Inter-rater variability between anaesthetists when classifying patients using the American Society of Anesthesiologists Physical Status (ASA-PS) classification system

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Declaration

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

..... (Signature)

Signed at: University of the Witwatersrand. Johannesburg

..... day of ....., 20.....

DEDICATIONS

All praise and thanks to the Almighty.

I would like to dedicate the following:

To my parents, Jalaluddin and Zubeida, for their never-ending encouragement and unwavering support, without them, this would not be possible;

To my fiancé, Muhammad for believing in me

To my siblings (Zakiyya, Ayesha and Abdullah) for keeping the standard set high and always being there.

ABSTRACT

Background

Anaesthetists convey the physical state of patients by use of the American Society of Anaesthesiologists Physical Status classification system (ASA-PS). It is a simple, popular tool with many uses, but not without fault, where variation between anaesthetists when classifying patients exists. To date there is no South African study comparing inter-rater variability between anaesthetists particularly between junior and senior anaesthetists. Our study includes scenarios with patients with Human Immunodeficiency Virus (HIV). A 'modifier' and it's level of acceptance is also proposed.

Method

A questionnaire comprising of two parts was distributed. The first part assessed demographics and attitude towards a proposed "modifier" and the second consisted of ten hypothetical case scenarios which were created to incorporate a wide variety of conditions including Human Immunodeficiency Virus (HIV).

Results

After receiving 134 of the 200 questionnaires distributed, 132 were analysed. There were 93 juniors and 39 seniors. A Cohen's kappa statistic over all the scenarios of 0.23 (fair agreement) was determined. In none of the scenarios was there complete agreement. In each case there was a majority viewpoint shared by both juniors and seniors except Scenario 2. Large ranges were found in scenarios which included pregnant, geriatric and emergency patients.

Conclusion

Results are in keeping with other studies. Inter-rater variability is prevalent despite guidelines being available. A simple modifier such as letter "G" denoting a gravid patient may be acceptable

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LIST OF ABBREVIATIONS

ASA	American Society of Anesthesiologists
APACHE II	Acute Physiology And Chronic Health Evaluation II
ASA-PS	American Society of Anesthesiologists Classification System
BMI	Body Mass Index
CCI	Charleson Co-morbidity Index
CEPOD	Confidential Enquiry into Peri-operative Deaths
E	Emergency classification
HIV	Human Immunodeficiency Virus
GCRI	Goldman Cardiac Risk Index
POSSUM	Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity
RCRI	Revised Cardiac Risk Index
SRS	Surgical Risk Scale
USA	United States of America
WITS	University of the Witwatersrand

SECTION 1: LITERATURE REVIEW

1.1 Introduction

The purpose of this literature review is to discuss the American Society of Anesthesiologists Physical State (ASA-PS) classification system in terms of its history, its role as a classification system, in clinical medicine and non-clinical related uses, comparisons to other tests and inter-rater variability. Inter-rater variability will be discussed in terms of patient and classification system related controversies; as well as factors which may improve it.

1.2 History

In 1941, the American Society of Anesthetists (which later became the American Society of Anesthesiologists (ASA)) asked Drs Saklad, Rovenstine and Taylor to devise a system which would enable standardising, collecting and tabulating statistical data. It is unknown how they set about this task, but they envisioned that uniformity could be achieved, by using set definitions and terms which they outlined as shown directly from the original in Table 1 (1). The authors stated that the proposed classification system should be a method of describing a patients “physical state” and not “operative risk” due to the multiple factors that are involved peri-operatively. With these ideas, the six class system of “physical state” was devised; which would eventually become the American Society of Anesthesiologists Physical Status (ASA-PS) classification system. The initial description of emergency surgery in class 5 and 6 was, “An emergency operation is arbitrarily defined as a surgical procedure which, in the surgeon’s opinion, should be performed without delay.”

Table 1 The first American Society of Anesthetist Physical Status (ASA-PS) classification system as proposed in 1941 (1)

Class	Description	Examples
Class 1	No organic pathology or patients in whom pathological process is localized and does not cause any systemic disturbances or abnormality	Fractures unless shock, blood loss, emboli or systemic signs of injury are present, congenital deformities unless they are causing systemic disturbances. Infections that are localized and do not cause fever, many osseous deformities and uncomplicated hernias. Any type of operation may fall into this class
Class 2	A moderate but definite systemic disturbance caused either by the condition that is to be treated by surgical intervention or which is caused by other existing pathological processes	Mild diabetes, functional capacity I or IIa, psychotic patients unable to care for themselves, mild acidosis, moderate anaemia, septic or acute pharyngitis, chronic sinusitis with postnasal discharge, nontoxic thyroadeoma causing partial respiratory obstruction mild thyrotoxicosis, pulmonary tuberculosis without other symptoms, minor or superficial infections that cause a systemic reaction
Class 3	Severe systemic disturbances from any cause or causes. It is not possible to state an absolute measure of severity as this is a matter of clinical judgment	Complicated or severe diabetes, functional capacity 11b, combinations of heart disease or respiratory disease that impair normal function severely, complete intestinal obstruction long enough to cause serious physiological disturbances, pulmonary tuberculosis which has reduced vital capacity causing dyspnoea or tachycardia, severe trauma from accident resulting in shock, pulmonary abscess
Class 4	Extreme systemic disorders which have already become an eminent threat to life regardless of the type of treatment. Because of their duration or nature there has already been damage to the organism which is irreversible. This class includes patients that are in extremely poor physical state. There	Functional capacity III (cardiac decompensation), severe trauma with irreparable damage, complete intestinal obstruction of long duration in a patient who is already debilitated. A combination of cardiovascular-renal disease with marked renal impairment. Patients who must have anaesthesia to arrest a

	may not much be occasion to use this classification, but it should serve a purpose in separating the patient in very poor condition from others	secondary haemorrhage where the patient is in poor condition associated with marked blood loss”
Class 5	Emergencies otherwise graded as class1 or class 2	
Class 6	Emergencies otherwise graded as class3 or class 4	

It is unknown if any changes were made until 1961 when Dripps et al (2) proposed improvements. These were ratified in 1963 (3) by the 1962 House of Delegates of the American Society of Anesthesiologists (ASA) as seen in Table 2. The last two classes which had previously been assigned to designate emergency cases were removed. A letter “E” was adopted in order to represent any emergency case across the remaining classes, where and Emergency (E) is being defined as “existing when a delay in treatment of patient would lead to a significant increase in threat to life or body part.” Further, compared to the original version, no examples were included and an additional class 5 was added that described as the “the moribund patient not expected to survive 24 hours with or without operation” (3).

Table 2 Classification of the American Society of Anesthesiolgists Physical Status (ASA-PS) classification system as amended in 1962 (3)

Class	Description
1	A normal healthy patient
2	A patient with mild systemic disease
3	A patient with severe systemic disease that limits activity but is not incapacitating
4	A patient with an incapacitating systemic disease that is a constant threat to life
5	A moribund patient not expected to survive 24 hours with or without operation

In 1984 two more modifications were established by the ASA. classification 6 was added being “a declared brain dead donor patient whose organs are being removed” and Class 5 was amended to a moribund patient who is not expected to survive 24 hours without an operation (4).

Although the ASA-PS classification system was a reliable test; there was a lack of uniformity. In an attempt to rectify this, examples were added by the House of

Delegates of the American Society of Anesthesiologists (ASA) in October 2014 and this was ratified in June 2015 June 2015 (5). This is shown in Table 3 which is taken directly from the ASA website. It is advised that examples were provided to give context but not to detract from medical judgment.

Table 3 Classification of the American Society of Anesthesiologists Physical Status (ASA-PS) classification system as amended in 2014 (5)

ASA-PS classification	Definition	Examples included but not limited to
ASA I	Normal, healthy patient	Healthy, non-smoking, non or minimal alcohol use
ASA II	A patient with mild systemic disease	Mild disease only without substantial functional limitations. Examples include (but not limited to) social alcohol drinker, pregnancy, obesity (30<BMI<40)[Body Mass Index], well controlled HT/DM [Hypertension/ Diabetes Mellitus], mild lung disease
ASA III	A patient with severe systemic disease	Substantive functional limitations; One or more moderate to severe diseases. Examples include (but not limited to): poorly controlled DM or HTN, COPD [Chronic Obstructive Pulmonary Disease], morbid obesity (BMI ≥40), active hepatitis, alcohol dependence or abuse, implanted pacemaker, moderate reduction of ejection fraction, ESRD [End Stage Renal Disease] undergoing regularly scheduled dialysis, premature infant PCA [Post conceptual Age] < 60 weeks, history (>3 months) of MI [Myocardial infarct], CVA [Cerebrovascular Accident], TIA [transient ischemic attack], or CAD [coronary artery device]/stents
ASA IV	A patient with sever systemic disease that is a constant threat to life	Examples include (but not limited to): Recent (< 3 months) history of MI, CVA, TIA or CAD/stents, ongoing cardiac ischemia or severe valve dysfunction, severe reduction of ejection fraction, sepsis, DIC [Disseminated Intravascular Coagulopathy], ARD [Acute Renal Disease] or ESRD not undergoing regularly scheduled dialysis
ASA V	A moribund patient who is not expected to survive without the operation	Examples include (but not limited to): Ruptured abdominal/thoracic aneurysm, massive trauma, intracranial bleed with mass effect, ischeamic bowel in the face of significant cardiac pathology or multiple organ/system dysfunction
ASA VI	A declared brain-dead patient whose organs are being removed for donor purposes	

Despite the classification being assigned in Roman numerals, it has been observed in clinical practice and in studies mentioned in the literature review, that Arabic numerals were used. This is likely for ease of discussion and in order to maintain consistency; thus Arabic numerals will also be used. A discussion now follows as to whether the ASA-PS classification system fulfils the criteria for a good classification system.

1.3 Classification systems

The ASA-PS classification system will be discussed in terms of its use as a classification system and criteria will be outlined in order to determine if it is an adequate classification system.

1.3.1 Uses of a classification system

Several classification systems exist in the healthcare setting and have many uses which may include:

‘‘• establishing a uniform and standard system for healthcare reimbursement
• providing treatment outcome data for indexing
• determining, collecting, and reporting statistical data
• maintaining a database for clinical, administrative, demographic and statistical data
• monitoring of fraud, abuse, and other compliance and regulatory issues
• supporting quality and performance efforts”(6).

The ASA-PS classification meets many of the above uses. It was originally designed to collect data for statistical purposes. Anaesthetists use the ASA-PS classification to describe their patients’ physical status for both record keeping and as a communication tool. As hospitals become more aware of cost saving, the ASA-PS classification has been used by health authorities to determine distribution of resources and compare performance variables (7). The ASA-PS classification is also used to determine financial remuneration, providing treatment, allocation of resources (many hospitals allow non-anaesthesia healthcare providers to provide intravenous sedation for patients ASA-PS classification 1 and 2) and predicting peri-operative risk etc.

1.3.2 Evaluating a classification system

A good classification system should meet some criteria as outlined by De Groot (8) who developed a framework for evaluating patient classification systems. He describes six variables: validity and reliability, simplicity and /efficiency, utility, objectivity and acceptability. The ASA-PS classification system will be discussed, using these variables.

Validity and reliability: Consistent demonstration of moderate predictive validity supports the ASA-PS classification system use as a component of risk adjustment models for comparing surgical outcomes across hospitals (9, 10). Reliability is the degree of consistency with which a tool measures what it has been designed to measure. This means that a measuring instrument applied to different groups under differing circumstances should produce similar results. This however is not the case with the ASA-PS classification system. Equivalence (inter-rater reliability) is where two raters test the same variable. Inter-rater reliability has been questioned in many studies (11-13)

Simplicity/ efficiency: most risk assessments are time consuming and require information that is readily not available. The ASA-PS classification system can be rapidly applied even without complicated information and is thus simple and fast (14).

Utility: it is used extensively worldwide even extending to non-anaesthesia uses such as in policy making and audit tools (15).

Objectivity: the biggest drawback of the ASA-PS classification system is its subjectivity discussed later.

Acceptability: It can be gauged that the wide usage of the ASA-PS classification system suggests acceptability; for example as a pre-operative measure of physical state or predictor of surgical outcome (16).

The ASA-PS classification system does fulfil some criteria outlined by De Groot for patient classification systems, but it also possesses certain limitations such as inter-rater variability which will be discussed later.

The ASA-PS classification system has many uses in clinical and non-clinical. In clinical medicine it is an important prognostic metric of post-operative outcomes which will now be discussed.

1.4 ASA-PS classification as a predictor of peri-operative outcome

The ability to predict post-operative complications is invaluable to the decision making process of all doctors involved in the peri-operative period (anaesthesiologist, surgeons, urologists, oncologist etc.) and their patients, with both clinical implications and economic considerations. Despite Saklad (1) stating that the classification system should not be used to prognosticate, it has established itself as the most widely used risk assessment classification. Other forms of risk assessment have been attempted across surgical specialities, where studies have used predictors such as experience (registrar versus consultant), obesity and age to quantify the risk of peri-operative complications, but have had varying degrees of success (9).

Prior to 1996, several retrospective studies and prospective studies had been done to correlate ASA-PS classification and peri-operative mortality. The prospective studies were either too small or focused on anaesthetic complications only. In 1996 Wolters et al (17) in Germany conducted a prospective study correlating ASA-PS classification with many peri-operative risk factors, which included operation duration, intra-operative blood loss, duration of intensive care stay etc. ASA-PS classification was also compared with post-operative complications and mortality. The higher the ASA-PS classification, the higher the risk of a post-operative complication with significant correlation ($p<0,05$) shown in ASA-PS classification 3 and 4 with odds ratios of 2,2 and 4,2 respectively compared to ASA-PS class ifcation1 (a ASA-PS classification 4 patient had a 4.36 higher risk of developing a complication over an ASA-PS classification 1). Despite a limitation being that it was univariate analysis trial, ASA-PS classification system became known as a predictor of post-operative outcome.

This was shown more conclusively in a large multivariate analysis trial conducted by Hackett et al (9) in April 2015 in Chicago. This study analysed 2 297 629 multi-institutional, multi-surgical cases and found with increasing ASA-PS classes, the

odds ratio for a complication or mortality also increased from 2, 05 to 63,25 ($p<0,001$). Even when other co-morbidities were eliminated for analysis; it was an independent predictive factor. The surgical department thus concluded it was a valuable prognostic metric for post-operative complications.

In Lundgren's (18) assessment of peri-operative deaths in 2 major academic hospitals in 2011 in Johannesburg, ASA-PS classification of patients was looked at as a possible risk factor of clinical importance to identify variables affecting mortality. The higher the ASA-PS classification assigned, the higher the likelihood of mortality. Higher mortalities were also found with trainees or junior doctors. In this study an important recommendation made by the United Kingdom Confidential Enquiry into Peri-operative Deaths (CEPOD) in 1987 was highlighted. The recommendation was that an ASA-PS classification 4 or 5 patient should only undergo an operation by a specialist or senior registrar or a trainee in direct consultation with a specialist for both anaesthetists and surgeons. Therefore, the ASA-PS classification is not only an important variable in predicting mortality; in order to prevent mortality an assessment of ASA-PS class would ensure the appropriate doctor involved (specialist).

The ASA-PS classification system has been proven in both univariate and large multivariate studies to be a valid prognosticator of post-operative outcome. This is important so that strategies can be implemented to prevent post-operative morbidity and mortality i.e. senior anaesthetist involvement when necessary. The ASA-PS classification system can also be used to avoid risky surgical interventions by adequately counselling patients and their families and this reduces the economic burden.

Being able to predict an outcome has importance in stratifying a disease and even possibly limiting the necessity for surgery. A study conducted by Kore et al (19) in the United Kingdom in 2000 aimed to asses if ASA-PS classification could predict good prognosis after a transurethral resection of the bladder (TURP) procedure in patients with benign prostatic hypertrophy. Previously factors such as age, renal function, acute and chronic urinary retention, bladder stone and weight of prostrate had been considered which had poor correlation, but it was demonstrated ASA-PS classification had a better correlation with treatment outcome in TURP by giving an indication for the global state of a patient's physical status.

The ability to predict post-operative complications using ASA-PS classification system not only reduces surgical burden, but can be utilised in patient and family counselling for high risk procedures. For example, patients requiring renal surgery may have multiple co-morbidities and may want to know the risk of post-operative complications. This may impact their decision to proceed. Han et al (20) conducted a study in 2004 in California, where the researchers set out to analyse this risk and they found that with increasing ASA-PS classification, nephrectomies could still be safely performed.

High risk patients are also monitored more intensely and require more workup pre-operatively. So by assessing ASA-PS classification adequately pre-operatively, and the necessary workup being completed for such a high risk patient, the economic burden could be reduced. Curatolo in 2017 (21) found that when patients were assigned pre-operative ASA-PS classifications by non-anaesthetists (surgeons), they were often lower and this lead to delays in operations, a high likelihood of case cancellations and more finances spent on pre-operative testing.

The ASA- PS classification is a valid predictive tool where a study by Sankar et al (10) conducted in Canada in 2014, assessed construct, concurrent and predictive validity with regards to ASA-PS classification. They did this by an anaesthesiologist assigning an ASA-PS classification to a patient attending a pre-operative clinic a while before the surgical procedure. A second ASA-PS classification was assigned on the day of the procedure by the attending anaesthesiologist and these 2 values were then compared (the result not being blinded with the second rater having access to clinic classification). With regards to predictive validity; when given an ASA-PS classification in an outpatient clinic a while before the surgery, complications such as postoperative mortality and cardiac complications could still be predicted with moderate ability.

The ASA-PS classification has gained importance as a valid prognostic metric on its own and will now be discussed in comparison and in conjunction with other patient scoring systems.

1.5 ASA-PS classification and other patient scoring systems

Other known patient scoring systems used to assess severity of a patient's condition includes the Acute Physiology And Chronic Health Evaluation II (APACHE II), Physiological and Operative Severity Score for the enUmeration of Mortality and Morbidity (POSSUM), Charleson Co-morbidity Index (CCI), Surgical Risk Scale (SRS), Lee's Revised Cardiac Risk Index (RCRI) and Goldman Cardiac Risk Index (GCRI) amongst others.

Prause et al (22) in Austria in 2007 conducted a study comparing ASA-PS classification to GCRI in order to predict peri-operative mortality. Both indices were shown to correlate with peri-operative mortality, but ASA-PS classification correlated more. The GCRI was a valid predictor of death in patients undergoing elective surgery and duration of hospital stay following colorectal surgery but was not better than ASA-PS classification when evaluated in other surgical specialities. Combining the ASA-PS classification system and GCRI had a better predictive ability.

In Brazil in 2003, a study conducted by de Cássia et al (23) compared the APACHE II and POSSUM and ASA-PS classification to determine risk of peri-operative complications in patients with oral and oropharyngeal cancer to facilitate treatment. They found the although ASA-PS classification system was less sensitive in predicting complications compared to the other 2 scoring systems, it still was a valuable tool.

ASA-PS classification can be used in conjunction with other variables in order to add more value and sensitivity. Grocott (16) in the United Kingdom in 2010 , described risk in relation to major surgery in the context of Enhanced Recovery (ER) programs to monitor outcome and evaluate peri-operative care. Scoring systems which include the ASA-PS classification are the SRS and a model proposed by Donati. The SRS combines the CEPOD categories for surgical urgency with the operative severity category of British United Provident Association (BUPA) and the ASA-PS classification by simply adding the numerical categories; giving a resulting score. With this scoring system, SRS predicted mortality in low risk surgery and did not over predict. Donati constructed a similar model which incorporated ASA-PS

classification, age, type and degree of surgery and this has better predictive performance than ASA-PS classification alone.

Froehner (24) in Germany in 2014 used the CCI to classify prognostic comorbidity in candidates for radical prostatectomy. Early prostate cancer stratification is important for clinical decision making as over diagnosis and over treatment is common. Although the guidelines of the European Association of Urology mention both the ASA-PS classification and CCI, these two scores assess different aspects of health status. The information provided by both scores complement each other by providing a more balanced distribution of patients over the risk group stratification for a better survival difference and less error. This combined score is already in use for patients with bladder cancer.

Unlike APACHE II and POSSUM, no provision is made by ASA-PS classification system for the patient suffering acute pathology or more than one medical admission or a major complication following elective surgery.

ASA-PS classification is used extensively in clinical medicine and can also be correlated with blood loss (25).

1.6 ASA-PS classification use as a correlation with blood loss

The ASA-PS classification has also been correlated with intra-operative blood loss and thus transfusions. Grosflam et al (25) found that ASA-PS classification 3 is a predictor of greater blood loss and therefore more transfusions are required compared to lower ASA-PS classification patients. It was hypothesized that the reason for this was anaesthetists aimed to reduce cardiac events and thus had lower threshold to transfuse. Also, the predictive impact of the ASA-PS classification was studied in abdominal hysterectomy patients and it was correlated with blood loss during surgery (26).

ASA-PS classification system has many non-clinical related uses too, which are now discussed.

1.7 ASA-PS classification and non-clinical medicine uses

The ASA-PS classification system has many uses besides classifying physical state of a patient, Table 5 outlines some of the non-anaesthesia uses as taken directly from the ASA newsletter (5) . It is especially important in resource allocation i.e. in sedation where ASA-PS classification 1 or 2 patient could be sedated by a non-anaesthetist.

ASA-PS classification is also used for billing where the higher the ASA-PS classification the higher the remuneration. Interestingly, studies have showed that there is no difference in private and public sector assigning of classes, despite a financial incentive for those classed as sicker. Even in Sankar et al (10)'s study where there were financial incentives for assigning ASA-PS classification 3 and 4, no difference in assignment was found.

Table 4 Details the non-anaesthesia uses for ASA-PS classification system (5)

Non anaesthetic uses for ASA-PS	Purpose
Government agencies	Justification for hospital admission of surgical patients
	Site of service determination (office or facility based)
Paediatric surgical services	Determination of the appropriate facility and resources for specialty care
Non-anaesthesia providers	Determination of administration of moderate versus deep sedation
Medical device manufacturers	Determination of eligibility for patient controlled sedation
Veterinary services	Small animal anaesthesia services

Despite the many uses of ASA-PS classification as described, the greatest drawback is that of the nature of subjectivity of the classification system. This variability present between individual raters is multi-factorial and will now be discussed.

I.8 Inter-rater variability

The biggest flaw of the ASA-PS classification system is its subjectivity and simplicity and hence inter-rater variability. This can be assessed from as early as 1978 with continuing discussion up until 2018. Studies make use of either hypothetical scenarios or actual patients; they test the variability between anaesthesia and non-anaesthesia providers as well as between the public and private sector. They even attempt to eliminate the heterogeneity in raters or in patient selection, but variability still exists. Discussion of inter-rater variability will now be outlined in greater detail.

Owens et al (27) conducted the first study in the United States of America (USA) in 1978 in order to determine the consistency of ratings between raters assigning ASA-PS classification. A questionnaire containing 10 hypothetical scenarios (which included 4 controversial variables such as age; obesity previous myocardial infarction and anaemia), was sent out and the results analysed. The answers were compared to 2 of the authors' assigned classification and variation was confirmed. They also compared classifications between respondents in private and academic (public) practice and found significant difference where academics rated higher ASA-PS classification.

Haynes and Lawler (28) in Great Britain in 1995 also distributed a questionnaire to assess consistency. No case scenario had complete agreement between raters; however there was always a majority opinion. The difference in their study was that they did not include any emergency cases and was non-judgemental by not proposing a correct answer. Problem scenarios included acute pathology such as in trauma or emergency class E. They concluded that insufficient consistency in ASA-PS classification rating excluded its use as a sole indicator of a patient's condition. Surgical procedure has also been a source of inter-rater disagreement and they found that patients undergoing minor surgical procedures got assigned a lower ASA-PS classification even if they had a serious medical illness.

Mak et al (7) did a similar study in Hong Kong in 2002 where they repeated the same 10 questions posed by Owens et al, twenty four years after that study. The ASA-PS classification system's variability was assessed 3 ways. It was assessed between raters in their study and Owens et al results, between local versus foreign trained

anaesthetists and between public and private sector. Using the kappa statistic the percentage of agreement fell in the “fair category” for all groups. Mak suggested a number of reasons why there continued to be variability some of which are that the ASA-PS classification system is too simple, chronic conditions such a stable malignant disease, anaemia’s and obesity are not well-documented. Other factors included possible difference in training and cultural background and confusion in terminology used in the ASA-PS classification system. They advised that if the ASA-PS classification system included specific measurable factors, improved precision and objectivity could be achieved. They proposed addition variables to be considered would be magnitude of the problem, trauma classes and genetic susceptibility to diseases.

Aronson in USA in 2003 (11) also tested variability by use of questionnaires in military and non-military personnel as well as nurses and anaesthetists. Besides having to assign grades, they had to assign and provide rationale for their decision. Inter-rater variability was demonstrated again with no statistical difference between the various groups. Several sources of variability were identified which included smoking, pregnancy, the nature of surgery, a potential difficult airway and acute injury.

The studies done in America, Hong Kong and Great Britain consisted of large heterogeneous population groups. Ranta et al (12) in Finland in 1997 hypothesised that in a smaller more culturally homogenous country, there may be less variability. They distributed their questionnaires in Finland and considerable variation was also reported. Their response rate however was poor and there was no difference found in specialists and non-specialists.

Cuvillon et al (29) in France in 2011 did a study to analyse reproducibility. They assigned ASA-PS classification to patients presenting to theatre and these patients’ records were then reassessed by a specialist in a blinded study. The kappa statistic showed “moderate agreement” and variability was postulated to be influenced by staff characteristics and disease complexity.

Inter-rater variability can be improved by addition of examples. Non-anaesthesia providers tend to under-rate ASA-PS classification compared to anaesthesia providers and this could be improved by addition of examples(30). Curotolo et al (21)

in USA in 2017 found that ASA-PS classification assigned in pre-operative clinics by non-anaesthesia participants was consistently downgraded when compared with assignments on the day of surgery. This has economic implications.

Hurwitz et al (31) from USA in 2017 compared anaesthesia and non-anaesthesia trained participants in assigning ASA-PS classification, they then assessed variability. After the addition of examples they retested the same participants and found the variability was improved.

Aplin et al (32) from Australia in 2007 did the first studies in paediatric population with hypothetical scenarios. There was considerable lack of consistency and scenarios with trauma, congenital malformations, syndromes and airway compromise had greater inconsistency which was worse than adult scenarios. It is a vast topic to discuss with different variable to the adult population and will not be included in this literature review as the primary focus is adults.

As discussed, ASA-PS classification inter-rater variability has many factors. Certain factors are related to the specific patient population groups and other factors are classification specific. A discussion will now follow on ASA-PS classification correlation with specific population groups which will then be followed by ASA-PS classification specific factors.

1.8.1 ASA-PS classification use in correlation with specific population groups

ASA-PS classification has proven inter-rater variability as discussed. One of the reasons is that specific population groups have not been included in the examples provided by ASA-PS classification guidelines and thus prone to rater opinion. The list is large with individual studies focusing on different variables. Some specific populations that will be discussed are patients at the extremes of age, patients who have Human Immunodeficiency Virus (HIV) as well as the trauma, obese and pregnant patient.

1.8.1.1 Extremes of age: geriatric and paediatric

Age is diverse; with differing opinion on whether it should be included in the guidelines. Dripps et al (2) suggest is that patients be classified according to

absence of disease and not according to age. However due to physiological changes associated with age, in the absence of co-morbidities, the extremes of age may increase the physical status rating which is not accounted for.

With global life expectancy on the increase, there will be an increased need for surgery in aging populations with co-morbid diseases. For example hip fractures in an elderly population are common and serious with significant effects on mortality. Kastanis et al (33) in 2016 aimed to determine if ASA-PS classification had any bearing on pre and post-operative outcomes in geriatric hip fractures. They concluded that higher ASA-PS classes correlated with longer waiting times and higher rate of complications. However this should not be a deterrent to operate as in a study by Han et al (20) no differences were found in number of intra-operative; peri-operative and post-operative complications in ASA-PS classification 1 to 3 patients. This is important for clinical decision-making, and older patients with comorbidities can undergo successful anaesthesia and surgery.

The only provision in the current ASA-PS classification guidelines is for a neonate whose post conceptual age is less than 60 weeks and the recommended is ASA-PS classification 3. Some researchers advocate that the ASA-PS classification should be modified and adapted to the paediatric population as there are many physiological and anatomic factors which affect risk (34).

1.8.1.2 Human Immunodeficiency Virus (HIV)

In a study by Penfold and Lundgren (35) in South Africa in 2005, they compared pre-operative clinical assessment using ASA-PS classification with blood results of HIV positive patients. Their concern was that patients who are clinically well on exam with no features of HIV may have a significant level of immune compromise. The finding was that ASA-PS classification did not correlate with blood results; where often a patient with ASA-PS classification 1 or 2 were severely immune-compromised with a CD4 count of less than 50 cells per millimetre cubed.

1.8.1.3 Trauma

Another important use of the ASA-PS classification system in predicting prognosis is in trauma or emergency classification “E”. Risk stratification is important in trauma,

especially when triaging and making pre-hospital and inter-hospital transfer decisions. The controversy surrounds on whether the pre-injury ASA-PS classification or current severity of injury be utilised.

Skaga et al (36) from Norway in 2007 proved that pre-injury ASA-PS classification was an independent predictor of mortality after trauma. Mortality increased with increasing pre-injury ASA-PS classification, increasing age, increasing Injury Severity Score (ISS) and decreasing Revised Trauma Score (RTS). After adjustment of variables (ISS, RTS and age) the ASA-PS classification remained a significant predictor of mortality ($p<0,004$) with an odds ratio of 1,76 for ASA-PS classification 2 and 2,24 for ASA-PS classification 3 and 4. They also suggested that inclusion of ASA-PS classification system in a survival predictive model would improve the predictive power without complicating it.

Ringdal et al (37) also from Norway, in 2013, showed pre-injury ASA-PS classification as an independent predictor of survival in trauma patients. The study showed moderate to substantial reliability. It was recommended as a co-morbidity score in the Utstein Trauma Template as a means of classifying pre-existing comorbidity in trauma patients. Tiret et al (38) reported the rate of peri-operative complications following emergency surgery to be related closely to physical state and thus correlating.

Another study in 2017 conducted by Kuza et al (39) from California, assessed rating of ASA-PS classification system between anaesthesiologists and trauma surgeons in designating classes in adult polytrauma patients. Their results had inconsistent ASA-PS classification; using a weighted kappa they also found fair inter-reliability. They however did not find that ASA-PS classification system could be used as a definitive trauma prognostic metric.

1.8.1.4 Obesity

In a review article by Daabiss (26), obesity was suggested as the worst possible anaesthetic risk and should be classed as ASA-PS classification 4, whereas Dripps et al (2) suggested it be ASA-PS classification 2. In the recent ASA-PS classification guidelines, an obese patient (BMI>30 kg/m^2) was used as an example of ASA-PS

classification 2, and a morbid obese patient (30>BMI>40 kg/m^2), even without co-existing medical problems, was used as an example of ASA-PS classification 3.

1.8.1.5 Pregnancy

In pregnant patients there is substantial inter-rater variability because physiological changes increase patients risk which is not adequately explained in ASA-PS classification which describes disease processes i.e. a healthy parturient should be assigned ASA-PS classification 2 (40).

Despite specific population groups being controversial, factors within the ASA-PS classification itself can cause differences in opinion.

1.8.2 ASA-PS classification and controversies

The ASA-PS classification is simple and thus its guidelines can be obscure and subject to interpretation. There is also the dilemma of ASA-PS classification 5 and the proposed modifiers in order to decrease inter-rater variability.

1.8.2.1 ASA-PS classification and unclear guidelines

A reason for explaining the discrepancy in such a well-documented universally grading system is use of the term “systemic” in the original table which causes a lot of confusion. For example a myocardial infarction affects a singular organ however it is classified as having a global effect on the body or systemic effect. Different interpretations of the term ‘functional limitation’ and ‘constant threat to life’ can also lead to differences of opinion in assigning classes. Further the classification lacks precision and despite examples provided there is inconsistent application with no follow through (7).

Hurwitz et al (31) encourage the use of examples provided, however Avidan and Weiniger in their 2018 editorial comment , bring to attention that its universality is because of its simplicity. They advocate maintaining its simplicity in the aptly named “Keep American Society of Anesthesiologist Physical Status Classification system Simple, Stupid” review. The ASA-PS classification’s simplicity is thus it strength and weakness.

1.8.2.2 Modifiers

Higashizawa and Koga (41) in Japan in 2006 reported difficulty in categorising ASA-PS classification 2 as it is a very broad group. They proposed a division of ASA-PS classification 1 and 2 into a and b. This was because the largest number of patients in ASA-PS and revised classifications were distributed in these classes. Their results showed the number of patients in revised classification gradually decreased whereas in the original ASA-PS classification assignment there was an uneven distribution. The incidence of complications increased in the revised classes in terms of emergency cases which were largely distributed in ASA-PS classification1b and 2a. They reported that this revised classification is practical and reasonable because the prediction of intra- and postoperative complications with this assessment was more accurate.

Barbeito et al (40) in North Carolina in 2006 describes the addition of a modifier “G” which denotes ‘gravid’. This modifier allows the rater to focus on the concomitant diseases of the patient’s and this allows better communication with regards to the pre-operative physical status. This allows a more accurate classification of patient groups and more accurate stratification for statistical analysis. In their study, consistency in ratings improved.

1.8.2.3 ASA-PS classification 5 dilemma

Nicholas Thackray in his correspondence to the editor of Anesthesiology 2011 brings to attention the change in definition of ASA-PS classification 5 (4). Previously it was defined as “a moribund patient who is not expected to survive for 24 hours **with or without** operation”. This definition was changed in 1980 to a “moribund patient not expected to survive **without** operation”, a change missed by many researchers and authors and many studies don’t specify which definition they are using. This dilemma is demonstrated in a study by Horwood et al (42) in the United Kingdom in 2006 who discusses how deciding to operate on high risk patients can be problematic. Using the old definition he says patients may have aggressive surgery being withheld. This is detrimental as he demonstrated 40% of patients classed as ASA-PS classification 5 who underwent surgery survived to discharge. The recommendation

was to use caution in withholding lifesaving treatment based on an ASA-PS classification system. Reverting to the most recent definition, such a dilemma might not exist because it states that all ASA-PS classification 5 patients require surgery for survival.

Sidi et al (43) in Florida, 2000 also did a study on ASA-PS classification 5 as it is the only category within in its definition which has a clear relation to mortality or time of mortality. The percentage of surgical patients classified as ASA-PS classification 5 ranged from 0,37% to 0,95%. Mortality of ASA-PS classification 5 patients varied between 9-70% with many different factors influencing such a patient population and severity in a particular population.

1.9 Summary

The ASA- PS classification system is a well-recognised universal classification system with multiple uses. Inter-rater variability has many causes and possible solutions have been attempted. No study has been conducted in South Africa to assess inter-rater reliability, neither has provision been made for HIV, either in a questionnaire or in the guidelines. There is thus a need for evaluation of inter-rater variability within the South African anaesthetists and to assess if it's in keeping with international variably.

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All articles should include an abstract. The structured abstract for an Original Research article should be between 200 and 230 words and should consist of four paragraphs labelled Background, Methods, Results, and Conclusions. It should briefly describe the problem or issue being addressed in the study, how the study was performed, the major results, and what the authors conclude from these results. The abstracts for other types of articles should be no longer than 230 words and need not follow the structured abstract format.

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Acknowledgements

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The following are sample references:

1.Jun BC, Song SW, Park CS, Lee DH, Cho KJ, Cho JH. The analysis of maxillary sinus aeration according to aging process: volume assessment by 3-dimensional reconstruction by high-resolutional CT scanning. Otolaryngol Head Neck Surg. 2005 Mar;132(3):429-34.

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5. All co-authors have made significant contributions to the manuscript to qualify as co-authors.

6. Ethics committee approval has been obtained for original studies and is clearly stated in the methodology.

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8. The submission adheres to the instructions to authors in terms of all technical aspects of the manuscript.

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The submitting author acknowledges that the Editorial Board reserves the right to use plagiarism detection software on any submitted material.

SECTION 3: DRAFT ARTICLE

Inter-rater variability between anaesthetists when classifying patients using the American Society of Anesthesiologists Physical Status (ASA-PS) classification system

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Keywords

American Society of Anesthesiologists (ASA-PS) classification system, Anaesthetists, Inter-rater variability, Modifier, Human Immunodeficiency virus (HIV)

Abstract

Background

Anaesthetists convey the physical state of patients by use of the American Society of Anaesthesiologists Physical Status classification system (ASA-PS). It is a simple, popular tool with many uses, but not without fault, where variation between anaesthetists when classifying patients exists. To date there is no South African study comparing inter-rater variability between anaesthetists particularly between junior and senior anaesthetists. Our study includes patients with Human Immunodeficiency Virus (HIV) in the scenarios. A 'modifier' and the level it's accepted is also proposed.

Method

A questionnaire comprising of two parts was distributed. The first part assessed demographics and attitude towards a proposed "modifier" and the second consisted of ten hypothetical case scenarios which were created to incorporate a wide variety of conditions including Human Immunodeficiency Virus (HIV).

Results

After receiving 134 of the 200 questionnaires distributed, 132 were analysed. There were 93 juniors and 39 seniors. A Cohen's kappa statistic over all the scenarios of 0.23 (fair agreement) was determined. In none of the scenarios was there complete agreement. In each case there was a majority viewpoint shared by both juniors and seniors except Scenario 2. Large ranges were found in scenarios which included pregnant, geriatric and emergency patients.

Conclusion

Results are in keeping with other studies. Inter-rater variability is prevalent despite guidelines being available. A simple modifier such as letter "G" denoting a gravid patient may be acceptable.

Introduction

Anaesthetists evaluate, handover, make decisions and communicate (often telephonically) the physical state of patients. To confer a sense of uniformity, this is accomplished with the use of the American Society of Anesthesiologists Physical Status classification system (ASA-PS). However, this classification system is not without fault or controversy.

In 1941, the American Society of Anesthetists, which later became the American Society of Anesthesiologists (ASA), introduced a six class classification for patients about to undergo surgery.[1] This classification system describing the "physical state" of the patient and not the "operative risk" was revised and subsequently ratified in 1963.[2] Further changes were made in the 1980s, with the latest amendment approved by the House of Delegates of the ASA in October 2014, which now included examples of each class.[3]

The ASA-PS classification system is popular with uses in self-reported quality assurances, influences in decision making processes, policy making processes and is frequently cited in clinical research allocation of resources and billing.[4] Knowing the ASA-PS classification of a patient may also affect the surgical or anaesthetic plan peri-operatively such as pre-arrangement of an intensive care unit or high care bed if needed.

Despite Saklad[1] stating that the ASA-PS classification system should not be used as a prognostic tool, studies have proven otherwise.[5, 6, 7] Wolters et al[8] in 1996 first showed that the classification could be used to predict complications and as recently as April 2015 Hackett et al[9] found conclusive evidence that the ASA-PS classification system had a strong independent association with post-operative mortality and complications and was deemed a valuable surgical prognostic metric. It has also been compared and incorporated with other classification systems to increase their validity and reliability. Nevertheless, many studies[4, 10, 11] showed that considerable variations exist between anaesthetists when classifying patients according to the ASA-PS classification system. In 1978 Owens et al[12] first reported inter-rater variability based on hypothetical adult patient scenarios. Subsequently, this study

has been replicated with results showing inter-rater variability when using ASA-PS classification system. [4, 11, 13]

A way to explain inter-rater variability is that the ASA-PS classification system is subjective, which one of its greatest weaknesses is according to Sweitzer [14] in an editorial. Some contentious variables which caused a difference in opinion include patients' weight, age, syndromes, smoking and other co-morbidities. The House of Delegates of the ASA in 2014[3] hoped to decrease variability by adding examples which was proven true in a small study by Hurwitz et al.[15]

Another factor contributing towards inter-rater variability is the classification of emergency cases. This is because the pre-injury ASA-PS classification differs from that of the post-injury.[16]

There have also been recommendations by small studies which show less variability following the addition of a "modifier" such as the addition of a letter "G" to denote pregnancy[17] or to introduce sub-classifications[18] for example the division of class 1 into 1a and 1b.

No South African study could be identified to assess whether inter-rater variability exists. Also no study has been conducted with specific reference to patients with Human Immunodeficiency Virus (HIV) in the scenarios used to assess for inter-rater variability. The extent of inter-rater variability which exists in the Department of Anaesthesiology at the University of the Witwatersrand (Wits) is also not known. Therefore, a study was done to describe the inter-rater variability in ASA-PS classification within the Department of Anaesthesiology at Wits.

Methodology

A prospective, contextual, descriptive research design was followed in this study. Approval to conduct this study was obtained from Human Research Ethics Committee (Medical) at Wits and other relevant authorities.

The study population consisted of all anaesthetists working in the Department of Anaesthesiology. A convenience sample was used in this study. The sample size was realised by the response rate. A minimum response rate of 60%[18] of anaesthetists working in the department was considered acceptable.

A questionnaire was compiled by the researcher based on an extensive literature review. It consisted of two sections. The first section included the demographics of the respondent (gender, position held, work experience) and questions about whether the ASA-PS classification system was helpful. Further questions assessed the respondents'' use of the system as a surgical or anaesthetic risk indicator; if the addition of "modifiers" would decrease inter-rater variability and respondents' could also make suggestions. The second section consisted of 10 hypothetical adult patient scenarios (Appendix). Case scenarios were identified in the literature[4, 11] and then modified to the South African context. To ensure face and content validity, the questionnaire were reviewed by three experienced anaesthesiology seniors (experienced being a consultant for 10 years or more) and their suggestions were then incorporated. There is no gold standard or "correct" answer when applying the ASA-PS classification to a scenario or patient. However, the author's opinion has been incorporated.

Data were collected by one author (ZJS) at departmental meetings. The nature of the study was explained and those present were invited to participate. Those who agreed received an information letter and a questionnaire which took about 15 minutes to complete. The researcher was present at all times to prevent data contamination and to answer questions. The questionnaires were returned into a sealed box.

Data collected from the surveys were captured onto Microsoft Office Excel 2007 spread sheets for analysis. The data were analysed using STATA 13 statistical software (STATA Corp, USA). The data were analysed using descriptive and inferential statistics. All values were rounded to the nearest whole number. Cohen's kappa statistic was used to determine inter-rater variability, where less than 0 (less than chance agreement) up to 1(almost perfect agreement).[19] This is shown in Table I.

Table I Guidelines for interpreting Cohen's kappa statistic[19]

Values	Description
< 0	Less than chance agreement
0.01 -0.20	Slight agreement
0.21- 0.40	Fair agreement
0.41- 0.60	Moderate agreement
0.61- 0.80	Substantial agreement
0.81-0.99	Almost perfect agreement

Fisher's exact tests were used for comparisons of experience and a p values of <0, 05 were considered statistically significant. Blank questionnaires were discarded. Partially complete questionnaires (not all the ten scenarios being answered) were accepted as analysis of data included inter-rater variability on the individual scenarios.

Results

Over four months of data collection, of the 200 questionnaires distributed, 134 were returned. Of these 132 were included in the study as two were returned blank. This resulted in a response rate of 61% of the department with a sample size realisation of 66%. Demographics of respondents are shown in Table II. Juniors comprise of medical officers and registrars and seniors consist of career medical officers and consultants.

Table II Demographics of respondents

Characteristic	Description	Frequency	Percentage
Gender	Male	47	36
	Female	85	64
Position held	Medical officer	26	20
	Registrar	67	51
	Career medical officer	6	5
	Consultants	33	25
Number of years of anaesthetic experience	<5 years	83	63
	5-10	29	22
	11-20	11	8
	>20	9	7

Table III shows the range of classifications, including the emergency (E) situations, for all the scenarios which were between 3 and 10. Scenario 3 with a pregnant emergency patient had the greatest range.

Table III ASA-PS classification range

Scenario	ASA-PS												Range
	1 n	1E n	2 n	2E n	3 n	3E n	4 n	4E n	5 n	5E N	6 n	6E n	
1	2	0	51	0	76	1	2	0	0	0	0	0	5
2	0	0	3	0	62	0	65	0	2	0	0	0	4
3	4	51	7	16	4	24	4	18	0	3	0	1	10
4	4	16	19	42	13	30	2	5	1	0	0	0	9
5	0	0	118	1	13	0	0	0	0	0	0	0	3
6	0	0	9	9	38	62	4	10	0	0	0	0	6
7	95	22	13	1	1	0	0	0	0	0	0	0	5
8	37	0	87	0	8	0	0	0	0	0	0	0	3
9	16	1	97	6	12	0	0	0	0	0	0	0	5
10	95	0	36	1	0	0	0	0	0	0	0	0	3

Inter-rater variability was compared between junior and senior anesthetists for each scenario using the Cohen's kappa statistic as shown by Table IV. In scenario 1 and 3 there was less than chance agreement. In scenario 2 and 4 there was slight

agreement and the remaining scenarios had fair agreement. The average Cohen's kappa statistic of the scenarios was fair, 0.23, with a corresponding agreement of 40%.

In only 2 scenarios was there a statistically significant difference between the responses of junior and senior anaesthetists per class, that is scenario 2 (p= 0.001) and scenario 6 (p= 0.02). As shown in Table IV.

Table IV Cohen's Kappa statistics and comparisons for each scenario

	Kappa statistic	**Fisher exact p-value**
Scenario 1	0.00	0,16
Scenario 2	0.17	0,001
Scenario 3	-0.06	0,19
Scenario 4	0.12	0,07
Scenario 5	0.40	0,18
Scenario 6	0.33	0,027
Scenario 7	0.25	0,46
Scenario 8	0.33	0,39
Scenario 9	0.33	1
Scenario 10	0.4	0,67
Average	0.23	

In order to further analyse data, as done in other similar studies, the emergency symbol 'E' was incorporated into that class for example ASA-PS classification 1 and ASA-PS classification 1E are classified together as ASA-PS classification 1, resulting in 6 classes. This is subdivided into choices made by junior and senior anaesthetists within each scenario as seen in Table V.

In none of the scenarios was there complete agreement between raters with ASA-PS classification. In each case there was a majority viewpoint shared by both juniors and seniors except Scenario 2 where more juniors (57%) assigned ASA-PS classification 3 and more seniors (67%) assigned ASA-PS classification 4. This is shown in Table V.

Table V Juniors and seniors and their ASA-PS classification

Scenario	Level	ASA1 n (%)	ASA 2 n (%)	ASA 3 n (%)	ASA 4 n (%)	ASA 5 n (%)	ASA 6 n (%)
1	Juniors	1 (1)	37 (40)	55 (59)	0	0	0
	Seniors	1 (3)	14 (35)	22 (57)	2 (5)	0	0
	Total	2 (2)	51 (39)	77 (58)	2 (2)	0	0
2	Juniors	0	1 (1)	53 (57)	39 (42)	0	0
	Seniors	0	2 (5)	9 (23)	26 (67)	2 (5)	0
	Total	0	3 (2)	62 (47)	65 (49)	2 (2)	0
3	Juniors	40 (43)	19 (20)	18 (19)	15 (16)	1 (1)	0
	Seniors	15 (38)	4 (10)	10 (26)	7 (18)	2 (5)	1 (3)
	Total	55 (42)	23 (17)	28 (21)	22 (17)	3 (2)	1 (1)
4	Juniors	15 (16)	43 (46)	33 (35)	2 (2)	0	0
	Seniors	5 (13)	18 (46)	10 (26)	5 (13)	1 (3)	0
	Total	20 (15)	61 (46)	43 (33)	7 (5)	1 (1)	0
5	Juniors	0	86 (92)	7 (8)	0	0	0
	Seniors	0	33 (85)	6 (15)	0	0	0
	Total	0	119 (9)	13 (10)	0	0	0
6	Juniors	0	16 (17)	71 (76)	6 (6)	0	0
	Seniors	0	2 (5)	29 (74)	8 (21)	0	0
	Total	0	18 (14)	100 (75)	14 (11)	0	0
7	Juniors	83 (89)	10 (11)	0	0	0	0
	Seniors	34 (87)	4 (10)	1 (3)	0	0	0
	Total	117 (89)	14 (11)	1 (1)	0	0	0
8	Juniors	28 (30)	60 (65)	5 (5)	0	0	0
	Seniors	9 (23)	27 (69)	3 (8)	0	0	0
	Total	37 (28)	87 (66)	8 (6)	0	0	0
9	Juniors	12 (13)	72 (77)	9 (10)	0	0	0
	Seniors	5 (13)	31 (79)	3 (8)	0	0	0
	Total	17 (13)	103 (78)	12 (9)	0	0	0
10	Juniors	68 (73)	25 (27)	0	0	0	0
	Seniors	27 (69)	12 (31)	0	0	0	0
	Total	95 (72)	37(28)	0	0	0	0

Table III and IV's results are further clarified in terms of each scenario. The "authors suggestion" based on recent ASA-PS classification guidelines accompany each scenario.

Scenario 1: Assessing smoking and severity of lung disease (*Author opinion: ASA-PS classification 3)*

Both juniors (59%) and seniors (57%) were in agreement with the majority being ASA-PS classification 3. Two seniors chose ASA-PS classification 4 whereas no junior chose this. Only one junior used emergency classification "E".

Scenario 2: Assessing cardiac patient in non-cardiac surgery (*Author opinion ASA-PS classification 4)*

Seniors and juniors differed, where 57% of juniors chose ASA-PS classification 3 and 67% of seniors chose ASA-PS classification 4. Only seniors chose ASA-PS classification 5.

Scenario 3: Assessing pregnancy and emergency (*Author opinion ASA-PS classification 2E)*

The most common choice was 42 % (55) of respondents selecting ASA-PS classification 1, 51 of the 55 of those being ASA-PS classification 1E. Both juniors and seniors answered similarly.

Scenario 4: Assessing acute disease in an emergency (*Author opinion ASA-PS classification 2E)*

ASA-PS classification 2 was the most common selection by 46 % (61) of respondents, of which 42 of those chose ASA-PS classification 2E. Majority of both juniors and seniors chose ASA-PS classification 2E. One consultant chose ASA-PS classification 5.

Scenario 5: Assessing well controlled HIV positive patient on antiretroviral treatment (*Author opinion ASA-PS classification 2)*

Most (90%) chose ASA-PS classification 2; 92% being juniors and 85 % being seniors.

Scenario 6: Assessing advanced HIV patient (*Author opinion ASA-PS classification 3E)*

The most common response was ASA-PS classification 3 with 75% (100) respondents choosing this, of which 62 chose the classification ASA-PS classification 3E. Both juniors and seniors responded similarly.

Scenario 7: Assessing a pregnant patient (*Author opinion ASA-PS classification 2)*

Seniors and juniors responded in a similar pattern with 89% (117) of respondents choosing ASA-PS classification 1 and only one consultant choosing ASA-PS classification 3.

Scenario 8: Assessing obesity (*Author opinion ASA-PS classification 2)*

The majority (66%) of respondents chose ASA-PS classification 2, with juniors and seniors responding similarly.

Scenario 9: Assessing a syndrome (*Author opinion ASA-PS* classification *2)*

There was little variability between juniors and seniors, where 78% respondents chose ASA-PS classification 2. Seven respondents assigned an emergency classification.

Scenario 10: Assessing a healthy geriatric patient (*Author opinion ASA-PS* classification *2)*

Junior and senior anaesthetists chose similarly with little variability with 72% of respondents choosing ASA-PS classification 1. One junior assigned an emergency classification ASA-PS classification 2E.

The helpfulness of the ASA-PS classification, its use as an anaesthetic and/or surgical risk indicator and the use of a modifier or subclasses is shown in Table VI. Acceptance of a simple modifier (“G”) as opposed to adding sub-classes is thus more acceptable as opposed to a seemingly more complicated one.

Table VI Helpfulness of, indicators for and additions to ASA-PS classification system

Question posed	Answers	Number (%)
ASA-PS classification helpfulness	Helpful	34 (26)
	Somewhat helpful	78 (59)
	Not helpful	20 (15)
Anaesthetic or surgical risk indicator	Surgical risk indicator only	1 (1)
	Anaesthetic risk indicator only	37 (28)
	Both surgical and anaesthetic risk indicator	87 (66)
	Neither of the two	7 (5)
Addition of modifier "G"	Yes	73 (55)
	No	59 (45)
Addition of sub- classification	Yes	49 (37)
	No	83 (63)

When asked what could decrease inter-rater reliability of the ASA-PS classification system, 71 (51%) of responses were received. These fell into four broad categories:

- having more specific or clearer guidelines was suggested by 35 respondents
- adding a modifier or subclass was suggested by 21 respondents
- that it was difficult to grade a paper scenario and a live patient would be easier by 10 respondents
- continuous education starting from medical school onwards by 5 respondents.

Discussion

The ASA-PS classification system is one of the most commonly used simple scoring systems available designed to describe pre-operative physical status, however variability between raters exist.[11, 12]The aim of this study was to determine the extent of inter-rater variability of anaesthetists in the Department of Anaesthesiology of Wits. As in previous studies, a questionnaire was used.

Our result of a Cohen's kappa statistic of 0,23 indicating "fair agreement" across all scenarios is in the same category of a previous international study by Mak et al[4] who had a kappa statistics in the range of 0,34 to 0,37. Other studies did not test inter-rater variability using the kappa statistic but also found fair agreement.[11, 12, 13] In our study six of the scenarios fell into the category of fair agreement. Scenario 1 and 3 had "less than chance" agreement and Scenario 2 and 4 had "slight agreement".

Inter-rater variability has been compared between different healthcare professionals. Mak et al[4] compared inter-rater variability between different groups (public and private sector anaesthetists, local and overseas trained anaesthetists and also a comparison between their results and a study by Owens et al[12] 24 years prior); the kappa statistic remained in a constant range. Even studies that compared anaesthetists and non-anaesthetists, [13, 15], or attempted to eliminate heterogeneity[20] by using a homogenous population had variability in assignment. In our study, we compared inter-rater variability between junior and senior anaesthetists and in none of the scenarios was there complete agreement. In each case there was a majority viewpoint shared by both junior and senior anaesthetists except Scenario 2. In only two scenarios was there a statistically significant difference between the responses of junior and senior anaesthetists per class, which is Scenario 2 and Scenario 6.

Inter-rater variability in the ASA-PS classification system is not only due to raters, but multi-factorial. Firstly, factors causing variability are related to the classification itself as it is simple, non-specific and prone to subjectivity. For example different interpretations of the term 'functional limitation' and 'constant threat to life' can also lead to differences of opinion in assigning classes. Secondly, the classification lacks precision and despite examples provided there is inconsistent application with no follow through. For example, Thackray[21] in his correspondence brings to attention the change in definition of ASA-PS classification 5. Previously it was defined as "a moribund patient who is not expected to survive for 24 hours with or without operation". This definition was changed in 1980 to a "moribund patient not expected to survive without operation", a change missed by many researchers and authors and many studies don't specify which definition they are using. Thirdly, some factors are related to the specific patient population groups such as geriatric, HIV, emergency or pregnant patients.

Interestingly, when assessing ASA-PS classification in Scenario 10 with a healthy geriatric patient, there was very little difference in opinions between junior and senior anaesthetist who mainly chose ASA-PS classification 1. However it is the author's opinion that such a patient should be considered ASA-PS classification 2. Age is diverse; with differing opinion on whether it should be included in the guidelines. This is discussed by Swietzer[14] in the 2017 editorial where, according to the ASA-PS classification, patients are assessed according to absence of disease.[22] However due to physiological changes associated with age, in the absence of co-morbidities, the extremes of age may increase the physical status rating which is not accounted for in the classification.

To our knowledge, this is the only study which included HIV patients in the scenarios (5 and 6). The current ASA-PS classification guidelines do not make provision for HIV and its different stages. Scenario 5 had the least inter-rater variability with most agreement. The more advanced the HIV status, the higher the ASA-PS classification assigned which was similar to results found in a previous study by Penfold and Lundgren.[23]

Scenarios 3 and 4 had the largest range (that is the greatest number of ASA-PS classification selection within each scenario) as it included an emergency situation. This has been a subject of discussion in the literature, where there is ambiguity with regards to a patient presenting in an emergency situation. There is controversy on whether the pre-injury ASA-PS classification or current severity of injury be utilised.[24]

As with geriatric patients, in pregnant patients there is substantial inter-rater variability because physiological changes increase patient's risk which is not adequately explained in ASA-PS classification.[17] A healthy parturient should be assigned ASA-PS classification 2. In the assessment of a pregnant patient in both Scenario 3 and Scenario 7, there was wide variability. A possible solution could be an addition of a modifier symbol "G" which denotes gravid as described by Barbeito et al.[17] This modifier allows the rater to focus on the concomitant diseases of the patient which allowed more accurate classification of patient groups. In their study, consistency in ratings improved.[17]

Another possible modifier is the addition of subclasses as proposed by Higashizawa and Koga.[25] They proposed a division of ASA-PS classification 1 and 2 into a and b.

Their results showed the number of patients in the revised classification gradually decreased whereas in the original ASA-PS classification assignment there was a wide distribution. They reported that this revised classification is practical and reasonable and more accurate. However, our results show that the addition of sub-divisions is not favoured by most.

Previous studies have postulated that the ASA-PS classification may be too simplistic and thus lack precision. Another possible suggestion to decrease inter-rater variability would be to educate raters on the examples provided in the 2014 ASA-PS classification system guidelines. In a study by Hurwitz et al[15] in 2017, this decreased inter-rater variability. However, Avidan and Weiniger[26] in a 2018 editorial are of a different opinion and they advocate maintaining simplicity in the aptly named review “Keep American Society of Anesthesiologist Physical Status Classification System Simple, Stupid”. The ASA-PS classification’s simplicity is thus its strength and its weakness.

Conclusion

Our results of fair inter-rater reliability are in keeping with previous studies and despite guidelines being available; the examples given are not yet in current practice. The variability in assigning ASA-PS classification in certain populations such as the extremes of age or pregnancy or trauma still exits. The use of a modifier “G”(G= Gravidity) or teaching the examples may decrease inter-rater variability.

Conflict of interest

The authors declare that they have no financial or personal relationships which may have inappropriately influenced them in writing this paper.

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Appendix

Scenario 1 (assessing smoking and severity of lung disease) A 65 year old gentleman is admitted for an elective repair of his inguinal hernia. He has smoked 25 cigarettes a day for the last 45 years. He gets breathless on climbing a single flight of stairs. On examination his chest is clear. His chest x-ray shows mild hyperinflation, his FEV1 is 80% and FEV/FVC ratio 60%.

Scenario 2 (assessing cardiac patient for cardiac surgery) A 50 year old gentleman is admitted for elective tendon release. He has stable angina for the last eight years which was treated with sublingual nitroglycerine, but suffered a myocardial infarction two months ago. On examination his BP is 180/90 mm Hg, with a grade 4 systolic murmur over the aorta, q waves in leads 2,3, AVF with left ventricular hypertrophy.

Scenario 3 (assessing pregnancy and emergency) A 23 year old previously well lady presents with an emergency ruptured ectopic pregnancy. This is her second pregnancy at eight weeks gestation. She is clinically pale, hypotensive, sweaty and tachycardiac. Her blood gas shows a haemoglobin of 7, 8 g/dl and base excess of -5

Scenario 4 (assessing acute disease in an emergency) A 16 year old young man presents with a blocked ventriculoperitoneal (VP) shunt. He had a previous anaesthetic when he was five months old for VP shunt insertion. He is in grade ten in school and has had no complications until now. He has presented with headaches, vomiting and blurred vision.

Scenario 5 (assessing well controlled HIV patient on treatment) A 45 year old lady presents to the ward for benign lipoma to be removal from her back. She was diagnosed with human immunodeficiency virus (HIV) three years ago and has been receiving treatment ever since (HAART). She also had pulmonary TB and completed six months of treatment. Currently her CD4 count is 367 with an undetectable viral load. She is clinically well on examination.

Scenario 6 (assessing advanced HIV not on treatment) A 36 year old gentleman is a newly diagnosed HIV positive patient presenting with a perianal abscess. On examination he is ill looking with oral candida and multiple skin lesions. He has had severe gastroenteritis with corrected electrolyte abnormalities.

Scenario 7 (assessing pregnancy) A 19 year old lady is pregnant for the first time. She has no other comorbidities and it has been an uneventful pregnancy. She presents in labour at 38 weeks gestation age, requesting an epidural.

Scenario 8 (assessing obesity) A 40 year old lady is scheduled for a laparoscopic cholecystectomy. Her BMI is 35. She has no other co-morbidities with a relatively good effort tolerance. She does not suffer from sleep apnoea, is a non-smoker, normotensive and does not have any daytime somnolence.

Scenario 9 (assessing syndrome) A 21 year old Down's syndrome lady presents for an elective skin graft after burning her hand with hot water. She has no cardiac defects or any other illness. She is mentally delayed and has never attended school.

Scenario 10 (assessing healthy geriatric patient) A 75 year old gentleman is booked for a transurethral resection of the prostrate. He currently experiences minimal urinary obstruction with no renal impairment. He is a farmer and still works on his farm ploughing. Thirty years ago he had an appendectomy with no residual complications. Examination reveals a fit gentleman who does not look his age.

SECTION 4: PROPOSAL

Inter-rater variability between anaesthetists when classifying patients using the American Society of Anesthesiologists Physical Status (ASA-PS) classification system

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4.1 Introduction

Anaesthesiologists evaluate, handover, make decisions and communicate (often telephonically) the physical state of patients. To confer a sense of uniformity, this is accomplished with the use of the American Society of Anesthesiologists Physical Status classification system (ASA-PS). However, this classification system is not without fault or controversy.

In 1941, the American Society of Anesthetists (which later became the American Society of Anesthesiologists) introduced a six class classification for patients about to undergo surgery (1). This classification system describing the “physical state” of the patient and not the “operative risk” was revised and subsequently ratified in 1963.(3) Further changes were made in the 1980s, with the latest amendment approved by the House of Delegates of the ASA in October 2014, which now included examples of each class. This was presented in the ASA June 2015 newsletter (5).

The ASA-PS classification system is popular with uses in self-reported quality assurances, influences in decision making processes, policy making processes and is frequently cited in clinical research allocation of resources and billing (7).

Despite Meyer (1) stating that the ASA-PS classification system should not be used as a prognostic tool, studies have proven otherwise (16, 22, 44). Wolters et al (17) in 1996 first showed that the classification could be used to predict complications and as recently as April 2015 Hackett et al (9) found conclusive evidence that the ASA-PS classification system had a strong independent association with post-operative mortality and complications and was deemed a valuable surgical prognostic metric. It has also been compared and incorporated with other classification systems to increase their validity and variability.

Nevertheless, many studies (7, 13, 28) show considerable variations exist between anaesthetists when classifying patients according to the ASA-PS classification system. In 1978 Owens et al (27) first reported inter-rater variability based on hypothetical adult patient scenarios. Subsequently, this study has been mimicked

with results showing inter-rater variability as a major flaw of the ASA-PS classification system.

Inter-rater variability can be explained by the fact that the ASA-PS classification system is subjective. This is due to the exclusion of examples in the guidelines since 1963, thus certain variables such as smoking, age, syndromes, weight and pregnancy, have caused differences in opinion. For example with regards to age, both the geriatric and paediatric population can be regarded as high risk populations without another contributing co-morbidity. The word “systemic” also causes confusion where an organ may be significantly injured and warrant a higher ASA-PS classification but it is not a systemic process for example myocardial infarction (26).

Another contributing factor towards inter-rater variability is the classification of emergency cases, where often the pre-injury ASA-PS classification differs from that of the post-injury despite it being an acute process (36).

Other ways to decrease the inter-rater variability have been amendments such as the inclusion of examples in the new guidelines (5). There have also been proposals by small studies which show less variability following the addition of a “modifier” for e.g. the addition of a letter “G” to denote pregnancy (40) or to introduce sub-classifications (41) for example the division of class 1 into 1a and 1b.

4.2 Problem statement

The ASA-PS classification system is a valuable tool, especially with regards to communicating a patient’s condition. Communication is vital when handing over patients on emergency lists as well as when discussing patients’ conditions telephonically with colleagues. Knowing the ASA-PS classification of a patient may also affect the surgical or anaesthetic plan peri-operatively such as pre-arrangement of an intensive care unit or high care bed if needed.

The major drawback, however, is the existence of inter-rater variability internationally (7, 12, 28). No study could be identified in South Africa in order to determine if inter-rater variability exists or whether this variability is found in condition specific scenarios such as the patient population diagnosed with HIV.

The extent of inter-rater variability which exists in the Department of Anaesthesiology at the University of Witwatersrand (Wits) is also not known.

4.3 Aim and objectives

4.3.1 Aim

The aim of this study is to describe the inter-rater variability in ASA-PS classification within the Department of Anaesthesiology at Wits.

4.3.2 Objectives

The primary objectives of this study are to:

- describe the anaesthetists ASA-PS classification of the 10 hypothetical adult patient scenarios
- describe the variability in ASA-PS classification.

The secondary objectives of this study are to:

- compare inter-rater variability between junior and senior anaesthetists
- describe the level of acceptance with the addition of a “modifier”.

4.4 Research assumptions

The following definitions will be used in the study.

Anaesthetist: in this study is a qualified doctor working in the Department of Anaesthesiology including medical officers, registrars and consultants.

Medical officer: is a qualified doctor practising in the Department of Anaesthesiology under specialist supervision. Medical officers with more than 10 years of experience are career medical officers and are regarded as consultants. Medical officers with less than 10 years of experience are regarded as junior anaesthetists.

Registrar: is a qualified doctor who is registered with the Health Professions Council of South Africa as a trainee anaesthetist. They are regarded as junior anaesthetists.

Consultant: is a specialist anaesthetist or career medical officer. They are regarded as senior anaesthetists.

Inter-rater variability: is a measure of the difference in agreement between two or more independent raters when the same test is being evaluated without it being attributed to chance(45).

Modifier: is the addition of a standardised alphabetical letter such as “G” denoting gravidity or the sub-classification of a class within the ASA-PS classification system.

Acceptable degree of inter-rater variability: The Cohen’s kappa statistic will be used to evaluate the degree of variability between observers. The kappa scale (Table 1) will be used to determine that the results are not due to chance with perfect agreement being kappa 1 and agreement equivalent to chance being kappa 0 (45).

Table 1: Interpretation of kappa (45)

Kappa	**Agreement**
<0	Less than chance agreement
0.01 – 0.20	Slight agreement
0.21 – 0.40	Fair agreement
0.41 – 0.60	Moderate agreement
0.61 – 0.80	Substantial agreement
0.81 – 0.99	Almost perfect agreement

4.5 Demarcation of study field

This study will be conducted amongst the anaesthetists in the Department of Anaesthesiology affiliated to the Faculty of Health Sciences at Wits. The staff

complement of the department is 85 consultants, 112 registrars and 21 medical officers. The following hospitals are affiliated to the department.

- Charlotte Maxeke Johannesburg Academic Hospital; a 1 200 bed central hospital with 23 theatres and approximately 23 000 surgical procedures performed annually.
- Chris Hani Baragwaneth Academic Hospital; a 2 888 bed central hospital with 25 theatres and approximately 65 000 surgical procedures performed annually.
- Helen Joseph Hospital; a 500 bed regional hospital with seven theatres and approximately 6000 surgical procedures performed annually.
- Rahima Moosa Mother and Child Hospital; a 338 bed regional hospital with five theatres with approximately 6600 surgical procedures performed annually.
- Wits Donald Gordon Medical Centre; a public/private hospital with 190 beds and eight theatres with approximately 8 500 surgical procedures performed annually.

4.6 Ethical considerations

Approval to conduct the study will be obtained by the Human Research Ethic Committee (Medical) and the Graduate Studies Committee, Wits.

Every participant will receive a letter which explains the study and an invitation to participate (Appendix 1). They will be given the two part questionnaire with the hypothetical adult patient scenarios (Appendix 2). Consent will be implied by return of the questionnaire. There will be no incentive, financial or otherwise.

Anonymity will be maintained at all times by no use of names or other identifying information. The forms will be numbered in order to keep track of results. Confidentiality will be ensured as only researchers and supervisors will have access to the raw data. The data will be stored securely for six years after completion of the study.

If the study reveals that there is wide inter-rater variability, a departmental academic lecture will be organised addressing the use of the ASA-PS classification system.

This study will be conducted in accordance with the Declaration of Helsinki (46) and the South African Good Clinical Practice Guidelines (47).

4.7 Research methodology

4.7.1 Research design

A prospective, contextual, descriptive research design will be followed in this study.

A prospective study is defined by Brink et al (48) as one in which: " Data about a presumed cause are first collected and then the effect or outcome is measured." Thus in this study, data about anaesthetists classification of hypothetical patients will be collected and thereafter the variability will be measured between two groups (junior and senior anaesthetists).

Contextual is where the variables are measured during the time the study is taking place, in the immediate circumstances or environment. This study will be taking place in the Department of Anaesthesiology at Wits with South African scenarios .

A descriptive study is aiming to describe the characteristics or gain more information of the variables being studied in order to answer the research question (48). These variables are not manipulated by the researcher and there is no intention of establishing a cause-effect relationship. This study will describe the inter-rater variability between two groups of anaesthetists when applying the ASA-PS classification.

4.7.2 Study population

The study population consists of all anaesthetists working in the Department of Anaesthesiology.

4.7.3 Study sample

Sampling method

A convenience sample will be used in this study. A convenience sample is one where the participants for inclusion in the sample are easily accessible (48).

Sample size

The sample size will be realised by the response rate. A minimum response rate of 60% is considered acceptable (49).

Inclusion and exclusion criteria

Inclusion criteria for this study will be:

- anaesthetists working in the Department of Anaesthesiology
- anaesthetists who agree to participate.

Exclusion criteria for this study will questionnaires returned blank.

4.8 Collection of data

Questionnaire

A questionnaire (Appendix 2) was compiled by the researcher based on an extensive literature review. It consists of two sections, the first being the demographics of the participant (gender, position held, working experience) after which a set of 10 hypothetical adult patient scenarios follows. Case scenarios were identified in the literature (7, 28) and then modified to the South African context were added to ensure content validity. To ensure face validity, these scenarios were reviewed by three experienced anaesthesiology consultants (experienced being a consultant for 10 years or more) and their suggestions were then incorporated into the questionnaire.

Data collection process

Data will be collected by the researcher at departmental meetings. Permission will be sought from the conveners to address the meeting. The nature of the study will be explained and those present will then be invited to participate. If they agree they will receive an information letter (Appendix 1) and a two-part questionnaire (Appendix 2) which should take about 15 minutes to complete. The researcher will be present at all times to prevent data contamination and to answer questions. The questionnaires will be returned into a sealed box.

Data collected from the surveys will be captured by the researcher onto Microsoft® Office Excel 2007 spread sheets for analysis.

Data analysis

The data will be analysed using STATA 13 statistical software (STATA Corporation, College Station, TX USA). The data will be analysed using descriptive and inferential statistics. The kappa coefficient will be used to determine inter-rater variability, where 1 indicates perfect agreement and 0 assigns agreement to chance, with frequencies in between (45). Chi squared or Fisher's exact test will be used for comparison of experience and a p value of <0,05 will be considered statistically significant. Blank questionnaires will be discarded. Partially complete questionnaires (not all the ten scenarios being answered) will be accepted as analysis of data will include inter-rater variability on the individual scenarios.

4. 9 Significance of the study

The ASA-PS classification system is a widely used well designed tool. Its simplicity is both its advantage and disadvantage, making observer subjectivity and thus inter-rater variability its greatest drawback. Its main use in anaesthesia clinical practice is as a communication means used to handover, discuss telephonically with consultants and to plan anaesthesia peri-operatively. This study is significant as inter-rater variability has, to the best of our knowledge, never been assessed in

South Africa with contextual scenarios. It also may serve as base for further work to be done in reducing this variability by implementing the new guidelines (5) or the addition of a possible modifier.

4.10 Validity and reliability of the study

According to Bothma (50), validity "indicates whether the conclusions of the study are justified based on the design and interpretation" and reliability represents "the consistency of the measure achieved." For a test to be reliable it must be valid.

The validity and reliability of this study will be ensured by the following measures:

- the research design being appropriate
- a representative sample of the department being used by targeting a minimum of 60% of the anaesthetists
- the data collection sheet has content and face validity
- data contamination is prevented by the researcher being present at the time of data collection
- when collating the data, every tenth data entry point will be checked
- data will be analysed in consultation with a biostatistician.

4.11 Potential limitations of the study

Limitations are the shortcomings, conditions or influences that the researcher may not be able to control, which could affect the results of the study (48).

Some possible limitations include:

- the use of hypothetical adult patient scenarios may be more difficult to assess than real patients. Also, from the literature review, the researcher identified possible scenarios which had posed as problems previously, and these were then adapted for use.
- this study is done contextually and may not be generalisable to other departments of anaesthesiology
- convenience sampling might not be representative of the entire department.

4.12 Project outline

Activity	May 2015	June 2015	July 2015	Aug 2015	Sept 2015	Oct 2015	Nov 2015	Dec 2015	Jan 2016	Feb 2016	Mar 2016
Proposal											
Literature review											
Proposal submission											
Ethics approval											
Postgrad Approval											
Data collection											
Data analysis											
Article											
Submission											

4.13 Financial plan

The Department of Anaesthesiology will bear the cost of printing and paper for the proposal, ethics and postgraduate approvals.

Description	**Number**	**Cost**	**Total**
Printing	1000	60c/page	R600
Binding	3	R150	R450
Total			R1050

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Appendices

Appendix 1: Information sheet

Dear colleague,

Good day, my name is Zaheera and I am a registrar in the Wits Department of Anaesthesiology. For the fulfilment of my M Med degree, I am conducting a study entitled “Inter-rater variability between anaesthetists when classifying patients using the American Society of Anesthesiologists Physical Status (ASA-PS) classification system”. This study has been approved by the post-graduate committee and Human Research Ethics Committee (HREC) certificate number and I would like you to participate in this research study.

The ASA-PS classification system is well-known and used often when communicating with regards to a patient’s physical state. Often a drawback is the subjectivity found in the classification system. This study aims to determine the variability that may exist between anaesthetists when classifying patients according to the ASA-PS classification system with the use of ten hypothetical adult patient scenarios.

Participation is voluntary and consent is implied by return of the questionnaire. All information provided is confidential and will only be viewed by me and my supervisors. Anonymity will be maintained as no personal information is required, with numbering used for data purposes in order to keep track of data collected and it will not be used as a means of identification. There will be no incentive for participating and no penalty for non-participation or withdrawal.

All questionnaires completed or not, should be placed in the sealed box. This questionnaire should not take longer than 15 minutes to complete and participants are encouraged not to share the information provided with each other as this may give an inaccurate representation of inter-rater variability. Before completion of this survey, please ensure that you understand the above information.

Any questions regarding this study can be directed to myself, Zaheera, on 0735554329 or to the chairperson of the HREC on 011 717 2301.

Your time is greatly appreciated.

Thank you.

Sincerely,

Zaheera Jalaluddin Soni

Appendix 2: Questionnaire

Section 1: Demographics

Please provide the following information by placing an X in the appropriate box.

1. Gender:

Female		Male	

2. Position held:

Medical Officer	
Registrar	
Career medical officer	
Consultant	

3. Number of years of anaesthetic experience:

< 5 years	
6-10 years	
11-20 years	
>21 years	

4. Do you find the American Society of Anesthesiologists Physical Status (ASA-PS) classification system helpful in daily practice?

Helpful		Somewhat helpful		Not helpful	

5. Do you see the ASA-PS classification system as an anaesthetic or surgical risk indicator or both?

Surgical risk indicator only	
Anaesthetic risk indicator only	
Both surgical and anaesthetic risk indicator	
Neither of the two	

"Inter-rater variability" means the difference that exists if two anaesthetists had to classify the same scenario.

6. A modifier is the addition of a "G" for pregnant patients, similar to the addition of "E" for emergency cases. Do you think the addition of a modifier would decrease inter-rater variability?

Yes		No	

7. Another form of modification would be dividing the ASA-PS classification into subclasses i.e. ASA-PS 1 could be divided into ASA-PS 1a and 1b. Do you think that this would decrease the inter-rater variability?

Yes		No	

8. What do you think could decrease the inter-rater variability in the ASA-PS classification?

_____
_____
_____
_____
_____

Section 2: Hypothetical adult patient scenarios

Please place an X in the box that you think corresponds to the patients ASA-PS classification.

Example

An 18 year old young man who is previously healthy is involved in a motorbike accident. He sustains a tibial fracture with an acute abdomen.

ASA-PS	*X1*	*2*	*3*	*4*	*5*	*6*	*XE*

Scenario 1

A 65 year old gentleman is admitted for an elective repair of his inguinal hernia. He has smoked 25 cigarettes a day for the last 45 years. He gets breathless on climbing a single flight of stairs. On examination his chest is clear. His chest x-ray shows mild hyperinflation, his FEV1 is 80% and FEV/FVC ratio 60%.

ASA-PS	1	2	3	4	5	6	E

Scenario 2

A 50 year old gentleman is admitted for elective tendon release. He has stable angina for the last eight years which was treated with sublingual nitroglycerine, but suffered a myocardial infarction two months ago. On examination his BP is 180/90 mm Hg, with a grade 4 systolic murmur over the aorta, q waves in leads 2,3, AVF with left ventricular hypertrophy.

ASA-PS	1	2	3	4	5	6	E

Scenario 3

A 23 year old previously well lady presents with an emergency ruptured ectopic pregnancy. This is her second pregnancy at eight weeks gestation. She is clinically pale, hypotensive, sweaty and tachycardiac. Her blood gas shows a haemoglobin of 7, 8 g/dl and base excess of -5

ASA-PS	1	2	3	4	5	6	E

Scenario 4

A 16 year old young man presents with a blocked ventriculoperitoneal (VP) shunt. He had a previous anaesthetic when he was five months old for VP shunt insertion. He is in grade ten in school and has had no complications until now. He has presented with headaches, vomiting and blurred vision.

ASA-PS	1	2	3	4	5	6	E

Scenario 5

A 45 year old lady presents to the ward for benign lipoma to be removal from her back. She was diagnosed with human immunodeficiency virus (HIV) three years ago and has been receiving treatment ever since (HAART). She also had pulmonary TB and completed six months of treatment. Currently her CD4 count is 367 with an undetectable viral load. She is clinically well on examination.

ASA-PS	1	2	3	4	5	6	E

Scenario 6

A 36 year old gentleman is a newly diagnosed HIV positive patient presenting with a perianal abscess. On examination he is ill looking with oral candida and multiple skin lesions. He has had severe gastroenteritis with corrected electrolyte abnormalities.

ASA-PS	1	2	3	4	5	6	E

Scenario 7

A 19 year old lady is pregnant for the first time. She has no other comorbidities and it has been an uneventful pregnancy. She presents in labour at 38 weeks gestation age, requesting an epidural.

ASA-PS	1	2	3	4	5	6	E

Scenario 8

A 40 year old lady is scheduled for a laparoscopic cholecystectomy. Her BMI is 35. She has no other co-morbidities with a relatively good effort tolerance. She does not suffer from sleep apnoea, is a non-smoker, normotensive and does not have any daytime somnolence.

ASA-PS	1	2	3	4	5	6	E

Scenario 9

A 21 year old Down's syndrome lady presents for an elective skin graft after burning her hand with hot water. She has no cardiac defects or any other illness. She is mentally delayed and has never attended school.

ASA-PS	1	2	3	4	5	6	E

Scenario 10

A 75 year old gentleman is booked for a transurethral resection of the prostrate. He currently experiences minimal urinary obstruction with no renal impairment. He is a farmer and still works on his farm ploughing. Thirty years ago he had an appendectomy with no residual complications. Examination reveals a fit gentleman who does not look his age.

ASA-PS	1	2	3	4	5	6	E

SECTION 5: APPENDIX

R14/49 Dr Zaheera Jalaluddin Soni

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M150708

NAME: (Principal Investigator)	Dr Zaheera Jalaluddin Soni
DEPARTMENT:	Anaesthesiology
PROJECT TITLE:	Inter-rater Variability between Anaesthetists when Classifying Patients using the American Society of Anesthesiologists Physical Status Classification System
DATE CONSIDERED:	31 July 2015
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Helen Perrie
APPROVED BY:	Professor A Woodiwiss, Co-Chairperson, HREC (Medical)
DATE OF APPROVAL:	27/08/2015

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

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House, University.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**.

Principal Investigator Signature

Date 17/9/15

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

Private Bag 3 Wits, 2050
Fax: 027117172119
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07 January 2016
Person No: 0400189W
PAG

Dr ZJ Soni
P O Box 96099
Brixton
2019
South Africa

Dear Dr Soni

Master of Medicine: Approval of Title

We have pleasure in advising that your proposal entitled *Inter-rater variability between anaesthetists when classifying patients using the American Society of Anaesthesiologists Physical Status (ASA-PS) classification system* has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences