SELF-PERCEPTION AND MANIFEST COMPETENCY OF PERFORMING (SELECTED) CORE-CLINICAL SKILLS BY 2012/2013 FINAL YEAR MEDICAL STUDENTS OF THE UNIVERSITY OF ZAMBIA CURRICULUM: A STUDY OF HOW MEDICAL STUDENTS ACQUIRE COMPETENCY IN CLINICAL PRACTICAL SKILLS

By

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DECLARATION

I, Patricia Katowa-Mukwato confirm that this thesis is my own work. The various sources to which I am indebted have been clearly referenced. The Thesis has also not been and will not be presented for any other degree at this or another university.

Signed…….. Date…….

CERTIFICATE OF APPROVAL

This Thesis of Katowa-Mukwato Patricia has been approved as fulfilling the requirements for the award of Doctor of Philosophy in Medical Education by the University of Zambia

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DEDICATION

This Thesis is dedicated to my late father and mother Joseph and Emma Katowa who never lived to see this success. To my husband, Jamie Mukwato Sr, for overwhelming support, encouragement and belief in me, and my dear Sons Thumba, Luyando and Jamie Jr who were deprived of motherly love and care while I worked on this Thesis. To you all, I am grateful.

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ABSTRACT

Fifty six (56) out of sixty 2012/2013 final year students (93% response rate) participated in a study that sought to determine how Undergraduate Medical Students of the University Of Zambia (UNZA) acquired competency in clinical practical procedures, their levels of knowledge on selected set of skills, and their self-perceived versus manifest competency at the time of graduation.

A Multiple Choice Question (MCQ) knowledge test consisting of 48 items was administered to ascertain the level of knowledge on 14 selected clinical practical procedures. Students were also asked to rank their self-perception of competence on 14 selected clinical practical skills using a five-point Likert ranking scheme. For each of the procedures on which students ranked their self-perception, they concurrently rated the frequency of experience using a five-point Likert scale. To measure manifest competency, three selected clinical practical procedures were included in the end-of year Objective Structured Clinical Examination (OSCE) but overall competency on four other practical stations was also studied. Immediately after the OSCE, 10 students were asked to talk through the practical procedures they had performed (Retrospectively Think Aloud Protocols). Additionally, 17 students participated in an in-depth interview on how they acquired competency in clinical practical skills.

Traditional, as well as, competence-based curricula specify the clinical practical skills in which medical graduates must be competent in and yet literature has demonstrated that many students graduate without the competency. Such a potential situation is detrimental to patient outcomes and determines success or failure in clinical settings. The context at UNZA concerning such a potential situation had not been studied prior to our study, therefore this study sought to answer the following research questions 1) How do Undergraduate Medical Students of the University Of Zambia acquire competency in clinical practical procedures during clinical years?, 2) What is the clinical practical procedures knowledge level of Final Year Medical Students of the University of Zambia in the last six months of the undergraduate medical education? and 3) How does self-perception of competence compare with manifest-competence in selected clinical practical procedures among University of Zambia Final Year Medical Students in the last six months of training? To answer these three

questions, our study applied a non-interventional cross sectional correlation design utilizing the concurrent transformative with concurrent embedded mixed method strategy.

The study revealed that:

a) Medical students at UNZA acquired and developed competence in clinical practical procedures through four development stages: passive observation to guided performance to unguided performance and finally peer teaching.

b) The knowledge levels of clinical practical procedures of the final year medical students were found to be inadequate, represented by a 39% pass rate on a 48-itemMCQ test.

c) There was negative correlation between self-perception (moderately competent for most respondents) and manifest competence (barely competent for most respondents) on overall competence on the seven practical stations of the OSCE (Spearman rho -.123) and on two out of the three specific individual procedures included in the OSCE. The correlations (Spearman rho) between self-perceived and manifest competence for the three procedures were: cardiopulmonary resuscitation (-.150); intravenous drug administration (-.521) and nasogastric tube insertion (.128).

In literature, there are three main theories of how students acquire clinical competence namely Dave's (1970) model, Miller's (1990) triangle and Dreyfus and Dreyfus (1980) model of clinical skills acquisition, while the approach to learning in a traditional curriculum is that of "see one, do one and teach one". From our study, a new model emerged called **"Passive Observation to Peer Teaching Model"** of Clinical Procedural Skills Acquisition and Competence Development. When compared to existing models of clinical skills acquisition in particular the three that underpinned our study, the main similarity is that although different terminologies are used to describe different stages of competency development, when considered in totality, the process is progressive in nature, with teaching and assessment related factors nurturing the progress. In addition the model generated from our study can be seen as an expanded version of the "see one, do one and teach one approach" with an expansion of the "doing one" which in our model is first guided then unguided. One notable difference between existing models and the one that emerged from our study is that while existing models (notably Dave's 1970) focus on actual manipulations to perform a psychomotor skill, our model focuses on the process of developing competency.

The benefits of our study to medical education are mostly located in the teaching of clinical practical procedures to ensure that medical students acquire competency. From our study, the following points are noteworthy: a) the pass rates on MCQ knowledge test were high on items from procedures that were formally taught and that formally taught procedures were performed more times with students reporting high self-perception on procedures they had high experience with b) students were more knowledgeable in those procedures where there was a high likelihood of being assessed and consequently practiced more of those procedures in comparison to others, c) majority of clinical practical skills that students never attempted during the three years of clinical medical education are those performed in emergency situations in which trial and error by students is not acceptable due to its negative implications on patient outcomes, and d) irrespective of the mode by which students first learnt clinical practical skills, they essentially had to observe someone perform the procedure before they could attempt.

The implications for practice therefore include: a) the need for structured teaching of practical procedures, b) use of alternative innovative teaching/learning avenues such as clinical skills laboratories in addition to bedside teaching and c) inclusion of More Clinical Practical Procedures in the OSCEs. In the light of our finding, we suggested an alternative model for teaching clinical practical procedures in which teaching/learning is more structured, students are accorded more time to observe how experts perform clinical practical procedures, practice under guidance before independent practice and encouraged to teach others as a means to developing competence. We further suggest use of alternative teaching avenues as an adjunct and not a replacement of bedside teaching, and inclusion of more procedural stations during the OSCEs.

Our study design's most significant imperfection was that we could not identically match all the clinical procedures in the self-perception and the manifest competence assessment because the manifest competence was measured in a final examination in which it was undesirable to interfere with the content and number of practical stations. However, three stations were conceded to, in matching of the self-perception and manifest competence. Further, our study was cross-sectional and the numbers were restrictive for statistical generalizations. However, we believe the findings provide enough credibility and fidelity.

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LIST OF ABBREVIATIONS & ACRONYMS

AAMC	Association of American Medical Colleges
ABG	Arterial Blood Gases
ACLS	Advanced Cardiac Life Support
ALS	Advanced Cardiac Life Support
BLS	Basic Life Support
CBE	Competence Based Education
CCB	Clinical Context Based
CPR	Cardiopulmonary Resuscitation
CTA	Cognitive Task Analysis
CSL	Clinical Skills Laboratory
GP	General Practitioner
IBMES	International Basic Medical Education Standards
OSATS	Objective Structured Assessment of Technical Skills
OSCE	Objective Structured Clinical Examination
OSLER	Objective Structured Long Case Examination
OSPE	Objective Structured Practical Examination
RACGP	Royal Australian College of General Practitioner
SP	Standardized Patient

TA	Task Analysis
USA	United States of America
UNZA	University of Zambia
WFME	World Federation of Medical Colleges

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1.0 CHAPTER 1: INTRODUCTION

1.1 Background Information

The ultimate goal of medical education is to prepare students to become clinically competent doctors (Elzubier and Rizk, 2001; Goodfellow and Claydon, 2001; Association of American Medical Colleges, 2008; Duvivier, et al. 2011). Clinical competence has been defined as "habitual and judicious use of communication, knowledge, technical skills, clinical reasoning, emotions, values and reflection in daily practice for the benefit of individuals and community being served" (Epstein and Hundert, 2007). Alongside humanistic qualities, clinical competence is an attribute expected of every practicing doctor (Carr, 2004) while demonstration of proficiency and appropriate use of procedural skills pre-registration is a requirement by certifying bodies (Morris, Gallagher and Ridgway, 2012). Our study focused on competence in clinical practical procedures.

Regarding clinical competence, the undergraduate medical education curriculum aspires to initiate the process of transforming novices to experts. While to a large extent, the transformation to experts happens after qualification (Lai, Sivalingam and Ramesh, 2007), undergraduate medical education has an important role to play. To initiate the transformation from novice to expert, essential skills in which every medical student must demonstrate competency by the time of graduation have been identified by medical schools, councils, associations and certifying bodies as indicated in table 1.1.

Table 1.1: Essential Skills for Graduating Medical Students

United Kingdom - essential clinical skills for graduating medical students-Source Goodfellow and Claydon, 2001 and Moercke and Eika, 2002	**United States**- technical procedures students must skillfully perform Source- Association of American Medical Colleges, 2008	**Zambia**- commonly encountered procedures in the University Teaching Hospital -Source Banda, 2004
1. Basic Life Support (BLS) 2. Advanced Life Support (ALS) 3. Venipuncture 4. Insertion of intravenous cannula 5. Securing patient airway 6. Endotreacheal intubation 7. Performing ECG 8. Simple wound suturing 9. Ophthalmoscopy 10. Local nerve analgesia 11. APGAR scoring 12. Examination of the newborn 13. Taking a cervical swab 14. Pelvic assessment 15. Performing normal vaginal delivery 16. Protoscopy 17. Taking a urethra swab	1. Phlebotomy 2. Insertion of an intravenous catheter 3. Arterial puncture 4. Thoracocentesis 5. Lumbar puncture 6. Insertion of nasogastric tube 7. Insertion of Foley's catheter 8. Suturing lacerations	1. Intravenous cannula insertion 2. Urethral catheterization 3. Examination of the placenta 4. Nasogastric intubation/lavage 5. Abdominal/ascetic tap 6. Lumbar puncture 7. Vaginal examination 8. Ear, nose and throat examination 9. Rectal examination 10. Venous cut down

Despite the differences in health care needs of populations in the three settings indicated in table 1.1, similar clinical skills have been identified as essentials for graduating medical

students. Intravenous cannula insertion for example is included among the three specifications, while Lumbar Puncture, urethral catheterization or insertion of Foley's catheter, nasogastric tube insertion/intubation, simple wound suturing or suturing lacerations, protoscopy or rectal examination and phlebotomy appear in at least two of the specifications.

In a traditional curriculum, as was the case for more than 40 years at the University of Zambia (UNZA) School of Medicine from 1966 to 2011, medical students are expected to acquire competence in specified clinical practical procedures through the apprenticeship model using the Halstedian approach of "see one, do one, teach one" (McGaghie, et al. 2011) as they rotated through clinical clerkships of medical and surgical disciplines. Using this model, the apprentice learns from the master 'duties' of a doctor' by observing and helping him/her treat patients (Dornan, 2005). This model requires a willing teacher and a receptive learner (Jaschinski and De Villiers, 2008).

In literature, it is contentious whether or not students are actually competent in essential skills at the time of graduation. A mismatch has been observed in terms of skills students are expected to learn in a particular clerkship compared to what they actually get to learn (Bax and Godfrey, 1997; Hayden and Panacek, 1999; Goodfellow, 2001; Neilsen, et al. 2003; Wu, et al. 2008). Scholars, for example Moercke and Eika (2002) demonstrated the gap between the intended and learned curriculum in their study of clinical skills level of newly graduated doctors. Their study revealed that a substantial number of newly graduated doctors had not mastered (not done procedures correctly on their own) common and essential procedures: securing patient airway (22%), applying oxygen mask (26%), Cardio Pulmonary

Resuscitation (CPR)(37%), suctioning the nose and throat (42%), bladder catheterization (36%), intramuscular injection (34%), examining the new born (21%) and simple wound suturing (15%). Sadly, a good proportion of newly graduated physicians had never even tried certain essential procedures: 15% never tried setting up an IV drip, 25% never tried intramuscular injection, 44% never tried endotreacheal suctioning, 40% never tried endotreacheal intubation, 43% never tried defibrillation, 57% never tried normal vaginal delivery and 68% never tried to clear newborn's airway.

The findings of Moercke and Eika (2002) are consistent with those of earlier and recent studies (Bax and Godfey, 1997; Panacek and Hayden, 1999; Goodfellow and Claydon, 2001; Neilsen, et al. 2003; Wu, et al. 2008). For example Neilsen, et al. (2003) indicated that 99% of students had to work hard and be active in order to get access to practice skills in a clinical setting, but only 36% had the chance to practice to the extent they wanted. In that particular study, all students tried out eight skills out of the expected 22 and that the number of skills practiced varied with the nature of skill, hospital and gender of student, with females finding it more difficult to get opportunities to practice. Therefore, a student may go through training without any opportunity to practice certain lifesaving skills which are essential for clinical practice upon graduation. Such findings must concern educators who are responsible for teaching clinical skills to undergraduate medical students.

The curriculum in place at the time of the study (UNZA School of Medicine -2010 Senate approved) listed 38 goals and 15 outcomes to be achieved from the goals. Development of

that curriculum followed the school's self- evaluation against the World Federation of Medical Education (WFME) International Basic Medical Education Standards (IBMES). It was also in response to a global paradigm shift from traditional towards Competence Based Education (CBE) (Wass, et al. 2001; Carr, 2004; Lai, Sivalingam and Ramesh, 2007; Duvivier, et al. 2011).

Eight out of the 15 outcomes of the School of Medicine curriculum at the time of the study were competence based, however this study focused on outcome number two which is competence in clinical practical procedures.

1. Competence in clinical skills
2. **Competence in clinical practical procedures**
3. Competence in investigating a patient
4. Competence in patient management
5. Competence in health promotion and disease prevention
6. Competence in communication
7. Competence in handling and retrieval of information using IT technology
8. Competence in scholarship and lifelong learning (UNZA- School of Medicine, 2010).

The earlier curriculum did not specify the competences that were expected of students even though clinical departments guided students and teachers of what was expected. Nonetheless, literature has alerted us that a discrepancy between what is expected and what is attained might exist (Bax and Godfrey, 1997; Hayden and Panacek, 1999; Goodfellow, 2001; Neilsen,

et al. 2003; Wu, et al. 2008). The focus of our study was therefore curriculum outcomes concerning competence in clinical practical procedures among students who had undergone the traditional curriculum at the University of Zambia-School of Medicine.

1.2 Problem Statement

Curricular of many medical schools state the clinical practical skills that students should learn by the time they graduate and yet many students graduate without learning these, mostly common and some potentially lifesaving, skills to the detriment of the quality of care for patients (Moercke and Eika, 2002; Engum, 2003; Neilsen, 2003; Colberly and Godenhar, 2006; Elango, et al. 2007; Wu, et al, 2008; Promes, et al. 2009 and Institute for Health Care Improvement 2010). Such a situation constitutes a problem for patients, medical students, junior doctors and the medical profession. At the University Of Zambia School Of Medicine this worrisome phenomenon had not been studied prior to our study. Our study therefore aimed at investigating how UNZA medical students acquire competence in clinical practical skills, their knowledge level on selected set of skills, and their self-perceived competence as compared to manifest comptence. Determination of the competency level of trainees at or near the point of graduation is critical as acquired competences are a central indicator of the quality of the curriculum (Barbosa, et al. 2011).

In medical education literature, it has been demonstrated that discrepancies exists between what students learn and what is expected of them (Goodfellow, 2001; Neilsen, et al. 2003, Colberly and Goldenhar, 2006; Wu, et al. 2008; Promes, et al. 2009). For example, Colberly and Goldenhar (2006) indicated that out of the six recommended basic procedures: arterial

puncture, insertion of nasogastric tube, phlebotomy, intravenous catheter insertion, lumbar puncture and Foley catheter insertion, vast majority of Fourth-Year Students reported not performing four (phlebotomy, intravenous catheter insertion, lumbar puncture and Foley catheter insertion) during their acting intern rotation at Cincinnati University -United States of America (USA). Similarly Wu, et al. (2008) in a study of procedural and interpretative skills of medical students, indicated that one fifth of fourth year students had not performed basic procedures such a phlebotomy or peripheral intravenous catheter insertion. Furthermore, 40% of fourth year students reported having not performed important procedures such as paracentesis and lumbar puncture. In other words there seems to be a mismatch between the 'intended' and 'learned curriculum'.

Discrepancies between what students learn and what is expected of them has resulted in lack of competency in certain clinical practical procedures. Lack of competence in essential practical procedures has negative impact on patients, medical students, junior doctors and the medical profession (Taylor, 1997; Hayden and Panacek, 1999; Liddell, et al, 2002; Rolfe and Sanson-Fisheer, 2000; Sicaja, Romic and Prka, 2006; Lai, Sivalingam; Ramesh, 2007; Institute of Health Care Improvement, 2010). For the patient, incorrect or delayed performance of certain procedures due to lack of competence by attending clinician can lead to disabilities with prolonged hospital stays and increase in health care costs and even death especially for acutely ill patients. According to the Institute for Health Care Improvement (2010), survival of acutely ill patients for example depends on care that is reliable, timely and error-free, and in the hospital setting, the first responders to such patients are often junior doctors. For a setting such as Zambia where the doctor patient ratio is high the junior doctor

may be the only one to attend to the acutely ill patient. If the attending doctor is not competent in necessary clinical procedures it puts the patients' lives in danger.

Apart from negative effects on patient care, for many junior doctors lack of competency in clinical skills is a significant source of stress as it provokes feelings of inadequacy and dissatisfaction with level of competence in functioning independently (Taylor, 1997; Liddell, et al. 2002; Rolfe and Sanson-Fisher, 2002; Tallentire, et al. 2011). For the medical profession, lack of proficiency in clinical skills could result in loss of public confidence. Conversely, competence in procedural skills ultimately benefits patients and leaves the doctor with a sense of self-worth and accomplishment (Jaschinski and De Villiers, 2008).Therefore, findings of our study could inform educational efforts aimed at ensuring that students acquire competence in requisite clinical practical procedures.

1.3 Significance of the Study

This study is significant in the area of undergraduate clinical medical education. As indicated in the problem statement, where clinical competences of graduating medical students have been investigated, discrepancies or gaps have been identified between what students learn and what is expected of them (Goodfellow, 2001; Neilsen, et al. 2003, Colberly and Goldenhar, 2006; Wu, et al. 2008; Promes, et al. 2009). These gaps have occurred despite medical councils, associations or individual medical schools' efforts in developing lists of clinical skills regarded as essential in which all students have to demonstrate competence by the time they qualify (Moercke and Eika, 2002; Engum, 2003; Coberly and Godenhar, 2006; Elango, et al. 2007; Wu, et al. 2008; Promes, et al. 2009). Similarly, investigating the clinical

competency of medical students at UNZA School of Medicine lead to identification of gaps between what students learnt in comparison to was expected of them.

Following identification of gaps, recommendations were made to educators of undergraduate medical students to promote structured teaching/learning, include alternative teaching/learning avenues in addition to bed side such as the use of simulation laboratories in order enhance competency acquisition and development, and inclusion of adequate numbers of procedural skills stations in the OSCEs. Results of our study also served as a bench mark for comparison with future studies that may seek to explore clinical competence of graduating medical students. In addition this study had both a conceptual and methodological significance; it was underpinned by three conceptual models (figure 2.3), and the qualitative arm applies Grounded Theory. Grounded Theory is a qualitative enquiry method that makes it possible to systematically generate a theory from data of social research (Glaser, 2005; Tavarol, Torabi and Zeinaloo, 2006). Through the use of Grounded Theory, theoretical constructs emerged on how medical students of the University of Zambia acquired competency in clinical practical procedures and a model of clinical procedural skills acquisition and competence development (figure 4.7) was generated thus contributing to the existing body of knowledge.

1.4 Delimitation of the Study

The focus of this study was acquisition, self-perception and manifest competence of final year students of the UNZA-School of Medicine in selected core-clinical practical procedures of the undergraduate medical curriculum. The core-clinical and practical procedures in this case

being: IV cannula insertion, nasogastric tube insertion, gastric lavage, urethral catheterization, CPR, endotreacheal intubation, wound suturing, vaginal examination, examination of the placenta and lumbar puncture. The list was an amalgamation of essential procedures for undergraduate medical students by the United Kingdom General Medical Council (Goodfellow and Claydon, 2001), AAMC Medical Schools Objective Project of 1996 (AAMC, 2008) and commonly encountered procedures at the Zambia's University Teaching Hospital as identified by Banda, 2004. The investigator also observed that in the Zambian health care system, normal vaginal delivery, examination of the newborn, intramuscular and intravenous drug administration were essential as such they were included.

In addition to investigating acquisition, self-perception and manifest competency in practical procedures, knowledge of clinical practical procedures was measured and correlated to manifest and self-perceived competency, and number of times practical procedures were performed through which associations were established.

1.5 Research Questions

1.5.1 How do Undergraduate Medical Students of the University Of Zambia acquire competency in clinical practical procedures during clinical years?

1.5.2 What is the clinical practical procedures knowledge level of Final Year Medical Students of the University of Zambia in the last six months of the undergraduate medical education?

1.5.3 How does self-perception of competence compare with manifest-competence in selected clinical practical procedures among University of Zambia Final Year Medical Students in the last six months of training?

1.6 Research Hypotheses

There is no association between the following factors:

1.6.1 Self-perceived competence and manifest competence of Final Year Medical Students of the University of Zambia in core-clinical practical procedures of the undergraduate curriculum.

1.6.2 Self-perceived competence and knowledge of core-clinical practical procedures of Final Year Medical Students of the University of Zambia

1.6.3 Self-perceived competence of Final Year Medical Students of the University of Zambia in core-clinical practical procedures and the number of times a procedure is performed

1.6.4 Manifest-competence and knowledge of core-clinical practical procedures of Final Year Medical Students of the University of Zambia.

1.7 Research Objectives

1.7.1 General Objective

To determine how Undergraduate Medical Students trained under the University Of Zambia School Of Medicine curriculum acquire competency in clinical practical procedures during clinical clerkships, and their level of competency at the time of graduation.

1.7.2 Specific Objectives

1.7.2.1 To explore how Undergraduate Medical Students trained under the University Of Zambia School Of Medicine curriculum acquire competence in clinical practical procedures during clinical clerkships

1.7.2.2 To determine the clinical practical procedures knowledge level of Final Year Medical Students of the University of Zambia

1.7.2.3 To determine and compare the self-perception and manifest- competence of Final Year Medical Students of the University of Zambia in core-clinical practical procedures of the undergraduate curriculum.

1.8 Study Variables

1.8.1 Dependent variables

1.8.1.1 Acquisition of competence in core-clinical practical procedures

1.8.1.2 Self-perceived competence in core-clinical and practical procedure

1.8.1.3 Manifest-competence in core-clinical practical procedures

1.8.2 Independent variables

1.8.2.1 Clinical practical procedures knowledge level

1.8.2.2 Clinical teaching methods

1.8.2.3 Clinical assessment methods

1.8.2.4 Number of times a clinical practical procedure is performed

Out of the four independent variables; clinical practical procedures knowledge level and number of times practical procedures were performed were measured quantitatively and

correlated with both self-perceived and manifest-competence to establish possible associations. As stated under delimitation of the study, the other two variables; clinical teaching methods and clinical assessment methods were not measured quantitatively. Qualitative information on the two variables was, however, obtained during the in-depth interviews when students described how they learnt different practical procedures and how they were assessed on the learnt procedures. In addition, the influence of clinical teaching and assessment methods on acquisition of competency in clinical procedures is discussed under literature review.

1.8.3 Conceptual Definition of Study Variables

1.8.3.1 Acquisition of competence in selected core-clinical practical procedure: "Gradual transition from rigid adherence to rules in performing a task to an intuitive mode of reasoning that relies heavily on deep tacit understanding" (Dreyfus and Dreyfus, 1990).

1.8.3.2 Self-perceived competence: Reported Self-efficacy in performing a task (Bandura 1997).

1.8.3.3 Manifest-competence: The observed behaviour or practice (Wimmer, 2006).

1.8.3.4 Knowledge of clinical and practical procedures: "Remembering of previously learnt facts" (Bloom, 1956) about clinical practical procedures.

1.9 Justification for the Study

With public expectation of competent doctors and a general global discourse around accountability among professionals, no one can be assumed to be competent, clinical competence has to be proven by testing, measurement and recording using authentic methods (Wass, et al. 2001; Carr, 2003; Lai, Sivalingam and Ramesh, 2007; Duvivier, et al. 2011; Tallentire, 2011). For undergraduate medical students trained under the University of Zambia, the matter of competence in clinical practical procedures had not been investigated prior to our study as no studies on the subject were found in our review of the literature on Pubmed, Google Scholar, African Journal on line and Index Medicus.

Our study therefore investigated how UNZA medical students acquired competence in clinical practical skills; their knowledge level on selected set of skills; and their self-perception of competence as compared to manifest competence in the last six months of training. Findings of this study revealed how undergraduate students acquired clinical competence and their level of competency at the time of graduation. The study further revealed practical skills students were less competent in performing at a level safe for practice as interns. Determination of the competency level of trainees at or near the point of graduation is critical as acquired competencies are a central indicator of the quality of a curriculum (Barbosa, et al. 2011). In addition, assessing the acquisition, manifest and self-perceived competency of medical students of the University of Zambia gave indication of the effectiveness of clinical teaching and assessment methods.

1.10 Key Findings and Implications for Theory and Practice.

1.10.1 Acquisition of competence in clinical practical procedures

Medical students at UNZA acquire and develop competence in clinical practical procedures through four developmental stages: passive observation to guided performance to unguided performance and finally peer teaching (figure 4.7).

1.10.2 Knowledge of clinical practical procedures

The knowledge levels of clinical practical procedures of final year medical students were found to be inadequate represented by a 39% pass rate on a 48-item MCQ test. The Angoff determined pass mark was 60%, Mean Score was 53.38, Standard Deviation 10.44 and Range 50. Most scores were skewed to the left or below average (Skewness of -124). The mean score of 53.38% was low considering that the students were in their last six months of the undergraduate medical education and were expected to possess adequate cognitive traits of common core clinical practical procedures. When the student pass rates for each question were compared to Expert (Angoff) determined pass rates, the Angoff pass marks were high on most questions compared to actual student scores (Table 4.5). This entails that teachers expected their students to know more than what actually students knew.

1.10.3 Self-perceived versus Manifest Competence

With Self-perception of competence, two thirds 36 (66.7%) of the participants perceived themselves as moderately competent in performing the 14 selected clinical practical procedures, 15 (27.8%) rated themselves as highly competent while 3 (5.6%) had low self-perception. On individual procedures, significant numbers of students reported low-self-perception in performing three out of the 14 selected procedures: 60.7% for CPR, 58.9 for gastric lavage and 50% for endotracheal intubation (Table 4.7). The low self-perception was

associated with low experience with the same procedures (Table 4.10). Regarding Manifest competence, all students passed the Objective Clinical Practical Examination (OSCE) using the school pass mark of 50% (Table 4.14). The Mean score was 65.6%, Standard Deviation, 7.85, Range, 35 and Skewness .242. The results were positively skewed. Following re-categorization in terms of levels of manifest competency, the majority of students 52 (92.8%) were barely competent while 4 (7.2%) were absolutely competent (Figure 4.6).

When self-perception was compared to manifest competence, there was negative correlation between self-perception (moderately competent for most respondents) and manifest competence (barely competent for most respondents) overall on seven practical stations of the OSCE (Spearman rho -.123), and on two out of the three specific individual procedures included in both the self-perception of competence questionnaire and the OSCE (Table 4.19 and 4.17). The correlations (Spearman rho) between self-perceived and manifest competence for the three procedures included in the OSCE were: cardiopulmonary resuscitation (-.150); intravenous drug administration (-.521, P) and nasogastric tube insertion (.128, P value 0.346).

The identified areas of inadequacy involve the following: low knowledge levels on clinical practical skills, low self-perception and low experience with lifesaving skills such as CPR and endotracheal intubation among others. These findings warrant emphasis by educators to increase students' learning, practice and feedback and array of clinical practical procedures assessed during OSCE. The finds may also warrant curricula review to pave way fro for inclusion of innovative teaching methods that enhance competence acquisition and development.

1.11 Outline of the Thesis

This Thesis is organized into six main chapters. Chapter one is the introduction, two is literature review, three methodology, four results of the study, five discussion of findings and six conclusion and implications. Each chapter is divided into a number of sections outlining or discussing a concept that builds up to that specific chapter. For the purposes of this thesis, the term 'our study' is used in reference to all the work undertaken upon which the thesis is based, including the outcomes, conclusions and limitations.

Chapter one sets out to provide the background to what clinical competence is with a focus on it being an attribute expected of every practicing doctor. The chapter also provides a comparison of essential skills that medical students must possess by the end of their undergraduate medical education, from the United Kingdom, United States of America and the Zambian perspectives. The chapter also presents the problem statement which points out the contentious debate as to whether or not medical students are competent in essential skills at the end of the undergraduate training based on discrepancies that have been recorded in the past between what students are expected to learn and what they actually learn. Since the thesis was a product of a mixed methods study, both research questions and hypotheses are outlined in chapter one. The research questions covers both the quantitative and qualitative components of the study while hypothesizes are stated for the purposes of the quantitative component. With regard to language, the term 'our' is used in this thesis in reference to the study upon which the thesis was based.

The second chapter presents the literature that was reviewed upon which the research questions were constructed and methodology built. The chapter begins with an overview of acquisition of psychomotor skills as expounded by Kopta (1971) and Peyton (1998). The concept of Cognitive Task Analysis (CTA) as it relates to teaching of psychomotor skills is also addressed. The chapter also discusses the role of conceptual knowledge (knowledge component of competence) in psychomotor skills acquisition and development and other factors that influence competence acquisition and development: curricular, teaching and learning and procedural related. Supersedes

Chapter two further outlines the meaning and dimensions of clinical competence with an emphasis on it being multidimensional to include cognitive, psychomotor and affective attributes, with a delimitation of the focus of our study which was competence in the psychomotor dimension. Additionally, the chapter presents a comparison of self-perceived and manifest competence, with the reviewed literature indicating that manifest competence among medical students has not been assessed as extensive as self-perceived, and where the two have been compared, most studies have reported varying degrees of agreement between the two facets of competence. Chapter two ends with a presentation of the conceptual framework that underpinned our study. The conceptual framework included three models: A= Dave's 1970 Levels of Psychomotor Domain B= Dreyfus and Dreyfus (1986) model of clinical skill acquisition and C= Miller's (1990) model of clinical competence (figure 2.3).

The third chapter outlines the methodology that was used to answer the research questions. The chapter sets out by providing a summary of study variables and their conceptual and operational definitions in table 3.1. This chapter also provides a brief description of the research paradigm within which the present study is located, which is mixed method, followed by the presentation of the design for the study which was non-interventional cross sectional correlation study using the concurrent transformative with concurrent embedded mixed method strategy. The study site, population, sample and sampling techniques are then outlined. Subsequently, data collection and analysis is presented starting with knowledge of clinical practical procedures, self-perception of competence, manifest competence and learning, and development of competency in clinical practical Procedures. Finally an outline of how threats to validity and reliability were dealt with is presented.

Chapter four sets out with a brief introduction outlining the research questions which were investigated and the hypotheses tested, followed by a summary of key-research findings on acquisition and development of clinical competence, knowledge on clinical practical procedures, and manifest versus self-perceived competence. The summary is followed by a detailed presentation of results on the demographic characteristics and clinical medical education context, knowledge of clinical practical procedures, self-perceived competence and manifest competence. In addition, results from the Think Aloud-Protocols are presented in form of mini-themes representing the different thoughts and emotional feelings students held during the time they were performing different procedural skills during the final OSCE. Findings of the qualitative component of our

study are then presented expounding how students learn and develop competence in clinical practical procedures. Alongside the presentation of the qualitative findings, a models of "Passive Observation to Peer Teaching of Clinical Procedural Skills Acquisition and Competence Development" that emerged as a result of Grounded Theory approach is also presented.

Chapter five is the discussion with nine subsections. The first section is an introduction which is followed by the discussion of the demographic characteristics of the study sample in the second section. In the third, fourth and fifth section, findings on the knowledge of clinical practical procedures, self-perception of competence, self-rated experience with the 14 clinical practical procedures are discussed. The sixth and seventh section presents the discussion on the findings of manifest competence and Think Aloud Process respectively. The eighth section discussion the qualitative findings regarding how medical students learn clinical practical procedures, and how they develop competency. The eighth section also discusses additional information on clinical medical education from the qualitative perspective. Additional information relates to the settings where practical skills were learnt, teachers of practical skills, and the commonly used methods for assessing competency in practical skills. The ninth and final sub-section discussed the contribution of the study to the existing body of knowledge.

Chapter Six, is the final chapter for the Thesis. It outlines the conclusions, implications and limitations of the study. The implications are mainly in the areas of teaching and

assessment of clinical practical procedures. They include use of structured teaching, use of alternative teaching avenues like simulation laboratories as adjunct to and not a replacement of bedside teaching, and inclusion of more practical stations in the OSCEs. Use of alternative teaching avenues is seen as panacea to limited student exposure to lifesaving skills.

2.0 CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter comprises six main sections, with each addressing or critiquing accessible scholarly literature that was critical to the conduct of our study. The first section is an introduction of what is contained in the chapter. The subsequent three sections from two to four are focusing on the three specific research objectives broadly headed as; acquisition of competence in clinical practical procedures, Knowledge of clinical practical procedures, and manifest versus self-perceived competence. The specific objectives in our study were closely aligned to the research questions as such objectives instead of research questions were used to organize the literature review chapter. The fifth section presents literature on assessment of clinical competence while the sixth outlines the conceptual framework underpinning the study. Each of the main sections is further divided into a number of sub-sections each focusing on a concept related to a particular specific objective.

As defined by LoBiondo-Wood and Haber (2006), scholarly literature refers to published and unpublished data based (research) reports as well as conceptual (theoretical) literature. Literature presented in this chapter is therefore mainly from medical education journals, books and/or book chapters, documents from medical boards and associations as well as unpublished data-based print and computer-accessible materials such as doctoral theses and conference presentations accessed from Google Scholar, Pub Med, African Journal Online and British National Index.

The overall aim of the review was to develop a strong knowledge base of acquisition of, self-perceived and manifest-competence in clinical practical procedures among undergraduate medical students as a means to support the conduct of the study. The review was also aimed at

determining what was known about the concept of "competency in clinical practical skills" in undergraduate medical education and to determine the gaps, consistencies, inconsistencies about the concept in the literature. It also aided in determining appropriate research methodologies for answering the research questions based on previous studies.

2.2 Acquisition of Competence in Clinical Practical Procedures/Skills

2.2.1 Overview of Skills Learning in Medical Education

Not until two decades ago, medical education curricula were designed according to Flexner's 2-stage model with a sharp division between pre-clinical and clinical medical education (Wimmers, Schmidt and Splinter, 2006). In pre-clinical years, the education was predominantly theoretical; students learnt basic medical sciences such as anatomy, biochemistry, physiology and pathology. The following years were centered on clinical education organized through clerkships with Halstedian approach of "See one, do one, and teach one" characterizing the teaching and learning of clinical skills. In the past two decades, from the 1990s to the 2000s, there have been calls to integrate basic biomedical and clinical sciences and to promote early clinical exposure (World Federation of Medical Education (WFME) 2003 and AAMC, 2008).

Traditionally, clinical teaching occurred in hospital wards, General Practitioner (GP) surgeries, outpatient settings and operating theatres (Bligh, 2002; Ahmed, 2008). Bedside teaching has long been considered the most effective method to teach clinical skills and has numerous other benefits such as promoting ethics, humanism and professionalism, communication skills and role modeling. However, bedside teaching is increasingly

becoming difficult to use due to several factors such as short hospital stays, increased service demand (workload) for clinicians, diminishing pool of clinical teachers versus increasing numbers of students, perceived inadequate preparation of students for clinical practice, increasing awareness by patients regarding their rights thus their consent to be used as part of medical education is no longer to be taken for granted (Monnickendam, et al. 2001, Ahmed, 2002, Ahmed, and 2008).

Based on the above factors, hospital based bed-side teaching is no longer able to provide sufficient skills experience for medical and other health care students. Thus, traditional bedside teaching based on the apprenticeship model of education alone can no longer be relied on to provide comprehensive training in clinical skills. This situation has led medical educators to think of alternative options to ensure adequate skill acquisition by medical students. Among such options, is the introduction of clinical skills centers, laboratories and more recently simulation centers with high-fidelity simulation to promote without necessarily replacing bedside teaching (Ahmed, 2008). A Clinical Skills Laboratory (CSL) is "a facility in which students and qualified staff learn clinical, communication, and information technology skills to a specified level of competence prior to, or coordinated with, direct patient contact" (Rees and Jolly 1998, and Al-Yousuf, 2005).

In a CSL, learning of skills takes place mainly through simulations. Simulation is an instructional process that substitutes real patient encounters with artificial models, live actors or virtual reality patients (Guba, 2004). In clinical education, simulation has been

shown to provide exceptional opportunities for safe practice and effective learning. It allows for learning and practicing of technical skills in a safe and controlled environment without posing danger to patient's well-being, which is critical in an era of increasing awareness of medical errors and concern for patient safety (Ogden et al, 2007; Barsuk, et al. 2009, Millington, et al. 2009; Institute of Medicine, 1999 and Stelfox, et al. 2006 cited in Shanks, et al. 2010). As opposed to a student having first attempt of a procedure on a living patient during a clerkship, Simulation allows trainees to perform their first attempt on a living patient at a level closer to competence (Lammers, et al. 2008)

When compared to traditional methods of medical training, simulation offers several potential advantages in both skills training and assessments (Shanks, et al. 2010). It removes issues of patient safety, instructor distraction, and unpredictability (Chapman, et al. 1996 cited in Lammers, et al. 2008). Simulation environment encourages learning through experimentation and trial and error with the ability to rewind, rehearse and practice without negative patient outcomes, which is critical in dealing with the issue of patient safety. Simulation also allows reproduction of important clinical scenarios that may be rarely encountered in real life. However it is important to note that clinical skills centers are aimed at improving and maintaining clinical skills and not to replace bedside teaching. Simulation should therefore augment, and not replace, real clinical practice, and one must be careful to reinforce this message in any clinical skills teaching programme. It is acknowledged that bedside teaching still remain essential for observing or demonstration of physical examination, medical interviewing and interpersonal skills (Ahmed, 2008).

For UNZA, School of Medicine, bedside teaching during clerkships was the main approach through which medical students acquired clinical skills for more than 40 years until 2012 when a clinical skills center was established. Wholly relying on bedside teaching without any alternative to skills learning prevailed and as such, our study sought to investigate how students within such a setting acquired competence in clinical procedures and their level of competency towards the end of training.

2.2.2 Acquisition of Psychomotor Skills

Kopta, (1971) cited in Hamdorf and Hall, (2000) outlined three phases in acquisition of motor skills: cognition, integration and automation. Cognition involves an understanding of a task; individuals who are provided with clear description and demonstration of a task are more likely to master a skill than those who are not. In the second stage (integration), motor skills unique to the task are applied to avoid inefficient movement. In the final stage (automation) the skill becomes automatic so that there is no need to think about each step or rely on external cues. During the cognition stage the most essential factor for learning is perceptual awareness, while during integration, the learner should comprehend the mechanical principles underlying the skill. Later during automation the motor abilities involve speed, efficiency and precision.

Table 2.1: Stages in acquisition of motor skills by Kopta, 1971

Phase	Psychomotor element	Focus of instruction
1	Cognition	Perceptual awareness

2	Integration	Comprehension of mechanical principles
3	Automation	Speed efficiency and precision

Source: Hamdorf and Hall, 2000

For our study, psychomotor learning was described using Dave's 1970 taxonomy of psychomotor domain. As indicated in the conceptual framework (figure 2.3), Dave, 1970 outlined five levels through which an individual learning a psychomotor skill progresses: imitation, manipulation, precision, articulation and naturalization (Amin and Hoon-Eng 2003; Chapman, 2006). Although Dave and Kopta's models differ with regard to the number of stages in acquiring a psychomotor skill, the underlying principles are similar. For example, Kopta's cognition stage which is characterized by perceptual awareness can be likened to Dave's imitation level. Imitation is the observed behavior underlying which are cognitive processes such as perceptual awareness or insight of the skill through observation that consequently enables a learner to imitate the teacher.

Kopta' second stage of integration (comprehension of mechanical principles) can be related to the manipulation level which according to Dave's taxonomy is characterized by performing skill from instruction. Similarly, performing a skill is observable behavior that stems from comprehension of principles underlying the performance. Finally Kopta's ultimate stage of automation (Speed efficiency and precision) can be explained by the last three levels of Dave's taxonomy (precision, articulation and naturalization). According to Dave, 1970, the three levels are progressive beginning with the ability to perform skill in limited context to

performing skill in any context with style, and ending with mastery level of performance which according to Allery, (n.d) is the level of "unconscious competence".

While there are three or five stages in learning a psychomotor skill, there are four distinct phases in teaching one (Peyton, 1998) and five stages in developing competence in performing one (Dreyfus and Dreyfus 1980). Stages of competency development are provided for in the conceptual framework diagram and narration in figure 2.3 and section 2.6.3 respectively. Peyton (1998), a general surgeon, describes an excellent and widely advocated model for teaching skills in simulated and other settings, known as the 'four-stage approach'. Peyton (1998) outlined four distinct phases in teaching a psychomotor skill, which are demonstration, deconstruction, formulation and performance as indicated in table 2.2. Peyton's final stage of performance (student demonstration accompanied with description of each step prior to performance) allows the observer (teacher) to understand at least in part the thought processes of a student while attempting to complete a task. The talking or description of different steps while performing a skill that characterizes Peyton's fourth stage of teaching a manual skill allows the teacher to understand in part the cognitive processes that may influence skill performance. The talking or verbalization of each step while performing a procedure can be equated to the concept of "Think Aloud".

Think Aloud data, also known as talk-aloud data, is that which is collected by listening and recording the participant's verbalization of thought while completing a task (concurrent Think Aloud) or immediately after completing the task (retrospective Think Aloud) (Ericsson and Simon, 1993; Young, 2005). Allowing participants to verbalize thoughts while undertaking a

task allows a researcher to access information that is held in the participant's short term memory. Retrospective Think Aloud data in our study were collected following the OSCE. Think Aloud Protocols in our study were used to understand in part the cognitive processes that may underlie performance in OSCE. Although Think Aloud data does not provide complete insight into the human mind (Wilson, 1994), it certainly in part helps to account for the cognitive processes underlying the psychomotor activity.

Table 2.2: Stages in teaching a manual skill

Phase	Task	Action
1	Demonstration	Instructor demonstrates the skill at normal speed with little or no explanation
2	Deconstruction	Instructor demonstrates the skill by breaking it down into simple steps with full explanation and encouraging learners to ask questions
3	Formulation	Instructor demonstrates the skill while being 'talked through' by the student' may need to be repeated multiple times
4	Performance	Student performs the skill under supervision, describing each step before performing it.

Source: Peyton 1998

In "traditionally oriented" medical schools, clinical skills are usually learnt by watching what clinicians do, by interviewing and examining patients and presenting findings to a supervisor (Sanson-Fisher, et al. 2002; Sicaja, Romic and Prka, 2006). Studies in teaching and learning in clinical setting have found that clinical teaching is variable, unpredictable, immediate and lacks continuity (Lawson and Bearman, 2007). Furthermore, literature has alerted us that individuals who are provided with clear description and demonstration of a task are more likely to master a skill than those who are not (Hamdorf and Hall, 2000). In an environment where teaching is unpredictable and lacks continuity, it is difficult to deduce whether or not

the four distinct phases in teaching clinical skills are followed, thus the purpose of this study was to investigate how students in the School of Medicine acquired competence in selected clinical practical skills.

Comparable to the concept of deconstruction (breaking down skill into simple steps) by Peyton (1998) are the concepts of Task Analysis (TA) and Cognitive Task Analysis (CTA). Task Analysis entails breaking down a complex task into its smaller steps or components where tasks with many steps or components may be divided into phases for teaching purposes (Alberto and Troutman, 2003). It is viewed as a decomposition of a complex task into a set of constituent subtasks. On the other hand Cognitive Task Analysis is the extension of traditional task analysis techniques to yield information about the knowledge, thought processes and goal structures that underlie observable task performance. It captures information about both overt observable behaviour and the covert cognitive functions behind performance in order to form an integrated whole (Chipman, Schraagen, and Shalin, 2000). It is an innovative method to teaching skills that has been used successfully in both nonmedical and health care fields (Velmahos et al, 2004). In the medical field for example, the principles of CTA were applied to teach surgical interns how to perform central venous catheterization and was reported to have improved the knowledge and technical skills of new surgical interns on the task (Velmahos et al. 2004).

CTA uses a variety of interview and observational strategies to capture a description of the knowledge that experts use to perform complex Tasks (Cooke, 1994). Complex tasks are

defined as those where performance requires the integrated use of both controlled (conscious, conceptual) and automated (unconscious, procedural or strategic) knowledge to perform tasks (van Merriënboer, Clark, and de Croock, 2002). CTA captures accurate and complete descriptions of cognitive processes, performance objectives, equipment, conceptual knowledge, procedural knowledge and performance standards used by experts as they perform a task. The descriptions are used to inform novices of different ways that can help them achieve performance in any context (Chipman, Schraagen, and Shalin, 2000).

Task Analysis guides trainers in selecting precisely what to teach, deciding the standard to which a skill should be taught, the teaching sequence as well as anticipating trainee's questions. TA has been identified as one solution to the problem that 'unconscious competent clinician' face in teaching novices, as it helps Trainer (experts) to break down the skill into manageable stages and to identify the essential maneuvers required to achieve proficiency. It has been recorded that for many clinicians who are routinely performing complex clinical procedures it is often a challenge to move into the role of a trainer. As trainers, experts are required to move away from 'auto-pilot mode- unconscious competence' which is often adopted for routine day to day practice to an explicit awareness (conscious competence) of precise stages and elements of a skill that are required for a competent execution of a skill. To this end TA (decomposition of a complex task into smaller components) can help experts to be effective teachers on one hand and trainees to precisely learn different components of a task on the other hand. As already alluded to, individuals who are provided with clear description and demonstration of a task are more likely to master a skill than those who are

not (Hamdorf and Hall, (2000). Therefore decomposition of a complex task can enhance trainees' learning of that particular task.

The main steps in undertaking a task analysis include: Establishing broad components of the skill, dividing the components into procedural steps first and then into sub-steps, anticipating difficulties that a novice trainee may encounter at any step in the process, and considering a variety of different circumstances and how performance of the skill might differ in these different situations (Allery,n.d).TA therefore provides a basis upon which to assess the trainee's performance and provide feedback as different components of a task can be isolated, evaluated individually and specific feedback provided accordingly.

2.3 Knowledge of Clinical Practical Procedural Skills

The role of conceptual knowledge in psychomotor skills is documented in literature (Kopta, 1971, Hamdorf and Hall, 2000; Amin and Hoon-Eng 2003 and Buckley, Manalo, and Lapitan, 2011). As asserted by Hamdorf and Hall (2000) individuals who are provided with clear description in addition to clear demonstration of a task are more likely to master a skill than those who are not. Description which is more cognitive involves explanation of what the procedure is, when it is indicated or contraindicated, where it is performed (anatomical structures involved), and guiding principles, while demonstration involves actual performance or process of undertaking the procedure. Similarly, Lake and Hamdorf, 2004 affirmed that demonstrating a skills require more than performing, instead it includes: Knowledge (indications, contraindications, complications and their prevention); skill (preparation,

technique, dexterity); and communication (consent, comfort and dignity of patients and realizing when to get help). It is on the basis of such documented relationships between conceptual knowledge and skill performance that the second specific objective of our study was to determine the clinical practical procedures knowledge level of final year medical students of the University of Zambia and compared it with both their self-perceived and manifest-competence.

In a study conducted by Buckley, Manalo, and Lapitan (2011) at the University of the Philippines, Manila to assess the knowledge and practices of medical interns relating to urethral catheterization and iatrogenic urethral injury secondary to traumatic catheter insertion, findings were that slightly more than half (55.6%) of the respondents stated that they had adequate theoretical training and (66.7%) adequate practical training. Despite relatively high levels of experience, deficits were identified in detailed knowledge of correct catheterization procedures and of risks associated with urethral injury. Those not trained by demonstration and re-demonstration methods were less likely to lubricate the urethra in line with widely accepted good practice. Compared with those who reported adequate theoretical training, those who reported minimal or no theoretical training were less likely to take a history an aspect considered critical in identifying risk factors for urethral strictures. One limitation of the Buckley, Manalo, and Lapitan (2011) study was that a survey questionnaire was used to assess acquired competence. From a skills training methodology point of view, direct observation is a better method than a questionnaire survey. Despite the methodological limitation, to some extent findings of this study demonstrated the importance of cognitive knowledge in clinical skills performance.

The role of cognition in skill performance is also demonstrated by Miller (1990) in the Pyramid of clinical competence. The pyramid conceptualizes the essential facets of clinical competence. It illustrates four levels of demonstrated learning as shown in figure 2.1

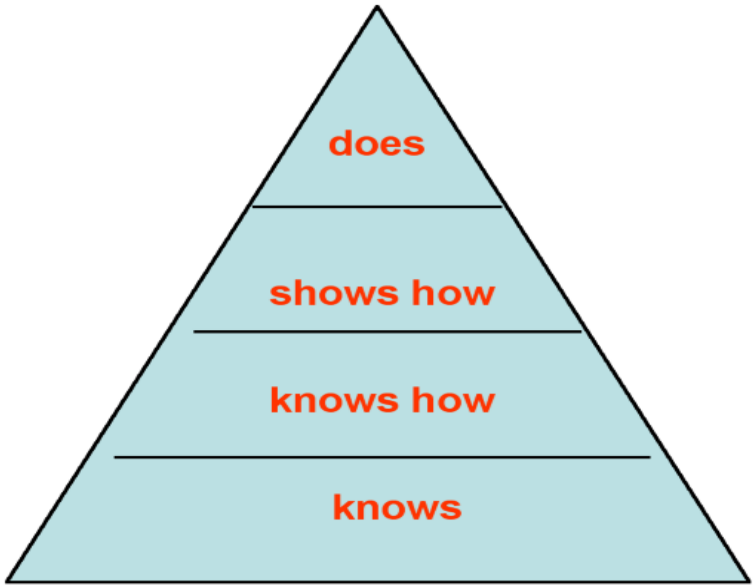


Figure 2.1: Miller's 1990 Pyramid of Clinical Competence (Adapted from Miller G. 1990)

The base represents the knowledge component of competence; the student has factual knowledge of a skill or field "Knows". At level two, the learner "Knows how" the skill is performed in theory (applied knowledge). Level three, the learner "Shoes how" to to perform the skill in a controlled or simulated environment and finally in stage four, the leaner "Does" the task in actual clinical practice. The first two levels of Miller's Pyramid (Knows and Knows how) are more cognitive in nature while the last two (Shows how and Does) are psychomotor in nature, implying that for an individual learner to Show how" a clinical

procedure is done and consequently perform it “Does”, one should possess the cognitive knowledge as a foundation for the psychomotor activity.

The role of cognition in teaching and learning procedural skills in medical education, is clearly delineated by Birnbaumer, (2011).

> “To teach procedures successfully, medical educators must focus on teaching both a thorough understanding of the cognitive aspects of the procedure and the ‘‘hands on’’ component. Before picking up an instrument, learners must understand the proper indications, contraindications, alternatives, steps involved, complications, and documentation needed for its use. Teaching this cognitive component should precede the student using that instrument or device. In fact, the learner should never attempt a skill until after a successful verbal ‘‘walk through” of the procedure. Many procedures are taught in the clinical environment with the teacher simultaneously demonstrating and describing the skill to the learner. To maximize acquisition of the cognitive information, however, some educators suggest that mental and manual skills should not be taught in the same session because learners tend to focus on the hands-on skill at the expense of understanding the thought processes involved. To facilitate learning the cognitive component, checklists provide an organized approach to teaching and learning the components of a procedure. These checklists should include a series of detailed, simple, sequential steps for the procedure being taught. They provide a reference for the learner to review and for the teacher to use while teaching the procedure as well as while watching the learner perform it”.

Possession of cognitive knowledge is, however, not the only factor underlying adequate skill performance. There are other factors that determine both acquisition and development of clinical competence including: curricular related, clinical teaching and assessment and skill/procedure related (AAMC, 2008). Others are deliberate practice, quality of clinical supervision and feedback (Griffith, et al. 1997; Ericsson, 2006; Wimmers, Schmidt and Splinter, 2006 and Duvivier, et al. 2011). These factors are discussed under section 2.4.2 on factors influencing acquisition and development of clinical competence.

2.4 Manifest and Self-Perceived Clinical Competence

2.4.1 Meaning and Dimensions of Clinical Competence

Defining clinical competence and devising methods to reliably and feasibly assess it has proven difficult (Carr, 2004). In literature there are many definitions of clinical competence, some simple and narrow, others broader and complex. For example Newble, et al, (1994) defined competence as "mastery of both a body of knowledge and a range of relevant skills including, interpersonal and clinical skills and it is a prerequisite to performance in the real clinical world". In 1999, Southgate defined it as partly the ability, partly the will to consistently select and perform relevant clinical tasks in the context of the social environment in order to resolve health problems of individuals in an efficient, effective, economic and humane manner". Later, in 2007 Epstein and Hundert defined it in a more complex way, "the habitual and judicious use of communication, knowledge, technical skills, clinical reasoning, emotions, values and reflection in daily practice for the benefit of individuals and community

being served. In the same year, another definition was given, “the ability to recognize and prioritize clinical problems, appropriate exercise of clinical judgment and technical abilities in practical procedures (Lai, Sivalingam and Ramesh, 2007).

From the foregoing definitions, one can deduce that clinical competence has several dimensions that can broadly be categorized as; cognitive (mastery of a body of knowledge), psychomotor (technical skills), and affective (emotions, values and reflections). The categorization is derived from the often used division of competence into knowledge (cognitive), skills (psychomotor), and attitudes (affective), (Mellish, Blink and Patton, 1998; Amin and Hoo-Eng, 2003). The same categorization is used for clinical competence as given by Norman (1985) as cited in Wimmers, 2006). For our study, competence was used to refer to the self-reported and objectively measured ability to perform the 14 selected clinical practical procedures as outline in section 1.4 under the delimitation of the study, while the term skill(s) was used to refer to clinical practical procedures.

The focus of our study was competence in the psychomotor dimension. The psychomotor domain is a sphere of manipulative or motor skills (Bloom 1956 and Amin and Hoon-Eng 2003). For the purposes of our study, the term psychomotor skills was used to refer to clinical practical procedures including intravenous cannula insertion, nasogastric tube insertion, gastric lavage, urethral catheterization, CPR, endotreacheal intubation, wound suturing, vaginal examination, lumbar puncture, normal vaginal delivery and examination of the newborn, intramuscular and intravenous drug administration.

Notwithstanding the focus of our study that is psychomotor domain, the cognitive domain was frequently referred to, discussed and even measured through the Multiple Choice Question (MCQ) knowledge test, due to the documented influence of the later on the former (Kopta, 1971; Miller, 1990; Hamdorf and Hall, 2000; Amin and Hoon-Eng 2003 & Buckley, Manalo, and Lapitan, 2011). Amin and Hoon-Eng 2003 further assert that to every psychomotor activity, there is a cognitive component. In addition, as stated earlier, mastery of a body of knowledge is an integral component of clinical competence; as such the cognitive domain could not be left out despite the focus on the psychomotor.

2.4.2 Factors that Influence Acquisition and Development of Clinical Competence

Several factors influence acquisition and development of competence in clinical skills. The factors are divided into three broad categories: curricular-related, teaching and assessment related and skill/procedure related.

2.4.2.1 Curricular Related Factors

Curricula-related factors that influence skills acquisition include; curriculum model, timing and duration of clinical exposure and curricula evaluation. WFME (2003) recommendation on curricular structure, composition and duration advocate for the integration of basic and clinical sciences into the curriculum, and early student clinical exposure and participation in patient care. Early clinical exposure enables student access to a large number of clinical cases to practice clinical skills.

There is literature that supports the view that medical students should be exposed to a large number of clinical cases in order to practice their diagnostic and management skills (Patel, and Groen, 1991; Sanson-Fisher, 2002). However, some literature on the contrary indicates that expert performance is neither dependent on the amount of time spent on practicing or exposure to a large number of cases but the amount of time spent on activities specifically targeted at aspects of performance that need improvement and quality of supervision and feedback (Griffith, et al. 1997; Ericsson, 2006; Wimmers, Schmidt and Splinter, 2006). Such literature indicates the significance of quality supervision and appropriate feedback in development of clinical competence.

In addition to curricula model, timing and duration of clinical exposure, curricula evaluation is another critical component of a successful curriculum implementation as it ensures continuous quality improvement. If done well, it provides essential information to guide learners, curriculum planners, faculty and other stake holders in delivering a relevant curriculum (AAMC, 2008). Curricular evaluation aids in identifying gaps between the 'intended' and the 'curriculum in action' so that concerns are identified and addressed without which the gaps remain unattended. The evaluation plan must address curricular implementation process, students and graduates performance. Medical Education scholars including Lai, Sivalingam and Ramesh, 2007 and Lai, et al, 2009 have asserted that measuring students' level of competence near the end of training is critical for education as it gives an indication of the effectiveness of the teaching and learning methods employed. Our study therefore to a greater extent evaluated the UNZA undergraduate medical curricula with regard to learning clinical practical procedures.

2.4.2.2 Teaching and Assessment related Factors

Traditionally, clinical medical education is predominantly bedside teaching through clerkships with the Halstedian approach of "see one, do one, teach one" (McGaghie, et al, 2011). With the Haldtedian approach, a student will only practice a skill once they have come across a patient on which it is indicated. Hayden and Panacek (1999) cited in Lammers et al, (2008) indicated that some procedures for example in emergency medicine are performed infrequently; therefore opportunities for training and assessment of these skills are unpredictable, and often simply unavailable. In addition procedures such as endotreacheal intubation are too risky and a patient's life may be endangered by allowing trial and error by a learner.

With traditional medical education, a student may go through training without any opportunity to practice certain life-saving skills which are essential for clinical practice upon licensure. Therefore, the teaching method being used may be the cause of inadequate skill acquisition. Bedside clinical education is further being challenged by the era of increasing student enrollment, concern for patient safety, increasing patients' awareness of consumer rights coupled with shorter hospital stay, all reducing available 'cases' for learning (Institute of Medicine, 1999; Ahmed, 2008; Okuda, et al. 2009; Shanks, et al. 2010 and Institute of health care improvements, 2010)**.**).

It is for the foregoing reasons that innovative teaching methods are encouraged (WFME, 2003 and AAMC, 2008). One such method is simulation. Simulation is an instructional process that substitutes real patient encounters with artificial models, live actors or virtual reality patients (Guba, 2004). As stated earlier, when compared to traditional methods of medical training,

simulation offers several potential advantages in both skills training and assessments (Shanks, et al. 2010). Simulation-based medical education prevails over several factors that negatively influence skill acquisition in traditional medical education. It removes issues of patient safety, instructor distraction, and unpredictability (Chapman, et al, 1996 cited in Lammers, et al 2008). Simulation environment encourages learning through experimentation and trial and error with the ability to rewind, rehearse and practice without negative patient outcomes, which is critical in dealing with the issue of patient safety.

Wass et al, (2001) and Epstein, (2007) asserted that assessment drives learning although many people may argue that this statement is incorrect and that the curriculum is key in any clinical course. A divergent view is that students feel overburdened by work and respond by studying only the parts of the course that are assessed (Hakstian, 1971 cited in Epstein, 2007 and Wass et al, 2001). If you want to change students learning, then change the assessment process (Newble and Jaeger, 1983 cited in Epstein, 2007; Brown, 1997; Wass, et al, 2001,).

Therefore in order to enhance learning World Federation for Medical Education (WFME, 2003) recommends the use of assessments that promote learning such as Objective, Structured Clinical Examination (OSCE). Bhat and Anald, (2006) described OSCE as a comprehensive, systematic and objective method of evaluation that involves an individual student rotating through a number of practical and theoretical "stations" where they are assessed using a set criteria. Recommendation of assessment methods that promote learning is based on the assumption that students will learn only what they are assessed on. Therefore, no matter how "core" the skill may be, students will not learn it as long as they know that opportunities for assessing such a skill are nonexistent.

2.4.2.3 Procedure/Skill Related Factors

Certain skills such as intubation are critical and time sensitive; thereby making opportunities for practice rare. In addition, not many patients are willing to be used by students for training in such skills. For example, a patient preference survey showed that if given the choice, only 42% would let a medical student perform their first venipuncture on them, and only 7% would allow a first time lumbar puncture. Approximately 50% of patients would never let a medical student perform a lumbar puncture, central line, or intubation on them at all (Graber, Pierre and Charlton, 2003). This is probably the reason why a vast majority of students do not get to practice certain basic procedures especially invasive ones and those required in emergencies such as intubation.

As indicated earlier, Neilsen et al. (2003) stated that 99% of students had to work hard and be active in order to get access to practice skills in a clinical setting, but only, 36% had the chance to practice to the extent they wanted. In that particular study, all students tried out at least eight skills out of the expected 22 and that the number of skill practiced varied with nature of skill, hospital and gender of student, with females finding it more difficult to get opportunities to practice. Therefore, a student may go through training without any opportunity to practice certain Lifesaving skills which are essential for clinical practice upon licensure. In addition, concerns for patient safety and increase in number of students make bed-side learning of such skills almost impossible.

2.4.3 Manifest versus Self-perceived Competence

As indicated earlier, manifest competence is the observed behavior or practice (Wimmers, 2006) while self-perceived competence is the reported self-efficacy in performing a task (Bandura, 1997). Competence of undergraduate medical students in performing basic clinical skills whether self-perceived or objectively measured has been investigated in Europe and North America with the former having been explored extensively (Hubbard, et al. 1965; Jones, McArdle and O'neill, 2001; Weiss, Koller and Wasser, 2005; Colberly and Goldenhar, 2006; Lai, Sivaligam and Ramesh, 2007; Lawson and Bearman, 2007; Lai, et al. 2009, Promes, et al. 2009; Barbosa, et al. 2011; Lai and Teng, 2011). However there is little or no information about how students of African medical schools evaluate their core-competences (Barbosa, et al. 2011). Similarly no such study had been conducted in Zambia prior to ours. In assessing competence, previous studies have reported varying degrees of agreement between self-perceived and objectively measured competence in medical students (Jones, McArdle and O'neill, 2001; Morgan and Cleave-Hogg, 2002; Barnsley, et al. 2004; Weiss, Koller, Hess and Wasser, 2005; Lai and Teng, 2011).

Colberly and Goldenhar, (2007) in a cross-sectional survey aimed at assessing Acting Interns' (Fourth year medical students at University of Cincinnati- United States of America) experience with and perceived level of competence performing six basic medical procedures, established that a vast majority of Fourth-Year Students reported not performing four (phlebotomy, intravenous catheter insertion, lumbar puncture and Foley catheter insertion). The six basic procedures were phlebotomy, intravenous catheter insertion, Arterial Blood Gas (ABG), nasogastric tube insertion, Foley catheter insertion and Lumbar Puncture. Procedure performance ranged from nine percentage for Foley catheter to 50% for Arterial Blood Gasses

(ABG). The most frequently performed were ABG and nasogastric tube insertion. Feeling of competency varied from 12% for Lumbar Puncture to 82% for Foley catheter insertion. Apart from Lumbar Puncture, the majority of students felt competent performing other stated procedures without supervision by the end of the second acting intern rotation (ranging from 53% for intravenous insertion to 82% for Foley's catheter insertion). For Lumbar Puncture compared to other procedures, statistically significantly few students 25% reported feeling competent performing it without supervision at the end of the second rotation ($P<.01$). Similarly except for Lumbar Puncture, students who performed a procedure at least once were significantly more likely to report feeling competent.

Studies conducted on third year medical students and residents have revealed that self-assessment of competence correlates with frequency of procedure performance (Fincher and Lewis, 1994 and Hicks, et al. 2000). For example Hicks et al, revealed that internal medicine residents reported needing 6-10 LP experiences to reach a "comfortable threshold" defined as the number of procedures at which two thirds of the house staff reported being comfortable or very comfortable performing. There is however some opposing views to this stance. For example Lai, Sivalingam and Ramesh (2007) in a study of medical students' progress in self-perceived clinical competence, and relationship between experience and confidence in practical skills indicated that the correlation between experience and self-perceived competence was at best moderate.

Based on the moderate correlation, Lai and his colleagues suggested that an increase in the student's experience with a skill might not be accompanied by the same degree of increase in

their self-perceived competence. Factors that have been suggested to facilitate development of self-confidence include direct supervision and feedback and deliberate practice (Ericsson, 1993; Bligh, 2002; Ericsson, 2004; Lai, Sivalingam and Ramesh, 2007; Duvivier, et al. 2011; Tallentire, et al. 2011).

It is worth noting that Colberly and Goldenhar study of 2007 only evaluated self-perceived competence. As indicated earlier previous studies that have compared self-perceived and objectively measured competence reported varying degrees of correlation between the two (Jones, McArdle and O'neill, 2001; Morgan and Cleave-Hogg, 2002; Barnsley, et al. 2004; Weiss, Koller, Hess and Wasser, 2005). In the Colberly and Goldenhar study manifest competence was not assessed, thus the high reported self-competence of 82% for Foley's catheter for example could probably be different if measured objectively. Because of such assumptions, our study measured both self-perceived and, manifest competence.

Promes and colleagues (Promes, et al. 2009) investigated the gaps in procedural experience and competence in medical school graduates at three teaching hospitals in the southeastern region of the United States. In their study, it was hypothesized that greater experience with procedures in medical school would be associated with higher levels of confidence in conducting procedures earlier in graduate medical education. Participants were asked to recall the number of times they had performed various procedures during medical school, rate their satisfaction with procedural skills education and select their own personal level of competence for each of the procedures. With regard to procedure experience, similar to the findings of Coberly and Goldenhar, 2007, Foley's catheter placement and venipuncture were among

procedures most experienced. The least experience was reported with thoracentesis, central venous access and splinting. Surprising enough most had not performed basic procedures such and basic life support and cardiopulmonary resuscitation.

Further findings indicated an association between number of times a procedure was performed and self-assessed competence ($p<0.001$) for all procedures. An exclusive finding of the study was that first year residents who completed a dedicated procedure course in medical school were significantly more likely to report adequacy in performing basic medical procedure (odds ratio = 2.5). This unique finding signifies the value of having a skills course in undergraduate medical training. Literature supports the need for an additional procedural course as methods which are used in medical schools to teach clinical skills (observing what clinicians do/role modeling) are variable, unpredictable and lack continuity (Lawson and Bearman, 2007).

Self-perception of competence among medical students has also been assessed across different cultures. Barbosa and colleagues evaluated the self-perceived competence of medical students in three different countries: Portugal and two African Portuguese speaking countries Angola and Mozambique (Barbosa, et al. 2011). The evaluation was across six domains of personal attitude, professional behavior, knowledge, clinical skills, general skills, and communication skills. The domain with the highest score across countries was personal attitude and professional behavior. Apart from Mozambique, clinical skills in Angola and Portugal received the lowest scores. The investigator assumed that the low values assigned to acquisition of competence in clinical skills could be due to students' fear of making mistakes

or the limited opportunities for practice during training. This signifies the importance of dedicated clinical skills training throughout the medical education.

Barbosa and colleagues' study like others cited above focused on self-reported competence, which is neither objective nor free from bias. Despite knowing what a student thinks about what she/he is capable of doing; self-perception is different from real or observed performance. Literature indicates poorer correlation between self-perceived and objectively measured competence in practical skills and comparatively better correlation in the "soft" skills like communication (Jones, McArdle and O'BNeill, 2001;Morgan and Cleave-Hogg, 2002; Barnsley, et al. 2004; Coberly and goldenher, 2007; Lai and Teng, 2011) As Eva and Regehr, (2005) suggested; the fundamental cognitive limitation in the ability of humans to know themselves as others see them restricts the usefulness of results of self-assessment.

Despite the subjectivity associated with self-perception in determining performance, Eva and Regehr, (2005) on the other hand asserted that self-assessment has two important functions both as a mechanism for identifying one's weaknesses and as a mechanism for identifying one's strengths. Each of these mechanisms having distinct and complementary functions. As a mechanism for identifying weaknesses or gaps in one's skills and abilities, self-assessment serves several potential functions. Firstly, in daily practice, the identification of one's weaknesses allows the professional to self-limit in areas of limited competence. For example, in many circumstances the professional can quickly reject certain plans of action because they are able to recognize that they are unlikely to complete the tasks. In other circumstances, an

individual can realize that the task is beyond his ability, and can decide to consult or refer the problem to another individual. Secondly, reflecting on one's ability in practice can lead to identification of areas of weaknesses consequently leading the professional to set appropriate learning goals. The outcomes of self-perception/self-assessment especially the ability to recognize tasks beyond one's competence and making appropriate referrals are critical especially in the medical field where trial and error has no room as practitioners deal directly with people's lives

In addition positive self-efficacy has been related to persistence, tenacity, and achievement in educational settings (Bandura, 1997). Therefore it can be contended that medical students with high self-perception towards a task are more likely to devote their energies towards learning such a task, consequently increasing the numbers of attempts with increased likelihood of success with each additional attempt leading to increased confidence, and improved performance. However as indicated earlier, increased attempts on a task can only lead to improved confidence and performance if attempts take form of deliberate practice and are coupled with direct supervision and feedback (Ericsson, 1993; Bligh, 2002; Ericsson, 2004).

Another dimension of self-perception of competence that has been reported in literature is that of comparisons between self-perceptions of medical students and that of their teachers. Sicaja, Romic and Prka, (2006) evaluated self-assessed level of competence of graduating medical students at Zagreb University School of Medicine in 99 clinical skills, and compared it with the level expected by their teachers and those defined by a criterion standard. The findings

were that students' perception of their own achievement differed from their teachers' expectations. Students tended to assess their skills much lower than expected by their teachers and published criterion standard. Similar findings have been reported from Great Britain, Denmark, Netherlands, Belgium and the United States. (Stillman, 1990; Board and Mercer, 1998; Remmen, et al. 1999, Ringsted, et al, 2001 and Moerck and Eika, 2002).

Factors that were associated with higher scores in Sicaja, Romic and Prka, study were better organization of clinical skills teaching in those subjects, having taken an additional clinical skills course and student interest. For example male students had higher scores in surgical subspecialties probably because males are more inclined to surgery which is traditionally male dominated (Kolcic, et al, 2005). Grade point average had no influence on clinical skills level. The association between higher scores in clinical skills and having taken an additional clinical skills course, made the investigators to conclude that an additional clinical skills training is required. The same conclusion made later by Promes and colleagues later in 2009. The need for additional skills training is also supported by Remmen et al, 1999 and Remmen, et al, 2000 who indicated that education during clinical rotation is not focused on skills acquisition and therefore dedicated clinical skills courses are a necessity.

Compare to self-perceived competence, manifest or objective competence among medical students has not been extensively assessed. Sacaja, Romic and Prka (2006) cited the cost of tools that can measure competence such as OSCE as a hindrance. However Elango et al, (2007) objectively measured the clinical skills of undergraduate students in Malaysia. In this

study a list of practical skills that students should be competent in were identified. The skills were demonstrated to students by academic staff/nurses using manikin in clinical skills unit. Students were then given opportunity to practice under supervision. Later they carried out the skills on actual patients in wards still under supervision. During the end of semester examination at 4^{th} and 5^{th} year level, students were assessed on the list of skills as part of Objective Structured Practical Examination (OSPE) using a structured checklist.

The major finding was that failure rate in practical skills was high in most of the station (seven out of eight). It is however interesting to note that despite of formal training in basic practical skills, many students in this study failed in practical skills stations. The investigators concluded that assessment of practical skills as part of composite examination does not ensure that all students acquire adequate level of competence. It was recommended that the curriculum must be well planned to provide students with structured opportunities for practice, timely feedback about their mastery of skills and opportunities for remediation. Clinical skills training require time and practice and that training should be monitored and skills be assessed through dedicated formative assessments. To address the problem of inadequate skill acquisition among undergraduate medical students, medical schools cannot rely on clerkships alone instead skills laboratory based training and performance based testing should be encouraged (Remmen, et al. 1999; Remmen et al, 2000). However training in skills laboratory using manikins should supplement and not substitute supervised training on actual patients.

2.5 Assessment of Clinical Competence

Assessment of clinical competence has historically involved direct observation of assesses by professional colleagues. This stems from a traditional apprenticeship model which existed for hundreds if not thousands of years, where knowledge and skills in medicine were passed down from one person to another. The apprentice learnt from the master by observing and helping him treat patients, thus competence was determined and certified by the master (Dornan, 2005). However, in the past few decades there has been a demand for a more rigorous assessment of competence. The shift has been necessitated mainly by public expectation of competent doctors and paradigm shift from traditional medical education towards competence based (Wass, et al. 2001; Carr, 2003; Lai, Sivalingam and Ramesh, 2007; Duvivier, et al. 2011). With such expectations and a general global discourse around accountability among professionals, no one can be assumed to be competent. Clinical competence has to be proven by testing, measurement and recording using authentic methods with theoretical underpinning.

As indicated earlier competence is developmental in nature, therefore, different assessment methods are recommended for different stages Wass, et al. 2001; Carr, 2003. In the assessment conundrum, Miller's Prism offers the most comprehensive way of assessing competency at different levels of development as shown in figure 2.2.

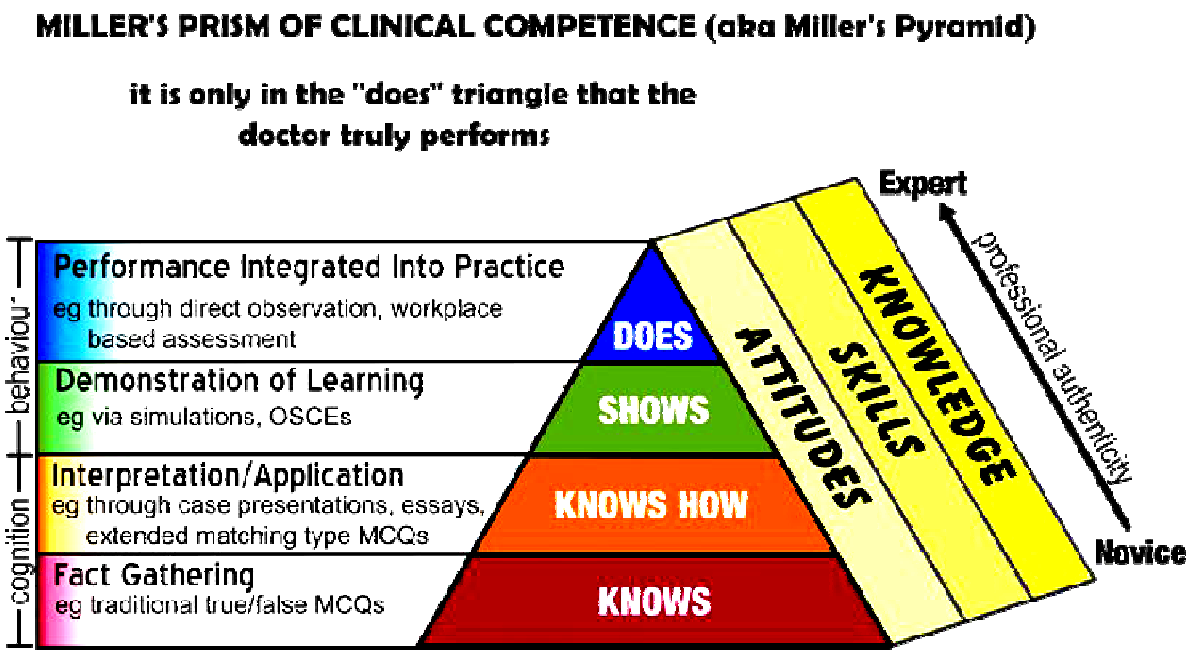


Figure 2.2: Miller's Prism of Clinical Competence adapted from Miller 1990 as modified by Drs. Mehay and Burns, 2009.

2.5.1 Assessment of "Knows" and "Knows how"

In this section, assessment of "Knows", and "Knows how" are briefly described while assessment of "Shows how" being the focus of this study is described in much more detail in the succeeding section. Assessment of competence at the level of "Knows" and "Knows how' is relatively easy. For example assessment of "Knows" that is the straight factual recall of knowledge is achieved using factual tests such as Multiple Choice Questions (MCQs), traditional true/false questions and oral examination. 'Knows how' which is the application of knowledge to problem solving and decision making is assessed using clinical context or clinical scenario based tests of MCQs, essays or case presentations (Wass, et al, 2001).

2.5.2 Assessment of "Shows how"

Assessment tools for clinical competence 'Shows how' include, the Traditional long and short case, the Objective Structured Long Case Examination Record (OSLER), the Objective Structured Assessment of Technical Skills (OSATS) and OSCE (Amin and Hon-Eng, 2003). In the traditional long case examination, the assessee spends one hour with the patient, during which they are expected to take a formal history and do a complete physical examination. The assessee is not observed during the process. On completion of the task, the assessee is questioned for 20-30 minutes on the case usually by a pair of examiners, and is occasionally taken back to the patient to demonstrate clinical signs. Due to lack of observation during the process, such exams are challenged on the ground of authenticity and reliability as assessment relies on the candidate's presentation thus 'knows how' is assessed rather than 'Show how' (Wass, et al, 2001).

In an attempt to improve long-case format OSLER was developed. It consists of ten 10 items, including four on history, three on physical examination and three on management and clinical acumen. For any individual item, the examiners decide on the overall grade and mark for the assessee and discusses with their co-examiner to agree on a joint grade. This is done for each item. OSLER includes some direct observation of the candidate interacting with the patient. There is evidence that OSLER is more reliable than standard long case, however to achieve a predicted Cronbach's alpha of 0.84, 10 cases and 20 examiners are required, thus raising issues of practicality.

OSATS is another method for assessment of technical skills. It was developed as a class room test for surgical skills by the Surgical Education Group at the University of Toronto. OSATS assessment is designed to test specific procedural skills for example caesarean section. It has two parts: first part assesses specificities of a procedure itself and second part is a generic technical skill assessment which includes judging competencies such as knowledge and handling of instruments and documentation. Data regarding reliability of OSATS is limited but it has high face and construct validity, however acceptability is low as educators consider OSATS as having been done in simulated settings.

As a solution to the difficulties of adequate sampling and standardization, OSCE method was designed (Wass, et al 2001). OSCE was developed in 1975 as a means of clinical competence assessment (Harden, et al, 1975 cited in Auewarakul et al, 2005). It is as a comprehensive, systematic and objective method of evaluation that involves an individual student rotating through a number of practical and theoretical "stations" where they are assessed using set criteria (Bhat and Anald, 2006; Gormley, 2011). It is an objective method for measuring clinical competence; it fulfills the criteria of validity, reliability and practicality (O'Connor and McGraw, 1997; Townsend et al, 2001 and Auewarakul et al, 2005; Gormley, 2011). It allows for testing of a wide range of knowledge, skills and attitudes and can accommodate large number of examinees in one examination session (Bhat and Anald, 2006).

During an OSCE, the competences to be assessed are identified for example history taking, focused physical examination, interpretation of laboratory results and documentation of findings. Each competence becomes an objective for one of the stations. There are two categories if OSCE stations: observer and marker. A typical observer station consists of a task

usually presented in two to three sentence scenarios and a request for appropriate action, with performance rated by an observer (examiner or Standardized Patient) using predetermined checklist. Observer stations are used for clinical skills of interpersonal or psychomotor nature for example history taking, physical examination and intervention of procedural nature such as intravenous cannula insertion.

A typical marker station consists of the presentation of data with a request for interpretation, synthesis or appropriate clinical action. Maker stations are relevant for assessment of clinical skills of conceptual nature such as decision making and problem solving (Wass et al, 2001; Townsend, et al. 2001; Amin and Hoon-End, 2003). Based on its validity, reliability and practicality, OSCE was used to measure manifest competence (Shows how) in our study. It should however be noted that to achieve a reliability of 0.85-0.90 a minimum of 10 stations are required which a student should visit in a course of 3-4 hours (Reznick and Blackmore, 1993 as cited in Turner and Dankoski 2008).

2.5.3 Assessment of "Does"

The most difficult facet of clinical competence to examine is the "Does" (Carr, 2004).Practitioners employ a system of observing a collection of videotaped consultations submitted by the trainee to demonstrate a range of clinical skills. Portfolios are also recommended for the "Does" level. No further details are provided for this level since the focus of our study was level three "Shows how".

Having considered the different types of assessment methods suitable for each level of competence from the knowledge related level to the demonstrable/apparent /factual level of

competence, the investigator was in agreement with the Association of American Medical Colleges (2008) and Promes and colleagues (2009) who recommended Miller's 1990 pyramid of clinical competence (figure 2.1) as a useful framework when considering students' skills acquisition. Miller's Pyramid addresses both the cognitive (knowledge) and the psychomotor components of clinical competence. The investigator therefore resolved that Miller's Pyramid (Figure 2.1) was the most "fit for purpose" in explaining medical's students' levels of clinical competence development. Further, Miller's Prism (Figure 2.2) which "marries" competence development with assessment methods right from the knowledge component of competence (knows) to the manifest component of competence (shows how and finally does") offers the most comprehensive way of addressing competence development in relation to assessment. Based on our deduction about Miller's Pyramid, we adopted it as one of the three models upon which our study was underpinned (see conceptual framework-figure 2.3).

2.5.4 Assessment of "Knows how" "Shows how" and Does" through Think-Aloud Protocols

Think-Aloud Protocols is a method that allows researchers to understand at least in part the thought processes of an individual as they use a product, manual device or complete a task (Ericsson and Simon, 1993; Young 2005). Using this method, the researcher observes while an individual tries to complete a task. The input from the researcher during the process is limited to prompts such as 'keep talking' should they lapse into silence. Participants' thoughts are captured using audio recording thus providing a permanent record of future review and analysis. Ericsson and Simon (1993) who have been instrumental in developing this approach

have suggested that the approach is capable of capturing what is held in the short term memory of the participant.

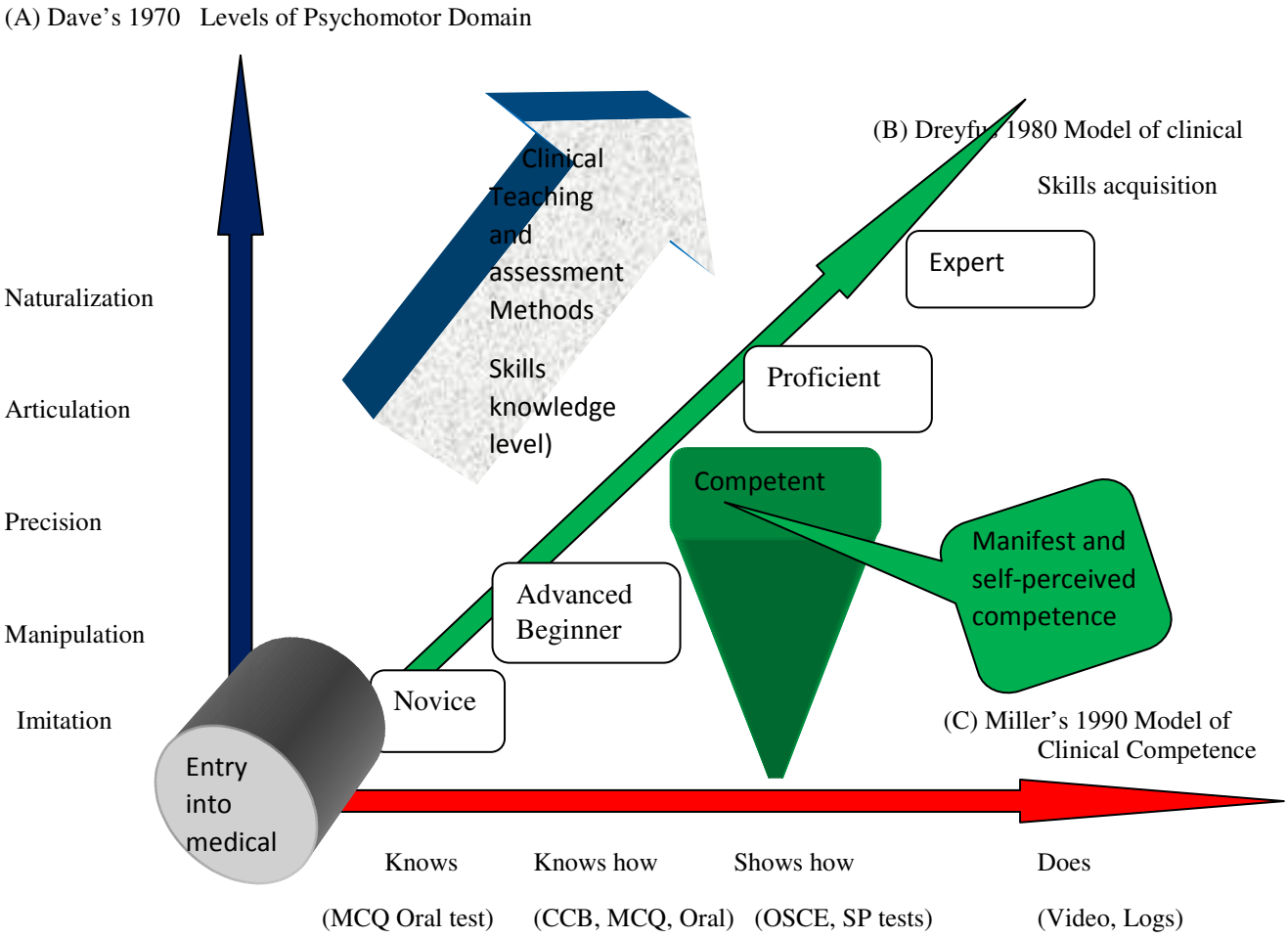
Typically Think Aloud data also known as talk-aloud data, verbal protocols or verbal report is that which is collected by listening and recording the participant's verbalization of thought while completing a task. Researchers can collect such data by concurrent probing- asking direct questions while the participant is undertaking a task to access information that is held in the participant's short term memory or retrospective probing where questions are asked after completion of a given task (Ericsson and Simon, 1993 and Young, 2005). For our study, retrospective approach was used where randomly selected number of students were asked questions immediately following their OSCE to determine in part what was going on in their minds as they performed practical procedures. Although Think Aloud data does not provide complete insight into the human mind (Wilson, 1994), it certainly in part helped to account for the cognitive processes underlying the psychomotor activity.

2.6 Conceptual Framework

2.6.1 Introduction

The conceptual framework for our study included three models: A= Dave's 1970 Levels of Psychomotor Domain B= Dreyfus and Dreyfus (1986) model of clinical skill acquisition and C= Miller's (1990) model of clinical competence (figure 2.3) (Dreyfus and Dreyfus, 1980; Dreyfus and Dreyfus, 1986; Miller, 1990; AAMC, 2008; Promes, et al. 2009). The key concepts in the framework are graphically presented in figure 2.3 followed by a narration.

Figure 2.3: Conceptual Framework on Stages of Skill Acquisition, Components of Competency, and the Phases of Competency regarding Teaching and Learning of Clinical Practical Procedures in Medical Education.



Modified versions of Dave's 1970, Dreyfus and Dreyfus 1980 and Miller 1990 Models

2.6.2 Narrative for Conceptual Framework

Learning in the psychomotor domain progresses through five levels; beginning with imitation moving to manipulation, precision, articulation and naturalization (Dave, 1970). The five stages of psychomotor learning can be equated to the five stages of competence acquisition as proposed by Dreyfus and Dreyfus' 1980 and the four stages of Miller's model of clinical competence. At each level of competence development, different assessment methods are recommended (Wass, et al, 2001; Carrs, 2004; AAMC, 2008; Promes, et al, 2009). The framework further indicates two major factors that may influence competence acquisition and development vis-à-vis clinical teaching and assessment methods (Brown, 1997; Wass, et al, 2001; Newble and Jaeger, 1983 as cited in Epstein, 2007).

With regard to learning in the psychomotor domain, Dave' 1970 taxonomy has been cited as most useful (Amin and Hoon-Eng 2003; Chapman, 2006).Despite Dreyfus and Dreyfus' critics who have contended that the model partially explains acquisition of some skills and not clinical skills (Pena, 2009), on the other hand, Dreyfus and Dreyfus, 1980 together with Miller's 1990 model of clinical competence are highly recommended as useful frameworks when considering students skill acquisition and assessment (AAMC, 2008; Promes, et al, 2009). In medical education literature there are however other models of clinical learning such as Pangaro's RIME schema (AAMC, 2008), which describes the developing clinical role of the learner, from Reporter of medical information through Educator (Reporter to Interpreter to Manager to Educator). Seemingly, Pangaro's RIME Schema describes clinical role of the learner in terms of cognitive development as opposed to competence acquisition and development.

Clinical skill acquisition is developmental in nature. Dreyfus and Dreyfus (1980) described five levels of competency from novice through expert; Novice, Advanced Beginner, Competent, Proficient (AAMC, 2008). At the point of entry into medical school, a student is regarded as a novice (Dreyfus and Dreyfus, 1980). Such a student has little or no exposure to skills set, requires extensive instruction and supervision to perform a given task adequately. Given a skill to perform, the psychomotor abilities are at the level of imitation (student repeating what is done by the instructor). Conversely, Miller 1990 describes a new entrant into medical school as one who possess factual knowledge of a field or skill "Knows" (Wass et al. 2001; Carr, 2004; AAMC, 2008). This stage represents the knowledge component of competence. The recommended assessment methods at this level are factual tests of MCQs, oral and essays

Advanced Beginner is likened to a mid-level clinical student with limited exposure to skills set requiring some supervision to complete a given task, the level described as 'knows how" by Miller (1990). In terms of psychomotor abilities, such a student is at the level of manipulation that's performing skill from instruction (Dave, 1970). The most appropriate assessment method for advanced beginner students are clinical context based MCQs and oral questions (Wass et al. 2001; Carr, 2004; AAMC, 2008).

A finalist student in the last six months of training and an intern is equated to Dreyfus' "competent level". At this stage the finalist or intern has basic knowledge, technical skills and understanding of anatomic, physiologic and procedural issues to perform selected skills

independently. In terms of psychomotor abilities, a final year medical student is assumed to be at the level of precision (student has practiced sufficiently to perform skill without mistakes, although skill can only be performed in limited setting). The 'competent' level was the focus of our study. This level equates to the 'Shows How" of Miller's model (AAMC, 2008).

The "Shows how" stage is best assessed using performance based assessments in vitro such as OSCE and Standardized Patient (SP) based tests. For our study, only OSCEs were used (Wass et al. 2001; Carr, 2004; AAMC, 2008). Notwithstanding the focus of our study, we equated the proficient level to a Registrar and the Expert level to a Senior Consultant (Promes, et al. 2009). According to the University of Otago, 2013, levels of achievement beyond competence are not usually attained in the undergraduate years. These are higher levels of performance and functioning (proficiency and expertise). Thus the focus of this study is the "competence level" which is the third level along the competence development continuum.

In the University of Zambia context, beginners learn basic biomedical sciences, community based education and first aid, and behavioural sciences and communication skills in medicine. Mid-level students are introduced to clinical sciences, and they have their first set of clerkships in internal medicine, surgery, obstetrics and gynaecology and paediatrics and child health. Finalist students have their third and final clerkships in internal medicine and surgery and second and final clerkships in obstetrics and gynaecology, and paediatrics and child health. In the last six months of training, it is expected that apart from the four major clerkships outlined above, students could have rotated through the following specialties: psychiatry, ophthalmology, community medicine, dermatology, orthopaedics, ear, nose, throat and maxillofacial, and

radiology. Having undergone the different clerkships, it is expected that students should be competent in basic clinical practical procedures.

As indicated in the conceptual framework, two dimensions of clinical competence were assessed, that is manifest and self-perceived. Manifest competence was the observed behavior or practice (Wimmers, 2006) while self-perceived competence was the reported self-efficacy in performing a task (Bandura, 1995, 1997). Self-perceived competence was assessed using a five point Likert scale on the selected clinical practical procedures, while manifest –competence was assessed using OSCE checklist. In addition, Retrospective Think-Aloud Protocols were administered to a randomly selected number of students. This was to supplement the data obtained through the OSCE by means of understanding in-part the thought processes of students while they were performing the practical skills during the OSCE.

2.7 Conclusion

Literature has revealed that competence of undergraduate medical students in performing basic clinical skills whether self-perceived or objectively measured has been investigated before in Europe and North America with the former having been explored extensively. However there is limited information about how students of African medical schools evaluate their core-competences. From the Zambian perspective no study was found with regard to evaluation of clinical competence among University of Zambia Medical Students. In comparing self-perceived and objectively measured (manifest) clinical competency, previous studies have reported varying degrees of agreement between the two facets. In

Zambia no such comparison has been done before among medical students trained under the University of Zambia curriculum. Therefore, in addition to measuring and comparing self-perceived and manifest-competence of the University of Zambia Medical Students, the point of departure for our study from previous studies is the study of acquisition of competence (how University of Zambia Medical Students acquired competence) in clinical practical procedures.

3.0 CHAPTER 3: METHODOLOGY

3.1 Introduction

This study sought to answer the following questions:

i. How do Undergraduate Medical Students of the University Of Zambia acquire competency in clinical practical procedures during clinical years?

ii. What is the clinical practical procedures knowledge level of Final Year Medical Students of the University of Zambia in the last six months of the undergraduate medical education?

iii. How does self-perception of competence compare with manifest-competence in selected clinical practical procedures among University of Zambia Final Year Medical Students in the last six months of training?

Chapter three therefore outlines the methodology that was used to answer the above questions. Prior to addressing the methodological issues, a summary of study variables and their conceptual and operational definitions is provided in table 3.1. The table is followed by a brief description of the research paradigm within which our study was located, which is mixed method. The research paradigm section is followed by a presentation of the design for the study which was non-interventional cross sectional correlation study using the concurrent transformative with concurrent embedded mixed method strategy (See section 3.3). The study site, population, sample and sampling techniques are then outlined, followed by data collection and analysis. The data collection and analysis section is followed by a section on threats to validity and reliability and how they were handled. An outline of the pre-test that was conducted prior to the study is then presented followed by a section on ethical considerations and protection of human subjects. Finally a summary of the research methodology is presented in table 3.2.

Table 3.1: Conceptual and Operational definition of Study Variables and Scales of Measurement

VARIABLES	CONCEPTUAL DEFINITION	OPERATIONAL DEFINITION	SCALES OF MEASUREMENT
		DEPENDENT VARIABLES	
Acquisition of competence in selected clinical practical procedures	Gradual transition from rigid adherence to rules in performing a task to an intuitive mode of reasoning that relies heavily on deep tacit understanding (Dreyfus and Dreyfus, 1990)	Self-report of how competence was acquired in the 14 selected clinical practical procedures (how the skill was initially learned and steps taken to reach the reported level of competency).	Not applicable, data will be in narrative form
Self-perceived competence	The reported self-efficacy in performing a task (Bandura, 1997).	Reported ability to perform the 14 selected clinical practical procedures Indicators for self-perceived competence are: 1= Low self-perception (Gross inadequacy or knowing the approach in theory, not confident in real situation) 2= Moderate self-perception (Only confident in making certain decision, need seniors to be readily available or on constant standby or Reasonably confident, but needs seniors who are contactable for consultation) 3= High self-perception (Very confident can be relied on without supervision	Ordinal

Manifest-competence	The observed behaviour or practice (Wimmer, 2006)	Observed ability to perform the selected clinical practical procedures during OSCE indicated by numeric scores expressed out of 100 percent Indicators for manifest- competence are: 1=Not competent (Scores-below pass mark) 2=Barely competent (Scores-pass mark up to mid-point between pass mark and total) 3=Competent (Scores-above mid-point between pass mark and total)	Interval when using percentage scores Ordinal when using cut-off points
INDEPENDENT VARIABLE			
Knowledge of clinical and practical procedures	Remembering of previously learnt facts (Bloom, 1956) about clinical practical procedures	Possessing the cognitive know-how of the 14 selected skills in terms of (indications for, principles, supplies required and steps on how a procedure is done). Knowledge level indicated by numeric scores expressed out of 100 percent. Indicators for knowledge are: 1=Fail (Scores- below pass mark) 2= Bare Pass (Scores-pass mark up to mid-point between pass mark and total) 3= Absolutes pass (Scores-above mid-point between pass mark and total)	Interval when using percentage scores Ordinal when using cut-off points

3.2 Research Paradigm

Our study applied a mixed method approach that is utilizing both quantitative and qualitative elements. In other words, an eclectic/ pluralistic approach to method selection was adopted. Johnson and Onwuedbuzie, (2004) referred to mixed method research as philosophically a "third Wave" or third research movement, a movement that moves past the paradigm wars by offering a logical and practical alternative, and endorsing eclecticism and pluralism, 'a paradigm whose time has come'.

The choice of mixed methods/eclecticism over and above either positivism or interpretivism was necessitated by a combination of research questions which could only be answered using methods from both the quantitative and quantitative paradigms. As asserted by Johnson and Onwuegbuzie, (2004) quantitative and qualitative research is important and useful, therefore the goal of mixed research is not to replace either but to draw from the strengths and minimize the weaknesses of both in a single study.

Our study envisaged that the weaknesses such as the subjectivity of a self-report (self-administered questionnaire) in measuring clinical competence will be offset by using an alternative method (structured observation) to get an objective measure of clinical competence. It is worth noting that mixed research has major challenges, for example, it can be difficult for a single researcher to carry out both qualitative and quantitative research especially if the two approaches are used concurrently (Johnson and Onwuegbuzie, 2004 and Creswell 2009) as the case was in our study. Despite this challenge with the concurrent approach, it was adopted for this study due to limited time

within which data had to be collected thereby making the sequential approach impracticable. Creswell (2009) indicated that concurrent approach is preferred by many medical personnel because it is manageable to collect both qualitative and quantitative at once to offset cost constraints.

3.3 Study Design

This was a non-interventional cross sectional correlation study (LoBiondo-Wood and Haber, 2006; Burns and Grove, 2005 and Polite and Beck, 2012), using the concurrent transformative with concurrent embedded mixed method strategy (Creswell, 2009). A concurrent transformative strategy is one that is guided by a specific theoretical perspective (critical theory, advocacy, or theoretical framework) (Terrell, 2012). In this regard, our study was guided by a conceptual framework (Figure 2.3). Non-interventional correlation design entails that there was no manipulation of study variables; instead variables were measured and compared to determine whether or not and to what degree a relationship existed between them.

With regard to time dimension, the design was cross-sectional as measurement of study variables were done at one point in time. Therefore, utilization of a specific theoretical perspective, concurrent collection of both qualitative and quantitative data sets, and use of a primary method that guided the project with a secondary data set that provided a supportive role qualifies this study as a concurrent transformative-concurrent embedded mixed method design (Creswell, 2009 and Polite and Beck, 2012).

In our study, the quantitative method was the primary (dominant), while the qualitative was secondary as it was embedded (nested) within the quantitative, refer to table 3.4. The embedded method addressed a different question from those addressed by the primary method. The primary (quantitative) method addressed the self-perceived and manifest competence, and the clinical and practical skills knowledge, while the secondary (embedded- qualitative) method addressed how students acquired clinical competence. In other words the primary (quantitative) method addressed the outcome of medical training (clinical competence) while the qualitative (secondary) method addressed the process (how students acquired clinical competence). This is referred to as 'use of one method within the framework of the other' (Creswell, 2009; Polite and Beck, 2012).

The quantitative arm utilized two data collection instruments: self-administered questionnaire to measure knowledge level of clinical practical procedures, self-perceived competence and number of times procedures were performed, and structured observation using OSCE checklist to measure manifest-competence.

Data in the qualitative arm was mainly obtained using in-depth interviews. Due to the nature of the qualitative question in our study (how do medical students of the University of Zambia acquire competence in core-clinical practical procedures?), Grounded Theory was applied within the qualitative arm of the study. Originally developed by Glaser and Strauss, Grounded Theory is a qualitative enquiry method that makes it possible to systematically generate a theory from data of social research (Glaser, 2005; Tavarol, Torabi and Zeinaloo, 2006). The theory allows for detailed rigorous and systematic

analysis of qualitative data thereby providing the researcher with greater freedom to explore the research area, allow issues to emerge (Glaser 1978; Bryant 2002 and Jones and Alony, 2011), and generate theoretical constructs and concepts (Tavarol, Torabi and Zeinaloo, 2006). In our study, it was envisaged that through the use of Grounded Theory, theoretical constructs would emerge on how medical students of the University of Zambia acquire competence in clinical practical procedures.

Quantitative and qualitative data sets were not mixed as the two methods answered different questions, instead the two data sets were analyzed and reported separately as two different pictures that provide an overall composite assessment of how students acquire competence in clinical practical procedures and their levels of knowledge and competence in those skills at the time of graduation.

Comparisons were only made on the four quantitative data sets (knowledge level, self-perceived, manifest competence and number of times clinical practical procedure were performed). This was done mainly as a means to determine whether there were differences between self-perceived and manifest competence as has been reported in the literature (Jones, McArdle and O'neill, 2001; Morgan and Cleave-Hogg, 2002; Barnsley et al, 2004; Weiss, Koller, and Wasser, 2005; Colberly and Goldenhar, 2007). In addition, comparisons of the four quantitative data sets determined relationship among knowledge level of clinical practical procedures, self-perceived and manifest competence and number of times a clinical practical procedure was performed.

3.4 Study Site

Our study was conducted at UNZA- School Of Medicine, located within the University Teaching Hospital, Lusaka. Established in 1966 it is the oldest public medical school in Zambia. At the time of the study, the school had graduated 1, 441 doctors (School of Medicine Strategic Plan, 2012-2016). For more than 40 years from inception in 1966 to 2010 the School conducted a traditional curriculum. Although the traditional curriculum did not specify the expected competencies for students by the end of training, medical students were expected to acquire clinical competence through apprenticeship during clinical clerkships. It was however not known as to whether or not graduates of UNZA-School of Medicine at the time of graduation had attained competency in core-clinical practical procedures as this matter had not been investigated prior to our study. Yet, it is worth noting that, in 2011 the school implemented an innovative curriculum following the school's self- evaluation against the World Federation of Medical Education (WFME) International Basic Medical Education Standards (IBMES).

3.5 Study Population and Sampling

The study population for our study were the sixty (60) 2012/2013 final year medical students of UNZA- School of Medicine. This population group was purposively selected based on the researcher's knowledge that the group would possessed the attributes (knowledge of, self-perceived and manifest competence in clinical practical procedures) to be measured in the study (LoBiondo-Wood and Haber, 2006; Burns and Grove, 2005 and Polite and Beck, 2012). In addition, this was the only group (at the time of the study-2013) on which the research questions could adequately be addressed (Teddlie and Yu,

2007). Therefore, selection of this group was based on the expectation/assumption that in the last six months of training medical students should be competent in selected clinical practical procedures to a level that they can safely practice as interns upon graduation (Lai, Sivalingam and Ramesh, 2007).

It was therefore assumed that assessing finalists' self-perceived and manifest competence towards the end of undergraduate training would give a general indication of the level of competence of graduating students. In addition as stated earlier, measuring students' level of competence near the end of training is critical for education as it gives an indication of the effectiveness of the teaching and learning methods employed (Lai, Sivalingam and Ramesh, 2007; Lai, Nalliah, Jutti, Hla and Lim, 2009).

Based on small population size, all those who accepted and consented to participate in the study answered the self-administered questionnaire that tested knowledge of selected clinical and practical procedures, and self-perceived competence, and determined the number of times clinical practical procedures were performed. Similarly all who accepted and consented were assessed on manifest-competence using their OSCE scores of selected clinical practical procedures.

For in-depth interviews, Theoretical sampling was used (Glaser, 1978), and sample size was determined using the principle of saturation (Burns and Grove, 2005; LoBiondo-Wood and Haber, 2006 and Polite and Beck, 2012). Glaser 1978 defined theoretical sampling as "the process of data collection for generating theory whereby the researcher

jointly collects, codes and analyses his/her data and decides what data to collect next and where to find the data, in order to develop his/her emerging theory.

The central question in theoretical sampling is: what groups or sub-groups does one turn to in data collection? (Tavarol, Torabi and Zeinaloo, 2006). That is selected participants are determined by emerging data and data analysis suggest further participants for further interviews. In our study, only one group (seventh year medical students) could adequately provide the information to answer the research question as they were at that time the only group which had undergone all clinical clerkships, thus they possessed information on how they had acquired competence in clinical practical procedures. The first candidate for the interview was purposively selected, that is, the class representative for the group. Subsequent participants were determined by emerging data. The most recently interviewed candidate was asked to suggest the name of the next participant. Data collection continued until saturation was reached when exploring further data could not add to the insights already gained (Tavarol, Torabi and Zeinaloo, 2006). Saturation was reached after interviewing 17 students.

3.6 Data Collection and Analysis

3.6.1 Knowledge of Clinical Practical Procedures

3.6.1.1 Data Collection for the Knowledge Test

Fifty-six (56) students from a class of 60 (93% response rate) of the final year medical students' class of 2012/2013 at the University of Zambia completed a 48-item multiple

choice question (MCQ) test. The knowledge test had 14 categories of questions, that is, 1) lumbar puncture, 2) cardiopulmonary resuscitation, 3) endotracheal intubation, 4) urethral catheterisation, 5) nasogastric intubation, 6) gastric Lavage, 7) examination of the new-born, 8) vaginal delivery, 9) vaginal examination, 10) examination of the placenta, 11) intravenous cannula insertion 12) suturing, 13) intramuscular drug administration, 14) intravenous drug administration.

The MCQs were purposively selected from relevant published question banks on each category (see appendix 1). The questions in the test focused mainly on the indications/contraindications, equipment used, principles of performing the procedure, correct technique, volumes or ratios, correct positions/sites/landmarks, and precautions while performing the procedures. The Q-Q plot test for normality revealed a normal distribution and Cronbach alpha for reliability was 0.774. Using a criterion referenced pass mark set at 60%, each answer script was manually scored for the right answer on all the items and totaled into a percentage to determine the knowledge level for each students.

The pass mark for the knowledge test in our study was determined using the classical Angoff Procedure. Angoff method is a criterion-based method of standard setting. This method uses experts in the field to determine the cut-off point/score. The cut-off score is defined as a score that a minimally competent candidate is likely to achieve (Canadian Association of Medical Technologists, 2006). This method was initially developed by Angoff in 1971. Although it has been modified, the classical Angoff method still

maintains the candidate's merit in reference to the test and an agreed achievement for pass standard. The original Andoff method was deemed appropriate because the expert determined pass mark for our study was only used once for the knowledge test and thus did not require subsequent modification. Using this method, all scores below the Angoff cut off point were deemed as failure. In our study, five local experts two from internal medicine, one from surgery, one from obstetrics and gynaecology and one from Paediatrics determined the pass mark depending on the difficulty level of each question. Two out of the five Angoff Panelist were Consultants while the other three were Senior Registrars, therefore they were considered experts in their medical fields.

It is worth noting that the classical Angoff method as postulated by William H Angoff in 1971 has undergone a number of modifications. One such modification was by Richard M. Jaeger. Jaeger developed the modified method to address the challenges of pass-marks set using the classical/original Angoff which are often perceive as too high once implemented (Ricker, 2006). The modified Angoff method requires that the standard setting panelists reconsider their initial item-level marks after reviewing examine-performance data on each item. In our study as indicated earlier, we utilized the classical Angoff method, because the knowledge test was taken once for the purposes of our investigation, as such there was no need for re-examination which could have necessitated the use of a modified Angoff method.

It is debatable that a written test of skills measures cognitive aspects of knowledge rather than hands-on performance, however studies have also shown that a written test has

sufficient reliability and predictive validity for performance on an OSCE particularly when group results are concerned (Van der Veleuten, van Luyk and Becker, 1989; Van der Vleuten, 1996; Kramer, Zuithoff and Dusman, 2002). When results of both an OSCE and a written test of Knowledge are combined, a high validity and reliability can be achieved (Verhoeven, Hamers and Scherpbier, 2000).

3.6.1.2 Data Analysis for the Knowledge Test

Following marking, responses from the MCQ knowledge test scripts was entered into SPSS version 17. The marking key was used to identify the correct answer for each question which was entered as the correct option for each respective question in SPSS. Following data entry, frequencies were computed for correct scores for each question. Computation of frequencies for each question determined the performance (Pass rate) of students on each individual question. The Q-Q plot test was performed which revealed a normal distribution. Given that the data for the knowledge test was normally distributed, descriptive statistics that is the Mean, Standard Deviation and Range were computed.

Since the self-administered questionnaire that had the MCQ knowledge test was also used to obtain information on demographic characteristics and clinical medical education context, self-perception of competence and number of times procedures were performed, responses on the other three components were entered onto SPSS at the same time as the knowledge test. Consequently, apart from computing frequencies for the knowledge test questions, frequencies for the all demographic variables and clinical medical education context, number of times procedures were performed and self-perceived competence

were computed at the same time. Findings on demographic characteristics are presented in section 4.3, those of the knowledge test in section 4.4.1, and those for self-perceived competence 4.4.2 and number of times procedures were performed in section 4.4.3

To test for association between the MCQ knowledge test scores and manifest-competence (OSCE scores), **Correlation coefficient (Pearson r) test was performed.** To facilitate rank order correlation of knowledge which were originally measured at interval level with other variables which were measured at ordinal level for example self-perception of competence, the knowledge test scores were re-categorized from the specific numeric scores in percentage form to ordinal level with three categories. The categories were; Fail (scores of 0-59% [below pass mark]), Bare Pass (score 60-80% [pass mark up to mid-point between pass mark and total]), and absolutes pass (score of 81-100% (above mid-point between pass mark and total]).

Following re-categorization, rank order correlations (**Spearman rho)** test was performed between: knowledge and self-perceived competence, and knowledge and number of times a procedure was performed. Correlation tests were performed to test our research hypothesis.

3.6.2 Self-perception of Competence on Selected Clinical Practical Procedures

3.6.2.1 Data Collection

Fifty-six (56) students from a class of 60 (93% response rate) of the final year medical students' class of 2012/2013 at the University of Zambia completed a questionnaire that required them to rate their perception of competence (on a 5-point Likert scale rating) on

14 clinical procedures : 1) Intravenous cannula insertion, 2) naso-gastric tube insertion, 3) gastric lavage, 4) urethral catheterisation, 5) lumbar puncture, 6) cardiopulmonary resuscitation, 7) endotracheal intubation, 8) wound suturing, 9) vaginal examination, 10) normal vaginal delivery, 11) examination of the placenta, 12) examination of the new born, 13) intravenous drug administration, and 14) intravenous drug administration. For each procedure, a student selected a corresponding level of self-confidence in doing the procedure, as shown in table 3.2. The five levels of self-perception of competence were later reduced to three for the purposes of data analysis.

Table 3.2 Self-Perception of Competency Scale & Analysis Categorisation

Self-Perception Competence Scale		**Data Analysis Categorisation**
1.	Grossly inadequate	Low Self-Perception
2.	Knows approach only in theory, not confident in real situation	
3.	Only competent in making certain decisions, needs seniors on constant standby	Moderate Self-Perception
4.	Reasonably competent, but needs seniors who are contactable for consultation	
5.	Very competent, can be relied on without supervision	High Self-Perception

Adapted from Lai N.M, Sivalingam, N., and Ramesh, J. C (2007)

Self-perception of competence in this study was operationally defined as 'reported ability to perform the 14 selected clinical practical procedures'. A Likert scale was therefore

suitable for measuring self-perceived competence as it allowed respondents to report themselves on a continuum with regard to the extent they agreed possessing an attribute being assessed (LoBiondo-Wood and Haber, 2006, Burns and Grove, 2005 and Polit and Beck).

The Likert scale that was used in this study was a modified version of one used to measure progress in medical students' self-perceived clinical competence and experience in practical procedures in the last six months of training at the International Medical School in Malaysia (permission requested and granted by first author- Dr. Lai Nai Ming- International Medical School Malaysia).

For each of the procedures included in the self-perception of competence questionnaire, students concurrently rated the frequency of experience on a 5-item Likert scale as shown in table 3.3. The five point Likert scale of experience was similarly reduce two three categories for the purposes of data analysis.

Table 3.3 Self-rated Experience Scale & Analysis Categorisation

Self-rated Experience with Procedure		**Data Analysis Categorisation**
1.	Never performed	Low Experience
2.	Performed 1-5 times	
3.	Performed 6-10 times	Moderate Experience
4.	Performed 11- 20 times	
5.	Performed more than 20 times	High Experience

With regard to the 14 selected skills, it is expected that in the last six months of undergraduate medical training, all students should be at least on level 3 for number of attempts at a particular procedure and level 4 of self-perceived competence on all items.

3.6.2.2 Data Analysis for Self-perception of Competence

Responses on self-perception of competence and number of times procedures were performed, were entered into SPSS version 17 at the same time as the knowledge test scores. Using SPSS, frequencies for the three levels of self-perception (low, moderate and high self-perception) were computed. In addition, frequencies for self-rated experience (low, moderate and high experience) with regard to number of times procedures were performed, were also computed at the same time. Findings on self-perceived competence and number of times procedures were performed are presented in section 4.4.2 and 4.4.3 respectively.

To test for association between self-perception of competence and the other three variables (manifest-competence, knowledge of clinical practical procedures and self-rated experience with procedures), rank order correlations (**Spearman rho)** test was performed as a means to testing the research hypotheses.

3.6.3 Manifest Competence on Selected Clinical Practical Procedures

3.6.3.1 Data collection

Manifest competence was measured in the final examination Objective Structured Clinical Examination (OSCE) held at the end of the 2012/2013 academic year for the final year medical students at University of Zambia. Fifty-six (56) of the 60 students

(93% response rate) consented to participate in our study. From the list of 14 categories of procedures that were measured in the knowledge test and 14 clinical practical procedures utilised in estimation of self-perception and frequency of experience, the investigator successfully negotiated to have three of the procedures included among the seven practical stations of the final OSCE. The investigator was aware of the need not to alter significantly by way of interfering in the natural settings of the OSCE. Since OSCEs are the prescribed means by which competency levels of students are assessed, the measure of manifest competence in our study therefore needed to be as close to reality as possible rather than stage managed.

The three procedures utilized in the study were, cardiopulmonary resuscitation, insertion of a nasogastric tube and intravenous drug administration. On all the practical OSCE stations, students were required to "show how" a procedure is done using a manikin. In addition to showing how, students were also require to give a running commentary of the requirements during the performance of the procedure, structures involved and the standard practice. Being a final examination, clinical experts in the clinical departments determined the OSCE stations, observed and scored the performance (manifest-competence) of students using structured checklist as normally done during OSCEs. The pass mark for OSCE was determined by the School at 50%.

Despite the short comings of observations, including behavior distortions when participants are aware of being observed (Polit and Beck, 2012 and Burns and Grove, 2005), OSCEs were selected as the main method for measuring manifest- competence as

this is the method the School uses to assess clinical competence of medical students. OSCE is also a recommended method for measuring clinical competence; it fulfills the criteria of validity, reliability and practicality (O'Connor and McGraw, 1997; Townsend, et al, 2001; Wass, et al, 2001; Elzubier and Rizk, 2003 and Harden, et al, 1975 cited in Auewarakul et al, 2005).

From the 56 consenting students, 10 students were randomly selected for the retrospective 'Think Aloud' protocol in which they recounted exactly the thought process in completing the clinical practical procedures on the practical OSCE stations (Se appendix IV). A retrospective approach to Think-Aloud was utilized in our study since students were asked to narrate their thought processes after performance of the procedure and not during the process.

The Think Aloud Protocol was administered immediately after the OSCE. The researcher administered the protocol in form of a structured interview. The verbal reports were recorded and analysed qualitatively. The narrative data obtained through the protocols allowed researchers to understand at least in part the thought process of students while they were completing the clinical procedures/tasks during OSCE (Ericsson and Simon, 1993 and Young 2005). Considering that the researcher had no formal relationship with the students with regards to teaching of clinical skills, this would have minimized any bias with regard to questioning during the Think Aloud process, and the reporting and interpretation of the verbal reports. In addition, the Think Aloud protocol was administered after the OSCE which was the final medical school assessment thereby

reducing chances of students reporting what would be academically acceptable as they narrated their thought processes.

3.6.3.2 Data analysis for Manifest-Competence

Results of OSCE (manifest competence) for each candidate were entered onto SPSS as percentages scores (internal level), and as re-categorized; not-competent, barely-competent and absolutely- competent (at ordinal level). Frequencies for pass/fail rate were computed using pass mark of 50% (school pass mark). In addition, frequencies for levels of manifest-competence (not-competent, barely-competent and absolutely-competent) were also computed and results are presented in figure 4.6.

To test for association between and manifest-competence (OSCE scores) and the MCQ knowledge test scores, **Correlation coefficient (Pearson r) test was performed.** Since the manifest competence and knowledge test data were in in form of percentage scores (interval level), Pearson r test was the most appropriate statistical test to be performed. To facilitate rank order correlation of manifest competence (OSCE scores) which was originally at interval level with other variables which were measured at ordinal level for example self-perception of competence, OSCE test scores were re-categorized from the specific numeric scores in percentage form to ordained level with three categories. The categories were; not competent (Score of 0-49%), barely competent (Score of 50-75%) and absolutely competent (Score 76 to 100%), see figure 4.6.

Re-categorization of OSCE scores meant that the three variables; manifest competence, self-perceived competence and number of times practical procedures were performed were all at ordinal level of measurement. Consequently, rank order correlations (**Spearman rho)** test was performed between; manifest-competence and self-perceived competence, and manifest-competence and number of times a procedure was performed. In addition to the three variables being measured at ordinal level, 93% of the study population participated in the study. With only 7% of the population not participating, the response level was sufficient to support the claim that the population of interest was adequately represented. We therefore asserted that the responses or data obtained were an adequate approximation of the population characteristics. Therefore the use of Spearman rho which is a population level statistic was appropriate.

3.6.4 How Students Learn and Develop Competency in Clinical Practical Procedures

Seventeen (17) students from a class of 60 final year medical students' class of 2012/2013 at the University of Zambia participated in semi-structured in-depth interviews in which they answered six questions in the interview guide (Appendix II). Finds from the in-depth interviews answered the first research question "How do Undergraduate Medical Students of the University Of Zambia acquire competency in clinical practical procedures during clinical years?", and constituted the qualitative component of our study.

Notwithstanding limitations of self-reports (interviews) with regard to validity and accuracy (Burns and Grove, 2005; LoBiondo-Wood and Haber, 2006, and Polit and Beck, 2012), interviews in our study allowed gathering of retrospective data on events that had occurred in

the past regarding how students learnt and developed competency in the selected clinical practical procedures. Two questions that were key for investigating how students learned clinical practical skills and how they developed competency were: a) "How did you first learn the clinical practical procedures that you fell competent in? And, b) "What steps did you take to develop to the level of competence you have reached?

Through the two questions, the medical students described *how they first learnt* the practical procedures and *steps they took to develop* from that initial learning to the level where they felt competent to perform the procedures without or with minimal supervision. It is from these two questions where themes emerged on the "acquisition and development of competence" in clinical practical clinical procedures. The other questions simply provided additional information on the process of acquiring and developing clinical competence. In addition, the findings from other questions were used to validate/answer/clarify/support the results obtained from the quantitative arm.

For this component of the study, Theoretical Sampling (Glasser, 1978) was used and it determined the sample size. The first candidate for the interview was purposively selected who was the class representative and then requested to suggest the name of the next student who should be interviewed based on the respondent's perception on who would be suitable to provide more information about how students learn clinical practical skills. Data collection was continued until the answers were no longer yielding any new information – saturation (Burns and Grove, 2005; LoBiondo-Wood and Haber, 2006 and Polite and Beck, 2012).

The method was informed by Glaser (1978) in which the process of data collection for generating theory is jointly collected, coded, and analysed and the researcher decides what

data to collect next and where to find the data, in order to develop the emerging theory. Using grounded theory principles (Tavaroi, Torabi and Zeinaloo, 2006) the data was analysed mainly through reading- and re-reading of the transcribed interviews and comparison of the transcribed interviews against audio records. Additional analysis was performed after the transcribed data was exported into ***nvivo*** version 10, in which the recurring terms or themes which were identified during the reading and re-reading were used as search items for identification of additional themes.

The identified themes were compared, revised and re-grouped into broader themes and coded in different nodes in the software. Finally, 11 themes were identified, seven regarding how students "first learnt" clinical practical skills and four on steps they took to develop competence on the learnt skill. The investigator then generated a model of how students learned and developed competence in clinical practical skills based on qualitative data themes and theoretical interconnections as best-represented by the data according to the investigator (Figure 4.7-The Grounded Theory Model).

3.7 Threats to Validity and Reliability

As a strategy for ensuring validity and reliability of the study results, all data collection instruments were subjected to scrutiny by clinical experts and research supervisors. Clinical experts reviewed items in the MCQ knowledge test and self-perception questionnaire for content coverage based on the 14 selected skills. In addition, the MCQs in the knowledge test were purposively selected from relevant published question banks on each category and are referenced as such (see appendix 1). To ensure content validity which is the most essential for written assessments, (Downing, 2003), items in the

knowledge test covered skills from internal medicine, surgery, obstetrics and gynaecology and paediatrics.

Furthermore some of the tools for example the self-perception of competence questionnaire had been validated and used before except for a few modifications made to suit the scope of the current study. The questionnaire had been used before to measure students' self-perceived clinical competence and experience in practical procedures in the last six months of training at the International Medical School in Malaysia (permission requested and granted by first author- Dr. Lai Nai Ming- International Medical School Malaysia).

Since manifest competence was measured using the end of final year OSCE, out of the 7 practical stations of the OSCE, the investigator successfully negotiated to have three of the procedures included in the knowledge test and self-perception questionnaire among the seven stations. Although this could have paused as a threat to validity in that only three out of the 14 procedures used to measure knowledge and self-perception were used to measure manifest competence, the investigator was alive to the need not to alter significantly by way of interference with the natural settings of the OSCE examination. The measure of manifest competence needed to be as close to reality as possible rather than stage managed. Suffice to note that the entire OSCE had only seven practical station in that OSCE as competence-based assessments are designed to measure not only psychomotor skills but cognitive such as clinical reasoning, and affective such as

emotions and values when dealing with patients (Newbel, 1994 & Lai, Sivalingam and Ramesh, 2007).

The fact that we could not could not identically match all the clinical procedures in the self-perception and the manifest competence assessment, was acknowledged as a major limitation or imperfection in our study design. However, we believe the findings still provided enough credibility and fidelity, since the three included procedure were compared in terms of knowledge levels, self-rated experience and manifest versus self-perception of competence.

Validity and reliability by the use of OSCE in measuring manifest competence. The use of OSCE in itself met the criteria of validity and reliability in that it is an objective method for measuring clinical competence; it fulfills the criteria of validity, reliability and practicality (O'Connor and McGraw, 1997; Townsend et al, 2001 and Auewarakul et al, 2005; Gormley, 2011). In addition the observation and scoring during the OSCE was done by clinical experts who had no interest in the research thus eliminating the aspect of researcher bias from the manifest competence scores. Furthermore, in our study, 93% of the population participated, we therefore acknowledged that 7% non-response could have threatened the findings' validity, however, the threat to validity was likely to be negligible.

To ensure reliability, the semi-structured interview schedule, the knowledge test and the self-perception of competence questionnaire were pretested. To ensure internal consistency, all items in the knowledge test, self-perception of competence questionnaire

focused only focus on the 14 selected skills. In addition the internal consistency for the MCQ knowledge test was evaluated using Cronbach's alpha, and yielded a 0.774. Furthermore, the use of mixed methods approach and in particular the use of multiple data collection tools from both the quantitative and qualitative paradigms, that is the MCQ knowledge test, self-perception of competence questionnaire, checklists for the Objective Structured Clinical Examination, Think-Aloud protocol and in-depth interviews is believed to have heightened the validity and reliability from the positivism point of view (Polit and Beck, 2012), and the dependability and trustworthiness of the results from the naturalistic point of view (Zohrabi, 2013).

3.8 Pre-test for the Data Collection Tools

Data collecting instruments were pre-tested on 5th year medical students of the University of Zambia. Being in their first clinical year, these students were not similar to the final year students however, this group was chosen as at the time of data collection (February to April, 2013) there was no other set of final year medical students in Zambia. Other three Medical Universities in the country were all established in 2011; as such they only had pre-clinical students. A sample of the fifth year students that is 10% of study population was used for pre-testing. The purposes of the pretest were; to determine the time required to administer the instruments, assess whether sequencing of questions was sensible, and to assure understanding of instruments by participants. Pre-test was also used to determine validity and reliability of instruments (Polit and Beck, 2012). Following the pre-testing the only adjustments made were in the sequencing of the MCQ

test items and in some areas the phrasing used in constructing MCQs which the participants in the pre-test had indicated that they were not well sequenced and phrased.

3.9 Ethical Considerations

The study proposal was submitted to the Biomedical Research Ethics Committee of the University of Zambia-School of Medicine to seek approval. Following approval, written permission was sought from the Dean-School of Medicine and the Coordinator for the MBChB Programme.

Prior to administration of any of the instruments, detailed explanation of the project was done with regard to the purpose, procedures, possible risks or discomforts and benefits. Potential participants were informed that should they agree to participate, their computer numbers will be used exclusively for the purposes of correlating findings from different instruments for example results from knowledge test with self-perception and manifest competence. In addition, it was emphasized that if they agreed to have their OSCE results utilized, the investigator was not going to obtain the results from the Clinical Departments until after publication by the school. However most students were unwilling to give their computer numbers for the knowledge test and self-perception questionnaire to avoid being identified. Auspiciously, 56 out of 60 were willing to have their OSCE results utilized for the study since this was going to be done after graduating from school. The refusal to provide computer numbers was accepted by the investigator. Therefore only group and not individual comparisons were made.

Assurance of anonymity with confidentiality was made to all who agreed to participate at different levels of data collection. To ensure confidentiality, all information obtained was kept in a private lockable cabinet and only the principal investigator had access to it.

Potential participants were finally informed about their rights to withdraw at any time during the course of the study if desired, and assured that their decision will not affect their education in anyway. Those who accept to take part were requested to sign an informed consent form.

In our study participants were not be subjected to any physical harm as the research did not involve any interventions and/or invasive procedures. Participants were also protected from psychological harm in the following ways:

3.9.1 Multiple Choice Question Knowledge Test and Self-perception of Competence Questionnaire

Participants answered the MCQ Knowledge Test and Self-perception of Competence Questionnaire in a naturalistic environment that is the main lecture theatre which was their usual natural setting for lectures and other learning activities.

3.9.2 In-depth Interviews

Interviews were conducted on one to one basis between the investigator and the participant. Participants were interviewed in the School of Medicine Clinical Skills

Laboratory. Although the interviews were recorded, participants were assured that no names but numbers were attached to the interview scripts.

3.9.3 Observations during OSCE

Being observed triggers anxiety. However in this study, the investigator did not do an independent observation of manifest-competence instead she used the final examination OSCE scores. Observations and scoring was conducted by the usual teaching staff, thus there was no additional stress imposed on participants except for the usual examination stress. In addition, students were already familiar with the task trainers used for the practical stations as these had been used for other prior examinations.

There was no immediate benefit for participating in the study, however participants were informed of potential benefits to future students in that the results of the study may be used to inform teaching, learning and assessment of clinical and practical skills for possible enhancement if need be.

Table 3.4: Research Methodology Summary

Research questions	Overall Design	Type of Mixed Method	Specific Paradigm	Variables to be measured	Data Collection Techniques and data type	Data Analysis
How do Undergraduate Medical Students of the University of Zambia acquirecompetence in selected clinical practical procedures during clinical years?	Non-interventional cross sectional correlation study using **mixed method approach**	Concurrent transformative with concurrent embedded strategy correlation study qualitative QUANTITATIVE (Qualitative method embedded/nested in the quantitative) Conceptual model (Dave's 1970 psychomotor domain, Dreyfus 1986 Model of Clinical Skill Acquisition and Miller's 1990 Pyramid of clinical competence)	Interpretivism (Qualitative) addressing question 1	Acquisition of competence in clinical practical procedures	In-depth interviews (qualitative data)	Using Grounded theory - data collection and analysis was conducted concurrently • Transcribed data was imported into Nvivo version 10 • Performed text search to identify themes • Coded themes. • Developed conceptual model of competence acquisition
What is the clinical practical procedures knowledge level of final Year Medical Students of the University of Zambia in the last six months of the undergraduate education?			Positivism (quantitative) addressing question 2	Knowledge level of core-clinical practical procedures	Self-administered questionnaire of knowledge test (quantitative data)	Using SPSS we performed: • Rank order coefficients of correlation (**Spearman rho**) for self-perceived competence and Knowledge of clinical practical procedure, and self-perceived and manifest competence • Correlation coefficient **(Pearson r)** for Manifest-competence (OSCE scores) and knowledge test scores • Linear regression for Manifest competence and knowledge test as not done because **r** = was less than 0.645 although **Q-Q plot** for the two variables showed normal distribution • Alpha = 0.05 • Confidence Interval = 95% • **Mean and SD** for knowledge and manifest competence were calculated because **Q-Q plot showed normal distribution of the two variables**
How does self-perception of competence compare with manifest-competence in selected core-clinical practical procedures among UNZA Final Year Medical Students in the last six months of training?			Positivism (quantitative) addressing question 3	Self-perceived competence in clinical practical procedures	Self-administered Likert scale questionnaire (quantitative data)	
				Manifest - competence in clinical practical procedures	-Structured observation during OSCE (quantitative) -Think- Aloud Protocols (qualitative)	

4.0 CHAPTER 4: RESULTS

4.1 Introduction

The present study sought to answer three research questions and test four research hypotheses as indicated below:

Research Questions

i. How do Undergraduate Medical Students of the University Of Zambia acquire competency in clinical practical procedures during clinical years?
ii. What is the knowledge level of clinical practical procedures of Final Year Medical Students of the University of Zambia in the last six months of the undergraduate medical education?
iii. How does self-perception of competence compare with manifest-competence in selected clinical practical procedures among University of Zambia Final Year Medical Students in the last six months of training?

Research Hypotheses

Null hypotheses: There is no association between the following factors:

i. Self-perceived competence and manifest competence of Final Year Medical Students of the University of Zambia in core-clinical practical procedures of the undergraduate curriculum.
ii. Self-perceived competence and knowledge of core-clinical practical procedures of Final Year Medical Students of the University of Zambia

iii. Self-perceived competence of Final Year Medical Students of the University of Zambia in core-clinical practical procedures and the number of times a procedures is performed

iv. Manifest-competence and knowledge of core-clinical practical procedures of Final Year Medical Students of the University of Zambia

The first research question "How do Undergraduate Medical Students of the University Of Zambia acquire competency in clinical practical procedures during clinical years?" was answered through the structured in-depth interviews which constituted the qualitative component of this study and the findings are presented in section 4.4.6 of this chapter. The second question "What is the clinical practical procedures knowledge level of Final Year Medical Students of the University of Zambia in the last six months of the undergraduate medical education?" was answered through the Multiple Choice (MCQ) Knowledge test whose results are presented in Section 4.4.1 of this chapter. While the third and last question "how does self-perception of competence compare with manifest-competence in selected clinical practical procedures among University of Zambia Final Year Medical Students in the last six months of training" was answered partially through the a self-administered five-point Likert Scale of Self-perception of competence and partly through the Objective Structured Clinical Examination whose results are presented in section 4.4.2 and 4.4.4respectively. The second and third question constituted the quantitative component of the study.

4.2 Summary of Research Findings

The study revealed the following:

4.2.1 Acquisition and Development of Competence in Clinical Practical Procedures

Research question 1: How do undergraduate medical students of the University of Zambia acquire competency in clinical practical procedures during clinical years? Medical students at UNZA acquire and develop competence in clinical practical procedures through four development stages: “Passive Observation, Guided Performance, Unguided Performance and finally Peer Teaching” (See Figure 4.7).

4.2.2 Knowledge of Clinical Practical Procedures

Research question 2: What is the clinical practical skills knowledge level of final year medical students of the University of Zambia in the last six months of the undergraduate medical education? The knowledge levels of clinical practical procedures of the final year medical students were found to be inadequate represented by a 39% pass rate on a 48-item MCQ test. Mean score 53.38, Standard Deviation 10.44, Range 50 and Skewness -124. When individual questions were analyzed, the highest correct score was on a question on vaginal examination where 80.4% of students answered the question correctly followed by a question on CPR and IV cannulation each with 78.6% of students answering the question correctly, while the worst performance was on a question on endotracheal intubation with 12.5% pass rate. As expected, vaginal examination and CPR were among the top five procedures where more than two thirds of participants indicated having been formally taught at 82.1% and 76.8% respectively.

4.2.3 Relationship between manifest and self-perceived competence

Research question 3: How does self-perception of competence compare with manifest competence in selected clinical practical procedures among University of Zambia final year medical students in the last six months of training? There was negative correlation between self-perception (moderately competent for most respondents) and manifest competence (barely competent for most respondents) on the seven practical stations of the OSCE (Spearman rho -.123 and P value 0.451), and on two out of the three specific individual procedures included in the OSCE. The correlations (Spearman rho) between self-perceived and manifest competence for the three procedures were: cardiopulmonary resuscitation (-.150, P value 0.270), intravenous drug administration (-.521, P value 0.000) and Nasogastric Tube insertion (.128, P value 0.346).

Our study further revealed a negative correlation between knowledge of clinical practical procedures (test scores) and manifest-competence (OSCE scores) Pearson r -.116 and P value 0.395. However, the study revealed significant association between self-perceived competence and the number of times procedures were performed P value =0.000 and Spearman rho 0.548. Similarly a significant association was revealed between self-perceived competence and knowledge of clinical practical procedures with P value = 0.007 and rank-order correlation Spearman rho of 0.360.

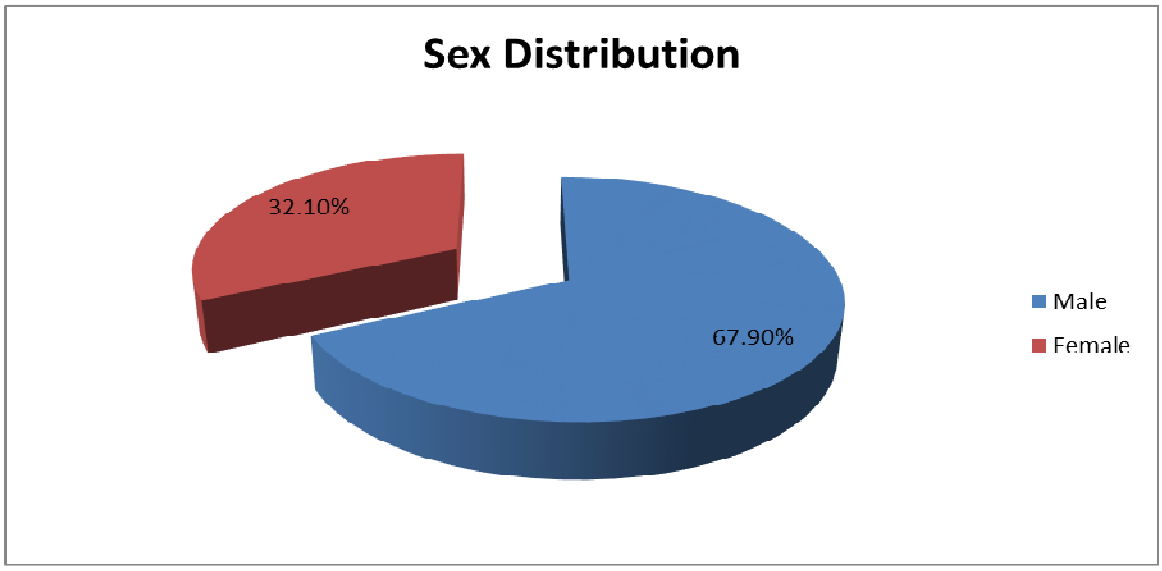
Although inferential statistics (alpha levels) were computed and were presented in our study, focus and discussion is on population level statistics (correlation co-efficient Pearson r and rank order coefficients of correlation - Spearman rho) since almost the

entire population (93%) participated in the study. It is assumed that with such a high level of participation, the correlation values reported adequately commutated the information about the population thereby eliminating the need for making inferences. In addition, it is worth noting that since student's identification numbers were not utilized, it meant that individual student performance could not be identified, therefore, all computed correlations in this study were done at group and not individual level as

4.3 Demographic Characteristics and Clinical Medical Education Context

The only demographic variable deemed relevant in our study was gender. In addition, relevant clinical information was also obtained which included; training in other health related fields prior to MBChB, clinical rotations (clerkships) in the different Medical and Surgical Specialties, practical procedures formally taught and formally assessed respectively.

Figure 4.1 Gender Distribution



The majority of the participants were male 38 (67.9%) compared to only 18 (32.1%) females.

Table 4.1 Training in other health care related fields prior to MBChB

Training in other health care related fields apart from MBChB	Frequency	Percentage	Cumulative Percentage
Yes	5	8.9	8.9
No	49	87.5	96.4
No Response	2	3.6	100
Total	54	100	

Only 5 (8.9%) of the respondents had training in other health care related fields prior to MBChB while 49 (87.5%) had not had.

Table 4.2 Clerkships in the following in Medical and Surgical Specialties

No.	Clerkship	Clerkship Undertaken		Total
		Yes	No	
1.	Internal Medicine	56 (100%)	0	100%
2.	Surgery	56 (100%)	0	100%
3.	Obstetrics and Gynaecology	56 (100%)	0	100%
4.	Paediatrics	56 (100%)	0	100%
5.	Psychiatry	56 (100%)	0	100%
6.	Ophthalmology	56 (100%)	0	100%
7.	Community Medicine	56 (100%)	0	100%
8.	Dermatology	56 (100%)	0	100%
9.	Orthopedics	56 (100%)	0	100%
10.	ENT/Maxillofacial	56 (100%)	0	100%
11.	Radiology	56 (100%)	0	100%

All the56 (100%) respondents had had clerkships in all the designated medical disciplines and their sub-specialties.

Table 4.3 Practical Procedures Formally Taught n=56

Practical Procedures	Formally Taught		TOTAL
	Yes	No	
Cardiopulmonary Resuscitation	46 (82.1%)	10 (17.9%)	100%
Normal Vaginal Delivery	46 (82.1%)	10 (17.9%)	100%
Vaginal Examination	43 (76.8)	13 (23.2%)	100%
Lumbar Puncture	39 (69.6%)	17 (30.4%0	100%
Examination of the new born	37 (66.1%)	19 (33.9%0	100%
Endotracheal Intubation	35 (62.5%)	21 (37.5%)	100%
Examination of the Placenta	33 (58.9)	23 (41.1)	100%
Intravenous Cannula Insertion	31 (55.4%)	25 (44.6%)	100%
Urethral Catheterization	31 (55.4%)	25 (44.6%)	100%
Nasal Gastric Tube Insertion	29 (51.8%)	27 (48.2%)	100%
Gastric Lavage	25 (44.6%)	31 (55%)	100%
Wound Suturing	24 (42.9%)	32 (57.1%0	100%
Intramuscular drug Administration	21 (37.5%)	35 (62.5%)	100%
Intravenous drug administration	8 (14.3%)	46 (82.1%)	100%

Table 4.3 shows that significantly large number of students had no formal teaching in most of the clinical practical procedures. It further shows major variations in the numbers of students who were formally taught in the 14 selected practical procedures. The least formally taught was administration of intravenous drug with only 8 (14.3) of the students reporting having been formally taught. Procedures that received the highest score for being formally taught are Cardiopulmonary Resuscitation and normal vaginal delivery at 46 (82.1) %. Other where at least two thirds of students were formally taught were examination of new born, Lumbar puncture and vaginal examination.

Table 4.4 Practical Procedures Formally Assessed

Practical Procedures	Formally Assessed			TOTAL
	Yes	No	N/R	
Lumbar Puncture	52 (92.9%)	2 (3.6%)	2 (3.6%)	100%
Normal Vaginal Delivery	31 (55.4%)	23 (41.1%)	2 (3.6%)	100%
Examination of the Placenta	30 (53.6%)	24 (42.9%)	2 (3.6%)	100%
Vaginal Examination	25 (44.6)	29 (51.8%)	2 (3.6%)	100%
Cardiopulmonary Resuscitation	17 (30.4%)	37 (66%)	2 (3.6%)	100%
Examination of the New Born	15 (26.8%0	39 (69.6%)	2 (3.6%)	100%
Intravenous Cannula Insertion	12 (21.4%)	42 (75%)	2 (3.6%)	100%
Endotracheal Intubation	11 (19.6%)	43 (76.8%)	2 (3.6%)	100%
Urethral Catheterization	10 (17.9)%	44 (78.6%)	2 (3.6%)	100%
Nasal Gastric Tube Insertion	9 (16.1%0	45 (80.4%)	2 (3.6%)	100%
Intramuscular Drug Administration	9 (16.1%)	45 (80.4%)	2 (3.6%)	100%
Intravenous drug administration	8 (14.3%)	46 (82.1%)	2 (3.6%)	100%
Wound Suturing	7 (12.5%)	47 (83.9%0	2 (3.6%)	100%
Gastric lavage	7 (12.5%)	47 (83.9%0	2 (3.6%)	100%

* N/R None Response

Table 4.4 show proportion of students who were formally assessed on the 14 selected practical procedures. Majority had no formal assessment in most of the clinical practical procedures. The least formally assessed was wound suturing where only 7 (12.5%) of participants indicated having been formally assessed followed by intravenous drug administration at 8 (14.3%). The highest formally assessed practical procedure was lumbar puncture where 52 (92.9%) of participants reported having been formally assessed.

4.4 RESULTS OF KEY RESEARCH QUESTIONS

4.4.1 Knowledge of Clinical Practical Procedures

Data presented in this section was derived from the analysis of MCQ knowledge test. Questions in the knowledge test focused on different cognitive aspects of the 14 selected clinical practical procedures. Presented in this section is the pass/fail rate for the test, categories of knowledge and the frequencies for correct scores on selected number of questions from the knowledge test.

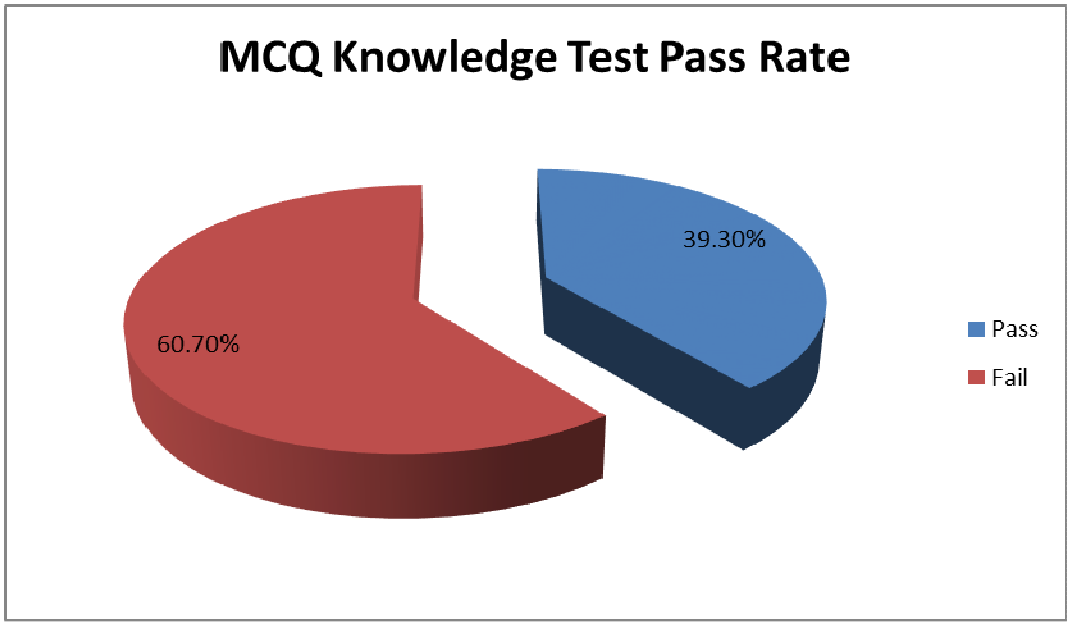


Figure 4.2 Criterion Referencing (Pass/fail rate). Angoff Pass Mark at 60%. N=56

Using criterion referencing for grading with Angoff Pass mark at 60%, only 22(39.3%) of participants passed the knowledge test.

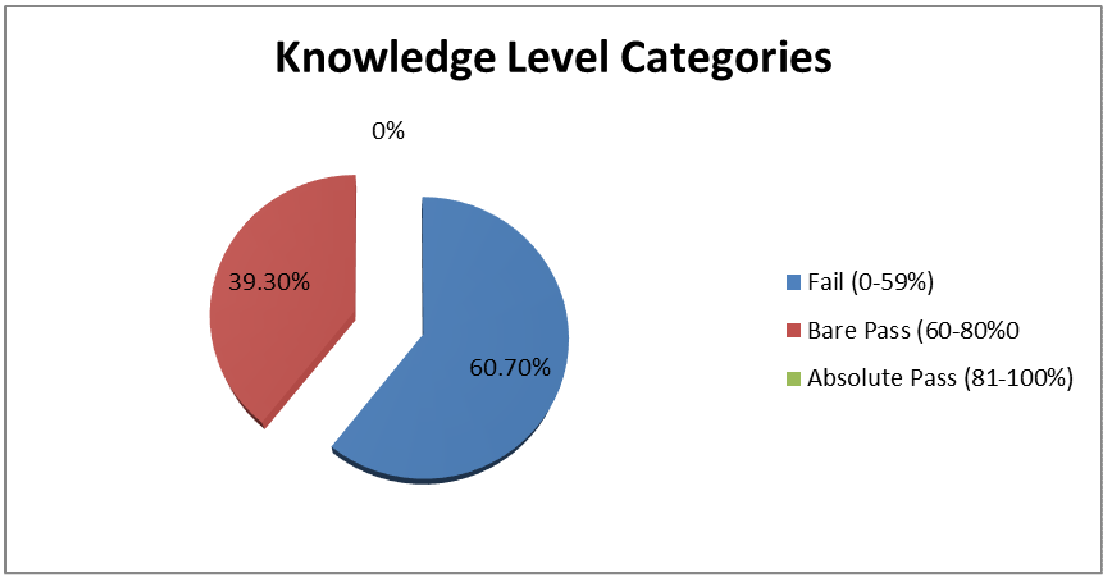


Figure 4.3: Knowledge Levels Categories n=56

Figure 4.3shows the knowledge levels of participants when grouped into three categories. Twenty-two (39.3%) of the participants passed the knowledge test. However, none of the participants had an absolute pass score (>80%). Majority 34 (60.7%) failed the test. The Mean Score was 53.4 (SD 10.44). The Range was 50 and Skewness -124, indicating a wide difference between the highest and lowest score and that most scores were skewed to the left or below average.

Table 4.5 Knowledge Scores (Percentage) on Selected Questions on frequently encountered Practical Procedures

Practical Procedure	Question(s)	Number of students with correct score (n=56)	Angoff Pass Mark for the question	Percentage of student with correct score	Level of difficulty
Cardiopulmonary Resuscitation (CPR)	Recommended rate of (CPR) compressions	44	57.5%	78.6%	0.78
	Recommended universal compression-to-ventilation ratio for all ages (except newborn infants)	29	56%	51.8%	0.52
Intravenous cannula insertion	Correct technique to follow as one advances cannula into center of the vein.	43	40%	76.7%	0.76
Urethral catheterization	During catheterization, once urine flows, how much further should the catheter be advanced in females?	20	57%	35.7	0.35
Nasogastric tube insertion	Correct technique when inserting an NG tube	17	60%	30.4%	0.30
Gastric lavage	Contraindications for gastric lavage	34	70%	60.7%	0.60
Lumbar puncture (LP)	Actions to take if you encounter bone resistance while advancing the needle when performing LP	25	66.2%	44.6%	0.44
	While advancing a LP needle which of the following is an indicator forreaching the subarachnoid space	16	61	28.6%	0.28
Endotracheal intubation	Minimum recommended distance above the carina for proper placement of ETT	23	33.3%	41.1%	0.41
	The best clinical sign that the ETT is in the trachea and not the esophagus?	7	68.3%	12.5%	0.12
Suturing	Correct technique for tying a surgical knot	37	58.7	66.1%	0.66
Vaginal examination	Correct interpretation of fetal presenting part for a head that is visible at vaginal introitus	45	84	80.4%	0.80
Normal vaginal delivery	Regularity of assessing uterine contractions in the first stage of labour for	38	73%	67.9%	0.67

	normal labour				
Examination of placenta	Most likely diagnosis for a greenish appearance of fetal surface of the placenta on gross inspection	38	82%	68.9%	0.68
	Most likely diagnosis for an umbilical cord length 100 cm for a normal full term newborn infant	27	63%	48.2%	0.48
Examination of the newborn	Determining an APGAR score 1 minute after birth for a newborn appearing blue in color, heart rate of 40/minute, no respirations, is flaccid with no movement, and does not respond to stimulation.	28	65%	50%	0.50
Intramuscular (IM) drug administration	Correct angle for administer an intramuscular injection	29	61%	51.8%	0.51
	Maximum volume of drug allowable per IM site?	28	65%	50%	0.50
	Recommended muscle for IM injection in infants	12	60%	21.4%	0.21
Intravenous drug Administration	Determining rate of flow for 1000mls or normal saline with 300mg of aminophyline to be administered in 8 hours	33	57.5%	58.9	0.58

* Angoff pass mark= proportion of students who according to experts are expected to get the item correct
* Level of Difficulty= proportion of students with correct scores on an item.

Table 4.5shows the proportions of students with correct scores on selected Multiple Choice (MCQs) from the knowledge test in comparison to the Angoff determined pass mark. The best performance with 80.4% pass rate was on a question about vaginal examination (correct interpretation of fetal presenting part for a head that is visible at vaginal introitus), followed by knowledge of recommended CPR compressions where 78.6% of the respondents knew the recommended compression rate for adults. The worst performance with 12.6% pass rate was on a question on endotracheal intubation regarding the best clinical sign that the ETT is in the trachea and not the esophagus. Other poor performance were noted on questions regarding

intramuscular injections (21% pass rate), lumbar puncture (28% pass rate), nasogastric tube insertion (30%), and urethral catheterisation (36%).

When individual questions were analyzed (item analysis) there were major variations in the levels of difficulty for different questions. The question on endotracheal intubation was more difficulty (0.12) compared to the question on VE (0.80) and CPR (0.78).It is worth noting that on most questions, the Expert (Angoff) determined pass mark was higher than the actual student scores. The detailed analysis of performance on the other selected MCQ is as indicated in table 4.5 above.

4.4.2 Self-perception of Competence on Selected Clinical Practical Procedures

To measure self-perception of competence on the 14 selected clinical practical procedures, a five point Likert scale was used. Table 4.6 presents a key to the self-perception questionnaire categories and result interpretation following re-categorization. Levels of self-perceived competence on individual procedures are presented in table 4.7, while the overall levels of self-perception are presented in figure 4.4.

Additionally Table 4.10 presents that the comparison of self-perception and experience on a selected number of clinical practical skills. In order to test the two hypotheses (number two and three), out of the four research hypotheses, rank order correlation were computed between self-perception of competence and knowledge of clinical practical procedures, and self-perception and number of times practical procedures were performed. Results of the correlations are presented in table 4.11 and table 4.12.

Table 4.6: Key to Self-perception Questionnaire Categories and Result Interpretation

Questionnaire Category		Self- Perception Interpretation
1.	Grossly Inadequate	Low Self-Perception
2.	Knows Approach only in Theory	
3.	Only Competent in making certain Decisions	Moderate Self-Perception
4.	Reasonably Competent	
5.	Very Competent	High Self-Perception

Table 4.6 provides a key to the self-perception questionnaire categories and the interpretation. The categories of self-perception ranged from: 1= grossly inadequate, 2= knows approach only in theory, 3= only competent in making certain decisions, 4= reasonably competent and 5= very competent. Prior to data entry, grossly inadequate, and knows approach only in theory were re- categorized as Low Self-Perception, only competent in making certain decisions and reasonably competent as Moderate Self-Perception, and very competent as High Self-perception**.**

Table 4.7 Levels of Self-Perceived Competence on 14 Selected Practical Procedures n=56

	Level of Self-perceived Competence				
Procedure	**Low Self-perception**	**Moderate self-perception**	**High self-perception**	**NR**	**Total**
Intravenous cannula insertion	0(0.0)	23(41.1)	31(55.4)	2(3.6)	**56(100)**
Normal vaginal delivery	0(0.0)	26(46.4)	28(50)	2(3.6)	**56(100)**
Vaginal examination	0(0.0)	31(55.4)	21(37.5)	4(7.1)	**56(100)**
Urethral catheterization	0(0.0)	31(55.4)	23(41.1)	2(3.6)	**56(100)**
Intramuscular drug administration	2(3.6)	27(48.2)	21(37.5)	6(10.7)	**56(100)**
Intravenous drug administration	4(7.1)	29(51.8)	23(41.1)	0	**56(100)**
Examination of the placenta	4(7.1)	20(35.7)	26(46.4)	6(10.7)	**56(100)**
Examination of the newborn	9(16)	27(48.2)	20(35.7)	0	**56(100)**
Lumbar puncture	8(14.3)	39(69.6)	5(8.9)	4(7.1)	**56(100)**
Nasal Gastric tube insertion	18(32.1)	33(58.9)	5(8.9)	0	**56(100)**
Wound suturing	11(19.6)	34(60.7)	8(14.3)	3(5.4)	**56(100)**
Endotreacheal intubation	28(50)	23(41.1)	1(1.8)	4(7.1)	**56(100)**
Gastric Lavage	33(58.9)	14(25)	2(3.6)	7(12.5)	**56(100)**
Cardiopulmonary Resuscitation	34(60.7)	20(35.7)	2(3.6)	0	**56(100)**

In four out of the 14 selected practical procedures, none of the participants had low self-perception of competence, instead they had either moderate or high self-perception. High self-perception was reported on insertion of intravenous cannula and in conducting normal vaginal deliveries with at least 50% of students perceiving themselves as highly competent. The lowest self-perception was in performing CPR where 34 (60.7%) of participants had low self-perception, followed by gastric lavage at 33 (58 9%) and endotracheal intubation at 28 (50%).

Moderate self-perception of competence was recorded for lumbar puncture (n-39, 69.6%), wound suturing (n=34, 60.7%), nasogastric tube insertion (n=33, 58.9%), vaginal examination and urethral catheterisation (n=31, 55.4% each).These are common day-to-day clinical practical procedures performed on the ward and it is therefore worrisome that mastery, measured with self-perception, is not pervasive.

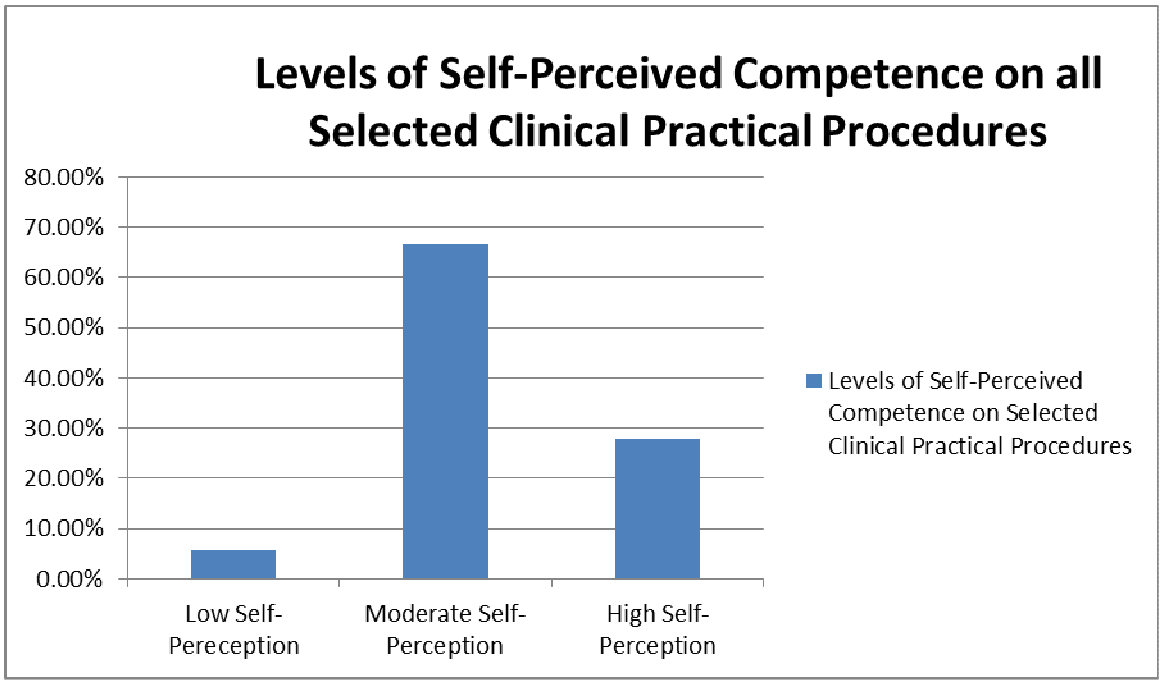


Figure 4.4 Levels of Self-Perceived Competence on all the 14Selected Clinical Practical Procedures

Overall, two thirds 36 (66.7%) of the participants perceived themselves as moderately competent in performing the 14 selected practical procedures, 15 (27.8%) rated themselves as highly competent while only 3 (5.6%) had low self-perception.

4.4.3 Self-rated experience with the selected Clinical Practical Procedures

Fifty Six (56) final year medical students who answered the self-perception questionnaire were requested to indicate number of times they had performed each of the 14 selected clinical practical procedures during the three clinical years. A five point Likert Scale was used; 1= Never performed, 2= performed one to five times, 3= performed 6-10 times, 4= performed 11-20 times and performed more than 20 times. Prior to analysis the five point Likert scale was reduced to a three point Likert Scale as; 1= Zero- five times, 2= six-ten times and 3= more than ten times. Table 4.8 presented the key to the Self-rated experience and result interpretation, table 4.9 shows the number of times before the Likert scale was collapse, while 4.6 shows the levels of experience for all the 14 practical procedures.

Table 4.8: Key to Self-rated Experience Categories and Result Interpretation

Questionnaire Category		**Self-rated experience Interpretation**
1.	Never performed	Low Experience
2.	Performed 1-5 times	
3.	Performed 6-10 times	Moderate Experience
4.	Performed 11-20 times	High Experience
5.	Performed more than 20 times	

Table 4.8 presents the key to the Self-rated experience and result interpretation for self-rated experience.

Table 4.9: Number of times Individual Procedures were Performed (n=56)

Practical Procedure	Times procedure Performed					
	Never	1-5	6-10	11-20	≥ 20	NR
Intravenous cannula insertion	0	0	3 (5.4%)	14 (25%)	37 (66.1%)	2 (3.6%)
Normal vaginal delivery	0	0	8 (14.3%)	9 (16.1%)	37 (66.1%)	2 (3.6%)
Vaginal examination	1 (1.8%)	5 (8.9%)	12 (21.4%	16 36.7%)	20 35.7%)	2 (3.6%)
Intravenous drug administration	1 (1.8%)	5 (8.9%)	11 19.6%)	10 (17.9%)	25 44.6%)	4 (7.1%)
Urethral catheterization	2 (3.6%)	12 (21.4%)	16 (28.6%)	11 (19.6%)	12 (21.4%)	3 (5.4)
Intramuscular drug administration	2 (3.6%)	11 (19.6%)	11 (19.6%)	10 (17.9%)	18 (32.1%)	4 (7.1%)
Examination of the placenta	2 (3.6%)	2 (3.6%)	8(14.3&)	10 17.9%	30 (53.6%)	4 (7.1%)
Examination of the newborn	3 (5.4%)	8 (14, 3%0	12 (21.4%)	12 (21.4%)	16 (28.6%)	5 (8.9%)
Lumbar puncture	6 (10.7%)	24 (42.9%)	15 (26.8%)	5 (8.9%)	4 (7.1%)	2 (3.6%)
Nasal Gastric tube insertion	8 (14.3%)	31 (55.4%)	8 (14.3%)	2 (3.6%)	4 (7.1)	3 (5.4%)
Wound suturing	6 (10.7%)	32 (57.1%)	8 (14.3%)	2 (3.6%)	6 (10.7%)	2 (3.6%)
Endotreacheal intubation	30 (53.6%)	19 (33.9%)	3 (5.4%)	1 (1.8)	1 (1.8%)	2 (3.6)
Gastric Lavage	36 (64.3%)	12 (21.4%)	3 (5.4%)	0	0	5 (8.9%)
Cardiopulmonary Resuscitation	27 (48.2%)	23 (41.1%)	2 (3.6%)	2 (3.6%)	0	2 (3.6%)

It was gratifying to note that all students had performed common procedures such as intravenous cannula insertion and normal vaginal deliveries at least 6 times during the clinical years with more than 80% performing the two procedures more than 10 times. To the contrary a significant proportion of the final year medical students had never performed common and life-saving procedures such as cardiopulmonary resuscitation (n=27, 48.2%), endotracheal intubation (n=30, 53.6%), and gastric lavage (n=36, 64.3%).

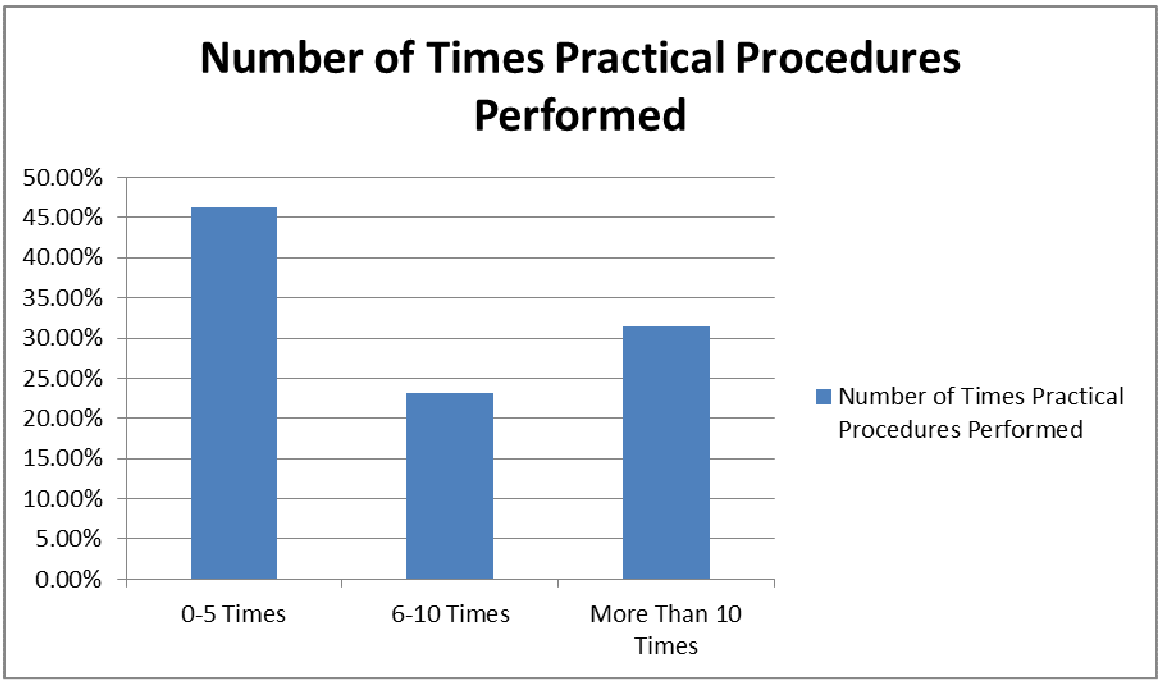


Figure 4. 5 Number of times core practical procedures were performed n=56

Almost half 26 (46.4 %) of participants had performed most procedures only five or less times, 13 (23.2%) performed most procedures six to 10 times, while 17 (31.5%) had performed the procedures more than 10 times.

Table 4.10: Relationship of self-perception and frequency of experience with the procedures

Perception Rating (number and percentage of students reporting high or low self-perception)		Practical Procedure	Experience Rating(number and percentage of students reporting high or low Experience)	
High Self-Perception	(n=31, 55.4%)	Intravenous Cannula Insertion	(n=51, 91%)	High Experience> 10 times
	(n=28, 50%)	Normal Vaginal Examination	(n=46, 82%0	
	(n=26, 46.4%)	Examination of the placenta	(n=40, 71%)	
Low Self-Perception	(n=28, 50%)	Endotracheal Intubation	(n=49, 87%)	Low Experience ≤ 5 times
	(n=33, 58.9%)	Gastric lavage	(n=48, 85.7%)	
	(n=34, 60.7%)	Cardiopulmonary Resuscitation	(n=50, 89%)	

Expectedly, the respondents had low self-perception for the procedures they had little experience with. The respondents had low self-perception of competence in endotracheal intubation (n=28, 50%), gastric lavage (n=33, 58.9%) and cardiopulmonary resuscitation (n=34, 60.7%). It is noteworthy that CPR had such high percentage of candidates with low self-perception when it is a lifesaving procedure and taught at first-aid level. It is a critical lifesaving procedure in emergencies in the hospital settings. Intravenous cannula insertion (n=31, 55.4%), normal vaginal delivery (n=28, 50%) and examination of the placenta (n=26, 46.4%) were highest scoring regarding self-perception of competence. In Intravenous cannula insertion and normal vaginal delivery more than half of the students reported to have had high

self-perception whiles than 80% reported to have performed the procedures more than 10 times.

Table 4.11 Cross tabulation and rank-order correlation between self-perceived competence and knowledge of core-clinical practical procedures

Level of Self-perceived Competence	Knowledge level (Ordinal)			Total	P = 0.007 rho= 0.360
	Fail	Bare Pass	Absolute Pass		
Low	3 (9.4%)	0 (0%)	0 (0%)	3 (5.6%)	
Moderate	24 (75%)	12 (54.5%)	0 (0%)	36 (66.7%)	
High	5 (15%)	10 (45.5%0	0 (0%)	15 (27.8%	
Total	32 (100%)	22 (100%)	0 (0%)	54 (100%)	

All the participants who had bare passes (score of 60-80%) had either moderate 12 (54.5%) or high 10 (45.2) self-perception of competence while the three with low-self competence failed the knowledge test. In addition, all the participants who passed had either moderate or high self-perception. Therefore, a significant association and positive correlation was observed between self-perceived competence and knowledge p= 0.007 with rank-order correlation Spearman rho of 0.360.

Table 4.12 Cross tabulation and rank order correlation between self-perceived competence and number of times core-clinical practical procedures were performed

Level of Self-perceived Competence	Number of times practical procedures performed			Total	P = 0.000 rho= 0.548
	0-5 Times	6-10 Times	More than 10 times		
Low	3 (%)	0 (0%)	0 (0%)	3 (5.6%)	
Moderate	20 (55.6%)	10 (27.8%)	6 (16.7%)	36 (66.7%)	
High	2(13.3%)	2 (13.3%)	11 (73.3%)	15 (27.8%	
Total	25 (100%)	12 (100)	17 (100%)	54 (100%)	

A significant association was observed between the level of self-perceived competence and the number of times procedures were performed p=0.000 and Spearman rho 0.548. Out of the 15 who reported high self-perception of competence, majority 11 (73.3%) had performed most practical procedures more than 10 times while the three with low-self competence had performed most procedure 5 times or less.

4.4.4 Manifest Competence on Selected Clinical Practical Procedures

To measure manifest-competence (actual performance) also referred to as "shows how" in the present study, results of the final year Objective Structured Clinical Examination were utilized. As opposed to the 14 selected clinical practical procedures included in the knowledge test and self-perception of competence questionnaire only seven practical

procedures were included in the OSCE. The seven practical procedure included were Cardio-Pulmonary Resuscitation, insertion of a nasogastric tube, administration of asthmatic drugs via the intravenous route, pericardiocentesis and Urinalysis. Others were performing a cystostomy and obtaining a Papanicolour Smear.

From the list of 14 clinical practical procedures that were selected for the knowledge test and questionnaire on self-perception, the investigator successfully negotiated to have three of the procedures included in the OSCE. Given that only seven stations were dedicated to practical procedures, it was acceptable to investigate three out of seven. Additionally the investigator was conscious not to interfere with the setting of the final examination. The three included procedures underwent detailed result analysis with regard to knowledge of students, self-perception of competency, manifest-competency and frequency of practice.

The three practical OCSE station required students to "show how" a procedure is done using a manikin. In addition to showing how, students were also require to give a running commentary of the requirements during the performance of the procedure, structures involved and the standard practice. Being a final examination, clinical experts in the department determined, observed and scored the performance (manifest-competence) of students using structured checklist as normally done during OSCEs.

Table 4.13: OSCE Scores (Percentage) on Seven Clinical Practical Procedural Stations n=56

Practical Procedure	Number of students with a Pass Score	Percentage of students with a Pass Score	Mean Score	SD	Skewness
Cardio-Pulmonary Resuscitation	38	67.8	5.42 (out of 10)	2.93	-285
Insertion of a nasal gastric tube	53	94.6	7.60 (out of 10)	2.35	-1.30
Administration of intravenous drugs	52	92.8	6.34 (out of 10)	1.34	-.681
Pericardiocentesis.	46	82.1	17.20 (out of 30)	3.32	.242
Urinalysis	56	100	14.48 (out of 20)	2.59	-.002
Cystostomy	20	35.7	4.84 (out of 10)	1.52	.469
PAP Smear	56	100	15.83 (out of 20)	2.85	-.657

***Pass Score= Score above 50%)**

Table 4.13shows that all the students who were examined got a score equal to or above pass mark (50%) in the PAP smear and the urinalysis station, while only 35.7% of students obtained a score equal to or above the pass mark on the cystostomy station. The table further shows that result of five out of the seven procedural skills were negatively skewed.

Table 4.14 Criterion Referencing (Pass/fail rate) in OSCE (Pass Mark at 50%), n=56

Criterion Reference	**Frequency**	**Percentage**	**Cumulative Percentage**
Fail	0	0	0
Pass	56	100%	100
Total	**56**	**100%**	

Using the school pass mark of 50%, all 56 (100%) of the participants passed the manifest- competence test (OSCE), when the results from different procedural OSCE stations were compiled.

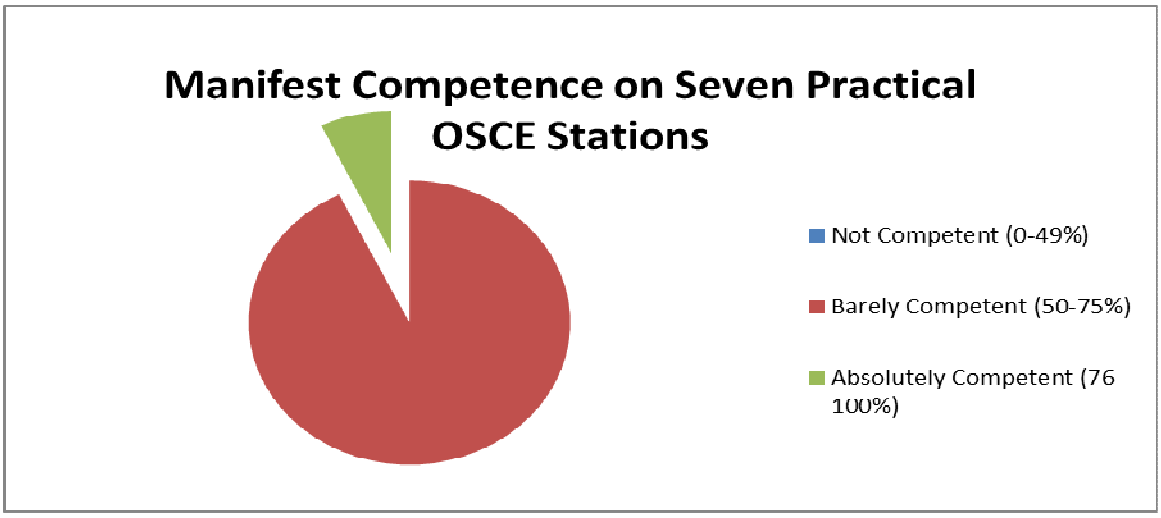


Figure 4.6 **Manifest-competence (OSCE Score levels)**

Figure 4.6 shows the overall levels of manifest –competence (OCSE performance). Majority 52 (92.8%) of the participants were barely competent (Scored 50-75%), while 4 (7.2%) were absolutely competent (Scored 76-100%). The lowest score in OSCE was 50%,

highest 85% with a range 35%. Mean 65.6, SD of 7.85and Skewness .242. The results were positively skewed.

Table 4. 15: Levels of Manifest-competence on the three Practical Skills included in the OSCE

	Level of Manifest Competence			
Procedure	**Not Competent (%)**	**Barely Competent (%)**	**Absolutely Competent (%)**	**Total**
Cardiopulmonary Resuscitation	24 (42.9)	16 (28.6)	16(28.6)	**56(100)**
Nasogastric Tube Insertion	7 (12.5)	16 (28.6)	33 (58.9)	**56(100)**
Intravenous Drug Administration	5 (8.9)	30 (53.6%)	21 (37.5)	**56(100)**

Table 4.15 show varying levels of manifest competence in performing the three practical procedures that were included among the seven OSCE stations. Cardiopulmonary resuscitation, recorded a highest number of students who were not competent (n=24, 42.9%). More than half (n=30, 53%) were barely competent in intravenous drug administration while majority 33 (58.9%) were absolutely competent in insertion of nasogastric tube. It is worrying to note that at the end of the undergraduate medical training, a good proportion of students 24 (42.9%), 7 (12.5) and 5 (8.9) were still not competent in the three commonly encountered procedures of CPR, nasogastric tube insertion and IV drug administration. Apart from the three procedures being required for day-to- day practice of junior doctors, two of the three CPR and IV drug administration are lifesaving skills necessary for patient survival.

Table 4.16: Relationship of knowledge, Self-perception, Manifest Competence, and Experience with the Three Practical Procedures.

	Cardiopulmonary Resuscitation	Insertion of a Nasogastric Tube	Intravenous Drug Administration
Knowledge level (% of students with correct answer	65.2%	30.4%	57.5%
Self-perception category for majority (>50%) of respondents	Low Self-perception	Moderate Self-perception	Moderate Self-perception
Manifest-competence category for majority (>50%) of respondents	Not Competent	Absolutely Competent	Barely Competent
Self-rated experience with procedure	Low Experience	Low experience	High Experience

Table 4.16 shows the comparisons in terms of knowledge, self-perception, manifest-competence and self-rated experience with the three procedures included in the OSCE. Despite 65.2% of students getting correct scores on questions on CPR, majority of them (>50%) were not competent and had low self-perception probably due to low-experience with the procedure. On the other hand, despite students reporting high experience with intravenous drug administration, majority were only barely competent with moderate self-perception.

Table 4.17: Cross tabulation and Correlation between manifest competence (OSCE) performance levels and self-perceived competence for the three practical procedures

	Manifest-Competence (OSCE Performance)	Self-perceived Competence			Total	P value and Spearman rho
		Low self-perception	Moderate self-perception	High self-perception		
Cardiopulmonary Resuscitation	Not Competent	13 (38.2%)	9 (45%)	2(100%)	24(42.9%)	P value 0.270 rho -.150
	Barely Competent	10 (29.4%)	6 (30%)	0(0%)	16(28.6%)	
	Absolutely Competent	11(32.4%)	5(25%)	0 (0%)	16(28.6%)	
	Total	**33 (100%)**	**2(100%)**	**2 (100%)**	**56 (100%)**	
Nasogastric Tube Insertion	Not Competent	0 (0%)	7(21.2%)	0(0)	7 (12.5%)	P value 0.346 rho .128
	Barely Competent	9(50%)	7(21.2%)	0(0%)	16(28.6%)	
	Absolutely Competent	9(50%)	19(57.6%)	5(100%)	33(58.9%)	
	Total	**18 (100)**	**33 (100)**	**5 (100%)**	**56(100%)**	
Intravenous Drug Administration	Not Competent	0(0%)	2 (6.9%	3(13%)	5(8.9%)	P value 0.000 rho -.521
	Barely Competent	3(75%)	7(24.1%)	20(86%)	30(53.6%)	
	Absolutely Competent	1(25%)	20(69%)	0(0%)	21(37.5%)	
	Total	**4 (100%**	**29(100%)**	**23(100%)**	**56(100%)**	

*Since Students Identification numbers were not utilized, all computed correlations were done at group and not individual level.

Table 4.17 shows further analysis of self-perceived and manifest competence of the three clinical practical procedures which were included in the OSCE. The results revealed negative correlation between self-perceived and manifest competence for two out of the three procedures included in the OSCE. The correlations (Spearman rho) between self-perceived and manifest competence were as follows: Cardiopulmonary Resuscitation (-.150, P value 0.270); Intravenous Drug Administration (-.521, P value 0.000) and Nasogastric Tube Insertion (.128, P value 0.346). Although the correlation (rho=0.128) between manifest and self-perceived competence was positive, it was rather weak.

Table 4.18Correlation coefficient (Pearson r) of overall manifest competence (OSCE scores) and Knowledge of clinical Practical Procedures

	OSCE Scores	Knowledge Scores
OSCE Scores (Pearson r) P value N	1 56	-.116 .395 56
Knowledge Score (Pearson r) P value N	-.116 .395 56	1 56

*Since students Identification numbers were not utilized, all computed correlations were done at group and not individual level.

Table 4.17 shows a negative correlation between knowledge test scores and OSCE scores. Pearson r -.116 and P value .395. With the negative correlation, there was no need for regression analysis of the two variables.

Table 4.19: Cross tabulation and correlation between manifest competence (OSCE) performance levels and self-perceived competence

Manifest-competence (OSCE Performance)	Self-perceived competence			Total	P value .451 rho -.123.
	Low self-perception	Moderate self-perception	High self-perception		
Not Competent	0 (0%)	0 (0%)	0 (0%)	0 (0%)	
Barely Competent	3 (100%)	32 (88.9%)	15 (100%)	50 (92.6%)	
Absolutely Competent	0(0%)	4 (11.1%0	0 (0%)	4(7.4%	
Total	3 (100%)	36 (100%)	100 (0%)	54 (100%)	

Table 4.19 shows a negative correlation between self-perceived competence and manifest-competence (OSCE performance). Spearman rho -.123 and P value .451. All the 15 (100%) participants who rated themselves as highly competent under self-perception of competence were categorized as barely competent with regard to performance in practical procedures during their OSCE.

4.4.5 The Think-Aloud Process

From the Think Aloud Protocols that was administered to 10 study participants immediately after the OSCE, mini-themes were generated on the thought processes and feelings while completing the clinical practical procedures during the OSCE. Data is presented in table 4.20 below.

Table 4.20: Thoughts and feelings during performance of practical procedures

Category	Thoughts during performance of practical procedures
Thoughts of…	1. **Procedure in totality**- I thought of the theory behind the procedure, instruments, anatomical structures involved landmarks, correct techniques, ideal practice" 2. **Integration-** I thought of what I had read (theory), observed, and practiced during clinical year (prior experience) 3. **Starting point and Sequence of performance of the procedure**- I thought of the what needed to be done before the procedure (preliminaries), during, after and the follow-up care 4. **Time**- I thought of the how to manage the limited time
Feelings of ….	1. Anxiety 2. Confidence 3. Doubt

Table 4.20 shows the "mini themes' that emerged from students' narratives of their thought process immediately before and while they were performing the practical procedures during the OSCE. The prominent thought were: the procedure in totality (theory behind the procedure, instruments, anatomical structures involved, landmarks, correct techniques, ideal practice), how to integration what was read (theory), observed, and practiced during clinical year, the starting point and how to sequence performance of the procedure. Other prominent

thoughts were; what needed to be done before the procedure (preliminaries), during, after and follow-up care and how to manage time. Accompanying the cognitive process, were emotions which also occurred immediately before and while performing the practical skills. The prominent feelings were; anxiety, confidence and doubt. The feeling of confidence mainly occurred independent of the other two while the other two usually occurred together or one following the other with the feeling of doubt preceding anxiety in most cases.

4.4.6 How Students Learn and Develop Competence in Clinical Practical Procedures

Medical students at UNZA acquire and develop competence in clinical practical procedures through four development stages: passive observation to guided performance to unguided performance and finally peer teaching as shown in the grounded theory model below.

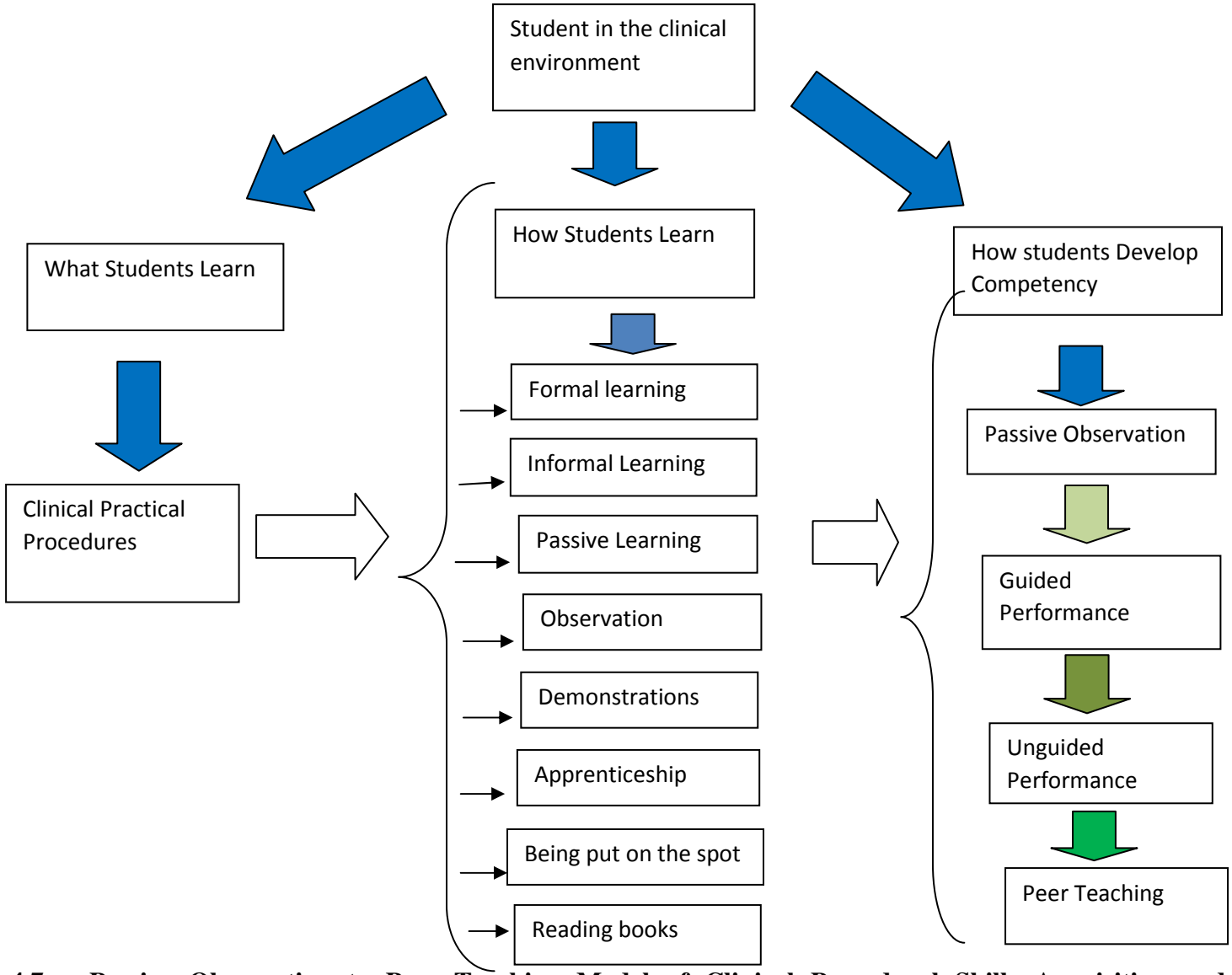


Figure 4.7 Passive Observation to Peer Teaching Model of Clinical Procedural Skills Acquisition and Competence Development.

Two key questions were asked to obtain information on how Undergraduate Medical Students of the University Of Zambia acquire competency in clinical practical procedures during clinical years. The two were: how did you first learn the clinical practical procedures that you feel competent in? and, what steps did you take to develop to the level of self-competence you have reached? Prior to the two specific questions, participants were asked one "ground breaking" question through which they were required to identify at least 10-14 clinical practical procedures that they felt competent in performing at that time when they were about to leave Medical School. Several practical procedures were identified. Typically all participants interviewed felt competent in intravenous cannula insertion. Other procedures majority of participants felt competent in performing were urethral catheterization, performing vaginal deliveries, Lumbar Puncture, nasogastric tube insertion, and pleural and ascetic tap.

Following the ground breaking question, the two key questions were asked that triggered medical students to describe *how they first learnt* the practical procedures and *steps they took to develop* from that initial learning to the level where they felt competent to perform the procedures without or with minimal supervision. From the students' descriptions, themes emerged on the "acquisition and development of competence" in clinical practical procedures, upon which the model presented as figure 4.7 is grounded.

4.4.6.1 The Process of Learning Clinical Practical Procedures

Participants described a number of ways using a variety of words/terms/ phrases regarding how they first learnt selected clinical practical procedures. The different words/terms/

phrases used to describe how procedures were first learnt led to the emergency of twelve themes on how medical students of the University Of Zambia, School Of Medicine learn and develop competency in clinical practical procedures. Eight of the themes described the process of learning, while the other four described the process of competency development as presented in the ensuing section. It is worth noting that although all participants provided answers to virtually all the all questions, only quotations that best reflected, represented or exemplified the theme under discussion were presented under each theme.

Theme 1: Learning through formal teaching

Participants who indicated that they were formally taught describe formal teaching in different ways. Some described it in form of a lecture where students are placed in a room and told what to do, and how to do it. Others describe it as having a tutorial were someone will be teaching the indications, when to do or not do a procedure followed by showing students how to do it, and then two or three students are expected to perform the procedure after the lecturer or the Doctor. Another participant described formal teaching as not necessary being taken for a lecture but when there is patient for such a procedure, the doctor teaches the procedure. Formal teaching whether through a lecture, tutorial, or at the bedside was at times followed by a demonstration. Statements below were used to describe formal teaching in participants' own words.

I was formally taught, I assume formal teaching means where you are placed in a room and told to do this or that or this is how we do it. ***Participant 1***

In Obstetrics and Gynaecology, procedures like getting a Papanicolour (PAP) smear, you usually have a tutorial someone will be teaching the indications, when to do or not do a PAP smear, them they get a manikin we have a manikin, then they will show you how to do it and then you get two or three students to do it after the lecturer or the Doctor. For procedures like Lumbar Puncture, they take it upon themselves to teach, not that they take you for a lecture, but when there is a patient for LP, they teach you. ***Participant 4***

The one I remember is intravenous cannula insertion in surgery, we were taught by one of the interns we found there during our rotation, he first of all explained to us what we were supposed to do, the approach, where you explain to the patient what you are supposed to do, the benefits to the patient and you also tell them that there will be pain which is an obvious thing. He then explained to us just by talking, then he did it himself and then gave us chance to do it one by one for the rest of the patients that need cannulation. ***Participant 10***

Theme 2: Learning through Informal Teaching

Informal teaching was described as being taught but "Not *a proper session" "Not an organized tutorial" "no organized programme" "no formal teaching or training"* but where senior doctors would *"talk about"* a procedure. Although some participants recommended for a more structured programme for teaching procedural skills, some preferred the informal way of teaching describing it as relaxed. Four participants described informal teaching:

There is really no formal teaching or training actually for most of the procedures. ***Participant 14***

Once in a while the senior doctors would talk about the procedure but not really like an organized tutorial to learn about a procedure, but mostly we learn from seniors and also from your own interests but was no organized programme that today we are going to learn how to do this. ***Participant 15***

An informal setting and personally I prefer it like that because you are more relaxed, because you are with your mentor usually not a very senior doctor, so it's more relaxing and easier to learn because most of the junior doctors we used to see them when we were junior students so it's easier to learn that way. ***Participant 9***

Procedures like Lumbar Puncture, was taught by one of the Postgraduate students on the ward, even catheterization, cannulation and deliveries, it wasn't a proper session but mostly by watching postgraduate students then doing it. ***Participant 3***

Informal teaching is when you just see and next time you do it. ***Participant 1***

But I wouldn't say we have had any serious formal classes or formal tutorials trying to explain how these procedures are done. ***Participant 17***

Theme 3: Learning through observation/watching

Learning through observation or what participants referred to as "watching" or "seeing" was probably the commonest method through which medical students first learnt the different procedural skills. Mostly the students observed a few being done, then attempted under supervision and eventually were able to perform with minimal supervision.

I observed what consultants or interns were doing on the ward after that I tried and repeated the same. ***Participant 2***

All of them -cannulation, Lumbar Puncture, Nasal Gastric Tube insertion, urinary catheterization, vaginal deliveries, PAP smear, manual vacuum aspiration, suturing, I first observed then that's when I tried. ***Participant 5***

The other one is lumbar puncture; I learnt it in 5th year in internal medicine, again it was seventh year medical student who led me to do it. The first time I was just watching. The second time I managed to do it. ***Participant 6***

First thing I ever did, that was in my first clinical experience in 5th year was IV cannula insertion, it wasn't taught anyway laughter …. So we were doing a ward round and I was told to insert a cannula on a patient, but…those were the instruction so I had to figure out I had seen it a few times when I was admitted and what I had observed and read, any way I managed but I don't think it was done the right way. ***Participant 7***

IV cannulation, I learnt it just from observation from the seventh year students and from interns, as just as you are doing clinical work on the ward you learn from them by seeing what they are doing and they show you also. ***Participant 12***

Most of the skills I leant by observing then trying out what I had seen, most were supervised by the Interns or nurses on the ward. ***Participant 13***

Like for cannulation, really we were never taught on how to do it, you just observe and try to do it next time, so you see how seniors are doing and try to do it. There is really no formal

teaching or training actually of most of the procedures, although you also have to go and look it up yourself although it's really difficult to grasp when you read on your own. I think it was mostly from observation. Even LP, you observe and go and ready on your own. ***Participant 14***

Well I learnt most of the procedures from the wards from seniors doctors, interns, registrars as they were performing the procedures, I learnt from them, after observing a few I attempted under supervision off course, then eventually I was able to do them with minimal supervision. ***Participant 17***

Theme 4: Learning through Demonstration

Demonstration was at times referred to as showing how. Those who learnt through demonstration indicated that procedures were demonstrated to them or they were *shown how* to perform a given procedure. Participants who indicated that they learnt through demonstration used the following phrases

NGT insertion, that one was in internal medicine, it was demonstrated to us by the Sister in Charge. She also ***demonstrated*** *how to test if the tube is in.* ***Participant 10***

It was through mentorship of senior students, and intern doctors in the wards for example IV, cannulation, when I was in fifth year one of the seventh year students was one who showed me how it is done, how to do, explained the procedure, the possible complications that may come, and the difficulties that you may encounter and demonstrated once or twice. ***Participant 9***

Then for the deliveries, I learnt from the midwives they showed me from delivering the baby, up to delivery of the placenta and finishing up the delivery. ***Participant 15***

Theme 5: Learning through Doing-Apprenticeship

From the words used by the participant number 7, "*I was assisted throughout the procedure by the Surgeon",* this particular way of learning could not be categorized as either learning by observation or demonstration as the participant learnt while performing the procedure under guidance of a competent teacher (surgeon). Although the student was assisted throughout the procedure, he thought he did it wrongly because he had no prior cognitive knowledge "*I did wrongly because I had not read"*.

In surgery, the first thing was suturing, which I think I did wrongly because I had not read much about it, so I was assisted throughout the procedure by the surgeon , I think that was the first experience. ***Participant 7***

Theme 6: Learning by "being put on the spot"

"Being put on the spot" denoted a situation where a student is not ready to perform a particular practical procedure. The student could have observed but not observed enough to reach a stage of readiness to attempt a procedure. One participant described how they first learnt how to insert an IV cannual by "being put on the spot".

Ok! like for cannulation, it's like I was just put on the spot, but initially I had observed a few and the next patient that came I was put on the spot, to say try to do what you have been observing, so from observation, I was told to do it. ***Participant 8***

Theme 7: Learning Passively

The key words that differentiated this types of learning from other types such as learning by observing is "standing there and watching someone" Standing and watching entails absence of activity possibly the reason this particular participant described it as "learning passively"

Ok let's start with cannulation, like in our curriculum we start in fifth year and learnt it passively, it's not like someone will come and teach you how to cannulate , you will be standing there and watching someone. ***Participant 4***

Theme 8: Learning from reading books

Reading from books was at times a standalone method of learning while at other time it was used to supplement what was taught, observed or demonstrated.

The first procedure I encountered was insertion of an intravenous cannula, the first time I didn't have any one to teach me per say, I was just asked to do it from what I had read from the text books so it was a bit difficult but I did manage to do it, after that I had problems until someone had to teach me how to do it, the best method and how to easily do it. ***Participant 11***

The additional knowledge I may have on those procedures were supplemented by formal reading particularly for procedures like Deliveries, LP, pleural tap, insertion of Inter Coastal Drainage tube which I can say am also am able to do. While you would be

taught practical things on the ward as the procedure is being done, the information was inadequate and needed to be supplemented by extra reading. ***Participant 17***

4.4.6.2 Steps Taken To Develop Competency in Learnt Procedures

Participants were asked about the steps they took to develop to the level of self-perceived competence they had reached. Each participant gave an account of their developmental process from **"first learnt to feeling of competence"**. Based on the participants' accounts, four themes emerged regarding steps taken by students to reach the level of self-perception of competence from the time a procedural skill was learnt.

Theme 1: Personal interest

An element of personal interest in becoming competent was important for students since there was no dedicated time for learning/acquisition or development of competence in practical procedures. Participants used different phrases to denote personal interest that included "self-push" "taking it upon oneself", "self-motivation" "putting in effort" or being proactive".

I think one of the things that has helped me is my own interest, where you try to push yourself especially for those skills I leant informally i took it upon myself to find patients or people to do the procedure on, I have been personally pushing myself. ***Participant 1***

Aaah, to increase my competence in practical aspect, I made sure that every time i was on the ward, I made myself proactive to do as many IV cannulation and blood drawings as I could and administer medication which I am allowed. ***Participant 2***

Because if you don't put in effort to learn you will never learn because some procedures you never actually get to see them. ***Participant 4***

It is challenging because it almost sorely depend on the individual, because if as a student you don't show any interest you can literally go through the training without learning anything, I know people who have finished fifth year without knowing even basic canulation probably they are just hiding behind others. ***Participant 8***

From the first time I learnt, I just took it upon myself every time they would say this patient needs a cannula, I would go there of course, the first time and second time I would struggle then if I fail I would call my seniors to help but as I continued to try later on I found that I could do it. Same applies to deliveries, first time it was a bit difficult, second time but I kept on trying until now I think am competent. ***Participant 15***

Basically I have just taken it upon myself to do as many as I can like for cannulation every time you are on call, you stick around the doctors, you cannulate and where you fail there is some ne to do but at least taking it upon myself to do as many as I can. ***Participant 16****.*

Theme 2: More Practice

A number of participants described how they reached a level of competence through more practice or doing a practical procedure over and over or practicing as much as was possible. This repetitive practice was achieved through the official clerkship rotations, when students were on call, during electives or through own arrangements such as going back to the clinical area after official school time such as during the evenings. Electives were particularly regarded as having provided more practice.

First observe, and then practice as much as you can, initially you ask someone to observe you and when you are competent you can do it by yourself. But then, the more you practice, the better you can do. ***Participant 3***

I think it's just practice the more you do it the better you become at it. I remember when we did in 5th year and in 6th year you are not attached to any clinical setting, and when I went back in 7th year I had lost touch, I think doing it over and over again makes you better in doing these things. ***Participant 6***

You practice, you offer yourself to practice the procedure as often as possible especially when you have stable patients you practice more, then you become better that way. Participant 9

aaah, the main thing I did is to do the procedures as many time as I could so I perfected it by doing as many times as possible. ***Participant 12***

As a student I kept on doing the same procedure, like every time am on the ward, I would volunteer to draw blood that's how I become competent in most of the skills/procedures.

Participant 13

Yes electives made a difference in that at the University Teaching Hospital, we are not allowed hands on practice but during electives you are given more time to do hands-on. Participant 1

Yes I have had electives, like in 5th and 6th year vacation you go for electives, so there you can even advance more because you even have more time to do more procedures, like catheterization, LP, even in 7th year during CBE we had chance to do most of those procedures. ***Participant 16***

Theme 3: Reading literature

Reading was described as one of the strategies that was used to enhance practice.

I had to read around LP literature and how they do it in an ideal way and observing more and trying to do a number. ***Participant 14***

While you would be taught practical things on the ward as the procedure is being done, the information was inadequate and needed to be supplemented by extra reading. ***Participant 17***

As you may be aware, in our OSCE in Internal medicine, little in OBS and in Peadiatrics particularly in Medicine there are designated spots where we are required to describe or perform a procedure so it's incumbent upon a student to look for details for those procedures because it's guaranteed that such a station would be there so it's necessary to do extra reading in preparation for exams and as a requisite for acquiring such a skill. Participant 17

Theme 4: Teaching Others

Some participants typically describe what is referred to as the Halstedian approach (see one, do one and teach one) in the process of developing competence. Apart from observing and performing a specific skill, some participants took a further step to teach their juniors. This type of teaching was regarding as important in their own learning and perfection of skills.

I think every time before you teach your juniors you have to be perfect you have to go back to your theory, get your theory right and even practice, I think, teaching is another way of helping you to learn and perfect a skill. ***Participant 9***

Yes, actually we have a lot of opportunities to teach our juniors, as I said we learn from our interns, Post Graduate students, but there comes a time when there is no Interns on the ward and you are with juniors for example the fifth year and you are doing cannulation, you teach them or if it's your turn to do a pleural tap, you call a fifth year, so someone is observing you as you are doing it and the fifth year is learning through you. It helps to gain competence.

Participant 4

4.4.6.3 Narrative of the Developed Grounded theory Model

The model of Clinical Procedural Skills Acquisition and competency development emerged from participants' description of how they first learnt specific procedural skills and steps they took to develop to a level they felt competent in performing the learnt skills. The model is therefore grounded in the qualitative data obtain during the in-depth interviews. It is based upon the participants' accounts of their developmental process from "first learnt to feeling of competency".

Although all participants described the process of "first learnt to feeling of competency", presented below are participants' own words through which the model can be traced.

First observe, and then practice as much as you can, initially you ask someone to observe you and when you are competent you can do it by yourself. But then, the more you practice, the better you can do. ***Participant 3***

…… but there comes a time when there is no Interns on the ward and you are with juniors eg the fifth year and you are doing cannulation, you teach them or if it's your turn to do a pleural tap, you call a fifth year, so someone is observing you as you are doing it and the fifth year is learning through you. It helps to gain competence. ***Participant 4***

I think every time before you teach your juniors you have to be perfect you have to go back to your theory, get your theory right and even practice, I think, teaching is another way of helping you to learn and perfect a skill. ***Participant 9***

Regardless of how medical students first learnt; formally, informally, through demonstrations, through observation, passively, by doing (apprenticeship), "being put on the spot or reading books, fundamentally they first had to observe another person perform a procedure, before they could attempt. The observation was done passively, thus the first step in the model **"passive observation".** Having observed once, twice or three times, how a procedure is done, the learner went on to attempt/perform the procedure under the guidance of competent practitioner. This constituted the second step in the model **"Guided performance"** .To some learners the first attempt was learner initiate "*initially you ask someone to observe you" **Participant 3**,* while others were either requested to perform a procedure after a few observations or had to be put on the spot *"but initially I had observed*

*a few and the next patient that came I was put on the spot, to say try to do what you have been observing, so from observation, I was told to do it" Participant 8.*The third step in the model is referred to as **"unguided performance".** Having performed a skill a number of times under observation, the learner proceeded to perform the skill unguided (more practice) when they felt competent "*initially you ask someone to observe you and when you are competent you can do it by yourself Participant 3"*.

The unguided performance was mainly self-motivated which was described as "*personal interest" "self-push" "taking it upon oneself", "putting in effort" or being proactive"*. Students made own arrangements to practice outside official working hours "d*uring the evenings and holidays when you had to go to the wards to practice*" or during electives *"Yes electives made a difference in that at the University Teaching Hospital, we are not allowed hands on practice but during electives you are given more time to do hands-on". **Participant 1***

The fourth and final step in the model is **"Peer Teaching".** This peer teaching was done by senior students to junior students. It served two purposes; junior student passively observed, the senior student "perfected a skill" ….. *I think, teaching is another way of helping you to learn and perfect a skill. Participant 9.But there comes a time when there is no Interns on the ward and you are with juniors……you teach them. It helps to gain competence. **Participant 4***

4.4.7 Learning and Assessment of Clinical practical procedures: Qualitative Perspective

In addition to the two key questions which were asked on how students learn clinical practical procedures and steps they took to develop competence, they were asked four other questions. The first one was a ground breaking question which required them to recall (think back) the three clinical medical educations years they had gone through and identify at least 10-14 practical procedure that they felt competent in performing at the time they were almost leaving the medical school. The second and third questions required students to identify those practical procedures they were formally assessed and the methods that were used for assessment respectively. The fourth and final questions in this section required students to recall settings where they learnt the practical procedures and the categories of teachers who taught the skills during the undergraduate medical education. The preceding section provides the information from the students' verbal reports.

4.4.7.1 Clinical Practical Procedures Participants felt Competent in Performing

The 17 students who participated in the study identified at the most 10-14 clinical practical procedures that they felt competent in performing at that time when they were about to leave Medical School. Typically all participants interviewed felt competent in intravenous cannula insertion. Other procedures majority of participants felt competent in performing

were urethral catheterization, vaginal deliveries, Lumbar Puncture, nasogastric tube insertion, and pleural and ascetic tap. Here is what selected participants stated;

"As regard to clinical skills, I feel I have learnt quite abit from the University Teaching Hospital (UTH); intravenous cannula insertion, administration of intrvenous drugs, nasogastric tube insertion, female and male urethral catheterization, Lumbar Puncture, drawing blood, collecting urine from paediatric patients under 2 years by suprapubic aspiration, resuscitation in Peadiatrics, placing a child on a ventilator and Intramuscular drug administration". ***participant 2***

"Alright, to make things easier, I will give them to you in terms of different departments that I have been through. To start with internal medicine I feel am competent in phlebotomy, IV cannulation, Lumbar Puncture, Plueral tap, ascetic tap, urethral catheterization (male and female), aaa…. Let me move to OBS and Gynae, am competent in manual vacuum extraction, I can competently deliver a baby, am not sure if am competent in vacuum delivery. In peadiatrics am I can say am competent in the same procedure as those in internal medicine, in addition, examination of a baby." ***Participant 17***

"Ok over the past three years most of the procedures that were done some were very repeated and thus the competency while other were very wide apart thus you could only see one or two, I can say some of them are vein puncture, IV cannular insertion, peritoneal tap, pleural tap, NGT insertion aaaaa....." ***Participant 7***

*I will start with surgery, cannulation, drawing blood, suturing, from medicine, pleural and ascetic tap, from OBS, Manual Vacuum Aspiration(MVA), from, Peadiatrics, peadiatric cannulation, aaahh, which other procedures, what else? What Else?.....****Participant 8***

4.4.7.2 Practical Procedures Formally Assessed

For most practical procedures participants felt competent in performing, they also reported to have been formally assessed, particularly LP, IV cannula insertion, *paracentesis and* occasionally pericardiocentesis. Although some participants felt that they were adequately assessed on a number of procedural skills, other felt that practical assessments were not adequate probably due to the mode of assessment used where mostly examinees are required to simply explain what they would do on practical OSCE station as opposed to actual performance. One participant agreed to have been formally assessed on a number of procedures although not formally taught.

Presented below are some of the responses obtained when study participants were asked regarding assessment of clinical practical procedures.

Ok that takes place in an OSCE, so on that spot you are told to insert a speculum and obtain a PAP smear, while the examiner is standing there, you use a dummy so you do a role play and explain to the dummy what you are going to do while the examiner is looking at what you are doing, they look at your technique, how you are handling the patient, and inserting the speculum.

Participant 13

I think on formal assessment, LP has been very well emphasized and assessed on, thoracocentesis as well as paracentesis occasionally pericardiocentesis, IV insertion, others it's just us students who make sure we do them…..but the ones that I have mentioned those have been emphasize on. ***Participant 6***

For assessment it differs from department to department, from example from Peadiatrics we were assessed on how to resuscitate a baby. From Internal Medicine, we were assessed how to catheterized, do LP, Ascetic tap, pleural tap. ***Participant 2***

Ok from the procedures I mentioned, we have been formally assessed on LP, pleural tap, ascetic tap, pericadiocentesis. Except for pericardiocentesis, we don't usually have the equipment that we need for example, it is written that we need an ECHO machine to be around, so when I say pericardiocentesis, you just have a patient and they ask you how you are going to insert the needle, what is the direction of the needle and not necessary that you have a manikin where you are going to push in the needle, so you simply explain. ***Participant 4***

None of them "silence" aaaah….. LP partially because at that time we didn't have dummies, so they could ask you to show how you can do it not actually doing it. Besides that, nothing has been specifically assessed. From Obstetrics, I can remember we had to demonstrate how to do PAP smear once and from Peads aaaah…. it's mostly examination rather than carrying out the procedure. ***Participant 3***

Formally assessed, well, we have been assessed on a number, we were assessed on how to do LP, ascetic tap, pericardiocentesis, thoracocentesis, pleural tap, and we have been formally assessed though not formally taught. Participant 14

4.4.7.3 Methods for Assessing Practical Procedures

Formal assessments were mainly through OSCE, although some participants indicated that at times a few questions with practical aspects were asked in theoretical examinations. There were varying context of practical assessments as others said it was more theoretical while others thought it was practical. When asked if they were assessed on practical procedures through their theoretical examinations, most said there were few questions asking them to describe a procedure, probably 10% of the entire examination, while others denied having had any practical questions in theoretical examinations and that it was not necessary.

Below is a typical description of an OSCE given by participant number 10, followed by other statements given in response to the question on methods of assessing clinical procedural skills.

Those assessments were through OSCE for example the whole OSCE will have 10 spots and every student will rotate through the 10 spots. For example a spot for LP, depending the question they put, it could be taking the examiner through the procedure for LP or could be starting from the patient aspect what you would explain to the patient so they are assessing you on the approach to the patient, approach to the procedure its self or approach after doing the procedure what measure you will put in place, so they would like say here is patient, there is an indication for doing a LP, can you proceed. So what you do is to explain to the patient what you are going to do, what you do with what you get and the benefits of doing a LP in that the treatment will be more specific, and explain to them the procedure, how you are going to position them and any complication one of them is pain and you explain to them that they will

be give an analgesic and anesthesia to at least to relieve the pain. Then you go ahead and position the pt and that it is a sterile procedure and you demonstrate the sterile aspect of the procedure, you put on gloves and an apron, and it is supposed to be a running commentary. Participant10

aah... there is usually a model, where they ask you to do a running commentary as you undertake a procedure, but at times its just theoretical they ask you to explain the procedure, yes. Ok, a running commentary is when you are doing it you are explaining to the examiners how you do the procedure step by step. Participant 11.

For the delivery of the placenta, there will be a dummy with a placenta in situ, them they give a short scenario, like a doctor has just delivered a baby and they have asked you to deliver the placenta, would you go ahead and do it, so you more like act on how you do it. They want to see you do it, so you wash, hands put on gloves, an apron, and you actually do the procedure

Participant 12

Yes but would say less than 10% for example in a paper out of 10 questions, you will only have one question that involves describing a procedure such as resuscitation. Participant 2

No, we don't have practical questions in theoretical papers, and I myself I don't think it is necessary to assess procedural skills in theoretical examinations, because there are a lot of medical conditions that should be assessed on. What I believe is that these clinical skills you can learn them as you go by, I can give you an example of those students who come from outside the country, they practically don't know anything but they manage to catch up.

4.4.7.4 Settings where Clinical Practical Procedures were Learnt

The question of where practical procedural skill were learnt generated three categories of responses; setting where skill was taught, teacher who taught and object upon which a skill was learnt. When asked about where they learnt the different skills they had learnt during the medical school, most indicated that it was at the bedside at the University Teaching Hospital (UTH) during their different clerkships and that procedures were learnt on actual patients. To some participants learning on actual patients proved to be a hindrance as indicated by one participant "to be honest I haven't had much practice as I would have liked because we have been doing it on actual patients, so it's a bit scarily because you know that is an actual patient, I guess I haven't had enough practice as I would have loved"

Apart from the UTH, other described having learnt from central and district hospitals they were placed during electives and Community Based Education. Teachers of procedural skills were mostly Doctors on Internship, and to a lesser extent Senior Doctors and Registrars. They also learnt a number of procedures from senior medical students. Apart from being taught by doctors and senior students, they also learnt a few procedures like nasal gastric tube insertions and vaginal deliveries from nurses and midwives respectively.

Ok quite a number of procedures I have learnt during school time but I have been able to perfect them during electives. It has been a habit of mine that during vacation for the three clinical hears I would take elective at my local hospital in Monze and I was attached to

different departments for electives and I learnt quite a few things during my time there. So even when I have learnt a lot of procedures here in UTH during the school time, I have been able to perfect them during electives. ***Participant 17***

Yes electives made a difference in that here at UTH we are not allowed hands on practice but during electives you are given more time to do hands-on. ***Participant 1***

Most of them was at the bed side. It was at the bedside within the University Teaching Hospital. To be honest I haven't had much practice as I would have liked because we have been doing it on actual patients, so it's a bit scarily because you know that is an actual patient, I guess I haven't had enough practice as I would have loved. ***Participant 11***

First of all I can say LP is one of the procedures I learnt, I learnt it when I was in 5th year from one of the intern Doctor, who was attending to the patients in our unit. He taught us how to do an LP on a patient, he taught us a number of things concerning LP actually the whole procedure and told us to go and read about it… Participant 16

Ok depending on the facility, most nursing staff have been very helpful in procedures such as catheterization, NGT insertions, these procedures are almost exclusively done by them and they are quite helpful in teaching. ***Participant 7***

Then for the deliveries, I learnt from the midwives they showed me from delivering the baby, up to delivery of the placenta and finishing up the delivery. ***Participant 1***

CHAPTER 5:

5.0 DISCUSSION OF FINDINGS

5.1 Introduction

This chapter presents the discussion of the findings of our study. The chapter is divided into nine sub-sections. Although each section presents data from a different tool or segment of the study, cross sectional references are made in as far as they are relevant to the concept being discussed. The first section is an introduction to the chapter which is followed by the discussion of the demographic characteristics of the study sample in the second section.

In the third, fourth and fifth section, findings on the knowledge of clinical practical procedures, self-perception of competence, self-rated experience with the 14 clinical practical procedures are discussed. The sixth and seventh section presents the discussion on the findings of manifest competence and Think –Aloud Process respectively. The eighth section discussion the qualitative findings regarding how medical students learn clinical practical procedures, and how they develop competency. The eighth section also discuss additional information on clinical medical education from the qualitative perspective, regarding settings where practical skills are learnt, teachers of practical skills, and the commonly used methods for assessing competency in practical skills. The ninth and final section discussed the contribution of the study to the existing body of knowledge.

5.2 Demographic Characteristics and Clinical Medical Education Information

In the present study, 67.9% of participants were males against 32.1% females. This was expected as currently in Zambia the medical profession is male dominated. Gender was the only demographic variable included in the present study because it has been documented that gender has an influence on medical students' access to practice skills in a clinical setting with females finding it more difficult to get opportunities to practice (Neilsen et al 2003). Findings of the association between gender and the number of times clinical practical procedures were performed are provided in section 5.5 of this chapter.

In addition to gender, relevant clinical medical education information was also obtained which included; training in other health related fields prior to MBChB, clinical rotations (clerkships) in the different Medical and Surgical Specialties, practical procedures formally taught and formally assessed respectively. The finds revealed that only 8.8% of the sample had training in other health related fields prior to medical education (Table 4.1). Training in health related fields was considered important in that it could have influenced the participants' recall of the number of times they had practiced the selected clinical procedures and their level of self-perception. In medical education literature (Colberly and Goldenhar, 2007), it is documented that participation in dedicated clinical courses in medical school is associated with increased attempts on clinical procedures and a likelihood to report adequacy in performing basic medical procedure by first year residents. Therefore, although participants in the present study were requested to indicate whether or not they had other training in health related fields prior to entry in medical school, it was still assumed that it

could influence their responses on self-perception of competency and number of times they had performed the selected clinical procedures.

Contrary to our assertion, in the present study, none of the five students with training in other health related fields had performed most procedures more than 10 times and consequently none rated themselves as highly competent. It is however worth noting that despite asking the respondents as to whether or not they had prior training in health related fields, they were not asked to specify the fields. Therefore they could have been trained in health care related fields which are less clinical in nature with minimal exposure to clinical skills.

With regard to clinical rotations, all the participants had completed the 11 designated clinical clerkships (Table 4.2). Despite completing all the designated clinical clerkships, there were a lot of disparities with regard to the formal teaching and assessment of the 14 selected clinical practical procedures. None of the 14 selected clinical procedures was taught to all students and none was of the students was assessed on all. The top 5 formally taught procedures (taught to at least to two thirds of students) were Cardiopulmonary Resuscitation (CPR), normal vaginal delivery, vaginal examination, Lumbar Puncture (LP) and examination of the newborn. Out of the top 5 formally taught three were from Obstetrics and Gynaecology and the other two from Internal Medicine (Table 4.3). The least formally taught were intravenous drug administration, intramuscular injection, wound suturing, gastric lavage and nasal gastric tube insertion. Apart from wound suturing, it was revealed through the in-depth interviews that the other four least taught procedures were considered mainly as nursing procedures in

the context in which our study was conducted (the University Teaching Hospital – Lusaka Zambia). This was probably the reason they were least formally taught to medical students. This was mentioned by one participant during the in-depth interview "*I must admit that there are a number of areas that I feel deficient. For instant nasal gastric tube insertion, because it's a procedure mainly done by nursing staff" Participant 17.*

With regard to formal assessment, to a large extent, procedures that were formally taught were also formally assessed (Table 4.4). Although one participant in the in-depth interview indicated that at times formal assessments were conducted even on procedures not formally taught…*and we have been formally assessed though not formally taught. Participant 14*. In our study it was revealed that out of the top five formally taught, four were among the top five formally assessed: Lumbar Puncture, normal vaginal delivery, examination of the placenta, vaginal examination and CPR. The least formally assessed were nasal gastric tube insertion, intramuscular drug administration, and intravenous drug administration, wound suturing and gastric lavage. In our study, formal assessment as compared to formal teaching influenced to a large extent the number of times procedures were performed and consequently the self-perception of competence (Details are provided in section 5.4 and 5.5).

5.3 Knowledge of Clinical Practical Procedures

The role of cognition in skill performance is well documented in medical education literature (Kopta, 1971; Miller, 1990; Hamdorf and Hall, 2000; Amin and Hoon-Eng 2003 & Buckley,

Manalo, and Lapitan, 2011). In addition, cognition (mastery of a body of knowledge) is regarded as one of the dimension of clinical competence as can be construed from Newble et al, (1994) and Epstein and Hundert, (2007) definition of clinical competence. Therefore in order to fully understand the concept of "clinical competence", an understanding of cognitive attributes is inevitable. With the focus of our study being acquisition of, self-perception and manifest-competency in clinical practical procedures, knowledge of clinical practical procedures was measured and correlated to manifest and self-perceived competency, and number of times practical procedures were performed.

The role of cognition in skill performance is further demonstrated by Miller (1990) in the Pyramid of clinical competence. Miller's pyramid of clinical competence together with two other conceptual models underpinned the present study (Figure 2.1). Miller (1990) demonstrated the value of cognition in skills performance by placing the knowledge component of clinical competence at the base of the pyramid; "Knows" = possession of factual knowledge of a skill or field and "Knows how" = applied knowledge" before the "Shoes how"= performance in a controlled environment and "Does" = performance in clinical practice". The first two levels of Miller's Pyramid (Knows and Knows how) are more cognitive in nature while the last two (Shows how and Does) are psychomotor in nature. The implication being, that for an individual learner to "show how" a clinical procedure is done and consequently perform it "Does", one should possess the cognitive knowledge to underline psychomotor activity.

It is with the above understanding that a knowledge test in the present study was administered. The focus of the test was on different cognitive aspects of the 14 selected clinical practical procedures; indications, contraindications, principles, correct techniques, anatomical structures involved, recommended rates, and interpretation of clinical signs, normal measurements and actions to take when one encounters the unexpected (Appendix 1). Using Angoff pass mark of 60% only 39.3% of students passed the test (Figure 4.2). Mean Score was 53.38, Standard Deviation 10.44, Range 50 and Skewness -124. With most scores skewed to the left or below average (Skewness of -124).

The mean score of 53.38% was low considering that the students assessed were in their last six months of medical education and are expected to possess adequate cognitive traits of common core clinical practical procedures. When the student pass rates for each question were compared to Expert (Angoff) determined pass rates, the Angoff pass mark was high on most questions compared to actual student scores (Table 4.5). This entails that teachers expected their students to know more than what actually students knew.

When Item analysis was performed to determine the level of difficulty of each question, there were major variations in the levels of difficulty for different questions. Level of difficult is defined as the proportion of students who answer the question correctly (Amin and Hoon-Eng, 2003). The lower the proportion the more difficult the item. From the knowledge test administered in our study, the highest correct score of 80.4% was obtained from a question on vaginal examination followed by 78.6% on a question on CPR (Table 4.5). The lowest

correct score of 12.5% was from a question on endotracheal intubation (table 4.5%). Consequently the level of difficulty for VE (0.80) and CPR (0.78) were lower than that for endotracheal intubation (0.12). The results therefore meant that the question on endotracheal intubation was more difficulty than the ones on VE and CPR.

Several reasons can be advanced for variations in the pass rates for different questions; probably the question on VE and CPR were truly less difficulty compared to that on endotracheal intubation or probably students had better understanding of VE and CPR compared to endotracheal intubation, as both VE and CPR were among the top five formally taught procedures (Table 4.3). Wass et al, (2001) and Epstein, (2007) assert that assessment drives learning. With this assertion, the three procedures; vaginal examination, CPR and endotracheal intubation, were considered in terms of the number of students who had been formally assessed on the three during the clinical years. It was established that 44.6% of students were formally assessed on VE, 30.45 on CRP compared to 19.6% who were formally assed on endotracheal intubation. Literature alerts us that students feel overburdened by work and respond by studying only the parts of the course that are assessed (Hakstian, 1971 cited in Epstein, 2007 and Wass et al, 2001). Therefore, the likelihood of being formally assessed could have lead students to study more literature related to vaginal examination and CPR compared to endotracheal intubation.

5.4 Self-Perceived Competence in Performing Clinical Practical Procedures

Bandura (1997) defines self-perceived competence as the reported self-efficacy in performing a task. In the present study, self-perception of competence on 14 selected practical procedures was measured using a five point Likert scale ranging from: 1= grossly inadequate, 2= knows approach only in theory, 3= only competent in making certain decisions, 4= reasonably competent and 5= very competent. Prior to data entry, grossly inadequate, and knows approach only in theory were re-categorized as Low Self-Perception, only competent in making certain decisions and reasonably competent as Moderate Self-Perception, and very competent as High Self-Perception. Self-perception of competence was assessed for individual practical procedures and as aggregate for all 14 selected practical procedures.

On aggregate, two thirds 36 (66.7%) of the participants perceived themselves as moderately competent in performing the 14 selected practical procedures, 15 (27.8%) rated themselves as highly competent while 3 (5.6%) had low self-perception. On individual procedures, significant numbers of students reported low-self-perception in performing three out of the 14 selected procedures: 60.7% for CPR, 58.9% for gastric lavage and 50% for endotracheal intubation (Table 4.7). This was despite CPR and endotracheal intubation being some of the commonly formally taught procedures (table 4.3). Although both endotracheal intubation and CPR were formally taught, more than half (53.6%) and almost half (48.2%) of students never performed endotracheal intubation and CPR respectively, during the three years of clinical medical education (Table 4.9). Therefore lack of practice could have contributed to the low self- perception.

Similar observations have been made by other researchers before. For example Barbosa, et al. 2011 in a study to evaluate the self-perceived competence of medical students in three different countries; Portugal, Angola and Mozambique, they reported that apart from Mozambique, clinical skills in Angola and Portugal received the lowest scores. The investigators assumed that the low values assigned to acquisition of competence in clinical skills could be due to the limited opportunities for practice during training. This signifies the importance of dedicated clinical skills training throughout the duration of medical education. The role of dedicated clinical courses have been highlighted by other researchers eg , Promes et al. 2009 reported that first year residents who completed a dedicated procedure course in medical school were significantly more likely to report adequacy in performing basic medical procedure (odds ratio = 2.5). This unique finding signifies the value of having a skills course in undergraduate medical training.

A positive findings from our study was that all the students had either moderate or high self-perception on intravenous cannula insertion, normal vaginal deliveries, vaginal examination and urethral catheterization (Table 4.7). Apparently the four procedures (intravenous cannula insertion, normal vaginal deliveries, vaginal examination and urethral catheterization) in consecutive order were performed more times with all students reporting performing IV cannula insertion and normal vaginal deliveries more than 6 times (Table 4.9). The high numbers of times these procedures were performed could have contributed to the improved levels of self-perception related to the same procedures. Previous studies have

reported associations between number of time a procedure was performed and self-assessed competence $p<0.001$ (Promes, et al. 2009). In addition normal vaginal deliveries and vaginal examinations were among the top three procedures where more than three quarters of the respondents were formally taught (table 4.3). Therefore the formal teaching coupled with the high numbers of times these procedures were performed could have contributed to the improved levels of self-perception related to the same procedures. This finding support those found in literature (Sullivan et al. 2010) that providing structured teaching sessions for procedural skills improves the confidence level of learners.

The motivation for students to conduct more vaginal deliveries could be due to the fact that the procedure was formally taught to most of them (Tables 4.3) and the high likelihood of being assessed (Table 4.4). In addition, patients for the procedure are readily available considering that the class of students investigated in the present study learnt all the procedures at the bed side. Similarly most students could have inserted more IV cannula due to the readily availability of patients indicated for the procedure. In a setting were clinical practical procedures are sorely learnt from the bedside on actual patients, whether a students perform or does not perform a procedure is to some extent dependent upon availability of patients indicated for such a procedure. As indicated earlier, Neilsen et al, (2003) stated that 99% of students had to work hard and be active in order to get access to practice skills in a clinical setting, but only, 36% had the chance to practice to the extent they wanted

Other procedures on which self-perception of competence was assessed included; intramuscular drug administration, intravenous drug administration, Lumbar Puncture, nasogastric tube insertion and wound suturing (Table 4.7). Studies in the past including one conducted by Colberly and Goldenhar, (2007) have reported low levels of self-perception on LP, with only 25% reporting feeling competent performing it without supervision. This was not the case for our study, as 69.6% and 8.9% reported feeling moderate and very competent respectively compared to only 14.3% who reported low self-perception in performing LP.

With the assertion that high self-efficacy (self-perception) is related to high achievement in educational settings (Bandura, 1997), self-perception of competency was correlated to the knowledge of clinical practical procedures (Table 4.11). A positive association was established between self-perception of competency and knowledge of clinical practical procedures (Spearman rho 0.360.and P value 0.007. Although the correlation was relatively weak (0.360), this finding still supports assertions by Bandura (1997) that individuals who perceive themselves highly, are likely to work hard and subsequently get better scores in examinations and tests. This was probably the reason why students who had high self-perception on clinical practical procedures got better scores in the knowledge test, consequently the recorded association between self-perception and knowledge. Equally, the high knowledge related to clinical practical procedures would have led to high self-perception. With a positive correlation and association between knowledge of clinical practical procedures and self-perception of competency, we rejected our second null hypothesis that predicted lack of association between the two variables.

5.5 Self-Rated Experience on 14 Selected Clinical Practical Procedures

To determine the number of times the 14 selected clinical practical procedures were performed, students were asked to rate themselves on a 5 point Likert scale from never performed, performed 1-5 times, 6-10 time, 11-20 times and more than 20 times. The five point Likert scale was reduced to three point with never performed and performed 1-5 times as re-categorized as low experience, performed 6-10 times and 11-20 timed as moderated experience and performed more than 20 times as high experience (Table 4.8). The frequently performed procedures in our study were IV cannula insertion and conducting normal vaginal deliveries where all students had performed these six or more times (Table 4.9). This findings was supported by data from the in-depth interview where virtually all those interviewed mentioned IV cannula as one of the procedures they first learnt, performed more times and felt competent in performing.

Proportions reported in our study where virtually all students had performed intravenous cannula insertion and normal vaginal deliveries more than six times, are higher than those from previous studies; for example an audit of clinical skills conducted among final year medical students in Nigeria at University of Port Harcourt reported that a small percentage 4.8% of finalist students had never inserted an intravenous cannula (Jebbin and Adotey 2012). In the United States, Colberly and Goldenhar (2006) reported that vast majority of Fourth-Year Students reported not performing intravenous cannula catheter insertion during their acting intern rotation at Cincinnati University -United States of America. In the United

Kingdom, Moercke and Eika (2002) reported that 15% and 57% of students in their last six months of undergraduate, medical education had never tried setting up an IV drip or performing normal vaginal delivery respectively.

Contrary to the impressive performance on IV cannula insertion and conducting normal vaginal delivery, significant numbers of students never performed important common procedure such as gastric lavage (64.3%), endotracheal intubation (53.6% and CPR (48.2%) (Table 4.9). In addition although relatively low, a number of students had not performed other procedures including Lumbar Puncture (10.7%), nasogastric tube insertion (14.3%) and suturing 10.7%). Other studies have also reported a number of either final year medical students or newly graduated doctors not attempting common procedural skills such as Basic Life Support (BLS), nasogastric tube insertion, simple wound suturing, lumbar puncture (LP), endotracheal intubation and thoracentesis (Jebbin and Adotey 2012 & Colberly and Goldenhar (2006).

It is however worth noting that majority of the skills that students never attempted are performed in emergency situations in which trial and error by students is not acceptable due to its negative implications on patient outcomes (Al-Yousuf, 2004 & Shanks, 2010). This could have limiting the chances for student to practice. Furthermore, for endotracheal intubation compared to CPR, apart from being required in emergency situations, it is an invasive procedure which further limits chances by students to perform it. It has been reported in medical education literature (Rosenson, Tabas and Patterson, 2004; Tabas et al,

2005) that opportunities to perform invasive procedures occur more infrequently as these procedures are required when there is greatest impact on patient outcomes and greatest need for timeliness and success. Furthermore Tabas and colleagues asserted that teaching medical students to perform invasive procedures poses a number of challenges as patients typically want the most experienced clinician to perform the procedure, not a medical student or resident who is doing it for the first time. Therefore, formal training in invasive procedures is often lacking in medical student and even resident curricula. This entails that even where a chance may arise, and there is no danger on the patient's life a student may not have a change to practice on a patient.

Therefore, educational use of plastic manikins, computer simulators or animal models to teach invasive procedures may be a helpful adjunct although it ultimately falls short of the physical reality of an actual human patient (Engum, Jeffries and Fisher, 2003; Tabas et al, 2005).Birnbaumer (2011) further espoused the importance of artificial model in learning clinical skill by indicating that, although the ultimate goal is for the learner to perform the procedure on an actual patient, previously learning a procedure on an inanimate model facilitates acquisition of the skill and improves patient safety. On the other hand Birnbaumer also noted that irrespective of whether or not the learner "first learns" a skill on a patient or artificial model, there will always be a ''first time'' that a medical learner performs a procedure on areal patient, which is an obvious "educational conundrum".

The finding where significant number of students does not perform basic clinical procedures is not unique to our study. Neilsen et al, (2003) stated that 99% of students had to work hard

and be active in order to get access to practice skills in a clinical setting, but only, 36% had the chance to practice to the extent they wanted. In their study, Neilsen and colleagues stated that students tried out only 8 skills out of the expected 22 and that the number of skill practiced varied with nature of skill, hospital and gender of student, with females finding it more difficult to get opportunities to practice. Therefore, a student may go through training without any opportunity to practice certain Lifesaving skills which are essential for clinical practice upon licensure.

The notion that females finding it more difficult to get opportunities to practice was assessed through a chi-square test, which revealed a significant association P value 0.003 between gender and number of times procedures were performed. Males were more likely to perform more procedures than females. For example out of the 17 students who had performed most procedures more than 10 times, 16 (94.1%) were males.

Overall when self-perception was compared to self-rated experience (Table 4.10), expectedly, respondents had low self-perception for the procedures they had little experience with and higher self-perception in procedures where they had more experience. The respondents had low self-perception in endotracheal intubation (n=28, 50%), gastric lavage (n=33, 58.9%) and cardiopulmonary resuscitation (n=34, 60.7%). It is noteworthy that CPR had such high percentage of candidates with low self-perception when it is a life-saving procedure and taught at first-aid level. It is a critical lifesaving procedure in emergencies in the hospital settings. Similarly, our study revealed that that students had high self-perception (n=51, 91% for intravenous cannula insertion, (n=46, 82% for normal vaginal delivery) and (n=40, 71% for examination of the placenta in procedures where they had high (Performed more than 10 times) see table 4.10.

When self-perception of competence was correlated to number of times clinical practical procedures were performed, a positive association was established between the two with Spearman rho 0.548 and P value = 0.000 (Table 4.12). Similar to the findings of this study, associations between the numbers of times a procedure is performed (experience) and self-perceived competence has been reported in earlier studies. For example Promes and colleagues (Promes, et al, 2009) investigating the gaps in procedural experience and competence in medical school graduates at three teaching hospitals in the southeastern region of the United States reported an association of P= 0.000 for all procedures.

It should however be noted that the direction of the relationship between self-perception and number of times a procedure was performed was not tested as such, it can either be assumed that participants who had high experience with procedures (with possible successful attempts) would have developed more confidence (high self-perceived competence) as a result, or the high self-perception, would have motivated participants to perform procedural skills more times. However as asserted by Bandura (1997), high self-efficacy has been related to persistence, tenacity, and achievement in educational settings. Therefore it can be contended that medical students with high self-perception towards a procedural skill are more likely to be motivated to perform such a procedure compared to those with low-self efficacy consequently increasing the likelihood of success with each additional attempt.

The positive correlation between self-perception of competence and number of times a procedural skill was performed is an important finding. Although it is not known which of

the two variables (self-perception of or number of times a procedure was performed) influenced the other, we can suggest that deliberate efforts be made to ensure that medical students perform procedural skills more times, which may consequently result in improved self-perception, as improved self-perception or efficacy has been related to improved achievement (Bandura, 1997).As stated by Rosenson, Tabas and Patterson (2004) and the Association of American Colleges (AAMC, 2008),learning to perform basic and common clinical procedures enables the student not only to better understand and perform selected procedures, but also to begin to develop confidence and competence at a more advanced level of patient-clinician interaction. To improve on the skills experience of undergraduate medical students, Goldacre and colleagues (2003) suggested the use of log books and skills laboratories. Skills laboratories allows students to learn clinical skills in a safe, standardized and controlled environment that encourages trial and error with the ability to rewind, rehearse and practice without negative patient outcomes thus expanding on students 'hand-on experiences (Al-Yousuf, 2004 & Shanks, 2010).

5.6 Manifest Competence-Objective Structured Clinical Examination.

Manifest-competence (actual performance) also referred to as "shows how" in our study, was measured using results of the final year Objective Structured Clinical Examination (OSCE). As opposed to the 14 selected clinical practical procedures included in the knowledge test and self-perception of competence questionnaire, only seven practical procedures were included in the final OSCE. From the seven practical OSCE stations, the investigator successfully negotiated to have three of the procedures included in the OSCE. Given that only seven stations were dedicated to practical procedures, it was acceptable to investigate

three out of seven. Additionally the investigator was conscious not to interfere with the setting of the final examination. The three included procedures underwent detailed result analysis with regard to knowledge of students, self-perception of competency, manifest-competency and frequency of practice as shown in table 4.16.

The three practical OCSE station required students to "show how" a procedure is done using a manikin. In addition to showing how, students were also require to give a running commentary of the requirements during the performance of the procedure, structures involved and the standard practice. Being a final examination, clinical experts in the department determined the, observed and scored the performance (manifest-competence) of students using structured checklist as normally done during OSCEs.

The pass rate for the OSCE ranged from 35.7% on a cystostomy station to 100% on PAP smear and urinalysis stations. Overall pass rates were higher in six out of seven stations. In addition all students passed (scored 50% and above) on the PAP smear and urinalysis stations. When results were aggregated, all the students passed the OSCE. One plausible reason for the high overall pass rate in manifest (OSCE) compared to knowledge test was the presumably "low" school pass mark of 50%. Raising the pass mark would have clearly reduced the pass rates. Although all students passed the OSCE (using criterion referencing), majority 52 (92.8%) were simply barely competent (Scored 50-75%).

When the three practical procedures included in the OSCE were compared, Table 4.15, there were varying levels of manifest competence in performing them. Among the three cardiopulmonary resuscitation, recorded a highest number of students who were not competent (n=24, 42.9%), followed by 7 (12.5%) and 5 (8.9%) who were not competent in nasal gastric tube insertion and intravenous drug administration respectively. It is worrying to note that at the end of the undergraduate medical training, a good proportion of students 24 (42.9%), 7 (12.5) and 5 (8.9) were still not competent in the three commonly encountered procedures of CPR, nasal gastric tube insertion and IV drug administration. Apart from the three procedures being required for day-to- day practice of junior doctors, two of the three CPR and IV drug administration are lifesaving skills required during emergencies, and therefore necessary for patient survival. As stated earlier, the fact that the two procedures are required during emergencies, where trial and error by students is not acceptable (Al-Yousuf, 2004 & Shanks, 2010) and typically for CPR, almost half 27 (42.2%) of the students never performed it during the three years of clinical medical education (Table 4.9), consequently the observed low level of manifest competence.

Other findings were that more than half (n=30, 53%) were barely competent in intravenous drug administration while majority 33 (58.9%) were absolutely competent in insertion of nasogastric tube (Table 4.15). This was despites most students reporting high experience with intravenous drug administration and low experience with nasogastric tube insertion (Table 4.16). When the three practical procedures included in the OSCE were correlated in terms of manifest and self-perceived competence, there was negative correlation on two out of the three specific individual procedures. The correlations (Spearman rho) were: cardiopulmonary

resuscitation (-.150, P value 0.270); intravenous drug administration (-.521, P value 0.000) and nasogastric tube insertion (.128, P value 0.346). Similarly, there was also a negative correlation (p= .451, rho -.123), between manifest competence (all seven practical procedures in the OSEC) and self-perceived competence (all the 14 practical procedure in the self-perception questionnaire). Consequently we failed to reject null hypothesis number one which predicted lack of association between self-perceived competence and manifest competence of Final Year Medical Students of the University of Zambia in core-clinical practical procedures of the undergraduate curriculum.

Similar to findings of our study, previous studies have reported varying degrees of agreement between self-perceived and objectively measured competence in medical students (Jones, McArdle and O'neill, 2001; Morgan and Cleave-Hogg, 2002; Barnsley, et al. 2004; Weiss, Koller, Hess and Wasser, 2005; Lai and Teng, 2011). As indicated, in our study, there was lack of associations between, self-perceived competence and manifest competence. All the students who perceived themselves as highly competent were categorized as barely competent with regard to performance in practical procedures during their OSCE.

Several reasons could be advance for these disagreements. Firstly self-reports are more subjective, and therefore it is generally accepted that competency may be better assessed using Objective Structure Clinical Examination (OSCE). The subjectivity of self-reports as an assessment tool is also supported by Eva and Regehr (2005) in their assertion that the fundamental cognitive limitation in the ability of humans to know themselves as others see them restricts the usefulness of self-assessment results. Secondly, medical students have been

shown to both overestimate and underestimate their clinical performance Blanchi-Hartigan (2010). Therefore the reported high self-perception could not be a true reflection. Although it can be argued that not all procedures in the self-perception of competence questionnaire were in the manifest (OSCE), on the contrary, when correlations were performed between manifest and self-perceived competence for the three practical procedures which were in both the self-perception questionnaire and OSCE, negative correlations were recorded for two out of the three.

Our study was one of the few unique ones that studied and compared manifest and self-perceived competence in clinical practical procedures. Medical education literature alerts us that in comparison to self-perceived competence, manifest competence among medical students has not been extensively investigated. Sacaja, Romic and Prka (2006) cited the cost of tools that can measure competence such as OSCE as a hindrance. Comparable to our study, Elango, et al, (2007) objectively measured the clinical skills of undergraduate students in Malaysia. As opposed to the high OSCE pass rates in our study, the major finding in the Malaysian study was that failure rate in practical skills was high in most of the station (7 out of 8). This finding was despite the skills having been demonstrated to students and an opportunity to practice on manikins and later on patients under supervision accorded. It's however worthy noting that the pass mark for the Malaysian study is not provided thus accurate comparisons with regard to pass rates between the our study and the Malaysian one could not be made.

In our study, there was also a negative correlation (Pearson r -.116) between knowledge of clinical practical procedures and overall manifest competence on the seven practical procedures. Disagreements were also recorded between knowledge and manifest competence for two out of the three practical procedures that were in both the OSCE and self-perception of competence questionnaire. Whereas 65.2% of students had correct scores on CPR knowledge questions, more than 50% were not competent on the CPR OSCE station (manifest-competence). For nasogastric tube insertion, only 30.4% had correct scores in the knowledge test, whereas more than 50% were absolutely competent on the OSCE station. For intravenous drug administration, more than half (57.5%) of students had correct scores in the knowledge test, similarly more than 50% were barely competent on the nasogastric tube insertion station of OCSE, see table 4.16. With these, finding we also failed to reject the fourth and last null hypothesis which predicted lack of association between manifest-competence and knowledge of core-clinical practical procedures of Final Year Medical Students of the University of Zambia. One important reason could be advanced for this outcome. OSCE being a final examination, students could have studied compared to the knowledge test which was not part of the School evaluation systems, as such students could not have prepared for it.

5.7 Think Aloud Protocol

From the Think aloud-Protocols that were administered to 10 randomly selected students following their Objective Structured Clinical Examination, data in form of "short narratives "was obtained on the thought processes of students while they were completing the clinical

procedures during the OSCE. From the narratives, four "mini themes" emerged which highlighted the students' thought processes while performing the practical procedures. In addition three prominent emotional feeling were also recorded. The "mini themes" supplementary information from the OSCE (manifest-competence) by way of providing an understanding of the cognitive processes that underlay the psychomotor activities during the OSCE. The seven mini themes are summarized below; four regarding the thought processes and three on the emotional feelings.

Theme one: The procedure in totality- "theory behind the procedure, instruments, anatomical structures involved landmarks, correct techniques, ideal practice".

This was one of the prominent thoughts among students the moment they arrived at a practical OSCE station. Immediately the student read the scenario, most of them thought of what we labeled as "the procedure in totality"(theory behind the procedure, instruments, and anatomical structures involved landmarks, correct techniques, ideal practice)."*I thought of the theory behind the procedure, instruments, structures and landmarks, correct techniques, ideal practice and patient condition…., like for pericardiocentesis, I had to ask the examiner if it was an elective pericardiocentesis or an emergency one"* ***Participant 3***. Apart from the correct technique, "the procedure in totality" involved cogitative processes of recalling the theory underlying the procedure including the required instruments, anatomical structures involved and landmarks. Such findings further supports the role of cognition in psychomotor performance which according to our conceptual framework (Figure 2.1) is the knowledge component of clinical competence (Miller, 1990). We once more concluded, that for an

individual learner to "show how" a clinical procedure is performed and consequently perform it, one should possess the cognitive knowledge to underpin the psychomotor activity.

Theme two: Integration what was read (theory), observed, and practiced during clinical years

Integration of theoretical knowledge with what was observed and practiced during the clinical years was yet another prominent thought while students performed the different procedural skills.*"…the first thought was how can I integration the theoretical knowledge, what I had observed and what I had done before". "I thought of the experience I have had with the procedure"* ***Participant 9****. My demonstration of CPR was influenced mainly through theory because such procedures on the ward we leave them for the interns to perform because it is an emergency, I had to think of the theory and what I had observed from the Intern Doctors"* ***Participant 7.*** With this finding we concluded that for a student to adequately perform a procedure, firstly they should have sound theoretical knowledge, secondly they should observe the procedure performed with the correct technique and thirdly they should practice. Correct demonstration of practical skills for learners is critical because despite students knowing the correct technique in theory, the first stage in learning a psychomotor skill according to Dave, 1970 is imitation. Consequently, if students observe a wrong technique they will imitate as such and perform as such.

Theme three: The starting point and how to sequence performance of the procedure- what need to be done before the procedure (preliminaries), during, after and the follow-up care?

Sequencing of the procedure was another prominent though that immediately intruded the mind of students once they realized they were at a practical OSCE station. *I thought of the starting point and strategized how to sequence, proceed and finish within the given time"* ***Participant 10****. "…. I asked myself, any preliminaries to do before the procedure and what to do after the procedure and follow-up care"* ***Participant 6***.This implies that for learners to adopt a correct sequence and achieve optimal performance or level of competency on a given skill, clinical medical educators should teach the correct sequence. As indicated earlier, Hamdorf and Hall (2000) asserts that individuals who are provided with clear description and demonstration of a task are more likely to master a skill than those who are not.

Theme four: How to manage time

Since all the OSCE stations have prescribe time within which to perform the given skill, most participants thought of how to manage their time immediately after reading the scenario. "*the first thought was, how do I demonstrate nasogastric tube insertion within this short time". I need all the marks…how do I manage time to finish the demonstration"* ***Participant 7****.*

Theme five and six: Feeling of anxiety versus feeling of confidence

In addition to the thought process, students also had varying emotional feelings as they performed different practical procedures. The most common reported were feelings of

anxiety versus feeling of confidence. The two feelings were mutually exclusive, except in cases where anxiety was sorely due to the examination process. Students who reported being confident had no anxiety while those who were not confident were very anxious. *"I was anxious because this was an examination, the process itself causes you to be anxious, usually because you do not know what to expect on each station* ***Participant 8****" "……the anxiety was mainly because I had not practiced the procedure as I would have loved to"* ***Participant 2.*** *"….I was anxious because I was 'caught unaware'; I didn't expect a procedure like aahh…..to perform a cystostomy"* ***Participant 9****. "The anxiety was because I had not read much about the procedure"* ***Participant 6***. Those who were confident also had reasons for their confidence. "*…I was confidence because I had the knowledge and had practical experience and theoretical backing"* ***Participant 2***.

Lack of competence due to inadequate practice of clinical skills has been recorded as a source major anxiety or stress among junior doctors. For many junior doctors lack of competency in clinical skills is a significant source of stress as it provokes feelings of inadequacy and dissatisfaction with level of competence in functioning independently (Taylor, 1997; Liddell, et al. 2002; Rolfe and Sanson-Fisher, 2002; Tallentire, et al. 2011). As shown from our study, those students who did not have adequate practice felt anxious not just from the examination process but from the lack of adequate practice of a given skill.

Theme seven: Feeling of doubt

This feeling was mainly triggered by thoughts of whether one was doing the right thing or not. It occurred mostly among students who had not practiced the particular procedure

adequately. *"I doubted myself whether I was doing the right thing" Participant 6. "…..I asked myself….Am I making a mistake?"****Participant 6.***

5.8 Learning and Development of Competence in Clinical Practical Procedures

5.8.1 Introduction

The question of how Undergraduate Medical Students of the University Of Zambia acquire competency in clinical practical procedures during clinical years was investigated. Using Grounded Theory, a model of how Medical Students of the University of Zambia learn procedural skills emerged "**Passive Observation to Peer Teaching Model of Clinical Procedural Skills Acquisition and Competency Development".** A great deal of information was generated during the in-depth interviews regarding what students learn, how they learn and how they develop from **"first learnt to feeling of competency".** All the information on the **what**, **how** and the **developmental process** from "**first leant to feeling of competency"** built into the different components of the generated model.

5.8.2 Learning Clinical Practical Procedures

Through this investigation we isolated the different clinical practical procedures that students commonly learnt and felt competent in performing towards the end of their under graduate medical education at the University of Zambia School of Medicine. Typically all participants interviewed felt competent in intravenous cannula insertion. Other procedures majority of participants felt competent in performing were urethral catheterization, vaginal deliveries, Lumbar Puncture, nasogastric tube insertion, and pleural and ascetic tap. "*Alright, to make*

things easier, I will give them to you in terms of different departments that I have been through. To start with internal medicine I feel am competent in phlebotomy, Intravenous cannulation, Lumbar Puncture, Plueral tap, ascetic tap, urethral catheterization (male and female), aaa…. Let me move to Obstetrics and Gynaecology, am competent in manual vacuum extraction, I can competently deliver a baby. Inpeadiatrics I can say am competent in the same procedure as those in internal medicine, in addition, examination of a baby." ***Participant 17***.

The group of medical students under investigation learnt using the traditional curriculum model thus the clinical education was predominantly at the bedside during the different clinical clerkships. Traditional medical curricula rely primarily on clerkships during the clinical period of study to acquire and train in clinical practical skills. Similarly Mileder, Wegscheider and Dimai (2014) affirmed that Clerkships are still the main source for undergraduate medical students to acquire necessary skills. On the other hand, Mileder and colleagues contend that although clerkships are the main source of undergraduate clinical medical education, these educational experiences may not be sufficient, as there are significant deficiencies in the clinical experience and practical expertise of medical students.

Accordingly, Nielsen et al (2003) reported that the chances of training practical procedures during clerkships are scarce and that medical students have to work hard in order to be able to perform relevant skills. Similarly in this study some students alluded to the fact that they didn't have much practice because they were doing it at the bedside. *Most of them was at the*

bed side. It was at the bedside within the University Teaching Hospital. To be honest I haven't had much practice as I would have liked because we have been doing it on actual patients, so it's a bit scarily because you know that is an actual patient, I guess I haven't had enough practice as I would have loved. Participant 11.

Teachers of procedural skills were mostly Internship Doctors, and to a lesser extent Senior Doctors such as Registrars and Consultants. As junior students, they also learnt a number of procedures from senior medical students. It was therefore concluded that medical students learn procedural skills from doctors at different levels. This is in confirmation with the Royal Australian College of General Practitioner (RACGP,2011) that Doctors at all levels of their learning lives are often involved in teaching procedural skills to their juniors: the medical student may learn skills from the first year intern or the registrar from the vocational doctor which is reflected in the traditional expression, 'See one, do one, teach one'. This was not different in the present study as indicated by one participant, *"I observed what consultants or interns were doing on the ward after that I tried and repeated the same". Participant 2.*

Apart from being taught by doctors and senior students, they also learnt a few procedures like nasal gastric tube insertions and vaginal deliveries from nurses and midwives respectively.*Ok depending on the facility, most nursing staff have been very helpful in procedures such as catheterization, nasogastric tube insertions, these procedures are almost exclusively done by them and they are quite helpful in teaching. Then for the deliveries, I learnt from the midwives Participant*

Regarding how they learnt the mentioned procedures, eight themes emerged; formally taught, informally taught, through demonstrations, through observation, passively, by doing (apprenticeship), "being put on the spot" or reading books. Irrespective of the mode of learning, fundamentally students first had to observe another person perform a procedure, before they could attempt. Initially the observation was mainly passive thus the first step in the model **"passive observation"**. *Ok let's start with cannulation*, *like in our curriculum we start in fifth year and I learnt it passively, it's not like someone will come and teach you how to cannulate, you will be standing there and watching someone Participant 4.* Passive observation asa mode of learning clinical practical procedures especially in junior clerkships is documented in medical education literature, for example Remmen (1998) as cited in Mileder, Wegscheider and Dimai (2014) indicated that junior clerkships were predominantly passive experiences with hardly any opportunity to train in clinical skills.

Investigators in the present study believe that passive observation is an important stage which prepares the student, and allows the learner to link the theoretical knowledge to clinical practice thus moving from the stage of "knows" to "knows how" as a prerequisite to "shows how". This progression from passive observation to performance along the continuum of acquiring competency in procedural skills was observes by Johannesson, 2012. Johanneson, illustrated that students learning procedural skills progressed from preparing, watching, practicing and reflecting. In reference to Johanneson, in our study the "watching" can be equated to the "passive observation". The watching/ passive observation is exemplified in this participant's words… *I learnt it passively, it's not like someone will come and teach you how to cannulate, you will be standing there and watching someone participant 4.*

Learning through demonstrations was one of the eight ways through which students learnt procedural skills. Some participants referred to demonstration as "showing how". Ideally teaching of procedural skill should progress through four stages (Peyton, 1998). Stage one (demonstration) involves the instructor demonstrating the skill at normal speed with little or no explanation. Stage two (deconstruction), the instructor demonstrates the skill by breaking it down into simple steps with full explanation. Stage three (formulation) instructor demonstrates the skill while being talked through' by the student' and stage four (performance) student performs the skill under supervision, describing each step before performing it (Table 2.2). In addition, literature has alerted us that individuals who are provided with clear description and demonstration of a task are more likely to master a skill than those who are not Hamdorf and Hall, (2000).

In an environment where doctors who are involved in clinical medical education are also involved in full time provision of clinical care, coupled with the use of actual patients for learning, it is not feasible to follow all the four step in teaching through demonstrations. Instead a one off time demonstration usually combining step one to three is commonly utilized and later students are observed as they perform the procedure during the rest of the clinical clerkship time. Worth noting is however that at times demonstrations were immediately followed by return demonstration which is a recommended approach and is practiced by medical educators at University of Zambia Medical School as pointed out by one participants. *In Obstetrics and Gynaecology, procedures like getting a Papanicolour (PAP) smear, someone will be teaching the indications, when to do or not do a PAP smear, them they get a manikin, then they will show you how to do it and then you get two or three*

students to do it after the lecturer or the Doctor Participant 4. However caution should be taken that Clinicians involved in teaching need to assess their teaching processes to ensure that they are teaching technical skills in a systematic manner (RACGP, 2011).

As expected in a traditional curriculum where medical students are expected to acquire clinical competence through the apprenticeship model (McGaghie, et al, 2011), findings of the present study were not different as one of the themes on learning was "learning through apprenticeship". These are some of the words from one participant "*In surgery, the first thing was suturing, which I think I did wrongly because I had not read much about it, so I was assisted throughout the procedure by the surgeon , I think that was the first experience. Participant 7.* The realization by the student that he/she did the procedure wrongly despite being assisted by the surgeon because he had not ready, depicts the importance of cognitive knowledge in psychomotor skills (Kopta, 1971; Miller, 1990; Hamdorf and Hall, 2000; Amin and Hoon-Eng 2003 & Buckley, Manalo, and Lapitan, 2011).

Following the initial learning students had to perform the procedures under guidance of qualified clinicians. It was on the basis of this revelation that the second step (guided performance) in our model emerged.To some learners the first attempt was learner initiate "*initially you ask someone to observe you" Participant 3,* while others were either requested to perform a procedure after a few observations or had to be put on the spot *"but initially I had observed a few and the next patient that came I was put on the spot, to say try to do what you have been observing, so from observation, I was told to do it" Participant 8.*Performance

of a skill by a student following observation of the teacher or instructor is recommended as a means to reinforce what has been learnt. Performance (Student performs the skill under supervision, describing each step before performing it) is the last stage in Peyton, 1998's four stage model in teaching a manual skill.

5.8.3 Steps Taken To Develop Competency

Four themes emerged on how students developed from the time they first learnt the procedural skill to the time they felt competent; personal interest, more practice, reading literature and teaching others. Without dedicated time for learning/acquisition or development of competency in practical procedures, personal interest was regarded as one of the major factors in the competence developmental process. Students had to take it upon themselves in seeking opportunities to practice learnt skills especially those learnt informally. Personal interest was also described as "self-push" "taking it upon oneself", "self-motivation" "putting in effort" or being proactive".

Studies in teaching and learning in clinical settings have found that clinical teaching is variable, unpredictable, and immediate and lacks continuity (Lawson and Bearman, 2007). In an environment where teaching is unpredictable and lacks continuity, it is definitely incumbent upon the learner to be proactive if they have to learn and develop their skills to acceptable levels. Without personal interest one participant revealed that it was possible to go through training without attempting even common procedures……*because if as a student you don't show any interest you can literally go through the training without learning anything, I know people who have finished fifth year (first year of clinical medical education)*

without knowing even basic cannulation probably they are just hiding behind others **Participant 8**.

In the present study "more practice" was identified as yet another strategy towards developing competency. The "more practice" was mostly undertaken outside school scheduled learning time, thus it was student initiated and mostly unguided. It was from the "more practice" outside where the third step (unguided performance)in our model emerged.From the participant's descriptions, "more practice" which was also referred to asdoing a practical procedure over and overin order to be competent can be equated to the concept of deliberate practice. Deliberate practice together with other factors including direct supervision and feedback have been suggested to facilitate development of self-confidence in performance of clinical skills (Duvivier et al, 20122 and Lai, Sivalingam and Ramesh, 2007).

Students interviewed in our study indicated that in order to have more practice, they had to make own arrangements such as going back to the clinical area after official school time such as during the evenings. In addition, they had to undertake some electives, and electives were particularly regarded as having provided more practice as can be noted in the following quote*" electives made a difference in that at the University Teaching Hospital, we are not allowed hands on practice but during electives you are given more time to do hands-on* ***Participant 1***.

Reading was described as one of the strategies that was used to enhance competency. Students were prompted to read literature related to procedural skills by several factors. These factors ranged from the fact that procedures in the clinical setting were not performed in an ideal manner due to limitations on resources and high patient turn over and that the information provided during the teaching sessions was inadequate and needed to be supplemented. This provoked students to read literature to discover the ideal way of performing the procedure. Participant 14 indicated "I *had to read around LP literature and how they do it in an ideal way"* on the other hand participant 17 disclosed "*While you would be taught practical things on the ward as the procedure is being done, the information was inadequate and needed to be supplemented by extra reading.*

Another motivator for reading literature which indirectly enhanced competency was the likelihood of being assessed on procedures during OSCEs. *As you may be aware, in our OSCE in Internal medicine, little in OBS and in Peadiatrics particularly in Medicine there are designated sports where we are required to describe or perform a procedure so it's incumbent upon a student to look for details for those procedures because it's guaranteed that such a station would be there so it's necessary to do extra reading in preparation for exams and as a requisite for acquiring such a skill* ***Participant 17***. This once more supported the notion that assessment drives learning Wass et al. (2001) and Epstein, (2007).

Teaching others (junior students) was one of the ways in which competency was developed for some students. Following the passive observation, guided performance and unguided

performance, some students felt the urge to teach junior student's in the similar manner they were taught by their seniors. It is from this phenomenon where the last stage of our model emerged **"peer teaching"**.

This observation of senior medical students or senior doctors teaching their juniors as a means of enhancing competency is not unique to our study. As indicated earlier doctors at all levels of their learning lives are often involved in teaching procedural skills to their juniors: the medical student may learn skills from the first year intern or the registrar from the vocational doctor, reflected in the traditional expression, 'See one, do one, teach one' (RACGP, 2011). However, medical educators and medical students alike should be "alive" to the fact that most procedures need multiple repetitions of the ''see one, do one, teach one'' cycle to ensure proficiency in the skill (Birnbaumer, 2011). The value of the "teach one" which is equated to "peer teaching" in our substantive model can never be over stated as can be deduced from participants' own descriptions…*I think every time before you teach your juniors you have to be perfect you have to go back to your theory, get your theory right and even practice, I think, teaching is another way of helping you to learn and perfect a skill, Participant.* RACGP (2011) also records that teaching can also be an important method of reinforcing learning in the teacher.

5.9 Contribution of the Study to the Body of Knowledge

5.9.1 The main contribution of the study to the body of knowledge is through the developed model designated as the "**Passive Observation to Peer Teaching Model of Clinical**

Procedural Skills Acquisition and Competence Development". Rather than merely describing and comparing self-perceived and manifest –competence, the use of Grounded Theory lead to the emergency of a substantive model.

5.9.2 The study also established the clinical practical procedure knowledge level, self-perceived and manifest competence of graduating medical students at the University of Zambia. This forms a basis for future comparisons.

CHAPTER 6

6.0 CONCLUSSIONS, IMPLICATIONS AND LIMITATIONS OF THE STUDY

6.1 Conclusion

We concluded that regardless of how medical students first learnt different clinical practical procedures: formally, informally, through demonstrations, through observation, passively,

through apprenticeship, "being put on the spot" or reading books, fundamentally they first had to observe another person perform a procedure, before they could attempt. The observation was initially done passively, thus the first step in the Grounded Theory model "**passive observation**". Having observed once, twice or three times how a procedure is done, the learner went on to attempt/perform the procedure under the guidance of a competent practitioner. This constituted the second step in the model "**Guided performance**". The third step referred to as "**unguided performance**" constituted mainly student initiated practice. Finally senior students taught junior students as a means for enhancing their level of competence in what was referred to as **Peer Teaching.**

Therefore studying the process of how medical students acquired and developed competency in clinical practical procedures at the University of Zambia lead to the emergency of a Grounded Theory model referred to as "Passive Observation to Peer Teaching Model of Clinical Procedural Skills Acquisition and Competence Development". When compared to existing models of clinical skills acquisition in particular those that underpinned our study, the main similarity is that although different terminologies are used to describe different stages of competency development, when considered in totality, the process is progressive in nature, with teaching and assessment related factors nurturing the progress. In addition our model can be seen as an expanded version of the "see one, do one and teach one approach" with an expansion of the "doing one" which in our model is first guided then unguided. One notable difference between existing models and the proposed model is that while existing models (notably Dave's 1970) focus on actual manipulations to perform a psychomotor skill, our model focuses on the process of developing competency.

From our study, we also concluded that knowledge of clinical practical procedures was inadequate represented by 39% pass rate. Teachers' expectations (Angoff pass marks) were higher than actual student scores on most questions and the entire MCQ knowledge test. For specific MCQ items, the pass rate was high on those items from procedures that were formally taught, and that formally taught procedures were performed more times with students reporting high self-perception on procedures they had high experience with. In addition, students were more knowledgeable in those procedures where there was a high likelihood of being assessed and consequently practiced more of those procedures in comparison to others. Important to note is that majority of the clinical practical skills that students never attempted during the three years of clinical medical education are those performed in emergency situations in which trial and error by students is not acceptable due to its negative implications on patient outcomes.

With regard to performing the selected clinical practical procedures, students in our study performed more common procedures such as IV cannula insertion and conducting normal vaginal deliveries (with all students performing the stated procedures more than 6 times) compared to what has been reported before in medical education literature. Contrary to the impressive performance on IV cannula insertion and conducting normal vaginal delivery, significant numbers of students never performed important common procedure such as gastric lavage, endotracheal intubation and CPR a phenomenon that has been reported in most previous studies. As expected, significant numbers of students reported low-self-perception in performing those procedures where they had no or limited practice, despite two thirds perceiving themselves as moderately competent in overall performance of the 14

selected practical procedures. It was later concluded that lack of practice could have contributed to the low self- perception.

Similar to most previous studies that that reported varying degrees of agreements between manifest and self-perceived competency, findings of our study revealed a negative correlation between self-perception (moderately competent for most respondents) and manifest competence (barely competent for most respondents) on overall competence on the seven practical stations of the OSCE and on two out of the three specific individual procedures included in the OSCE (Cardiopulmonary Resuscitation and intravenous drug administration).

In the light of our conclusions, we suggested an alternative model for teaching clinical practical procedures in which teaching/learning is more structured, students are accorded more time to observe how expert perform clinical practical procedures, practice under guidance before independent practice and encouraged to teach others as a means to developing competency. We further suggested use of alternative teaching avenues as an adjunct and not a replacement of bedside teaching and inclusion of more procedural stations during the OSCEs.

With the preceding conclusions, we asserted that the most important contribution of our study to medical education is mostly located in the teaching of clinical practical procedures.

6.2 Implications of The Study

Findings of this study have three major implications:

6.2.1 Implications for Teaching of Clinical Practical Procedures

6.2.1.1 Structured Teaching/Learning of practical Procedures

In relation to learning of clinical practical procedures, the study revealed that most students had correct scores on MCQ test items from procedures that were formally taught. Cognitive competence is important as it forms a foundation for "psychomotor competence" In addition the formally taught procedures were also performed more times with significant number of students reporting moderate or high self-perception. The need for structured learning was resounded by, most of the respondents during the in-depth interviews. For example participant number 12

"My biggest suggestion is that there should be a more formal approach to teaching clinical skills because most of our tutorials cover theoretical aspects of medicine and how to manage patients, so we don't focus so much on practical skills they just expect that we will learn it somehow or somewhere along the way. For us there has been no formal structure of teaching skills, I feel there should be a formal way of getting people to learn the skills, because you find a student may go through the entire clinical years without ever having to do an LP because you can get away with it. Participant 12.

No matter how basic it is like cannulation they don't bother to teach because it's like they assume that everyone already knows. Participant 7

6.2.1.2 Alternative innovative teaching/learning avenues

Majority of the clinical practical skills that students never attempted during the three years of clinical medical education are those performed in emergency situations in which

trial and error by students is not acceptable due to its negative implications on patient outcomes. To this end we recommend inclusion of alternative teaching learning avenues in addition to bed side teaching and learning. Such avenues include clinical skills laboratory where students can have opportunities to practice procedures that are performed in emergency situation that do not permit trial and error by students. In the skills laboratory, students can also practice skills in an environment that is controlled, conducive, standardized and less scarily as there is no life at risk. Below is a recommendation for learning in a clinical skills laboratory from the in-depth interview of Participant 11.

I think learning the skills on a model where someone will be trying to help you will helpful as opposed to learning on the bedside for the first time it is a challenge and a bite scarily because you are doing it on the actual patient.

6.2.2 **Implications for Assessment of Clinical Practical Procedures**

6.2.2.1 **Inclusion of More Clinical Practical Procedures in OSCE**

Assessment drives learning Wass et al, (2001) and Epstein, (2007). Findings of the present study supported the assertion that assessment drives learning. Results revealed that students were more knowledgeable in those procedures where there was a high likelihood of being assessed and consequently practiced more of those procedures in comparison to other. Qualitative findings also revealed that for most practical procedures participants felt competent in performing, they also reported to have been formally assessed. Therefore if students are aware of the likelihood of being assessed they will learn those procedures and become competent to the benefit of future patients. To this end we recommend inclusion of more practical skills in the OSCE.

6.2.2.2 Review of OSCE Pass Mark

In the present study, there was a 100% rate for OSCE which used 50 % as a pass mark compared to the 39.3% pass rate for the MCQ knowledge test where the pass mark was determined by clinical experts. Due to the presumably low OSCE pass mark, more than two third of students had pass scores on the CPR despite two thirds of them reporting low self-perception. Similarly almost all students had a pass score of on the NGT insertion station of OSCE despite a quarter reporting low self-perception. This could be an indication that the OSCE pass mark is not adequate to discriminate between low and higher performing students, thus implying the need for determining/reviewing OSCE pass mark using recommended methods other than arbitrary determination.

6.2.3 Implication for future Research

One limitation of this study is that not all practical procedures that were self-reported on were objectively assessed during the OSCE. This limited comparisons that were made between the two data sets. We therefore recommend that for accurate comparisons, a study should identically match the procedures for self-perceived competence to those of manifest competence.

6.3 Limitations of the Study

The investigator recognizes and acknowledges limitations in the current study:

6.3.1 The most significant limitation was that we could not identically match all the clinical procedures in the self-perception and the manifest competence assessment because the manifest competence was measured in a final examination in which it was undesirable to interfere with the content and number of practical stations. However, three practical procedures from the self-perception questionnaire were assessed in the OSCE (manifest competence) and therefore direct comparisons for the three were made in terms of knowledge levels, self-perception and manifest competence. In addition, our study was cross-sectional and the numbers were restricted for statistical generalizations. However, we believe the findings provide enough credibility and fidelity.

6.3.2 A retrospective approach was used to determine how students acquired competency in clinical skills. Having undergone different clerkships in the three clinical years, there could have been recall biases regarding how specific practical procedures were learned and the numbers performed.

6.3.3 A 48-item MCQ test was used to cover 14 listed practical procedures thereby causing a likelihood of under-sampling and putting the study at risk of inadequate representation of the student knowledge base, however only a limited sub-topics for each procedure were included such as indications/contraindications, anatomical structures involved, correct techniques thus the limited items included in the test.

6.3.4 Use of 5th year medical students in pre-testing the instruments. Fifth year students are in their first set of clinical clerkship, as such they are less comparable to the 7th years as

they had not been extensively exposed to a number of clinical practical procedures. This could have limited the pre-testing.

6.3.5 Based on accessible reviewed literature, no other study has been conducted to measure clinical competence at the end of training; as such there was no comparison. Ideally this would have been a comparative study with other schools within the country or the sub-region. However, within the country, there is no any other medical school that had final year medical students. The other three medical schools were all established in 2011 as such by 2013 these schools only had only first year pre-clinical students. Regarding comparison with school in the sub-region, the scope of this study with regards to financial resources and duration of the PhD scholarship within which the study has to be conducted, it is limited. Therefore as opposed to comparison across groups, comparison within group (manifest and self-perceived competence, self-perceived and number of times procedures were performed and finally and manifest and knowledge levels) was done. With information from this study future comparisons will be possible.

6.3.6 Inter-rater variability.

In this study, OSCE scores of the final examination for medical students were utilized. Scoring during these examinations was done by different clinical experts who are faculty of the Medical School. As such there could have been rater differences in the way different faculty scored a skill using the same rating scale since students were divided into two or four streams. However being an examination situation, no training on rating was done as this could have interfered with the conduct of the examination. Therefore the

examination was conducted based on already established guidelines. The candidate simply obtained and used the OSCE scores as graded by faculty.

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APPENDIX I

UNIVERSITY OF ZAMBIA

SCHOOL OF MEDICINE

DEPARTMENT OF MEDICAL EDUCATION DEVELOPMENT

SELF ADMINISTERED QUESTIONNAIRE

STUDY TITLE: ACQUISITION OF COMPETENCE IN SELECTED CLINICAL PRACTICAL PROCEDURES: SELF-PERCEPTION VERSUS MANIFEST COMPETENCE OF FINAL YEAR UNIVERSITY OF ZAMBIA MEDICAL STUDENTS.

DATE……. COMPUTER NO……

INSTRUCTIONS TO RESPONDENTS

1. Do not write your name on the questionnaire, only computer number. Computer numbers are required exclusively for comparison with other data set
2. Circle the most appropriate response (s) to the question
3. Attempt all the questions in all the three sections
4. All information provided will be kept confidential

SECTION A: DEMOGRAPHIC CHARACTERISTICS

1. What is your gender?
    a. Male
    b. Female
2. Have you had any other training in health care related fields apart from MbChB?
    a. Yes
    b. No

3. In which of the following clinical specialties have you had clerkship during training? (circle all that applies)
    a. Internal Medicine
    b. Surgery
    c. Obstetrics and Gynaecology
    d. Paediatrics
    e. Psychiatry
    f. Ophthalmology
    g. Community Medicine
    h. Dermatology
    i. Orthopedics
    j. ENT/Maxillofacial
    k. Radiology
4. Which of the following procedures were you formally taught during your undergraduate medical training?(circle all that applies)
    a. Intravenous cannula insertion
    b. Nasal gastric tube insertion
    c. Urethral catheterization
    d. Lumber puncture
    e. Cardiopulmonary resuscitation
    f. Endotreacheal intubation
    g. Wound suturing
    h. Vaginal examination
    i. Normal vaginal delivery
    j. Examination of the placenta
    k. Examination of the new born
    l. Intramuscular drug administration
    m. Intravenous drug administration

5. Which of the following procedures were your formally assessed during your undergraduate medical training? (circle all that applies)

a. Intravenous cannula insertion
b. Nasal gastric tube insertion
c. Urethral catheterization
d. Lumber puncture
e. Cardiopulmonary resuscitation
f. Endotreacheal intubation
g. Wound suturing
h. Vaginal examination
i. Normal vaginal delivery
j. Examination of the placenta
k. Examination of the new born
l. Intramuscular drug administration
m. Intravenous drug administration

SECTION B: MULTIPLE CHOICE KNOWLEDGE TEST ON SELECTED CLINICAL PRACTICAL PROCEDURES

LUMBAR PUNCTURE

1. Which spinal interspace does the imaginary line connecting the posterior superior iliac crests cross?

   L1-L2

   L2-L3

   L3-L4

   L4-L5

   L5-S1

   Source: Queens University, Department of Emergency Medicine. Technical skills programme. Available at http://meds.queensu.ca/simlab/undergraduate_medicine/techinical_skills_program

2. Which of the following positions should a patient assume to ensure a successful lumbar puncture?

   a. Left lateral with back at the edge of the bed, and neck flexed.
   b. Left lateral with back at the edge of the bed, and neck hyperflexed

c. Right lateral with back at the edge of the bed, and neck flexed

d. Right lateral with back at the edge of the bed, and neck hyperflexed

Source: Queens University, Department of Emergency Medicine. Technical skills programme. Available at http://meds.queensu.ca/simlab/undergraduate_medicine/techinical_skills_program

3. Which of the following actions would you take if you encounter bone resistance while advancing the needle when performing LP?

    a. Remove the needle completely and re-start the procedure

    b. Remove the needle up to the skin and re-direct it

    c. Remove the needle to the subcutaneous tissues and re-direct it

    d. Redirect the needle away from point of resistance

Source: Queens University, Department of Emergency Medicine. Technical skills programme. Available at http://meds.queensu.ca/simlab/undergraduate_medicine/techinical_skills_program

4. While advancing a Lumbar puncture needle which of the following would indicate that you have reached the subarachnoid space?

    a. Increased feeling of 'resistance'

    b. Decreased feeling of 'resistance'

    c. Feeling of a 'pop'

    d. Flow of CSF

Source: Queens University, Department of Emergency Medicine. Technical skills programme. Available at http://meds.queensu.ca/simlab/undergraduate_medicine/techinical_skills_program

5. Which of the following positions would you advise the patient to assume after a lumbar puncture?

    a. Left lateral with head flat

    b. left lateral with head elevated to about 15 degrees

c. Supine with head flat

d. Supine with head elevated to about 15 degrees

Source: Queens University, Department of Emergency Medicine. Technical skills programme. Available at http://meds.queensu.ca/simlab/undergraduate_medicine/techinical_skills_program

6. What is the most common complication following lumbar puncture?

a. Post LP headache

b. Post LP back pain

c. Spinal hematoma

d. Seeding of infection into the CSF

Source: Queens University, Department of Emergency Medicine. Technical skills programme. Available at http://meds.queensu.ca/simlab/undergraduate_medicine/techinical_skills_program

CARDIOPULMONARY RESUSCITATION

7. What is the recommended rate of CRP compressions?

a. 70 compressions/minute

b. 80 compressions/minute

c. 90 compressions/minute

d. 100 compression/minute

Source American Heart Association (2005). Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. 112(24) (Supplement):IV-1-IV-5.

8. What is the recommended universal compression-to-ventilation ratio for all ages (except newborn infants)?

a. **15:2**

b. 20:1

c. **30:1**

d. 30:2

Source American Heart Association. (2005). Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. 112(24) (Supplement):IV-1-IV-5.

9. What is the rate of compressions and ventilations in a newborn resuscitation?
    a. 90 compressions to 10 ventilations/minute
    b. 90 compressions to 20 ventilations/minute
    c. 90 compressions to 30 ventilations/minute
    d. 90 compressions to 40 ventilations/minute

Source American Heart Association. (2005). Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. 112(24) (Supplement):IV-1-IV-5.

ENDOTRACHEAL INTUBATION

10. Where is the *Murphy eye* located on an endotracheal tube ?
    a. At the tip of the tube
    b. Below the bevel end of the tube
    c. Above the bevel end of the tube
    d. On the side of the bevel end of the tub

Source: Daniel, F. Danzl, R. J. (no date). Vissers Emergency Medicine 6th Ed., Section 3: Resuscitative Problems and Techniques, Chapter 19. Tracheal Intubation and Mechanical Ventilation,

11. What is the minimum distance above the carina should the ETT be for proper placement?
    a. At least 1 cm
    b. At least 2 cm
    c. At least 3 cm
    d. At least 4 cm

Source: David Whitaker, D.O. - Kaiser Permanente

12. What is the approximate distance from the end of the ETT to the corner of the mouth for proper placement in males?
    a. 19cm
    b. 21cm
    c. 23 cm
    d. 25cm

Source: David Whitaker, D.O. - Kaiser Permanente

13. When performing an intubation what is the best clinical sign that the ETT is in the trachea and not the esophagus?
    a. Direct visualization of the tube passing through the vocal cord
    b. Ventilate patient and observe for rising of the chest
    c. Ventilate patient auscultate the chest bilaterally
    d. Ventilate the patient and auscultate epigastric region

Source: David Whitaker, D.O. - Kaiser Permanente

14. During endotracheal intubation, which of the following maneuvers is most likely to bring the vocal cords into view?
    a. Opening the mouth widely by separating the lips and pulling on the upper jaw with the index finger
    b. Inserting the laryngoscope into the mouth with the blade directed to the right tonsil
    c. Sweeping the laryngoscope blade to the midline while keeping the tongue on the left
    d. Lifting the laryngoscope upwards and away from the nose - towards the chest

Source: Endotrcheal intubation procedure. (2000). Associate clinical nurse manager, high dependency unit

URETHRAL CATHETERIZATION

15. During catheterization, once urine flows, how much further should the catheter be advanced in females?

    a. 1.5- 2cm
    b. 1.5 -3cm
    c. 2.5 - 4cm
    d. 2.5 - 5cm

16. When inserting a urethral catheter in males
    a. Lift the penis to a position perpendicular to the patient's body and apply light upward traction
    b. Lift the penis to a position perpendicular to the patient's body and apply light downward traction
    c. Lift the penis to a position perpendicular to the patient's body avoiding any traction
    d. Lift the penis to 60 degrees angle above the patient's thighs and apply light upward traction
17. Which of the following solutions is recommended for filling the urinary catheter balloon
    a. Tap water
    b. Sterile water
    c. Saline solution
    d. Isotonic solution

NASAL GASTRIC TUBE INSERTION

18. Which of the following is correct regarding length of NG tube to be inserted?
    a. Place exist point of tube at tip of the nose, extend to ear lobe and then to xiphisternum
    b. Place exist point of tube at tip of the nose, extend to ear lobe and then to a point halfway between the xiphisternum and the umbilicus
    c. Place exist point of tube at tip of the nose, extend to ear lobe and then to a point one third between the xiphisternum and the umbilicus

d. Place exist point of tube at tip of the nose, extend to ear lobe and then to a point two thirds between the xiphisternum and the umbilicus

Source: Salford Royal NHS Foundation Trust. Nasogastric Feeding Tube placement and management manual

19. To achieve a successful nasogastric tube insertion, which position would you place a conscious patient at the beginning of the procedure?
    a. Upright with the head level
    b. Upright with the head tilted back wards
    c. Upright with head tilted forward
    d. Upright with the head hyperextended

    Source: University Hospital of Leicester. NHS (2005). Policy and procedures for the insertion and post-insertion management of nasal gastric tubes in adults, children and infants

20. When advancing a nasal gastric tube, which of the following techniques is correct?
    a. Pass the tube along floor of the nasal passage, aiming down wards towards the client's ear unto the oropharynx
    b. Pass the tube along roof of the nasal passage, aiming down wards towards the client's ear unto the oropharynx
    c. Pass the tube along nasal septum passage, aiming down wards towards the client's ear unto the oropharynx
    d. Pass the tube along lateral aspect of the nasal passage, aiming down wards towards the client's ear unto the oropharynx

    Source: University Hospital of Leicester. NHS (2005). Policy and procedures for the insertion and post-insertion management of nasal gastric tubes in adults, children and infants

GASTRIC LAVAGE

21. All the following are indications for gastric lavage **except**

    a. Organophosphate poisoning
    b. Opiate poisoning
    c. H_2SO_4 poisoning
    d. Food poisoning

Source: Loeb, 1992

EXAMINATION OF THE NEWBORN

22. When examining a premature neonate, all the following are likely findings **except:**

    a. Absence of creases on the soles.
    b. Abundant lanugo
    c. Thick ear cartilage
    d. Empty scrotum.

Source: 2006 India GP entrance examination

23. You are examining a newborn at 1 minute after birth, the baby appears blue in color, has a heart rate of 40/minute, exhibits no respirations, is flaccid with no movement, and does not respond to stimulation. What would be the baby's APGAR score?

    a. 0
    b. 1
    c. 2
    d. 3

Source: Canadian question bank for MCCEE

24. You have just delivered a 16 -year-old primigravida at 38 week gestation. Upon examining the umbilical cord you note that it has a single artery and vein. Which of the following will be your greatest concern?

    a. Greater likelihood for congenital anomalies
    b. Maternal diabetes is probably present
    c. There is increased risk for infection
    d. Increased risk for respiratory distress

Source: Canadian question bank for MCCEE

VAGINAL DELIVERY

25. You are managing a mother in second stage of labour, how often will you assess her uterine contractions?
    a. Every 5 minutes
    b. Every 15 minutes
    c. Every 30 minutes
    d. 1Every 60 minutes

Source: MCQs for MSc. Entrance in Nepal

26. A client whose is admitted for labour and delivery has the following essential findings, gravid 2 para1, estimated 40 weeks gestation, contractions 2 minutes apart lasting 45 seconds, vertex +4 station. Which of the following would be priority at this time
    a. Place client in bed to begging fetal monitoring
    b. Prepare client for immediate delivery
    c. Check for ruptured membranes
    d. Provide comfort measures

Source: MCQs for MSc. Entrance in Nepal

27. A 20-year-old Gravida 2 Para 1 woman has had an uncomplicated pregnancy, but she has received no prenatal care. She goes into labor at term. During the birth process, she experiences sudden extensive hemorrhage with profuse vaginal bleeding. The baby is live born and weighs 2790 gm. Which of the following is the most likely diagnosis?
    a. Umbilical cord prolapse
    b. **Placenta previa**
    c. Placental abruptioninfarction
    d. Placental infarction

Source: MCQs for MSc. Entrance in Nepal

VAGINAL EXAMINATION

28. While doing a vaginal examination in a woman in labour, you determine that the fetal presenting part is right occipital anterior position and at -1 station. What would be your interpretation regarding fetal presenting part
    a. 1cm below the ischial spines
    b. Direct in line with the ischial spines
    c. 1cm above the ischial spines
    d. In no relationship with ischial spines

    Source: MCQs for MSc. Entrance in Nepal

29. While working in labour ward, you have schedule a vaginal examination for a multiparous woman to be done every four hours, after 2 hours you observe the woman pushing, and are able to see the fetal head at the vaginal introitus, which of the following will be a correct interpretation.
    a. The baby's head is engaged
    b. The baby if floating
    c. The baby's head is at the ischial spines
    d. The baby's head is almost crowing.

    Source: DeSevo, M. M. (2009).Maternal and newborn success. Philadelphia. F.A. Davis Company

EXAMINATION OF THE PLACENTA

30. A 29-year-old Gravida 5, Para 4 woman gives birth via vaginal delivery at 40 weeks gestation to a to a live male neonate weighing 3020 gm. Ten minutes later you deliver the placenta, upon gross inspection, the fetal surface has a greenish appearance. Which of the following is the most likely diagnosis for this placental appearance?
    a. Placenta previa
    b. Abruptio placenta
    c. Amnion nodosum

d. Meconium staining

Source: DeSevo, M. M. (2009).Maternal and newborn success. Philadelphia. F.A. Davis Company

31. Following a normal spontaneous vaginal delivery, examination at term, examination of the placenta reveals that the umbilical cord is 100cm long. This may have contributed to occurancve of any of the following **except**
    a. Velamentous insertion
    b. Torsion
    c. True knot
    d. Nuchal cord

Source: DeSevo, M. M. (2009).Maternal and newborn success. Philadelphia. F.A. Davis Company

INTRAVENOUS CANNULA INSERTION

32. Regarding intravenous cannula insertion, Which cannula size would you ideally choose for infusion in a patient with hypovolaemic shock
    a. 14G
    b. 19G
    c. 21G
    d. 30G

Source: Final MBBS surgery MCQs and Loeb, 1992

33. Regarding intravenous cannula insertion, all the following will influence choice of vein except.
    a. Patient clinical status
    b. Age of patient

c. Sex of patient

d. Type of treatment

Source: Sanders, M. (1995). Mosby's Paramedic textbook.

34. The following statements are true regarding intravenous cannula insertion **except**

a. Hold the cannual to an angle of 10-20 degrees on top of the skin overlying the chosen vein

b. Lower the angle of the cannula as you continue to advance into the center of the vein

c. Raise the angle of the cannula as you continue to advance into the center of the vein.

d. Once in centre of the vein use continuous slow motion to advance the cannula

Source: Sanders, M. (1995). Mosby's Paramedic textbook.

35. Which of the following veins if cannulated has an increased risk of brachial arterial puncture?

a. Median basilica

b. Median Cephalic

c. Median cubital

d. Median antebrachial

Source: Loeb, 1992

36. All the following are correct about colloids **except**

a. Contain large molecules such as protein that do not readily pass through the capillary membrane.

b. They remain in the intravascular space for extended periods.

c. They remain in the intravascular space for only a short period

d. They increase the osmotic pressure in the intravascular space when administered

Source: Sanders, M. (1995). Mosby's Paramedic textbook. Pg. 326

37. In an emergency such as trauma, which of the following veins would you recommend for fluid or blood replacement"

a. Antecubital

b. Radial

c. Ulnar

d. Cephalic

Source: Sanders, M. (1995). Mosby's Paramedic textbook. Pg. 326

SUTURING

38. In a mesh repair of inguinal hernia, which type of suture would you recommend for suturing mesh to muscle

a. Silk

b. Propylene

c. Catgut

d. Nylon

Source: Queens University, Department of Emergency Medicine. Technical skills programme. Available at http://meds.queensu.ca/simlab/undergraduate_medicine/techinical_skills_program

39. All the following are recommended for internal suturing **except**

a. Catgut

b. Polyglactin (vicryl)

c. Polygylconate (maxon)

d. Nylon

Source: Queens University, Department of Emergency Medicine. Technical skills programme. Available at http://meds.queensu.ca/simlab/undergraduate_medicine/techinical_skills_program

40. You are on call in casualty department, a 16 year old girl presents with a superficial laceration of the face. Which of the following suture would you use?
    a. 3-0
    b. 4-0
    c. 5-0
    d. 6-0

Source: Queens University, Department of Emergency Medicine. Technical skills programme. Available at http://meds.queensu.ca/simlab/undergraduate_medicine/techinical_skills_program

41. Which of the following is true regarding sutures?
    a. 6-0 is stronger than a 4-0
    b. 6-0 is larger than a 4-0
    c. 4-0 is stronger than a 6-0
    d. 4-0 is smaller than a 6-0

Source: Queens University, Department of Emergency Medicine. Technical skills programme. Available at http://meds.queensu.ca/simlab/undergraduate_medicine/techinical_skills_program

42. Which of the following is true regarding toothed forceps
    a. They are considered more traumatic to tissues rather than non-toothed forceps
    b. They are considered less traumatic to tissues rather than non-toothed forceps
    c. They can substitute as needle holders if necessary
    d. They should not be used when suturing simple lacerations

Source: Queens University, Department of Emergency Medicine. Technical skills programme. Available at http://meds.queensu.ca/simlab/undergraduate_medicine/techinical_skills_program

43. All the following are true about tying a surgical knot **except**

a. Extra ties are required to strengthen a knot
b. The knot must be as small as possible
c. Sutures for approximation of tissue should not be too tight
d. Completed knot must be firm

Source: Queens University, Department of Emergency Medicine. Technical skills programme. Available at http://meds.queensu.ca/simlab/undergraduate_medicine/techinical_skills_program

INTRAMASCULAR DRUG ADMINISTRATION

44. Which of the following muscles would you recommend for intramuscular injection in children less than 7 months old?

a. Gluteas maximus
b. Gluteas minimus
c. Vastus lateralis
d. Vastus meadialis

Source: Workman, B. (1999). Safe injection techniques. Nursing Standards. 13; (39). 47-53.

45. In administering intramascular injection, what is the maximum volume of drug allowable per site?

a. 4mls
b. 5mls
c. 6 mls
d. 7 mls

Source: Workman, B. (1999). Safe injection techniques. Nursing Standards. 13; (39). 47-53.

46. At what angle would you administer an intramuscular injection in order to prevent shearing?
    a. 60 degrees
    b. 70degrees
    c. 80degrees
    d. 90 degrees

Source: Workman, B. (1999). Safe injection techniques. Nursing Standards. 13; (39). 47-53.

47. Which of the following techniques is recommended for minimizing pain associated with intramuscular injection?
    a. Position the patient in such a way the designated muscle group is extended
    b. Position the patient in such a way the designated muscle group is relaxed
    c. Injecting the medication as quickly as possible
    d. Withdrawing the needle immediately after completion of injection

    Source: Workman, B. (1999). Safe injection techniques. Nursing Standards. 13; (39). 47-53.

INTRAVENOUS DRUG ADMINISTRATION

48. You have prescribed 300mg of aminophyline to be administered in 1000mls of 5% dextrose in 8 hours. How many drops per minute would you expect the nurse to administer using an intravenous infusion set with drop factor of 15?
    a. 21
    b. 31
    c. 41
    d. 51

Source: Source: Final MBBS surgery MCQs

SECTION C: SELF-PERCEIVED COMPETENCE AND NUMBER OF ATTEMPTS ON A PROCEDURE

PERFORMANCE OF SELECTED CLINICAL PRACTICAL PROCEDURES DURING CLERKSHIPS

Instructions

1. Rate your experience with respect to number of times you performed the selected clinical practical procedures on a scale of **1** to **5** by circling the number that represents your attempts at a procedure

   1= Never performed

   2= performed one to five times

   3= performed six to ten times

   4= performed 11 to 20 times

   5= performed More than 20 times

2. Rate your level of competence/confidence in performing those skills you have performed before on a scale of **1** to **5** by circling the number that represents your level of competence/confidence in performing the skill

   1= Grossly inadequate

   2= Know the approach in theory, not confident in real situation

   3= Only competent in making certain decision, need seniors to be readily available or on constant standby

   4= Reasonably competent, but needs seniors who are contactable for consultation

   5= Very competent can be relied on without supervision.

	Number of times performed		**Level of competence/confidence in performing procedure**

Practical procedure	Never performed	Performed one to five times	Performed six to ten times	Performed 11to twenty times	Performed more than twenty times		Grossly inadequate	Knows approach only in theory	Only competent in making certain decisions	Reasonably competent	Very competent
	1	2	3	4	5		1	2	3	4	5
1. Intravenous cannula insertion											
2. Nasal Gastric tube insertion,											
3. Gastric lavage											
4. Urethral catheterization											
5. lumbar puncture											
6. Cardiopulmonary resuscitation											
7. Endotreacheal intubation											
8. Wound suturing											
9. Vaginal examination											
10. Normal vaginal delivery											
11. examination of the placenta											
12. Examination											

of the newborn			
13. Intramuscular drug administration			
14. Intravenous drug administration			

End: Thank you for participating in this study.

APPENDIX II

UNIVERSITY OF ZAMBIA

SCHOOL OF MEDICINE

DEPARTMENT OF MEDICAL EDUCATION DEVELOPMENT

SEMI-STRUCTURED IN-DEPTH INTERVIEW GUIDE

TITLE: ACQUISITION OF COMPETENCE IN SELECTED CLINICAL PRACTICAL PROCEDURES: SELF-PERCEPTION VERSUS MANIFEST COMPETENCE OF FINAL YEAR UNIVERSITY OF ZAMBIA MEDICAL STUDENTS.

Place of interview:……

Date of interview:…….

Time started…….Time ended……..

Name of Interviewer……..

Instructions for the interviewer

a) Introduce yourself to the interviewee
b) Explain the process at which the potential participant was selected
c) Explain the nature of the project
d) Explain the purpose, nature and length of the interview
e) Inform the interviewee that the interview will be audio recorded
f) Assure the interviewee of confidentiality
g) Obtain an informed consent
h) Once interview begins, tape record, and probe to obtain detailed information

Interview Items

1. Identify at least 13 clinical practical procedures that you have learnt in medical school in which you feel competent.
2. Describe how you first learnt the identified procedures.
3. Where did you first learn the identified procedures from?
4. What steps did you take to develop to the level of self-competence you have reached?
5. Among the identified skills, which ones have you been assessed on?
6. Which method of assessment was employed to assess the skills?
7. Any question or additional information

End of interview

Thank you for participating in this study.

APPENDIX III

UNIVERSITY OF ZAMBIA

SCHOOL OF MEDICINE

DEPARTMENT OF MEDICAL EDUCATION DEVELOPMENT

TITLE OF STUDY: ACQUISITION OF COMPETENCE IN SELECTED CLINICAL PRACTICAL PROCEDURES: SELF-PERCEPTION VERSUS MANIFEST COMPETENCE OF FINAL YEAR UNIVERSITY OF ZAMBIA MEDICAL STUDENTS.

OBJECTIVE STRUCTURED CLINICAL EXAMINATION (OSCE)

CHECK LIST

Example of the University of Zambia, School of Medicine OSCE checklists used during final clinical examinations.

	ASPECT BEING ASSESSED	**POSSIBLE SCORE**	**STUDENT SCORE**
1.	Student introduces him/herself and explains what he/she is about to do	1	
2.	Students puts on apron washed hands and puts on gloves	1	
3.	Student performs active management of third stage of labour		
	• Gives oxytocin 10IU intramuscular within 1 minute of delivery of the baby	1	
	• Clamps the cord near the vulva with artery forceps	2	
	• Waits for the uterus to contract (left hand feels for contraction)	3	
	• Applies counter traction with the left hand on the uterus above level of symphysis pubis	2	

	• Right hand grasps forceps and cord and at same time applying stead traction on the cord in down ward direction	2	
	• When placenta appears on vulva, grasps it with both hands, and rolls it and delivers membranes, and places it into the receiver		
	• Massages uterus and expels any blood clot	2	
Q4	What is the next important examination		
A	Examination of placenta and membranes for completeness	1	
Q5	Demonstrate the examination		
A	Student should explain nature of examination , to include		
	• Hold cord in one hand and allow placenta and membranes to hang down, and inspects for membrane completeness	1	
	• Places placenta on surface and checks whether all the lobes are present	2	
	• Inspects the cut end of the cord for presence of 2 arteries and one vein	1	
	TOTAL		

APPENDIX IV

UNIVERSITY OF ZAMBIA

SCHOOL OF MEDICINE

DEPARTMENT OF MEDICAL EDUCATION DEVELOPMENT

TITLE OF STUDY: ACQUISITION OF COMPETENCE IN SELECTED CLINICAL PRACTICAL PROCEDURES: SELF-PERCEPTION VERSUS MANIFEST COMPETENCE OF FINAL YEAR UNIVERSITY OF ZAMBIA MEDICAL STUDENTS.

RETROSPECTIVE THINK ALOUD PROTOCOL GUIDE

Instructions to Researcher/ Research assistants

a) Introduce yourself to the Participant
b) Explain the nature of the project
c) Explain the purpose, nature and length of the Think Aloud Protocol
d) Inform the participant that the verbal data will be tape recorded
e) Inform the participant that their computer number will used to identify the data
f) Assure the participant of confidentiality
g) Obtain an informed consent
h) Once consent is signed, begin recording and encourage participant to keep talking to obtain complete verbal reports

Think Aloud Protocol Items

Based on any of the practical procedures performed during OSCE;

1. **Grand question**- describe the thoughts that were going through your mind while performing the procedure? Unambiguously
2. Probing questions- participants who lapse into silence will be encourage to "keep talking" using the following probing questions:
    a. How about your **thoughts** while performing the procedure
    b. How about your **feelings** while performing the procedure
    c. How about **perceptions** while performing the procedure
    d. How did you decide on the **technique** you use (what made you perform the procedure the way you did)?
    e. How did you decide on the on the **equipment** you used?
    f. Any **difficulties** encountered while performing procedure?
3. Keep talking, and indicate when you are through.

Thank you for participating in this study.

APPENDIX V: INFORMED CONSENT

STUDY TITLE: ACQUISITION OF COMPETENCE IN SELECTED CLINICAL PRACTICAL PROCEDURES: SELF-PERCEPTION VERSUS MANIFEST COMPETENCE OF FINAL YEAR UNIVERSITY OF ZAMBIA MEDICAL STUDENTS.

INTRODUCTION

I Patricia M. Katowa a PhD candidate in the Department of Medical Education Development at the University of Zambia, School of Medicine is kindly requesting for your participation in the research study mentioned above. Before you decide whether or not to participate in this study, I would like to explain to you the purpose of the study, procedures involved and any risks or benefits. Your participation in the study is entirely voluntary. You are under no obligation to participate, you may choose to participate or not to participate .If you decline to participate, no privileges will be taken away from you. If you agree to participate, you will be asked to sign an informed consent in front of a witness. Agreement to participate will not result in any immediate benefits.

PURPOSE OF THE STUDY

The study will obtain information on how medical students acquire and develop competence in selected clinical practical procedures and their levels of competence towards the end of the undergraduate training. The information obtained will help in identifying how medical students learn different practical skills and the steps they take to develop to a specific level of competence. The study will also identify actual practical procedures students are competent in and compare if there is any difference between what students get to learn and what they are expected to learn. In addition the study seeks to establish the graduating students' level of knowledge, their confidence (self-perceived competence) and manifest-competence in selected practical procedures and compare the three. Findings of the study are therefore going to inform educational efforts aimed at ensuring that students acquire competence in requisite clinical practical procedures.

PROCEDURE

After you have understood what is involved in this study and have asked questions, you will be requested to sign a consent form. After signing the consent form, you will be requested to take part in any one or more of the following components of the study to which you would have consented to:

i. Answering the self administered questionnaire
ii. Participating in the in-depth interview
iii. Participating in the think-aloud protocol
iv. Allowing your OSCE results to be used in the study

You will also be given a chance to make suggestions on how you think learning and teaching of clinical practical procedures can be improved.

RISK AND DISCOMFORTS

No risks or discomforts are involved apart from the use of your time in answering the self-administered questionnaire. In addition in participating in in-depth interviews and think-aloud protocols that which will be audio recorded, allowing your OSCE results to be used in the study, and the use of you computer number to identify different data sets may cause minimal stress.

BENEFITS

Participating in this study will not directly benefit you as there are no monetary favours that will be given in exchange for the information. However, by taking part in this study, you will be able to provide information that the School of Medicine will use enhance the teaching and learning of practical clinical procedures that are necessary for the optimal practice of newly qualified doctors.

CONFIDENTIALLY

Your research records and any information you will give will be confidential to the extent permitted by law. You will be identified by a computer number, and personal information will not be released without your written permission except when requested by law. The University of Zambia, Research Ethics committee or the School of Medicine may review your records again this will be done with confidence.

APPENDIX VI: INFORMED CONSENT FORM

The study has been explained to me and I understand the purpose, the benefits, risks and discomforts involved. I confirm that I have been given opportunity to ask questions about the study and answers have been given to my satisfaction. I understand that my involvement in this study and any information I will provide will remain strictly confidential

I further understand that if I agree to take part in this study, I can withdraw at anytime without having to give an explanation and that taking part in this study is purely voluntary.

I therefore, agree to participate in the study and give my consent to be audio-taped during the in-depth interview and think-aloud protocol. I also agree that my computer number will be used on the self administered questionnaire and OSCE result exclusively for the purpose of comparing the two results at individual level and that my name will not be attached to either.

I…….. (Names)

Agree to:

i. Answer the self administered questionnaire
ii. Participate in the in-depth interview
iii. Participate in the think-aloud protocol
iv. Have my OSCE results used in the study

Tick only that applies.

Signed:……..Date:……(participant)

Signed:……..Date:……(Witness)

Signed:……..Date:……(Researcher)

PERSON TO CONTACT FOR PROBLEMS OR QUESTIONS

1. Patricia. M. Katowa, University of Zambia, Department of Medical Education Development, P.O.BOX 50110, Lusaka.
2. Prof. S.S. Banda Cavendish University Zambia, Munali Campus, P.O BOX 34625, Lusaka
3. Dr. P. Mweemba, University of Zambia. Department of Nursing Sciences, P.O.BOX 50110, Lusaka
4. The chairperson, University of Zambia Biomedical Research Ethics Committee, University of Zambia, P.O BOX 50110, Lusaka.

APPENDIX VII: LETTER FOR VALIDATION OF MCQ KNOWLEDGE TEST

Department of Medical Education Development

School of Medicine

University of Zambia

11th December, 2012.

UFS: Prof S.S Banda

University of Zambia

Dr. M. L

Department of Surgery

School of Medicine

Dear Dr. M.L

RE: CRITERION BASED PASS/FAIL STANDARD SETTING FOR THE MCQ KNOWLEDGE TEST

Reference is made to the above subject matter. The MCQ knowledge test is one of the tools that have been developed for data collection for the PhD study titled "**Acquisition of Competence in Selected Clinical Practical Procedures: Self-Perception versus Manifest Competence of Final Year University Of Zambia Medical Students".** The proposal to which the knowledge test is part was presented tothe Graduate Proposal Presentation Forum (GPPF) which was held on 1st November, 2012, and was rated as successfully defended. The proposal has since undergone a desk review and permission has been granted for submission to the UNZA Biomedical Research Ethics Committee.

To determine thepass/fail or cut-off point/score for the knowledge test, the test items need to be reviewed by clinical experts. This is a criterion based-method of standard setting using the Modified Angolf Technique. You have therefore been identified as one of the clinical experts to undertake the process.

Find enclosed the test and answer key, notes for reviewers and two letters from the Office of the Assistant Dean Post-Graduate.

Awaiting your response.

Thank You.

Patricia Mukwato. Katowa . (PhD Candidate)

NOTES TO REVIEWERS

Consider each question as an expert in the field and indicate the percentage of students who you think would get it correct. For example question 30 depending on your judgment you may assume that 65% of students may get it right, therefore you give it a cut-off point of 65% and you continue for the rest of the questions.

30. You are examining a newborn at 1 minute after birth, the baby appears blue in color, has a heart rate of 40/minute, exhibits no respirations, is flaccid with no movement, and does not respond to stimulation. What would be the baby's Apgar score?
    a. 0
    b. 1
    c. 2
    d. 3

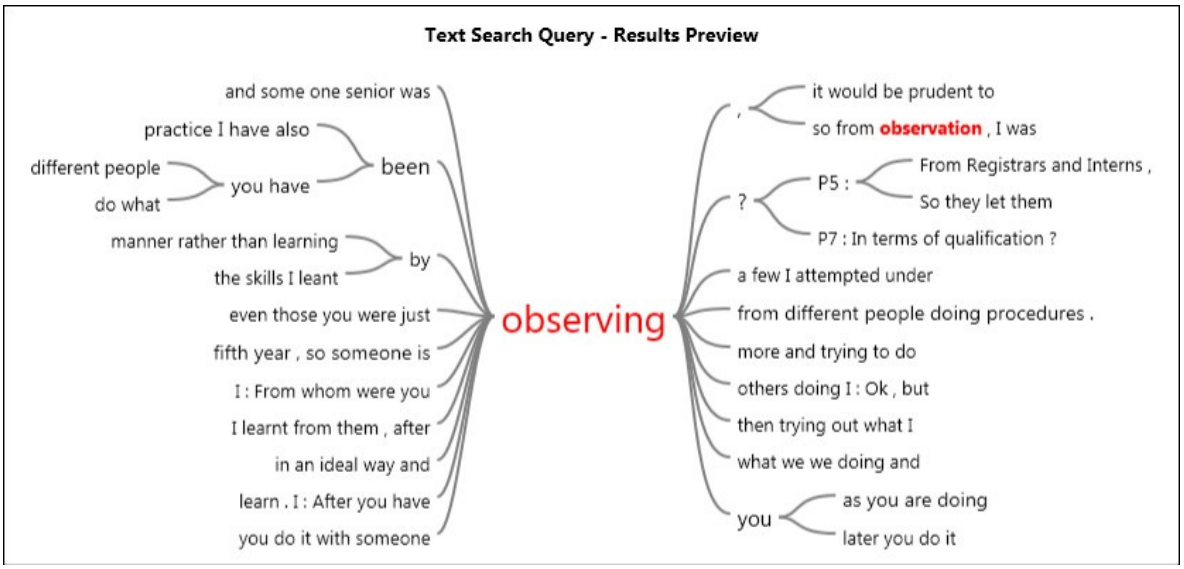
Source: Canadian question bank for MCCEE

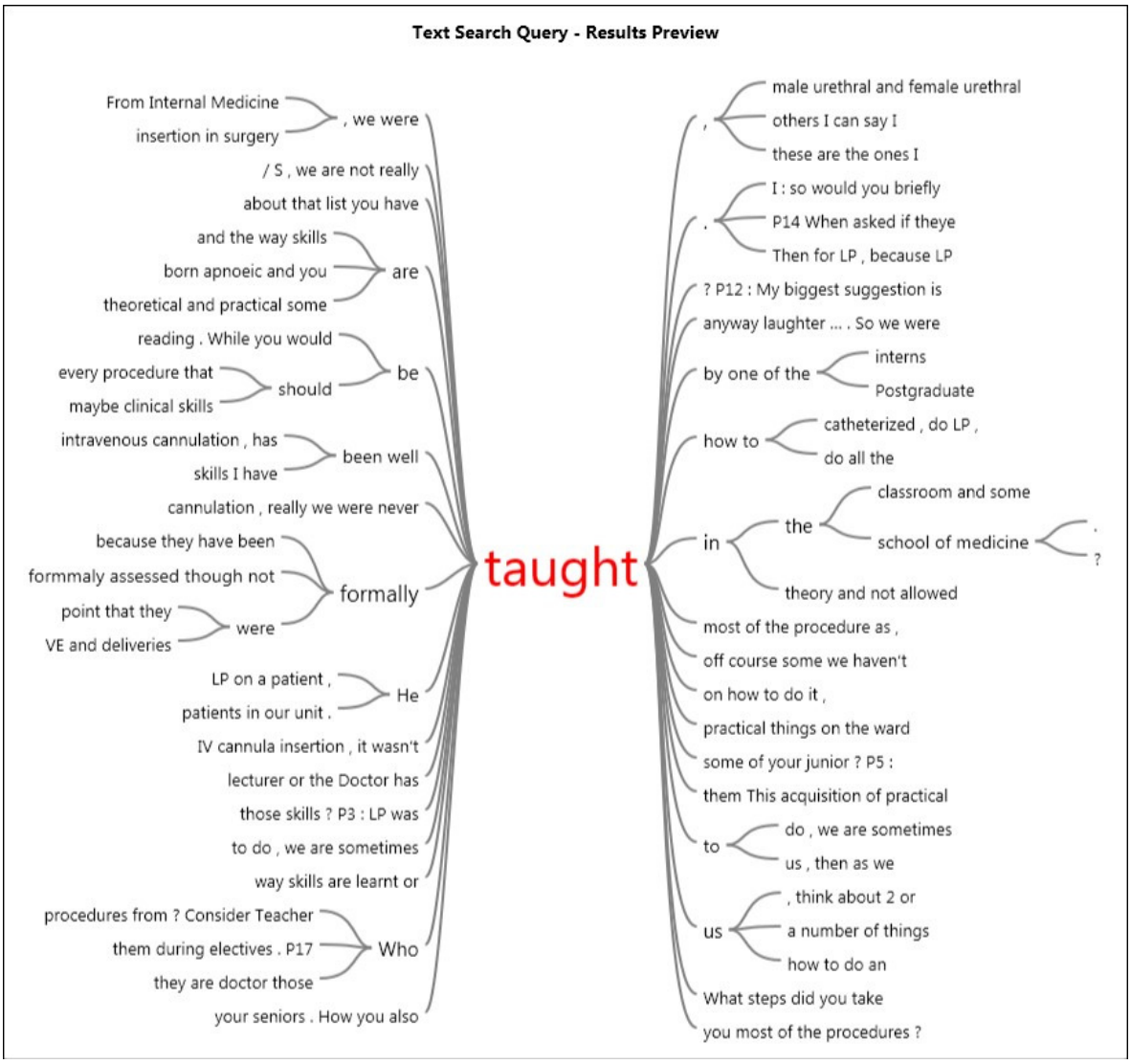
Cut-off point 65%

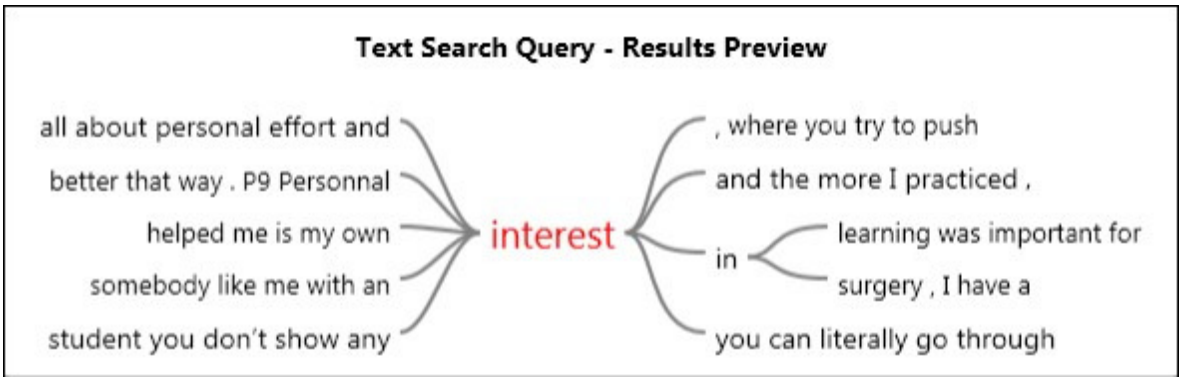
All the percentages for each question from all the experts will be aggregated to determine the pass mark for the entire test. This technique is known as the Angoff method (Angoff, 1971) and is recommended is a criterion-based means of standard setting. It uses experts in the field to determine the cut-off point/score otherwise known as pass mark. The cut-off score is defined as a score that a minimally competent candidate is likely to achieve (Canadian Association of Medical Technologists (2006).

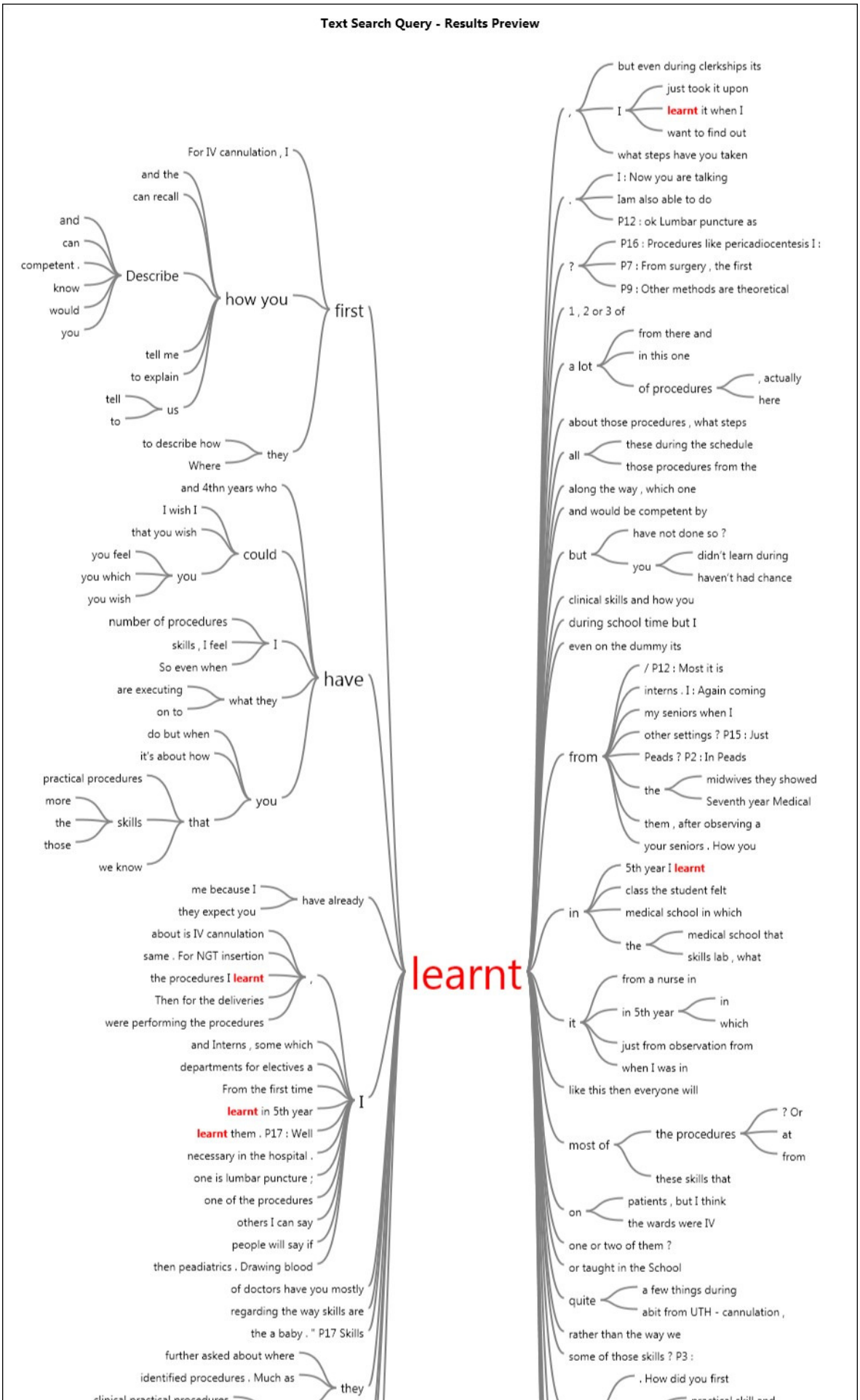
You are free to add some questions as you deem necessary on any of the selected clinical practical procedures.

APPENDIX VIII: TREE DIAGRAMMES OF QULAITATIVE DATA ANALYSIS

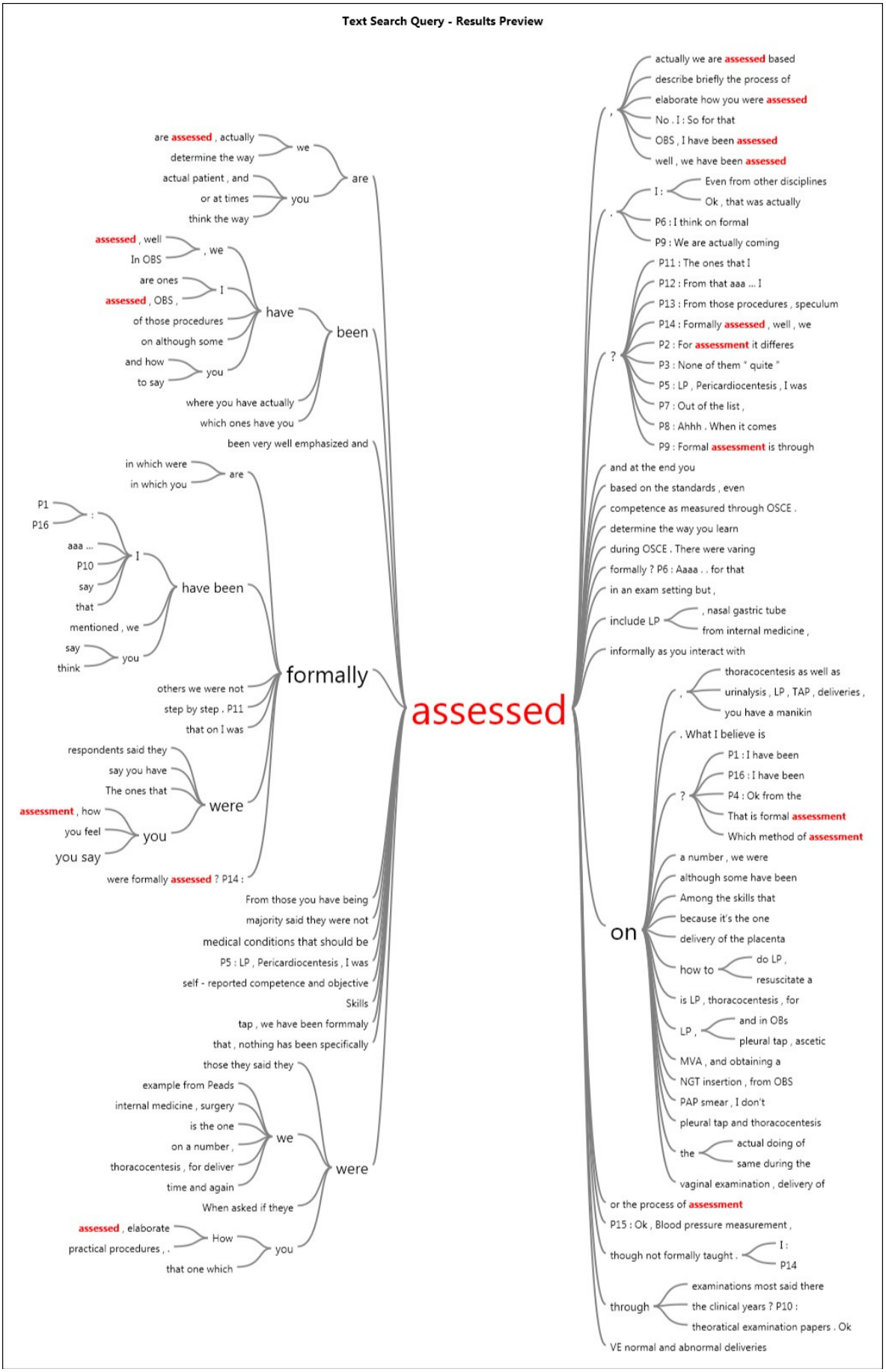

Text Search Query - Results Preview
and some one senior was
practice I have also
been
different people
you have
do what
manner rather than learning
by
the skills I leant
even those you were just
fifth year , so someone is
I : From whom were you
I learnt from them , after
in an ideal way and
learn . I : After you have
you do it with someone
observing
,
it would be prudent to
so from observation , I was
?
P5 :
From Registrars and Interns ,
So they let them
P7 : In terms of qualification ?
a few I attempted under
from different people doing procedures .
more and trying to do
others doing I : Ok , but
then trying out what I
what we we doing and
you
as you are doing
later you do it

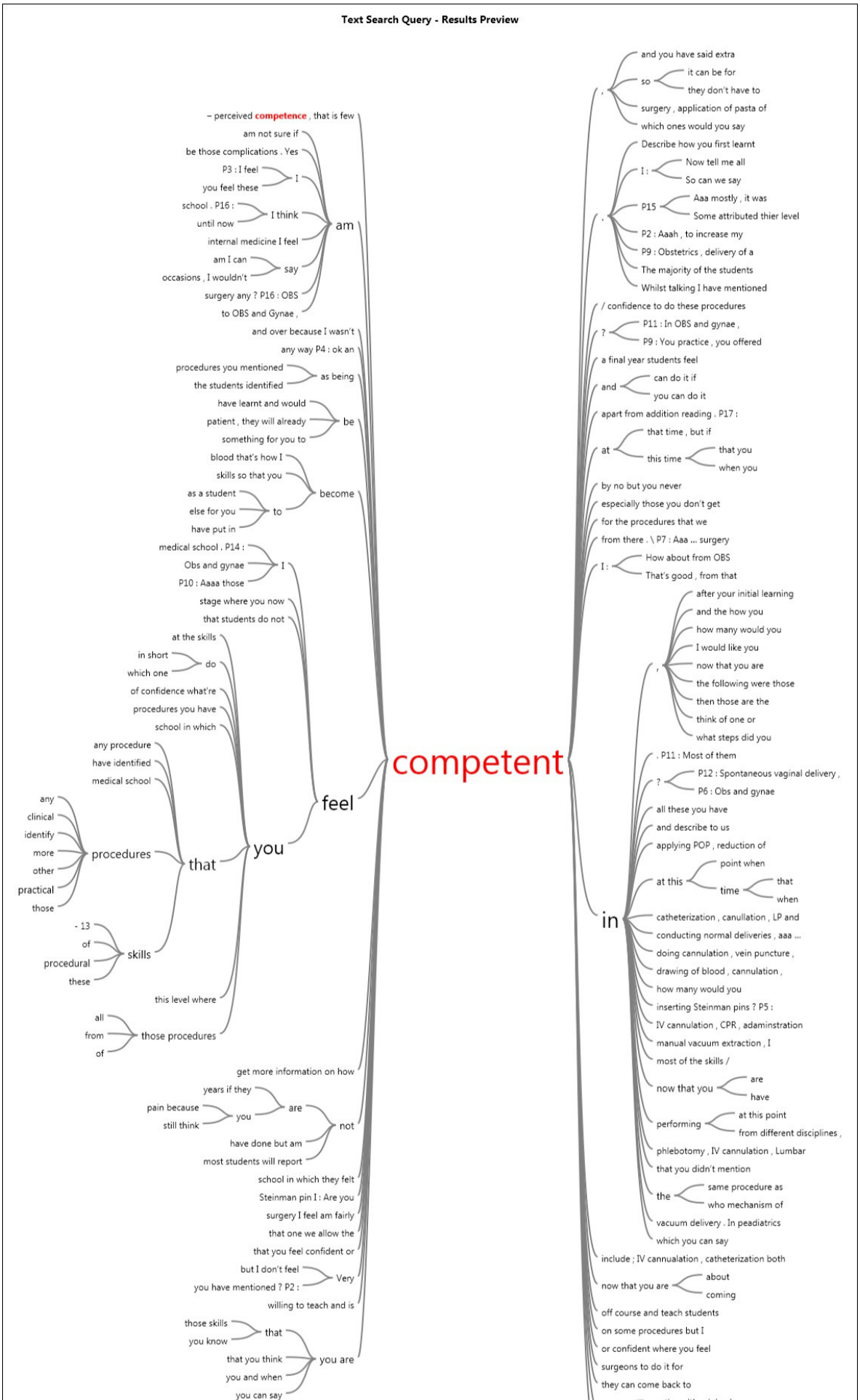

Text Search Query - Results Preview
From Internal Medicine
insertion in surgery
, we were
/ S , we are not really
about that list you have
and the way skills
born apnoeic and you
theoretical and practical some
are
reading . While you would
every procedure that
maybe clinical skills
should
be
intravenous cannulation , has
skills I have
been well
cannulation , really we were never
because they have been
formmaly assessed though not
point that they
VE and deliveries
were
formally
LP on a patient ,
patients in our unit .
He
IV cannula insertion , it wasn't
lecturer or the Doctor has
those skills ? P3 : LP was
to do , we are sometimes
way skills are learnt or
procedures from ? Consider Teacher
them during electives . P17
they are doctor those
Who
your seniors . How you also
taught
,
male urethral and female urethral
others I can say I
these are the ones I
.
I : so would you briefly
P14 When asked if theye
Then for LP , because LP
? P12 : My biggest suggestion is
anyway laughter ... . So we were
by one of the
interns
Postgraduate
how to
catheterized , do LP ,
do all the
in
the
classroom and some
school of medicine
.
?
theory and not allowed
most of the procedure as ,
off course some we haven't
on how to do it ,
practical things on the ward
some of your junior ? P5 :
them This acquisition of practical
to
do , we are sometimes
us , then as we
us
, think about 2 or
a number of things
how to do an
What steps did you take
you most of the procedures ?


Text Search Query - Results Preview
all about personal effort and
better that way . P9 Personnal
helped me is my own
somebody like me with an
student you don't show any
interest
, where you try to push
and the more I practiced ,
in
learning was important for
surgery , I have a
you can literally go through


Text Search Query - Results Preview
learnt
first
For IV cannulation , I
and the
can recall
how you
Describe
and
can
competent .
know
would
you
tell me
to explain
tell
to
us
they
to describe how
Where
have
and 4thn years who
could
I wish I
that you wish
you feel
you which
you wish
you
number of procedures
skills , I feel
So even when
I
are executing
on to
what they
do but when
it's about how
you
practical procedures
more
the
those
skills
that
we know
have already
me because I
they expect you
I
about is IV cannulation
same . For NGT insertion
the procedures I learnt
Then for the deliveries
were performing the procedures
,
and Interns , some which
departments for electives a
From the first time
learnt in 5th year
learnt them . P17 : Well
necessary in the hospital .
one is lumbar puncture ;
one of the procedures
others I can say
people will say if
then peadiatrics . Drawing blood
of doctors have you mostly
regarding the way skills are
the a baby . " P17 Skills
they
further asked about where
identified procedures . Much as
, but even during clerkships its
I
just took it upon
learnt it when I
want to find out
what steps have you taken
I : Now you are talking
Iam also able to do
P12 : ok Lumbar puncture as
P16 : Procedures like pericadiocentesis I :
P7 : From surgery , the first
P9 : Other methods are theoretical
1 , 2 or 3 of
a lot
from there and
in this one
of procedures
, actually
here
about those procedures , what steps
all
these during the schedule
those procedures from the
along the way , which one
and would be competent by
but
have not done so ?
you
didn't learn during
haven't had chance
clinical skills and how you
during school time but I
even on the dummy its
from
/ P12 : Most it is
interns . I : Again coming
my seniors when I
other settings ? P15 : Just
Peads ? P2 : In Peads
the
midwives they showed
Seventh year Medical
them , after observing a
your seniors . How you
in
5th year I learnt
class the student felt
medical school in which
the
medical school that
skills lab , what
it
from a nurse in
in 5th year
in
which
just from observation from
when I was in
like this then everyone will
most of
the procedures
? Or
at
from
these skills that
on
patients , but I think
the wards were IV
one or two of them ?
or taught in the School
quite
a few things during
abit from UTH - cannulation ,
rather than the way we
some of those skills ? P3 :
. How did you first


Text Search Query - Results Preview
practice
also said they enhenced their
and then you
you had to
go
go to the wards
once we learn here
they leart through observations
it
process
was through observation
and
we have had theory
are not allowed hands on
better start with their clinical
do . I : Apart from the
find out , during your holiday
guess I haven't had enough
honest I haven't had much
terms of competence , yes
we call that as
individual
know that if I don't
enpugh as they needed
I had had abit
more
Now tell me all this
P6 : I think it's just
should inculcate into students a
start from the pre - clinical ,
students to find time for
taken were , first observe , then
be given
to have
a
gave them more
had any other
students have no
chance
go to the wards
a lot of
not having adequate
opportunity
make my
make your
own arrangement
practice , you offered yourself
so they don't have
that they were forced
haven't had enough
those procedures . P16
Time
to the skills lab
you now feel competent
to
to make sure that I
to read and translate into
up . I : So all that
But then , the more
I am allowed . P2
to become competent ? P9 :
vacation are also helpful
you have stable patients
you
,
the better you can do .
was it organized by the
you offered yourself to practice
As alluded to the interns ,
I :
I wanted to find
With regards to assessment ,
In addition , information obtained from
It was thriough individual initiatives
Ok quite a number of
Some also said they enhenced
Therefore the majority of the
Yes electives made a difference
.
?
I : So are you saying
P1 : I would say yes ,
P14 : I think these spans
a few procedures on the
and someone to help me
as
I would have
liked
loved .
much as you can ,
because they
have been formally
would be examined
but during electives you are
by reading books . Among the
did you do during the
elsewhere weather as part of
I have also been observing
in the
actual clinical setting ,
wards at UTH
like in the hospital may
more
, then you become better
. I : Very Good I
of keeping pt's welfare at
on
a patient . So its
human beings Yah , many
models and not hands
patients they could check
P I : Again going back
P2 : Aaah , in terms of
some of those skills . I :
the
more you do it
procedure as often as
skills , because you find
There was
indication that there
nothing that was
these procedures ? P15 : Most of
this procedure , am going to
under observation . The steps taken
was it during the official
with minimal or no supervision ?
you have had in the


Text Search Query - Results Preview
assessed
formally
are
we
are assessed , actually
determine the way
you
actual patient , and
or at times
think the way
been
have
, we
assessed , well
In OBS
I
are ones
assessed , OBS ,
of those procedures
on although some
you
and how
to say
where you have actually
which ones have you
been very well emphasized and
were
are
in which were
in which you
have been
I
P1
P16
:
aaa ...
P10
say
that
mentioned , we
you
say
think
others we were not
step by step . P11
that on I was
respondents said they
say you have
The ones that
you
assessment , how
you feel
you say
were formally assessed ? P14 :
From those you have being
majority said they were not
medical conditions that should be
P5 : LP , Pericardiocentesis , I was
self - reported competence and objective
Skills
tap , we have been formmaly
that , nothing has been specifically
were
those they said they
we
example from Peads
internal medicine , surgery
is the one
on a number ,
thoracocentesis , for deliver
time and again
When asked if theye
you
How
assessed , elaborate
practical procedures , .
that one which
,
actually we are assessed based
describe briefly the process of
elaborate how you were assessed
No . I : So for that
OBS , I have been assessed
well , we have been assessed
.
I :
Even from other disciplines
Ok , that was actually
P6 : I think on formal
P9 : We are actually coming
?
P11 : The ones that I
P12 : From that aaa ... I
P13 : From those procedures , speculum
P14 : Formally assessed , well , we
P2 : For assessment it differes
P3 : None of them " quite "
P5 : LP , Pericardiocentesis , I was
P7 : Out of the list ,
P8 : Ahhh . When it comes
P9 : Formal assessment is through
and at the end you
based on the standards , even
competence as measured through OSCE .
determine the way you learn
during OSCE . There were varing
formally ? P6 : Aaaa . . for that
in an exam setting but ,
include LP
, nasal gastric tube
from internal medicine ,
informally as you interact with
on
,
thoracocentesis as well as
urinalysis , LP , TAP , deliveries ,
you have a manikin
. What I believe is
?
P1 : I have been
P16 : I have been
P4 : Ok from the
That is formal assessment
Which method of assessment
a number , we were
although some have been
Among the skills that
because it's the one
delivery of the placenta
how to
do LP ,
resuscitate a
is LP , thoracocentesis , for
LP ,
and in OBs
pleural tap , ascetic
MVA , and obtaining a
NGT insertion , from OBS
PAP smear , I don't
pleural tap and thoracocentesis
the
actual doing of
same during the
vaginal examination , delivery of
or the process of assessment
P15 : Ok , Blood pressure measurement ,
though not formally taught .
I :
P14
through
examinations most said there
the clinical years ? P10 :
theoratical examination papers . Ok
VE normal and abnormal deliveries


Text Search Query - Results Preview
competent
– perceived competence , that is few
am not sure if
be those complications . Yes
P3 : I feel
I
you feel these
school . P16 :
I think
until now
internal medicine I feel
am I can
say
occasions , I wouldn't
surgery any ? P16 : OBS
to OBS and Gynae ,
am
and over because I wasn't
any way P4 : ok an
procedures you mentioned
the students identified
as being
have learnt and would
patient , they will already
something for you to
be
blood that's how I
skills so that you
as a student
else for you
have put in
to
become
medical school . P14 :
Obs and gynae
P10 : Aaaa those
I
stage where you now
that students do not
at the skills
in short
which one
do
of confidence what're
procedures you have
school in which
any procedure
have identified
medical school
any
clinical
identify
more
other
practical
those
procedures
that
you
feel
- 13
of
procedural
these
skills
this level where
all
from
of
those procedures
get more information on how
years if they
pain because
still think
are
you
have done but am
most students will report
not
school in which they felt
Steinman pin I : Are you
surgery I feel am fairly
that one we allow the
that you feel confident or
but I don't feel
you have mentioned ? P2 :
Very
willing to teach and is
those skills
you know
that
that you think
you and when
you can say
you are
,
and you have said extra
so
it can be for
they don't have to
surgery , application of pasta of
which ones would you say
Describe how you first learnt
I :
Now tell me all
So can we say
P15
Aaa mostly , it was
Some attributed thier level
P2 : Aaah , to increase my
P9 : Obstetrics , delivery of a
The majority of the students
Whilst talking I have mentioned
/ confidence to do these procedures
?
P11 : In OBS and gynae ,
P9 : You practice , you offered
a final year students feel
and
can do it if
you can do it
apart from addition reading . P17 :
at
that time , but if
this time
that you
when you
by no but you never
especially those you don't get
for the procedures that we
from there . \ P7 : Aaa ... surgery
I :
How about from OBS
That's good , from that
after your initial learning
and the how you
how many would you
I would like you
now that you are
the following were those
then those are the
think of one or
what steps did you
. P11 : Most of them
?
P12 : Spontaneous vaginal delivery ,
P6 : Obs and gynae
all these you have
and describe to us
applying POP , reduction of
at this
point when
time
that
when
catheterization , canullation , LP and
conducting normal deliveries , aaa ...
doing cannulation , vein puncture ,
drawing of blood , cannulation ,
how many would you
inserting Steinman pins ? P5 :
IV cannulation , CPR , adaminstration
manual vacuum extraction , I
most of the skills /
now that you
are
have
performing
at this point
from different disciplines ,
phlebotomy , IV cannulation , Lumbar
that you didn't mention
the
same procedure as
who mechanism of
vacuum delivery . In peadiatrics
which you can say
include ; IV cannualation , catheterization both
now that you are
about
coming
off course and teach students
on some procedures but I
or confident where you feel
surgeons to do it for
they can come back to
in

APPENDIX IX: TIME FRAME

GANTT CHART

2012

Task to be performed	**Responsible person**	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**
Research Proposal development	Researcher	→											
Finalizing Research Proposal	Researcher										→		
Graduate Presentation Forum	Researcher										→		
Ethical clearance	Researcher												→

2013 -2014

Task to be performed	**Responsible person**	**JAN –DEC 2013**						**JAN –DEC 2014**					
		JAN - FEB	**MAR-APR**	**MAY-JUN**	**JUL-AUG**	**SEP-OCT**	**NOV-DEC**	**JAN - FEB**	**MAR-APR**	**MAY-JUN**	**JUL-AUG**	**SEP-OCT**	**NOV-DEC**
Pilot Study	Researcher	→											
Analysis of Pilot study data	Researcher	→											
Field work (Data Collection)	Researcher and research assistants		→										
Data analysis	Researcher			→	→	→	→						
Report writing	Researcher						→	→	→				
Draft 1 Report& Revisions	Researcher								→	→			
Submission of final Report	Researcher										→		
Research monitoring										→	→	→	→

APPENDIX VIII: BUDGET FOR THE RESEARCH STUDY

Serial	Budget category	Quantity	Unit cost in (K)	Total cost
1.	**Stationery**			
	Bond paper	20 reams	35	700
	Pens	Box	30	30
	Pencils	1 Box	20	20
	Note books	5	10	50
	Tippex	5	8	40
	Stapler	1	50	50
	Staples	2 Boxes	20	20
	Perforator	1	150	150
	Bag for data collection tools	1	900	900
		1	1,500	1,500
	Audio Tape Recorder	1	1,000	1,000
	External drive	3	1,500	4,500
	Printer cartilage			
				K8, 960:00
	SUBTOTAL			

2.	**Personnel** Lunch allowance for the researcher during field work (preparation and data collection) Lunch allowance for the research Assistant during field work (preparation and data collection) **SUBTOTAL**	 60 days 60 days	 150 90	 9,000 **5,400** **14,400**
3.	**Secretarial services** • Typing proposal • Binding proposal • Photocopying self-administered questionnaire • Photocopying in-depth interview schedule • Photocopying Think-Aloud Protocols	 120 pages 4 copies 13pages X 62 copies 2 pages X 25 copies 2 pages X 62 copies	 120 X 3 20 806 X .2Per page 50 X .2 124 X 0.2	 360 80 161 10 28.8

	• Typing final report • Photocopying report • Binding report **SUBTOTAL**	350 pages X 1 copy 350 pages X 5 copies	350 X 3 1750 pages X.2 100,000	1,050 350 500 **2,540**
4.	**Data analysis** Software (nvivo) Data analysis costs **SUBTOTAL**	 1 1	 5,500 5,000	 5,500 **5,000** **10,500**
5.	**Research Ethics review cost** **SUBTOTAL**	1	500	500 **500**
	SUBGRAND TOTAL **CONTINGENCY 10%** **GRAND TOTAL**			**36,900:00** **3,690:00** **K40,590:00**

BUDGET JUSTIFICATION

The budget for this research proposal is intended to facilitate smooth conducting of the study. A number of costs will be incurred during the course of the study including; stationary, secretarial, personnel costs and data analysis.

Stationery

The researcher will need stationery such as reams of paper for printing research proposal, data collection tools and the final report. Pens, pencils and note books for writing literature summaries during proposal development, and notes during field work. Stapler and staples for securing papers together. HP tonner will be required for printing the research proposal, data collection tools and final report. External drives for storage of research data, and tape recorder for audio recording of in-depth interviews and think-aloud verbal reports. Research bag for carrying data collection tools and various other items for research purposes.

Personnel Cost

The researcher and research assistant will need money for lunch during the course of data collection.

Secretarial Services

Money will be required for typing and photocopying of research proposal, data collection tools, and for binding the final report.

10% Contingency of Total Amount

10% contingency of the total budget has been added in case of unforeseen costs and to cater for any inflation.