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**Title:-**

**“Teaching Lumbar Puncture procedures at Yekatit 12 Hospital  
Medical College Pediatrics Department” - an exploratory and  
descriptive study**

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## Abstract

**Background-** Lumbar puncture (LP) is one of commonly performed invasive procedures during the evaluation of multiple conditions. An incorrectly performed traumatic LP indicates poor technique, worsened diagnostic value, and increased trauma to the patient (5).

**Objective-**To see the teaching-learning process of LP procedure and to identify additional factors for unsuccessful LP procedures in a pediatric department

**Methods-** A descriptive and explorative study was conducted using qualitative methods. The laboratory log book was reviewed to see traumatic CSF samples in pediatric patients. Focus group discussions were conducted with resident, GPs and interns. Key informants were interviewed to see the teaching-learning process of LP and to identify factors for unsuccessful LPs in pediatric.

**Result-** Reasons for performance difference were mentioned as. (I) teaching methodology; (ii) set up for practical activities; (iii) availability of instructional materials; (iv) curriculum; (v) type and number of procedures performed;(vi) number of students; (vii) students' or teachers' interest; and (viii) a lack of standardized evaluation tools. Factors for traumatic LPs includes: - patient, performer, contextual, & assessment factors. Barriers of Teaching-learning LP includes: - class sizes, language, and instructors' commitment. All agreed unsuccessful LP rate in neonates is highest followed by children then adults.

**Conclusion-** unsuccessful LPs in neonate higher than children and adults. Factors for unsuccessful LPs was, skill, age, anatomy and, resources. Gaps were identified in teaching-learning process of LP practice and procedure. Skill assessment was not defined and standardized. Barriers existed including large class size, workload, language, constraints of resources.

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## **Acronyms**

|             |                                             |
|-------------|---------------------------------------------|
| NIMEI ----- | New Innovative Medical Education Initiative |
| USA -----   | United States of America                    |
| ME -----    | Medical education                           |
| LP -----    | Lumbar Puncture                             |
| CSF -----   | Cerebrospinal fluid                         |
| SD -----    | Standard deviation                          |
| RBCs-----   | Red blood cells                             |
| ICU-----    | Intensive care unit                         |
| ED -----    | Emergency department                        |
| SBME -----  | Simulation-based medical education          |
| ILP -----   | Infant lumbar puncture                      |
| TD -----    | Thyroid disease                             |
| DM -----    | Diabetes mellitus                           |
| CBVT -----  | Computer-based video training               |
| BMI-----    | Body mass index                             |
| PBM -----   | Pediatric bacterial meningitides            |
| LAMIC ----- | Low and middle income country               |
| OSCE-----   | Objective structured clinical examination   |

## **Key words**

- ✓ LP procedure
- ✓ Traumatic CSF sample.
- ✓ Medical education
- ✓ Clinical skills lab
- ✓ Procedural learning tools
- ✓ Performance assessments

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# CHAPTER ONE

## INTRODUCTION

### 1.1 Back Ground of the Study

**Lumbar puncture (LP)** is a diagnostic or therapeutic procedure in which a hollow needle and stylet are introduced into the subarachnoid space of the lumbar part of the spinal canal to obtain cerebrospinal fluid (CSF). Diagnostic indications include measuring of CSF pressure; obtaining CSF for laboratory analysis; and for radiographic visualization of the structures of the nervous system of the spinal canal, meninges and brain by injecting oxygen or a radiopaque substance. Therapeutic procedures include withdrawing CSF to reduce intracranial pressure, introducing a local anesthetic to induce spinal anesthesia, and placing a small amount of the patient's blood in the subarachnoid space to form a clot to patch a hole in the dura to prevent leak of CSF into the epidural space **(1)**.

LP is one of the well-known ancillary procedures in clinical neurology performed for a variety of functions dating to more than 100 years ago. The question of who was the discoverer of LP is still under debate. Most authors assume that it was Heinrich Irenaeus Quincke (1842-1922), a German internist who was introduced the procedure to medicine in 1891; however, some authors (2) the American neurologist James Leonard Corning (1855-1923) as the first one who performed LP using bird's quills in 1885 (Frederiks et al., 1997; Dakka et al., 2011) **(2)**.

**Cerebrospinal fluid (CSF)** is a clear, colorless fluid that fills the ventricles and subarachnoid space surrounding the brain and spinal cord. Performing a Lumbar Puncture allows this fluid to be sampled, facilitating the diagnosis of various conditions. LP has become an important diagnostic tool, particularly when considering the diagnosis of meningitis. Evaluation of CSF can help establish a diagnosis and guide antimicrobial therapy. LP is also used as part of the diagnostic workup of patients with suspected subarachnoid haemorrhage, demyelinating disease, leptomeningeal metastasis **(3)**.

Although the procedure has important diagnostic and therapeutic uses, it can be rendered inaccurate or have adverse effects on the patient (such as headache) when it is done improperly, resulting in the CSF sample being contaminated with red blood cells (RBCs).

**Traumatic LP** is defined as a LP in which cerebrospinal fluid contains at least 400 RBCs per microliter and bloody LP, as one in which the cerebrospinal fluid contained at least 5000 RBCs per microliter (5).

The majority of physicians who work at hospitals in Ethiopia are general practitioners (GPs). GPs and medical students need medical education around procedural skills training, such as LPs in order to be competent in their work as hospitalists; however little is known about this specific area of training and its evaluation in Ethiopia. A national survey of medical education was conducted in all regions of Ethiopia in 2009 in which 700 medical doctors and 72 hospitals participated. Through a self-administered questionnaire, survey participants reported about the knowledge, skills and values they acquired from their medical education, what they felt was missing, which areas needed strengthening and what new areas should be introduced to better equip GPs. One major finding from the survey was the existence of gaps in the competency of GPs (4). Focus group discussions among medical doctors working in the 72 hospitals were also conducted using the same questionnaire. The results indicated that the majority of GPs believed medical education needed more practical skills training, and that the clinical and internship years were the most valuable to their practice of medicine. A majority felt they were not adequately equipped with life-saving clinical skills, nor did they have the ability to perform common clinical procedures. This has forced the medical education community to reassess current teaching and learning practices and equally important, the evaluation of the medical education learning outcomes (4).

It is believed that in the 21<sup>st</sup> century, although reading materials are available on websites and accessed by students and hence teaching of knowledge or a theory is more easily learned; to teach and learn a procedural skill is more challenging in medical education because it needs experts, learning opportunities with patients and where possible, well organized skills labs, with repetitive clinical practice for every step in the learning process. Better understanding of suboptimal performance of invasive procedural skills by trainees is especially needed in order to improve procedural skills training in medical education. Is there a gap in the teaching-

learning process at Yekatit 12 Hospital Pediatrics Department which can be a factor for unsuccessful LP? In this project, I thought to conduct an exploratory study of Lumbar Puncture teaching and training at Yekatit 12 Hospital Medical College, Pediatrics Department. The Hospital Medical College is an institute that provides clinical, research, and academic service for the community. It is also importantly a surveillance site for pediatric bacterial meningitides (PBM) in Ethiopia. According to PBM data from 2014—2015, 348 LP procedures were performed on children between the ages of 1 month-5 years in the pediatrics department. However, over 10.3% (36/348) were traumatic (PBM logbook). When the procedure is done, success is dependent on the skill of the performer, although the type and size of needle, anatomy, positioning and comfort of the patient also impacts on unsuccessful completion of LP procedures. An incorrectly performed traumatic LP, when there is blood along with CSF, indicates poor technique, worsened diagnostic value, and increased trauma to the patient (5). The present study seeks to explore influencing factors of why traumatic (bloody) CSF samples occur in pediatric department, and will describe the assessment and teaching-learning of LP procedure in Pediatric Department of Yekatit 12 Hospital Medical College.



## 1.2 SIGNIFICANCE OF THE STUDY

Figures from the Federal Ministry of Health of Ethiopia (Ethiop. J. Health Dev. 2013 ;) showed that the physician to population ratio was 0.03 per 1,000, which is significantly lower than the WHO recommended standard of 1: 10,000 for developing countries. To fill these gaps, the government expanded medical schools throughout the country (6). Among 13 newly opened medical colleges, Yekatit 12 Hospital became one of the medical colleges in 2012. Starting from 2012, 5 rounds of 65—75 undergraduate medical students have enrolled to complete their medical doctorate degree. In the current era of medical curriculum development, undergraduate medical intern students are expected to perform certain practical clinical procedures competently.

Although some hemorrhagic CSF samples are expected due to multiple factors, the log book in the Yekatit 12 Hospital laboratory (7) shows that higher rates of traumatic and bloody CSF samples come from pediatrics; mainly in the neonatal department, and the LP procedures were performed by interns, GPs, residents and pediatricians. For example, 8 months of LP patient data was reviewed from the Lab Logbook between June 1 and February 28, 2015. From a total of 550 CSF samples, adult age (> 15 years) bloody CSF samples were 9.6 % (10/104), children ages 1month—15 years bloody CSF samples were 11% (28/257), and neonate age below 30 days, bloody CSF samples were 27 % (50/185). As above noted traumatic or bloody lumbar puncture reduces the diagnostic value of a procedure and may worsen the outcome of a patient's condition, leading to substantial diagnostic ambiguity, potential misdiagnosis, unnecessary antibiotic use, hospitalization, in addition to patient discomfort (8).

The aim of this study is to see the teaching-learning of LP procedures and to identify additional factors for unsuccessful LP procedures in a pediatric department of Yekatit 12 Hospital Medical College.

## **1.3. OBJECTIVES**

### **1.3.1 GENERAL OBJECTIVE**

- To see the teaching-learning processes of Lumbar puncture procedure and to identify factors influencing the unsuccessful, traumatic pediatric lumbar punctures (LPs) performed at Yekatit 12 Hospital in 2016 G.C

### **1.3.2 SPECIFIC OBJECTIVE**

- To see LP procedural skills teaching-learning process in pediatrics department.
- To identify factors influencing the unsuccessful LPs in pediatrics department,
- To assess performance evaluation & assessment tools for LP procedure skills in pediatrics.
- To explore LP procedure improving techniques in teaching LP procedures in pediatrics.

### **1.3.3 ETHICAL CONSIDERATION**

Ethical clearance was obtained from IRB of AAU. Support letter was obtained from medical education department. Letter of permission was given from Yekatit 12 hospital medical college. Then the study participants were informed about the purpose of the study, the importance of their participation, withdrawal at any time and verbal consent obtained prior to data collection.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

An electronic search of studies, using Medline, PubMed and Web of Science was conducted in which specific training on LPs skills were implemented and evaluated. These studies are below summarized.

A descriptive study by Auerbach et al (2013) in Yale university USA, described pediatric interns' medical school experiences, knowledge, attitudes, and skills with regard to preparedness to do infant lumbar punctures. Participants answered 8 knowledge questions, 3 attitude questions, and 6 experience questions online. Skills were assessed on an infant LP simulator using a 15-item subcomponent checklist and a 4-point global assessment. The majority (68%) had never performed an infant LP; however, (73%) had observed an infant LP during school. The mean knowledge score was 63% ( $\pm 21\%$ ). The mean subcomponent skills checklist score was 73%. On the global skills assessment, (62%) interns were rated as beginner, and (38%) were rated as competent, proficient, or expert. At the start of residency, the majority of pediatric interns have little experience, poor knowledge, and low confidence and are not prepared to perform infant LPs (8).

In a prospective cohort study by Conroy(2010) In Allen town USA, of first- and second-year emergency medicine residents, they completed a baseline survey and then viewed a 5-minute PowerPoint slide presentation and a 15-minute video on performing the procedure following baseline assessment of competency using a lumbar puncture simulator, received feedback on their performance, and subsequently practiced the procedure. Within 3 to 6 months, they performed the procedure for a third observation. The assessments were performed with the same simulator and directly observed by two raters. Twelve of 17 first-year residents and 10 of 13 second-year residents demonstrated competence on the baseline evaluation. All residents demonstrated competence after practice ( $N = 30$ ) and at the retention check ( $N = 24$ ). The mean standard deviation (SD) number of practice attempts before the post-practice assessment was 3.6 (1.1) for first years and 2.4 (2.3) for second years. This showed the achievement and retention of competency in the steps of the LP procedure in a task trainer model (9).

Pappano et al. (2010) USA, in his "Traumatic Tap in Pediatric LP" study showed that LPs done by a physician in an ER setting who has completed training and performs the procedure frequently yielded a very low traumatic LP rate of only 1% - with one bloody LP on which no cell count was performed with the remaining 99 procedures that yielded red blood cell counts of less than 1000. The proportion of bloody or traumatic results from pediatric lumbar puncture reported from pediatric training centers is typically in the 20% to 30% range. This represents an overestimation of a more ideal proportion possible when the procedure is performed by a physician who has completed training and performs the procedure frequently (10).

A study was done by Kaushal in Israel Deaconess medical center to estimate the rate of traumatic LPs in the ER as compared to rest of a hospital. 786 CSF samples were recorded over one year. 24 samples were obtained via a neurosurgical procedure. Of the remaining 762 CSF samples in the study population, 119 were traumatic using a cut off of 400 RBCs, and 80 were traumatic, using a cut off of 1,000 RBCs. 503 LPs were done in the emergency department and 259 were attributed to all other locations in the hospital. Using a cut off of 400 RBCs, the incidence of traumatic LP in the emergency department was 13.3%, compared with 20% in the rest of the hospital. Similarly, using a cut off of 1,000 RBCs, the incidence of traumatic LP in the emergency department was 8.9%, compared with 13.5% in the rest of the hospital. The incidence of "champagne taps" (defined as zero RBCs in the first and last tubes) in the emergency department was 34.4%, compared with 24.3% in the rest of the hospital. He concluded that the incidence of traumatic lumbar puncture was approximately 15% using a cut off of 400 RBCs, and 10% using a cut off of 1,000 RBCs. In this study, the rate of traumatic lumbar puncture was significantly less (with a cut off of 400 RBCs) and the rate of champagne tap was significantly greater for LPs done in the emergency department compared with the rest of the hospital (11).

A prospective cohort study was done by Nigrovic in Boston USA, to determine patient, physician, and procedural factors associated with traumatic and unsuccessful LPs. Of 1,474 LPs, 1,459 (99%) were included in the analysis. Of these, 513 (35%) were traumatic. After

adjustment for patient characteristics, physician and procedural factors associated with an increased risk of a traumatic or unsuccessful LP included: less physician experience (adjusted odds ratio for an ordinal decrease in experience 1.08; 95% confidence interval [CI] 1.01 to 1.15), lack of local anesthetic use (adjusted odds ratio 1.6; 95% CI 1.1 to 2.2), advancement of the spinal needle with stylet in place versus stylet removed (adjusted odds ratio 1.3; 95% CI 1.04 to 1.7), and increased patient movement (adjusted odds ratio 2.1; 95% CI 1.6 to 2.6). The authors concluded of the factors associated with traumatic or unsuccessful LPs in children, advancement of the spinal needle with the stylet in place, and lack of local anesthetic use are the most modifiable. Modification of these procedural factors may reduce the risk of traumatic or unsuccessful lumbar punctures in children (12)

Kessler conducted a research study in Colombia University New York, to evaluate whether deliberate practice simulation-based training after audio visual training (AV) improves infant LP skills compared with a control group receiving AV training only. 51 residents reported 32 clinical encounters. 16/ 17 subjects (94%) in the intervention group who performed a clinical infant LP obtained CSF compared with 7 of 15 subjects (47%) in the control group (difference = 47%; 95% CI = 16%-70%). There was no difference between groups at 6 months on observed structured clinical examination performance, knowledge, or confidence. Participation in a simulation-based deliberate practice intervention was found to acutely improve infant LP skills (13).

Kessler conducted another study in USA, to evaluate the impact of a Simulation-based Medical Education (SBME) session on pediatrics interns' clinical procedural success. Interns were surveyed on infant lumbar puncture (ILP) and child intravenous line placement (CIV) knowledge and watched a video of an expert modeling of both procedures. Participants were randomized to SBME mastery learning for ILP or CIV and for 6 succeeding months reported clinical performance for both procedures. ILP success was defined as obtaining a sample on the first attempt with, 1000 red blood cells per high-power field or fluid described as clear. CIV success was defined as placement of a functioning catheter on the first try. Each group served as the control group for the procedure for which they did not receive the intervention. 200 interns participated (104 in the ILP group and 96 in the CIV group). ILP success rates were no different between groups - 34% for interns who received ILP mastery learning and 34% for

controls (difference: 0.2% [95% confidence interval: -0.1 to 0.1]). The CIV success rates were minimally different -54% for interns who received CIV mastery learning compared with 50% for controls (difference: 3% [95% confidence interval]). Participation in a single SBME mastery learning session was insufficient to affect pediatric interns' subsequent procedural success (14).

A recent medical education study by Hibbert (2013) in Australia was conducted to see how high quality video demonstration improved clinical skills. The skills demonstrated on video were history taking in diabetes mellitus (DM), examination for diabetes lower limb complications (LLE), and examination for signs of thyroid disease (TD). Students were assessed on these clinical skills in an observed structured clinical examination two weeks after randomization. Result show that exposure to high quality videos demonstrating clinical skills can significantly improve medical students' skill performance in an observed structured clinical examination of these skills, when used as an adjunct to clinical skills face-to-face tutorials and deliberate practice of skills in a blended learning format. Video demonstrations can provide an enduring, on-demand, portable resource for reference, which can even be used at the bedside by learners. Such resources may be cost-effectively scalable in some settings for large numbers of learners (15).

Nathan Jowett (2006), in Ontario Canada, showed how Computer-based video training (CBVT) can provide flexible opportunities for surgical trainees to learn fundamental technical skills. 30 novice trainees used CBVT to learn the 1-handed square knot while self-assessing their proficiency every 3 minutes. On reaching self-assessed skill proficiency, trainees were randomized to either cease practice or to complete additional practice. Performance was evaluated with computer and expert-based measures during practice and on pre-tests, post-tests, and 1-week retention tests. Analyses revealed performance improvements for both groups but no differences between the 2 groups on all tests. CBVT for the 1-handed square knot is effective in a self-directed learning environment among novices. This lends support to the implementation of self-directed digital media-based learning within surgical curricula (16).

In a study by Edwards (2015) in New York, to show factors influencing the success of adult LPs in an academic health center, retrospective analysis was done on all consecutive patients

who underwent elective LP in the Neurology Clinic between 2009 and 2012. Data extraction included demographics, anthropometric, and clinical information, and the level of training of the resident performing the procedure. Outcomes measure was unsuccessful LP. A total of 328 patients (59% women) were included. 19 % of the LPs were unsuccessful. They found a strong correlation between patient body mass index (BMI) and unsuccessful outcome. Age of the patient and level of training of the operator did not predict unsuccessful LP. In conclusion, patient BMI is a key factor that determines unsuccessful LP by neurology residents in an outpatient setting, an association that might be applicable to different clinical settings. Given the high failure rate in patients with BMI of  $\geq 35$ , the authors suggest implementation of compensatory interventions such as use of imaging guidance (17).

A study by Srivastava (2012) in university of Texas, Dallas was conducted to see how educational video improves technique in performance of pediatric lumbar punctures. A result shows that from 668 LPs, 391 during year 1 and 277 during year 2 were performed. There was neither a significant change in overall LP success rate between the 2 years (56.8% year 1 vs 53.4% year 2) nor a significant difference in median number of LP attempts required per patient ( $P = 0.78$ ). 78% of participants who viewed the LP video during year 2 stated that the video helped increase their comfort level with performing LPs. The odds of using the techniques endorsed in the educational video were significantly higher during year 2 compared to year 1 for use of local anesthetic, early stylet removal, and vertical patient position (18).

A paper by wiley-liss (2004) in university of Pretoria, South Africa, explained that safe and successful performance of lumbar puncture demands specific skill and knowledge of anatomy the procedure is by no means innocuous and anatomical pitfalls include inability to find the correct entry site and lack of awareness of structures in relation to the advancing needle. With a thorough knowledge of the contraindications, regional anatomy and rationale of the technique, and adequate prior skills practice, the authors concluded that a lumbar puncture can be carried out safely and successfully (19).

A retrospective chart review in university of Michigan was done by Shawna Shafer (2015) in admitted infants from January 2011 to November 2011 who underwent a lumbar puncture that highlights the challenges of this procedure. A total of 184 charts were reviewed. Procedure notes were incomplete (58%) and lacked pertinent details. 8% of samples obtained had no record of the procedure being performed. There was inadequate sample acquisition in 23% of the lumbar punctures. More than three attempts were noted in 14% of lumbar punctures performed. Many specimens contained very high red blood cell counts. 75% of lumbar punctures with full documentation ( $n = 60$ ), resulted in cerebrospinal fluid with more than 1,000 red blood cells/mm<sup>3</sup> and 55% of under documented lumbar punctures resulted in cerebrospinal fluid with more than 1,000 red blood cells/mm<sup>3</sup> ( $n = 71$ ). What she found was poorly documented lumbar punctures are common and the ability of residents to obtain satisfactory cerebrospinal fluid is low. The inability of residents to consistently perform non traumatic lumbar punctures is likely a common phenomenon. She recommended new educational methods and evaluation criteria were needed to address this gap in resident education (20).



## **CHAPTER THREE**

### **METHODOLOGY**

#### **3.1 SETTING**

The study was conducted at Yekatit 12 Hospital, the 2<sup>nd</sup> oldest government hospital in Ethiopia. Next to Black Lion, have well organised paediatric medical centre. Surveillance site for Paediatric bacterial meningitides in Ethiopia(PBM). A Centre for neonatology training. Starting from 2012, Yekatit 12 Hospital became a medical college and has 5 cohorts of medical students. Based on the above features, I prefer to choose the hospital as study site.

#### **3.2 STUDY DESIGN**

A descriptive and explorative study was conducted using qualitative methods. The laboratory registration log book was reviewed to see the presence of traumatic CSF samples in paediatric patients. Focus groups and key informant interviews were conducted. Focus group discussions were conducted with residents, GPs and interns. Key informants were interviewed to see how they teach LP procedural skills and to identify factors for unsuccessful LPs in paediatric interns and residents. An interview guide questionnaire was developed for the key informant group and focus group (Appendix)

- ❖ Why is performing lumbar punctures difficult?
- ❖ Factors associated with, and reasons for traumatic LPs procedural performance differences; and with adult, children and neonate patients?
- ❖ Experiences of teaching-learning LPs procedures?
- ❖ How is LP skills and procedural competence assessed and evaluated including feedback protocol?
- ❖ Barriers to teaching and learning of LP procedural skills?
- ❖ How can teaching and learning of LP procedural skills be improved?

### 3.3 STUDY POPULATION

Residents, interns, GPs, and senior paediatricians in Paediatric Department at Yekatit 12 Hospital Medical College were invited to participate, and laboratory registration log books was used to extract data on bloody CSF rates.

### 3.4 TARGET POPULATION

A total of 9 participants were invited to participate in the focus group that included 1 resident, 2 staff GPs and 6 interns from pediatrics who did LP procedures. Also 3 senior pediatricians as key informants were interviewed in-depth about how they teach and assess LP procedural skills and their perspectives on major problems of traumatic CSF sampling.

#### Demographic Data of study participants

**Table-1. Key Informant's Demographic Data**

|           | <b>Age of Respondent</b> | <b>Sex of Respondent</b> | <b>Year of Experience</b> | <b>Educational Level</b>    | <b>Position from the Department</b> |
|-----------|--------------------------|--------------------------|---------------------------|-----------------------------|-------------------------------------|
| <b>K1</b> | 45                       | Male                     | 10 year                   | Pediatrician + neonatology  | Assistant Professor                 |
| <b>K2</b> | 34                       | Female                   | 6 year                    | Pediatrician + child health | Assistant Professor                 |
| <b>K3</b> | 40                       | Male                     | 7 year                    | Senior Pediatrician         | Assistant Professor                 |

**Table-2. Focus Group Discussion Participant's Demographic Data**

|       | <b>Age of Respondent</b> | <b>Sex of Respondent</b> | <b>Year of Experience</b> | <b>Educational Level</b>      | <b>Position from the Department</b> |
|-------|--------------------------|--------------------------|---------------------------|-------------------------------|-------------------------------------|
| FGR-1 | 27                       | Female                   | 6 year                    | 2 <sup>nd</sup> year resident | Focal person                        |
| FGR-2 | 29                       | Female                   | 2 ½ year                  | Undergraduate GP              | Lecturer                            |
| FGR-3 | 28                       | Male                     | 3year                     | Undergraduate GP              | Lecturer                            |
| FGR-4 | 29                       | Male                     | C2 internship             | Final year Intern             | Representative                      |
| FGR-5 | 30                       | Male                     | C2 internship             | Final year Intern             | —                                   |
| FGR-6 | 34                       | Male                     | C2 internship             | Final year Intern             | —                                   |
| FGR-7 | 34                       | Male                     | C2 internship             | Final year Intern             | —                                   |
| FGR-8 | 33                       | Male                     | C2 internship             | Final year Intern             | —                                   |
| FGR-9 | 29                       | Male                     | C2 internship             | Final year Intern             | —                                   |

The mean age of the participants was 33 years and female participants accounted for 3/12 (25%).

### **3.5 ELIGIBILITY CRITERIA**

#### **3.5.1 Inclusion criteria**

Residents, GPs, intern students and senior paediatricians in the paediatric department who have done LPs were eligible for the study, and data was extracted from the Yekatit 12 Hospital patient files who had LPs from the laboratory log books.

#### **3.5.2 Exclusion criteria**

Other health workers and senior doctors (specialists) other than paediatricians were not included in the study. Incomplete data was excluded from the registration log books.

## **3.6 SAMPLING**

### **3.6.1 Sample size**

Because this is a qualitative study, a large sample size was not necessary. Purposive selection of differing kinds of respondents included interns, residents, GPs and pediatricians. From a total of 6 senior pediatricians 3 were recruited as key informants and interviewed. For the focus group, from the total 20 residents, 1 resident, 2 staff GPs and 6 intern, from a total of 30 participated in a focus group discussion. Each key informant was interviewed in-depth with interview guide questionnaires and the same questionnaire was used for the focus group discussion. All participants have done LPs at Yekatit 12 Hospital Medical College Pediatric Department, since 2015

### **3.6.2 SAMPLING TECHNIQUE**

A purposive sampling technique was used for a representative sample to be drawn from the paediatrics department.

## **3.7 DATA COLLECTION AND PROCESSING**

Open ended interview guide questions were developed and then interviews and a focus group from pediatric department were conducted exploring the consenting participants' perspectives on the main factors why traumatic samples were common in pediatrics and how trainees and residents learn LP procedural skills from instructors and their senior trainees. The questionnaire contained: socio-demographic data, main problems in LP procedures and the LP procedural skills teaching-learning process. The interview guide questionnaire was prepared in English. Pediatrician interviews and the focus group discussion were audio-recorded and transcribed for analysis.

## **3.8 DATA COLLECTION TOOLS**

Open ended interview guide questionnaires were used to collect data from consenting focus group participants and key informants. An audio recorder device was utilized. Excel sheets was used to record data from laboratory registration log book.

### **3.9 DATA QUALITY ASSURANCE**

The quality of data was supervised daily based and all the interview and group discussions were recorded, securely stored, and checked for completeness and consistency during data collection. Vague ideas were elaborated and participants were asked to clarify their perspectives and opinions.

### **3.10 DATA ANALYSIS AND INTERPRETATION**

Recorded data was transcribed, thematically grouped and coded after re-reading several times. Analysis and interpretation was done manually. Meaningful findings were explained and checked with a subset of participants to ensure validity. Transcribed data was re-checked with participant members to avoid transcriptional and translational errors and to ensure validity.

### **3.11 DISSEMINATION OF THE STUDY**

The findings of this study will be disseminated to the Addis Ababa University School of Medicine, Department of Health Science Education and Yekatit 12 Hospital Medical College, and will be submitted to a peer-reviewed journal for publication.

## CHAPTER FOUR

### 4. FINDINGS

#### 4.1 RESULTS

The recorded data was coded and grouped in to three major themes.

- I. Why is it difficult? Perspectives on associated factors, reasons for traumatic LPs & procedural performance differences
- II. Practices and experiences of teaching-learning, assessment and evaluation process for LP procedures including feedback protocol.
- III. Barriers of Teaching-learning process and how teaching-learning of LP procedures skill and competency can be improved

- I. Why is it difficult? Perspectives on factors associated with, and reasons for traumatic LPs procedural performance differences

#### **A. Procedural performance differences and possible reasons**

All but (KI-3) agreed that there are practical LP procedural performance differences among trainees in different medical school. He disagreed and believed there were theoretical knowledge differences, but not procedural performance differences. His justification was that all private and government medical students were assigned to government hospitals for their practical attachment program.

Many possible reasons for the procedural differences in traumatic LP rates were described by the respondents. These included: (i) teaching methodology; (ii) school set up for practical procedural activities; (iii) availability and utility of instructional materials and equipment; (iv) curriculum of the institute; (v) type and number of procedures performed in medical college or university; (vi) number of students; (vii) individual students' or teachers' interest or motivation to learn or teach; and (viii) a lack of standardized evaluation tools.

## **B. Perspectives on factors associated with traumatic LPs**

All participants were aware and agreed that unsuccessful LP rates in neonates were higher followed by children, and then adults, in keeping with the actual findings from the logbook.

**PATIENT FACTORS:** Participants discussed that as age increased the LP site becomes easier to identify for insertion of the needle. Also the majority of respondents endorsed a reason for traumatic LPs in neonates as being due to the procedure's need for positioning the patient based on the recommended guidelines being difficult to position with infants, with challenges to identify the appropriate puncture site thus leading to the procedure being unsuccessful. As (KI-3) explained that, "the inter-vertebral space between lumbar and sacral bone for infant is very narrow and makes the procedure difficult."

- ❖ A big debate during the focus group and interviews was on the patient related factors. The majority said that patient by himself/herself can be a major factor for unsuccessful LPs due to: high movement against pain response, age and anatomy of the patient, and uncooperativeness for the procedure especially pediatric patients. Gender was also considered as a factor since females are generally more flexible than males thus making the procedure potentially easier for female patients. However, exception (KI-1), two key informants disagreed and (KI-2) commented that, "patients by themselves cannot be the factor for the high rate of unsuccessful LP because we clinicians were responsible to make them cooperative, to position properly, and sedate to remove pain response and high movement." (KI-3) pointed out that, "instead of patient factors, it is better to say attendant factors in pediatrics because attendants are assisting us when we perform the procedure."
  
- ❖ **PERFORMER FACTORS:** All of the participants agreed and were in consensus that LP performer's skill had a big share in contributing to an unsuccessful LP; and that some individuals were overconfident and did not necessarily follow guidelines. As (FGR-3) explained, "there are recommended guidelines how to do the procedure, how to use and sedate the patients, how to identify puncture site, how to position patients for LP procedure, how to insert appropriate needle and remove the stylet, how to collect CSF sample aseptically, and what type of needle to use, but no one follows this guideline even the instructors too, just they feel confident and they were not a role model for us as an instructor"

❖ **CONTEXTUAL FACTORS:** The majority of respondents mentioned the challenges of a lack of appropriate resources for the procedures as a factor that impacted on unsuccessful LP. Those resource and contextual challenges listed by the participants included: no appropriate LP set with needles specifically sized for pediatric patients; a lack of access to anesthesia to sedate and calm the patient's movement; and no well-organized procedure room with appropriate equipment, aseptic conditions or good lighting. (FGR-4) commented, "In pediatric and neonates [there are] no LP sets, [so] we just use ordinary syringes with needles... even sometimes we couldn't have the appropriate size of the needle to do LP procedure." (FGR-6) explained, "when we do a LP we lay down a patient on a mattress, with no bright light, [and instead] we use our mobile as a light source, with no guideline in place to refer to as a junior trainee, there must be a standard bed or chair, bright light, even no hand wash facility mostly." Another contextual factor above mentioned was the variability of support and skill if in those who assist, the "attendants," with LP procedures.

## **II. Practices and experiences of teaching-learning, assessment and evaluation process for LP procedures including feedback protocol.**

### **A. Practices and experiences of LP teaching-learning process.**

Teaching-learning process of LP as the majority of participants described, similar to the medical educational practice and experience of teaching-learning other common procedures, was just direct observation; however, there were several who were aware of a newly available simulation lab. Historically, after having a theoretical course, learners will have clinical attachments in different medical departments, and seniors and staff GPs will perform procedures with detailed stepwise explanation for a scheduled period of time. After repeated exposure to observation, they are allowed to try the procedure under the supervision of the person in charge. A focus group respondent (FG-1) explained as: - "basically the teaching-learning process is almost the same for every institute, as usual basic science course will be given first then system based clinical practicum attachment will follow finally internship this was the process of teaching in medicine and I am the pediatric resident now. When I finished my undergraduate program I felt that I was not confident and competent enough with what I have learnt, through my 4 years' experience I have better knowledge and skill now."



Some of the trainees and faculty have had opportunity to use a new simulation teaching-learning process. (KI-1) described the way he now teaches LP procedures through a simulation center to foster procedural competence - “now a days there is a simulation center and skill labs, where we first expose them [trainees] to those practical teaching classes with practice with artificial models in how to perform LP procedures repeatedly, then they will observe all the steps of LP procedures with seniors doing the LP procedure, then they will try under supervision.” Another focus group respondent (FG-3) explained “there is a clinical training course which will be given to improve clinical skills, and trainees will practice LP procedures with a model manikin ...[with] iliac crust and fluids which mimics CSF samples for the teaching purpose. We in Yekatit 12 Hospital follow this system and thanks to St. Paul hospital we use their skill lab and simulation center for our students. I know there are many medical colleges who don’t have skills lab or simulation centers.”

## **B. Assessment and evaluation process for LP**

- ❖ Perspectives on performance assessment and evaluation were different based on the interviews and focus group discussion results. The majority of participants stated that the current practical performance assessment method was just direct observation when the performer/trainee was doing the procedure. No standardized system to evaluate the performance was described. It was mentioned that no reference was used to compare each other on their competence to do LPs. Another kind of tool used to measure performance was reviewing of their respective patients, with respect to whether there was blood in the CSF samples from LPs done, in the individual procedure recording logbook which had to be signed by their seniors.
- ❖ One key informant (KI-3) pediatrician-teacher said that in addition to the procedure recording logbook, he used a kind of progressive assessment as an evaluating tool to measure performance and commented that experience is necessary for learning in the acquisition of procedural skills. He elaborated, “Currently we don’t have any criteria to pass or fail trainees based on the number of procedures they have performed, assisted or observed...but [these numbers of procedures] will have impact on their progress assessment. Progress assessment value may be varied in different medical schools based on the criteria they set. In ours, we evaluate by their activities who did better - even we assigned [trainees to be] on duty to expose them to different procedures under supervision

of seniors. But I am not confident to say we have indicators, because some apply strictly and others will not. Those who did more LPs will have good progress assessment values and vice versa. The value will have 15-20 points.”

- ❖ One key informant (**KI-1**) used a checklist for evaluation that included requiring a base minimum number of procedures - “I usually prepare a checklist for evaluation and I have used OSCE to measure their performance and to the extent I always construct certain criteria for each trainee to do minimum of 5-10 LP procedures.” The other two pediatrician participants explained that they use non-standardized check lists just to see how trainees perform the given procedures, but not for pass and fail purposes, and with no graded value. Also they observe each trainee’s procedure logbook to check how many LP procedures a trainee has observed, assisted and performed during their practical attachment and they give credit as a progress assessment tool.

### **C. Feedback protocol**

- ❖ Feedback on assessed performance is important for trainees to acquire skills. All respondents mentioned that even though feedback was not systematically based and practiced by all teachers, there was always some kind of feedback provided, based on the type of procedures performed in varying ways. Some received feedback on spot. The participants and interviewees discussed limitations about feedback being mostly given for failed procedures with negative feedback being common, whereas appreciation and positive feedback being uncommon for successful procedures. Repeated positive feedback can help to improve confidence and skills leading to some students progressing. Repeated negative feedback can lead to a loss of confidence and interfere with learning, making some performers to not progress and underperform.

### **III. Barriers of Teaching-learning process and how teaching-learning of LP procedures skill and competency can be improve**

#### **A. Barriers of Teaching-learning process**

- ❖ **Class sizes:** Almost all participants agreed that teaching LP practical procedures for large numbers of trainee was very difficult, resource intensive, and difficult to utilize an equitably allocate instructional materials for all trainees. Faculty was challenged to balance many competing demands and priorities. As KI-3, one of the teachers, stated, “We instructors are very stretched in doing so many activities. Our responsibilities sometimes double and triple based on the activities we engaged. We have to supervise, consult juniors; we need to visit patients, teach class, research projects, [provide] advisory service and help other burdened instructors.”
- ❖ **Language:** In Ethiopia, with 80 differing languages with several more common, instruction in the local language could help to improve uptake of knowledge and skills as sometimes language presents as a barrier to learning. Equipment, supplies and teaching set ups: The majority of participants endorsed that the absence of well-equipped and more contemporary, organized practical teaching set ups to teach procedures might help to improve medical education skills teaching, like a simulation center, skill laboratory, or a video or procedural animation demonstration facility. Challenges exist to provide needed supplies and resources for procedural activities, negatively impacting the teaching-learning process.
- ❖ **Time, teaching format & grading:** The allotment of time spent on learning theories versus time practicing procedures, and the importance or weight given to theoretical knowledge versus practice skills were areas brought up by respondents. One respondent(**FGR-8**) said that “the time given to practical activity was very short compared to theoretical sessions. For one module depending on the type of course, it may take 1-2 weeks of lecture sessions; but for practical session, only 2 hours for 20 trainees [was allotted], which was unfair. How could we fully practice within 2 hours? [And] sometimes no gloves to practice even.” (**FGR-2**) Others (**FGR-2** and **FGR-9**) also elaborated that more focus was given to theoretical teaching than practical [skills] teaching part, because of the fact that there was serious exam for the theory but no pass or fail exam for the procedural activities, and no retention time test. Instructor’s commitment: Personal interest and the instructor’s commitment were also mentioned as

having an adverse effect on the teaching-learning process. “Some instructors were very committed to share everything what they know and devoted their spare time for helping students. Others were not cooperative and interested to teach what they were supposed to do, instead making us busy with assignment”(FGR-4).

**EVALUATION:** Aside from one exception, a key pediatrician/instructor informant (KI-1) who used OSCE to assess performance of trainees, all agreed that there was neither a standardized performance assessment system for procedural activities nor performance measuring indicators or checklists to evaluate LP procedure performance. In contrast, for theory there are several tools and evaluative processes with graded values to assess trainees. As (KI-2) explained “Currently we don’t have any checklists to follow procedures performed by trainees, but during my previous training course in abroad when we performed any procedure, I remember there was a checklist and our seniors or instructors were evaluating us by those checklists. During my undergraduate training no, one used checklists for procedural performance evaluation. Ideally I agree that there should be a checklist for common procedure performance evaluation.” Another respondent (FGR-7) commented that there was, “No standard assessment system at all. I guess it is not included in the curriculum. The importance of skill is not only for LP but also for delivery [in childbirth], and others. In general, in the majority of [Ethiopian] universities, a lot needs to be done concerning clinical skill building, and the assessment and evaluations tools should be included [in the curriculum development around teaching of] those procedures”.

#### **B. How teaching-learning of LP procedures skill and competency can be improved**

- ❖ As listed below, feedback and suggestions were made by the participants on ways to build up practical skills and knowledge, to improve confidence, and competency. This included the establishment and consistent availability of well-organized and equipped practical and procedural teaching set ups such as a skills lab, a simulation center, or a video and animation demonstration display station. Faculty development to improve instructor commitment, motivation, and teaching of procedural skills can also lead to improved interest, learning outcomes, and satisfaction of trainees and instructors. In some cases, where language may present as a barrier to learning, the medium of instruction should be in the local language. Learning needs assessment about practical skills/procedural

activities could identify specific areas of needed instruction and the development of a more trainee-centered curriculum. Practical teaching set ups, with improved monitoring of performance is needed. Supervision and consistent follow-up of each procedural activity by seniors, with use of checklists that outlines a set of objective criteria or indicators to measure performance activities could improve and standardize teaching and evaluation processes. Practical lectures could be enhanced with procedural demonstration videos. In addition, a pass and fail evaluation system might also be applied to common procedural and clinical practical exams with a retention time test for common procedures, with assessment and feedback for practical attachments. Consistent, equitable access to available instructional materials, utilizing procedural guidelines, with practice reminders in the form of job aids should be posted in procedure rooms. Finally, more practice is needed to acquire competence in procedural skills. **(FGR-4)** explained, “Confidence will be build up by performing repeatedly. One who did LP once or twice will not have the same confidence and skill performance with those who did LP several times. The more you practiced in a skill laboratory or [with] real patients, the more you build up and increase your confidence and your practical skill and knowledge.” **(KI-2)** and one GP **(FGR-2)** also agreed that the best way of skills transfer is repeated practice and exposure – for example, with a manikin in a skills lab, enhanced by watching either an animated video or recorded procedure videos with detailed explanations could increase the confidence and interest of learners/performers.

## 4.2 DISCUSSION

As the majority of participants described, the practice and experience of teaching-learning LP procedures was just direct observation, after having a theoretical course. Learners have clinical attachments in differing medical departments and observe seniors and staff GPs who perform LP procedures with detailed explanation. After repeated observational exposure, trainees are then allowed to try the procedure under the supervision of seniors or the person in charge. As Kaushal's study stated, the rate of traumatic lumbar puncture in pediatric was approximately 15% using a cut-off of 400 RBCs and 10% using a cut-off of 1,000 RBCs. The proportion of bloody LPs was greater among infants (23%) than among older pediatric patients (10%). The authors commented that the increased risk of bloody LP in infants may be due to technical difficulty in performing the LP that results from the smaller inter vertebral space and the shallow depth of needle insertion required to reach the thecal sac. Also age less than 1 year was associated with an increased risk of traumatic LP (11). Keeping what others found, our result showed that all participants agreed that the unsuccessful LP rate in neonates is highest followed by children then adults. as the patient's age increased, the LP site becomes easy to identify for insertion of the needle and also the procedure is performed by positioning the patient based on the recommended guideline, but for neonatal patients, it is difficult to position the infant and to easily identify the appropriate puncture site thus leading to the procedure being unsuccessful. (Weisman et al., 1983) offered suggestions on the altering of techniques to decrease the traumatic LP rate. For example, in preterm infants it has been suggested that the sitting or modified lateral recumbent, without knees-to-chest position, which results in less hypoxemia with the neck maintained in the neutral position is better than the classic position. With respect to training as a factor in traumatic LPs, respondents endorsed the need for more practice. This is in keeping with what others have found that practitioner experience level was a more important predictor of outcome than education level, which suggests that practice is important to achieve optimal skill in performing LP (22). (California Pacific Medical Centre, 2007). A study by Pappano et al. (2010) showed that LPs done by a physician who has completed training and performs the procedure frequently yielded a very low traumatic LP rate, whereas the proportion of bloody or traumatic CSF from pediatric lumbar puncture reported from

pediatric training centers was typically in the 20% to 30% range (10). As Yodit Abraham, (2012) mentioned, curriculum developed by the NIMEI program is competency based help to standardize and improve teaching of LP procedural skills - whereby measurable learning outcomes are defined with teaching-learning methods and assessment tasks that are aligned with those learning outcomes (4). The respondent's report of performance assessment and evaluation was different based in the interviews and focus group discussions. The majority of participants said the current practical performance assessment method was just direct observation when the performer was doing the procedure with no standard system to evaluate the performance. Another kind of tool used to measure LP performance was reviewing of individual procedure recording logbook prepared by trainees and signed by their seniors. A checklist and use of an infant LP simulator such as that used in Auerbach et al's study (2013) might serve as a template to standardize and improve teaching and evaluation of this procedural skill for trainees at Yekadit 12 (6). Alternatively, exposure to video demonstrations might help to mitigate the challenges of teaching to increasingly larger numbers of students and class sizes, was an adjunct to clinical skills face-to-face tutorials and deliberate practice of skills in a blended learning format. (13). Only one key informant(KI-3) teacher said "I usually prepared checklist for evaluation and I used OSCE to measure their performance and to the extent I always construct certain criteria for each trainee to do minimum of 5-10 LP procedures". A study by Nigrovic showed that some of the factors associated with traumatic or unsuccessful LPs in children such as the advancement of the spinal needle with the style in place, and lack of local anesthetic use, are modifiable. Modification of these procedural factors may reduce the risk of traumatic or unsuccessful lumbar punctures in children (10). Our study also identified modifiable factors in the lack of appropriate resources for the procedures that impact on unsuccessful LPs. Resource and contextual factors listed by the participants included, no appropriate LP set, lack of anesthesia to sedate and calm the patient's movement, and no well-organized procedure room with appropriate equipment. These kinds of resource challenges present as problems in LAMIC medical education settings. With respect to choice of needle, when differing gages are available: As mentioned by (FGR-4), "In pediatric and neonatal [patients, there was] no LP set. We just use ordinary syringe with needle, even sometimes we couldn't have appropriate size of the needle to do LP procedure." Using appropriate size and type of needle minimizes the high rate of unsuccessful LP. The smaller the gauge number, the bigger the diameter of

the needle. For diagnostic collection of CSF, a larger gauge needle (18, 19 or 20 standard gauge needles; 22 G, 3.5-cm long needle for neonates; 20 G, 5-cm long needle for children) should be used. (Boon, Abrahams et al., 2004). The choice of needle type (cutting versus atraumatic) and bore size can influence the risk of a post-LP headache, but also may increase the technical difficulty of the procedure. Also, correct patient positioning is an important determinant of success in obtaining non-traumatic CSF. (Kimberly S Johnson, Feb 03, 2016). A study by Wiley-Liss emphasizes the importance of the skill of the practitioner/performer of an LP procedure, (18), our result revealed that all the participants agreed and were in consensus that LP performer's skill had a big share for unsuccessful LPs.

Teaching-learning process: From our study, **(FGR-1)** explained as: - "basically the teaching-learning process is almost the same for every institute, as usual basic science course will be given first then system based clinical practicum attachment will follow finally internship this was the process of teaching in medicine and I am pediatric resident now when I finished my

undergraduate program I felt that I was not confident and competent enough with what I have learnt, through my 4 years' experience I have better knowledge and skill now". From literature review, (11,13,14,15,16) others like technology assisted practical and procedural teaching-learning methods of instruction were identified that might be considered at Yekatit 12. A Study by Kessler showed that audio visual training (AV) did not improve infant LP performance skills but Participation in a simulation-based deliberate practice intervention was found to acutely improve infant LP performance skills (11). **(FGR-4)** endorsed this finding mentioning that the establishment and availability of well-organized and equipped practical and procedural teaching set ups including a skill lab, simulation center, video and animation demonstration display station, could improve the LP performance skills.

One of the limitations of our study is that traumatic LP rates were calculated based on data extracted from the log book which might be incomplete. Shawna Shafer (2015), found that poor documentation of LP data are common and the ability of residents to obtain satisfactory cerebrospinal fluid is low. Inability of residents to consistently perform non-traumatic LP is a common phenomenon. She recommended that new educational methods and evaluation criteria must be developed to address this gap in resident education (20). The unmodifiable risk factors for traumatic and bloody LP include black race, age < 1year,



previous Modifiable risk factors include procedural factors, an interval of 15 days or less between LPs, and LP performed by less experienced practitioner. (Scott C. Howard, 2002). Our study also identified factors in the lack of resources for the procedures that impact on unsuccessful LPs. factors listed by the participants included, no appropriate LP set, lack of anaesthesia to sedate and calm the patient's movement, and no well-organized procedure room with appropriate equipment. These kinds of resource challenges present as problems in paediatric department at yekatit 12 hospital medical college. A descriptive study by Auerbach et al (2013) showed us, at the start of residency, the majority of paediatric interns have little experience, poor knowledge, and low confidence and are not prepared to perform infant LPs. (8). A study by (Yodit Abraham, 2012) showed us among medical doctors working in the 72 hospitals in Ethiopia, majority of GPs believed that medical education needs more practical skill training and the clinical and internship years were the most valuable to their practice of medicine. A majority felt they were not adequately equipped with life-saving clinical skills

nor have the ability to perform common clinical procedures (4). From our study, **(FGR-1)** explained as: - “basically the teaching-learning process is almost the same for every institute, as usual basic science course will be given first then system based clinical practicum attachment will follow finally internship, this was the process of teaching in medicine and i am paediatric resident now. when I finished my undergraduate program I felt that I was not confident and competent enough with what I have learnt, through my 4 years ‘experience i have better knowledge and skill now”. A study by (Hibbert 2013) in Australia showed that Video demonstrations can provide an enduring, on-demand, portable resource for reference, which can even be used at the bedside by learners. Such resources are cost-effectively scalable for large numbers of learners. (13). **(KI-1 and FGR-3)** also agreed that the best way of skill transfer is repeated practice with manikin in skill lab, watching either animated video or recorded procedure videos with detail explanations will increase confidence and interest of performers competency.

### **4.3 LIMITATIONS**

- ❖ Recruitment to participate presented as a challenge, as students and staff were very busy with competing priorities; thus introducing selection bias
- ❖ Data incompleteness from log book. It didn't show the LP done by senior, junior and trainee separately.
- ❖ It is possible that some important points were missed during discussions
- ❖ Time limitations for the group discussion and interview.
- ❖ Representativeness and generalizability, as only the Pediatric Department of Yekatit 12 Hospital Medical College in Ethiopia was studied.

## **CHAPTER FIVE**

### **5.1 CONCLUSION**

- ❖ Risk factors for unsuccessful LPs was, age, anatomy and positioning of the patients, appropriate resources like LP set, proper procedure room, performer's skill and experience, and training were mentioned as major factors.
- ❖ A gap was identified in the teaching-learning process of LP practice and procedure. Only direct demonstration by seniors then trial under supervision. Well organized practical and procedure teaching set up was not available, no simulation center, skill laboratories.
- ❖ LP Skill and procedural performance assessment system was not well defined and not standardized. Performance was not measured based on checklists, measuring tools or indicators. As well there was no retention time test done for common procedures nor was there a pass fail exam for practical skills.
- ❖ Many LP procedural teaching-learning barriers exist at the Yekatit 12 Medical College including large numbers of student, instructor's workload, language of instruction, and constraints of instructional materials and resources. Due to teaching-learning barriers, procedural performance differences or skill gaps were observed among different trainees. After finishing medicine GPs did not feel comfortable or confident in this procedure, and they felt they had missed something in their training. To fill the identified gaps, many LP skill performance improving teaching guides were recommended by study participants.

## **5.2 RECOMMENDATIONS**

- 1.** Standardized practical and procedural performance assessment measuring tools should be in place for common procedures
- 2.** Increased opportunities for practical activities are needed to build up competence and procedural skills in performing pediatric LPs.
- 3.** Retention time test for skill performance should be done periodically
- 4.** Resources and instructional materials (including videotaped demonstrations) should be available for practical teaching processes.
- 5.** Establishment of an infant LP simulation center skills lab with access for all learners
- 6.** Well organized and properly equipped aseptic procedure rooms with needles gagged for pediatric patients and anesthesia to calm infants are needed
- 7.** Needs assessment and feedback before and during training of students should be done to intervene skills gaps with provision of constructively critical feedback when improvement is needed or errors are made, and/or positive feedback when procedures are well done.
- 8.** Pass and fail evaluation system should be applied to common procedural and practical exams, and for practical attachments.
- 9.** Access to trainings in pediatric departments for LP procedures with repetitive performance of skills, assessment and feedback could help to decrease the rate of traumatic LP.

## 6. REFERENCES

1. Mosby's Medical Dictionary, © 2009, 9th edition., Elsevier
2. Ali Moghtaderi<sup>1</sup>, et.al, (2012) Neurology Department, Zahedan University of Medical Sciences Research Center for Infectious Diseases and Tropical Medicine University of Medical Sciences, Zahedan, Iran ISBN 978-51-0333-2, intech, march
3. Sharon E. et.al, (2012) How Do I Perform a Lumbar Puncture and Analyse the Results to Diagnose Bacterial Meningitis? JAMA, October 25, 2006—Vol 296, No.16 (2)
4. Yodit Abraham, Aklilu Azaje, (2012) The new innovative medical education system in Ethiopia: Background and dev.t *Ethiop. J. Health Dev.* 2013;27 Special Issue 1:36-40]
5. Howard SC, et.al (2002) Risk factors for traumatic and bloody lumbar puncture in children with acute lymphoblastic leukemia. JAMA. 2002 Oct 23-30;288(16):2001-7
6. Federal Ministry of Health 16th National Annual Review Meeting Group Discussion Improving competence of health professionals: Challenges and opportunities in availing effective human resource for the health sector Human Resource Development and Administration Directorate. Document #ARM 16-Doc09/14. 2014
7. Yekatit 12 Hospital CSF Laboratory Logbook. Unpublished. Addis Ababa, Ethiopia.
8. Auerbach, et.al (2013) Are Pediatric Interns Prepared to Perform Infant Lumbar Punctures? A Multi-Institutional Descriptive Study *Pedi. Emerg. Care*: April 2013 - Volume 29
9. Conroy SM, Bond WF, Pheasant KS, (2010) Competence and retention in performance of the lumbar puncture procedure in a task trainer model. *Simul Health C.* 2010; 5(3):133-8
10. Pappano, Dante MD, MPH (2010) "Traumatic Tap" Proportion in Pediatric Lumbar Puncture *Pediatr Emerg. Care*: - Volume 26 - Issue 7
11. Kaushal H., et.al (2008) Incidence of Traumatic Lumbar Puncture,
12. Lise E. Nigrovic, MD, MPH Nathan Kuppermann MD, MPH et.al , MPH (2007) Risk Factors for Traumatic or Unsuccessful Lumbar Punctures in Children, Volume 49, Issue 6, Pages 762–771
13. Kessler, David o.; et al. (2011) A randomized trial of simulation-based deliberate practice for infant lumbar puncture skills, *journal of the society for simulation in healthcare* Volume: 6 Issue:

14. Kessler, David O., Arteaga, Grace, Ching, Kevin, et.al.(2013;) Interns' Success with Clinical Procedures in Infants After Simulation Training, American Academy of Paediatrics, journal of the society for simulation in healthcare.
15. Hibbert. et al. (2013) A randomized controlled pilot trial comparing the impact of access to clinical endocrinology video demonstrations with access to usual revision resources on medical student performance of clinical endocrinology skills. BMC Medical Education vol. 13:135
16. Nathan Jowett, LeBlanc, Vicki, et.al , (2006) Surgical skill acquisition with self-directed practice using computer-based video training , Association for Surgical Education,
17. Edwards, Cory, Leira, Enrique C and Gonzalez-Alegre, Pedro. (2015), Residency Training: A failed lumbar puncture is more about obesity than lack of ability Journal of American Academy of Neurology.
18. Srivastava, Geetanjali; Roddy, Mark; Langsam, Daniel; (2012) An Educational Video Improves Technique in Performance of Pediatric Lumbar Punctures Published: : by pediatric emergency care volume: 28
19. Wiley-Liss; et al. (2004) Lumbar puncture: Anatomical review of a clinical skill clinical anatomy Published: , Volume: 17
20. Shawna Shafer<sup>a\*</sup>, Deborah Rooney<sup>b</sup>, et. al (2015) Lumbar Punctures at an Academic Level 4 NICU: Indications for a New Curriculum <sup>c</sup> Published online:
21. Howard SC1, et.al, (2002). Risk factors for traumatic and bloody lumbar puncture in children with acute lymphoblastic leukemia. JAMA.
22. Center for Patient and Community Education in association with the staff and physicians, © (2005-2007) California Pacific Medical Center.”
23. Duvivier et al; (2011), The role of deliberate practice in the acquisition of clinical skills, *BMC Medical Education*, **DOI:** 10.1186/1472-6920-11-10
24. Kimberly S Johnson, MD, Daniel J Sexton, MD, (2016) Lumbar puncture: Technique, indications, contraindications, and complications, JAMA.

## 7. APPENDIX

An open ended interview guide questioner for key informants and focus groups  
at Yekatit 12 hospital medical college pediatric department

### **PART ONE: - DEMOGRAPHIC DATA**

- I. Age of the respondent-----
- II. Sex of the respondent -----
- III. Year of experience at the teaching school-----
- IV. Educational level -----
- V. Position from pediatric department-----

### **PART TWO: - SEMI STRUCTURED QUESTION**

1. Laboratory log book shows high rate of bloody CSF samples in pediatric especially in neonate. What are factors associated with an increased rate of a traumatic or unsuccessful lumbar puncture with regard to physicians, patient, and procedures?
2. How do physicians learn procedures like lumbar puncture during their clinical training course and how do they improve their confidence and practical skill knowledge?
3. How is LP skills and procedural competence assessed and evaluated including feedback protocol?
4. What are barriers to teaching and learning of LP procedural skills?
5. What are factors associated with, and reasons for traumatic LPs procedural performance differences between medical schools; and with adult, children and neonate patients?
6. What else you think hidden to improve clinical skill performance?
7. How can teaching and learning of LP procedural skills be improved during teaching-learning process?