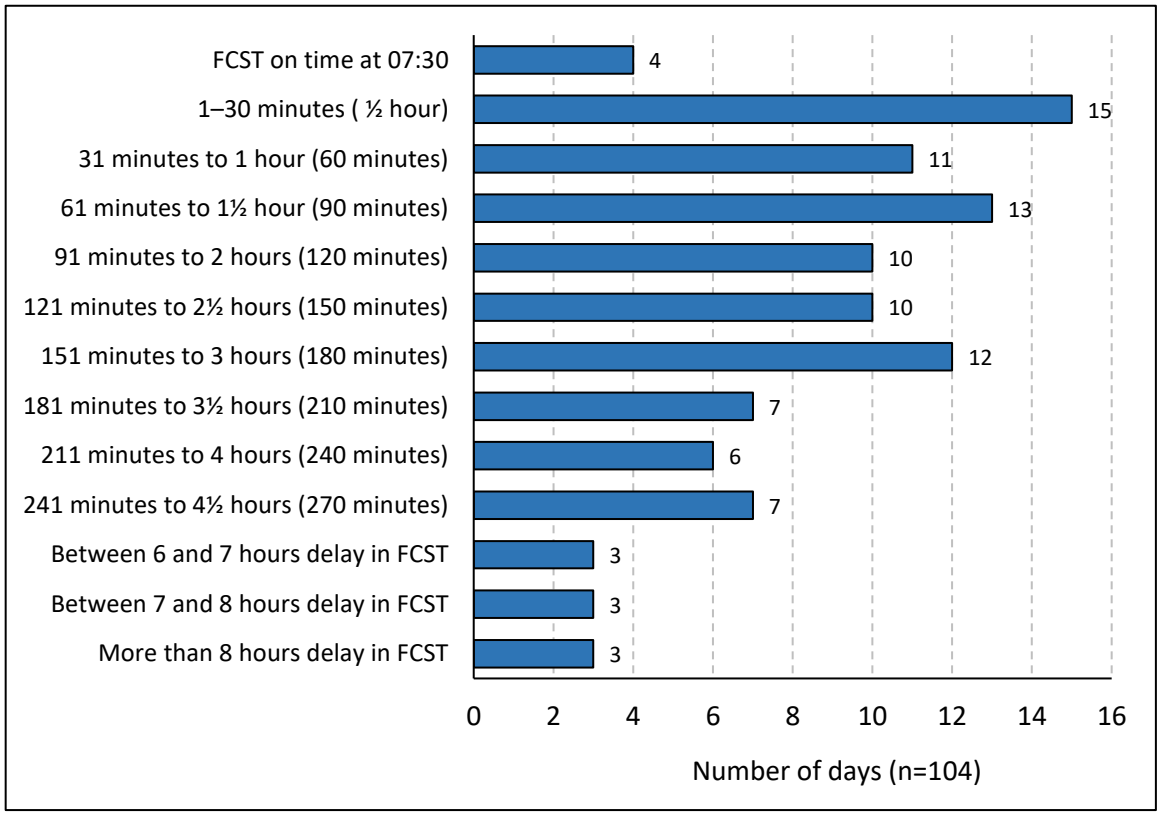

Figure 3. First case start times (FCST) on 104 normal working days during the study period (1 July 2019 to 31 December 2019).

Discussion

This study showed that the obstetric theatre time at Pelonomi Hospital was not used efficiently during the period investigated. The utilisation of this theatre was 44% during working hours and 47% after hours.

Elective C-sections represented 2.7% of the total number of C-sections done during the study period, of which 32.1% were performed after hours. Approximately two-thirds of the elective C-sections done after hours could have been done during working hours.

A large number of emergency obstetric cases were performed compared to the number of elective obstetric cases (n=1 020 versus n=28). This could possibly be due to incorrect recording of cases. There is a policy at our institution that elective C-sections should not be done after 6:00 pm. It is possible that the obstetrician labeled an elective case an emergency in order to get it done.

An elective surgery is a planned procedure that is scheduled in advance. An emergency surgery needs to be done as soon as possible. Scheduling is complicated if an operating room needs to be available immediately for emergency cases. If the same theatre is used for both elective and emergency cases, there is a trade-off between cancellation or postponement of an elective case and responsiveness to an emergency case, which can lead to over-running of an elective case. When an operating room is dedicated for emergency cases and not in use at a specific time, it becomes costly. Both scenarios contribute to inefficiency. There must be a balance between efficiency and responsiveness.[5]

Multiple measures of theatre efficiency have also been proposed. The Canadian Paediatric Surgical Wait Times (CPSWT) project identified the following metrics of efficiency: off-hours surgery, same-day cancellation rate, first case start-time accuracy, operating room use, percentage of unplanned closures, case duration accuracy, turnover time and excess staffing costs.[6]

There is still no universal accepted concept of theatre efficiency. Van As et al.[7] described the following pre-operative performance indicators related to efficiency: admission time to procedure start time, elective/emergency cases ratio, cancellations and availability of

surgical beds. Intra-operative performance indicators included average procedure time, change-over time and time utilisation.[7]

Utilisation of theatre time is regarded as the principle marker of theatre performance and guides the management of a theatre complex.[8] It involves the usage of resources and is not equal to how efficiently a theatre is operating. Utilisation is the proportion of scheduled theatre list time used by surgery and anaesthesia.[9] Tyler et al.[10] suggested a utilisation rate of 80% to 90%. Pandit et al.[9] proposed a formula to describe the efficiency of theatre utilisation expressed as a percentage and suggested an efficiency of 85% as a minimum and more than 90% desirable. The following formula has been proposed:[9]

Efficiency = [(fraction of scheduled time utilised) – (fraction of scheduled time over-running)] x [fraction of scheduled operations completed]

Under-utilisation occurs when scheduled work hours are not used, while over-utilisation is when a scheduled case continues beyond the planned period of time, also referred to as over-running.[10] Utilisation of theatre time can give a value of more than 100% by way of over-running a list and under-utilisation by way of cancellations, and can still give a utilisation percentage of more than 85%. However, if a case is cancelled it increases inefficiency. Over-running of a theatre list and cancellations are both inefficient.

In this study, the theatre time utilisation during working hours was 44%, which means that under-utilisation had occurred compared to the recommendation made by Tyler et al.[10] The calculation of theatre efficiency as a percentage proposed by Pandit et al.[9] is for a theatre where only scheduled elective cases are done. For this reason, it will not be appropriate to use the efficiency formula for the obstetric theatre at Pelonomi Hospital, because it is also used for emergency cases.

This study identified under-utilisation and delayed FCST as two indicators for inefficient theatre usage at the Pelonomi Hospital obstetric theatre. Improvement in FCST will lead to better theatre utilisation during working hours and potentially reduce the need to do an elective case after hours.

Improvement in FCST can be achieved in two ways; firstly, by getting the first case of the day in the theatre on time, and secondly, by starting the process earlier. Tiwari et al.[11] investigated the FCST initiative and found that the over-all FCST improved by improvement of the process and not by starting the process earlier. Better process performance resulted from better process control due to better communication between team members and training of administrative staff.

Conclusion

This study showed inefficient use of obstetric theatre time at Pelonomi Tertiary Hospital, as some elective C-sections were done after hours when enough time were available during working hours. Remarkably few cases were classified as elective cases and needs further investigation. The possibility of calling most cases an emergency to justify doing it after hours cannot be ruled out.

Declaration

The research reported in this article was conducted as a requirement for the Master of Medicine (MMed) degree in Anaesthesiology.

Acknowledgements

Mr. Cornel van Rooyen, Department of Biostatistics, Faculty of Health Sciences, University of the Free State, for assistance with data analysis and interpretation.

Author contributions

MLS and GL conceptualised the study and developed the protocol. MLS performed the data collection and wrote the article. GL contributed to editing the article. Both authors approved the final version of the document.

Funding

None.

Conflict of interest

The authors have no conflicting interests to declare.

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APPENDIX A

ETHICS COMMITTEE LETTER OF APPROVAL

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

UFS·UV
HEALTH SCIENCES
GESONDHEIDSWETENSKAPPE

Health Sciences Research Ethics Committee

29-Jan-2020

Dear **Dr Matthys Swart**
Ethics Number: UFS-HSD2019/1967/2801

1. Ethics Clearance: **An investigation to determine if the theatre time allocated to the obstetric theatre at Pelonomi Hospital is being utilised appropriately**
2. Principal Investigator: **Dr Matthys Swart**
3. Department: **Anaesthesiology Department (Bloemfontein Campus)**

SUBSEQUENT SUBMISSION APPROVED

With reference to your recent submission for ethical clearance from the Health Sciences Research Ethics Committee. I am pleased to inform you on behalf of the HSREC that you have been granted ethical clearance for your request as stipulated below:

Updated timeline in Inclusion Criteria

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

For any questions or concerns, please feel free to contact HSREC Administration: 051-4017794/5 or email EthicsFHS@ufs.ac.za. Thank you for submitting this request for ethical clearance and we wish you continued success with your research.
Yours Sincerely

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

Health Sciences Research Ethics Committee Office of the Dean: Health Sciences
T: +27 (0)51 401 7795/7794 | E: ethicsfhs@ufs.ac.za
IRB 00011992; REC 230408-011; IORG 0010096; FWA 00027947
Block D, Dean's Division, Room D104 | P.O. Box/Posbus 339 (Internal Post Box G40) | Bloemfontein 9300 | South Africa www.ufs.ac.za

APPENDIX B

PERMISSION FROM HOD TO CONDUCT RESEARCH

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

UFS·UV
HEALTH SCIENCES
GESONDHEIDSWETENSKAPPE

MASTER OF MEDICINE

This is to certify that the Departmental Research Meeting approved of the following MMed research protocol:

DATE OF MEETING	17/07/2019

DEPARTMENT	ANAESTHESIOLOGY
STUDENT NUMBER	19990709 21
INITIALS AND SURNAME OF CANDIDATE	ML SWART
NAME OF DEGREE	MMED ANAESTHESIOLOGY
SUPERVISOR	PROF G. LAMAGRAFT
CO-SUPERVISOR	N/A

TITLE OF THE RESEARCH PROJECT
AN INVESTIGATION TO DETERMINE IF THE THEATRE TIME ALLOCATED TO THE OBSTETRIC THEATRE AT PELONOMI HOSPITAL IS BEING UTILISED APPROPRIATELY

G. Lamagraft — RESEARCH CHAMPION — 1.10.2019. — DATE

G. Lamagraft — SUPERVISOR(S) — 1.10.2019 — DATE

HEAD OF THE DEPARTMENT — 3.10.2019 — DATE

APPENDIX C

PERMISSION FROM FREE STATE PROVINCE DEPARTMENT OF HEALTH

health
Department of Health
FREE STATE PROVINCE

19 November 2019

Dr M Swart
Dept. of Anaesthesiology
UFS

Dear Dr M Swart

Subject: An investigation to determine if the theatre time allocated to the obstetric theatre at Pelonomi Hospital is being utilised appropriately

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

Trust you find the above in order.

Kind Regards

Dr D Motau
HEAD: HEALTH
Date: 22/11/19

Head : Health
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APPENDIX D

COPY OF THE RESEARCH PROTOCOL

AN INVESTIGATION TO DETERMINE IF THE THEATRE TIME ALLOCATED TO THE OBSTETRIC THEATRE AT PELONOMI HOSPITAL IS BEING UTILISED APPROPRIATELY

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SUPERVISOR: LAMACRAFT, G

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1 INTRODUCTION

1.1 THE PROBLEM

An informal in-house audit has showed that the obstetric theatre at Pelonomi Hospital may not be being used efficiently, potentially compromising maternal and child health.

Results from this informal audit indicated that there may be frequent episodes during normal working hours that the theatre is not utilised. This may have led to elective cases being done after hours. As most after hour cases are done by relatively less experienced anaesthesiology medical officers and junior anaesthesiology registrars, doing these elective cases after hours results in having a less experienced anaesthetist administering the anaesthetic than if it had been done during working hours. This could lead to anaesthesia complications arising and also loses the opportunity for the less experienced anaesthetists to be taught obstetric anaesthesia during working hours when the Consultant Anaesthetist can directly supervise them.

(Normally, there are no anaesthesiology consultants in the obstetric theatre after hours as these consultants have to cover emergencies both at Pelonomi and Universitas Hospitals, although they always endeavour to attend if there is a complicated case that requires senior anaesthetic care).

In addition, after hours, there are limited theatre nursing staff. Therefore, if an elective case, that was scheduled to be done earlier that day, in working hours, but was not done, is subsequently in progress after hours and an emergency obstetric case (e.g. caesarean section) now arises, then it may not be possible to open another theatre after hours to do this emergency case. This can lead to a delay in performing the emergency obstetric case and maternal and foetal compromise.

The reason for performing the audit is to determine if the obstetric theatre utilisation time is adequate or if interventions are required to improve theatre time utilisation and thereby improve maternal and child health.

1.2 RESOURCE MANAGEMENT

Operating theatres is a large expenditure for all major hospitals. It consumes up to 40% of a hospital's budget.[1] Optimal theatre time utilization is therefore a priority for financial and well as patient care reasons.

1.3 THEATRE UTILIZATION

Pandit *et al*. proposed a formula to describe the efficiency of theatre utilization. Efficiency = [(fraction of scheduled time utilized) – (fraction of scheduled time over-running)] x [fraction of scheduled operations completed].

They suggest an efficiency of 85% as a minimum and more than 90% as desirable.[2] It is recommended by the NHS Management Executive that hospitals should aim to use 90% of planned theatre time.[3] According to another study the global benchmark is 70% - 80%.[4]

1.4 CAUSES OF INEFFICIENCY

Inefficient use of theatre time is a waste of resources and is often caused by cancellation of electively booked operations and by a delay in turn over time.[5,6] Delays are mostly caused by hospital related issues and are multifactorial.[7] Cancellations can be classified under medical reasons, patient related factors and administrative factors.[8]

1.5 EFFECT ON PATIENTS

Increased waiting time for surgery can leads to deterioration of a patient's health, prolonged hospitalization, anxiety, inconvenience, staff frustration and increased costs.[5] Delay in performing Casearean sections can lead to foetal morbidity and mortality.

2 AIM

The aim of this study is to determine if theatre time is being used appropriately in the obstetric theatre at Pelonomi Hospital. The primary objectives will be to determine the amount of time the theatre is not in use during working hours versus after hours, and to determine, if an elective case was done after hours, if there was time available during working hours during which it could have been done.

3 METHODOLOGY

3.1 Study design

This will be a retrospective audit.

3.2 Sample

3.2.1 *Inclusion criteria*

All procedures done in the obstetric theatre at Pelonomi Hospital (emergency and non-emergency procedures) from 7.30 am, 1st January 2019 to midnight, 30 June 2019.

3.2.2 *Exclusion criteria*

Incomplete and illegible records.

3.3 Measurement

The obstetric theatre at Pelonomi Hospital has a theatre register. For the purpose of this study, theatre time used will be defined as from the start time to the end time of anaesthesia for each case, as this data is routinely recorded in the theatre register for every procedure done in the obstetric theatre. This is the data that will be collected from this theatre register and recorded by the researcher on a data collection form (Appendix 1), for each case.

The information indicated in this register also includes the type of procedure done, and if it was an elective or emergency case. This information will also be recorded by the researcher on the data collection form, for each case.

According to Dr Turton, Head of Department of Anaesthesia, the obstetric theatre working hours is defined as between 07.30 and 17.00h, Monday to Friday, except public holidays and weekends. After hours is defined as all other times.

If there was a time period of 90 minutes or more, between cases during working hours, then this will be considered by the researcher as sufficient time to have performed an elective case, if it was subsequently postponed and done after hours.

3.4 Pilot study

The researcher will capture data for the 48 hour time period from 07.30h, 4th December to midnight on 5th December 2018, in order to determine if any changes need to be made to the protocol and data collection form. This data will not be used for the study.

4 ANALYSIS

Descriptive statistics namely means and standard deviations or medians and percentiles will be calculated for continuous data. Frequencies and percentages will be calculated for categorical data. The analysis will be done by the Department of Biostatistics, University of the Free State.

5 IMPLEMENTATION OF FINDINGS

The data will be used for the researcher's MMed research thesis. The results will be made available to the Departments of Obstetrics and Gynaecology, and Anaesthesiology. The results may be presented at conferences and published in peer reviewed medical journals.

6 TIME SCHEDULE

Protocol submission	9 October 2019
Pilot Study	2 January 2019
Data collection	28, 29, 31 January 2019
Final submission	1 November 2020

7 BUDGET

The cost of this study will be minimal and paid by the researcher himself.

Stationery	R300
Travel to Pelonomi Hospital *(It is estimated that less than one full 70L Diesel tank will be used. Current diesel price is R16,17)*	R1100
Total costs	**R1400**

8 ETHICAL ASPECTS

The study will commence after approval by the Health Sciences Research and Ethics Committee of the University of the Free State, the Free State Department of Health, and the Head of Department of Anaesthesiology.

The privacy of the patients in these cases will be protected by not writing their names on the data collecting form. The case record forms will be stored in a locked container.

Captured data will be stored on the researcher's laptop and access is protected with a password only known to the researcher.

9 REFERENCES

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6. Mesmar M, Shatnawi NJ, Faori I, Khader YA. Reasons for cancellation of elective operations at a major teaching referral hospital in Jordan. East Mediterr Heal J. 2018;17(08):651-655. doi:10.26719/2011.17.8.651
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10 DATA CAPTURE FORM (APPENDIX 1)

1	**Rank order of patient for this 24h time period****									
2	**Procedure (tick one)**									
	C Section									
	ERPC									
	Suture perineal tear									
	Other (describe)									
3	**Urgency of case (tick one)**									
	Emergency									
	Elective*									
	Not documented									
4	**Time procedure started (use 24h clock)**									
5	**Time procedure finished (use 24hr clock)**									
6	**Started in day time (07:30 -17:00)? (tick one)**									
	Yes									
	No*									
7	***If No, AND this was an ELECTIVE case, was there ≥90 minutes during the day (07:30-17:00) that the theatre was not being utilised? (yes/no)**									
8	**Is this day a Public Holiday or a Weekend? (yes/no)**									
9	**Overall time theatre not being utilised in this 24 hour period**									
	From 7:30-17:00									
	From 17:00-07:30									

**as entered in theatre book i.e. 1st, 2nd, 3rd etc

APPENDIX E

DATA COLLECTION INSTRUMENT

DATA CAPTURE FORM

1	**Rank order of patient for this 24h time period****									
2	**Procedure (tick one)**									
	C Section									
	ERPC									
	Suture perineal tear									
	Other (describe)									
3	**Urgency of case (tick one)**									
	Emergency									
	Elective*									
	Not documented									
4	**Time procedure started (use 24h clock)**									
5	**Time procedure finished (use 24hr clock)**									
6	**Started in day time (07:30 -17:00)? (tick one)**									
	Yes									
	No*									
7	***If No, AND this was an ELECTIVE case, was there ≥90 minutes during the day (07:30-17:00) that the theatre was not being utilised? (yes/no)**									
8	**Is this day a Public Holiday or a Weekend? (yes/no)**									
9	**Overall time theatre not being utilised in this 24 hour period**									
	From 7:30-17:00									
	From 17:00-07:30									

**as entered in theatre book i.e. 1st, 2nd, 3rd etc

APPENDIX F

AUTHOR GUIDELINES SOUTH AFRICAN MEDICAL JOURNAL

South African Medical Journal

2016 new guidelines

Author Guidelines

The *SAMJ* has launched a new submission and tracking system. Authors will be required to register a profile on the Editorial Manager platform in order to submit a manuscript.
To submit a manuscript, please proceed to the *SAMJ* Editorial Manager website:
www.editorialmanager.com/samj
To access and submit an article already in production, please see the guidelines here.

Please take the time to familiarise yourself with the policies and processes below. If you still have any questions, please do not hesitate to ask our editorial staff (tel.: +27 (0)21 532 1281, email: submissions@hmpg.co.za).

SAMJ Policies

Type of articles considered by the SAMJ

The *SAMJ* will no longer limit the articles accepted to those that have 'general medical content', but is intending to capture the spectrum of medical and health sciences, grouped by relevance to the country's burdens of disease. This content will include research in the social sciences and economics that is relevant to the medical issues around our burden of disease. Please see 'A new vision for the *SAMJ* – and a call for papers' for a full discussion of the new directions for the *SAMJ*.

*Contact claudian@hmpg.co.za for information on submitting ad hoc/commissioned supplements, including guidelines, conference/congress abstracts, Festschrifts, etc.

Authorship

Named authors must consent to publication. Authorship should be based on: (*i*) substantial contribution to conceptualisation, design, analysis and interpretation of data; (*ii*) drafting or critical revision of important scientific content; or (*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)

If authors' names are added or deleted after submission of an article, or the order of the names is changed, all authors must agree to this in writing.

Please note that co-authors will be requested to verify their contribution upon submission. Non-verification may lead to delays in the processing of submissions.

Conflicts of interest

Conflicts of interest can derive from any kind of relationship or association that may influence authors' or reviewers' opinions about the subject matter of a paper. The existence of a conflict – whether actual, perceived or potential – does not preclude publication of an article. However, we aim to ensure that, in such cases, readers have all the information they need to enable them to make an informed assessment about a publication's message and conclusions. We require that both authors and reviewers declare all sources of support for their research, any personal or financial relationships (including honoraria, speaking fees, gifts received, etc) with relevant individuals or organisations connected to the topic of the paper, and any association with a product or subject that may constitute a real, perceived or potential conflict of interest. If you are unsure whether a specific relationship constitutes a conflict, please contact the editorial team for advice. If a conflict remains undisclosed and is later brought to the attention of the editorial team, it will be considered a serious issue prompting an investigation with the possibility of retraction.

Research ethics committee approval

Authors must provide evidence of Research Ethics Committee approval of the research where relevant. Ensure the correct, full ethics committee name and reference number is included in the manuscript.

If the study was carried out using data from provincial healthcare facilities, or required active data collection through facility visits or staff interviews, approval should be sought from the relevant provincial authorities. For South African authors, please refer to the guidelines for submission to the National Health Research Database. Research involving human subjects must be conducted according to the principles outlined in the Declaration of Helsinki. Please refer to the National Department of Health's guideline on Ethics in Health research: principles, processes and structures to ensure that the appropriate requirements for conducting research have been met, and that the HPCSA's General Ethical Guidelines for Health Researchers have been adhered to.

Clinical trials

Since 1st December 2005, all clinical trials conducted in South Africa have been required to be registered in the South African National Clinical Trials Register. The *SAMJ* therefore requires that clinical trials be registered in the relevant public trials registry at or before the time of first patient enrollment as a condition for publication. The trial registry name and registration number must be included in the manuscript.

Protection of rights to privacy

Patient

Information that would enable identification of individual patients 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) has given informed written consent for publication and distribution. We further recommend that the published article is disseminated not only to the involved researchers but also to the patients/participants from

whom the data was drawn. Refer to Protection of Research Participants. The signed consent form should be submitted with the manuscript to enable verification by the editorial team.

Other individuals

Any individual who is identifiable in an image must provide written agreement that the image may be used in that context in the *SAMJ*.

Copyright notice

Copyright remains in the Author's name. The work is licensed under a Creative Commons Attribution - Noncommercial Works License. Authors are required to complete and sign an Author Agreement form that outlines Author and Publisher rights and terms of publication. The **Author Agreement form** should be uploaded along with other submissions files and any submission will be considered incomplete without it.

Material submitted for publication in the *SAMJ* is accepted provided it has not been published or submitted for publication elsewhere. Please inform the editorial team if the main findings of your paper have been presented at a conference and published in abstract form, to avoid copyright infringement. The *SAMJ* does not hold itself responsible for statements made by the authors.

Previously published images

If an image/figure has been previously published, permission to reproduce or alter it must be obtained by the authors from the original publisher and the figure legend must give full credit to the original source. This credit should be accompanied by a letter indicating that permission to reproduce the image has been granted to the author/s. This letter should be uploaded as a supplementary file during submission.

Privacy statement

The *SAMJ* is committed to protecting the privacy of its website and submission system users. The names, personal particulars and email addresses entered in the website or submission system will not be made available to third parties without the user's permission or due process. By registering to use the website or submission system, users consent to receive communication from the *SAMJ* or its publisher HMPG on matters relating to the journal or associated publications. Queries with regard to privacy may be directed to publishing@hmpg.co.za.

Ethnic/race classification

Use of racial or ethnicity classifications in research is fraught with problems. If you choose to use a research design that involves classification of participants based on race or ethnicity, or discuss issues with reference to such classifications, please ensure that you include a detailed rationale for doing so, ensure that the categories you describe are carefully defined, and that socioeconomic, cultural and lifestyle variables that may underlie perceived racial disparities are appropriately controlled for. Please also clearly specify whether race or ethnicity is classified as reported by the patient (self-identifying) or as perceived by the

investigators. Please note that is not appropriate to use self-reported or investigator-assigned racial or ethnic categories for genetic studies.

Continuing Professional Development (CPD)

SAMJ is an HPCSA-accredited service provider of CPD materials. Principal authors can earn up to 15 CPD continuing education units (CEUs) for publishing an article; co-authors are eligible to earn up to 5 CEUs; and reviewers of articles can earn 3 CEUs. Each month, *SAMJ* also publishes a CPD-accredited questionnaire relating to the academic content of the journal. Successful completion of the questionnaire with a pass rate of 70% will earn the reader 3 CEUs. Administration of our CPD programme is managed by Medical Practice Consulting. To complete questionnaires and obtain certificates, please visit MRP Consulting

Manuscript preparation

Preparing an article for anonymous review

To ensure a fair and unbiased review process, all submissions are to include an anonymised version of the manuscript. The exceptions to this are Correspondence, Book reviews and Obituary submissions.

Submitting a manuscript that needs additional blinding can slow down your review process, so please be sure to follow these simple guidelines as much as possible:

- An anonymous version should not contain any author, affiliation or particular institutional details that will enable identification.
- Please remove title page, acknowledgements, contact details, funding grants to a named person, and any running headers of author names.
- Mask self-citations by referring to your own work in third person.

General article format/layout

Accepted manuscripts that are not in the correct format specified in these guidelines will be returned to the author(s) for correction, which will delay publication.

General:

- Manuscripts must be written in UK English.
- The manuscript must be in Microsoft Word or RTF document format. Text must be single-spaced, in 12-point Times New Roman font, and contain no unnecessary formatting (such as text in boxes).
- Please make your article concise, even if it is below the word limit.
- Qualifications, ***full*** affiliation (department, school/faculty, institution, city, country) and contact details of ALL authors must be provided in the manuscript and in the online submission process.
- Abbreviations should be spelt out when first used and thereafter used consistently, e.g. 'intravenous (IV)' or 'Department of Health (DoH)'.
- Scientific measurements must be expressed in SI units except: blood pressure (mmHg) and haemoglobin (g/dL).
- Litres is denoted with an uppercase L e.g. 'mL' for millilitres).

- Units should be preceded by a space (except for % and ºC), e.g. '40 kg' and '20 cm' but '50%' and '19ºC'.
- Please be sure to insert proper symbols e.g. µ not u for micro, a not a for alpha, b not B for beta, etc.
- 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.
- If you wish material to be in a box, simply indicate this in the text. You may use the table format –this is the *only* exception. Please DO NOT use fill, format lines and so on.

Preparation notes by article type

Research
Guideline word limit: 4 000 words

Research articles describe the background, methods, results and conclusions of an original research study. The article should contain the following sections: introduction, methods, results, discussion and conclusion, and should include a structured abstract (see below). The introduction should be concise – no more than three paragraphs – on the background to the research question, and must include references to other relevant published studies that clearly lay out the rationale for conducting the study. Some common reasons for conducting a study are: to fill a gap in the literature, a logical extension of previous work, or to answer an important clinical question. If other papers related to the same study have been published previously, please make sure to refer to them specifically. Describe the study methods in as much detail as possible so that others would be able to replicate the study should they need to. Results should describe the study sample as well as the findings from the study itself, but all interpretation of findings must be kept in the discussion section, which should consider primary outcomes first before any secondary or tertiary findings or post-hoc analyses. The conclusion should briefly summarise the main message of the paper and provide recommendations for further study.

Select figures and tables for your paper carefully and sparingly. Use only those figures that provided added value to the paper, over and above what is written in the text.
Do not replicate data in tables and in text .

Structured abstract
- This should be 250-400 words, with the following recommended headings:
  - **Background:** why the study is being done and how it relates to other published work.
  - **Objectives:** what the study intends to find out
  - **Methods:** must include study design, number of participants, description of the intervention, primary and secondary outcomes, any specific analyses that were done on the data.

- **Results:** first sentence must be brief population and sample description; outline the results according to the methods described. Primary outcomes must be described first, even if they are not the most significant findings of the study.
- **Conclusion:** must be supported by the data, include recommendations for further study/actions.

- Please ensure that the structured abstract is complete, accurate and clear and has been approved by all authors.
- Do not include any references in the abstracts.

Here is an example of a good abstract.

Main article

All articles are to include the following main sections: Introduction/Background, Methods, Results, Discussion, Conclusions.

The following are additional heading or section options that may appear within these:

- Objectives (within Introduction/Background): a clear statement of the main aim of the study and the major hypothesis tested or research question posed
- Design (within Methods): including factors such as prospective, randomisation, blinding, placebo control, case control, crossover, criterion standards for diagnostic tests, etc.
- Setting (within Methods): level of care, e.g. primary, secondary, number of participating centres.
- Participants (instead of patients or subjects; within Methods): numbers entering and completing the study, sex, age and any other biological, behavioural, social or cultural factors (e.g. smoking status, socioeconomic group, educational attainment, co-existing disease indicators, etc)that may have an impact on the study results. Clearly define how participants were enrolled, and describe selection and exclusion criteria.
- Interventions (within Methods): what, how, when and for how long. Typically for randomised controlled trials, crossover trials, and before and after studies.
- Main outcome measures (within Methods): those as planned in the protocol, and those ultimately measured. Explain differences, if any.

Results

- Start with description of the population and sample. Include key characteristics of comparison groups.
- Main results with (for quantitative studies) 95% confidence intervals and, where appropriate, the exact level of statistical significance and the number need to treat/harm. Whenever possible, state absolute rather than relative risks.
- Do not replicate data in tables and in text.
- If presenting mean and standard deviations, specify this clearly. Our house style is to present this as follows:
- E.g.: The mean (SD) birth weight was 2 500 (1 210) g. Do not use the ± symbol for mean (SD).

- Leave interpretation to the Discussion section. The Results section should just report the findings as per the Methods section.

Discussion
Please ensure that the discussion is concise and follows this overall structure – sub-headings are not needed:
- Statement of principal findings
- Strengths and weaknesses of the study
- Contribution to the body of knowledge
- Strengths and weaknesses in relation to other studies
- The meaning of the study – e.g. what this study means to clinicians and policymakers
- Unanswered questions and recommendations for future research

Conclusions
This may be the only section readers look at, therefore write it carefully. Include primary conclusions and their implications, suggesting areas for further research if appropriate. Do not go beyond the data in the article.

Editorials
Guideline word limit: 1 000 words

These opinion or comment articles are usually commissioned but we are happy to consider and peer review unsolicited editorials. Editorials should be accessible and interesting to readers without specialist knowledge of the subject under discussion and should have an element of topicality (why is a comment on this issue relevant now?) There should be a clear message to the piece, supported by evidence.
Please make clear the type of evidence that supports each key statement, e.g.:
- expert opinion
- personal clinical experience
- observational studies
- trials
- systematic reviews.

CME
CME is intended to provide readers with practical, up-to-date information on medical and related matters. It is aimed at those who are not specialists in the field.
From January 2016, all CME articles will be printed in full in the *SAMJ*. Please try to adhere strictly to the guidelines on word count as we have a page limit for the print issue of the *SAMJ*. We reserve the right to place some tables and reference lists online if this is necessary for space.
In practice, this means that each CME topic usually covers two issues of the print issue of the *SAMJ*.

The guest editor, in consultation with the editor, is responsible for convening a team of authors, deciding on the subjects to be covered and for reviewing the manuscripts submitted. The suggestion is for 4 - 5 articles, although there is some room for flexibility contingent on discussions with the editor.

For queries about these guidelines please feel free to contact the CME editor, Dr Bridget Farham, by email (ugqirha@iafrica.com) or telephone (+27 (0)21 789 2331).

Review process
The guest editor reviews the articles and returns them to the CME editor for review and final approval.

Guest editorials
Guideline word limit: 1 000 words
- Include the guest editor's personal details (qualifications, positions, affiliation, e-mail address, and a short personal profile (50words)).
- If possible, include a photograph of the author(s) at high enough resolution for print. It is preferable to provide two guest editorials, one for each issue, so that the content of the articles in each issue is covered.

Articles
Guideline word limit: 2 000 - 3 000 words
- Each article requires an abstract of ±200 words.
- The editor reserves the right to shorten articles but will send a substantially shortened article back for author approval.

Personal details
Please supply: Your qualifications, position and affiliations and MP number (used for CPD points); Address, telephone number and fax number, and your e-mail address; and a short personal profile (50 words)and a few words about your current fields of interest.

In Practice
Guideline word limit: 2 000 - 3 000words

This section includes articles that would previously have been accepted into the Forum section, and case reports.
In practice articles are those that draw attention to specific issues of clinical, economic or political interest regarding medicine and healthcare in southern Africa. They are assigned to a topic:

- Case report
- Clinical practice
- Clinical alert
- Issues in medicine

- Issues in public health
- Healthcare delivery
- Consensus/Position statement
- Medicine and the environment
- Medicine and the law
- Cochrane corner

An In Practice article should follow the following format – sub-headings are not necessary, but may be used for clarity:

- Author affiliations and qualifications: to be the same as for Research. Provide all authors' names and initials, qualifications and full affiliations, and corresponding author.
- Short abstract: does not need to be structured, but should capture the essential features of the article
- Introduction: the reason for the article and the issue being addressed
- Recent research, discussion, local policy around the issue – include your own research where appropriate
- All statements should be referenced and, if opinion only, this should be stated
- Discussion: how this article adds to the discussion around a particular topic
- If a clinical practice or policy point is at issue, this needs to be emphasised, using a box with highlights if appropriate.

Essentially In practice is an opportunity for a more discursive approach to topics of clinical, economic or political importance in southern African health systems. It is not an opportunity to put forward unsubstantiated opinions!

Case reports

The *SAMJ* has recently started to accept case reports. The cases must come from Africa, preferably southern Africa unless the condition is common to all African countries, and must be either a completely new description of a clinical condition or result (use Google!) or a case that highlights important practice or management issues.

Please use the following format for case reports:

- Title of case: do not include the words 'a case report' in the title
- Summary/abstract: up to 150 words summarising the case presentation and outcome
- Background: why is this case important and why did you write it up?
- Case presentation: presenting features, medical, social, family history as appropriate
- Case management: should be according to best practice, and if not, please explain why
- Investigations, if relevant: save space by simply saying 'normal' if, for example, renal function was completely normal, rather than listing normal results, highlight the abnormal – or indeed the normal if this is clinically significant
- Differential diagnosis, if relevant
- Treatment, if relevant
- Outcome and follow-up
- Discussion – a VERY BRIEF review of similar published cases

- Teaching points: 3 - 5 bullet points
- References: as per the *SAMJ* house style
- Tables and figures: keep to a minimum. Use clinical images where relevant – we need hi-res versions for print, and identifiable persons must have a consent form
- Patient consent: please include a statement about patient consent to a written case report. This should be uploaded as a supplementary file.

Clinical trials

Guideline word limit: 4000 words

As per the recommendations published by the International Committee of Medical Journal Editors (ICMJE), clinical trial research is any research that assigns individuals to an intervention, with or without a concurrent comparison/control group to study the cause-and-effect relationship between the intervention and health outcomes. All clinical trials should be registered with the appropriate national clinical trial registry (or any international primary register, if relevant), and the trial registration number should be cited at the end of the abstract. Since 1st December 2005, all clinical trials conducted in South Africa have been required to be registered in the South African National Clinical Trials Register. The *SAMJ* therefore requires that clinical trials be registered in the relevant public trials registry at or before the time of first patient enrollment as a condition for publication. The trial registry name and registration number must be included in the manuscript.

Please refer to the general guidelines for all papers at the top of this article for additional requirements with respect to ethics approval, funding, author contributions, etc. The format of original research articles should be followed for reporting of clinical trial results.

Review articles

Guideline word limit: 4 000 words

These are welcome, but should be either commissioned or discussed with the Editor before submission. A review article should provide a clear, up-to-date account of the topic and be aimed at non-specialist hospital doctors and general practitioners.

Please ensure that your article includes:

- Abstract: unstructured, of about 100-150 words, explaining the review and why it is important
- Methods: Outline the sources and selection methods, including search strategy and keywords used for identifying references from online bibliographic databases. Discuss the quality of evidence.
- When writing: clarify the evidence you used for key statements and the strength of the evidence. Do not present statements or opinions without such evidence, or if you have to, say that there is little or no evidence and that this is opinion. Avoid specialist jargon and abbreviations, and provide advice specific to southern Africa.

- Personal details: Please supply your qualifications, position and affiliations and MP number (used for CPD points); address, telephone number and fax number, and your e-mail address; and a short personal profile (50 words) and a few words about your current fields of interest.

Correspondence (Letters to the Editor)
Guideline word limit: 500 words

Letters to the editor should relate either to a paper or article published by the SAMJ or to a topical issue of particular relevance to the journal's readership

- May include only one illustration or table
- Must include a correspondence address.

Book reviews
Guideline word limit: 400 words
Should be about 400 words and must be accompanied by the publication details of the book. Provide a hi-res image of the cover if possible (with permission from the copyright holder).

Obituaries
Guideline word limit: 400 words
Should be offered within the first year of the practitioner's death, and may be accompanied by a photograph.

Guidelines
Guidelines should always be discussed with the Editor prior to submission.

Because of the intensive review process required to ensure Guidelines are independent, evidence-based and free from commercial bias, they are usually published as a supplement to the *SAMJ*, the costs of which must be covered by sponsorship, advertising or payment by the guideline authors/association. We will provide a quote based on the expected length of the guideline and whether it is to appear online only, or in print, which must be accepted by the body putting the guidelines together before submitting the work to the SAMJ.

The Editor reserves the right to determine the scheduling of supplements. Understandably, a delay in publication must be anticipated dependent upon editorial workflow.

All guidelines should be structured according to Agree II.
Please access this website before putting the guidelines together, download the Agree 11 instrument and use this to put the guidelines together.
All submitted guidelines will be sent to the local Agree II appraisal committee for review and must be endorsed by an appropriate body prior to consideration and all conflicts of interest expressed.

A structured abstract not exceeding 400 words (recommended sub-headings: *Background, Recommendations, Conclusion*) is required. Sections and sub-sections must be numbered consecutively (e.g. 1. Introduction; 1.1 Definitions; 2.etc.) and summarised in a Table of Contents.

Illustrations/photos/scans

- If illustrations submitted have been published elsewhere, the author(s) should provide consent to republication obtained from the copyright holder.
- Figures must be numbered in Arabic numerals and referred to in the text e.g. '(Fig. 1)'.
- Each figure must have a caption/legend: Fig. 1. Description (any abbreviations in full).
- All images must be of high enough resolution/quality for print.
- All illustrations (graphs, diagrams, charts, etc.) must be in PDF form.
- Ensure all graph axes are labelled appropriately, with a heading/description and units (as necessary) indicated. Do not include decimal places if not necessary e.g. 0; 1.0; 2.0; 3.0; 4.0 etc.
- Scans/photos showing a specific feature e.g. *Intermediate magnification micrograph of a low malignant potential (LMP) mucinous ovarian tumour. (H&E stain).* –include an arrow to show the tumour.
- Each image must be attached individually as a 'supplementary file' upon submission (not solely embedded in the accompanying manuscript) and named Fig. 1, Fig. 2, etc.

Tables

- Tables should be constructed carefully and simply for intelligible data representation. Unnecessarily complicated tables are strongly discouraged.
- Embed/include each table in the manuscript Word file - do not provide separately as supplementary files.
- Number each table in Arabic numerals (Table 1, Table 2, etc.) and refer to consecutively in the text.
- Tables must be cell-based (i.e. not constructed with text boxes or tabs) and editable.
- Ensure each table has a concise title and column headings, and include units where necessary.
- Footnotes must be indicated with consecutive use of the following symbols: * † ‡ § ¶ || then ** †† ‡‡ etc.

Do not: Use [Enter] within a row to make ‘new rows’:

Rather:
Each row of data must have its own proper row:

Do not: use separate columns for *n* and %:

Rather:
Combine into one column, *n* (%):

Do not: have overlapping categories, e.g.:

Rather:
Use <> symbols or numbers that don't overlap:

References

NB: *Only complete, correctly formatted reference lists in Vancouver style will be accepted. Reference lists must be generated manually and not with the use of reference manager software. Endnotes must* ***not*** *be used.*

- Authors must verify references from original sources.
- Citations should be inserted in the text as superscript numbers between square brackets, e.g. These regulations are endorsed by the World Health Organization,[2] and others.[3,4-6]
- 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 three names should be given followed by et al.
- Volume and issue numbers should be given.
- First and last page, in full, should be given e.g.: 1215-1217 **not** 1215-17.
- Wherever possible, references must be accompanied by a digital object identifier (DOI) link). Authors are encouraged to use the DOI lookup service offered by CrossRef:
  - On the Crossref homepage, paste the article title into the 'Metadata search' box.
  - Look for the correct, matching article in the list of results.
  - Click Actions > Cite
  - Copy the DOI between { }, which will always start with 10.
  - Provide as follows: DOI:10.7196/07294.937.98x

Some examples:

- *Journal references:* Price NC, Jacobs NN, Roberts DA, et al. Importance of asking about glaucoma. Stat Med 1998;289(1):350-355. DOI:10.1000/hgjr.182
- *Book references:* Jeffcoate N. Principles of Gynaecology. 4th ed. London: Butterworth, 1975:96-101.
- *Chapter/section in a book:* Weinstein L, Swartz MN. Pathogenic Properties of Invading Microorganisms. In: Sodeman WA, Sodeman WA, eds. Pathologic Physiology: Mechanisms of Disease. Philadelphia: WB Saunders, 1974:457-472.
- *Internet references:* World Health Organization. The World Health Report 2002 - Reducing Risks, Promoting Healthy Life. Geneva: WHO, 2002. http://www.who.int/whr/2002 (accessed 16 January 2010).
- Legal references
- Government Gazettes:

National Department of Health, South Africa. National Policy for Health Act, 1990 (Act No. 116 of 1990). Free primary health care services. Government Gazette No. 17507:1514. 1996.

In this example, 17507 is the Gazette Number. This is followed by :1514 - this is the notice number in this Gazette.

- Provincial Gazettes:

Gauteng Province, South Africa; Department of Agriculture, Conservation, Environment and Land Affairs. Publication of the Gauteng health care waste management draft regulations. Gauteng Provincial Gazette No. 373:3003, 2003.

- Acts:

South Africa. National Health Act No. 61 of 2003.

- Regulations to an Act:

South Africa. National Health Act of 2003. Regulations: Rendering of clinical forensic medicine services. Government Gazette No. 35099, 2012. (Published under Government Notice R176).

- Bills:

South Africa. Traditional Health Practitioners Bill, No. B66B-2003, 2006.

- Green/white papers:

South Africa. Department of Health Green Paper: National Health Insurance in South Africa. 2011.

- Case law:

Rex v Jopp and Another 1949 (4) SA 11 (N)

Rex v Jopp and Another: Name of the parties concerned

1949: Date of decision (or when the case was heard)

(4): Volume number

SA: SA Law Reports

11: Page or section number

(N): In this case Natal - where the case was heard. Similarly, (C) woud indicate Cape, (G) Gauteng, and so on.

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APPENDIX G

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Chapter 1

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TO WHOM IT MAY CONCERN

I hereby declare that with regard to the following document:

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- I have performed the language editing (grammar, vocabulary and syntax).
- I assisted the author with the technical preparation of the manuscript, including layout and formatting.
- I verified the accuracy of the citations in the list of references.
- Where applicable, I obtained and verified the most recent active uniform resource locator (URL) for internet-based references.

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Date: 8 March 2021