Anaesthetists' knowledge regarding the 2015 resuscitation guidelines at three academic hospitals in Johannesburg

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Of

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Declaration

I, Alexa Joslin Dal Lago, declare that this research is my own work. It is being submitted for the Degree of Master of Medicine in Anaesthesia at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other university.

Signed

At Johannesburg on this date

Abstract

Background

Cardiac arrest remains a significant cause of death in many parts of the world despite advances in medical technology and scientific research in the field of resuscitation.

Aim

The aim of this study was to describe the knowledge profile of anaesthetists in the faculty of Health Sciences at Wits regarding the 2015 resuscitation guidelines: interns, medical officers, registrars, consultants were included in the study. The study focused on the course material found in the BLS, ACLS, PALS courses from the Resuscitation Council of South Africa.

Method

A prospective, observational, transversal, research design was used.

Data was collected in the form of an anonymous questionnaire, which was distributed at the departmental academic meetings. Information collected included basic demographics, resuscitation course qualifications, and 25 multiple choice questions based on coursework from the 3 resuscitation courses mentioned above. The questions were specifically structured to highlight the knowledge of the changes in the guidelines from its previous version.

Results

One hundred and sixty-eight (168) participants were entered into the study. Overall knowledge levels were low with only 7.1% of the participants having adequate

knowledge (scoring 80% or above). BLS, ACLS and PALS courses were completed by 136, 116 and 70 participants respectively. Of the participants who had completed these courses, 28.4%, 20.7%, 11.2% were current in their certification in the respective courses mentioned above.

A statistically significant difference was found in the comparison of knowledge levels of certified compared to non-certified anaesthetists. The number of participants who had adequate knowledge in the certified group was 8 (14.5%) compared to 4 (3.5%) in the non-certified group knowledge ($p= 0.010$). The mean of correct answers in the certified group was 67.13 vs 56.88 in the non-certified group ($p<0.05$) with 95% Confidence interval of 3.6, thus indicating that certified anaesthetists had higher resuscitation knowledge levels than non-certified anaesthetists.

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List of abbreviations and acronyms

ACLS	Advanced Cardiovascular Life Support
AED	Automatic External Defibrillator
AHA	American Heart Association
ALS	Advanced Life Support
ATLS	Advanced Trauma and Life Support
BLS	Basic Life support
CMSA	Colleges of Medicine of South Africa
CPR	Cardiopulmonary resuscitation
DA	Diploma in Anaesthetics
ERC	European Resuscitation Council
ILCOR	International Liaison Committee on Resuscitation
PALS	Pediatric Advanced Life Support
ROSC	Return of spontaneous circulation
RCSA	Resuscitation Council of South Africa
SASA	South African Society of Anaesthesiologists
WITS	University of the Witwatersrand

Chapter 1: Overview of the study

1.1 Introduction

In this chapter an overview of the study is given that includes the background to the research problem as well as the problem statement. In addition, the aims and objectives, research assumptions, ethical considerations, as well as the proposed methodology will be discussed. A brief mention of the significance of the study and the validity and reliability will be made. Lastly, an overview of the research report will be made.

1.2 Background

Despite advances in medical technology and scientific research in the field of resuscitation, cardiac arrest remains a significant cause of death in many parts of the world. Approximately 209000 people in the United States suffer a cardiac arrest in hospital every year, and despite resuscitation attempts, survival rates are only about 18-25%, according to the American Heart Association (AHA). (1, 2)

Over the years, various attempts have been made by individuals or groups of individuals to produce guidelines, starting with the first documented guidelines for cardiopulmonary resuscitation (CPR) being published by the AHA in 1966. These guidelines have been based on trial and error, tested hypotheses and presumptions regarding resuscitation methodology ranging from basic airway management, to closed chest cardiac compressions and later electrical defibrillation. (3) Since the inception of CPR as a formal concept, there has been an ever-increasing demand for training and a move toward an international consensus for a standardized guideline that encompassed input from various international scientific communities.

The Advanced Life Support (ALS) guideline (4) was one such guideline developed by both the AHA and European Resuscitation Council (ERC), in conjunction with the International Liaison Committee on Resuscitation (ILCOR). The guidelines have evolved over the years, based on the expert opinion and most current scientific evidence and although continually revised, are updated and published every five years.

The most notable changes in the guidelines took place between the 2005 and 2010 editions. Major changes like the sequence of CPR from airway-breathing-circulation (A-B-C) to circulation-airway-breathing (C-A-B) were made, in addition to greater emphasis on CPR and changes in electrical defibrillation rates for ventricular fibrillation (VF). In addition, the 2010 guidelines included a new chapter on education and implementation, which highlights the value of educating resuscitation providers to optimize positive outcomes in CPR. (5)

The latest edition of the resuscitation guidelines that were released in October 2015 saw more subtle changes compared to the 2010 guidelines, with a few additional chapters (first aid, special circumstances, and special causes amongst others). Core components of the management of CPR remain the same: early detection of cardiac arrest and rapid initiation of correctly performed uninterrupted CPR and early defibrillation of shockable rhythms. However, additional changes include airway management options based on the skill level of the provider, waveform capnography monitoring during resuscitation, as well the omission of vasopressin and atropine as part of the drugs administered. Novel methods like using ultrasonography to aid in narrowing down possible causes of cardiac arrest as well as extracorporeal CPR (ECPR) have also been introduced. (6)

Based on these ALS guidelines, the AHA developed the Basic Life Support (BLS), Advanced Cardiovascular Life Support (ACLS), and Pediatric Advanced Life Support (PALS) courses, designed to train healthcare professionals (and lay people) to provide high quality CPR. In South Africa, these courses are administered under the umbrella of the Resuscitation Council of South Africa (RCSA). The RCSA has adapted the course whilst maintaining the core principles to work together with local culture and it's economy. (7)

CPR training comprises of two levels: BLS which is basic CPR that can be taught to a spectrum of people from a lay person to a medical professional and does not have any pre-requisites. (8) ACLS consists of an advanced management approach to cardiac arrest victims in both the peri-arrest and post-resuscitation period. ACLS builds on the foundation of BLS, but has additional components that may require specialized equipment, drugs and invasive techniques in the protocol and are intended for use by healthcare professionals only. (9)

The benefit of training and adherence to ACLS guidelines is reported on using the two most measured outcomes of CPR namely return of spontaneous circulation (ROSC) and survival to discharge rate. Camp et al. (10) published a landmark paper about a retrospective study in a rural hospital that followed the survival to discharge rate before and after an ACLS teaching program intervention was instituted in the first 10 years post-ACLS course development. This was the first study of its kind to demonstrate an increase in cardiac arrest survivors, after the intervention, that was statistically significant. Other studies contributed to the ACLS training momentum. (11, 12) In Brazil it was shown that long term survival from in-hospital cardiac arrest (IHCA) improved when ACLS trained individuals were part of the responding team. (13) These studies (11-13) prove that there is a definite correlation between the level of

knowledge of the ALS guidelines and the effective implementation thereof, thereby resulting in positive outcomes.

The three main factors that ILCOR has found that influences the outcome from cardiac arrest are: guideline quality (science), 'chain of survival' (local implementation), and the quality of the education given to CPR providers (education). (14) It therefore goes to show that implementation of clinical guidelines can be impaired at any point within these three broad categories. (15) Some of the pitfalls in implementation include poor knowledge of the guidelines (16-19), inadequate training and performance in resuscitation (20-22), and a decline of knowledge over time from even as early as 6 months. (23, 24) McEvoy et al. (25) highlighted that in addition to adherence to protocols and guidelines, commission of wrong actions were just as detrimental as omission or ill-timed indicated actions.

Anaesthetists are assumed to be skilled in resuscitation, as much of the management of the airway, respiratory and circulatory systems which form the majority of daily general anaesthetic practice, overlap with the A-B-C components of resuscitation. (26) Compared with other specialties, anaesthetists may fare better in some aspects of resuscitation. (19, 27) Other specialties that see cardiac arrests more frequently may score better based on experiential learning as opposed to theoretical knowledge only. (21, 28, 29)

Studies done abroad among anaesthetists (26, 27, 30-33) have shown that resuscitation knowledge levels are low. On the African continent, studies done in Nigeria (34, 35) seem to agree. A study done locally at a tertiary hospital (29) has reiterated what the studies abroad have said: knowledge levels are low among

clinicians with regard to resuscitation guidelines. Moreover, there is a correlation between decreasing knowledge levels with increasing seniority. (30, 33)

Knowledge on ALS obtained during the undergraduate period has been shown not to influence overall knowledge level later on into postgraduate years due to poor postgraduate support. (21) South African Society of Anaesthesiologists (SASA) practice guidelines 2012 revision recommend that 'any doctor proposing to administer anaesthesia must be able to perform basic life support and advanced life support and resuscitation'. (36)

1.3 Problem statement

Poor outcomes achieved during resuscitation efforts for cardiopulmonary arrest may be due to lack of knowledge by anaesthetists regarding the current updates to the resuscitation guidelines. These resuscitation guidelines are reviewed and updated every five years with the most recent update being October 2015. This study seeks to determine the resuscitation knowledge levels of anaesthetists at three academic hospitals in Johannesburg. These hospitals include Charlotte Maxeke Johannesburg Academic Hospital (CMJAH), Chris Hani Baragwanath Hospital (CHBAH), and Helen Joseph Hospital (HJH)/ Rahima Moosa Mother and Child Hospital (RMMCH).

1.4 Aims and Objectives

Aim

To describe the anaesthetists' knowledge of the 2015 resuscitation guidelines at three academic hospitals in Johannesburg.

Objectives

The objectives of this study are to:

- describe anaesthetists' knowledge regarding the 2015 resuscitation guidelines
- determine the number of anaesthetists who have completed formal resuscitation courses (BLS/ ACLS/ PALS)
- determine the number of anaesthetists with current certification in the above-mentioned resuscitation courses
- compare the level of knowledge of resuscitation guidelines between:
  - Certified vs. non-certified anaesthetists
  - Junior vs. senior anaesthetists

1.5 Research assumptions

Anaesthetist: any qualified doctor working in the department of Anaesthesiology including interns, medical officers, registrars, and consultants.

Medical Officer (MO): a qualified doctor practicing 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. Includes community service doctors.

Registrar: a qualified doctor that is registered with the Health Professions Council as a trainee anaesthetist.

Consultant: a registrar that has successfully completed all the College of Anaesthetists of South Africa examinations, or equivalent, and meet all the criteria required to become a specialist. Career medical officers are included in this group.

Junior anaesthetist: are interns, medical officers, and registrars with less than 5 years of anaesthetic experience.

Senior anaesthetist: registrars, consultants, or career medical officers with 5 or more years of anaesthetic experience.

Adequate knowledge: will be taken as a score of 80% and above for the questionnaire used.

Current certification: refers to those having done a resuscitation course within a two-year period at time of data collection.

1.6 Ethical considerations

Approval to conduct the study will be obtained from the Human Research Ethics Committee (Medical) of the University of the Witwatersrand. (Appendix 3)

The study will be a knowledge-based study using an anonymous self-administered questionnaire (Appendix 2). Participation will be voluntary, and consent is implied by completion of the questionnaire. No identifying information will be requested of the participants. Only the researcher and supervisors will have access to the raw data. These measures will ensure anonymity and confidentiality

1.7 Research methodology

1.7.1 Research design

A prospective, observational, transversal, research design will be followed. There will be descriptive and comparative components to the study.

1.7.2 Study Population and sample

All interns, MOs (including community service MOs), registrars and consultants in the department of Anaesthesiology at Wits (CMJAH, CHBAH, HJH/ RMMCH) will be included in the study.

Of the 219 Anaesthetists in the Department of Anesthesiology, only 60% of the staff will receive the questionnaire since at any given time 30% of the total complement is either pre- or post-call or rotating to outlying areas like Klerksdorp or to ICU. Thus, the sample will be a total of 140 doctors. It is hoped that by using multiple handout sessions a sample size close to the maximum can be reached.

Inclusion criteria are:

- All anaesthetists attending the department's academic meetings
- All who are willing to participate

Exclusion criteria:

- Blank questionnaires

Incomplete questionnaires will be included but a mark of zero will be allocated to unanswered questions

1.7.3 Data collection methods and technique

Data will be collected by means of a knowledge-based, self-administered, multiple choice questionnaire (Appendix 2). The questionnaire has been formulated based on the 2015 South African Resuscitation Council guidelines (which are based on AHA BLS/ ACLS/PALS guidelines.)

The questionnaire will comprise a demographic component, as well as a knowledge component, which will seek to elicit knowledge of some of the salient changes to the resuscitation guidelines.

Before distribution of the questionnaires, all questionnaires will be numbered to keep track of questionnaires completed, and to calculate a response rate.

Data will be collected at the Department of Anaesthesiology's academic meetings. It may be necessary to collect data at multiple meetings to account for those people that may not attend the meeting due to rotation/ pre-/post call to maximise sample size. The researcher will approach the chairperson for permission to address the meeting. The researcher will explain the aim of the study and invite participation.

An information letter (Appendix 1) describing the study aims and objectives will accompany the questionnaire. Questionnaires will be distributed, and anaesthetists can decide whether to participate or not. Consent will be implied by completion of questionnaire. The questionnaire will take approximately 10 minutes to complete. The researcher will be present during completion of the questionnaire to assist with queries and to prevent data contamination.

After completion of the questionnaire, the participant will place the questionnaire into a sealed box for collection.

1.7.4 Data analysis and interpretation

Data will be entered on a Microsoft Excel® spread sheet and analysed using descriptive and inferential statistics. Categorical data will be summarised using frequencies and percentages. Continuous variables will be described using means and standard deviations or medians and interquartile ranges depending on the distribution of the data. Comparisons between groups will be analysed using Chi^2 test for categorical variables and an unpaired t-test for normal distributed data, or Mann-Whitney for skewed data. A *p* value of <0.05 will be taken as statistically significant. A mark of 80% will be deemed as adequate knowledge for the questionnaire.

1.8 Significance of study

No study similar to this one has been conducted in these academic hospitals in Johannesburg. Currently, it is possible to specialise in Anaesthesia at the University of Witwatersrand and the College of Anaesthetists without formal certification in resuscitation (37).

This study may raise awareness regarding the need for ongoing training in resuscitation and increase patient safety in those undergoing CPR as well as improving overall resuscitation outcomes.

1.9 Validity and reliability

This study will maintain validity and reliability by:

- using a questionnaire that has been formulated based on the 2015 South African Resuscitation Council BLS/ACLS/PALS guidelines, and which has been validated by Professor Walter Kloeck (certified BLS/ACLS/PALS instructor).
- having the researcher present during the completion of questionnaire to answer any questions and prevent data contamination
- maintaining anonymity in participants, ensuring a non-threatening environment
- checking every tenth data entry point on the spreadsheets for accuracy.

1.10 Limitations of the study

There is a reported 1.5 year delay in implementation of revised guidelines. (38) At the time of proposed data collection it may be one year since release. It therefore leaves an opportunity for a follow-up study of a similar nature to be conducted to see if there is any change in the results.

Convenience sampling will be used so there might be the possibility of under- or over-responses.

The study is contextual to Wits.

1.11 Outline of the research report

The outline of the research report is as follows:

Chapter 1	Overview of the study
Chapter 2	Literature review
Chapter 3	Research methodology
Chapter 4	Results and discussion
Chapter 5	Summary, limitations, recommendations and conclusions

1.12 Summary

In this chapter an overview of the study was given that included the background to the research problem as well as the problem statement. In addition, the aims and objectives, research assumptions, ethical considerations, as well as the proposed methodology was discussed. A brief mention of the significance of the study and the validity and reliability was made. Lastly, an overview of the research report was given. In the next chapter, a review of the literature with regards to this topic will be given.

Chapter 2: Literature review

2.1 Introduction

Cardiac arrest remains a significant cause of death in many parts of the world despite advances in medical technology and scientific research in resuscitation. Approximately 209000 people experience a cardiac arrest while in hospital in the United States every year, and despite resuscitation attempts, survival rates are only about 18-25%.(1)

Verified protocols for the management of this potentially fatal, yet reversible condition exists.

2.2 History of CPR

The advent of CPR, from ancient times to present day CPR, results from the evolution of scientific developments in the fields of basic life support, advanced life support and later, prolonged life support.

The account in the Old Testament of the Bible makes reference to the resuscitation of a boy by the prophet Elijah, and this may very well be the first documented report of artificial respiration (39).

Further discoveries by Vesalius in the 1500's was made regarding crude forms of artificial respiration and airway control by placing a reed in the airway of animals as a means of life support while studying them. In the early 1700's William Tossach, a British surgeon, documented mouth-to-mouth resuscitation on a miner overcome by fumes from a coal fire. Mouth-to-mouth resuscitation was not favoured because of hygienic reasons so other means of artificial respiration were introduced. The superiority of mouth-to-mouth resuscitation over other manual methods was demonstrated in a definitive study published by Safar in 1958. (40)

The 1800s saw the development of cardiac massage. Initially closed chest cardiac massage was attempted and after unsuccessful attempts, was replaced by open chest cardiac massage. The first successful closed-chest cardiac massage in a person was achieved in 1892 by Friedrich Maass. However it was only in 1960 that closed-chest cardiac massage gained popularity, when Kouwenhoven et al reported a 70% survival rate in 20 patients ranging from ages 20 months to 80 years. (40)

With the advent of electricity in the mid-1700s and the discovery of its effect on muscle tissue, developments in the field of electrical resuscitation began. The first successful internal defibrillation of a human heart was performed in 1947 by Claude Beck in an operating theatre. The first human external defibrillation came much later in 1956 by Zoll et al. The first portable automatic external defibrillator (AED) was developed in 1979. (40, 41)

CPR as we know it today, is a culmination of the work of Kouwenhoven et al. and Safar in combining mouth-to-mouth resuscitation and chest compressions in 1960. Two years later, the mnemonic A-B-C was coined as a means to remember the sequence of the steps of CPR, Airway, Breathing, and Circulation. In 1963 the American Heart Association (AHA) formally acknowledged CPR, and by 1966 over 30 national organizations attended the first CPR conference. From there, the concept of CPR spread globally, with conferences held internationally in various countries as resuscitation organizations faced the growing need for CPR training. (42)

2.2.1 Guidelines:

2.2.1.1 History and formation

Since the inception of CPR as a formal concept in 1966, there has been an ever-increasing demand for training and a move toward an international consensus for a

standardized guideline that encompassed input from various international scientific communities. This stemmed from the fact that as the CPR movement gained momentum internationally, the various sites began to try different resuscitation techniques and other training methods. (42)

This led to the formation of the International Liaison Committee on Resuscitation (ILCOR) in 1992, to coordinate international research and scientific evidence behind resuscitation standards and guidelines, and to ensure the various international resuscitation organisations had published advisory statements to update their guidelines and maintain uniformity. (42)

The Advanced Life Support (ALS) guideline (6) is one such guideline developed by both the AHA and European Resuscitation Council (ERC), in conjunction with ILCOR. The guidelines have evolved over the years, based on the expert opinion and most current scientific evidence and although continually revised, are updated, and published every five years. (6)

2.2.1.2 Evolution of guidelines

Periodic revisions were made with the most recent occurring in 2015. These guidelines have been based on trial and error, tested hypotheses and presumptions regarding resuscitation methodology. These include basic airway management, closed chest cardiac compressions and later, electrical defibrillation. (43)

The most notable changes in the guidelines took place between the 2005 and 2010 editions. Major changes like the sequence of CPR from airway-breathing-circulation (A-B-C) to circulation-airway-breathing (C-A-B) were made, in addition to an emphasis on the quality of CPR and changes in electrical defibrillation rates for ventricular fibrillation (VF). In addition, the 2010 guidelines included a new chapter on ‘education

and implementation', which highlighted the need for increased education to resuscitation providers to optimize positive outcomes in CPR. (6)

2.2.1.3 Current guidelines

The latest edition of the resuscitation guidelines that were released in October 2015 saw more subtle changes compared to the 2010 guidelines. The focus was mainly on areas with new scientific developments or that were currently controversial in resuscitation. It is therefore seen as more of an update to rather than a replacement of the 2010 guidelines. (6)

A few new chapters were added. Of particular note one chapter recognized that to achieve good outcomes in resuscitation there are multiple inter-dependent working parts and have an effect on the other aspects of care in that system. It also elucidated the fact that out-of-hospital cardiac arrest (OHCA) is different form in-hospital cardiac arrest (IHCA) in terms of the system of care. OHCA has been noted to be the result of an unexpected event to which there is a reaction, whereas the focus of IHCA has shifted from reaction to an event to prevention of said event. (44)

Another new chapter worth mentioning focuses on evidence-based recommendations to improve implementation of the guidelines into practice in both lay-rescuers and healthcare providers. Additional chapters include: first aid, special circumstances, and special causes, amongst others. (45)

Core principles of CPR remain the same:

- early recognition of arrest
- rapid initiation of high-quality uninterrupted CPR
- early defibrillation if a shockable rhythm is present.

A few specific changes to the 2015 guidelines (6) include the following:

- Chest compressions

Changes to the rate and depth have been made based on evidence suggesting that a rate of 100/min to 120/min is optimal. A rate of more than 120/min may result in shallower depth thus resulting in ineffectual compressions (46). On the other hand, compressions that exceed the 5-6cm recommendation carry the risk for potential injury due to excessive depth. (47)

Residual leaning (sustained pressure over the victim's chest between compressions) has been identified as another factor that may compromise high quality CPR (48) by impairing venous return to the heart, that would occur in the decompression phase. Full chest recoil is essential to allow for optimal blood flow back to the heart, and thus for adequate cardiac output.

- Ventilation :

During cardiac arrest, delivery of oxygen to the lungs is achieved through various artificial means of ventilation: mouth-to-mouth, mouth-to-mask, bag-valve-mask (BVM), and endotracheal tube. Studies have not shown any superiority of more complex methods of ventilation regarding improved outcomes. (47). Compression only CPR has obtained similar results with regard to outcomes compared to standard CPR, suggesting the ventilation component of CPR only becomes a significant factor when the cause of the arrest is respiratory in nature. However, the AHA still supports the use of ventilation in the 30 compressions to 2 ventilations ratio, with ventilation generating minimal chest rise to reduce the risk of hyperinflation. (6)

- Timing:

Timing of components in high quality CPR revolve around the reduction of down-time. Because chest compressions are the sole means by which blood flow is generated during a cardiac arrest, any interruption in compressions interrupts this vital factor. In adult cardiac arrest, interruptions in chest compressions should minimized between defibrillation because fewer pauses have been shown to result in greater success in restoring sinus rhythm, return of spontaneous circulation (ROSC) and, in some studies, higher survival to hospital discharge. (49, 50).

The 2015 Guidelines Update has re-emphasised the need to reduce such pauses (6) Pauses include stopping to check for pulses, changing over of people doing compressions and rhythm analysis. These delays in resumption of chest compressions have been shown to reduce the chances of survival and increase the incidence of neurological sequelae. (51) It is estimated that for every minute of brain ischaemia, about two million neurons are lost and thus irreversible neurological damage occurs within 4-5 minutes of cessation of cerebral blood flow. (52)

- Early defibrillation

The early detection of shockable rhythms and the appropriate administration of defibrillation when indicated in a resuscitation scenario has been proven to improve outcome in CPR. (53) Data suggests that the likelihood of survival is reduced by 7-10% per unit of time of untreated ventricular fibrillation. (40) The AHA thus recommends shock within three minutes of collapse as supported by evidence of a study of resuscitations in casinos by Valenzuela et al. (54) who reported a survival to hospital discharge rate of 74% if patient was defibrillated within three minutes of a cardiac arrest.

- Other changes

Additional changes include more advanced airway management options based on the skill level of the provider, waveform capnography monitoring during resuscitation, as well the omission of vasopressin and atropine as part of the drugs administered. Novel methods like using ultrasonography to detect reversible causes of cardiac arrest as well as extracorporeal CPR (ECPR) have also been introduced. (6)

2.3 Life support Courses

Based on these ALS guidelines, the AHA developed various courses and protocols which are supported by ILCOR. In South Africa, these courses are administered under the umbrella of the RCSA. The RCSA has adapted the AHA course curriculum to work together with the local culture and economy whilst maintaining the core principles. Courses are administered at various centres around the country by AHA certified providers so that integrity of the course is maintained. (7)

2.3.1 Basic Life Support (BLS)

The BLS course teaches participants the skill of basic CPR as well as how to manage choking in both adults and children as well as ventilation using various methods including bag-mask-valve ventilation in addition to the appropriate use of an AED. BLS can be taught to a spectrum of people from a lay person to a medical professional and does not have any pre-requisites. Certification in BLS involves a 36-lesson course facilitated by a certified BLS instructor, where students are allowed to practice in simulated clinical scenarios and learning stations, after which a written and skills test is administered. Recertification is required every two years. (8)

2.3.2 Advanced Cardiac Life Support (ACLS)

ACLS covers a more advanced management strategy for cardiac arrest victims, peri-arrest circumstances as well as post-resuscitation aspects. ACLS builds on the foundation of BLS, with emphasis on continuous high-quality CPR, but has additional components that may require specialized equipment, drugs and invasive techniques in the protocol and are intended for use by healthcare professionals only. BLS is a pre-requisite for ACLS. (9)

Certification for ACLS is obtained by completing an AHA approved provider course. Mandatory pre-reading is expected, and four to six weeks before the actual course, a provider manual is sent to the participant. An entry exam in the form of multiple-choice questions is administered on the first day of the course and a pass mark of 70% is required as entry to the course. The course itself comprises of two days of didactic teaching, small group instruction on equipment and skills, as well as resuscitation scenarios. A practical exit exam is mandatory at the end of the course, in which the participant must demonstrate mastery of the algorithm-based management protocols with a pass mark of 80%. As with BLS, recertification interval is also two years. (9)

2.3.3 Paediatric Advanced Life Support (PALS)

The PALS course uses a combination of multi-media resources and simulation-based paediatric emergency scenarios to equip the participant in assessment of paediatric emergencies, paediatric BLS, PALS treatment algorithms and a team-based approach to paediatric resuscitation. This course also requires pre-reading of instructional manuals and is run over two days, encompassing small group teaching and interactive feedback sessions. (55)

2.4 Outcomes

The benefit of training and adherence to ACLS guidelines is reported on using the two most measured outcomes of CPR namely 1.) ROSC and 2.) survival to discharge rate.

2.4.1 Positive outcomes after ACLS

Camp et al. (10) published a landmark paper about a retrospective study in a rural hospital that followed the survival to discharge rate before and after an ACLS teaching program intervention. This was instituted just ten years after the first ACLS guideline was published in 1974 and it was the first study to demonstrate increased numbers of cardiac arrest survivors of statistical significance after the intervention. The study reported an increase of almost six-fold, having 17.3 per year at the end of the study from an average of 3.0 per year in the initial phase.

A similar study by Lowenstein et al. (11) looked at short term survival rates in a series of 90 cardiac arrests in two six-month periods before ACLS training (1979- 1980) and after ACLS training (1982-1983). An improvement in short term survival rate (ROSC) of about 30 % was noted after ACLS training.

Other studies contributed to the ACLS training momentum, both in rural and urban settings. Sanders et al. (12) looked at cardiac arrests in a 13 -month period pre- and post- ACLS training policy institution at a rural hospital in Southern Arizona and found an improvement in resuscitation rates and long term survival in both IHCA as well as OHCA.

In Brazil it was shown that there was an increase in ROSC from 27.1% to 43.4% and improved long-term survival from IHCA when ACLS-trained individuals formed part of the responding team. There was both an increase in 30 day survival as well as

improved one year survival in the group of patients treated by ACLS-trained personnel. (13)

A similar study in India a few years later compared the outcomes of resuscitations after IHCA in the two eight-month time periods before and after BLS/ACLS training was instituted respectively. The total number of IHCA assessed was 627 during this time period, 284 pre- and 343 post-BLS/ACLS training periods respectively. ROSC was achieved in 52 patients (18.3%) in the period before BLS/ACLS training, compared with 97 patients (28.3%) after the resuscitation training was introduced ($p < 0.005$). Survival to hospital discharge was also significantly higher in the latter group (67 patients, 69.1%) than in the former group (12 patients, 23.1%). (56)

In a non-teaching hospital in Greece, Chalkias et al. (22) found the immediate survival and 24hr survival rate to be much lower than the standard at only 15.6%. This study inferred that because most of the arrests were treated by a non-ACLS certified provider, they achieved less successful resuscitations, took longer to initiate CPR, and took longer time to achieve ROSC in both shockable and non-shockable rhythms as compared to their ACLS-certified counterparts.

Positive outcomes were not only achieved with ACLS-trained physicians but even the presence of a nurse trained in ACLS had a four times higher rate of survival to discharge as published by Dane (57). This may be a pivotal factor in achieving better resuscitation outcomes during in-hospital cardiac arrests as nurses are usually stationed in the wards and are therefore first responders to cardiac arrest, thus initiating resuscitation protocols earlier.

These studies (11-13, 56) prove that there is a definite correlation between knowledge of the ACLS guidelines and the effective implementation thereof, thereby resulting in positive outcomes.

2.4.2 Factors influencing outcomes

ILCOR identified three factors that influence the outcome from cardiac arrest namely

- guideline quality (science),
- 'chain of survival' (local implementation), and the
- quality of the education given to CPR providers (education). (14)

Implementation of clinical guidelines can be impaired at any point within these three broad categories. (15)

2.4.2.1 Quality of guidelines (Science):

Many years of research and evidence-based medicine have gone into formulating and reviewing the guidelines and therefore the quality of guidelines is expected to be at the forefront of the scientific research community. Task forces and teams have been employed to continually investigate and identify possible knowledge gaps after each conference. Databases are searched for abstracts of relevant articles, which are graded according to level of evidence and classified according to the quality of the study. The evidence is then summarized into one of three categories namely 'supportive', 'neutral' or 'opposing'. Thereafter, a 'consensus on science statement' is made and a treatment recommendation is drafted, which is open to the scrutiny of the task forces to be reviewed, debated and edited. It is then left to the regional resuscitation organisations to formulate detailed clinical guidelines for practice. (42)

2.4.2.2 Local implementation (what is actually being done)

However scientifically sound a guideline may be, clinical implementation of said guideline is equally as important to achieve good outcomes. It is the responsibility of the local resuscitation organization to disseminate the guidelines. (58)

Historically it has been relied upon by spread through journals and scientific publications, however this has not shown to be effective in changing professional behavior. There remains a barrier in translating knowledge into practice. With advances in technology and social media, the internet and web-interactive tools have been capitalized on to disseminate information more efficiently. Full implementation can take up to 18 months to 5 years because time and resources are needed for both teaching and adapting to new guidelines. (58)

Ageron et al. (59) noted a cyclical change in the frequency and efficiency of CPR in relation to the publication of the new guidelines every 5 years. That, coupled with the fact that knowledge levels already start to decline even as early as 6 months from acquisition, has sparked the need for a more continuous, user-friendly interface between new science and updated guidelines. (58)

The development of standardized courses to facilitate resuscitation education has been an effective means of disseminating information. (58) The reality however, is that courses are only available from specialized AHA approved centres, at a cost, which may not always be feasible logistically and financially for many people, especially those in resource poor communities. (35) Due to the scarcity of these centres, the limited amount of spaces for these small-group courses tend to fill up quickly, often resulting in long waiting periods to get in.

Schmidt et al. (60) studied adherence to guidelines found that a lack of consistency with regard to course structure and retraining led to a delay in implementation of guidelines. With regards to compliance it has been found that if the guidelines are known, then the likelihood of proper implementation is high. (61) Many doctors may be found to be non-compliant or not adhere simply because they are ignorant of the current guidelines. (35)

Non-compliance or poor adherence may be more prevalent in countries where there is no formal resuscitation council or governing body to regulate resuscitation practices among doctors. For example, in Nigeria there is no formal resuscitation council and thus resuscitation training is often healthcare institution based. The task of resuscitation training is often left to the doctors in Anaesthetic departments to coordinate. Consequently, there is no mandatory laws on resuscitation training or recertification thereof. Doctors are thus not compelled to do training courses and even if previously done, may not recertify timeously. (35)

Zha et al. (62) did a recent survey to assess the resuscitative services in low and middle-income countries in Africa. Of the 17 referring hospitals in Nigeria that participated, only 26.7% of hospitals had a significant majority of physicians trained in BLS, and only a fifth of the hospitals contained 50% or more ACLS-trained physicians despite the fact that a large number of the 17 hospitals surveyed had an on-site resuscitation training programme.

Many studies showed improved outcomes in centres practicing ACLS protocols, but there has been an equal if not greater amount of literature documenting poor resuscitation knowledge, and in these cases, suboptimal knowledge translated into low skill levels in these individuals. (31, 33, 61, 63).

Filho et al. noted that out of 305 emergency physicians working at both public and private hospitals in Brazil, only 27% attended an ACLS course and their mean proportion of correct answers was 54% (mean of 12 out of 22 correct answers). (16)

In a study in Greece by Kyriakou et al. (18), it was found that despite resuscitation training being mandatory in the post-graduate training of all doctors, less than 50% of the 137 residents surveyed had attended a BLS course, and even fewer attended an ACLS training course. Of those that had attended a resuscitation course, the time that had passed since initial course attendance was more than three years thus rendering them not current with regards to certification. This translated into poor theoretical knowledge with less than 50% knowing the correct ratio of chest compression to breaths, only two thirds were able to recognize a shockable rhythm or were familiar with the ACLS algorithms for defibrillation and only one third knew defibrillation recommendations with regards to initial energy to shock.

A similar study at a teaching hospital in the West Indies by Howell et al. (19) looked at the resuscitation knowledge levels of 143 physicians using a knowledge questionnaire of the CPR guidelines at the time, and found knowledge level to be inadequate. Only 55% of participants got 50% or above, with less than 50% of the surveyed population being current with regards to certification.

A study measuring knowledge of healthcare workers in North-Kerala of BLS/ACLS guidelines was also found to be low, with mean scores of 44.5%, when compared to similar studies done in South India (41.6%), and Nepal (44%). (64)

On the African continent, Okonta et al. (34) surveyed the CPR knowledge level of house officers at a teaching hospital in Nigeria and found the level of knowledge to be poor with only 17% scored above 50% in the questionnaire.

Two separate studies in two different provinces in South Africa showed that resuscitation knowledge levels were poor among doctors. In the first study in a public hospital in the Northern Province only 5% of a sample size of 152 medical practitioners achieved the standard set of 80% with only a quarter reaching above 50%.(65) In the second study in a tertiary hospital in Pretoria of 100 doctors, a mean total score of 35.1% was obtained, which was far below the average expected score of 84%. (29)

The resuscitation knowledge levels has been shown to impact on CPR skill level as demonstrated by Brown et al. (61) where knowledge of the resuscitation guidelines did correlate with better CPR performance by emergency medical technicians. Bell et al. (31) and Iirola et al.(66) found similar correlations between lack of knowledge of guidelines regarding indications for defibrillation, and how this translated into delays for defibrillation when indicated, and thus worse outcomes in ROSC. Cowie et al. (33) in his study of anaesthetist's resuscitation knowledge at various levels of their anaesthetic training, found that 70% of the participants were unsure of the defibrillation protocol and this resulted in a 27% success rate in cardiac arrest scenarios that required defibrillation.

Many healthcare workers are also lulled into a false sense of feeling knowledgeable because they have at one point done a formal resuscitation course (29) but may not be current with regards to the certification. Even though knowledge of CPR is considered important to doctors (30), this fact is not supported by their education or current certification in CPR, as evidenced by the following literature on this topic.

Krajina et al. (27) noted that 45% of medical doctors, 48% of surgeons and 77% of anaesthesiologists claimed to have renewed their knowledge of CPR within 5 years of the study. One third of the medical doctors and a quarter of the surgeons reported

never having renewed their knowledge since medical school. Poor certification rates were also seen in a study that looked at current resuscitation certification by Howell et al. (19) where it was found that below 50% of the participants were current with regards to resuscitation certification. Botha et al. (29) and Saravan et al. (30) had similar results with only 31% and 27 % having current resuscitation certification respectively.

It is interesting to note that it has been mentioned in the literature that prior knowledge or experience of resuscitation may increase confidence levels in a resuscitation scenario, however, it does not necessarily translate into proficiency. (17, 29, 65)

Motor skill is known to decay faster than knowledge but repetition of a skill has been proven to reinforce and thus maintain the knowledge level. (21, 26)

In a study observing incidents regarding patient safety in England, Panesar et al. (67) documented that 'poor application of knowledge and skills' accounted for 37% of the weaknesses in the management of cardiac arrests. He further sub-categorized the reasons as 'poor ALS management' and 'failure to adhere to clinical guidelines'. Regarding 'poor ALS management': indecisiveness regarding recognition and poor decision-making by clinicians and nursing staff in a resuscitation situation, proved to be a major factor. With regard to 'failure to adhere to clinical guidelines': there was a lack of standardization demonstrated regarding management of cardiac arrest patients, for example delays in or omission of defibrillation when indicated.

McEvoy et al. (25) highlighted that in addition to adherence to protocols and guidelines, omission or ill-timed indicated actions were just as detrimental as commission of wrong actions. It has been shown that reduced survival rates of inpatients who experience IHCA in the US are more commonly associated with errors

in the resuscitation system. Avoidable pitfalls in cardiac arrest management included errors in staff education, monitoring of patients and recognizing change in clinical condition, and once deterioration was noted, if help was called for and if it resulted in rapid response. The most frequent system errors which require human effort included delays in administering the required medication, defibrillation, airway management and chest compression errors. (67)

2.4.2.3 Education

The benefit of ongoing education and improvement in the education systems in resuscitation training has been highlighted previously with the mention of the new chapter in the 2015 ACLS guideline. The focus on education is to identify areas where actual performance is not up to the standard of desired performance in both lay provider as well as healthcare provider CPR and to bridge the gaps. (6)

Some of the new recommendations include (45):

- The use of a CPR feedback device to facilitate the acquisition of the psychomotor skills required to perform CPR
- Using high-fidelity manikins to improve resuscitation skill and performance in programmes where resources are not a limiting factor.
- Blended learning formats which include video or computer-based modules. This self-instruction method has been found to achieve the same results as instructor-led courses and has been shown to be more cost-effective in resource-poor areas.
- Targeted training aimed at primary caregivers or families of high-risk patients to ensure early recognition and prompt initiation of CPR when indicated

- Expanded training for the use of AEDs to minimize the time to defibrillation
- Emphasis on team dynamics and its role in achieving good outcomes in the complex process of resuscitation
- Compression-only CPR as a simpler means to engage lay providers to initiate CPR in OHCA
- Decreasing the training interval in between resuscitation courses to account for decay in knowledge and skill over time

Inadequate training and performance in resuscitation remains a problem. Kiyan et al. (21) found that even though residents had received undergraduate ACLS training, it was inadequate with regards to duration and content and therefore, combined with a lack of postgraduate ACLS training to support undergraduate training, there was incompetence noted in the performance of CPR.

Yang et al. (24) did a systematic review of retention of adult ALS knowledge and skills in healthcare providers and has found deterioration starting from 6 months to a year. It was also noted that skill levels decline faster than knowledge levels and the recommendation was made for a review of the current retraining interval from two years to possibly sooner.

Frequent retraining may not be financially feasible, especially in resource-poor countries, therefore other alternatives were sought. As evidenced by the decline pattern, it was found that knowledge levels usually plateau after an initial steep descent, and the postulation was that if the plateau is at an acceptable level that is safe for patient care, further retraining may not be mandated intermediately. (24)

2.5 Why is it important for Anaesthetists to be knowledgeable?

The SASA practice guidelines 2012 revision (36) recommend that ‘any doctor proposing to administer anaesthesia must be able to perform basic life support and advanced life support and resuscitation’.

At present, no mandatory requirement for certification in resuscitation courses exists for the entrance as a registrar into College of Anaesthetists of South Africa, unlike in the surgical specialties like orthopedics and surgery where Advanced Trauma and Life Support (ATLS) certification is a requirement for entry into the registrar program. Wits doesn’t require certification for entry into any registrar programme. (37)

Anaesthetists are assumed to be skilled in resuscitation, as much of the management of the airway, respiratory and circulatory systems which form the majority of daily general anaesthetic practice, overlap with the A-B-C components of resuscitation (26) In addition, drugs used in the ACLS protocols are often used in theatre by anaesthetists. In a study done in Croatia by Krajina et al. (27) regarding the attitudes of doctors toward CPR, 69 of the 70 surgeons in the group and 79 of 93 medical doctors reported that they would call an anaesthesiologist for help in a resuscitation instead of their departmental colleagues.

In India, hospitals have a designated code team who are meant to respond to all IHCA alarms announced through a public announcement system in their hospitals. The team consists of an anesthesiology registrar, a medicine registrar, on-duty resident medical officer, attending staff nurse and nursing shift-supervisor. (56).

A nationwide study of all cardiac arrest teams in hospitals in Denmark by Lauridson et al.(68) showed that 66% of code teams consisted of an anaesthetist and in almost 100% of those teams, an anaesthetic nurse was responsible for providing airway

management. Similarly, in Croatia, Ruzman et al. (69) has alluded to the fact that their response team for cardiac arrests comprises of an anaesthesiologist as well as a nurse-anaesthetist. Even the Anaesthesiology department in their hospital is situated in a position that facilitates immediate access to high cardiac arrest-risk wards, to ensure rapid response to cardiac arrest scenarios.

AHA guidelines for the management of cardiac arrest in pregnancy include an obstetric anaesthesiologist or staff anaesthesiologist as part of their recommendations for the composition of the team involved in obstetric cardiac arrest. (70)

The focus in resuscitation medicine has shifted toward extra vigilance and recognition of at-risk people for IHCA, as well as rapid response system to initiating resuscitation, thus decreasing the burden of morbidity and mortality associated with IHCA. (50)

Tran et al. (71) looked at 627 IHCAs during an 8-year period and found that there was an improvement in both survival as well as neurological outcomes due to earlier recognition and improved resuscitation. This involves a multi-disciplinary approach toward pre-emptive resuscitation, where all parties involved in the patient's care are skilled in detecting clinical deterioration and intervening before progression to cardiac arrest.

Hajbaghery et al. (72) looked at all IHCAs in a 6-month period in 4 educational hospitals in Iran and found a correlation between CPR and time of day during which it occurred. The findings were that there was higher rates of both ROSC and survival to discharge in the group that were resuscitated during the day than at night and they attributed this to the fact that there is increased vigilance during the day, more staff on hand to attend to resuscitation attempt and faster response times to cardiac arrests than at night.

No literature was found to suggest the code system for cardiac arrests being used in South African hospitals. It is assumed that it falls upon the staff at hand to fulfill that role in a cardiac arrest scenario. In Nigeria, of the 15 hospitals surveyed by Zha et al. (62) regarding CPR practices, only 3 hospitals had a formal cardiac arrest response team. The response to the call for resuscitation was mostly left to the primary attending physician. As mentioned above, it is the perception among medical personnel that anaesthetists are better equipped to deal with resuscitation situations and are thus called to assist or even lead in a resuscitation attempt. (27)

2.5.1 Comparison with other specialties:

Compared to those who encounter resuscitation situations on a more regular basis than those who don't, there are some specialties that perform better than others: Emergency medicine physicians as well anaesthetists seem to have consistently scored higher in more than one study regarding resuscitation knowledge. (19, 21, 29)

Passali et al. (28) noted that healthcare workers in areas of the hospital with patients more prone to cardiac arrest like intensive care units, emergency departments and anaesthesiology departments, tend to be more motivated to maintain their resuscitation knowledge levels.

Other specialties that see cardiac arrests more frequently may score better based on experiential learning as opposed to theoretical knowledge only as they rely on training-on-the-job (19, 27). Kiyan et al. (21) noted that Cardiology residents had better resuscitation knowledge than two out of the total of four groups of residents assessed, even though they had the least post-graduate resuscitation training. This he attributed to improvement of knowledge by apprenticeship and use of ACLS principles in daily

practice. Even though Anaesthetists fare better than other specialties, overall knowledge levels are still low.

2.5.2 Experience as a factor

There is a correlation between decreasing knowledge levels with increasing seniority and a postulation has been made that more senior staff may not be as actively involved in resuscitations as junior colleagues (30). Brown et al. (61) has shown that years of experience does not equate to better performance in emergency medicine technicians. The hypothesis being that more senior people generally tend to be in managerial or non-clinical posts and may not frequently be exposed to resuscitation situations.

In Pakistan, first year medical students have a higher knowledge of resuscitation because of competition among high school students to get into undergraduate programmes. At school-level they are prepared for the field in which they plan to pursue a career and as such, are prepared for basic resuscitation scenarios. (63)

It was found by Cowie (33) that resuscitation knowledge increases in subsequent years of medical school due to repetition over the years in preparation for exams, however Kiyan et al. (21) found that knowledge on ALS obtained during the undergraduate period has been shown not to influence overall knowledge level later into postgraduate years due to poor postgraduate support. Saravan et al (30), in his study of 94 consultant anaesthetists in Bristol UK, found that only 27% were current in their ALS certification. Consultants may recognize the importance of life support skills as a core of anaesthetic skill and may have at one time in their careers attended a resuscitation course but may have failed to recertify for various reasons.

Cowie (33) documented how the level of training in anaesthesia affects the knowledge of resuscitation protocols among anaesthetists at a tertiary referral hospital in

Melbourne. They found that consultants performed sub optimally in the knowledge questionnaire achieving a median of three out of ten answers correct, with pooled correct answers of 42%. Junior anaesthetists scored a median nine out of ten correct, with pooled correct answers of 84%. The conclusion was however, that although consultants' knowledge may be poor, consultants may have superior technical skills which may still prove valuable in the management of cardiac arrest. However, a good knowledge base is needed to correctly teach and supervise resuscitation.

Howell et al.(19) found that rank was inversely related to resuscitation knowledge scores, with 83% of interns scoring on or above the median score compared to 25% of the consultants.

Thake et al.(73) surveyed the compliance with resuscitation training requirements of three groups consisting of 40 anaesthetists each of three differing grades. Consultant anaesthetists, trainees in anaesthesia and fourth year medical students from the Department of Anaesthetics in a hospital in Plymouth UK were thus assessed and resuscitation knowledge levels were compared between them. It was found that 15% consultants were currently certified vs 70% of trainees, and this was evidenced by far lower knowledge levels in the consultant group compared to the two groups. The knowledge of the correct chest compression: breath ratio as well as the correct numbers of shocks per cycle were assessed. Consultants scored 63% and 60% respectively. Trainees scored slightly better and achieved 88% and 89% respectively. Medical students scored the highest of the three groups in both categories and obtained 98% and 93% respectively.

2.6 Conclusion

From the literature above it is evident that cardiac arrest is still a major problem worldwide and that although the means to achieve better outcomes i.e. resuscitation guidelines exist, the knowledge thereof and thus implementation remains poor.

Chapter 3: Research methodology

3.1 Introduction

In this chapter, the problem statement, aims and objectives, ethical considerations, research methodology, validity and reliability will be discussed.

3.2 Problem Statement

Poor outcomes achieved during resuscitation efforts for cardiopulmonary arrest may be due to low knowledge levels by anaesthetists regarding the current updates to the resuscitation guidelines. The guidelines are updated every five years, with the most recent update being October 2015. The study seeks to determine the resuscitation knowledge levels of anaesthetists.

3.3 Aim and objectives

Aim

The aim of this study was to describe the anaesthetists' knowledge of the 2015 resuscitation guidelines at three academic hospitals in Johannesburg.

Objectives

The objectives of this study were to:

- describe anaesthetists' knowledge regarding the 2015 resuscitation guidelines
- determine the number of anaesthetists who have completed formal resuscitation courses (BLS/ ACLS/ PALS)
- determine the number of anaesthetists with current certification in the above-mentioned resuscitation courses

- compare the level of knowledge of resuscitation guidelines between:
    - Certified vs. non-certified anaesthetists
    - Junior vs. senior anaesthetists

3.4 Ethical considerations

Approval to conduct the study was obtained from the Human Research Ethics Committee (Medical) of the University of the Witwatersrand (Appendix 3).

The study was a knowledge-based study using an anonymous self-administered questionnaire. (Appendix 2)

An information sheet preceded each questionnaire which invited the anaesthetist to participate in the study after detailing the topic, aim and objectives as well as the ethical considerations. Participation was voluntary, and consent was implied by the participant's completion of the questionnaire. Completed questionnaires were collected in a sealed box.

No identifying information was requested of the participants and only the researcher and supervisors had access to the raw data, thus ensuring anonymity and participant confidentiality.

The study was conducted in accordance with the principles of Declaration of Helsinki (74) and the South African Good Clinical Practice Guidelines (75)

3.5 Research methodology

3.5.1 Research design

A prospective, observational, transversal design was used in this study.

A prospective study is one in which data is collected during the course of the study. A population is identified and followed over time to define outcomes. This study is prospective in that a group of anaesthetists were identified for study and data was collected from them prospectively during the course of the study.(76)

An observational study uses a sample to infer a quality or behaviour to a population where the researcher does not have control of independent variable .(76)

A transversal study is a type of observational study that analyses data collected from a population, or a representative subset, during a specific period of time.(76)

3.5.2 Study population

All interns, MOs (including community service MOs), registrars and consultants in the department of Anaesthesiology at Wits (CMJAH, CHBAH, HJH/ RMMCH) were included in the study.

3.5.3 Study sample

Sampling method

A convenience sampling method was used. This involves the selection of the most readily available people or objects for a study. (76)

Sample size

Sample size was realised by response rate. A response rate of 60% was considered acceptable. Of the 219 Anaesthetists in the Department of Anaesthesiology, it was assumed only 60% of the staff would receive the questionnaire since at any given time 30% of the total complement is either pre- or post-call or rotating to outlying areas like Klerksdorp or to ICU. Thus, the sample was a total of 140 doctors. It was hoped that

by using multiple handout sessions a sample size close to the maximum would be reached.

Inclusion and exclusion criteria

Inclusion criteria were:

- All anaesthetists attending the department's academic meetings
- All who were willing to participate
- Complete questionnaires (all questions answered)

Exclusion criteria were:

- Anaesthetists on leave/ or rotating out of the circuit at time of data collection
- Those who did not wish to participate

3.5.4 Data collection

Questionnaire development

A questionnaire was formulated based on the 2015 South African Resuscitation Council BLS/ACLS/PALS guidelines, thus ensuring content validity. (Appendix 2)

Face validity was ensured by Professor Walter Kloeck (certified BLS/ACLS/PALS instructor), who reviewed the questionnaire and suggested changes that were incorporated into the questionnaire.

The questionnaire consisted of 2 parts:

- **Demographic component:** information requested included age, gender, years of anaesthetic training, and exams completed.

Resuscitation qualifications: information on BLS, ACLS, PALS qualifications, and date of last certification for each qualification.

- **Knowledge component**: a set of 25 self-prepared multiple-choice questions with five options each based on the 2015 guidelines that highlighted changes to the guidelines.

Data collection method

The study population was delineated with the assistance of the department of anaesthesiology who provided an updated number of anaesthetists within the department for the time specified for data collection.

Data was collected at the department of Anaesthesia academic meetings on Wednesday afternoons at the specified academic hospitals during the period June 2017 to October 2017.

The researcher approached the chairperson of the academic meeting for permission to address the meeting. The researcher gave a brief summary of the aim of the study as well as the ethical principles adhered to and invited participation.

Questionnaires were handed out, accompanied by the information letter (Appendix 1).

The questionnaire took approximately 10 minutes to complete.

The researcher was available to answer any questions or queries regarding the study. On completion of the questionnaire, participants were asked to place the completed questionnaires in a sealed box for collection at the end of the meeting.

It was necessary to attend multiple meetings in order to account for people that were not present at previous meetings. Each participant was only allowed to fill in the questionnaire once.

3.5.5 Data analysis

All data collected was entered into a Microsoft Excel spreadsheet for review and analysis.

Data was analysed using descriptive and inferential statistics. Data analysis was performed using Microsoft excel and GraphPad In Stat. Frequencies and percentages were used to summarise categorical data. Continuous variables were described using means and standard deviations or medians and interquartile ranges depending on the distribution of the data. Comparisons between groups were analysed using Chi^2 test for categorical variables and an unpaired t-test for normal distributed data, or Mann-Whitney for skewed data.

A *p* value of <0.05 was taken as statistically significant.

A mark of 80% was deemed as adequate knowledge for the questionnaire. A biostatistician was consulted to assist with the data analysis.

3.6 Validity and reliability

Validity is defined as “the degree to which a measurement represents a true value”
Reliability refers to “consistency of the measure achieved” (77)
Validity and reliability in this study were ensured by:

- Using a research design that was appropriate for the nature of the study
- Using a questionnaire that was both content and face-valid
- Checking every tenth data entry for accuracy

- Consulting a biostatistician to assist with data analysis

3.7 Summary

In this chapter an in-depth discussion was done as to the methodology used in this research project. In the following chapter, the results of this study are presented and discussed.

Chapter 4: Results and discussion

4.1 Introduction

In this chapter the results of this study will be presented in accordance with the study objectives.

The objectives of this study were to:

- describe anaesthetists' knowledge regarding the 2015 resuscitation guidelines
- determine the number of anaesthetists who have completed formal resuscitation courses (BLS/ ACLS/ PALS)
- determine the number of anaesthetists with current certification in the above-mentioned resuscitation courses (have completed courses in the last 2 years)
- compare the level of knowledge of resuscitation guidelines between:
    - Certified vs. non-certified anaesthetists
    - Junior vs. senior anaesthetists

4.2 Results

Data collection took place from June 2017 to October 2017 at Wits Anaesthetic department academic meetings at the three academic hospitals (CHBAH, CMJAH, HJH/RMMCH). One hundred and seventy-six questionnaires were handed out and collected on the same day after the meetings.

4.2.1 Sample realisation

A total number of 176 questionnaires were distributed, with 168 (95%) being admissible for use in the study.

4.2.2 Demographics

Gender

From the 168 participants in the study, 156 indicated their gender with 41.7% being male and 58.3% were female as seen in fig 4.1.

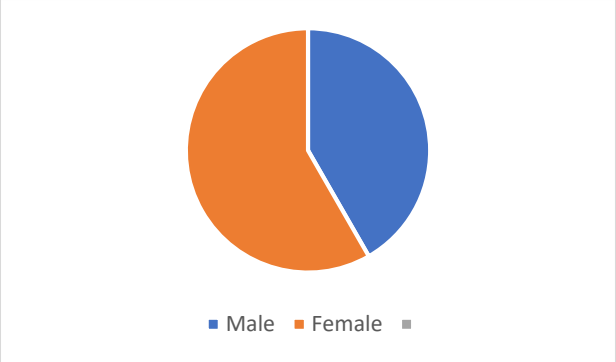

Fig 4. 1 Gender of participants

Age

Table 4.1 reveals that the majority of the participants fell into the younger age group 20-39 years (144) and only 22 were from the age bracket 40-59 years. 2 participants did not specify their age.

Table 4. 1 Age of participants

Age	**Number of participants (n)**	**Percentage of participants (%)**
20-29	60	36.2
30-39	84	50.6
40-49	14	8.4
50-59	8	4.8

Designation

The study population consisted of interns, MOs, registrars, and consultants. The table below describes the proportions of the various groups.

Table 4. 2 Designation of participants

Designation	Number of participants (n)	Percentage of participants (%)
Intern	44	26.2
MO	24	14.3
Registrar	57	33.9
Consultant	43	25.6

Exams completed

The exams falling within the scope of anaesthetic training being surveyed were completed by 112 of the 168 participants as evidenced in table 4.3.

Table 4. 3 Exams completed

Exam	Number of participants (n)	Percentage of participants (%)
DA	58	34.3
FCA 1	50	29.6
FCA 2	4	2.4

Years of anaesthetic experience

The table below shows participants who indicated their number of years of anaesthetic experience, the total of which was 161. As stipulated in our research assumptions, 98 (60.9%) of the participants fell into the junior anaesthetist category and 63 (39.1%) were senior.

Table 4. 4 Years of anaesthetic experience

Years of anaesthetic experience	Number of participants (n)	Percentage of participants (%)
<5 years	98	60.9
5-10 years	43	26.7
>10 years	20	12.4

4.2.3 Resuscitation questionnaire

Objective 1: describe anaesthetists' knowledge regarding the 2015 resuscitation guidelines

The total number of participants who had adequate knowledge as per research assumptions was 12 (7.1%). When adequate knowledge levels were analysed by designation, MOs were found to be the highest scoring, followed by consultants and registrars. No interns were found to have adequate knowledge in this study.

Interestingly, females made up two thirds of the total number with adequate knowledge.

Perceived adequate knowledge: 100 (59.2%) of the participants felt that their resuscitation knowledge was adequate. The majority (67) felt that experience was contributing to this, closely followed by 53 people who said that prior attendance to a resuscitation course made them feel adequate in their resuscitation knowledge. Reading literature pertaining to resuscitation was mentioned by 32 participants as their reason for confidence in resuscitation, and 3 people attributed their confidence level to teaching.

Questions were allocated as follows:

- BLS: Questions 1-7
- ACLS: Questions 8-14
- PALS: Questions 15-25

The correct responses for each question testing knowledge of each of the three courses surveyed are depicted in the tables 4.5 to 4.7.

Table 4. 5 BLS: Percentage of correct answers by question (1-7)

Question	**Correct answer n (%)**
1. Latest recommended chest compression rate for adult patients with cardiac arrest?	88 (52.4%)
2. What is latest recommended depth for chest compressions?	64 (38.1%)
3. Which of the following is correct sequence for basic CPR?	143 (85.1%)
4. What is chest compression to ventilation ratio for an adult for one-person CPR?	117 (69.6%)
5. How many breaths per minute if there is no definitive airway?	18 (10.7 %)
6. Which drugs are not administered via the ET tube during CPR?	146 (86.9%)
7. Which does not cause pulseless electrical activity (PEA)?	100 (59.5%)

Table 4. 6 ACLS: Percentage of correct answers by question (8-14)

Question	**Correct answer n (%)**
8. Which of these rhythms require defibrillation?	152 (90.5%)
9. Correct sequence for Mx of ventricular fibrillation?	65 (38.7%)
10. Correct course of action for persistent ventricular fibrillation?	48 (28.6%)
11. Most correct option for Mx of asystole/PEA?	148 (88.1%)
12. Initial dose of Atropine for patient with sinus bradycardia and HR of 42, diaphoretic and BP of 80/60?	73 (43.5%)
13. Which monitoring modality proven to be useful to measure effectiveness of CPR?	139 (82.7%)
14. Role for ultrasound in resuscitation for cardiac arrest?	86 (51.2 %)

Table 4. 7 PALS: Percentage of correct answers by question (15-25)

Question	Correct answer n (%)
15. Most frequent cause of cardiac arrest in children?	158 (94%)
16. Two most common initial rhythms seen in paediatric cardiac arrest?	75 (44.6%)
17. High quality CPR for young children includes?	147 (87.5%)
18. What compression to ventilation ration should be used for 2-rescuer infant CPR?	127 (85.6%)
19. What is the first drug of choice for a child with bradycardia?	50 (29.8%)
20. What is the rhythm in child with HR of 200 with narrow QRS and no p waves?	122 (72.6%)
21. What does AVPU stand for?	82 (48.8%)
22. Indirect markers of circulatory status?	131 (77.9%)
23. Most common cause of bradycardia in children?	154 (91.7%)
24. Fastest way to gain access for medication in children?	115 (68.5%)
25. Regarding calcium chloride in paediatrics?	117 (69.6%)

The percentage of correct answers by question is shown below in fig. 4.2

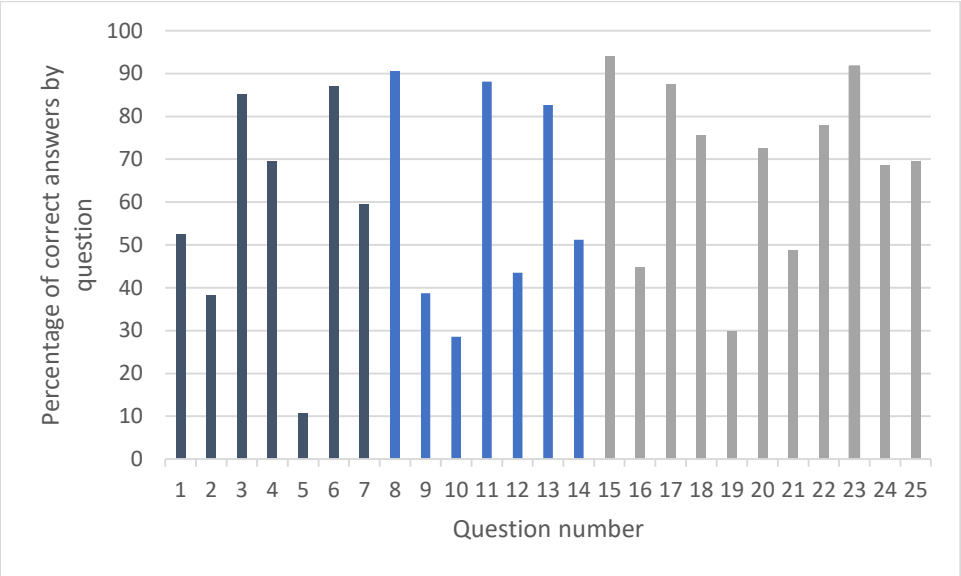

Fig 4. 2 Percentage of correct answers

The mean percentage of correct answers per course are illustrated in fig 4.3.

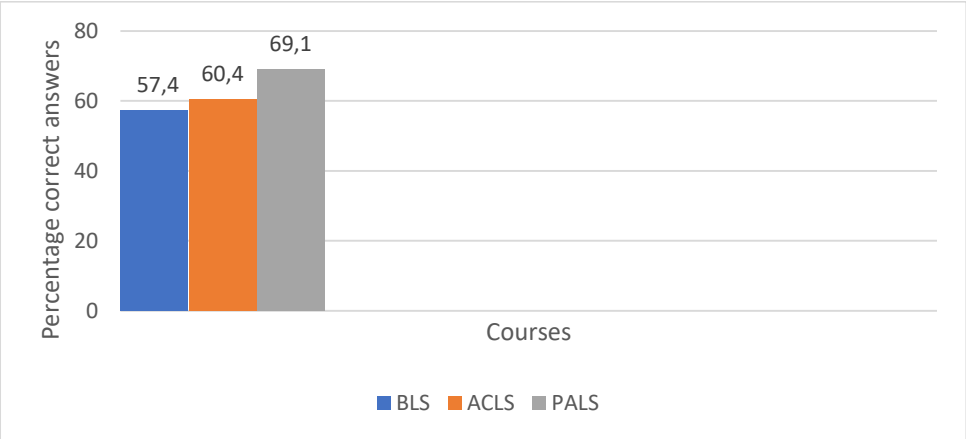

Fig 4. 3 Mean percentage of correct answers per course

Objective 2: to determine the number of anaesthetists who have completed formal resuscitation courses (BLS/ ACLS/ PALS)

The number of participants who completed the resuscitation courses are listed in the table 4.8. below.

Table 4. 8 Completion of resuscitation courses

	Number of participants (n)	**Percentage of participants (%)**
BLS	136	80.5
ACLS	116	68.6
PALS	70	41.4

When questioned about the reasons for not attending courses, 51 participants noted that lack of time was a factor, 17 indicated cost was an issue, 11 said that it was not a specialty requirement and therefore did not do it, and 7 found it not relevant. Other reasons for not doing courses included not having leave to do the courses and some planned to do the courses in future. A participant mentioned that they had read the PALS manual and therefore felt it not necessary to the course.

Objective 3: to determine the number of anaesthetists with current certification in the above-mentioned resuscitation courses

BLS was completed by 136 participants but only 35.2% were noted to be currently certified, 30.1% of the 116 were current with regard to ACLS, and 27% had done PALS in the last two years, as seen in table 4.9.

Table 4. 9 Participants with current certification in resuscitation courses

	Number of participants (n)	Currently certified (n)	Percentage of Participants (%)
BLS	136	48	35.2
ACLS	116	35	30.1
PALS	70	19	27

The fig 4.4 below shows the number of participants that were found to be currently certified was 55: 10 of which were interns, 21 MOs, 19 registrars and 5 consultants.

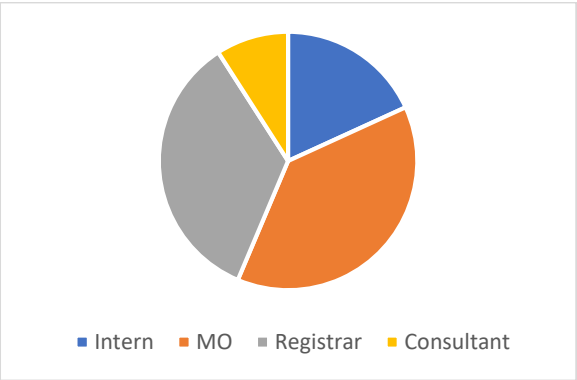

Fig 4. 4 Currently certified participants by rank

When analysed according to our research assumptions regarding junior and senior anaesthetists, 46 (83.6%) were from the junior group and 9 (16.3%) were from the senior group.

Objective 4: to compare the level of knowledge of resuscitation guidelines between:

i. Certified vs. non-certified anaesthetists

The knowledge levels of anaesthetists who were noted to be current with regards to certification were compared to those that had not done a resuscitation course within the last two years of the study period. A total number of 55 anaesthetists in this study sample were currently certified and 113 were not currently certified at the time of the study. Of the 55 participants that were currently certified at the time of data collection, 8 (14.5%) were noted to have adequate knowledge. In the non-certified group only 4 (3.5 %) of the 113 were considered to have adequate knowledge ($p = 0.010$), indicating the knowledge levels of certified anaesthetists were statistically significantly higher than non-certified anaesthetists.

A statistically significant difference was seen in the comparison of the mean of correct answers in the certified group of 67.13 vs 56.88 in the non-certified group ($p<0.05$) with 95% Confidence interval of 3.6. These results can be seen in the response rate per question between certified and non-certified anaesthetists as seen in fig 4.5 and fig 4.6 below.

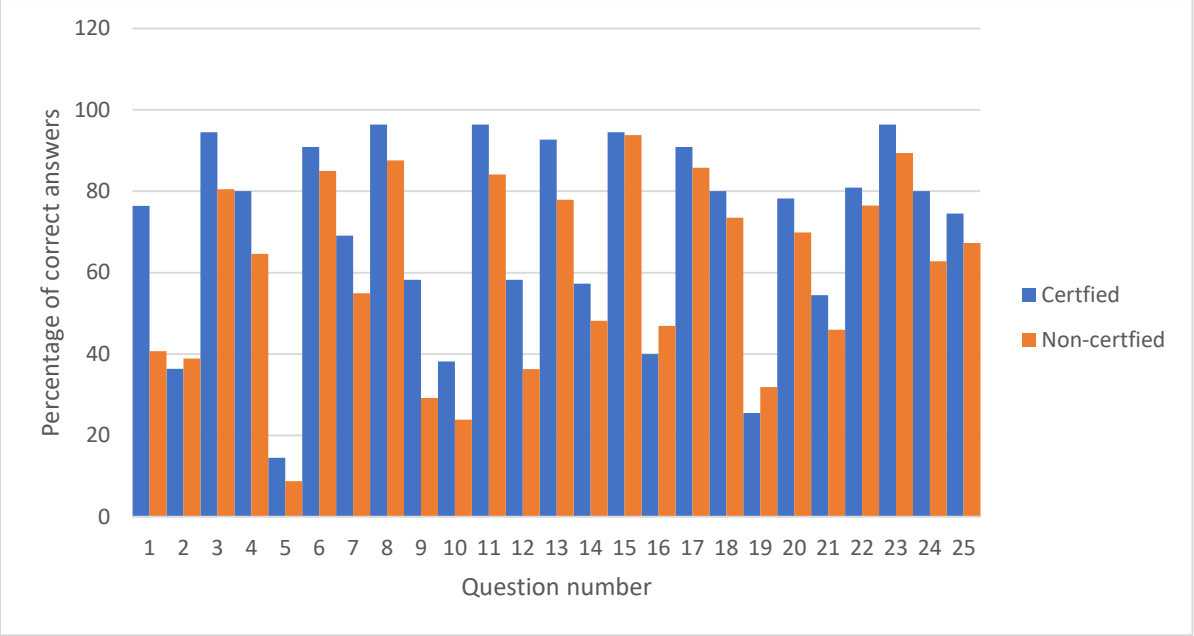

Fig 4. 5 Response rate per question between certified vs. non-certified anaesthetists

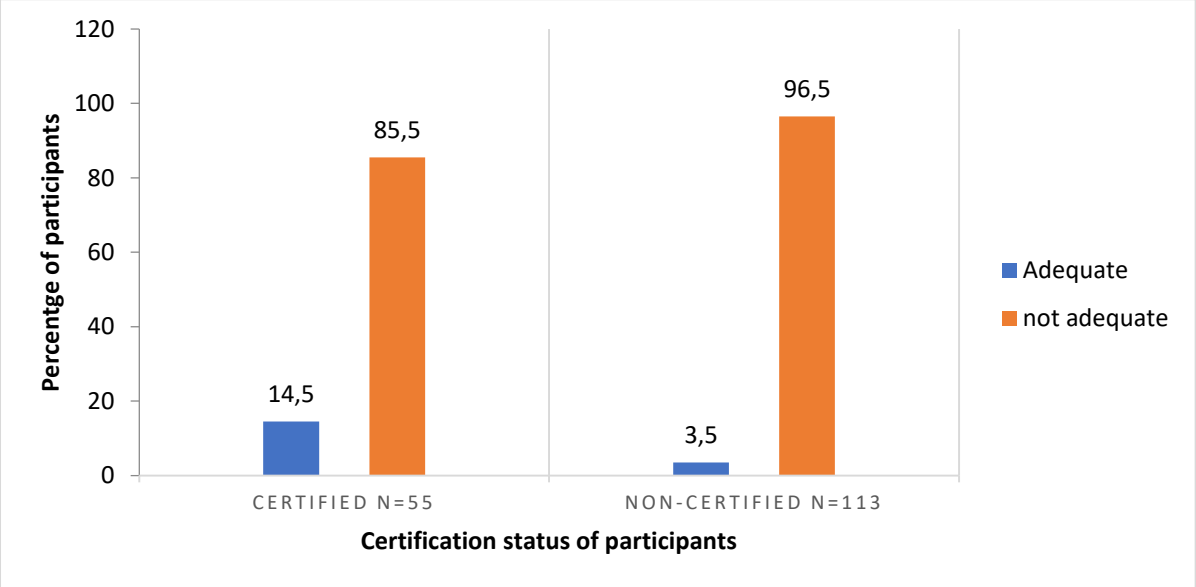

Fig 4. 6 Knowledge of certified vs. non-certified anaesthetists

ii) Junior vs. senior anaesthetists

The knowledge levels of junior anaesthetists were compared to their senior counterparts. Of the 161 participants that indicated their years of anaesthetic experience, 98 were junior and 63 were senior. Comparing junior to senior anaesthetists, 7 (7.1%) and 4 (6.3%) of the participants were noted to have adequate knowledge respectively and was not seen as statistically significant (*p=0.84)*.The mean score of correct answers in the junior group was 15.3 (61.5%) compared to 14.5 (58.9%) in the senior group with *p*=0.23 and therefore no statistically significant difference in knowledge levels were found between junior and senior anaesthetists as evidenced in fig 4.7 and 4.8.

In terms of current certification between junior and senior anaesthetists, 5 out of the 7 junior participants were currently certified and 2 of the 4 in the senior group were current.

One of the participants who achieved 80% or above did not specify their years of anaesthetic experience and therefore was excluded from these statistics.

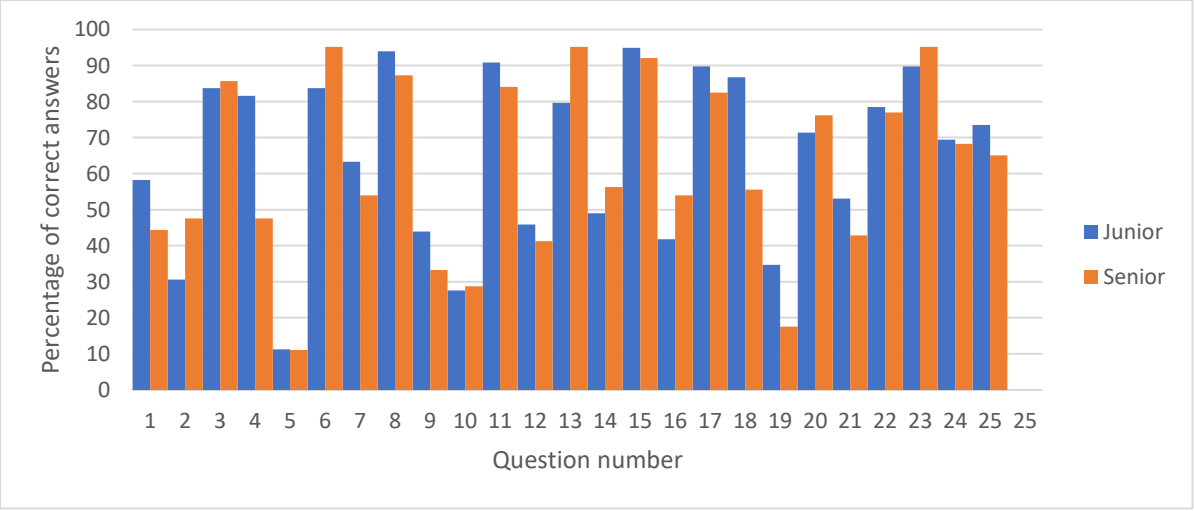

Fig 4. 7 Response rate per question between junior vs. senior anaesthetists

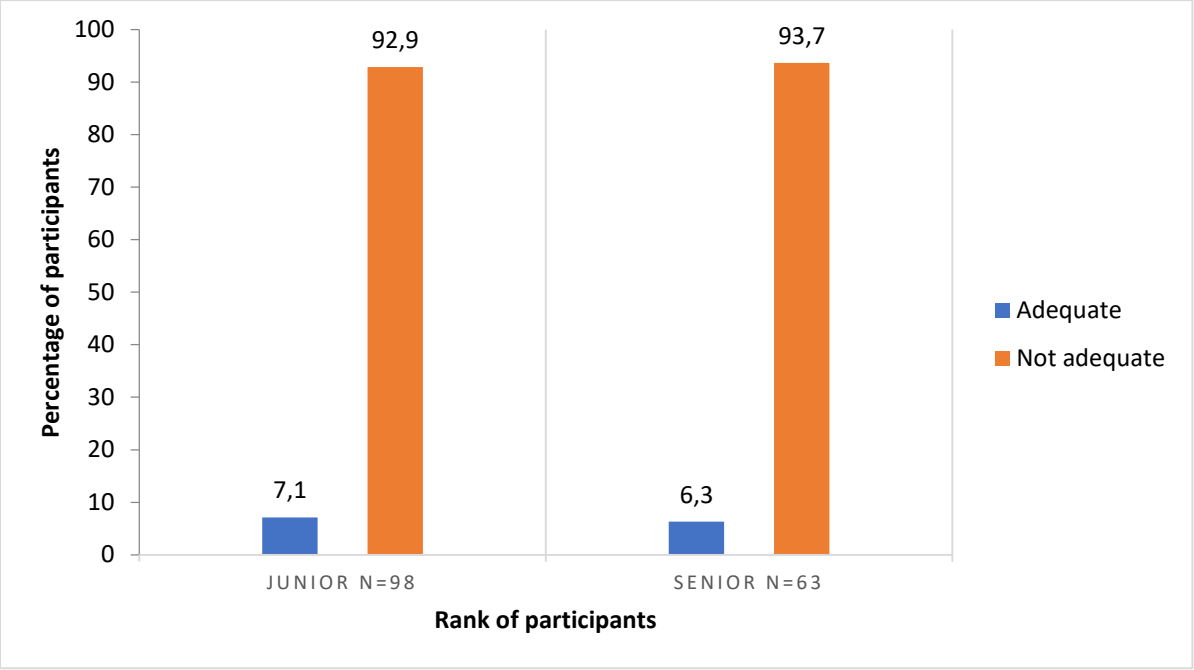

Fig 4. 8 Comparison of resuscitation knowledge levels of anaesthetists according to rank

4.3 Discussion

The results of the questionnaire indicate that the knowledge levels amongst anaesthetists regarding resuscitation guidelines is poor, with only 7.1% of the total number of participants scoring 80% or above. This result is similar to a study done in South Africa by Ragavan et al. (65) in which 5% of the sample size achieved 80%.

Most of the literature found with regard to resuscitation knowledge levels use 50% as an average knowledge level and many other studies abroad document mean correct answers (16, 19, 29, 34, 64). When our results were calculated to reflect the number who had scored above 50%, 105 (62.5%) of the 168 participants, were found to be adequate with regards to knowledge levels. This is noted to be far better than Howell et al. (19) in the West Indies who had 55% of participants achieving 50% or above and

a contrasting result was seen by Okonta et al. (34) with a shocking 17% scoring above 50%.

Of the studies that noted mean results, Filho et al. (16) had a mean of 54%, Nambiar et al. (64) noted means of 44.5% in North Kerala, 41.6% in South India, and 44% in Nepal. In South Africa, Botha et al. (29) had a mean of 35.1% and in our study, the mean of correct answers was 15 out 25 which equates to 60%.

This encouraging number could be due to the fact that the number of participants who had completed resuscitation courses were significantly higher in our study for BLS (80.5%), ACLS (68.6%), and PALS (41.4%), than noted in both Brazil and Greece by Filho et al. (16) with only 27% attending ACLS, or Kyriakou et al. (18) with less than 50% attending ACLS respectively.

These numbers could be attributed to the fact that the study was conducted in a metropolitan area with easier access to the courses as compared to Ragavan et al. (65) where the study was conducted in a rural area.

Similar findings regarding anaesthetist's attendance of resuscitation courses were found by Ravid in a recent study comparing resuscitation skill levels between 4 departments on the Wits Academic registrar circuit, (anaesthetics, orthopaedics, obstetrics and gynaecology, and surgery). He reported anaesthetists to have the highest rate of resuscitation course attendance between the four disciplines. Of the 85 anaesthetists in their study, 95% had completed BLS course and 87% had completed ACLS. Possible reasons for high attendance by anaesthetists could be that resuscitation is an integral part of anaesthesia as much of the airway control and drugs used in the protocols are commonly used in every day anaesthetic practice.

An interesting finding to the contrary was noted by Zha et al. (62) in Nigeria regarding the poor attendance by doctors to resuscitation courses despite having on-site resuscitation training programmes. This suggests that there may be other reasons for non-attendance of resuscitation courses. In this study, when asked about reasons for not completing a course, participants noted a lack of time, cost, the fact that it was not a specialty requirement, and a few found it not relevant. Other reasons for not doing courses included not having leave to do the courses and some planned to do the courses in future. A participant mentioned that they had read the PALS manual and therefore felt it not necessary to the course.

The number of anaesthetists who perceived their knowledge to be adequate was much higher than the actual number of those with adequate knowledge in our study population, with 100 (59.2%) of the participants feeling confident that their knowledge was adequate. The reasons given for this perception include experience, attending courses, reading literature, teaching. This finding is consistent with literature on the perceived confidence levels in resuscitation scenarios, by those who had done resuscitation courses previously, but who may not necessarily be currently proficient as a result.(29, 65, 70)

The positive correlation between ACLS training and increased knowledge levels resulting in better outcomes in resuscitation has been well described in the literature (10-13, 22, 56). Dane et al. (57) demonstrated that even the presence of ACLS-trained nurses in the resuscitation team improved the survival to discharge rate fourfold. The correlation between adherence to guidelines and the success achieved in resuscitation scenarios has been well described by McEvoy et al. (25) as well as Brown et al. (61). Unfortunately, the scope of our study did not include resuscitation

outcomes as part of our investigations, and this may be a possible avenue for further research in future.

Even though there were a large number of the participants in this study that had completed the resuscitation courses, it was disappointing to note that only 35.2% were still current with regards to BLS and 30.1% were still current with regards to their ACLS certification status. The numbers are similar to those found in a UK study by Saravan et al. (30) who noted 27% of the participants were currently certified. Locally, Botha et al. (29) in their study of South African physicians at a tertiary hospital in Pretoria found that 31% were currently certified.

Of those that were noted to have done a resuscitation course, knowledge levels were higher in those who were currently certified. Of the 55 participants that were currently certified at the time of the data analysis, 8 (14.5%) were noted to have adequate knowledge. In the non-certified group only 4 (3.5 %) of the 113 were considered to have adequate knowledge.

The postulation is that low knowledge levels may be due to the decline in knowledge over time. Yang et al. (24) in their systematic review of retention of adult ALS knowledge and skills found a deterioration in knowledge and skills from as early as 6 months to a year. The current interval in certification is two years and thus those who are found to no longer be current may very well be on the decline. This has been well described in literature and recommendations have been made to change the certification interval in order to overcome this, however it still remains an issue of concern. (24)

Analysis of the age demographic in our study revealed that the majority of the participants fell within the 20-39 age bracket (148), compared to 22 in the 40-59 group.

However, when sorted according to years of anaesthetic experience, the numbers evened out, with interns and MOs and roughly half of the registrar contingent falling into the junior category and the other half of the registrars as well as consultants forming the senior component.

The highest number of people that were found to be certified came from the junior group. Of the 10 interns, 21 MOs, 19 Registrars, and 5 consultants that were found to be current, 46 (83.6%) were from the junior group and 9 (16.3%) were from the senior group.

Regarding the knowledge levels of junior vs. senior anaesthetists, the assumption was that senior anaesthetists would have lower scores due to longer length of time passed between courses, lack of practice of CPR or limited exposure to resuscitation situations. (30, 33, 61) (73)

Cowie et al. (33) documented that resuscitation knowledge may be better in those who are in preparation for, or have recently written exams. We did find that in the group that had adequate knowledge, 3 of the 7 junior participants had stated that they had recently completed DA and FCA 1 exams.

Another finding in our study that agrees with literature stating that knowledge may be better in junior participants is that of the 7 junior anaesthetists with adequate knowledge, 5 of the 7 were found to be MOs. Zamir et al. (63) described a higher level of knowledge among high school students wanting to get into undergraduate programmes. The same could be said of the MOs in our study perhaps wanting to get into a registrar programme, where points are allocated in one's favour during interviews for resuscitation courses done.

Analysis of the gender demographic in this study revealed that females made up two thirds of the contingent scoring 80% or above. This may be attributed to the fact that females made up 58.3% of the sample population.

Although resuscitation levels have been shown to be poor in general among the anaesthetists in this study, the results were not statistically significant to show that older anaesthetists are worse off than their younger counterparts. There has been a definite correlation between current certification and higher knowledge levels which may explain the better performance of the junior component who were found to have higher certification rates.

4.4 Summary

In this chapter the results of the study were presented in accordance with the aims and objectives of the study. In the next chapter, a summary of the results will be presented, taking into account limitations encountered, and recommendations for future practice will be given.

Chapter 5: Summary, limitations, recommendations and conclusions

5.1 Introduction

In this chapter the aims, objectives, study design and results of the study will be reviewed. The limitations of the study will be addressed, recommendations made, and a conclusion presented.

5.2 Summary of the study

5.2.1 Aim

The aim of this study was to describe the anaesthetists' knowledge of the 2015 resuscitation guidelines at three academic hospitals in Johannesburg.

5.2.2 Objectives

The objectives of this study were to:

- describe anaesthetists' knowledge regarding the 2015 resuscitation guidelines
- determine the number of anaesthetists who have completed formal resuscitation courses (BLS/ ACLS/ PALS)
- determine the number of anaesthetists with current certification in the above-mentioned resuscitation courses
- compare the level of knowledge of resuscitation guidelines between:
    - Certified vs. non-certified anaesthetists
    - Junior vs. senior anaesthetists

5.2.3 Methodology

A prospective, observational, transversal design was used in this study.

All interns, MOs (including community service MOs), registrars and consultants in the department of Anaesthesiology at Wits (CMJAH, CHBAH, HJH/ RMMCH) during the period of data collection were included in the study.

Data was collected using an anonymous questionnaire (Appendix 2) which was distributed during the anaesthetic department academic meetings and collected immediately after each meeting into a sealed box. One hundred and seventy-six questionnaires were distributed during the specified data collection period.

The questionnaire comprised of a demographic component, their resuscitation course qualifications to date, self-perceived knowledge as well as a knowledge component which comprised of a set of 25 self-prepared multiple-choice questions based on the 2015 resuscitation guidelines. Each question had five options that highlighted changes to the guidelines from the PALS, ACLS and BLS resuscitation courses.

All data collected was entered into a Microsoft Excel spreadsheet for review and analysis. A mark of 80% was deemed as adequate knowledge for the questionnaire. Data was analysed using descriptive and inferential statistics. A biostatistician was consulted to assist with the data analysis. A p value of <0.05 was taken as statistically significant.

5.2.4 Results

The study population consisted of 168 participants. Even though 59.2% of the participants felt that their knowledge was adequate, only 7.1% scored 80% or above

on the questionnaire. The perception was attributed to experience, attendance of resuscitation courses, reading literature and having received teaching.

Resuscitation course attendance was noted to be high among all three of the courses surveyed with BLS attendance at 80.5%, ACLS at 68.6% and PALS at 41.4%. The numbers of those who had done the courses and who were still current with regards to certification was low overall with 35.2% still currently certified in BLS, 30.1% in ACLS and only 27% in PALS. Reasons given for not attending courses included lack of time, cost, the fact that it is not part of the specialty requirement and some participants felt that the courses were not relevant.

A statistically significant difference was found in the comparison of knowledge levels of certified compared to non-certified anaesthetists. The number of participants who had adequate knowledge in the certified group was 8 (14.5%) compared to 4 (3.5%) in the non-certified group knowledge (*p= 0.010)*. The mean of correct answers in the certified group was 67.13 vs 56.88 in the non-certified group ($p<0.05$) with 95% Confidence interval of 3.6, thus indicating that certified anaesthetists had higher resuscitation knowledge levels than non-certified anaesthetists.

Of the 161 participants that indicated their years of anaesthetic experience, 98 were junior and 63 were senior. Comparing junior to senior anaesthetists, 7 (7.1%) and 4 (6.3%) of the participants were noted to have adequate knowledge respectively(*p=0.84)*. The mean score of correct answers in the junior group was 15.3 (61.5%) compared to 14.5 (58.9%) in the senior group revealing no statistically significant difference between the resuscitation knowledge levels in these two groups.

5.3 Limitations

This study was conducted at a single academic department in one university in a metropolitan area and may not necessarily be representative of the knowledge levels of anaesthetists in the rest of the country.

Furthermore, a convenience sampling technique was used and although a 95% response rate was achieved, sample bias could not be excluded.

Participation in the study was left to the discretion of the potential participant. It is possible that participants may have opted not to participate or hand in incomplete questionnaires if they felt their knowledge was inadequate. This could have affected the analysis of the data received and affected the overall results.

This study only looked at resuscitation knowledge and did not cover resuscitation skills. It is possible that participants who would have scored better in a didactic testing environment may have been missed. This could possibly be an avenue for future research in which resuscitation knowledge and skills are tested together and the data correlated.

5.4 Recommendations

As evidenced in the results of this study, current certification in resuscitation results in higher knowledge levels. Higher resuscitation knowledge levels have been shown in literature to lead to better outcomes.

In accordance with the SASA guidelines locally as well as with international recommendations abroad for all healthcare providers to be proficient in resuscitation, anaesthetists are to be encouraged to attend resuscitation courses. The continued

benefit and need for current certification should be emphasised and factors relating to non-attendance of courses should be sought and addressed.

One could argue the point for making resuscitation course attendance and certification a compulsory requirement for anaesthetists wishing to enter the post-graduate programme, seeing as how they play an integral role in the work of an anaesthetist. This would serve to raise the standard of education amongst graduates entering the programme as well as the quality of CPR provided in a resuscitation scenario.

Anaesthetists who have completed a resuscitation course should be encouraged to keep their certification current as this is less costly and time consuming than having to redo the course each time the current window lapses. Provision should be made at a departmental level for subsidised regular refresher courses and short courses, as well as leave allowances to do these necessary courses. Hopefully this will help to reinforce the knowledge base and maintain a high level of knowledge to counteract the natural tendency to decline over time.

5.5 Conclusion

Despite high attendance rate of resuscitation courses as well as high perceived resuscitation knowledge rates, the level of resuscitation knowledge in anaesthetists remains low. Low certification in resuscitation courses may be a contributing factor, leading to a decline in knowledge over time. Regular refresher courses and encouragement to recertify may be needed to address this issue and improve resuscitation service delivery.

References

1. Mozaffarian D, Benjamin EJ, Go AS, Arnett DK, Blaha MJ, Cushman M, et al. Heart disease and stroke statistics--2015 update: a report from the American Heart Association. Circulation. 2015;131(4):e29-322.

2. American Heart Association. Basic Life Support manual for healthcare providers 2010.

3. American Heart Association. History of CPR. [17 Sept 2019] Available from: http://www.cpr.heart.org/AHAECC/CPRAndECC/AboutCPRFirstAid/HistoryofCPR/UCM_475751_History-of-CPR.jsp.

4. Chamberlain D. European Resuscitation Council. Resuscitation. 1992;24(2):99-101.

5. Field JM, Hazinski MF, Sayre MR, Chameides L, Schexnayder SM, Hemphill R, et al. Part 1: Executive Summary: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2010;122(18 Suppl 3):S640-56.

6. Neumar RW, Shuster M, Callaway CW, Gent LM, Atkins DL, Bhanji F, et al. Part 1: Executive Summary: 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2015;132(18 Suppl 2):S315-67.

7. Resuscitation Council of Southern Africa. [17 Sept 2019] Available from: http://resus.co.za/home.

8. Resuscitation Council of Southern Africa. BLS course [17 Sept 2019] Available from: http://resus.co.za/basic-life-support-bls/

9. Resuscitation council of Southern Africa. ACLS course [17 Sept 2019] Available from: http://resus.co.za/advanced-cardiovascular-life-support-provider-course/

10. Camp BN, Parish DC, Andrews RH. Effect of advanced cardiac life support training on resuscitation efforts and survival in a rural hospital. Ann Emerg Med. 1997;29(4):529-33.

11. Lowenstein SR, Sabyan EM, Lassen CF, Kern DC. Benefits of training physicians in Advanced Cardiac Life Support. Chest. 1986;89(4):512-6.

12. Sanders AB, Berg RA, Burress M, Genova RT, Kern KB, Ewy GA. The efficacy of an ACLS training program for resuscitation from cardiac arrest in a rural community. Ann Emerg Med. 1994;23(1):56-9.

13. Moretti MA, Cesar LA, Nusbacher A, Kern KB, Timerman S, Ramires JA. Advanced cardiac life support training improves long-term survival from in-hospital cardiac arrest. Resuscitation. 2007;72(3):458-65.

14. Chamberlain DA, Hazinski MF, European Resuscitation C, American Heart A, Heart, Stroke Foundation of C, et al. Education in resuscitation. Resuscitation. 2003;59(1):11-43.

15. Cabana MD, Rand CS, Powe NR, Wu AW, Wilson MH, Abboud PA, et al. Why don't physicians follow clinical practice guidelines? A framework for improvement. JAMA. 1999;282(15):1458-65.

16. Filgueiras Filho NM, Bandeira AC, Delmondes T, Oliveira A, Lima AS, Jr., Cruz V, et al. Assessment of the general knowledge of emergency physicians from the hospitals of the city of Salvador (Brazil) on the care of cardiac arrest patients. Arq Bras Cardiol. 2006;87(5):634-40.

17. Green RJ, Bromilow J, Richardson D, Deakin CD. Are anaesthetists adequately trained to resuscitate patients? Eur J Anaesthesiol. 2008;25(3):251-2.

18. Kyriakou F, Iacovidou N, Garofalakis I, Trianti M, Stasinakis D, Xanthos T. Residents' resuscitation training and theoretical knowledge in a Greek General Hospital. Eur J Emerg Med. 2011;18(1):34-7.

19. Howell P, Tennant I, Augier R, Gordon-Strachan G, Harding-Goldson H. Physicians' knowledge of cardiopulmonary resuscitation guidelines and current certification status at the University Hospital of the West Indies, Jamaica. West Indian Med J. 2014;63(7):739-43.

20. Abella BS, Alvarado JP, Myklebust H, Edelson DP, Barry A, O'Hearn N, et al. Quality of cardiopulmonary resuscitation during in-hospital cardiac arrest. JAMA. 2005;293(3):305-10.

21. Kiyan S, Yanturali S, Musal B, Gursel Y, Aksay E, Turkcuer I. Determination of advanced life support knowledge level of residents in a Turkish university hospital. J Emerg Med. 2008;35(2):213-22.

22. Chalkias A, Koutsovasilis A, Mystrioti D, Dragoumanos V, Xanthos T. Outcomes of cardiopulmonary resuscitation efforts in a Greek tertiary hospital. Acute Card Care. 2013;15(2):34-7.

23. Soar J, Nolan JP, Bottiger BW, Perkins GD, Lott C, Carli P, et al. European Resuscitation Council Guidelines for Resuscitation 2015: Section 3. Adult advanced life support. Resuscitation. 2015;95:100-47.

24. Yang CW, Yen ZS, McGowan JE, Chen HC, Chiang WC, Mancini ME, et al. A systematic review of retention of adult advanced life support knowledge and skills in healthcare providers. Resuscitation. 2012;83(9):1055-60.

25. McEvoy MD, Field LC, Moore HE, Smalley JC, Nietert PJ, Scarbrough SH. The effect of adherence to ACLS protocols on survival of event in the setting of in-hospital cardiac arrest. Resuscitation. 2014;85(1):82-7.

26. Quiney NF, Gardner J, Brampton W. Resuscitation skills amongst anaesthetists. Resuscitation. 1995;29(3):215-8.

27. Krajina I, Kvolik S, Steiner R, Kovacevic K, Lovric I. Cardiopulmonary resuscitation, chest compression only and teamwork from the perspective of medical doctors, surgeons and anesthesiologists. Iran Red Crescent Med J. 2015;17(3):e18208.

28. Passali C, Pantazopoulos I, Dontas I, Patsaki A, Barouxis D, Troupis G, et al. Evaluation of nurses' and doctors' knowledge of basic & advanced life support resuscitation guidelines. Nurse Educ Pract. 2011;11(6):365-9.

29. Botha L. Knowledge of cardiopulmonary resuscitation of clinicians at a South African tertiary hospital. S Afr Fam Pract. 2012;54(5):447-54.

30. Saravanan P, Soar J. A survey of resuscitation training needs of senior anaesthetists. Resuscitation. 2005;64(1):93-6.

31. Bell JH, Harrison DA, Carr B. Resuscitation skills of trainee anaesthetists. Anaesthesia. 1995;50(8):692-4.

32. Kurrek MM, Devitt JH, Cohen M. Cardiac arrest in the OR: how are our ACLS skills? Can J Anaesth. 1998;45(2):130-2.

33. Cowie DA, Story DA. Knowledge of cardiopulmonary resuscitation protocols and level of anaesthetic training. Anaesth Intensive Care. 2000;28(6):687-91.

34. Okonta KE, Okoh BA. Basic cardiopulmonary resuscitation knowledge of house-officers in a tertiary institution: factors determining accuracy. Pan Afr Med J. 2014;18:209.

35. Desalu I, Kushimo O, Akinlaja O. Adherence to CPR guidelines during perioperative cardiac arrest in a developing country. Resuscitation. 2006;69(3):517-20.

36. SASA Practice Guidelines 2012 Revision. Sect. III: Training, certification and accreditation, D. Essential training for general practitioners proposing to administer anaesthesia.

37. CMSA. Regulations for the admission to the Diploma in Anaesthetics of the College of Anaeshetists of South Africa DA(SA). 2016.

38. Berdowski J, Schmohl A, Tijssen JG, Koster RW. Time needed for a regional emergency medical system to implement resuscitation Guidelines 2005--The Netherlands experience. Resuscitation. 2009;80(12):1336-41.

39. The Holy Bible. King James Version. 2 Kings 4:32-35

40. Cooper JA, Cooper JD, Cooper JM. Cardiopulmonary resuscitation: history, current practice, and future direction. Circulation. 2006;114(25):2839-49.

41. LaHood N, Moukabary T. History of cardiopulmonary resuscitation. Cardiol J. 2009;16(5):487-8.

42. Nolan JP. International CPR guidelines - perspectives in CPR. Best Pract Res Clin Anaesthesiol. 2013;27(3):317-25.

43. Chamberlain D, Cummins RO. Recommended guidelines for uniform reporting of data from out-of-hospital cardiac arrest: the 'Utstein style'. European Resuscitation Council, American Heart Association, Heart and Stroke Foundation of Canada and Australian Resuscitation Council. Eur J Anaesthesiol. 1992;9(3):245-56.

44. Kronick SL, Kurz MC, Lin S, Edelson DP, Berg RA, Billi JE, et al. Part 4: Systems of Care and Continuous Quality Improvement: 2015 American Heart

Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2015;132(18 Suppl 2):S397-413.

45. Bhanji F, Donoghue AJ, Wolff MS, Flores GE, Halamek LP, Berman JM, et al. Part 14: Education: 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2015;132(18 Suppl 2):S561-73.

46. Kleinman ME, Brennan EE, Goldberger ZD, Swor RA, Terry M, Bobrow BJ, et al. Part 5: Adult Basic Life Support and Cardiopulmonary Resuscitation Quality: 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2015;132(18 Suppl 2):S414-35.

47. Link MS, Berkow LC, Kudenchuk PJ, Halperin HR, Hess EP, Moitra VK, et al. Part 7: Adult Advanced Cardiovascular Life Support: 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2015;132(18 Suppl 2):S444-64.

48. Meaney PA, Bobrow BJ, Mancini ME, Christenson J, de Caen AR, Bhanji F, et al. Cardiopulmonary resuscitation quality: [corrected] improving cardiac resuscitation outcomes both inside and outside the hospital: a consensus statement from the American Heart Association. Circulation. 2013;128(4):417-35.

49. Edelson DP, Abella BS, Kramer-Johansen J, Wik L, Myklebust H, Barry AM, et al. Effects of compression depth and pre-shock pauses predict defibrillation failure during cardiac arrest. Resuscitation. 2006;71(2):137-45.

50. Sandroni C, Nolan J, Cavallaro F, Antonelli M. In-hospital cardiac arrest: incidence, prognosis and possible measures to improve survival. Intensive Care Med. 2007;33(2):237-45.

51. Saver JL. Time is brain-quantified. Stroke. 2006;37(1):263-6.

52. Gutierrez LG, Rovira A, Portela LA, Leite Cda C, Lucato LT. CT and MR in non-neonatal hypoxic-ischemic encephalopathy: radiological findings with pathophysiological correlations. Neuroradiology. 2010;52(11):949-76.

53. Chan PS, Krumholz HM, Nichol G, Nallamothu BK, American Heart Association National Registry of Cardiopulmonary Resuscitation I. Delayed time to defibrillation after in-hospital cardiac arrest. N Engl J Med. 2008;358(1):9-17.

54. Valenzuela TD, Roe DJ, Nichol G, Clark LL, Spaite DW, Hardman RG. Outcomes of rapid defibrillation by security officers after cardiac arrest in casinos. N Engl J Med. 2000;343(17):1206-9.

55. Resuscitation Council of Southern Africa. PALS course [17 Sept 2019] Available from: http://resus.co.za/pals-provider-course/.

56. Sodhi K, Singla MK, Shrivastava A. Impact of advanced cardiac life support training program on the outcome of cardiopulmonary resuscitation in a tertiary care hospital. Indian J Crit Care Med. 2011;15(4):209-12.

57. Dane FC, Russell-Lindgren KS, Parish DC, Durham MD, Brown TD. In-hospital resuscitation: association between ACLS training and survival to discharge. Resuscitation. 2000;47(1):83-7.

58. Nadkarni VM, Nolan JP, Billi JE, Bossaert L, Bottiger BW, Chamberlain D, et al. Part 2: International collaboration in resuscitation science: 2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. Circulation. 2010;122(16 Suppl 2):S276-82.

59. Ageron FX, Debaty G. Survival is surfing on the guidelines wave. Resuscitation. 2016;98:e2-3.

60. Schmidt AS, Lauridsen KG, Adelborg K, Lofgren B. Hospital implementation of resuscitation guidelines and review of CPR training programmes: a nationwide study. Eur J Emerg Med. 2016;23(3):232-4.

61. Brown TB, Dias JA, Saini D, Shah RC, Cofield SS, Terndrup TE, et al. Relationship between knowledge of cardiopulmonary resuscitation guidelines and performance. Resuscitation. 2006;69(2):253-61.

62. Zha Y, Ariyo M, Olaniran O, Ariyo P, Lyon C, Kalu Q, et al. Cardiopulmonary Resuscitation Capacity in Referral Hospitals in Nigeria: Understanding the Global Health Disparity in Resuscitation Medicine. Journal of the National Medical Association. 2017.

63. Zamir Q, Nadeem A, Rizvi AH. Awareness of cardiopulmonary resuscitation in medical-students and doctors in Rawalpindi-Islamabad, Pakistan. J Pak Med Assoc. 2012;62(12):1361-4.

64. Nambiar M, Nedungalaparambil NM, Aslesh OP. Is current training in basic and advanced cardiac life support (BLS & ACLS) effective? A study of BLS & ACLS knowledge amongst healthcare professionals of North-Kerala. World J Emerg Med. 2016;7(4):263-9.

65. Ragavan S, Schneider H, Kloeck WG. Basic resuscitation knowledge and skills of full-time medical practitioners at public hospitals in northern province. S Afr Med J. 2000;90(5):504-8.

66. Iirola T, Lund VE, Katila AJ, Mattila-Vuori A, Palve H. Teaching hospital physicians' skills and knowledge of resuscitation algorithms are deficient. Acta Anaesthesiol Scand. 2002;46(9):1150-4.

67. Panesar SS, Ignatowicz AM, Donaldson LJ. Errors in the management of cardiac arrests: an observational study of patient safety incidents in England. Resuscitation. 2014;85(12):1759-63.

68. Lauridsen KG, Schmidt AS, Adelborg K, Lofgren B. Organisation of in-hospital cardiac arrest teams - a nationwide study. Resuscitation. 2015;89:123-8.

69. Ruzman T, Tot OK, Ivic D, Gulam D, Ruzman N, Burazin J. In-hospital cardiac arrest: can we change something? Wien Klin Wochenschr. 2013;125(17-18):516-23.

70. Hui D, Morrison LJ, Windrim R, Lausman AY, Hawryluck L, Dorian P, et al. The American Heart Association 2010 guidelines for the management of cardiac arrest in pregnancy: consensus recommendations on implementation strategies. J Obstet Gynaecol Can. 2011;33(8):858-63.

71. Tran S, Deacon N, Minokadeh A, Malhotra A, Davis DP, Villanueva S, et al. Frequency and survival pattern of in-hospital cardiac arrests: The impacts of etiology and timing. Resuscitation. 2016;107:13-8.

72. Hajbaghery MA, Mousavi G, Akbari H. Factors influencing survival after in-hospital cardiopulmonary resuscitation. Resuscitation. 2005;66(3):317-21.

73. Thake JCH, Casemore C, Ferguson M. Medical students or consultants in anaesthesia – who would you want to resuscitate you? Anaesthesia. 2010;65(1):104.

74. World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. JAMA. 2013;310(20):2191-4.

75. Guidelines for good practice in the conduct of clinical trials in human participants. In: Department of Health. Pretoria 2006.

76. Brink HI, Van Der Walt C, Van Rensburg G. Fundamentals of Research Methodology for Health Care Professionals. Second ed: Juta and Company Ltd; 2006.

77. Bothma Y, Greef M, Mulaudzi FM, Wright SCD. Research in Health Sciences. Cape Town: Heinemann; 2010.

Appendix 1 - Information letter

Hello Colleagues

My name is Alexa Dal Lago and I am an Anaesthesiology registrar on the Wits Anaesthesiology circuit.

I would like to invite you to participate in a research study, "**Anaesthetists' knowledge regarding the 2015 resuscitation guidelines at three academic hospitals in Johannesburg**", which will be handed in to the Wits University Department of Health Sciences as part of my MMed degree.

I wish to survey the knowledge of the 2015 Resuscitation guidelines by Anesthetists at the Department of Anesthesiology at Wits in order to assess if poor outcomes achieved during resuscitation efforts for cardiopulmonary arrest may be due to lack of knowledge by anesthetists regarding the current resuscitation guidelines and/or lack of training in resuscitation.

Your participation in this study is entirely voluntary and there is no penalty for not participating. You are free to withdraw from the study at any time, without having to provide a reason.

Your participation in this study is also entirely anonymous: your questionnaire will in no way identify you and no identifying information will be collected or published with the results.

The questionnaire will take about 10 minutes to complete. Once completed, your questionnaire will be placed in a sealed box, the contents of which will only be viewed by me and my supervisor.

By completing this questionnaire your consent to take part in this study is implied. Please ensure that you have read and understood all the above information before completing it.

You should only complete this questionnaire once. If you have completed it before, kindly inform the researcher who handed you this document.

Thank you for taking the time to read this letter. If you have any questions or concerns with regard to the study, you may contact the following people with your queries:

- Professor Cleaton-Jones (chairperson of the HREC): 011 717 1234
- Alexa Dal Lago (researcher): 083 425 9225

Yours sincerely

Alexa Dal Lago (Researcher)

Appendix 2 - Questionnaire

APPENDIX 2: Questionnaire

Kindly complete ALL questions

Date:

PART 1: Demographic

1. Age ☐20-29 ☐30-39 ☐40-49 ☐50-59
2. Gender ☐male ☐female
3. Designation: ☐Intern ☐M O ☐Registrar ☐Consultant ☐Career MO
4. If Registrar:

   -Year of training ☐1 ☐2 ☐3 ☐4

   -Exams completed: ☐DA ☐FCA1 ☐FCA2
5. Years of Anaesthetic experience: ☐<5years ☐5-10years ☐>10years

6. 1. Have you ever completed a BLS course? ☐Yes ☐no

   If yes, when last did you complete it? | Yyyy | Mm |

   Are you currently certified? ☐ Yes ☐No

   2. Have you ever completed an ACLS course ☐Yes ☐No

   If yes, when last did you complete it? | Yyyy | Mm |

   Are you currently certified? ☐ Yes ☐ No

3. Have you ever completed a PALS course? ☐ Yes ☐ No

If yes, when did you last complete it?

Yyyy	Mm

Are you currently certified? ☐ Yes ☐ No

7. If you have not completed a formal course in resuscitation please indicate which of the reasons below best represent your reason for non-completion

   ☐ Not relevant

   ☐ Cost to yourself

   ☐ Not a specialty requirement

   ☐ No time

   ☐ other (specify_____

8. Do you think your resuscitation knowledge is adequate? ☐Yes ☐no

9. If yes to question above, what do you think most contributes to your knowledge?

   ☐ Experience

   ☐ Reading current literature

   ☐ Attending courses

   ☐ Other (specify)_____

10. How many cardiac arrest resuscitations have you been involved in over the last 6 months?_____

11. How confident do you feel in handling a resuscitation scenario?

    (1: not at all to 5: very confident)

1	2	3	4	5

PART 2: Knowledge regarding the 2015 resuscitation guidelines

Please place an “X” in the box next to the correct answer (There is **only one correct answer per question** unless specified.)

1. What is the latest recommended chest compression rate for adult patients with cardiac arrest?

   ☐ 60 to 80 per minute

   ☐ 80 to 100 per minute

   ☐ At least 80 per minute

   ☐ 100 to 120 per minute

2. What is the latest recommended depth for chest compressions?

   ☐ 3 cm to 4 cm

   ☐ 4 cm to 5 cm

   ☐ 5 cm to 6 cm

   ☐ 6 cm to 7 cm

3. Which of the following is the correct sequence for basic CPR?

   ☐ A-B-C

   ☐ C-B-A

   ☐ C-A-B

   ☐ B-A-C

4. What is the chest compression to ventilation ratio for an adult for one person CPR?

   ☐ 5:1

   ☐ 15:2

   ☐ 30:1

   ☐ 30:2

5. How many rescue breaths per minute should be given if the patient has no definitive airway in place?

   ☐ 6 to 8

   ☐ 8 to 10

   ☐ 10

   ☐ 12

6. Which of the following drugs **are not administered** via the endotracheal tube during CPR?

   ☐ Sodium Bicarbonate

   ☐ Atropine

   ☐ Lignocaine

   ☐ Adrenaline

7. Which of the following **does not cause** Pulseless Electrical Activity (PEA)?

   ☐ Hypokalaemia

   ☐ Subarachnoid Haemorrhage

   ☐ Pericardial Tamponade

   ☐ Massive Pulmonary Embolism

8. Which of these rhythms require defibrillation?

- ☐ Asystole
- ☐ Pulseless Electrical Activity
- ☐ Pulseless Ventricular Tachycardia
- ☐ Bradycardia

9. Which is the correct sequence for management of patient with Ventricular Fibrillation (VF)?

- ☐ CPR→ Defibrillation → Pulse check→ Resume CPR
- ☐ CPR→ Pulse check→ Defibrillation→ CPR
- ☐ CPR→ Defibrillation→ CPR→ Pulse check
- ☐ Adrenaline→ CPR→ Defibrillation→ Pulse check

10. What is the correct course of action for persistent Ventricular Fibrillation?

- ☐ Defibrillation→ 2minutes CPR→ Adrenaline
- ☐ Defibrillation→ 2min CPR→ Vasopressin
- ☐ Defibrillation→ 2min CPR→ Defibrillation
- ☐ Defibrillation→ 2min CPR→ Atropine

11. What is the most correct option for the management of Asystole/ PEA?

- ☐ CPR→ Defibrillation→ Adrenaline
- ☐ CPR→ Atropine→ Look for H's and T's
- ☐ CPR→ Defibrillation→ Vasopressin
- ☐ CPR→ Adrenaline→ Look for H's and T's

12. For a patient with sinus bradycardia and a heart rate of 42/minute, who is diaphoretic, and has a blood pressure of 80/60. What is the initial dose of Atropine?

    ☐ 0.1mg

    ☐ 0.5mg

    ☐ 1mg

    ☐ 3mg

13. Which one of these monitoring modalities has been proven to be useful to measure effectiveness of CPR?

    ☐ Non-Invasive Blood Pressure

    ☐ End tidal CO2

    ☐ Pulse oximetry

    ☐ Blood glucose

14. Which of the following best defines the role for ultrasound in a resuscitation for cardiac arrest? (more than 1 answer may be correct)

    ☐ Confirmation of correct endotracheal tube placement

    ☐ Looking for reversible causes

    ☐ Peripheral nerve blocks

    ☐ Placement of central venous line

15. Which of the following is the **most frequent cause** of cardiac arrest in children?

    ☐ Ventricular Fibrillation

    ☐ Trauma

    ☐ Respiratory Arrest

    ☐ Intoxication

16. In infants and school age children, the two most common initial rhythms seen in paediatric cardiac arrest are:

- ☐ Asystole and PEA
- ☐ Asystole and VF
- ☐ PEA and VF
- ☐ Pulseless VT and VF

17. High quality CPR for young children includes:

- ☐ Compress to a depth of at least one third of the child's chest diameter
- ☐ Compress at a rate of between 100-120 compressions per minute
- ☐ Minimize interruptions to chest compressions
- ☐ All of the above

18. What compression to ventilation ratio should be used for 2-rescuer infant CPR?

- ☐ 30:2
- ☐ 20:2
- ☐ 15:2
- ☐ 5:1

19. What is the first drug of choice for a child with bradycardia?

- ☐ Sodium Bicarbonate
- ☐ Atropine
- ☐ Adrenaline
- ☐ Dopamine

20. The 8 year old child you are treating has a heart rate of 200 and on the monitor you see a rapid rhythm with narrow QRS complexes and no discernible P waves. The rhythm is probably:

    ☐ Sinus tachycardia

    ☐ Supraventricular tachycardia

    ☐ Sinus rhythm

    ☐ Ventricular tachycardia

21. The AVPU scale is a scale used to evaluate cerebral cortex function and is used to rate a child's level of consciousness. What does the acronym AVPU stand for?

    ☐ Alert, Voice, Painful, Unresponsive

    ☐ Active, Verbal, Painful, Unresponsive

    ☐ Alert, Voice, Pupils, Unresponsive

    ☐ Alive, Voice, Pulses, Understands

22. Which of the following are indirect indicators of circulatory status? (more than one answer may be correct)

    ☐ Urine output

    ☐ Oxygen saturation

    ☐ Level of consciousness

    ☐ Respiratory rate

23. What is the most common cause of bradycardia in children?

    ☐ Sepsis

    ☐ Drug overdose

    ☐ Hypoxia

    ☐ Complete heart block

24. What is the fastest way to gain access for medication in a child?

- ☐ Intravenous
- ☐ Intra-osseus
- ☐ Subclavian central line
- ☐ Endotracheal intubation

25. Which statement is correct about the use of calcium chloride in paediatric patients

- ☐ Recommended dose is 1-2mg/kg
- ☐ It is indicated for hypercalcemia, hypokalemia, hypomagnesemia
- ☐ It has the same bioavailability of elemental calcium as calcium gluconate
- ☐ Routine administration is not indicated in cardiac arrest

Appendix 3 – Ethics approval

R14/49 Dr Alexa Dal Lago

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M160703

NAME: (Principal Investigator)	Dr Alexa Dal Lago
DEPARTMENT:	Anaesthesiology
PROJECT TITLE:	Anaesthetists' Knowledge Regarding the 2015 Resuscitation Guidelines at Three Academic Hospitals in Johannesburg
DATE CONSIDERED:	29/07/2016
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Lizil Gilliland
APPROVED BY:	Professor P Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	17/08/2016

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

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary in Room 10004, 10th floor, Senate House/3rd Floor, Phillip Tobias Building, Parktown, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in July and will therefore be due in the month of July each year.

Principal Investigator Signature Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix 4 – Turnitin report

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ORIGINALITY REPORT

4%	6%	1%	5%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

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