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A COMPARISON OF TWO WEEK VERSUS TWO MONTH ANAESTHETIC TRAINING FOR INTERNSHIP DOCTORS

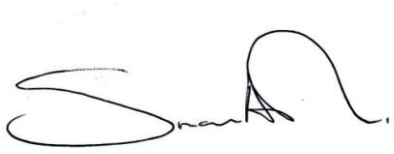
SIMON ALISTAIR ASH

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

Johannesburg 2012

DECLARATION

I, Simon Alistair Ash, declare that this research report is my own work. It is being submitted for the degree of Master of Medicine in the branch of Anaesthesia at the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.



SA Ash

23rd April 2012

For my father, who would have been proud.

PRESENTATIONS ARISING FROM THIS STUDY

1. Presented as a poster at the 14th World Congress of Anaesthesiologists, Cape Town, March 2008.
2. Presented as a poster at the 9th Prakash Vallabh Primary Healthcare Conference, Johannesburg, November 2008.
3. Presented as an oral presentation at the South African Society of Anaesthesiologists (SASA) Congress, Durban, March 2009.

   *Winner of 2009 SASA Registrar prize.

PREFACE

Upon completion of my internship year at Bloemfontein, which included four weeks of anaesthesia training, I was sent to Benedictine Hospital, Nongoma, KwaZulu-Natal, for my Community Service year.

As I had expressed an interest in anaesthesia, I was assigned the role of lead anaesthetist and put in charge of theatre and ICU. Fortunately, I had the insight to request further training and I did one month's intensive training under Dr Derek Barrett at Ngwelezane Hospital, Empangeni, KwaZulu-Natal, before taking up my duties as lead anaesthetist. Following that intensive period of training, I continued to seek further training while on leave and during off-duty periods, first at Ngwelezane and then under the auspices of the Department of Anaesthesia at Chris Hani Baragwanath Hospital, Johannesburg.

During my year of Community Service I was exceptionally lucky as potentially difficult cases of a type that would later prove challenging as an anaesthetic registrar went well. Ignorance is bliss.

Experiences during my Community Service year contributed to a strong sense that interns are inadequately prepared for the safe provision of anaesthesia in an unsupervised environment. Moreover, those early insights contributed to a fervent belief in the necessity for improved education and training of interns in South Africa, while engendering an enduring passion for Obstetric anaesthesia.

During my first year as a registrar, the opportunity arose to assess the benefit of increased anaesthesia training time during the two year internship. I jumped at it.

Fortuitously, I was able to construct the instrument and obtain the necessary post-graduate and ethics approval in time to collect data from the LAST group of one year interns. This allowed the comparison of the two-week and two-month anaesthesia rotations in the research report that follows.

Dr Simon Ash

Johannesburg, November 2011

ABSTRACT

BACKGROUND

Since the inception of Community Service in 1998, junior doctors have been required to administer anaesthesia in rural areas with poor or no supervision, despite a lack of technical skills and an initial need for increased supervision.

Up until the end of 2006, internship training included a two-week anaesthesia rotation. From 2007, the two-year internship was introduced in Gauteng, with new two-month anaesthesia rotation being instituted from 2008, as part of this two-year internship program.

OBJECTIVES

The aim of this study was to compare the adequacy of an internship doctor's knowledge after two weeks versus two months of training in anaesthesia. The objectives of this study were to determine the anaesthetic knowledge of internship doctors completing a two-week and two-month anaesthetic rotation and compare their knowledge.

METHOD

After Wits Ethics Committee approval, 108 two-week interns (73% of the intern population) and 107 two-month interns (72% of the intern population) at the

Witwatersrand Academic Complex were approached at the end of their internship (December 2006 and 2008 respectively). They completed a questionnaire in the form of short questions and case study vignettes, drawn up with a two-tier vetting process to assess basic anaesthetic knowledge as dictated by the Health Professions Council Of South Africa guidelines. Demographic data included the undergraduate institution and hospital where they had been trained.

RESULTS

The average result for the two-week interns was 38.95 (14.9) %. Knowledge of the anaesthetic machine check and anaesthetic pharmacology was inadequate (49% of respondents unable to describe the nitrous oxide pipeline, only 7% of respondents able to give the induction dose of Etomidate and 24% unable to list one contraindication to Suxamethonium). Analysis of variance showed a difference in the performance of respondents from the different WAC hospitals and undergraduate institutions.

The average result for the two-month interns was 48.95 (21,77) %, an improvement of 10% overall. However, knowledge of the anaesthetic machine check and anaesthetic pharmacology remained inadequate (only 4% of respondents able to give the gauge pressure of a full oxygen cylinder, 63% of respondents unable to give the antidote for a benzodiazepine and 85% unable to give the induction dose of Etomidate). Analysis of variance again showed a difference in the performance of respondents from different undergraduate institutions, and further analysis of undergraduate institutions revealed that only

three out of six institutions showed improvement between two weeks and two months of training in anaesthesia.

CONCLUSION

The following conclusions can be drawn from the study:

1) While the two-month anaesthesia rotation appears to improve the anaesthetic knowledge acquired during internship, increased exposure time alone may not be sufficient. Cognisance of other potential contributing factors should guide the design of the anaesthetic rotation so as to supplement potential shortfalls (e.g. undergraduate knowledge).

2) Anaesthetic knowledge after a two-month internship-training period, as assessed by our questionnaire, shows an improvement over the two-week training period, but still appears to be inadequate for the safe provision of unsupervised anaesthesia during Community Service.

ACKNOWLEDGEMENTS

I am grateful to the following people:

Dr Des Lines; my mentor, supervisor and friend, for his endless advice, encouragement and support during the supervision of this project.

Prof A.C. Lundgren, for her encouragement, expertise and advice during this project.

Dr E. Liebhaber, for teaching me how to use STATISTICA® and confirming my interpretation of the statistics.

Dr P. Abrahams and Mr L. Wright, for their editing prowess, when spell check failed.

The Department of Anaesthesia, Chris Hani Baragwanath Hospital, for the countless hours of research time given for data collection, writing and presentations.

Mrs J. Ash, my loving wife, without whom this document would not have page numbers.

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CHAPTER 1

1. INTRODUCTION

In Chapter 1 an overview of the study shall be given. The following shall be addressed:

- A brief introduction of the literature review, more formally discussed in Chapter 2.
- The problem statement, as well as the aims and objectives of the study.
- The definitions to be used within the study.
- The ethical considerations.
- An outline of the research methodology, more formally discussed in Chapter 3.
- The significance of the study.
- The potential limitations of the study.
- An outline of the research report

1.1. Introduction

Since 1998, junior doctors in South Africa have been required to complete a compulsory Community Service year on completion of their internship before being granted registration for independent practice. The Department of Health's aim with Community Service is to "distribute health personnel throughout the country in a more equitable manner" (1).

From a pioneer cohort of 26 in 1998, the number of Community Service doctors has swelled to more than 1600 expected in 2009 (2, 3). Of the 1088 Community

Service doctors in 1999, 24% were allocated to rural areas (1, 2, 4). Since 2003, the Department of Health has endeavoured to place an increasing percentage of community service doctors in primary health care, district and secondary hospitals in rural areas (5).

Community Service doctors in rural areas are required to administer anaesthesia to cope with the burgeoning number of surgical cases in South Africa (1, 2, 6, 7, 8, 9, 10). Cases for which Community Service doctors may be required to administer anaesthesia in rural district hospitals include caesarean sections, ectopic pregnancies and interventions following motor vehicle accidents (7).

The technical challenges of administering safe anaesthesia in rural areas, including faulty oxygen supplies (9), are compounded by inadequate anaesthetic training and supervision (8, 11, 12, 13,).

There is no literature investigating the standard and outcomes of Community Service anaesthetic practice. Anaesthetic-related mortality, with the exception of maternal mortality, is largely unknown. However, the overall operative mortality in rural areas may be as high as 1:216 (13).

According to Saving Mother's reports, anaesthesia-related deaths account for 5.1% to 7.5% of all direct causes of maternal death (14, 15, 16). The following factors contributed to maternal death: inadequate pre-operative assessment, failure to perform a machine check, inappropriately high doses of local anaesthetic for

spinal anaesthesia, inadequate doses of atropine for treatment of bradycardia and failure to manage intraoperative desaturation (2, 14).

Reid found that technical skills required by Community Service doctors included anaesthesia and resuscitation (2). Reid also noted that Community service doctors were deficient in these skills.

These skills should be imparted under the internship Domain of Anaesthesia as outlined by the published guidelines of the Health Professions Council of South Africa (HPCSA) (17).

Until 2006/2007 internship included only a two-week anaesthesia rotation, which Gordon and James felt was inappropriate for unsupervised practice (13). All medical graduates after 1 July 2006, however, have been required to complete a two-year internship, which includes a two-month anaesthesia rotation. For the Witwatersrand Academic Complex (WAC) the two-year internship began in January 2007.

At this time of change it seems appropriate to compare the anaesthetic knowledge acquired by the two-week anaesthesia rotation with that acquired by the two-month anaesthesia rotation.

1.2. Problem statement

Preparation for Community Service provision of anaesthesia should be accomplished during the internship Domain of Anaesthesia. As of 1 January 2007,

WAC interns are required to complete a two-month anaesthesia rotation, whereas internship doctors before 2007 only completed a two-week anaesthesia rotation. It is important to compare the knowledge acquired during the two-week rotation with that acquired during a two-month rotation, to determine whether the two-month rotation improves preparation for community service anaesthesia provision.

1.3. Aim and Objectives

1.3.1 Aim of the Study

The aim of this study is to compare the anaesthetic knowledge acquired by interns completing a two-week rotation through anaesthesia with those completing a two-month anaesthesia rotation.

1.3.2 Objectives of the Study

- To determine the anaesthetic knowledge of internship doctors completing a two-week anaesthetic rotation by means of a questionnaire consisting of both short questions and case study vignettes.
- To determine the anaesthetic knowledge of internship doctors completing a two-month anaesthetic rotation by means of a questionnaire consisting of both short questions and case study vignettes.
- To compare the anaesthetic knowledge of internship doctors completing a two-week anaesthetic rotation with that of those completing a two-month anaesthetic rotation

1.4 Research Assumptions and Definitions

The following definitions shall be used in this study:

Community Service: A compulsory twelve-month period of service within the South African public health system on completion of formal training.

Community Service doctors: Post-internship doctors completing Community Service in order to obtain registration for independent practice as general practitioners from the HPCSA.

Witwatersrand Academic Complex: The cluster of hospitals utilised by the University of the Witwatersrand Faculty of Health Sciences for the training of undergraduate and postgraduate medical students, including Chris Hani Baragwanath Hospital, Helen Joseph and Coronation Hospital complex and Johannesburg Hospital.

Chris Hani Baragwanath Hospital: This is an academic hospital associated with the University of the Witwatersrand, and part of the Witwatersrand Academic Complex. It is a tertiary hospital acting as a

referral hospital for a number of smaller regional hospitals and clinics. It is now known as Chris Hani Baragwanath Academic Hospital.

Helen Joseph Hospital: This refers to the academic hospital complex consisting of Helen Joseph and Coronation Hospitals, associated with the University of the Witwatersrand, and part of the Witwatersrand Academic Complex. The Helen Joseph Hospital complex consists of secondary hospitals acting as referral hospitals for a number of smaller regional hospitals and clinics. Helen Joseph provides services in all medical domains other than Obstetrics & Gynaecology and Paediatrics. Coronation provides services in the domains of Obstetrics & Gynaecology and Paediatrics. Coronation Hospital is now known as the Rahima Moosa Mother & Child Hospital.

Johannesburg Hospital: This is an academic hospital associated with the University of the Witwatersrand, and part of the Witwatersrand Academic

	Complex. It is a tertiary hospital acting as a referral hospital for a number of smaller regional hospitals and clinics. It is now known as Charlotte Maxeke Johannesburg Academic Hospital.
Anaesthesia-related death:	A death occurring unexpectedly either during or shortly after anaesthesia, which was either directly due to anaesthesia or for which no cause could be found. (14)
Internship:	A mandatory period of supervised practice in multiple medical disciplines after completion of undergraduate medical training. Prior to July 2006, internship was twelve months; thereafter it was increased to 24-months.
Internship doctor/ Intern:	A doctor currently completing his/her internship.
Domain of Anaesthesia:	The anaesthesia rotation contained within the internship period, where internship doctors have supervised anaesthesia practice and training.

Anaesthesia rotation:	A period of two-weeks/ two-months within the internship period for practice in the Domain of Anaesthesia.
Short questions:	Questions testing the simple recall of facts: requiring the respondent to fill in the blanks with a word or phrase or provide a brief listing or one-sentence answer.
Case Study vignettes:	Written case simulations consisting of an introductory narrative and subsequent event cues where the aim is to assess the respondent's knowledge, choices and judgements of hypothetical situations by guiding the respondent into a particular context.
Exam conditions:	For this study exam conditions mean that, while the completion of the study questionnaire shall have no time limit, no consultation between participants or of reference material shall be allowed and completion of the study questionnaire shall be invigilated.

1.5 Location of the Study

The study shall be conducted at the hospitals of the Witwatersrand Academic Complex, namely Chris Hani Baragwanath Hospital, Helen Joseph and Coronation Hospital complex and Johannesburg Hospital.

1.6 Ethical considerations

Ethics clearance for the study shall be obtained from the Human Research Ethics Committee (Medical) of the University of the Witwatersrand, Johannesburg, Gauteng Province, South Africa, prior to commencement of the study.

Approval for the study shall be obtained from the Postgraduate Committee of the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, Gauteng Province, South Africa, prior to commencement of the study

Approval for the study shall be obtained from the relevant authorities of the Witwatersrand Academic Complex, including the internship co-ordinator and Academic Head of the Department of Anaesthesia, prior to commencement of the study.

Informed consent shall be obtained from participants by means of an information sheet and written consent form. Steps shall be taken to ensure confidentiality, with the participant's consent form being placed in an envelope and separated from the completed questionnaire.

Participation or non-participation shall not benefit or disadvantage participants in any way.

1.7. Research methodology

1.7.1 Research design

This study follows a prospective contextual descriptive research design by means of a questionnaire consisting of short questions and case study vignettes.

1.7.2 Study population and sample

1.7.2.1 Study population

The study population shall comprise all the internship doctors employed at the hospitals of the WAC from January 2006 to December 2006 (two-week interns), and those employed from January 2007 to December 2008 (two-month interns).

The study sample shall include all two-week and two-month interns who have completed their anaesthesia rotation and had their Form 10-A, HPCSA Intern Duty Certificate signed off by the Department of Anaesthesiology.

1.7.2.2 Study sample

1.7.2.2.1 Sample statement

A sample size of 83 internship doctors in each group shall be required to have 99% power to detect a difference in means of 10, assuming that the population standard deviation is 14.9, using a two group t-test with a 0.05 two-sided significance level.

1.7.2.2.2 Sampling method

A consecutive convenience sampling method shall be used.

The convenience sampling method was chosen because of time constraints and the scope of the research. It is recognised that a convenience sampling method may not fully represent the study population (18).

The study will further use a consecutive sampling method where every eligible internship doctor will be invited to take part in the study. Consecutive sampling is the most reliable form of convenience sampling as research bias is limited (18).

1.7.3 Inclusion and exclusion criteria

1.7.3.1 Inclusion criteria

The following inclusion criteria shall be used for the study:

- Interns that give voluntary informed consent.
- Interns that have completed their anaesthesia rotation.
- Interns that have already had their Form 10-A, HPCSA Intern Duty Certificate signed off by the Department of Anaesthesiology.
- Ability to complete the study questionnaire under exam conditions.

1.7.3.2 Exclusion criteria

The following exclusion criteria shall be used for the study:

- Refusal to volunteer for the study.
- Not having completed their anaesthesia rotation.

- Not having their Form 10-A, HPCSA Intern Duty Certificate signed off by the Department of Anaesthesiology.
- Inability to complete the study questionnaire under exam conditions.

1.7.4 Schedule of dates

Ethics approval shall be obtained in November 2006.

Postgraduate Committee approval shall be obtained in November 2006.

Two-week intern data shall be collected in December 2006.

Two-month intern data shall be collected in December 2008.

1.7.5 Construction of the instrument

The study shall take the form of a questionnaire. The questionnaire shall consist of three sections: Section A: Demographic survey, Section B: Short questions and Section C: Case study vignettes.

Sections B and C shall be drawn up by Dr S. Ash in consultation with the Centre for Health Science Education, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, Gauteng Province, South Africa.

For validation of the instrument, Section B and C's short questions and case study vignettes shall undergo a two-tier expert review/ vetting process.

1.7.6 Procedure for data collection

The study population shall be invited to voluntarily participate in the study and subsequent data collection shall take place in December 2006 and December 2008, for the two-week and two-month internship groups respectively.

Completion of the questionnaire shall have no time limit, but shall be conducted under exam conditions, without consultation between participants or of reference material. Dr S. Ash shall invigilate questionnaire completion.

1.7.7 Data analysis

The data shall be entered into a database and analysed using STATISTICA® statistics software (Release 8) in consultation with a biostatistician. Data shall be continuous. Analysis techniques shall include basic descriptive statistics (mean, median, minimum, maximum, standard deviation and 95% confidence levels), as well as parametric and non-parametric analysis (T-test, ANOVA test, Mann-Whitney U test and Kruskal Wallis test). A p-value of less than 0.05 shall be considered as significant.

1.8. Significance of the Study

The significance of this study is that it will allow for assessment whether or not the two-month anaesthesia rotation during the two-year internship increases knowledge acquisition among interns and, by proxy, whether or not the two-month anaesthesia rotation improves preparation for the provision of Community Service anaesthesia as compared with the now defunct two-week anaesthesia rotation.

1.9. Potential Limitations of the Study

The following potential limitations of this study have been identified:

- Convenience sampling method
- The study is contextual and the study population may not be representative of the national internship group nor of internship groups preceding or following them.
- While every effort shall be made to avoid it, bias secondary to preparation may occur.
- This study assesses knowledge rather than skills. Skills may better represent competency.
- The study cannot test all anaesthetic knowledge.
- Answers to the questionnaire are assigned to either correct or incorrect categories, with no elucidation of the thought process involved in reaching the answer.
- Collection of data is at the end of the year rather than the end of the rotation.
- The validity of the case study vignettes cannot be established via comparison with a standardised patient.
- There is no option to “call for help”.

1.10 Research Report Outline

This research report shall consist of the following chapters:

Chapter 1:	An introduction to the study, including the aim and objectives of the study, and a brief summary of the methodology used.
Chapter 2:	A review of the literature pertinent to the topics raised by the study.
Chapter 3:	A description of the methodology used for the study.
Chapter 4:	The results of the study.
Chapter 5:	Interpretation and discussion of results and directions for future research.
Chapter 6:	Summary of research and conclusion.

In Chapter 1 we have given an overview of the study, including a brief introduction of the literature review, the problem statement, aims and objectives of the study, the definitions to be used within the study, the ethical considerations, an outline of the research methodology, the significance of the study, the potential limitations of the study and an outline of the research report.

CHAPTER 2

2. LITERATURE REVIEW

In Chapter 2 an overview of the literature relevant to the topics raised by the study shall be given. The following shall be addressed:

- Community Service, including community service doctors and community service in rural areas.
- Community Service Anaesthesia, including anaesthesia caseload, technical challenges and supervision.
- Consequences of Community Service Anaesthesia, including Saving Mothers.
- Skills and training, including the domain of anaesthesia and the internship anaesthesia rotation.
- Assessment of anaesthetic knowledge, including short questions and case study vignettes.

2.1 Introduction

Community Service doctors placed in rural areas are required to administer anaesthesia. In rural areas, Community Service doctors face both technical challenges and lack supervision. Training for this Community Service anaesthetic practice is imparted during the internship Domain of Anaesthesia.

2.2 Community Service

Community Service refers to a compulsory 12-month period of service within the South African public health system on completion of formal training.

The Department of Health states that: “the main objective of Community Service is to ensure improved provision of health services to all the citizens of our country. In the process, this also provides our young professionals with the opportunity to develop skills, acquire knowledge, behaviour patterns and critical thinking that will help them in their professional development.” (2)

Several professional groups, including doctors, dentists and pharmacists, are required to complete Community Service before the HPCSA will grant registration for independent practice.

2.2.1 Community Service Doctors

For South African doctors formal training consists of an undergraduate medical degree followed by internship. Completion of Community Service is required after internship training before the HPCSA will extend registration for independent practice as a general practitioner.

Medical doctors were the first professional group to participate in Community Service with a pioneer cohort of 26 Community Service doctors in 1998. (2) They are the largest professional group to undergo Community Service each year, with 1609 Community Service doctors expected in 2009. (3)

Allocation to Community Service sites is co-ordinated nationally in 3 rounds of allocations. Internship doctors apply for five initial choices and 85% are normally placed in the first round. Those not placed in the first round (15%) apply for a further five choices in the second round. The five percent not placed by the first and second rounds are allocated wherever vacant posts are available around the country. However, the allocation process resulted in largely rural provinces having unfilled Community Service posts and undermined the objective of servicing under-staffed areas. (2)

The Department of Health has endeavoured to place an increasing percentage of Community Service doctors in rural areas. (2, 5)

2.2.2 Community Service in Rural Areas

Since 2003, the Department of Health has made a concerted effort to place Community Service doctors in hospitals outside Gauteng and the Western Cape, moving them from tertiary academic hospitals to primary health care, district and secondary hospitals, with increasing numbers being allocated to more rural areas. (5)

In 1999, 259 of 1088 Community Service doctors (23.8%) were allocated to rural areas. (1, 2, 4) Even if this percentage had not increased, 383 Community Service doctors would be allocated to rural areas in 2009, a 48% increase in the absolute number of Community Service doctors allocated to rural areas.

Community Service doctors in rural areas are required to administer anaesthesia to cope with the burgeoning number of surgical cases in South Africa. (1, 2, 6, 7, 8, 9, 10)

2.3 Community Service Anaesthesia

Community Service doctors, especially those in rural areas, are required to administer anaesthesia for emergency cases as well as a proportion of complicated elective cases. (8) This is done in the face of technical challenges and poor supervision.

2.3.1 Anaesthesia Caseload

Caesarean sections are the most common emergency surgery performed in rural district hospitals. (6) Both regional and general anaesthesia are performed for caesarean section. (6, 14, 15, 16) Many district hospitals also deal with trauma surgery following motor vehicle accidents, orthopaedic surgery for fractures, gynaecological surgery for ectopic pregnancies and other complicated surgeries for which anaesthesia is required. (7) Community Service doctors handle the majority of emergency cases as well as a proportion of the complicated elective cases. (8)

Van der Reyden reports performing over 1000 anaesthetics during an 18-month period that included Community Service, with a patient age range of eight weeks to 92 years old and three cases that required inotropic support. (8)

2.3.2 Technical challenges

Community Service doctors are faced with technical challenges associated with the rural hospital to which they are allocated. These include oxygen or electricity cutting out, no diesel for the generator and faulty oxygen supplies. (9) Bateman reports one hospital that had a state of the art anaesthetic machine but no oxygen with which to use it. (9) In a study conducted in Limpopo, 95.7% of Community Service doctors reported equipment not working. (4)

2.3.3 Supervision

Community Service is the first time in the junior doctor's medical career that they will work unsupervised, while forming the front line of the public health system. (18) Community Service doctors tend to be young and inexperienced. Their skills vary widely and to practice effectively they are generally in need of supervision and support. (2)

Some studies suggest that Community Service doctors may initially require increased supervision. (2) De Villiers and De Villiers noted that the degree of supervision available affected the competence of Community Service doctors. (19) Nemutandani et al found that the main challenges identified by Community Service doctors with regards to skills development and confidence included inadequate support and supervision by senior doctors. (4)

Supervision of Community Service doctors is significantly poorer in rural versus more urban settings, with some rural hospitals having no full-time staff apart from

the Community Service doctors themselves, who are solely responsible for service provision. (1, 2, 4, 9, 19)

Nemutandani et al found that the majority of Community Service doctors worked without any senior staff to support them in case of an emergency. In addition, where supervision was present, 35.7% of Community service doctors reported no feedback on management by seniors, while 32.9% reported feedback was meagre and unhelpful. (4)

More specific to the domain of anaesthesia, it has been found that there is inadequate anaesthetic training and cover in rural areas. (8, 11, 12, 13) There are very few diplomates (Colleges of Medicine of South Africa Diploma in Anaesthesia), let alone specialist anaesthesiologists, in rural areas (11, 13) and the average rural doctor is unlikely to have any anaesthetic experience beyond internship. (4)

Lamacraft et al found that 13% of respondents performing obstetric anaesthesia in the Free State had never performed obstetric anaesthesia before being required to do so, and that over half of Community Service doctors worked in hospitals without any doctors with senior anaesthesia experience. (6)

Of concern are the findings that over 50% of surgeries are performed by a single surgeon-anaesthetist. (11) Van der Reyden even reports an internship doctor, let alone a Community Service doctor, conducting both the surgery and the

anaesthetic for a caesarean section because he/she was unable to contact a senior doctor. (8)

2.4 Consequences of Community Service Anaesthesia

There is no literature on the standards and outcomes of Community Service anaesthetic practice. Anaesthetic-related mortality outside major academic centres, with the exception of maternal mortality, is largely unknown. Overall operative mortality in rural areas may be as high as 1:216. (13)

Van der Reyden reports one theatre-related death in his Community Service year (8), while 58% of Limpopo Community Service doctors report the death of a patient due to system failure, which may include anaesthesia-related deaths. (4)

2.4.1 Saving Mothers

Saving Mothers reports documented 27 anaesthesia-related deaths in 1998, 22 in 1999 and 91 for the period 2002-2004, ranging from 2.8% to 4.8% of all maternal deaths. (14, 15, 16) An anaesthesia-related death was defined as a death occurring unexpectedly either during or shortly after anaesthesia, which was either directly due to anaesthesia or for which no cause could be found. (14)

Causes of maternal deaths were divided into indirect and direct causes. Indirect causes of maternal death include non-pregnancy-related infections, acquired immunodeficiency syndrome (AIDS) and pre-existing maternal diseases (e.g. cardiac disease, hypertension). Direct causes of maternal death include pregnancy-

induced hypertension, ante-/postpartum haemorrhage, pregnancy related sepsis, ectopic pregnancy, acute collapse, embolism and anaesthesia. (14, 15, 16)

Anaesthesia-related deaths accounted for 5.1% to 7.5% of all direct causes of maternal deaths (combined figures for Level 1, 2 and 3 hospitals). (14, 15, 16)

The majority of maternal deaths related to anaesthesia (78%) occurred in Level 1 and 2 hospitals, with up to 57.1% occurring in Level 1 hospitals. (15) The number of maternal deaths in Level 1 and 2 hospitals is increasing. (16)

In Level 1 hospitals, which include rural District hospitals, anaesthesia-related deaths accounted for as much as 9.7% of all maternal deaths and 13.6% of direct causes of maternal death. (15) Unfortunately, the maternal death notification form does not include the details on grade and qualification of the doctor/s involved and thus the impact of Community Service doctors cannot be stated. However, all three Saving Mothers reports documented a generally low competence in those called to provide anaesthesia and recommended obstetric anaesthesia competency be improved. (6, 14)

The majority of anaesthesia-related deaths were associated with general anaesthesia. The most common single factor responsible for death was a difficult or failed intubation. Anaesthesia was the direct cause of, or significantly contributed to, 70% of anaesthesia-related deaths. (14) 90.1% of anaesthetic deaths were deemed to be avoidable, accounting for 6.8% of avoidable deaths, while lack of adequately trained staff accounted for 12.8% of avoidable deaths.

Avoidable deaths are defined as deaths classified by assessors as being clearly avoidable within the health system, i.e. patient factors were excluded. (16)

The following factors, directly related to the training and preparation of Community Service doctors, contributed to maternal death (2, 14):

- Inadequate pre-operative assessment.
- Failure to perform a machine check.
- Inappropriately high doses of local anaesthetic for spinal anaesthesia.
- Inadequate doses of atropine for treatment of bradycardia.
- Failure to manage intra-operative desaturation.

Saving Mothers reports noted that differences in maternal physiology and pharmacology are covered inadequately at undergraduate level. (14)

2.5 Skills and Training

Priority technical skills required by, and lacking among, Community Service doctors relate to anaesthesia and resuscitation. (2) Van der Reyden noted that Community Service anaesthesia required techniques to which there was limited exposure at undergraduate level. (8) Cameron et al found all internship doctors studied expressed a lack of confidence in their ability to administer a general anaesthetic, especially for a caesarean section or on a child, at the end of their internship year and that 67% of junior doctors expressed a lack of confidence in using a defibrillator. (7)

It was also noted that Community Service doctors might not be aware of gaps in their professional knowledge and skills. (7)

Skills and training in anaesthesia and resuscitation should be covered under the internship Domain of Anaesthesia as outlined by the HPCSA published guidelines, which specify the skills and competencies internship doctors are expected to acquire during their internship anaesthesia rotation. (17)

2.5.1 Domain of Anaesthesia

The stated objectives of the Domain of Anaesthesia are: " to teach trainees the basic principles of the preparation and assessment of patients prior to anaesthesia, resuscitation, peri-operative analgesia and the principles of safe administration of elementary general and regional anaesthesia." (17)

Skills internship doctors are expected to acquire during their anaesthesia rotation include: (17)

- Anaesthetic machine checks.
- Basic adult and paediatric anaesthetic circuit checks.
- Airway control (including mask and endotracheal tube).
- Ventilation (including manual and machine ventilation).
- Principles of ICU ventilation and weaning.
- Regional anaesthesia.
- Placement of peripheral and central lines.
- Placement of underwater chest drains.

Competencies internship doctors are expected to acquire during their anaesthesia rotation include: (17)

- Pre-operative patient assessment (including airway, cardiovascular, central nervous and respiratory systems).
- Interpretation of special investigations.
- Peri-operative fluid management.
- Anaesthetic breathing systems.
- Cardio-pulmonary resuscitation and advanced cardiac life support.
- Diagnosis and treatment of anaphylaxis.
- Pharmacology of anaesthetic drugs.
- Assessment of post-operative recovery from anaesthesia.

2.5.2 Internship Anaesthesia Rotation

Since the introduction of internship in South Africa in the 1950's, the internship exposure to anaesthesia slowly developed into a two-week anaesthesia rotation that internship doctors were required to complete until 2006/2007.

Internship training is intended to produce doctors competent to perform Community Service and equipped for the challenges of the public health system. (3, 6) In this regard, the nature of the one-year internship rotations was found to give inadequate exposure and consequently internship was lengthened to two years. (21) The first 134 internship doctors in the two-year internship started in 2005 and all graduates after 1 July 2006 are required to complete a two-year internship. For the WAC, the majority of two-year internship doctors began in January 2007.

Gordon and James were of the opinion that it is inappropriate to allow doctors to practice elective anaesthesia unsupervised after just two weeks of anaesthesia training. (13) While a six-month anaesthesia training period was recommended (13), the new two-year internship includes a two-month anaesthetic rotation.

2.6 Assessment

The aim of this study is to compare the anaesthetic knowledge acquired by internship doctors completing a two-week anaesthesia rotation with those completing a two-month anaesthesia rotation. This shall be done by means of questionnaires consisting of short questions and case study vignettes.

2.6.1 Short questions

Short questions/ short answer questions are the standard initial types of questions in examinations. Short questions may take several forms, from simple requests to fill in the blanks with a missing word or phrase to a brief listing or one-sentence answer.

Short questions tend to test the lower levels of the cognitive domain (22), i.e. the simple recall of facts, and are most effective where there can be no disagreement on satisfactory answers. Short questions are suited to convergent forms of knowledge where material from a variety of sources is brought to bear on a problem to obtain the correct answer.

The disadvantage of short answer questions is that in assessing the simple recall of facts they do not necessarily assess the higher levels of the cognitive domain. Short answer questions do not necessarily reflect that the respondent understands the knowledge being tested or can apply, analyse or evaluate the same. (22)

Short answer questions cannot adequately represent the respondent's judgement. For this purpose, case study vignettes have been selected.

2.6.2 Case Study Vignettes

Case study vignettes are written case simulations consisting of an introductory narrative and subsequent event cues where the aim is to study the respondent's knowledge, choices and judgements of hypothetical situations by guiding the respondent into a particular context.

The gold standard for assessment of quality of patient care and physician competence is the use of standardised patients. However, use of standardised patients is both logistically and ethically challenging within the speciality of Anaesthesia. Vignette scores have been found to reflect actual physician practice as recorded from standardised patient visits. (23) Vignettes can comprehensively evaluate the range of knowledge/skills needed to care for a patient, as they do not focus on a single task. Vignettes are a measure of knowledge and can be a valid reflection of what doctors do during actual clinical encounters with patients. (24)

Vignettes should be consistent, credible and not too complex. Finn notes that this introduces an intrinsic limitation to the applicability of vignettes, i.e. their

construction eliminates the complexity and ambiguity of a real patient. (25) The disadvantages of vignettes are associated with establishing reliability and validity. (26)

However, vignettes are uniquely appropriate for comparative analyses as they better control for case-mix variation and reduce the impact of structural effects. (23)

Advantages of vignettes include: (26, 27)

- Less expensive and more quickly conducted than observational studies.
- Ability to collect information simultaneously from a large number of subjects while providing a standard scenario with more uniform data.
- Ability to influence a large number of variables at once in a manner not possible in observational studies.
- Absence of observer effect.
- Avoidance of ethical dilemmas commonly encountered during observational studies.

In chapter 2 we reviewed the current literature and discussed topics pertinent to this research project. This included discussions pertaining to Community Service, Community Service Anaesthesia and its consequences, skills and training, and the assessment of anaesthetic knowledge.

CHAPTER 3

3. METHODOLOGY

This chapter shall provide an in-depth description of the methodology used for the study.

3.1 Introduction

Community Service doctors placed in rural areas are required to administer anaesthesia. Training for this Community Service anaesthetic practice is imparted during the internship Domain of Anaesthesia. Internship training in anaesthesia has increased from two weeks to two months.

The aim of this study is to compare the anaesthetic knowledge acquired by internship doctors completing a two-week anaesthesia rotation with those completing a two-month anaesthesia rotation.

The objectives of this study include:

- To determine the anaesthetic knowledge of internship doctors completing a two-week anaesthetic rotation by means of a questionnaire consisting of both short questions and case study vignettes.
- To determine the anaesthetic knowledge of internship doctors completing a two-month anaesthetic rotation by means of a questionnaire consisting of both short questions and case study vignettes.

- To compare the anaesthetic knowledge of internship doctors completing a two-week anaesthetic rotation with that of those completing a two-month anaesthetic rotation

3.2 Study Design

This study follows a prospective contextual descriptive research design by means of a questionnaire consisting of short questions and case study vignettes.

3.3 Study Site

The study shall be conducted at the hospitals of the Witwatersrand Academic Complex (WAC), namely Chris Hani Baragwanath Hospital, Helen Joseph Hospital complex and Johannesburg Hospital.

3.4 Study Population

A study population is a complete set of persons/ objects possessing a common characteristic that is of interest.

The study population for this study was the internship doctors employed at the hospitals of the WAC from January 2006 to December 2006, who completed a two-week anaesthesia rotation (hereafter referred to as two-week interns) and those employed from January 2007 to December 2008, who completed a two-month anaesthesia rotation (hereafter referred to as two-month interns).

Internship doctors beginning their internship in January 2007 underwent their two-month anaesthesia rotation in their second year, i.e. 2008.

3.5 Study Period

The data collection for this study was done in December 2006 for the two-week interns and in December 2008 for the two-month interns.

3.6 Ethical Considerations

3.6.1 Authorisation

Ethics clearance for the study was obtained in November 2006 from the Human Research Ethics Committee (Medical) of the University of the Witwatersrand, Johannesburg, Gauteng Province, South Africa, prior to commencement of the study. (**Appendix A**)

Approval for the study was obtained in November 2006 from the Postgraduate Committee of the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, Gauteng Province, South Africa, prior to commencement of the study. (**Appendix B**)

Approval for the study was obtained from the relevant WAC authorities, including the internship co-ordinator and Academic Head of the Department of Anaesthesia, prior to commencement of the study.

3.6.2 Participation and Informed Consent

Internship doctors who had already completed their anaesthesia rotation and had had their Form 10-A completed were approached by Dr S. A. Ash (to whom they were not subordinate) and asked to volunteer to participate in the study.

Informed consent was obtained from internship doctors for their voluntary participation by means of an information sheet and written consent form. Participation or non-participation did not directly or indirectly benefit or disadvantage the sample population in any way. (**Appendix C**)

3.6.3 Confidentiality

Separating the internship doctor's consent and identification and placing them in a sealed envelope, which was kept separate to the questionnaires, ensured confidentiality. Sealed envelopes shall only be opened for audit purposes, should that be required.

3.7 Sampling Method

A consecutive convenience sampling method was used.

The convenience sampling method was chosen because of time constraints and the scope of the research. It is recognised that a convenience sampling method may not fully represent the study population (18), although it is unlikely to have an effect in this study.

The study shall further use a consecutive sampling method where every eligible internship doctor shall be invited to take part in the study. Consecutive sampling is the most reliable form of convenience sampling as research bias is limited (18).

3.8 Sample Statement

It was decided that a 10% improvement in score for the questionnaire would be considered significant.

A sample size of 83 internship doctors in each group shall be required to have 99% power to detect a difference in means of 10, assuming that the population standard deviation is 14.9, using a two group t-test with a 0.05 two-sided significance level.

3.9 Inclusion and exclusion criteria

3.9.1 Inclusion criteria

The following inclusion criteria were used for the study:

- Interns that give voluntary informed consent.
- Interns that have completed their anaesthesia rotation.
- Interns that had already had their Form 10-A, HPCSA Intern Duty Certificate signed off by the Department of Anaesthesiology.
- Ability to complete the study questionnaire under exam conditions.

3.9.2 Exclusion criteria

The following exclusion criteria were used for the study:

- Refusal to volunteer for the study.
- Not having completed their anaesthesia rotation.
- Not already having had their Form 10-A, HPCSA Intern Duty Certificate signed off by the Department of Anaesthesiology.
- Inability to complete the study questionnaire under exam conditions.

3.10 Construction of the Instrument

The instrument took the form of a questionnaire.

The questionnaire consisted of three sections:

A. A demographic survey section.

B. Short questions.

C. Case study vignettes

3.10.1 Section A: The demographic survey section

The demographic survey section served to provide sub-categories within the study sample by which the data could be analysed. These included:

- Age.
- Sex.
- University where internship doctor qualified.
- Additional tertiary education/qualifications.
- Time between graduation and internship.
- Rotations preceding anaesthesia rotation.
- Number of anaesthetics observed.
- Time between anaesthesia rotation and completion of questionnaire (divided into first, second and third trimester by dates).
- Hospital where internship doctor rotated (Chris Hani Baragwanath Hospital, Helen Joseph/Coronation Hospital complex or Johannesburg Hospital)
- Level of supervision.
- Continuity of supervision.

- Presence or absence of individual hospital department guidelines for anaesthesia rotation.
- Attendance of academic training programme within the Department of Anaesthesia.
- Whether or not the internship doctor feels adequately prepared for Community Service anaesthetic practice.

Also included in Section A was an open-ended question asking internship doctors to comment on and/or suggest improvements to the anaesthesia training they received. (**Appendix D**)

3.10.2 Sections B and C: Short questions and Case study vignettes

Sections B and C were drawn up by Dr S. Ash in consultation with Dr L. Green Thompson of the Centre for Health Science Education, University of Witwatersrand Faculty of Health Sciences, to test the adequacy of internship anaesthetic training with regards to knowledge, insight and judgement in accordance with the guidelines for internship training in the Domain of Anaesthesia as outlined by the HPCSA. (17)

Section B consisted of fifteen short questions and was the same for all respondents. The short questions were aimed at relaxing the participants into the questionnaire by testing basic knowledge, mostly anaesthetic, but including questions that an internship doctor would be expected to know even without completion of an anaesthesia rotation. (**Appendix E**)

Section C consisted of three case study vignettes. The vignettes were drawn from a bank of twelve case study vignettes, which were categorised into easy, medium and difficult. Each questionnaire consisted of case studies drawn randomly from each of the three categories, such that it was unlikely that a respondent would receive the same three vignettes as another respondent at the time of completion of their questionnaire. (**Appendix F**)

3.10.3 Validation of the instrument

Section B and C's short questions and case study vignettes underwent a two-tier expert review/vetting process (Illustrated in **Figure 3.1**) to:

- Legitimise the standard of the questions and validate the adequacy of the instrument.
- Allow for stratification of case study vignettes into easy, medium and difficult.
- Allow for stratification of questions within both the short questions and case study vignettes in order of importance for analysis.

Four current examiners for the Colleges of Medicine of South Africa Diploma in Anaesthesia employed by the Department of Anaesthesia, Faculty of Health Sciences, University of the Witwatersrand, conducted the first tier of expert review.

The second tier of expert review consisted of the current (2006) Heads of the Department of Anaesthesia at the four WAC hospitals.

Consensus was obtained by majority decision, while the final consensus was approved by the 2006 Academic Head of the Department of Anaesthesia, Faculty of Health Sciences, University of the Witwatersrand.

3.11 Costs

Costs for the administration of this study were borne by the Department of Anaesthesia, Chris Hani Baragwanath Hospital.

Costs included:

- Photocopying.
- Collation of questionnaires.
- Envelopes for storage of consent forms.
- Storage of data for analysis.

Participants in the study incurred no costs.

3.12 Data collection

The study population were invited to voluntarily participate in the study and data collection took place over 10 days in December 2006 for the two-week interns and 11 days in December 2008 for the two-month interns. A list of interns in the WAC was provided by the internship supervisors for the three sites and collated. There were 148 two-week interns and 149 two-month interns at the WAC, according to the published lists.

The study population was given an information sheet in order to obtain informed consent. Confidentiality was maintained by collecting data in an anonymous fashion where the respondent's consent form and identification were placed in a sealed envelope and stored separately to the questionnaire. These sealed envelopes shall only be opened for audit purposes should it be required.

Completion of the questionnaire had no time limit but was conducted under examination rules, without consultation between respondents or of reference material. Dr S.A. Ash invigilated questionnaire completion.

The order in which data was collected was noted for further demographic sub-categorisation for analysis, such that any bias secondary to preparation could be detected.

3.13 Data Management/Analysis

The data was entered into a Microsoft Excel® spreadsheet, converted to a database and analysed using STATISTICA® statistics software (Release 8) by Dr S.A. Ash in consultation with a biostatistician.

Analysis techniques included the Shapiro-Wilk test, to test for normality of distribution of the data, basic descriptive statistics (mean, median, minimum, maximum, standard deviation and 95% confidence levels), as well as parametric and non-parametric analysis (t-test, ANOVA test, Mann-Whitney U test and Kruskal Wallis test), depending on the normality of the data and number of

variables being compared. A p-value of less than 0.05 was considered as significant.

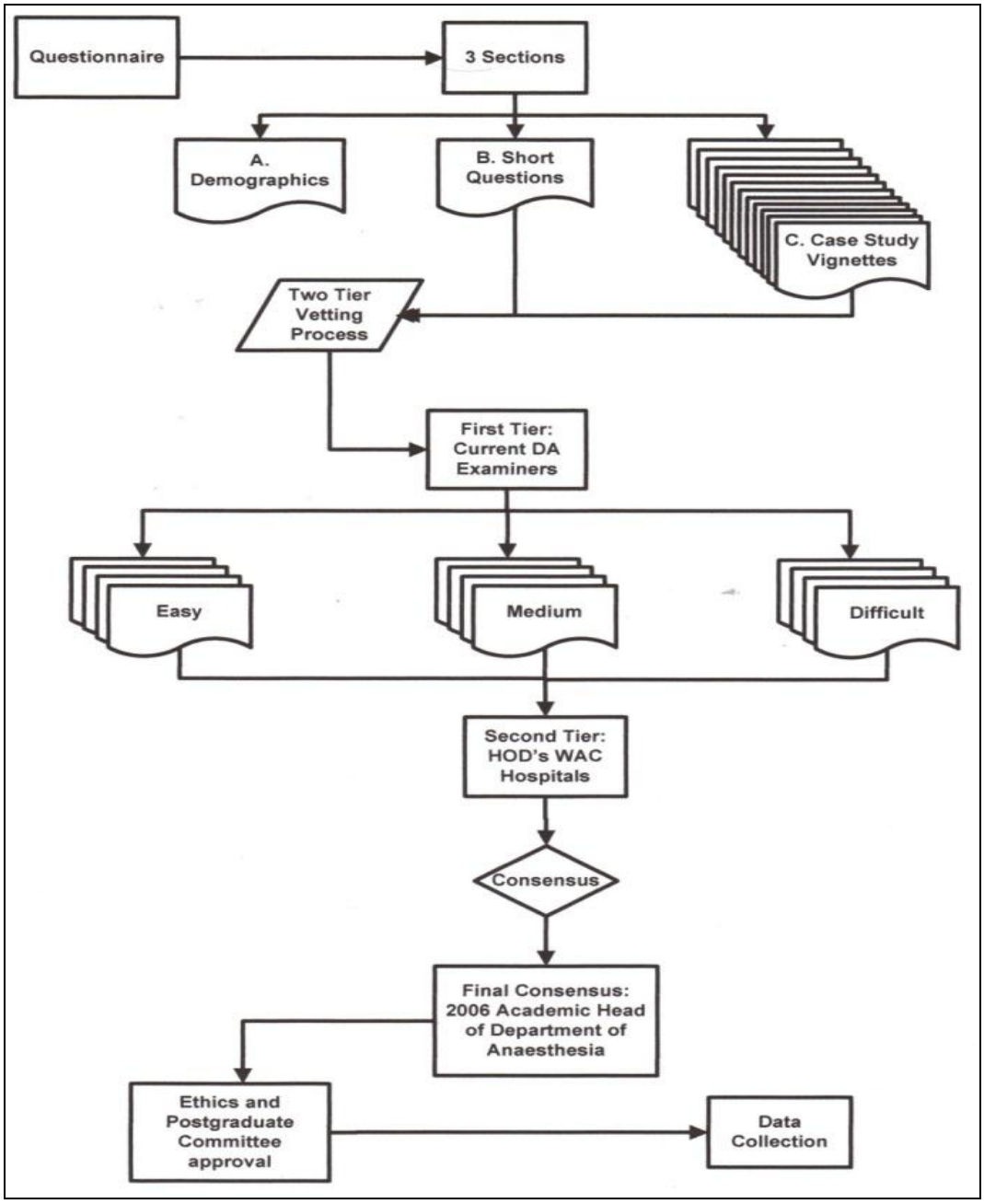


Figure 3.1: illustration of instrument construction and two-tier vetting process.

In Chapter 3 we discussed the methodology used for the study in detail. The results of the study are presented in Chapter 4.

CHAPTER 4

4. RESULTS

In Chapter 4 we shall present the results of the study.

The data was entered into a Microsoft Excel® spreadsheet, converted to a database and analysed using STATISTICA® statistics software (Release 8) by Dr S.A. Ash in consultation with a biostatistician.

Analysis techniques included the Shapiro-Wilk test, to test for normality of distribution of the data, basic descriptive statistics (mean, median, minimum, maximum, standard deviation and 95% confidence levels), as well as parametric and non-parametric analysis (t-test, ANOVA test, Mann-Whitney U test and Kruskal Wallis test), depending on the normality of the data and number of variables being compared. A p-value of less than 0.05 was considered as significant.

4.1 Introduction

Community Service doctors placed in rural areas are required to administer anaesthesia. Training for this Community Service anaesthetic practice is imparted during the internship Domain of Anaesthesia. Internship training in anaesthesia has increased from two weeks to two months.

The aim of this study is to compare the anaesthetic knowledge acquired by internship doctors completing a two-week anaesthesia rotation with those completing a two-month anaesthesia rotation.

The objectives of this study include:

- To determine the anaesthetic knowledge of internship doctors completing a two-week anaesthetic rotation by means of a questionnaire consisting of both short questions and case study vignettes.
- To determine the anaesthetic knowledge of internship doctors completing a two-month anaesthetic rotation by means of a questionnaire consisting of both short questions and case study vignettes.
- To compare the anaesthetic knowledge of internship doctors completing a two-week anaesthetic rotation with that of those completing a two-month anaesthetic rotation.

The key guide used to describe the box-plot and bar graphs in this chapter is included in **Figure 4.1**.

4.2 The Two-Week Anaesthetic Rotation

4.2.1 Sample and Exclusions

The 148 two-week interns at the WAC were invited to voluntarily participate in the study. 24 two-week interns were excluded (1 refused to participate, 23 were unable to complete the questionnaire under exam conditions) and 16 two-week interns could not be contacted.

108 two-week interns participated in the study [72.9% (108/148) of the study population]. Data was collected over a period of 10 days.

4.2.2 Results

The score for the questionnaire for the sample was 38.95 (14.9) % [mean (standard deviation)]. The distribution of the observations for this data is represented in **Figure 4.2** and the Shapiro-Wilk, Mean, Median, Minimum (Min), Maximum (Max), Standard Deviation (SD) and 95% Confidence Intervals (95% CI) are shown in **Table 4.1**.

No statistical difference in score for the questionnaire was detected (all $p > 0.86$ on Kruskal Wallis test) for results collected on different days (1-10). This data is reflected in **Figure 4.3**.

On Kruskal Wallis analysis of the scores based on the undergraduate University (uni) the two-week interns attended, it was found that the outcomes for two-week interns that attended University 4 were different to all other Universities ($p < 0.01$) except University 5 ($p = 0.24$). The Shapiro-Wilk, Mean, Median, Min, Max, SD and 95% CI are shown in **Table 4.2** and the comparison represented in **Figure 4.4**.

On initial Kruskal Wallis analysis of the scores based on Trimester (trm) when two-week interns completed their anaesthesia rotation, it was found that two-week interns in Trimester 3 (i.e. September – December) performed better than Trimester 2 ($p = 0.03$) but not Trimester 1 two-week interns. The Shapiro-Wilk,

Mean, Median, Min, Max, SD and 95% CI are shown in **Table 4.3** and the comparison represented in **Figure 4.5**. However, analysis of the raw data displayed a disproportionate distribution of University 4 in Trimesters 1 and 2. Exclusion from the analysis of scores from University 4 two-week interns from the analysis revealed no difference between Trimesters. The corrected comparison is represented in **Figure 4.6**.

On Kruskal Wallis analysis of the scores based on division of WAC complex that trained the two-week intern for their anaesthesia rotation, two-week interns trained at Hospital B performed worse than Hospital A ($p = 0.014$), but not Hospital C two-week interns. The Shapiro-Wilk, Mean, Median, Min, Max, SD and 95% CI are shown in **Table 4.4** and the comparison represented in **Figure 4.7**. Scores for University 4 two-week interns were excluded, although no disproportionate representation was seen, and the analysis repeated with the same result ($p = 0.015$).

No statistical difference in score for the questionnaire was detected ($p > 0.05$ on t-test) for those two-week interns who considered themselves prepared (prp) for Community Service anaesthesia and those that did not. The Shapiro-Wilk, Mean, Median, Min, Max, SD and 95% CI are shown in **Table 4.5** and the comparison represented in **Figure 4.8**. Controlling for the differences between undergraduate Universities by excluding University 4 did not alter the result.

4.3 The Two-Month Anaesthesia Rotation

4.3.1 Sample and Exclusions

The 149 two-month interns at the WAC were invited to voluntarily participate in the study. 23 two-month interns were excluded (2 refused to participate, 21 were unable to complete the questionnaire under exam conditions) and 19 two-month interns could not be contacted.

107 two-month interns participated in the study [71.8% (107/149) of the study population]. Data was collected over a period of 11 days.

4.3.2 Results

The score for the questionnaire for the sample was 48.95% (21,77) [median (Min, Max)]. The distribution of the observations for this data is represented in **Figure 4.9** and the Shapiro-Wilk, Mean, Median, Minimum (Min), Maximum (Max), Standard Deviation (SD) and 95% Confidence Intervals (95% CI) are shown in **Table 4.6**.

No statistical difference in score for the questionnaire was detected (all $p > 1.00$ on Kruskal Wallis test) for results collected on different days (1-11). This data is reflected in **Figure 4.10**.

The Universities that were represented in the two-week anaesthesia rotation data were numbered again 1 to 6 in the two-month anaesthesia rotation data, while two additional undergraduate institutions were added and numbered 7 and 8 respectively. On Kruskal Wallis analysis of the scores based on undergraduate University the two-month interns attended, it was found that the outcomes for two-month interns that attended University 4 were different to Universities 1 and

2 ($p < 0.05$ and $p<0.01$ respectively); those that attended University 5 were different to Universities 1 and 2 ($p < 0.05$ and $p<0.01$ respectively); and those that attended University 7 were different to University 2 ($p < 0.05$). The Shapiro-Wilk, Mean, Median, Min, Max, SD and 95% CI are shown in **Table 4.7** and the comparison represented in **Figure 4.11**.

No statistical difference in score for the questionnaire was detected (all $p > 1.00$ on Kruskal Wallis test) when the Trimester the two-month interns completed their anaesthesia rotation was analysed. The Shapiro-Wilk, Mean, Median, Min, Max, SD and 95% CI are shown in **Table 4.8** and the comparison represented in **Figure 4.12**. Controlling for the differences between undergraduate Universities by excluding Universities 4, 5 and 7 did not alter the result.

No statistical difference in score for the questionnaire was detected (all $p > 0.20$ on Kruskal Wallis test) when division of WAC complex that trained the two-month interns for their anaesthesia rotation was analysed. The Shapiro-Wilk, Mean, Median, Min, Max, SD and 95% CI are shown in **Table 4.9** and the comparison represented in **Figure 4.13**. Controlling for the differences between undergraduate Universities by excluding Universities 4, 5 and 7 did not alter the result.

No statistical difference in score for the questionnaire was detected ($p > 0.05$ on Mann-Whitney U test) for those two-month interns who considered themselves prepared (prp) for Community Service anaesthesia and those that did not. The Shapiro-Wilk, Mean, Median, Min, Max, SD and 95% CI are shown in **Table**

4.10 and the comparison represented in **Figure 4.14**. Controlling for the differences between undergraduate Universities by excluding Universities 4, 5 and 7 did not alter the result.

4.4 Comparison of Two-week and Two-month Anaesthesia Rotations

4.4.1 Total

The score for the questionnaire was 38.95% (14.9) for the two-week interns and 48.95% (21,77) for the two-month interns. An improvement of 10% was shown (Mann-Whitney U test, $p < 0.01$). The comparison is demonstrated in **Figure 4.15** [Group (grp) 1 = two-week interns, grp 2 = two-month interns].

4.4.2 University

An improvement was shown for University 1 (Mann-Whitney U test, $p < 0.01$), University 2 (t-test, $p < 0.01$) and University 4 (Mann-Whitney U test, $p < 0.01$) when comparing two-week and two-month interns. The comparisons are demonstrated in **Table 4.11**, **Figure 4.16**, **Figure 4.17** and **Figure 4.18** respectively. No statistical difference was shown for Universities 3, 5 and 6. Universities 7 and 8 could not be compared.

4.4.3 Trimester

An improvement of 10.58% and 14.57% was shown for Trimester 1 (t-test, $p < 0.01$) and Trimester 2 (Mann-Whitney U test, $p < 0.01$) respectively when comparing two-week and two-month interns. The comparisons are demonstrated in **Figure 4.19** and **Figure 4.20**. No statistical difference was shown for Trimester 3.

4.4.4 WAC site

An improvement was shown for all three WAC sites, 8.69% for Hospital A (t-test, $p < 0.01$), 11.95% for Hospital B (Mann-Whitney U test, $p < 0.05$) and 9.45% for Hospital C (Mann-Whitney U test, $p < 0.05$), when comparing two-week and two-month interns. The comparisons are demonstrated in **Figure 4.21**, **Figure 4.22** and **Figure 4.23**.

4.4.5 Assessment of Preparedness

31.4% (34/108) two-week interns considered themselves prepared for Community Service Anaesthesia [29% (10/34) of positive respondents qualified their response with "under supervision" or "spinals only"].

87.8% (94/107) two-month interns considered themselves prepared for Community Service Anaesthesia [46% (43/94) of positive respondents qualified their response with "under supervision" or "spinals only"].

An improvement of 8.07% was shown for those that considered themselves prepared for Community Service Anaesthesia (Mann-Whitney U test, $p < 0.01$) when comparing two-week and two-month interns. The comparison is represented in **Figure 4.24**. No statistical difference was shown for those that did not consider themselves prepared for Community Service Anaesthesia.

4.4.6 Comparison of Responses

A comparison of the two-week and two-month intern scores for the short questions posed in Section B is presented in **Table 4.12**.

A comparison of the two-week and two-month intern scores for Case Study Vignette Topics posed in Section C is presented in **Table 4.13**.

A comparison of the two-week and two-month intern scores for important questions posed as part of the Case Study Vignettes in Section C is presented in **Table 4.14**.

59% (64/108) two-week interns had at least one potentially fatal error compared with 52% (56/107) two-month interns.

□ *: Median*

I range **:** *Min-Max*

□ (large box) *: 25th-75th percentile*

- : Expected Normal

Figure 4.1: Key guide used to describe the box-plots and bar-graphs in this chapter

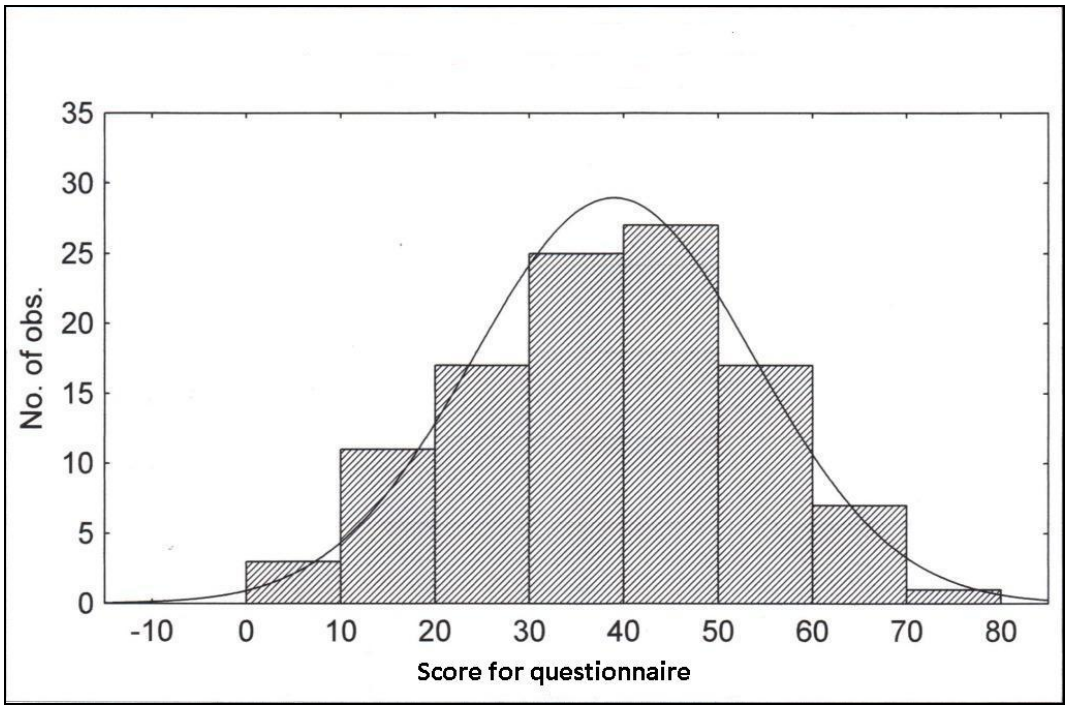


Figure 4.2: Bar-graph representing distribution of data for two-week interns.

Table 4.1: Results pertaining to two-week interns.

Shapiro-Wilk	n	Mean	Median	Min	Max	SD	95% CI
P = 0.641	108	38.95	39.50	2	73	14.9	9.7-68.2

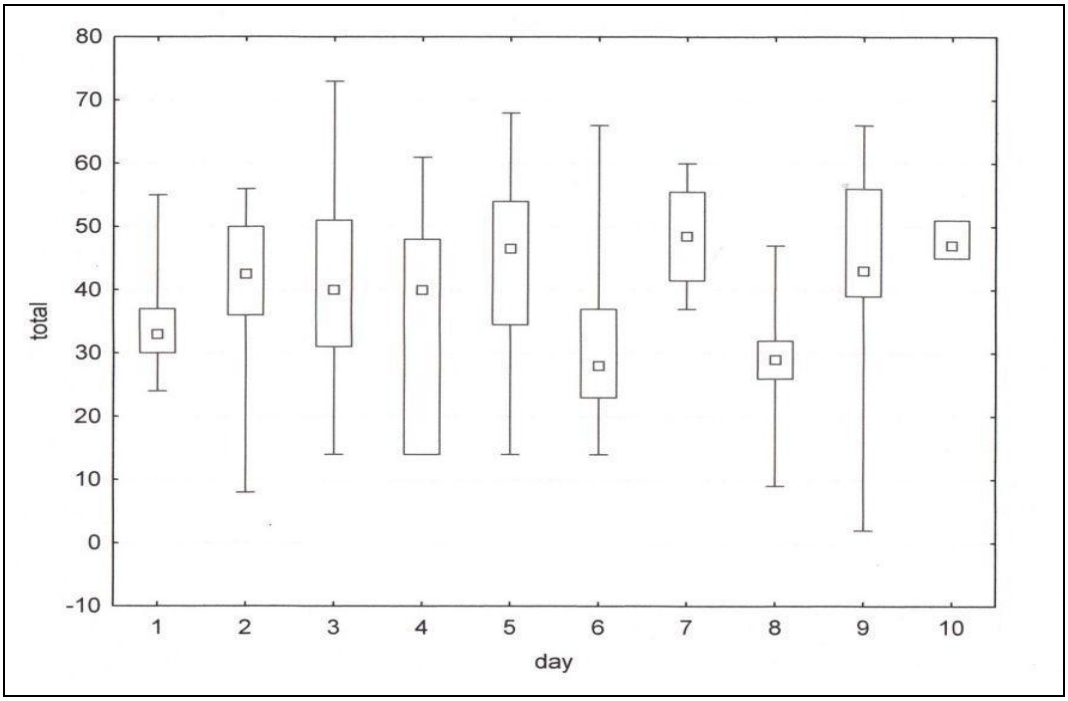


Figure 4.3: Representation of scores from days 1-10 of collection of two-week intern data.

Table 4.2: Results pertaining to two-week interns according to undergraduate University attended.

uni	Shapiro-Wilk	n	Mean	Median	Min	Max	SD	95% CI
1	P=0.011	48	43.27	42.50	26	73	12.95	17.9-68.7
2	P=0.867	15	44.20	43.00	28	60	9.38	25.8-62.6
3	P=0.839	14	39.92	37.50	23	65	11.24	17.9-62.0
4	P=0.003	14	16.71	14.50	2	48	10.51	0.0-37.3
5	P=0.792	10	34.30	34.00	14	61	15.13	4.6-64.0
6	P=0.280	7	47.28	50.00	31	56	8.92	29.8-64.8

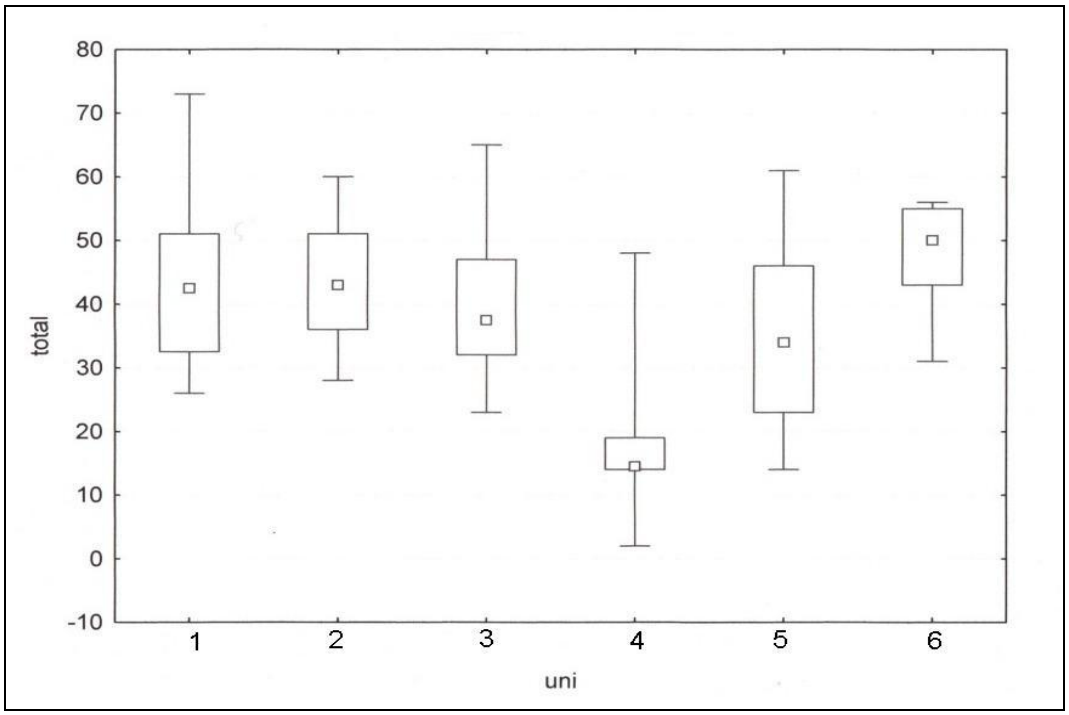


Figure 4.4: Box-plot representing scores for two-week interns according to undergraduate University attended.

Table 4.3: Results pertaining to two-week interns according to Trimester anaesthesia rotation was completed.

trm	Shapiro-Wilk	n	Mean	Median	Min	Max	SD	95% CI
1	P=0.822	36	37.11	38.50	2	73	14.80	8.1-66.1
2	P=0.123	34	34.62	34.00	8	65	16.76	1.8-67.5
3	P=0.091	38	44.58	43.00	27	68	11.38	22.3-66.9

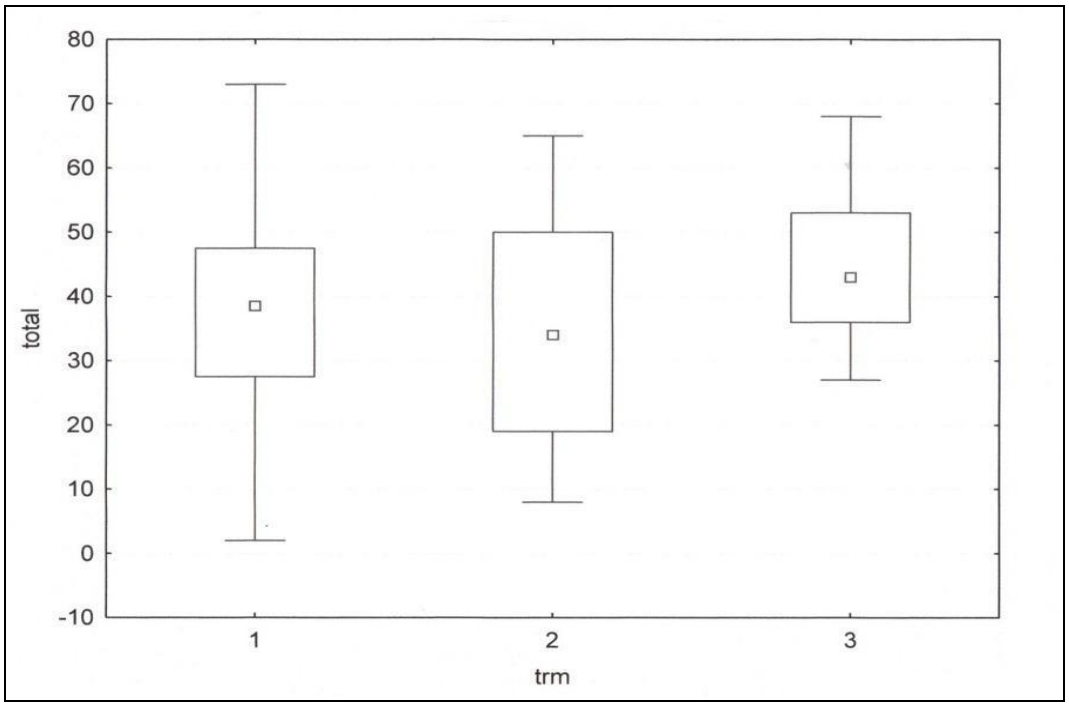


Figure 4.5: Box-plot representing scores for two-week interns according to Trimester anaesthesia rotation completed.

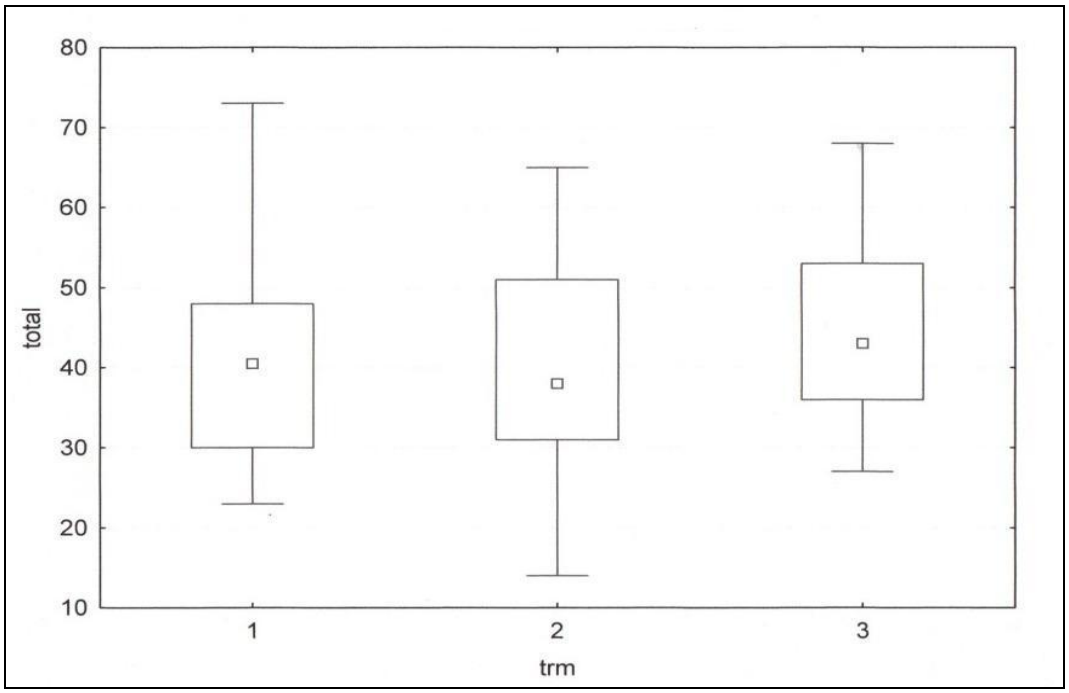


Figure 4.6: Box-plot representing scores for two-week interns according to Trimester anaesthesia rotation completed (University 4 removed).

Table 4.4: Results pertaining to two-week interns according to WAC Hospital where anaesthesia rotation was completed.

Hsp	Shapiro-Wilk	n	Mean	Median	Min	Max	SD	95% CI
A	P=0.408	42	42.93	43.00	2	68	15.25	13.0-72.8
B	P=0.412	31	33.65	32.00	9	73	13.48	7.2-60.1
C	P=0.121	35	38.89	43.00	8	61	14.52	10.4-67.3

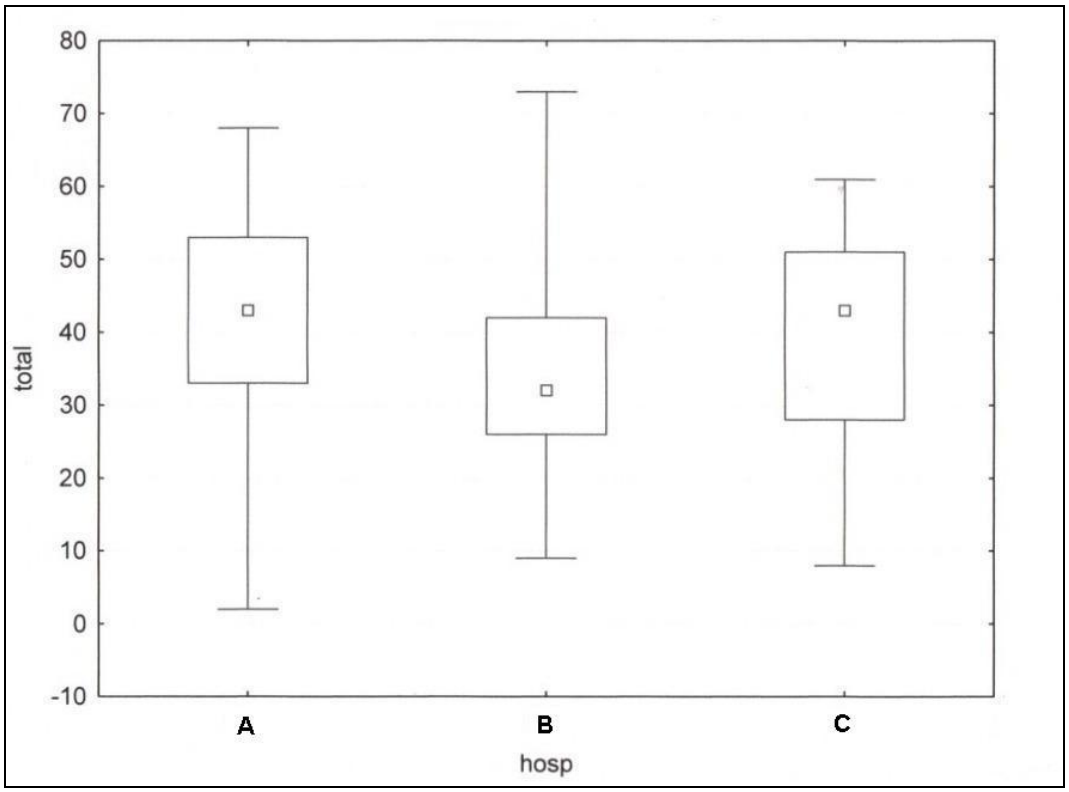


Figure 4.7: Box-plot representing scores for two-week interns according to WAC Hospital where anaesthesia rotation completed.

Table 4.5: Results pertaining to two-week interns according to assessment of preparedness.

Prp	Shapiro-Wilk	n	Mean	Median	Min	Max	SD	95% CI
no	P=0.767	74	37.67	37.00	2	73	15.26	7.8-67.6
yes	P=0.651	34	41.73	42.50	14	66	13.81	14.7-68.8

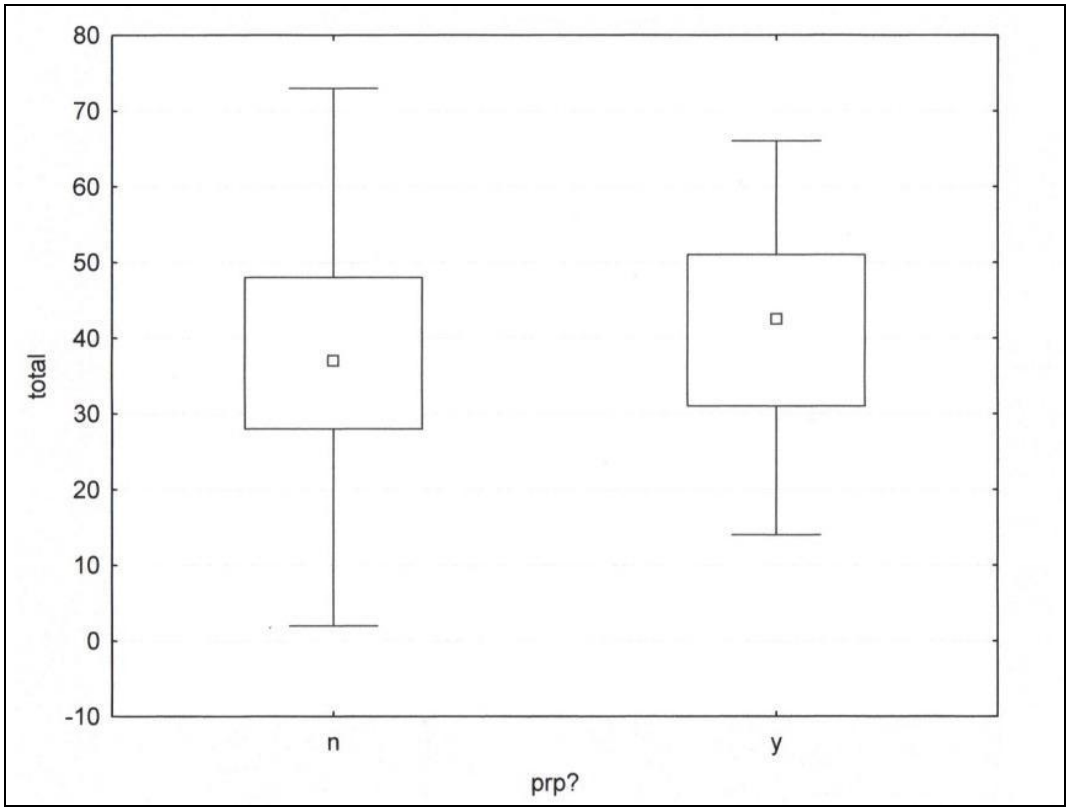


Figure 4.8: Box-plot representing scores for two-week interns according to whether they considered themselves prepared for Community Service anaesthesia.

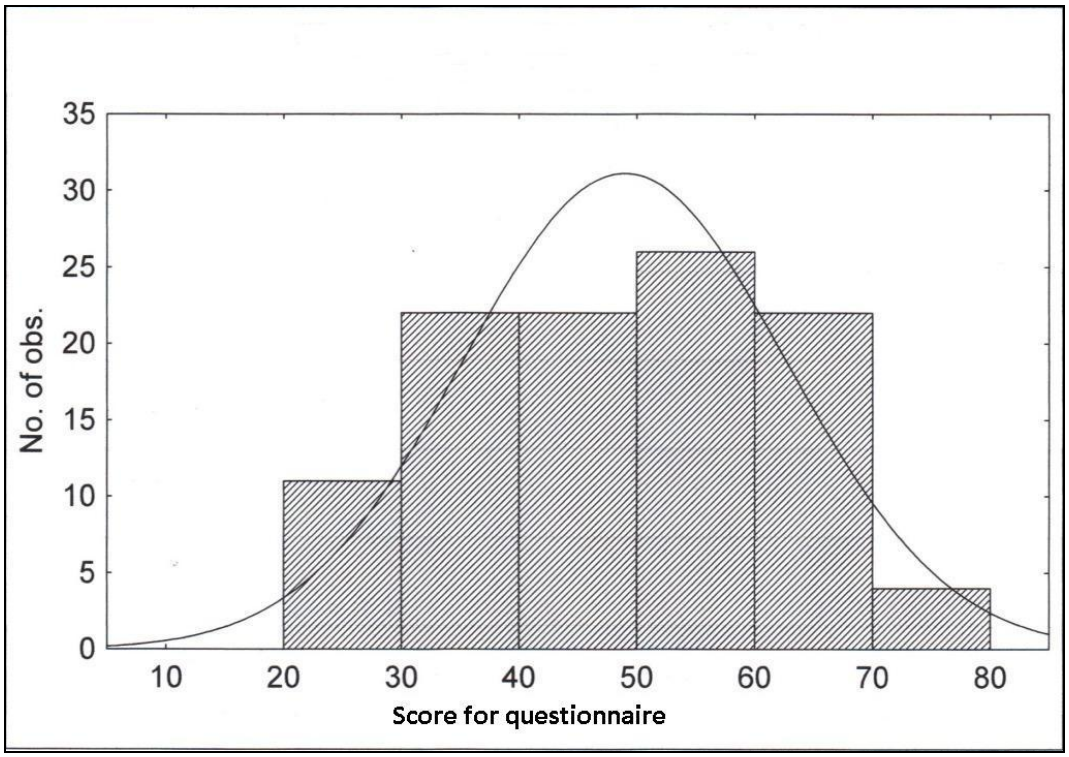


Figure 4.9: Bar-graph representing distribution of data for two-month interns.

Table 4.6: Results pertaining to two-month interns.

Shapiro-Wilk	n	Mean	Median	Min	Max	SD	95% CI
P = 0.036	107	48.95	50.00	21	77	13.7	22.1-75.8

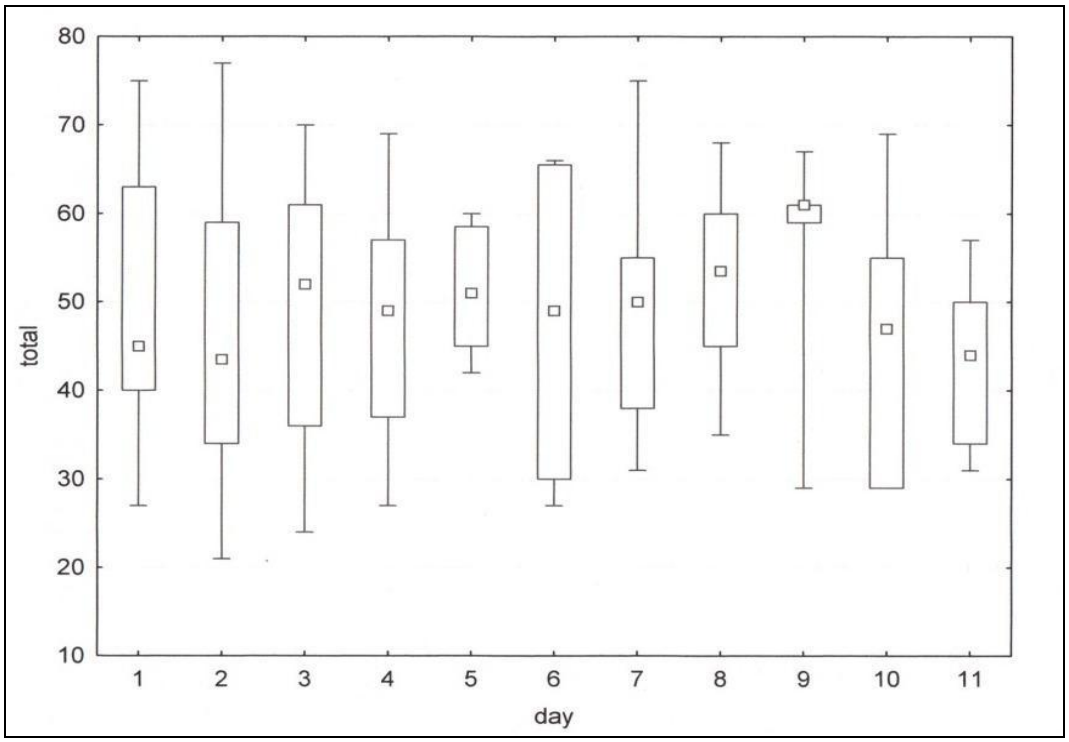


Figure 4.10: Representation of scores from days 1-11 of collection of two-month intern data.

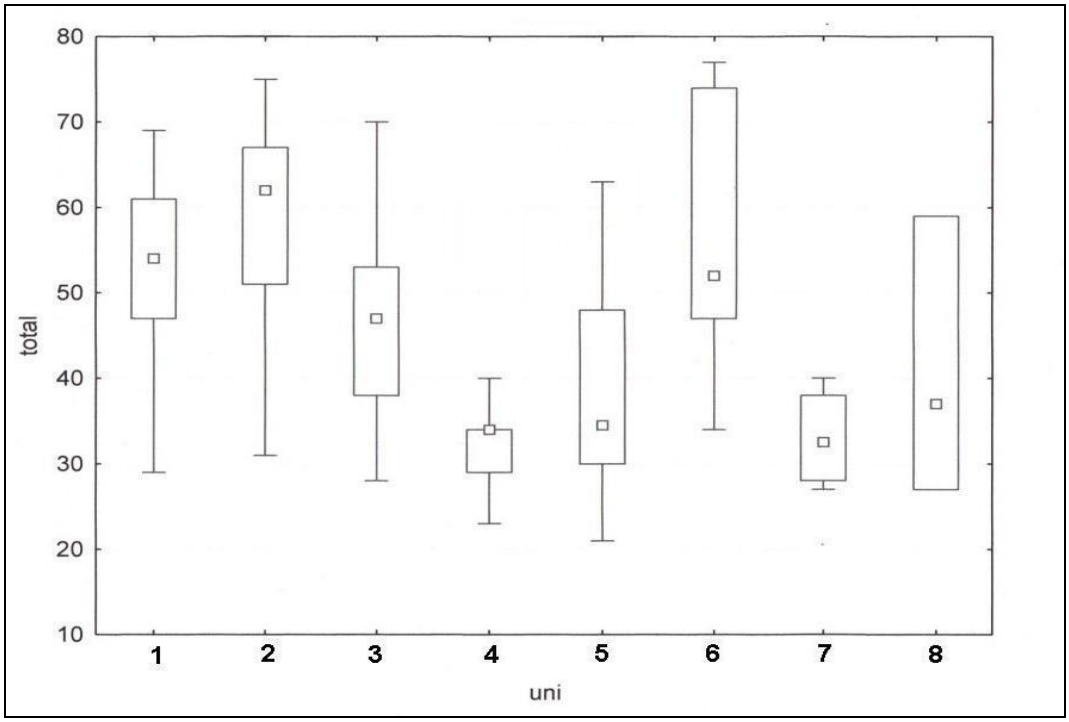


Figure 4.11: Box-plot representing scores for two-month interns according to undergraduate University attended.

Table 4.7: Results pertaining to two-month interns according to undergraduate University attended.

uni	Shapiro-Wilk	n	Mean	Median	Min	Max	SD	95% CI
1	P=0.210	43	52.63	54.00	29	69	9.81	33.4-71.9
2	P=0.262	18	58.22	62.00	31	75	12.54	33.6-82.8
3	P=0.993	13	46.46	47.00	28	70	11.88	23.2-69.7
4	P=0.845	5	32.00	34.00	23	40	6.36	19.5-44.5
5	P=0.109	16	39.00	34.50	21	63	13.22	13.1-64.9
6	P=0.512	5	56.80	52.00	34	77	18.32	20.9-92.7
7	P=0.578	4	33.00	32.50	27	40	6.06	21.1-44.9
8	P=0.593	3	41.00	37.00	27	59	16.37	8.9-73.1

Table 4.8: Results pertaining to two-month interns according to Trimester anaesthesia rotation was completed.

trm	Shapiro-Wilk	n	Mean	Median	Min	Max	SD	95% CI
1	P=0.427	33	47.69	47.00	21	75	14.19	27.8-75.5
2	P=0.212	36	49.19	47.50	28	77	13.32	26.1-75.3
3	P=0.025	38	49.81	52.50	27	75	13.94	22.5-77.1

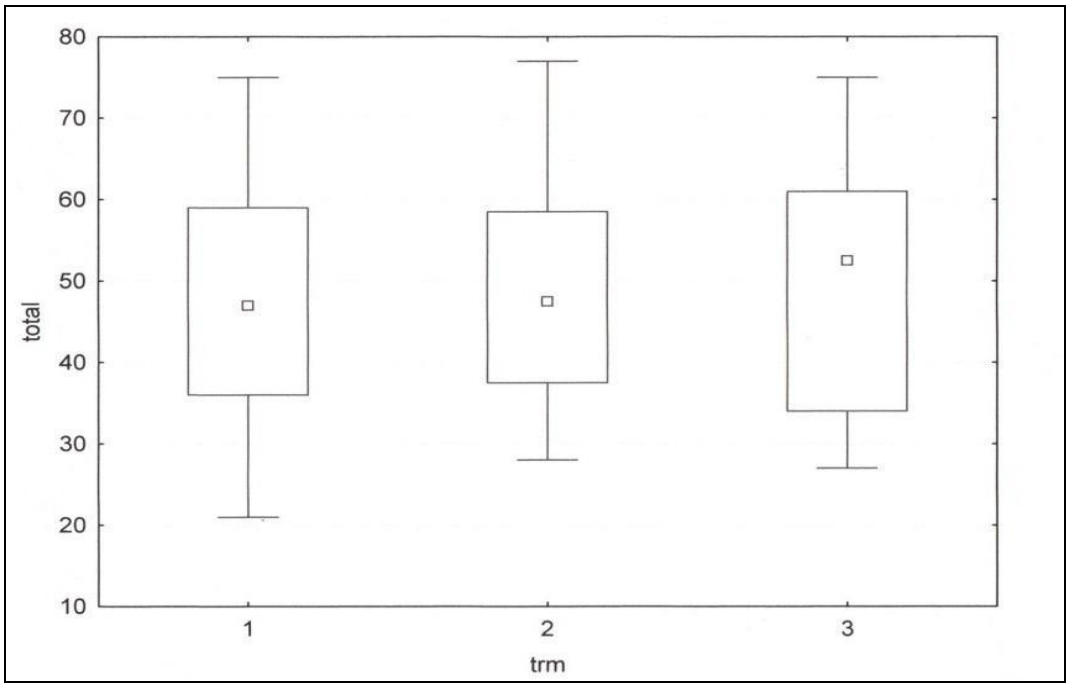


Figure 4.12: Box-plot representing scores for two-month interns according to Trimester anaesthesia rotation completed.

Table 4.9: Results pertaining to two-month interns according to WAC Hospital where anaesthesia rotation was completed.

Hsp	Shapiro-Wilk	n	Mean	Median	Min	Max	SD	95% CI
A	P=0.209	45	51.62	53.00	24	75	11.22	29.6-73.6
B	P=0.027	30	45.60	43.50	21	77	17.08	12.1-79.1
C	P=0.240	32	48.34	47.00	27	75	13.02	22.8-73.9

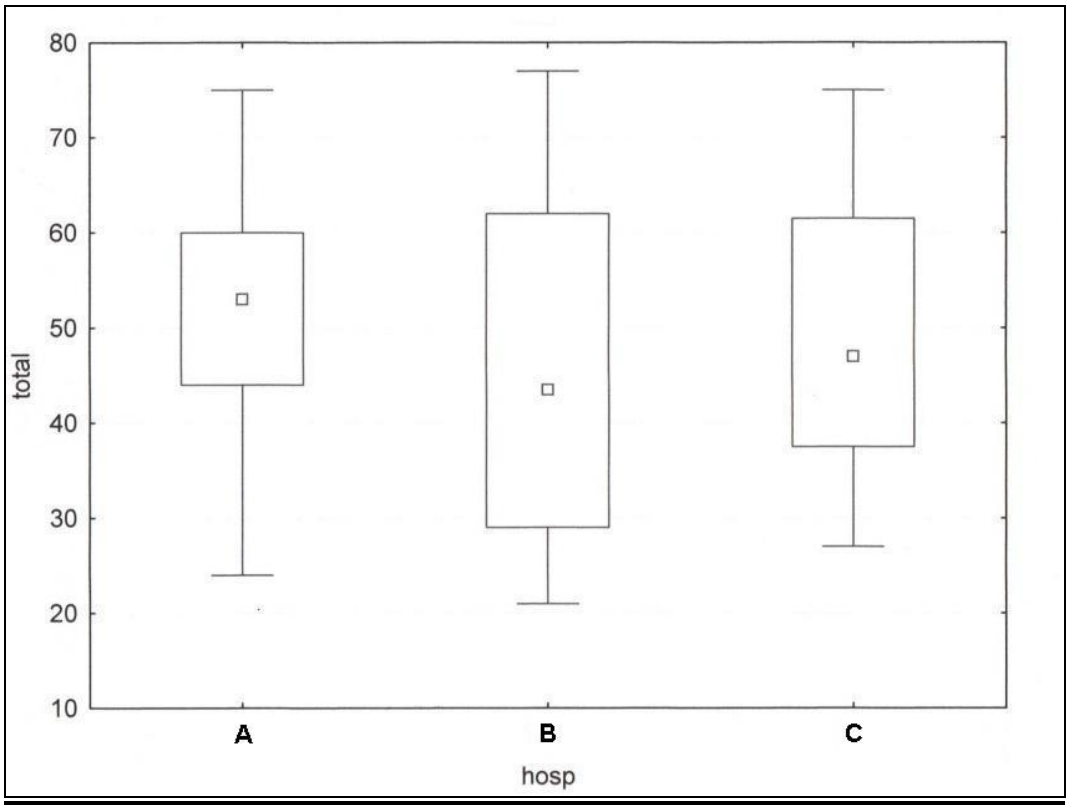


Figure 4.13: Box-plot representing scores for two-month interns according to WAC Hospital where anaesthesia rotation completed.

Table 4.10: Results pertaining to two-month interns according to assessment of preparedness.

Prp	Shapiro-Wilk	n	Mean	Median	Min	Max	SD	95% CI
no	P=0.334	13	42.85	46.00	21	75	13.42	16.5-69.2
yes	P=0.015	94	49.80	52.00	23	77	13.61	23.1-76.5

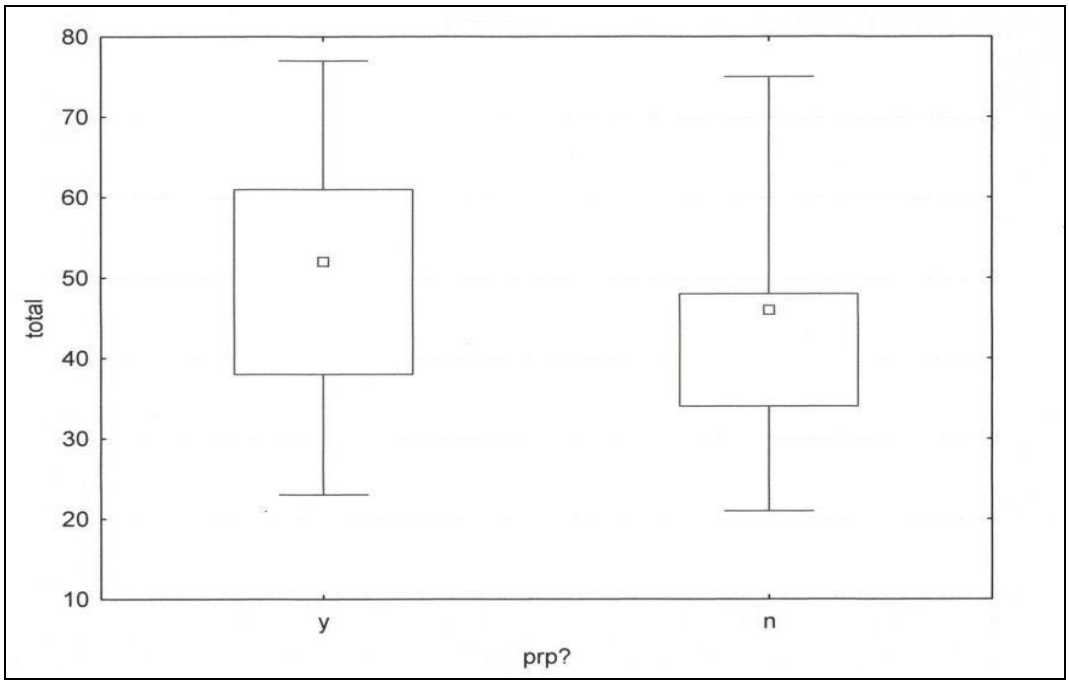


Figure 4.14: Box-plot representing scores for two-month interns according to whether they considered themselves prepared for Community Service anaesthesia.

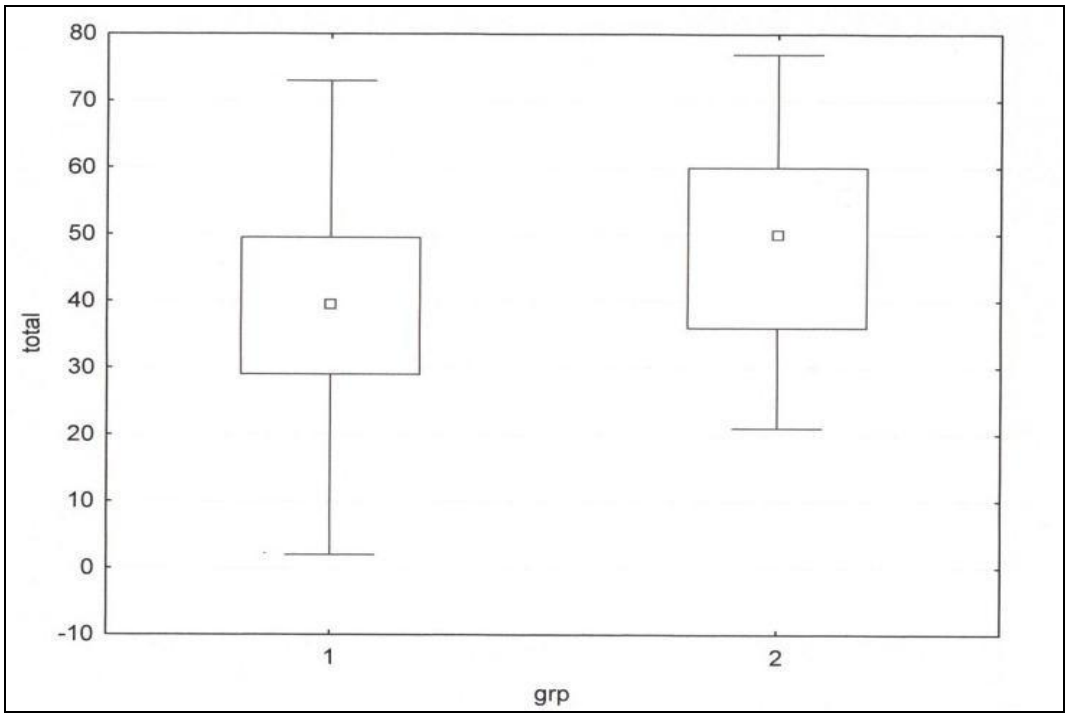


Figure 4.15: Box-plot representing comparison of overall scores between two-week (grp 1) and two-month (grp 2) interns.

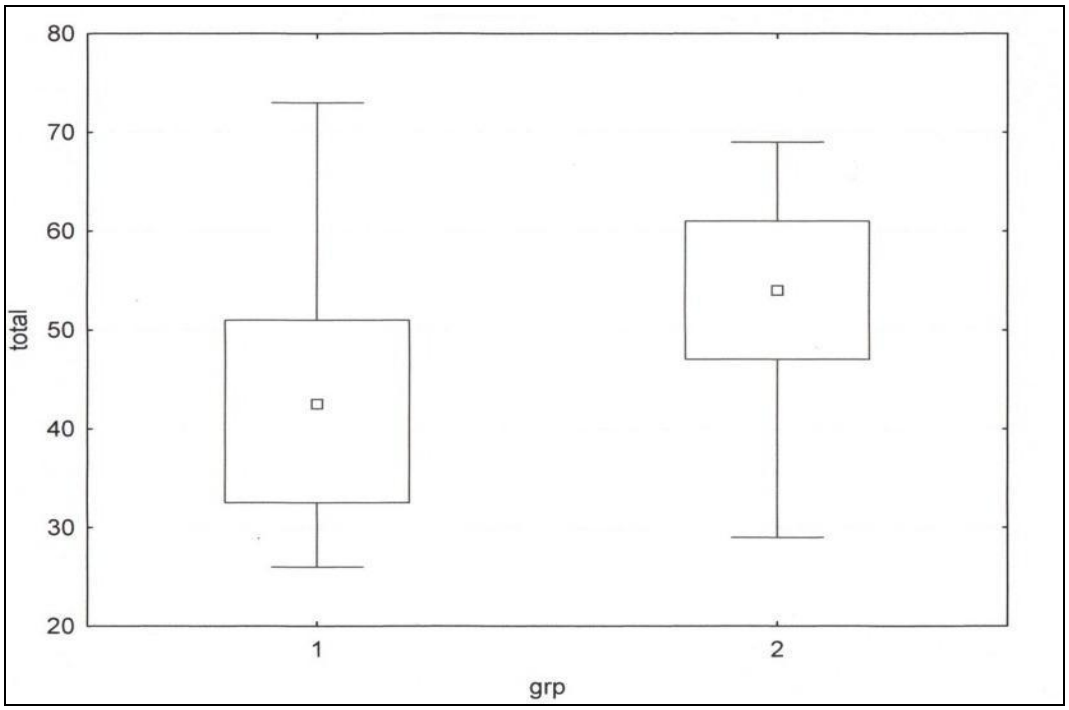


Figure 4.16: Box-plot representing comparison of scores between two-week (grp 1) and two-month (grp 2) interns with respect to University 1.

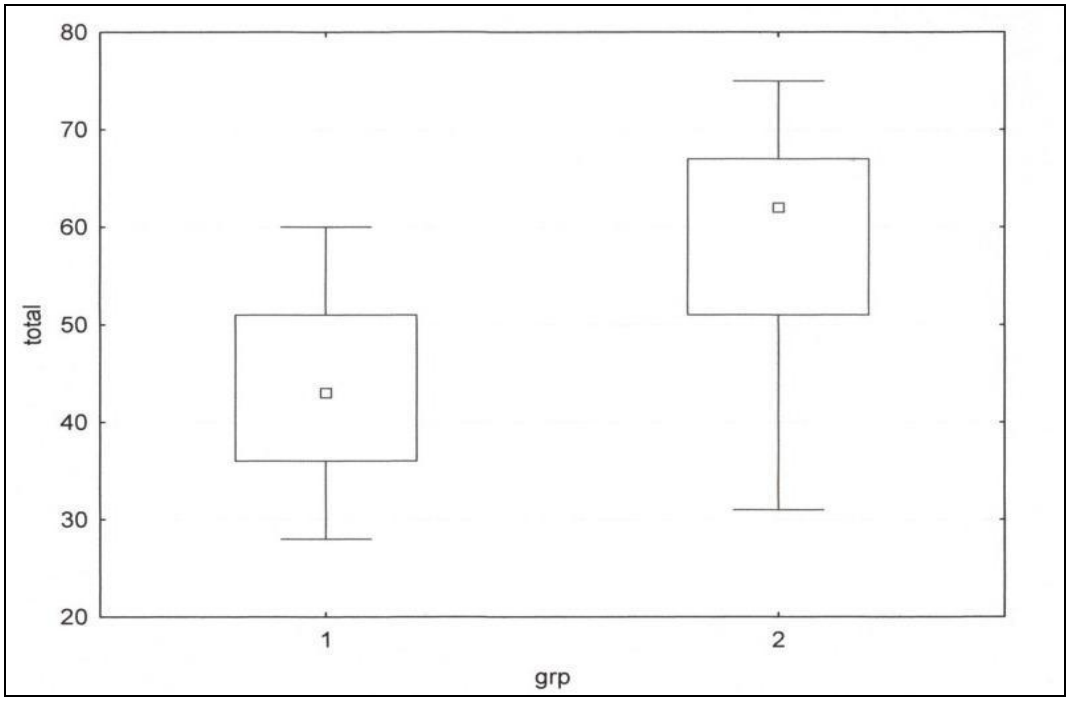


Figure 4.17: Box-plot representing comparison of scores between two-week (grp 1) and two-month (grp 2) interns with respect to University 2.

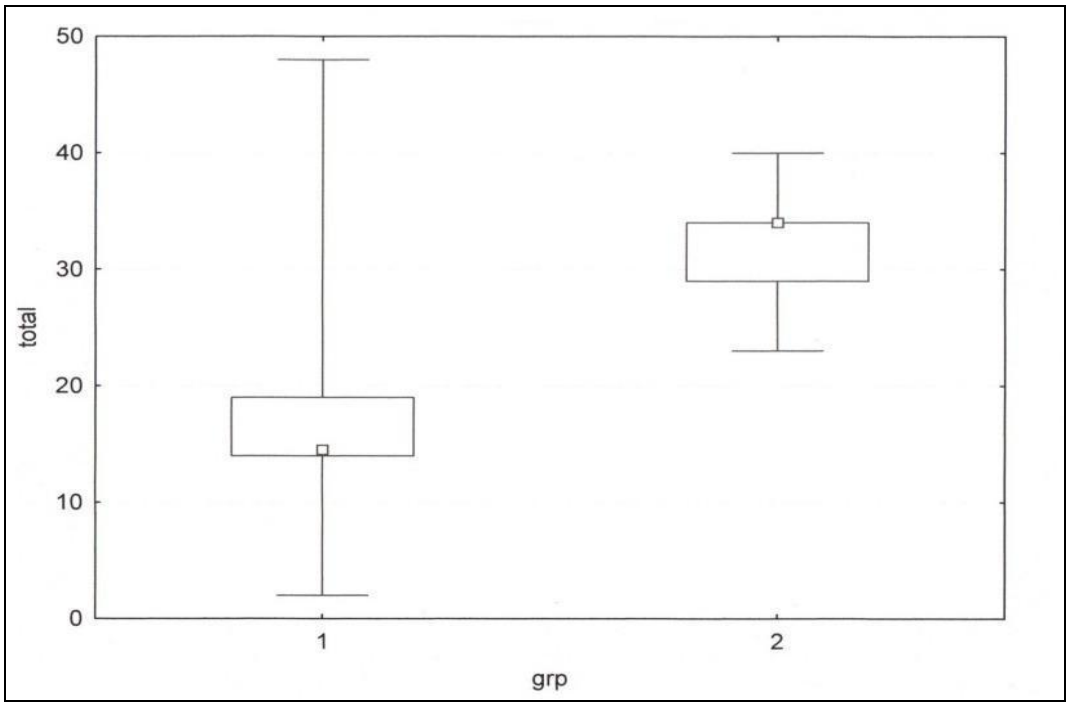


Figure 4.18: Box-plot representing comparison of scores between two-week (grp 1) and two-month (grp 2) interns with respect to University 4.

Table 4.11: Comparison of two-week and two-month interns by University attended.

uni	n	Two-weeks %	n	Two-months %	Change %	p-value (if applicable)
1	48	43.27 (26,73)	43	52.62 (9.81)	9.35	$p < 0.01$
2	15	44.20 (9.38)	18	58.22 (12.54)	14	$p < 0.01$
3	14	39.92 (11.24)	13	46.46 (11.88)	6.54	
4	14	16.71 (2,48)	5	32.00 (6.36)	15.29	$p < 0.01$
5	10	34.30 (15.13)	16	39.00 (21,63)	4.7	
6	7	47.28 (8.92)	5	56.80 (18.32)	9.52	

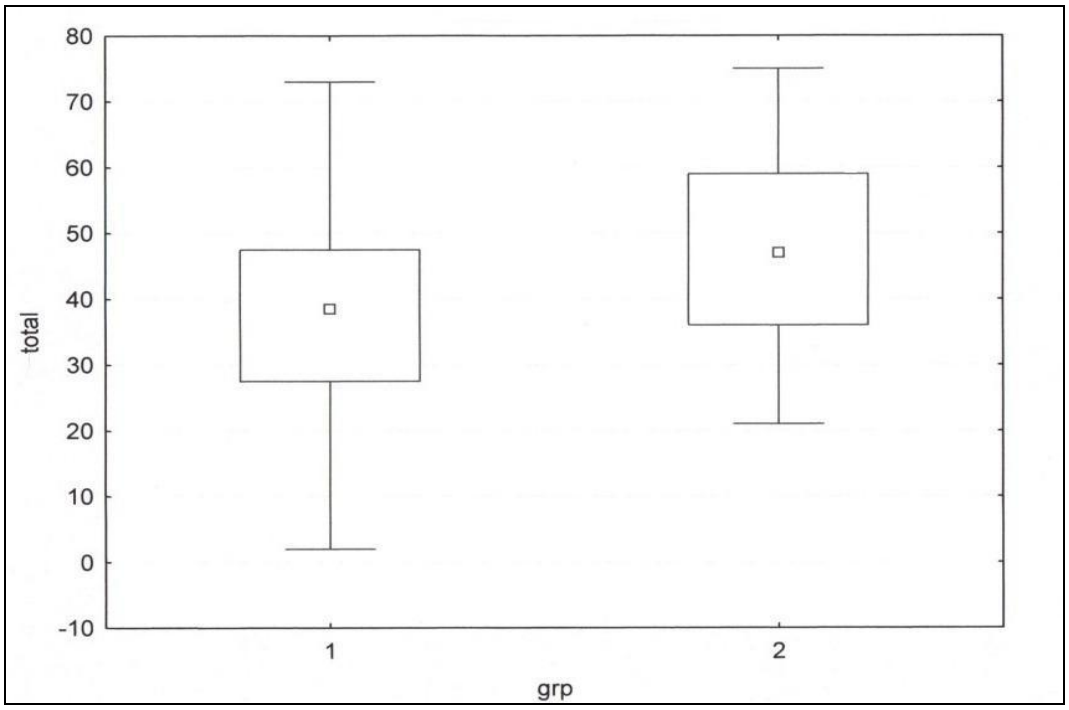


Figure 4.19: Box-plot representing comparison of scores between two-week (grp 1) and two-month (grp 2) interns with respect to Trimester 1.

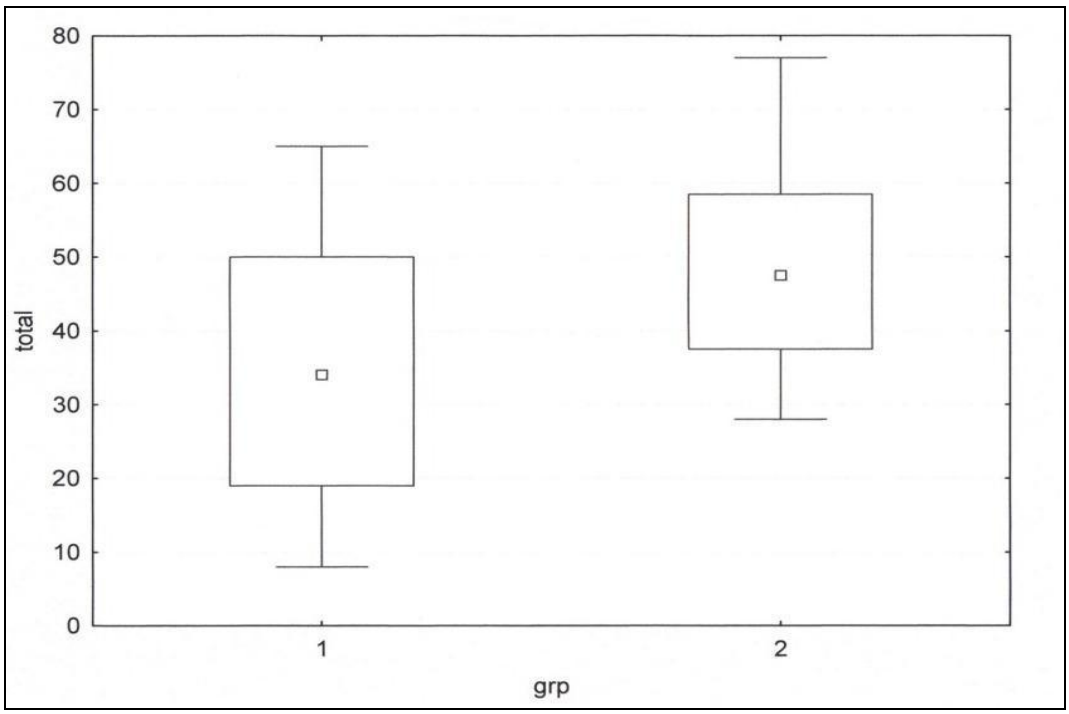


Figure 4.20: Box-plot representing comparison of scores between two-week (grp 1) and two-month (grp 2) interns with respect to Trimester 2.

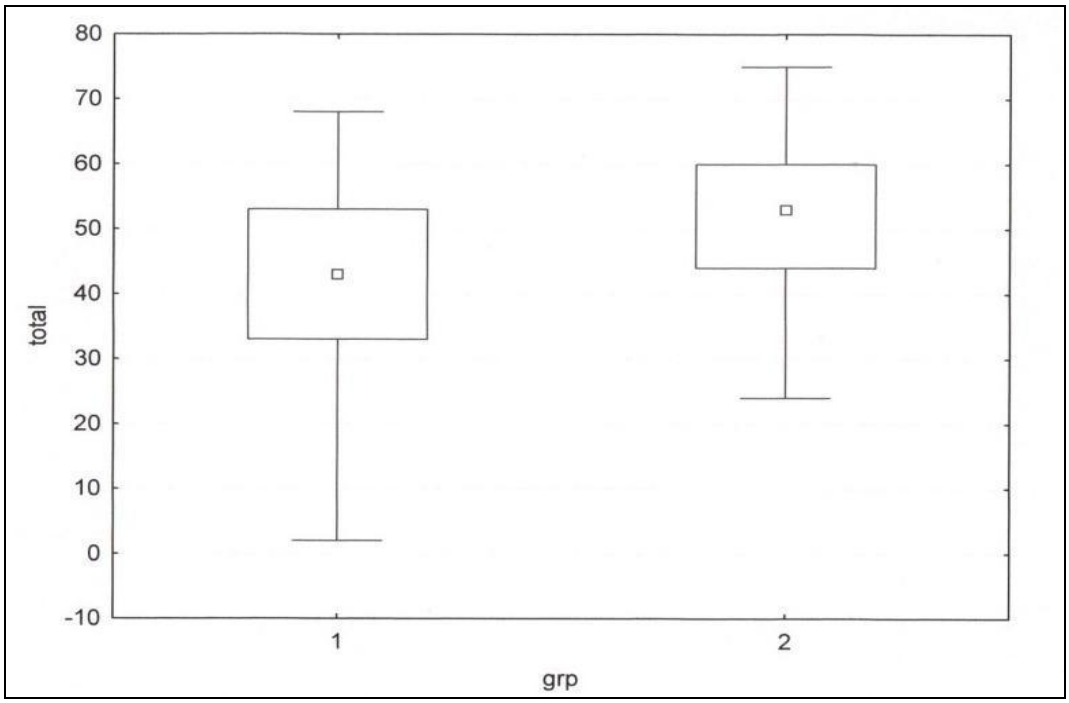


Figure 4.21: Box-plot representing comparison of scores between two-week (grp 1) and two-month (grp 2) interns with respect to Hospital A.

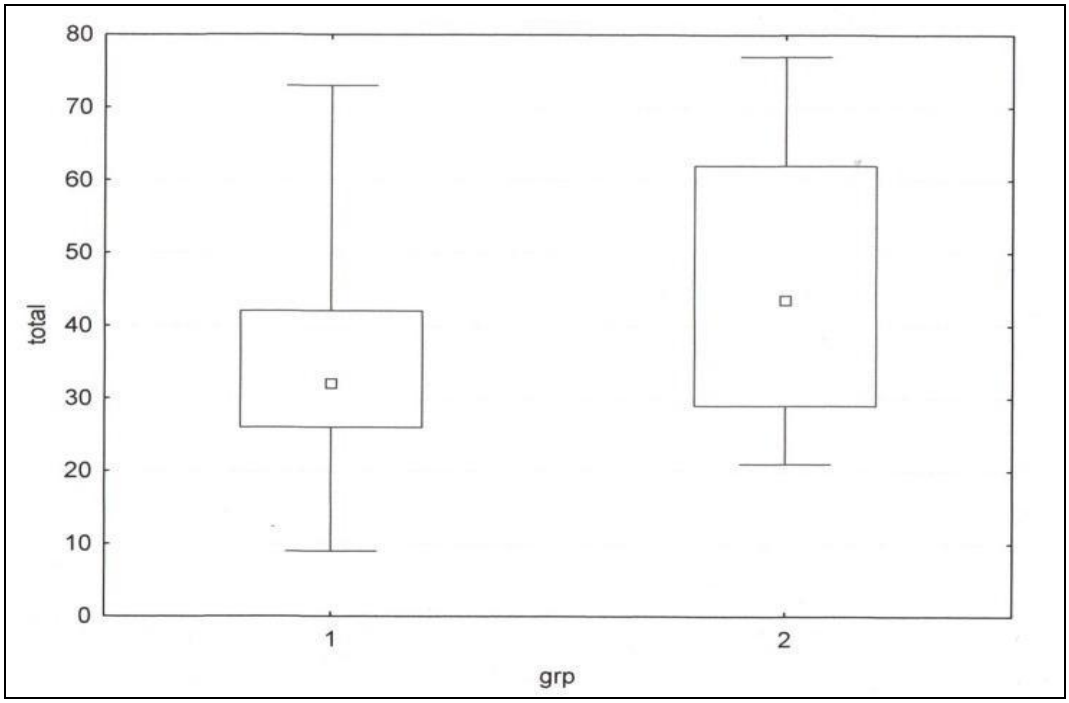


Figure 4.22: Box-plot representing comparison of scores between two-week (grp 1) and two-month (grp 2) interns with respect to Hospital B.

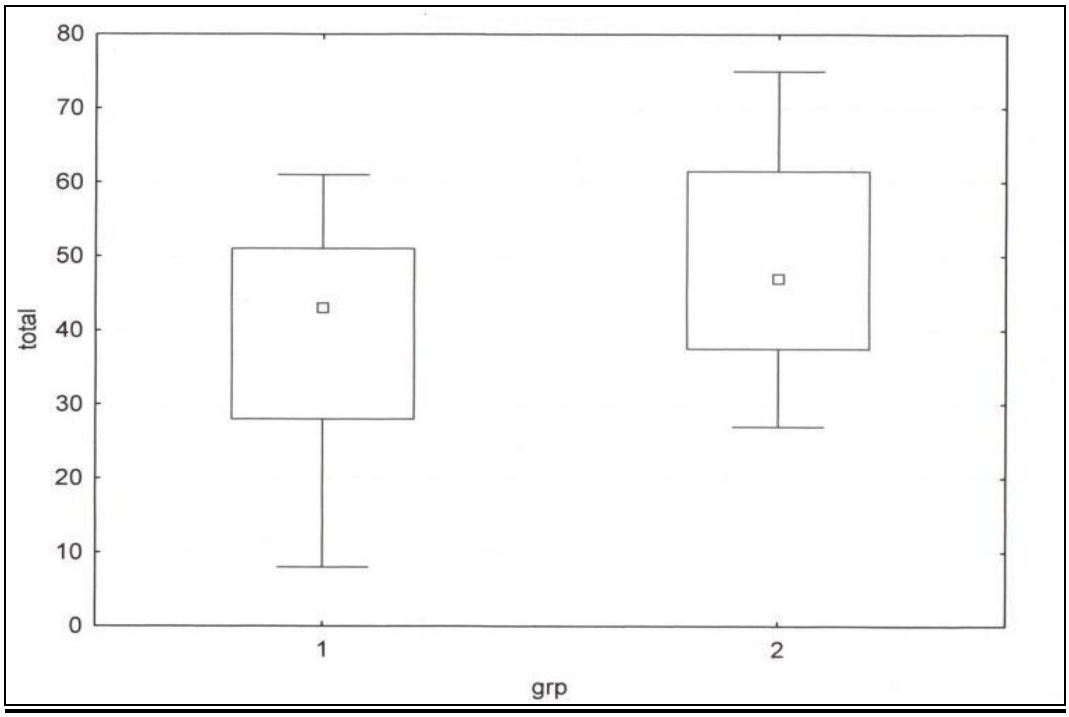


Figure 4.23: Box-plot representing comparison of scores between two-week (grp 1) and two-month (grp 2) interns with respect to Hospital C.

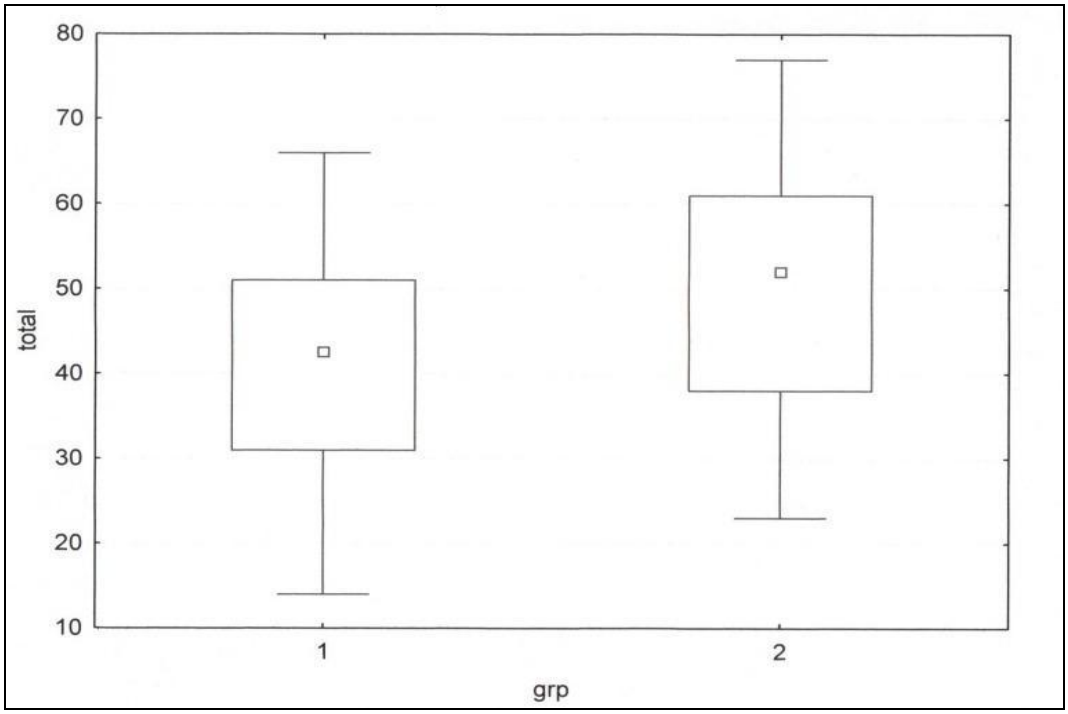


Figure 4.24: Box-plot representing comparison of scores between two-week (grp 1) and two-month (grp 2) interns who considered themselves prepared for Community Service anaesthesia.

Table 4.12: Comparison of responses by two-week and two-month interns to short questions posed in Section B.

Short Question	Two-weeks %	Two-months %	Change %
22G Spinal needle	48	45	-3
Antidote – opiate	79	89	10
Antidote – benzodiazepine	26	37	11
Oxygen cylinder	19	48	29
Gauge pressure	5	4	-1
Nitrous oxide pipeline	61	85	24
Machine check	0	5	5
Milligrams lignocaine	19	31	12
Dose Etomidate	7	15	8
Dose Suxamethonium	25	46	21
Size ETT	19	34	15
Gauge IV catheter	31	49	18
S/E Propofol	72	86	14
Isoflurane and heart rate	49	53	4
3 Contraindications – Suxamethonium (None)	34(24)	54(7)	20

Table 4.13: Comparison of responses by two-week and two-month interns to case study vignettes posed in Section C.

Case Study Vignette Topic	Two-weeks %	Two-months %	Change %
Pharmacology	38	42	4
Ventilation/ Ventilators	32	34	2
Circuits	22	28	6
Local Anaesthetic toxicity	29	50	21
Post operative nausea and vomiting	25	36	11
Positioning	44	56	12
Bronchospasm	42	54	12
Airway assessment/ Management	43	49	6
Equipment	28	31	3
CO2 Absorbent	48	54	6
Patients with pregnancy induced hypertension	53	60	7
Premedication	41	77	36
ASA classification	44	78	34
Nil per os times	36	26	-10
Laryngospasm	86	71	-15

Table 4.14: Comparison of responses by two-week and two-month interns to important questions posed in Section C.

Important Questions	Two-weeks %	Two-months %	Change %
Suxamethonium to burns patient	63	48	-15
Opened Oxygen cylinder with loss of pipeline pressure	30	44	14
Dantrolene to manage Malignant Hyperthermia	65	68	3
Rapid sequence for full stomach	89	90	1
Adrenaline in anaphylaxis	40	37	-3
Spinal to severe Aortic stenosis	48	62	14

4.5 Summary of Results

In this chapter the results of the study were presented. The two-month anaesthetic rotation showed a significant improvement in anaesthetic knowledge, as measured by short questions and case study vignettes, over the two-week anaesthetic rotation. However, sub-sectional analysis revealed areas of concern. Detailed discussion shall follow in Chapter 5.

CHAPTER 5

5. DISCUSSION

Chapter 5 shall include an interpretation of the results of the study, and a discussion of the issues raised by the results. Chapter 5 will also include a discussion of the study in terms of potential limitations of the study, implications for clinical practice and further research. In the previous chapter, the results of the study were presented. The two-month anaesthetic rotation showed a significant improvement in anaesthetic knowledge, as measured by short questions and case study vignettes, over the two-week anaesthetic rotation. However, sub-sectional analysis revealed areas of concern.

5.1 Discussion of results pertaining to the aim of the study

This study showed a statistically significant 10% improvement in scores for the questionnaire assessing anaesthetic knowledge in two-month interns when compared with two-week interns.

However, it is an unfair assumption to say that increased knowledge makes for a better anaesthetist, especially in the absence of assessment of practical and clinical skills. What can be stated is that a lack of knowledge creates a potentially bad anaesthetist in the same way that a lack of skills creates a potentially bad anaesthetist. This is because anaesthesia is both an art and a science, where the correct mixture of knowledge and skills combine to create a good anaesthetist. It is a limitation of this study that skills were not assessed for both practical and

ethical reasons and thus assessment is based on basic and applied knowledge alone.

It was felt that 10% would be practically and clinically significant when the study was being designed and this figure was used to determine the sample statement: A sample size of 83 internship doctors in each group shall be required to have 99% power to detect a difference in means of 10, assuming that the population standard deviation is 14.9, using a two group t-test with a 0.05 two-sided significance level.

However, neither group averaged what would classically be assumed to be a passing mark, i.e. 50%. So while a 10% improvement in scores was found, the two-month interns still scored on average below 50% suggesting that their anaesthetic knowledge is potentially inadequate for the safe provision of Community Service anaesthesia. This was further affirmed by the fact that 52% of two-month interns made at least one potentially fatal error. While this is a 7% improvement over the two-week interns, it suggests that two-month interns may not be adequately prepared for safe Community Service anaesthesia provision.

When the responses to the short questions, case study vignette topics and important questions posed in the vignettes are analysed more concerning questions are raised regarding adequacy of anaesthesia knowledge and preparation for safe Community Service anaesthesia provision.

The short questions were designed to test basic anaesthetic knowledge with non-threatening simple questions, some of which any intern would be expected to

know even without anaesthesia training. The two-month interns showed an improvement in the number of interns responding correctly in only 13 of 15 questions (a range of 4-29%), but worsened in 2 of 15 questions (1 and 3%). One would have expected their knowledge to have improved such that all questions showed an improved correct response.

When looking at the content of the short questions, it is important to note that not a single basic anaesthetic knowledge question had 100% of two-month interns giving the correct answer and that while, for example, there is a 10% increase in the number of two-month interns correctly identifying the antidote for a benzodiazepine overdose when compared with the two-week interns, 63% of two-month interns did not answer the question correctly. In only 5 of 15 questions did more than 50% of two-month interns give the correct response.

To repeat the above statement for all the short questions would be nonsensical, but the following issues should be highlighted: 7% of two-month interns could not name a single contra-indication for Suxamethonium, 85% of two-month interns could not give the induction dose for Etomidate, 52% of two-month interns could not fully describe an oxygen cylinder, 69% of two-month interns could not give the milligrams of Lignocaine contained in the volume given.

It could be argued that Etomidate is not a regularly used induction agent and that Suxamethonium has fallen out of favour such that a two-month intern may not have seen them used during their anaesthesia rotation. But the knowledge taught during the anaesthesia rotation would have included both drugs, and an intern’s

knowledge would not be expected to be confined only to drugs they had practical experience with. This logic applies equally to the antidotes for overdoses, where interns demonstrate a lack of knowledge of the corrective measure required in a situation to which they may well be exposed as a Community Service doctor.

Regarding the full identification of an oxygen cylinder as a black body with a white shoulder, it could be argued that an intern would be able to identify an oxygen cylinder or, more importantly, recognise when an incorrect cylinder was provided when faced with a cylinder in a real-world situation. However, this was not tested and the assumption cannot be made.

Lignocaine is a drug that internship doctors would have had exposure to in many rotations outside of anaesthesia and they would definitely be expected to use in Community Service, even if they were not providing anaesthesia services. The fact that their knowledge of the dosage per volume is poor is of concern.

Particularly poorly answered were questions pertaining to the machine check, with 96% of two-month interns unable to give the correct gauge pressure for the oxygen cylinder and 95% unable to correctly name all “6 metals and 6 plastics” required on the anaesthetic machine to provide safe anaesthesia. While it could be argued that machine checks are not standardised nationwide, all the interns assessed were trained on the WAC anaesthesia circuit where the machine check is standardised to Diploma of Anaesthesia standards and where the concept of “6 metals and 6 plastics” is uniformly applied.

It could also be argued that interns are no longer exposed to Boyle's machines and that they may have been exposed to several different types of anaesthesia delivery units, most of which have automated self-test features where the intern would not be exposed to the full machine check as required of candidates for the Diploma of Anaesthesia. However, the questions were drawn up cognisant of these facts and the questions focused on two parts of the machine check that are universal, irrespective of the anaesthesia delivery unit, and would be expected to be known irrespective of what anaesthesia delivery unit the intern were to face as a Community Service doctor.

The case study vignettes were designed to test applied anaesthetic knowledge with multiple choice questions. These were broadly assigned to 15 topics as illustrated in **Table 4.13**. The two-month interns showed improvement in the number of interns responding correctly in only 13 of 15 topics (a range of 2-36%), but worsened in 2 of 15 topics (10 and 15%). Again, one would have expected their knowledge to have improved such that all topics showed an improved correct response. In only 8 of 15 topics did more that 50% of two-month interns respond correctly.

Lack of knowledge appears to span all topics but is worst in ventilators, circuits, equipment and nil per os times, which are specific to anaesthesia. Pharmacology questions were aimed at anaesthetics drugs and again the knowledge is poor.

Looking at the 6 isolated important questions posed within the case study vignette topics, it should be noted that the two-month interns improved in 4 of 6 questions

but worsened in 2 of 6 questions. Again one would have expected their knowledge to have improved such that all topics showed an improved correct response. It is important to note that not a single important question had 100% of two-month interns giving the correct answer and that while, for example, there is a 15% decrease in number of two-month interns administering Suxamethonium to a burns patient when compared with the two-week interns, 48% of two-month interns would administer Suxamethonium to a burns patient.

As with the short questions, it should be high-lighted that 56% of two month interns failed to open the oxygen cylinder when pipeline pressure was lost, 62% of two-month interns would give a spinal to a severe aortic stenosis, 63% would not give Adrenalin in Anaphylaxis, 32% would not give Dantrolene in a case of Malignant Hyperthermia.

It could be argued that interns may never have been exposed to either Anaphylaxis or Malignant Hyperthermia and that their inability to differentiate between the two could be on this basis and thus affect their treatment decisions. However, these are two examples of the very few true isolated anaesthetic emergencies and even though they are rare, when they occur an anaesthetic provider should be able to recognise and treat them as their consequences are dire. It would be beholden on a Community Service doctor administering anaesthesia to be able to recognise and treat these conditions were they to occur.

When all of the above is considered, it cannot be stated that two-month interns are adequately prepared to provide safe Community Service Anaesthesia, despite the fact that the two-month anaesthesia rotation appears to increase their knowledge.

Another factor that should be considered is that statistical improvement did not occur in all subgroups analysed. While the study was not powered for the analysis of subgroups, the fact that there was no improvement of two-month over two-week interns for three of the universities and one of the trimesters compared is of concern. Ideally, improvement should have been seen across all two-month interns, irrespective of subgroup analysed, demonstrating the potential superiority of the two-month anaesthesia rotation.

In this regard, even had the improvement in knowledge not been questionable in its own right, the results suggest that certain subgroups of two-month interns would remain inadequately prepared for Community Service anaesthesia, despite the increased exposure to anaesthesia during their internship time.

Of concern is the fact that the vast majority (87.8%) of two-month interns considered themselves prepared for Community Service Anaesthesia. However, this is perhaps tempered by the fact that 46% of these two-month interns qualified their response with “under supervision” or “spinals only”, but it must be remembered that Community Service doctors often work without adequate supervision and that general anaesthesia may be required as a consequence of a failed spinal or spinal anaesthesia complication.

Anaesthetic knowledge appears inadequate in key areas for both two-week and two-month interns and the increased time of anaesthesia exposure alone may not be sufficient to address these gaps in knowledge.

As to the reasons for the lack of anaesthesia knowledge among two-week and two-month interns, a few contributing causes are suggested in the analysis of secondary factors.

5.2 Discussion of results pertaining to secondary factors

At the outset it has to be stated that this study was not powered to analyse these secondary factors and that the outputs are suggested by their statistical significance, but cannot be definitively stated as true due to inadequate power. However, cognisance of these factors may prove beneficial in the design of an internship anaesthesia training program.

5.2.1 Undergraduate training

Undergraduate training appears to influence the results for the study questionnaire, and thus may impact on the adequacy of the knowledge obtained and subsequent preparation for Community Service anaesthesia. For example, both two-week and two-month interns who underwent undergraduate training at University 4 scored significantly lower than other universities, although the two-month anaesthesia rotation did improve their scores.

It must, however, be noted that a new curriculum for undergraduate training was introduced by several universities in the years preceding the study and that the

two-month interns reflect one of the first groups of interns having graduated under the new curriculums. How this influenced the outcome of the questionnaire cannot be determined.

5.2.2 Training hospital

The hospital where the intern underwent training appears to influence the outcome of the study questionnaire, and may thus impact on the adequacy of the knowledge obtained and subsequent preparation for Community Service anaesthesia. While a significant difference between two WAC hospitals was only seen among two-week interns and appeared to be rectified by the introduction of the two-month anaesthesia rotation, this result does suggest that the adequacy of training may be hospital dependent.

Given the contextuality of this study in general, and this subgroup in particular, and the inadequate power for subgroup analysis, it is important to say that the role of training hospital is suggested but cannot be definitively confirmed.

5.2.3 Trimester training completed

It is surprising that there is no significant difference between the Trimesters when the internship doctor completed their anaesthesia rotation. Given that all interns were assessed at the end of their internship and the end of the year that they completed their anaesthesia rotation, it was expected that Trimester 3 interns would score better than Trimester 1 and 2 interns as they had completed their anaesthesia rotation more recently and thus their knowledge would be “fresher”, as no preparation was allowed for the questionnaire.

This lack of difference between Trimesters suggests that the knowledge is more passively than actively acquired, where a basic knowledge base is memorised through passive observation and experience rather than actively studied. Thus a similar amount of passive knowledge gain is seen.

5.3 Discussion of potential limitations of the study

The following were identified as potential limitations of the study:

- Convenience sampling method
- Contextuality
- Preparation
- Skills versus knowledge
- Anaesthetic knowledge
- Absolute values
- Data collection
- Validity
- Call for help

5.3.1 Convenience sampling method

The convenience sampling method was chosen because of time constraints and the scope of the research. It is recognised that a convenience sampling method is not as robust as other methods and introduces the risk of selection bias, such that the sample may not fully represent the study population.

However, the study used a consecutive convenience sampling method where every eligible internship doctor was invited to take part in the study. Consecutive sampling is the most reliable form of convenience sampling as research bias is limited (18).

It is unlikely that consecutive convenience sampling had a significant impact on the outcome of this study, although it may have impacted on the normality of the distribution of the results and the statistical measures used which have their own limitations as outlined separately below.

5.3.2 Contextuality

The study is contextual and was conducted in the context of the WAC hospital anaesthesia rotations. The study population and its results may not be representative of the national internship group nor of WAC internship groups preceding or following them. Generalisation to other populations may be limited.

5.3.3 Preparation

It was felt at the outset that bias secondary to preparation may occur; i.e. that subsequent interns, having fore-knowledge of the questionnaire, would prepare/ study for the questionnaire and thus alter their scores. However, analysis of the results from different collection days failed to show any significant differences, suggesting that internship doctors, despite undoubtedly knowing that data collection was taking place, did not prepare for the questionnaire.

5.3.4 Skills versus knowledge

It cannot be stated that increased knowledge makes for a better anaesthetist, especially in the absence of assessment of practical and clinical skills. The correct mixture of knowledge and skills are required to create a good anaesthetist, adequately prepared for safe provision of Community Service anaesthesia. It is a limitation of this study that skills were not assessed and thus assessment is based on basic and applied knowledge alone. Skills may better represent competency.

Skills were not assessed for both practical and ethical reasons:

1) From a practical perspective, it was not possible to have all interns complete a standardised skills test, whether that had been in the form of a standardised patient or simulation scenario. Even had it been logistically possible to arrange, the bias towards preparation may have been enhanced.

2) It may not have been ethical to expose a standardised patient to a potentially inadequate anaesthetic as the end point for intervention would have had to be tight enough for the patient to be protected and would possibly have limited the outcomes of the study.

5.3.5 Anaesthetic knowledge

It is impossible for the study to assess all anaesthetic knowledge. However, the questionnaire was set to examine knowledge based on the author's personal experiences of Community Service anaesthesia, the literature, HPCSA guidelines and expert opinion. Whether the study's content was adequate to fully evaluate knowledge required for safe provision of Community Service anaesthesia cannot be certain, however, the key areas assessed raise cause for concern.

5.3.6 Absolute values

Answers to the questionnaire are assigned to either correct or incorrect categories and absolute scores were assigned to both; for example, 1 or 0 respectively. There was no accounting for the thought process involved in determining the answer (unmeasured) and a partially correct answer could not be and was not assigned a value.

This may be a limitation in this study and specifically the assessment of knowledge, as it does not allow for the determination as to whether the answer was correct for the thought process involved. Nonetheless, it was deemed at the time of drawing up the questionnaire during the two-tier vetting process that the scenarios were unambiguous and that the basic diagnostic knowledge being tested was required for safe provision of Community Service anaesthesia.

This factor may, however, have impacted on the normality of the distribution of the results and the statistical measures used which have their own limitations as outlined separately below.

5.3.7 Data collection

A suggested limitation of this study was that interns were being approached at the end of their internship year rather than the end of their anaesthetic rotation and that this would give an inaccurate result. However, given that there was no significant difference in scores for the different Trimesters the interns completed their anaesthetic rotation, it is unlikely that this was a factor in this study.

5.3.8 Validity

The validity of the case study vignettes cannot be established via comparison with a standardised patient. This would have to be examined by a future study.

5.3.9 Call for help

At no time in the questionnaire was there an option to "call for help" which would be a legitimate and valid response when faced with a situation in Community Service anaesthesia. However, this does not allow for the assessment of knowledge, as an intern could "call for help" with any scenario.

It must also be asserted that Community Service doctors often work unsupervised and may not have anyone to call.

5.4 Discussion of the distribution and statistical tests used to analyse the data

A proportion of the data collected was analysed by a Shapiro Wilk test and was found to have a non-normal distribution. It was therefore decided to analyse the data utilising non-parametric test, namely the Mann-Whitney U test and Kruskal-Wallis test depending on the number of variables to be compared.

5.4.1 Discussion of the non-normality of data

There are six reasons frequently deemed responsible for non-normality of data which may pertain to the data collection for this research (28):

5.4.1.1 Extreme values

If too large a number of extreme values exist in a data set, the result will be a skewed distribution. Normality of data can be obtained by cleaning the data, which involves determining measurement errors, data-entry errors and outliers, and removing them from the data for valid indications (28).

The assessment of knowledge by the questionnaire may have resulted in outliers which, if removed, may have resulted in a normal distribution. However, the nature of normally distributed data is such that extreme values are expected and it is impossible to determine whether the extreme values in this study's data are truly special and can be accounted for by a specific reason allowing for their removal.

5.4.1.2 Overlap of two or more processes

Data may not be normally distributed because it actually comes from more than one process, operator or shift, or from a process that frequently shifts (28).

This could have occurred during this study due to the convenience sampling. However, the data does not appear bi- or multimodal in nature as might be expected if two or more sets of normally distributed data are overlapped and thus this is an unlikely explanation in this study.

5.4.1.3 Insufficient data discrimination

Round-off errors or measurement devices with poor resolution, i.e. resulting in insufficient numbers of different values, can make continuous and normally distributed data look discrete and non-normal (28).

This may have occurred due to inherent problems with the determination of percentages, firstly for each section and then for the questionnaire overall, where rounding occurred.

This may also be a factor in the results of this study because an answer to a question was deemed either correct or incorrect and absolute scores were assigned to both; for example, 1 or 0 respectively. There was no accounting for the thought process involved in determining the answer (unmeasured) and a partially correct answer could not be and was not assigned a value.

5.4.1.4 Sorted data

Collected data may not be normally distributed if it represents a subset of the total data a process produced, where the original data is normally distributed but is only analysed after sorting (28). This does not apply to the data in this study.

5.4.1.5 Values Close to Zero or a Natural Limit

If a process has many values close to zero or a natural limit, the data distribution will skew to the right or left (28). This is unlikely to apply to the data in this study.

5.4.1.6 Data Follows a Different Distribution

There are many data types that follow a non-normal distribution by nature and cannot be made normal (28). An example would be the log-normal distribution, found with length data such as heights. It is unlikely that the data collected in this study was of this nature.

5.4.2 Discussion pertaining to the tests used

The Mann-Whitney U test is the alternative test to the t-test. The Mann-Whitney U test is a non-parametric test which does not make any assumptions related to the distribution that is used to compare two population means that come from the same population or to test whether two population means are equal or not (29, 31, 32).

However, some assumptions are supposed in Mann-Whitney U test (29, 31, 32). It is assumed that:

1. The sample drawn from the population is random.
2. There is independence both within and between the samples.
3. There is an ordinal measurement scale.

The Kruskal-Wallis one-way analysis of variance by ranks is a non-parametric method for testing equality of population medians among groups. Intuitively, it is identical to a one-way analysis of variance (ANOVA) with the data replaced by their ranks. It is an extension of the Mann-Whitney U test utilised to analyse data from three or more groups (29, 30, 31, 32, 33).

The sample sizes in the Kruskal-Wallis test should be as equal as possible, but some differences are allowed. The Kruskal-Wallis test also has one limitation: if the researcher does not find a significant difference in his data while conducting the Kruskal-Wallis test, then he cannot say that the samples are the same (30, 32, 33).

Non-parametric tests have both advantages and disadvantages.

The advantages of non-parametric test are (29, 30, 31, 32, 33):

1. A Nonparametric test makes less stringent demands of the data. For standard parametric procedures to be valid, certain underlying conditions or assumptions must be met, particularly for smaller sample sizes.

2. Non-parametric procedures can sometimes be used to get a quick answer with little calculation.

3. Non-parametric methods provide an air of objectivity when there is no reliable (universally recognised) underlying scale for the original data and there is some concern that the results of standard parametric techniques would be criticised for their dependence on an artificial metric. For example, patients might be asked whether they feel extremely uncomfortable / uncomfortable / neutral / comfortable / very comfortable.

4. Sometimes the data does not constitute a random sample from a larger population, such that standard parametric techniques based on sampling from

larger populations are no longer appropriate. Because there are no larger populations, there are no population parameters to estimate. Nevertheless, certain kinds of non-parametric procedures can be applied to such data by using randomisation models.

The disadvantages of non-parametric test are (29, 30, 31, 32, 33):

1. In some non-parametric tests there are no parameters to describe and it becomes more difficult to make quantitative statements about the actual difference between populations. For example, when the sign test says two treatments are different, there is no confidence interval and the test doesn't say by how much the treatment differs. However, it is sometimes possible to compute estimates and even confidence intervals for medians and differences between medians, but the calculations are tedious and a computer with specialised statistical software is required.

2. Non-parametric procedures discard information. Ranks preserve information about the order of the data but discard the actual values. Because such information is discarded, nonparametric procedures cannot be as powerful or robust in their ability to detect existing differences between samples as their parametric counterparts when parametric tests can be used.

These advantages and disadvantages were taken into account during the analysis of the data from this study.

5.5 Further research

This study highlights areas where further research could be conducted. The comparison between two-week and two-month anaesthesia rotations could no longer be conducted as the two-week anaesthesia rotation no longer exists, thus this study could not be repeated and its results verified. However, analysing the knowledge of two-month interns regarding the adequacy of their preparation for Community Service anaesthesia remains a valuable and worthwhile objective given that Community Service continues and may be extended to two years in the future.

5.5.1 Other academic complexes

As this study is contextual and can only be applied to the WAC anaesthesia rotation, it would be of interest to assess the anaesthetic knowledge of two-month interns in a countrywide context. To begin with, it may be easier to look at other academic complexes in addition to WAC and see whether trends in subgroup analysis are borne out with an adequately powered study.

5.5.2 Skills test

A limitation of this study is the fact that skills are not assessed, and skills may be a better marker of competency. In view of this limitation, it would be of interest to conduct a skills assessment on two-month interns to determine whether or not they have the necessary skills for the safe provision of Community Service anaesthesia, or, at the very least, meet the HPCSA skills and proficiency requirements.

5.5.3 Comparison of results of questionnaire to a skills test

A limitation of this study is the fact that skills are not assessed, and skills may be a better marker of competency. It would be of interest to compare the outcomes of the questionnaire with the outcomes of a skills test, whether that be a standardised patient or a simulation scenario. This would serve to further validate the instrument as an indirect representation of skills and lend further credence to the assessment of knowledge as a marker of anaesthetic proficiency.

Chapter 5 included an interpretation of the results of the study, and a discussion of the issues raised by the results. This chapter also included a discussion of the study in terms of potential limitations of the study, implications of statistical tests used and further research paths. A summary of the study and the conclusions shall be presented in Chapter 6.

CHAPTER 6

6. SUMMARY AND CONCLUSION

Chapter 6 shall include a summary of the study and the conclusions drawn from the study.

6.1 Summary

Since the inception of Community Service in 1998, junior doctors have been required to administer anaesthesia in rural areas with poor or no supervision, despite a lack of technical skills and an initial need for increased supervision.

Up until the end of 2006, internship training included a two-week anaesthesia rotation. From 2007, the two-year internship was introduced in Gauteng, with new two-month anaesthesia rotation being instituted from 2008, as part of this two-year internship program. The goal of this study was to compare the adequacy of an internship doctor's knowledge after two weeks versus two months of training in anaesthesia.

After Wits Ethics Committee approval, 108 two-week interns (73% of the intern population) and 107 two-month interns (72% of the intern population) at the WAC were approached at the end of their internship (December 2006 and 2008 respectively). They completed a questionnaire in the form of short questions and case study vignettes, drawn up with a two-tier vetting process to assess basic anaesthetic knowledge as dictated by the HPCSA guidelines. Demographic data included the undergraduate institution and hospital where they had been trained.

The average result for the two-week interns was 38.95 (14.9) %. Knowledge of the anaesthetic machine check and anaesthetic pharmacology was inadequate (49% of respondents unable to describe the nitrous oxide pipeline, only 7% of respondents able to give the induction dose of etomidate and 24% unable to list one contraindication to suxamethonium). Analysis of variance showed a difference in the performance of respondents from the different WAC hospitals and undergraduate institutions.

The average result for the two-month interns was 48.95 (21,77) %, an improvement of 10% overall. However, knowledge of the anaesthetic machine check and anaesthetic pharmacology remained inadequate (only 4% of respondents able to give the gauge pressure of a full oxygen cylinder, 63% of respondents unable to give the antidote for a benzodiazepine and 85% unable to give the induction dose of etomidate). Analysis of variance again showed a difference in the performance of respondents from different undergraduate institutions, and further analysis of undergraduate institutions revealed that only three out of six institutions showed improvement between two weeks and two months of training in anaesthesia.

6.2 Conclusion

The results of this study, particularly those underpowered to be more than suggestions/ trends, have shown potential for further research into these areas as discussed in Chapter 5.

The following conclusions can be drawn from the study:

1) While the two-month anaesthesia rotation appears to improve the anaesthetic knowledge acquired during internship, increased exposure time alone may not be sufficient. Cognisance of other potential contributing factors should guide the design of the anaesthetic rotation so as to supplement potential shortfalls (e.g. undergraduate knowledge).

2) Anaesthetic knowledge after a two-month internship-training period, as assessed by our questionnaire, shows an improvement over the two-week training period, but still appears to be inadequate for the safe provision of unsupervised anaesthesia during Community Service.

The results of this study have provided useful information which can be directly applied in the clinical setting, with the aim of improving the training of internship doctors in anaesthesia such that they can provide safe, unsupervised anaesthesia services during their Community Service period.

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APPENDICES

Appendix A: Ethics approval certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Ash

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER MO61126**
PROJECT	A Comparison of Two Week VS Two Month Anaesthetic Training for Internship Doctors (New Title)
INVESTIGATORS	Dr S Ash
DEPARTMENT	Anaesthesia
DATE CONSIDERED	06.11.24
DECISION OF THE COMMITTEE*	APPROVED UNCONDITIONALLY

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 06.12.12 **CHAIRPERSON** .....
(Professor P E Cleaton Jones)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Dr D Lines

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10005, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix B: Post-graduate Committee approval

Faculty of Health Sciences
Medical School, 7 York Road, Parktown, 2193
Fax: (011) 717-2119
Tel: (011) 717-2075/6

Reference: Mrs Alison Mclean
E-mail: mcleanam@health.wits.ac.za
14 May 2007
Person No: 9604163M
PAG

Dr SA Ash
PO Box 1560
Olivedale
2158
Johannesburg, South Africa

Dear Dr Ash

Master of Medicine (in the specialty Anaesthesia): Approval of Title

We have pleasure in advising that your proposal entitled "*A comparison of two week versus two month anaesthetic training for internship doctors*" has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

Appendix C: Consent form

CONSENT FORM

A COMPARISON OF TWO WEEK VERSUS TWO MONTH ANAESTHETIC TRAINING FOR INTERNSHIP DOCTORS

I, _____ consent to complete the survey form to assess the adequacy of Anaesthetic knowledge provided to me during my Anaesthetic block.

I understand that participation in this study is completely voluntary and that I may withdraw at any stage without having to give a reason.

I understand that participation/ non-participation shall not prejudice me in any way.

	NAME	SIGNATURE	DATE
PARTICIPANT			
RESEARCHER	Dr Simon Ash		

Appendix D: Questionnaire section A

A COMPARISON OF TWO WEEK VERSUS TWO MONTH ANAESTHETIC TRAINING FOR INTERNSHIP DOCTORS

END OF INTERNSHIP ANAESTHETICS ROTATION QUESTIONAIRE

SECTION A:

Please answer the following demographic questions:

1) Age: _____

2) Sex (M/ F): _____

3) University where qualified: _____

4) Any Tertiary education before medical school? (Y/N) _____

If yes, please state: _____

5) Any additional qualifications? (please list below)

_____

_____

_____

6) Any delay between graduation from medical school and beginning internship? (Y/N) _____

If yes, how long: _____

7) What rotations had you completed before beginning your Anaesthetic rotation? What rotations have you done this year? (please list below)

_____

_____

_____

8) Number of general anaesthetics observed: _____

9) Number of regional anaesthetics observed: _____

10) During which portion of the year did you do anaesthetics? (please select one below)

Jan-Apr _____ May-Aug _____ Sep-Dec _____

11) Which hospital did you rotate at? (please select one below)

CHBH _____ HJH/CORO _____ JH _____

12) What level of supervision did you receive? (please select one below)

MO (pre DA) _____ MO (post DA) _____ Career MO _____

Registrars: 1st year _____ 2nd year _____ 3rd year_____

4th year _____ Consultant: _____

13) Where you with the same supervisor during the whole rotation? (Y/N) _____

If no, how many different supervisors did you spend time with?

_____

Please give a reason:

_____

_____

_____

14) Did you receive any written guidelines from your department as to the requirements from the anaesthetic rotation? (Y/N) _____

If yes, did you find them helpful? (Y/N) _____

Why/ How?

_____

_____

_____

15) Did you attend any formal tutorials, journal clubs or academic meetings during your anaesthetic rotation? (Y/N) _____

If yes, was attendance voluntary or compulsory? _____

Did you find them helpful? (Y/N) _____

Why/ How?

_____

_____

_____

16) Do you feel you are adequately prepared to administer an anaesthetic during your community service year? (Y/N) _____

Please justify your answer:

_____

_____

_____

Are there any improvements to the anaesthetic rotation you would like to suggest?

_____

_____

_____

Thank you for completing the above demographic information and quality questionnaire.

INSTRUCTIONS FOR QUESTIONAIRE:

The questionnaire is divided into two sections. Section B comprises short questions. Section C is comprised of 3 case study vignettes for which there are multiple-choice questions. There is ONLY ONE correct answer for each multiple-choice question. Please circle the correct answer.

Please turnover and proceed with the Anaesthetics questionnaire.

While there is no time limit, you should complete this questionnaire in 30 minutes.

In the interests of this study's objectives, it is requested that you do not talk to your fellow interns during or about this questionnaire (although it should be noted that the questionnaires are different) and that you do not use any reference materials to complete this questionnaire.

Appendix E: Questionnaire section B

SECTION B:

1) What colour is a 22G spinal needle? _____

2) What is the antidote for an opiate overdose? _____

3) What is the antidote for a benzodiazepine overdose?_____

4) What colour is an oxygen cylinder? _____

5) How many kPa/ BAR should be in an oxygen cylinder during a machine check? _____

6) What colour is the nitrous oxide pipeline? _____

7) List the six “metals” and six “plastics” required by your machine check before beginning an anaesthetic case:

_____

_____

_____

8) What is the dose (in milligrams) contained in 3mls of 2% lignocaine? _____

9) What is the induction dose of Etomidate (in mg/kg)? _____

10) What is the normal adult dose (in mg/kg) of Suxamethonium for intubation? _____

11) What size ETT would be correct for a 4 y/o patient? _____

12) What gauge is a grey intravenous catheter? _____

13) Name one local side effect of Propofol: _____

14) Does Isoflurane increase/ decrease heart rate? _____

15) List three (3) contraindications to Suxamethonium:

_____

_____

_____

Appendix F: Questionnaire section C – Vignettes 1 to 12

Question 1. **ASSESSED: EASY**

Ms. N., a 30 year old female, presents in labour to the obstetrics department. On examination the obstetrician finds that the umbilical cord is in the vaginal vault and books her for an emergency caesarean section.

On her arrival at theatre you are given the further history that she is a known epileptic who is well controlled on treatment. She weighs 81kg. She has not eaten for 12 hours.

On examination of her airway you find that you can only visualize the top half of her uvula and she has a short neck. Her chest is clear with good air entry bilaterally. She has normal heart sounds and no murmurs. She has a BP of 139/89, a pulse rate of 98bpm and a respiratory rate of 22 bpm. Her ward Hb is 10.

1) The most appropriate ASA rating for this patient is:

a) 1
b) 2
c) 3
d) 4
e) 5

2) This patient may be given a Mallampati score of:

a) 1, which correlates well with a difficult intubation.
b) 2, which correlates well with a difficult intubation.
c) 3, which correlates well with an easy intubation.
d) 2, which does not necessarily correlate with ease of intubation.
e) 3, which does not necessarily correlate with difficulty of intubation.

You elect to administer general anaesthesia and, after positioning the patient, begin preoxygenation with a Mapleson A circuit.

3) The minimum fresh gas flow required with the Mapleson A circuit is:

a) 0.7 x minute volume.
b) 1.7 x minute volume.
c) 2.7 x minute volume.
d) 3.7 x minute volume.
e) 4.7 x minute volume.

The following drugs are available to you for induction and maintenance: Thiopentone, Propofol, Midazolam, Ketamine, Suxamethonium, Atracurium, Rocuronium, Morphine, Fentanyl, Halothane, and Nitrous Oxide.

4) Which one of the following is the most appropriate sequence of events for induction post preoxygenation in this patient?

a) Fentanyl, Thiopentone, Suxamethonium, intubation.
b) Thiopentone, cricoid pressure, Suxamethonium, intubation.
c) Propofol, manual ventilation, Atracurium, intubation.
d) Fentanyl, Propofol, cricoid pressure, Rocuronium, intubation.
e) Fentanyl, Thiopentone, cricoid pressure, Suxamethonium, intubation.

After the baby has been delivered you administer oxytocinon as an IVI bolus.

5) The most likely changes in response to oxytocinon IVI is:

a) Dilation of the pupils.
b) Shivering.
c) Tachycardia and a drop in BP.
d) Vasodilation and bradycardia.
e) Uterine relaxation.

Question 2. **ASSESSED: DIFFICULT**

Ms. M., a 19 year old female, is seen at the antenatal clinic of your level 1 hospital and is diagnosed with Pre-Eclampsia. The obstetrician starts her on Aldomet and books her for an elective caesarean section at 38 weeks, admitting her 2 days before surgery.

You visit her the day before surgery to do a preoperative assessment.

She has no past medical history. On surgical history, she has had one previous caesarean section for “a big baby”. Her BP is 148/95 and has been in a similar range since admission the day before. She has 2+ proteinuria. Her chest is clear and her heart is normal. She has sacral oedema and mild grade 3 pitting pedal oedema. She weighs 60kg. There are no blood results in her file.

1) The most appropriate combination of drugs for her premedication would be:

a) 30ml 0.3M sodium citrate and 5mg midazolam.
b) 10mg metoclopramide and 5mg morphine.
c) 30ml 0.3M sodium citrate and 10mg metoclopramide.
d) 10mg metoclopramide and 5mg midazolam.
e) 30ml 0.3M sodium citrate and 6mg morphine.

When she arrives at theatre the next morning Ms M’s BP is 159/ 99 and her heart rate is 115bpm. She has an Hb of 11,2g/dl and a platelet count of 105. Her U&E shows a normal sodium and potassium but a mild pre-renal picture. The obstetrician has also pulled LFT’s, which are normal. She is NOT in labour.

2) With regards this patient, which one of the following statements is correct:

a) The LFT's have no relevance with regards anaesthesia of choice.
b) Surgery should be delayed for better BP control.
c) Her U&E result is a contraindication to the use of suxamethonium.
d) Airway assessment is not required before regional anaesthesia.
e) She requires a careful administration of 500 – 1000ml of crystalloid before commencing with general or regional anaesthesia.

You elect to proceed with a spinal anaesthetic.

Under aseptic conditions you administer 2% lignocaine (without adrenalin) as local anaesthetic and, using an orange spinal needle with introducer, administer 2ml of hyperbaric 0,5% bupivicaine.

3) One of the following statements is correct:

a) The needle is a 25-gauge Quinke needle.
b) The dose of bupivicaine administered is 20mg.
c) The maximum dose of this 2% lignocaine for this patient would be 7mg/kg.
d) The minimum spinal level required for a caesarean section through a Pfannenstiel incision is T12.
e) A wedge should be placed under her right hip to ensure uterine displacement.

Shortly after positioning, Ms. M's BP falls to 110/65.

4) Which one of the following statements is correct?

a) This BP does not require treatment as it is within normal limits.
b) The drop in BP is most likely secondary to pain relief from the spinal anaesthetic.
c) This BP may be treated with a 50mg bolus of ephedrine.
d) This BP may be treated with a 50–100mcg bolus of phenylephrine.
e) This BP does not require treatment, as it will go up with surgical stimulation.

As the surgeon begins his last sutures for the skin, Ms M complains of pain.

5) The most appropriate treatment would be:

a) Ketamine 10mg IVI.
b) Midazolam 6mg IVI.
c) Induction with Propofol and mask ventilation.
d) Rapid sequence induction and intubation.
e) Fentanyl 50mcg IVI.

Question 3. **ASSESSED: EASY**

Master Z., 4-year-old male, is booked as a healthy elective case for removal of an extra digit.

He weighs 20kg and his last full meal was in the evening at 19h00. He has no signs of upper or lower respiratory tract infection and is apyrexial.

On arrival in theatre at 08h00 his mom informs you that he had a glass of water 2 hours ago.

1) The most appropriate action to be taken is:

a) Cancel the procedure because he is a full stomach.
b) Postpone the procedure till after 12h00.
c) Proceed with a rapid sequence induction.
d) Proceed with an LMA/ Mask anaesthetic.
e) Insert a NGT and drain the stomach contents before proceeding.

2) The most appropriate Mapleson classification circuit for this patient is:

a) A
b) C
c) E
d) F
e) B

3) Of the following, the minimum fresh gas flow requirement for a Jackson Reese circuit would be:

a) 0.7 x MV with a minimum of 2 litre per minute.
b) 2-3 x MV with a minimum of 3 litres per minute.
c) 1 x MV with a minimum of 3 litres per minute.
d) 2-3 x MV with a minimum of 0,5 litre per minute
e) 1 x MV with a minimum of 0,5 litre per minute.

The second patient on the list is a 20 year old known asthmatic booked for manipulation of the elbow.

After induction and intubation he develops severe bronchospasm with normal haemodynamics.

4) Which of the following statements is INCORRECT:

a) Immediate therapy may include adrenaline.
b) Immediate therapy may include increasing the inspired oxygen to 100%.
c) Immediate therapy should include switching off halothane.
d) You should maintain controlled ventilation.
e) Ketamine is an appropriate choice for treating this condition.

5) Which of the following is NOT a possible cause of intra-operative wheezing:

a) Kinked ETT.
b) Endobronchial intubation.
c) Subclinical viral pneumonia unmasked by anaesthesia.
d) Pulmonary oedema.
e) A vapouriser leak.

Question 4. **ASSESSED: DIFFICULT**

Mr Z., a 26 year old 50kg male, presents at the casualty department of your hospital at 15h30 having eaten lunch during which he sustained a severe laceration to his right hand. He is a regular patient having sustained burns to his entire left arm only a week ago. The medical officer who examines him decides that he needs debridement in theatre.

You are, however, busy finishing with an emergency caesarean section. The medical officer does not wish to stay after 16h00 and elects to proceed with the debridement under an axillary block in the theatre next door.

As your hospital has no nerve stimulator, he administers the axillary block using a trans-arterial approach eliciting parasthesias. He uses 2% lignocaine for it's fast onset. Because he is concerned about the discomfort associated with this technique, he gives the patient 50mg of Pethidine IMI.

When he begins to clean and drape the patient, he notices that the patient appears confused. He sends a nurse to call you. On examination the patient is not confused but incredibly anxious

1) The most appropriate question to ask this patient on your arrival is:

a) Can you wiggle your fingers on the right?
b) Do you know where you are?
c) Are you arms and legs numb?
d) How long ago were you burnt?
e) Do your ears ring or do lips tingle or feel numb?

The patient answers "yes" to the above question.

2) Which one of the following is inappropriate treatment?

a) Give supplemental oxygen.
b) Administer 50mg Thiopentone.
c) Monitor the patient's ventilation.
d) Administer Naloxone.
e) Put appropriate cardiac monitors on the patient.

Your treatment, while appropriate, fails and you elect to convert to general anaesthesia.

3) Of the following, the most appropriate sequence of events for induction in this patient following preoxygenation is:

a) Propofol, fentanyl, Laryngeal mask airway.
b) Propofol, fentanyl, cricoid pressure, suxamethonium, intubation.
c) Thiopentone, fentanyl, cricoid pressure, suxamethonium, intubation.
d) Thiopentone, fentanyl, Laryngeal mask airway.
e) Propofol, cricoid pressure, rocuronium, intubation.

You ventilate Mr Z. using volume-cycled ventilation, maintaining anaesthesia with Isoflurane.

4) Regarding Isoflurane, which one of the following is correct?

a) It has a higher Blood:Gas partition coefficient is higher than halothane's and is therefore more soluble in blood.
b) It causes a decreased heart rate leading to a characteristic drop in blood pressure.
c) It has a MAC_{50} of 1,68%.
d) In comparison with other volatiles, it causes minimal changes in cerebral blood flow during light anaesthesia.
e) It is a halogenated hydrocarbon.

5) Regarding volume-cycled IPPV, which one of the following statements is correct?

a) IPPV causes ileus and hypertension.
b) IPPV decreases intra-thoracic pressure leading to increased venous return.
c) Increased airway pressure causes hypoventilation.
d) The preset volume determines the end of the inspiratory phase.
e) The pressure delivered will always be the same.

Question 5. **ASSESSED: EASY**

Miss S, a white Afrikaans first year student at Johannesburg University, presents in January for elective laproscopic treatment for endometriosis.

She has no past surgical history and her only past medical history is that of abdominal cramps, which, in addition to the fact she sunburns easily, ruined her December vacation. On family history she mentions that her dad is also sensitive to the sun and that he has had problems with anaesthesia before.

She has no clinical findings on examination. And appears fit and healthy.

She weighs 48 kg.

1) Which one of the following drugs should probably be avoided in this patient?

a) Propofol.
b) Nitrous oxide.
c) Thiopentone.
d) Fentanyl.
e) Suxamethonium.

You proceed with an elective sequence induction, which is uneventful, and maintain her with volume-cycled ventilation and low flow anaesthesia. The surgeons begin the laproscopic surgery with Trendelenberg position.

2) Which one of the following findings are NOT attributable to laproscopic surgery in the Trendelenberg position:

a) Displacement of the diaphragm is caudal.
b) Increased $ETCO_2$.
c) Increased peak inspiratory pressure.
d) Decreased cardiac output.
e) Increased likelihood of regurgitation.

Towards the end of the procedure you notice that the gauge for pipeline oxygen on the Boyle's machine reads 3,15 kPa (3,15 Bar) and is steadily dropping.

3) Which measure should be taken immediately?

a) Check that the Boyle's machine is still connected to the wall.
b) Change the oxygen cylinder on the Boyle's machine, as it is empty.
c) Disconnect the central oxygen pipeline and ventilate with room air.
d) Pressure is irrelevant as long as a hypoxic mixture isn't delivered.
e) Open the oxygen cylinder.

4) A true statement regarding anaesthesia equipment is that:

a) Assigning a classification of high flow, medium flow and low flow and basal flow have to do with the percentage vapour added to the fresh gas.
b) The main advantage of the Jackson Rees circuit over the circle system for paediatric patients is its conservation of humidity and heat.
c) The main advantage of a closed system is that there is no rebreathing allowed by the system.
d) The lower the fresh gas input into the system, the higher the rebreathing and the shorter the lifespan of soda lime.
e) Soda lime is incompatible with desflurane.

5) Compared with low flow rates, high flow rates cause:

a) Increased system dead space.
b) Less predictability of inspired anaesthetic concentration.
c) Greater tendency towards atmospheric pollution.
d) Higher humidity of inspired gases.
e) Faster exhaustion of soda lime.

Question 6. **ASSESSED: DIFFICULT**

Miss X., a healthy 23-year-old female, presents at 3am at your district hospital complaining of PV bleeding and abdominal pain. The medical officer on call does a pregnancy test, which is positive, and a sonar that shows a right adnexal mass. He assesses her as an ectopic pregnancy and books an emergency laparotomy.

During her pre-operative assessment you note that she has no surgical or medical history, nil known allergies and is otherwise fit and well.

She is haemodynamically stable with a BP of 120/80, a pulse rate of 72bpm and a room air Saturation of 99%. Examination of her systems reveals no abnormalities.

You conduct an uneventful modified rapid sequence induction with etomidate, fentanyl and rocuronium. You maintain anaesthesia with halothane and volume-cycled ventilation.

Shortly after the patient is draped you notice the following:
The patient is flushed and warm to the touch. Her HR is 140bpm and BP 75/30. Her peak inspiratory pressure is 33cm (H_2O) and her $ETCO_2$ is 20mmHg.

Her diagnosis is an anaesthetic emergency.

1) The most common cause of this diagnosis in theatre is:

a) An antibiotic.
b) A Volatile anaesthetic.
c) A Non-depolarising muscle relaxant.
d) An Opioid.
e) N_2O.

2) The most important drug to use in the treatment of this condition is:

a) Hydrocortisone.
b) Adrenaline.
c) Dantrolene.
d) Salbutamol.
e) Aminophylline.

3) With regards etomidate, which one of the following is INCORRECT?

a) Contains the solvent proyleneglycol, which causes pain on injection.
b) Can be safely used as an infusion.
c) Is metabolised by the liver.
d) May cause abnormal movements due to disinhibition of cortical centres.
e) Is associated with rapid awakening in 3 – 8 minutes with no hangover

4) Which one of the following statements about anaesthesia ventilators is true?

a) Pressure control ventilation often elicits barotraumas.
b) Compressed carbon dioxide is the driving force behind the bellows.
c) A standing bellow is generally safer than hanging bellows.
d) Pressure support ventilation is an essential mode of ventilation in theatre.
e) PEEP increases the cardiac output.

5) A Mapleson A circuit is classified as a/an:

a) Open system.
b) Semi closed system.
c) Closed system.
d) Low Flow system.
e) None of the above.

Question 7. **ASSESSED: MEDIUM**

Miss X., a healthy 23-year-old female, presents at 3am at your district hospital complaining of PV bleeding and abdominal pain. The medical officer on call does a pregnancy test, which is positive, and a sonar that shows a right adnexal mass. He assesses her as an ectopic pregnancy and books an emergency laparotomy.

During her pre-operative assessment you note that she has no surgical or medical history, nil known allergies and is otherwise fit and well.

She is haemodynamically stable with a BP of 120/80, a pulse rate of 72bpm and a room air Saturation of 99%. Examination of her systems reveals no abnormalities.

You conduct an uneventful rapid sequence induction with etomidate and suxmethonium. You maintain anaesthesia with halothane and volume-cycled ventilation giving the patient fentanyl for analgesia.

Shortly after the patient is draped you notice the following:
The patient is cyanosed and hot to the touch. Her HR is 180bpm and BP 156/90. Her peak inspiratory pressure is 15cm (H_2O) and her $ETCO_2$ is 65mmHg.

Her diagnosis is an anaesthetic emergency.

1) The most common cause of this diagnosis in theatre is:

f) An antibiotic.
g) A volatile anaesthetic.
h) A Non-depolarising muscle relaxant.
i) An Opioid.
j) N_2O.

2) The most important drug to use in the treatment of this condition is:

f) Hydrocortisone.
g) Adrenaline.
h) Dantrolene.
i) Salbutamol.
j) Aminophylline.

3) With regards etomidate, which one of the following is INCORRECT:

f) Contains the solvent proyleneglycol, which causes pain on injection.
g) Can be safely used as an infusion.
h) Is metabolised by the liver.
i) May cause abnormal movements due to disinhibition of cortical centres.
j) Is associated with rapid awakening in 3 – 8 minutes with no hangover

4) The clinical condition that would lead to the greatest disparity between ventilation and perfusion, creating a large gradient between the $PaCO_2$ and the $ETCO_2$, is:

a) Atelectasis.
b) Pneumonia.
c) Pulmonary embolism.
d) Bronchial intubation.
e) Pregnancy.

5) The plateau of the capnograph wave form represents the:

f) CO_2 free gas present in the dead space
g) Gas from the terminal airways and alveoli.
h) Anatomic dead space gas.
i) Inspiratory baseline gas.
j) Gas that is equivalent to $PvCO_2$.

Question 8. **ASSESSED: MEDIUM**

Mr M., a 70kg 35-year-old male, is involved in a motor vehicle accident and is rushed to your district hospital, as it is the closest. He is seen at casualty by the surgeon on duty who assesses Mr M. to have a fractured forearm, multiple lacerations and a possible c-spine injury, although there is no obvious neurological fall out. The X-ray machine is not working and he is unable to exclude a c-spine injury clinically.

After applying POP to Mr M's forearm and suturing the lacerations, the surgeon notices that Mr M. is complaining of a painful abdomen and on examination determines that he has an acute abdomen.

He books Mr. M for an emergency laparotomy.

Mr. M has no past medical history. His past surgical history includes an ORIF ankle after a mining accident, an appendicectomy and a tendon repair on his right hand. All three operations were done under general anaesthesia. He reports severe postoperative nausea and vomiting.

On examination he is haemodynamically stable, he has no sign of chest or cardiac pathology. He has no neurological fallout.

1) The most reasonable approach to intubation of this patient would be:

a) Perform a rapid sequence induction with nasal intubation.
b) Perform an awake oral intubation after regional anaesthesia of the airway.
c) Perform a blind nasal intubation after rapid sequence induction.
d) Insist on a tracheostomy before commencing anaesthesia
e) Apply a soft collar and proceed with a laryngeal mask airway after induction.

After successfully intubating Mr M. you notice that the ETT is at 27cm at the teeth.

2) The tip of the ETT is probably located:

a) In the right main bronchus.
b) At the tracheal midpoint.
c) In the laryngopharynx.
d) 2cm above the carina.
e) Just below the vocal cords.

3) With regards to minimising post-operative nausea and vomiting in this patient, you would NOT:

a) Use TIVA with Propofol.
b) Use minimal, if any, opioids.
c) Use N_2O for added analgesia.
d) Use high FiO_2.
e) Use droperidol.

On emergence from anaesthetic while the ETT was still in situ, Mr M. vomits a large amount of undigested food. No aspiration occurs and the anaesthesia ends with a safe extubation.

4) The most plausible explanation for the vomiting is:

a) The surgeon pressing on the stomach while closing the laparotomy wound.
b) The anticholinergic administered with reversal causes nausea and regurgitation.
c) Stimulation of the chemoreceptor trigger zone, inhibition of gastric motility due to pain and stress.
d) Due to electrolyte disturbances caused with washout of the abdomen.
e) Unknown and unimportant as vomiting is common after general anaesthesia in this patient.

5) With regards Propofol, one of the following statements is correct:

a) Induction is smooth and painless.
b) It is soluble in water.
c) At a dose of 1mg/kg in a normovolumic patient it will cause minimal drop in blood pressure.
d) It can be safely used for prolonged sedation as an infusion in the ICU setting at a dose of 1mg/kg/min.
e) It contains an antimicrobial agent that prevents bacterial growth.

Question 9. **ASSESSED: MEDIUM**

Mrs T., a 43-year-old 70kg female, is involved in a PVA at 08h00 and presents to your casualty at 15h00, having had difficulty arranging transport. Her only injury turns out to be an open fracture dislocation of her left ankle. She is in severe pain and the nurses administer morphine on telephonic orders from the orthopod. After reviewing her at 20h00, the orthopod books her for debridement and ORIF.

Mrs T. has no medical or surgical history and no known allergies. She last ate or drank at 07h30, a full meal of meat and pap.

Examination of her systems reveals no abnormalities. She is haemodynamically stable.

Her airway assessment reveals that she has a short neck with poor extension and is a Mallampati 4.

1) A correct fact regarding this patient is:

a) The period of fasting is adequate to ensure her stomach is empty.
b) Her stomach may not be empty due to pain and an activated stress response
c) The analgesia that this patient received will not interfere with her stomach emptying.
d) A nasogastric tube should be inserted pre-operatively to drain the stomach.
e) The important time is from the administration of morphine to the time of induction of anaesthesia.

You wish to give Mrs T. a spinal anaesthetic but she refuses.

2) Besides patient refusal, which one of the following is an absolute contraindication to spinal anaesthesia?

a) A platelet count of 80.
b) INR of 1.4.
c) Sepsis.
d) Severe aortic stenosis.
e) A demyelinating lesion.

3) The most appropriate sequence of events for the induction of anaesthesia in this patient would be:

a) Propofol, cricoid pressure, Suxamethonium, intubation.
b) Propofol, cricoid pressure, Alfentanyl, intubation.
c) Atracurium (priming dose), Fentanyl, Propofol, cricoid pressure, Atracurium (remaining dose), intubation.
d) Propofol, cricoid pressure, Vecuronium, bag ventilate, intubation.
e) Propofol, cricoid pressure, Rocuronium, intubation.

On direct laryngoscopy you cannot visualise her epiglottis or glottic opening.

4) Her Cormack and Lahane score will be a:

a) 1
b) 2
c) 3
d) 4
e) None of the above.

After inducing the patient you find yourself unable to intubate the patient and she begins to desaturate.

5) A reasonable course of action would include all EXCEPT:

a) Ventilate by facemask with 100% oxygen and have one further attempt.
b) Insert a laryngeal mask airway if you cannot ventilate with the mask.
c) Immediately attempt a blind nasal intubation.
d) Maintain cricoid pressure.
e) Wake the patient up and abandon the procedure.

Question 10. **ASSESSED: DIFFICULT**

Mr R., a 21-year-old man, presents at casualty. You are called to theatre for what is booked with the sister's as an incision and drainage of an abscess in this young man.

Upon arrival in theatre you find Mr R. sitting upright on his trolley. He has a gross swelling of the neck and submandibular spaces. He has limited mouth opening and is drooling pus out of his mouth.

After talking to the surgeon you find out that he has been diagnosed with Ludwig's angina and requires emergency Incision and drainage.

1) The best and safest way to secure the airway in this patient would be:

a) Have the surgeon do an awake tracheotomy under local anaesthesia.
b) Perform a rapid sequence induction with Thiopentone and suxamethonium.
c) Attempt a blind nasotracheal intubation after induction and unconsciousness.
d) Perform a retrograde intubation after intravenous induction.
e) Insert a laryngeal mask airway while awake.

While you are planning your approach to this patient he obstructs and cannot breathe.

2) An emergency airway can be established most quickly in a patient with an obstructed airway by means of a:

a) Cricothyroidotomy.
b) Tracheostomy.
c) Bronchoscopy.
d) Nasal airway.
e) Blind intubation.

3) The above procedure (2) is contraindicated under the following circumstance:

a) Laryngeal trauma.
b) Tracheal obstruction.
c) Failed intubation.
d) Inability to ventilate.
e) Obesity.

You were well trained as an intern and manage to secure the airway and elect to proceed with the surgery.

You have sevoflurane available at your hospital and maintain this patient with sevoflurane on low flow anaesthesia and IPPV.

Halfway through the procedure you notice that most of the soda lime is purple.

4) What is the most appropriate course of action?

a) Stop the operation and call the technician to change the canister immediately while the anaesthetic nurse bags the patient on 100% oxygen.
b) Increase the fresh gas flow rate and change the canister immediately.
c) Switch immediately to a new anaesthetic machine.
d) Wait and change the canister after the procedure.
e) Take patient off IPPV and allow patient to breathe spontaneously.

5) The reaction within soda lime produces:

a) Heat.
b) Heat and carbon monoxide.
c) Heat and carbon dioxide.
d) Heat and water.
e) Heat and H_2CO_3.

Question 11. **ASSESSED: EASY**

Mr K., a healthy 45-year-old male, presents for elective removal of a lipoma on his abdomen, an operation that has been postponed several times in the past month owing to over full lists.

He has no past surgical history, but has hypertension for which he is receiving treatment. He is currently well controlled. He weighs 60kg.

Your district hospital pharmacy has run out of Propofol and only has Thiopentone available for induction and only suxamethonium for muscle relaxation. Isoflurane is, however, available.

After administering a hypnotic dose of Thiopentone, Mr K. becomes apnoeic.
You are not concerned as spontaneous ventilation will return without treatment within 5 minutes.

1) One of the reasons for the return of spontaneous ventilation is:

a) Redistribution of Thiopentone from the brain to other tissues.
b) Hepatic metabolism of most of the administered Thiopentone.
c) A 45-year-old patient will metabolise Thiopentone faster than a younger patient.
d) The kidneys have excreted most of the injected Thiopentone.
e) Pseudocholinesterase has metabolised the majority of the Thiopentone.

Following the administration of 75mg suxamethonium IVI for intubation the patient exhibits severe muscular twitching.

2) You should:

a) Administer an additional 25mg of suxamethonium IVI.
b) Administer Diazepam IVI.
c) Give additional Thiopentone to halt seizure activity.
d) Wait for the twitching to stop and intubate the patient.
e) Suspect malignant hyperthermia.

Having appropriately addressed the above situation surgery proceeds. You maintain tight control of Mr K's blood pressure with a balanced anaesthetic technique maintaining the depth of anaesthesia with Isoflurane.

Towards the end of surgery you are planning to extubate the patient.

3) All of the following are criteria for removal of an ETT EXCEPT:

a) Respiratory rate of 12 to 25 bpm.
b) Tidal volume of 5 to 8ml/ kg.
c) Maximum inspiratory force < -20cm of H_2O.
d) Vital capacity greater than 15ml/kg.
e) Adequate oxygenation.

As Mr K. fulfils these criteria, you extubate him and continue to give oxygen via a facemask. Suddenly the capnograph alarms for apnoea and you notice that despite obvious respiratory effort from Mr K., the bag is not moving.

4) Your first action should be:

a) Administer suxamethonium and re-intubate.
b) Place head in the sniffing position and re-administer Isoflurane.
c) Institute gentle positive pressure ventilation with 100% oxygen.
d) Draw up lignocaine and administer it topically to the vocal cords.
e) Immediately apply head-tilt-jaw-thrust and watch the bag.

5) All the following statements about Thiopentone are true EXCEPT:

a) The pH of a 2,5% solution is 6,8.
b) A 2,5% solution contains 25 mg/ml.
c) It is the sulphur analogue of phenobarbitone.
d) It is more that 50% protein bound.
e) It exists in plasma in both ionised and un-ionised forms.

Question 12. **ASSESSED: MEDIUM**

Ms. M., a 34-year-old mother of two, presents at your district hospital with PV bleeding after being amenorrhoeic for 2 months. The medical officer on call does a pregnancy test, which is positive, and a sonar that shows retained products of conception. He assesses Ms M as having suffered an incomplete abortion at 12 weeks by dates and books her for evacuation of the uterus.

She is starved overnight and presents for evacuation in the morning. Ms M. is not actively bleeding and haemodynamically stable, has an Hb of 11g/dl and a potassium of 4.2. She has no past medical or surgical history and no known allergies.

On systemic examination no abnormalities are found. You then assess her airway.

1) A difficult oral intubation may be due to all EXCEPT:

a) A receding mandible.
b) Poor mobility of the mandible.
c) Protruding upper central incisors.
d) Gold caps on the central incisors.
e) Poor neck mobility.

Fortunately she is a Mallampati 1 with no obvious limitation to intubation.

As she is 12 weeks by dates and an evacuation is a short procedure you elect to induce with Propofol and insert a laryngeal mask airway. You maintain the patient on Nitrous oxide and halothane, ventilating her with a bag while she is apnoeic.

2) The most difficult area of the airway to obtund and the most sensitive is the:

a) Epiglottis.
b) Carina.
c) Trachea.
d) Cricoid.
e) Rima glottides.

After induction you notice premature ventricular contractions (PVC's) on the ECG.

3) A true statement regarding PVC's is that:

a) They are rarely indicative of anything other than myocardial ischaemia.
b) They are mostly benign without any known intraoperative aetiology.
c) It is difficult to distinguish from premature atrial contractions.
d) New onset PVC's need no preoperative investigation as they're mostly benign.
e) Halothane is well known to elicit ventricular premature beats.

During the course of the anaesthetic you notice that Ms M. has become cyanosed.

4) One of the following statements is true:

a) Immediate management should be to establish the presence of a palpable pulse, especially on the background of PVC's.
b) Immediate management should include checking the placement of the ETT.
c) Anaesthesia should be lightened as a primary treatment option.
d) If cardiac arrest has occurred the capnograph will be of no benefit in making the diagnosis.
e) MethHb does not cause this picture.

The sister chooses this time to tell you that maintenance has been working on the theatre gas supplies for the last 20 minutes, maintenance you were unaware of when starting this case. You are worried that a crossover may have occurred between the nitrous oxide and oxygen pipeline supplies.

5) You must take two actions immediately: open the oxygen cylinder at the back of the Boyles and:

a) Suction the patient and call for help.
b) Increase the rate of mechanical ventilation.
c) Check the scavenger and reset if necessary.
d) Disconnect the oxygen and N2O pipelines from the wall.
e) Disconnect the oxygen pipeline from the wall.