Addis Ababa University

College of Health Sciences School of Medicine

Department of Internal Medicine

A survey on the indications, diagnostic efficacy and safety of Fiberoptic bronchoscopy in Tikur Anbessa Specialized Hospital

Principal Investigator –Dr. Seid Ahmed, MD, Internal medicine resident

Advisors–Dr. Hanan Yusuf, MD, Assistant professor of Internal Medicine and consultant PCCM Specialist

Dr. Dawit Kebede, MD, Associate professor of Internal Medicine and consultant PCCM Specialist

Dr. Aschalew Worku, MD, Assistant professor of Internal Medicine and consultant PCCM Specialist

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A thesis to be submitted to Addis Ababa University, College of Health Sciences, School of Medicine, Department of Internal Medicine in preparation for partial fulfilment of the requirement for a Specialty certificate in Internal Medicine

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Name of Investigator	Dr. Seid Ahmed Hassen
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Address of the investigator	Phone number: +251919231914 E-mail: seidahmededuc@gmail.com
Name of Advisor(s)	Dr. Hanan Yusuf (Consultant internist and PCCM Specialist) Dr. Dawit Kebede (Consultant internist and PCCM Specialist) Dr. Aschalew Worku (Consultant internist and PCCM Specialist)

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Acknowledgment

First and foremost, I will give all glory to God, who has been and will always be alongside me throughout my journey in life.

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List of Abbreviations

AAU Addis Ababa University

ACCP American College of Chest Physicians

AQuIRE ACCP Quality Improvement Registry, Evaluation, and Education

CCSI Charlson Comorbidity Severity Index

COPD Chronic Obstructive Pulmonary Disease

COVID Corona Virus Disease

CT Computed Tomography

EBBx Endobronchial biopsies

EBUS Endobronchial Ultrasound

EMR Electronic medical record

ENB Electromagnetic Navigation Bronchoscopy

FOB Fibreoptic Bronchoscopy

IRB Inistuitional Review Board

MRN Medical Registration Number

PCCM Pulmonary and Critical Care Medicine

PCR Polymerase Chain Reaction

SPN solitary pulmonary nodule

SPSS Statistical Package for Social Sciences

TASH Tikur Anbessa Specialized Hospital

TB Tuberculosis

TBNA Transbronchial needle aspiration

TNM Tumor, Node, Metastasis

1. Abstract

Back ground

In the field of respiratory medicine, Fiberoptic bronchoscopy (FOB) is a crucial diagnostic tool for both infectious respiratory diseases including Tuberculosis and non-infectious conditions, including lung cancer since it allows for direct visualization and sampling of the airways. Given the fact that both are one of the leading causes of morbidity and mortality in Ethiopia and worldwide, a comprehensive retrospective analysis of its usage, safety and diagnostic yield is beneficial to optimize its integration into the hospital's diagnostic protocols.

Objective

This study aims to assess the indications, diagnostic efficacy and safety of FOB in the context of Tikur Anbessa Specialized Hospital (TASH) over a two-year period from December 2021 to November 2023.

Methods

This study systematically analyses electronic medical records, bronchoscopy procedural reports and pathology and microbiology reports from TASH over a two-year period spanning from December 2021 to November 2023. Data extraction focuses on patient demographics, smoking history, platelet count and coagulation profile, indications for the procedure, bronchoscopic procedures and finally the safety and diagnostic outcomes of all patients who undergo bronchoscopy over the specified period of time. A waiver was taken from the IRB for the Ethical aspect of the study and patients' information is anonymised. Collected data is evaluated for consistency and completeness by the investigator. Following collection, data is cleaned, coded, and analysed by SPSS version 26 software.

Results

From a total of 227 bronchoscopies, records were available for 205 procedures, with a mean patient age of 43.63 years. The majority were male (52.2%), and 83.9% fell within the age range of 18-65 years. From the cases with HIV testing result, 11/108 (10.2%) were positive. Common indications for bronchoscopy include suspected mass or malignancy (45.85%), tuberculosis (28.29%), and airway inspection (13.66%). Comorbidities such as hypertension (14.15%) and bronchiectasis (11.71%) were identified. Samples collected during bronchoscopy include bronchoalveolar lavage (78.54%), transbronchial biopsy (25.85%), and endobronchial biopsy (10.24%). The overall diagnostic yield for FOB was 75.6%, with specific diagnostic yields for TB, sarcoidosis, and lung cancer at 41.38%, 45.45%, and 51.06%, respectively. Lung cancer was diagnosed in 23.41% of all cases, with adenocarcinoma (43.3%) being the most prevalent subtype. Tuberculosis and sarcoidosis were diagnosed in 14.63% and 5.36% of cases, respectively. Most cases (93.17%) were complication-free, with minor bleeding, hypertension, hypoxemia, and pneumothorax (on 2 patients) observed in a small percentage.

Conclusion

Our study shows that the commonest indication for FOB is workup of suspected mass. FOB in TASH has a better yield compared to most other reports from Africa. The highest yield as expected was when there was a visible mass and coupled with endobronchial sampling. Cytology from fluid analysis has the lowest yield for malignancy. The practice of FOB in TASH is a safe procedure and even though rare, blind transbronchial biopsy has a risk of pneumothorax. The commonest histologic type of lung cancer identified is Adenocarcinoma but it was squamous cell carcinoma among smokers.

Key words: FOB, usage, safety, diagnostic yield, TASH

2. Introduction

2.1.Background of the study

Respiratory diseases, particularly lung cancer, constitute a significant global health challenge, demanding precise and efficient diagnostic approaches. The development of FOB in 1968 changed the practice of pulmonary medicine more than any other advance in technology. (1) When it comes to procedures, FOB is safer and easier to do than rigid bronchoscopy. Because FOB can be done as an outpatient procedure and is safer, it is replacing rigid bronchoscopy. It can also be carried out under local anesthetic and conscious sedation, which avoids the associated risks of general anesthesia and enables it to be done as an outpatient procedure.

Even in developed nations including UK, diagnostic FOB practices are not standardized, even though there are recommendations available that largely address the safety of the procedure. (2) Because of this, the 2013 British Thoracic Society guideline on the practice of diagnostic FOB recommends routine clinical audits of the bronchoscopic performance, including its diagnostic yield, patient satisfaction, and complications to ensure compliance with the guidelines. (3)

One of the top medical facilities in Ethiopia, Tikur Anbessa Specialized Hospital (TASH), frequently uses fiberoptic bronchoscopy as a diagnostic technique for respiratory disorders. But for the last decade a thorough assessment of its diagnostic yield and usefulness in the particular healthcare setting of TASH has not been methodically carried out. So, the goal of this study is to have an update on its overall usage, safety and to evaluate its diagnostic yield at TASH, specifically from December 2021 to November 2023.

2.2.Statement of the problem

Although fiberoptic bronchoscopy is widely used to diagnose respiratory disorders, there is a significant updated knowledge gap about its effectiveness and diagnostic efficacy in the unique healthcare setting of TASH over the past decade. Even if FOB is a vital tool in the study of infectious diseases and non-infectious ones like lung cancer and other respiratory disorders, our capacity to evaluate its efficacy and influence on patient outcomes is limited at TASH due to the absence of a thorough recent analysis. By analysing the indications, complications and the diagnostic yield of FOB retrospectively over a two-year period, this study aims to address this knowledge gap. It does so by performing an overall survey on all the bronchoscopies done on the study period, pinpointing possible areas for development, and offering insightful information that can improve care of patients at TASH with pulmonary complaints.

2.3.Significance of the study

There are only two researches done in Ethiopia, one of which was done four decades back and the other a decade back (available as preprint article but not published) showing that there is paucity of updated data on assessment of the usage, safety and diagnostic yield of FOB for diagnosing pulmonary diseases. (4, 5)

For several reasons mentioned below, this Survey of fibreoptic bronchoscopy usage, safety and diagnostic yield in TASH holds considerable significance. Significant advancements have occurred in the field of pulmonary disease epidemiology and technology since those earlier studies, notably with the emergence of conditions like COVID-19, and newer technological

advancements. For instance, one of the previous research did not have access to imaging techniques such as chest CT scans. (4) Moreover, the bronchoscopy equipment now in use is more advanced, and newer modalities like EBUS have been recently incorporated into the hospital's bronchoscopy unit. Furthermore, the introduction of electronic medical records, absent during earlier studies, could enhance the data quality in this research, underscoring the importance of this study.

Firstly, it fills in a significant updated knowledge gap by offering a thorough analysis of fibreoptic bronchoscopy's diagnostic efficacy in the TASH healthcare setting. This data is crucial for improving and maximizing diagnostic approaches, which helps for a more accurate and timely diagnoses of respiratory conditions, particularly lung cancer.

Second, the results of the study can help TASH clinicians and healthcare professionals make evidence-based decisions by assisting them in choosing the most appropriate diagnostic techniques with the potential for enhancing patient outcomes. By determining the factors that affect fibreoptic bronchoscopy's diagnostic yield, the research could result in the creation of customized protocols and improved procedural methods.

Thirdly, the research contributes to the broader field of respiratory medicine by generating insights into the real-world application of fibreoptic bronchoscopy specially in a developing countries healthcare setting. The results may have implications for global practices, aiding healthcare institutions worldwide in optimizing their diagnostic approaches for respiratory diseases.

In summary, this study's significance lies in its potential to provide updated information on the clinical usage, safety, improvements in diagnostic precision, guide clinical decision-making, and advance the quality of respiratory care at TASH, with broader implications for respiratory medicine practices globally.

3. Literature Review

Usage of bronchoscopy in Countries outside of Africa

From a rural-based tertiary hospital in India which assess the role of FOB in diagnosing pulmonary diseases, studied 100 patients retrospectively over 2 years period. Most of the participants were males (74) and cough was the most common symptom (94%), followed by fever (86%), weight loss (60%), and others. The primary reasons for bronchoscopy were lower respiratory infections, including TB, and malignancy. The overall diagnostic success rate was 62%. Notably, in suspected TB cases, bronchoscopy confirmed the disease in half of them. Among pneumonia cases, bacterial growth was seen in 83%, with Gram-negative organisms more common in patients with underlying lung diseases. For suspected malignancy cases, bronchoscopy detected it in 68% of cases using various techniques and the commonest malignancy identified was squamous cell carcinoma followed by adenocarcinoma, and highest yield was seen from the fluid cytology samples. The study emphasizes the importance of bronchoscopy in diagnosing pulmonary diseases, suggesting its wider use can improve early detection of diseases like tuberculosis and lung cancer, particularly beneficial in resource-limited settings. (6)

In Saudi Arabian university teaching hospital, a survey done to review the indications and complications of FOB analysed 124 bronchoscopies, most of them being male (69%) with a

mean age of 49.9 years and half of them were current or ex-smokers. The majority of bronchoscopies (98%) were conducted for diagnostic purposes. The most common indication was suspicion of pulmonary TB (31%), followed by a lung mass and hemoptysis (about 18% each). Common procedures included bronchial brushing and washing in 90% of patients and biopsies in 82%. Histopathological analysis of a radiological tumor-like mass revealed that 86% of those cases were lung cancer and 5% were tuberculous granuloma and from those with lung cancer 84% of patients are either current or ex-smokers. The complications seen on their patients were Hypoxemia occurring in 14% of patients and pneumothorax in but there was no Mortality. The study concluded that FOB is a safe and valuable diagnostic tool for various chest diseases when performed under appropriate conditions, with a high diagnostic yield and low complication rates. (7)

Another study in Saudi Arabia, assessing the utility of FOB retrospectively over three years period; there were 216 patients who underwent FOB and the average age was 50 years and the primary indication for FOB was respiratory infections including TB in about (47.5%), while suspected malignancy accounts for 17.2%. The overall diagnostic yield from the FOBs was 46% but is higher (85.7%) in cases of pulmonary infiltrates linked to HIV. TB was confirmed in 37.7% while malignancies were confirmed in another 35.3% of cases. Among the therapeutic bronchoscopies, the primary indication observed was lung collapse. Encouragingly, the study reported no fatalities, and complications were minimal, occurring in only 1.5% of the cases. (8)

A study done in Pakistan investigated the indications, diagnostic outcomes, and complications of FOB by analysing the medical records of 153 individuals who underwent bronchoscopic at a Medical Teaching Hospital in Peshawar between in 2021. Demographically, 59% of the patients were men, and more than half were above 60 years old, with prevalent comorbidities such as hypertension (40%), DM-II (39%), and asthma (22%). Notably, 40% had significant exposure to tobacco smoke. The primary indications for bronchoscopy included suspected pulmonary infections (27%), suspected malignancy or lung mass on chest CT (23%), the overall diagnostic yield was 51%, with higher diagnostic yield seen on those with suspected pulmonary TB (79%) underscoring its benefit for diagnosis of smear-negative TB; and the diagnostic yield for suspected malignancy was 52%. It was highlighted as a safe method with a good diagnostic yield for various respiratory illnesses and had no major complications but with a 4.5% of minor complications including bleeding, bronchospasm, and desaturation. (9)

A study done in Norway on 363 patients with the aim of comparing the diagnostic yield of different bronchoscopic methods for suspected lung malignancy cases and focusing on predictors such as endobronchial visibility and tumor size. Notable findings include a higher diagnostic yield in procedures with visible lesions (76.6%), with biopsy and transbronchial needle aspiration (TBNA) having the highest yield when used in combination than alone or the other methods. The overall diagnostic yield for non-visible lesions was 16.7%, and it was 34.4% in procedures with compression, constriction or suspected submucosal changes. According to the study, biopsy plus TBNA may provide a better diagnostic yield for visible and non-visible lesions than other sampling methods. This suggests that the BTS recommendation, which currently recommends biopsy, brushing, and washing for visible lesions, may need to be challenged.

. The study identified methodological issues, emphasizing the real-world clinical practice setting, potential biases in operator skills, and the influence of sample selection methods and further investigation and cost-effectiveness analysis are recommended to refine the optimal combination of sampling techniques to increase the diagnostic yield of lung cancer. (10)

Usage of bronchoscopy in Africa

From a comprehensive study in South Africa, analysed all bronchoscopies performed at a large hospital over 8 years. The mean age of patients undergoing the procedure was 56.2 years, with males comprising 66% of the study population. Twenty-nine percent of the study population with documented HIV status were HIV seropositive, and HIV-positive patients were less likely to be diagnosed with a malignancy compared to HIV-negative patients. A suspected endobronchial lesion was the commonest indication for FOB (52%), and endobronchial lesions were noted in 44% of the study population. Of all the diagnoses, lung cancer accounted for 39% of cases; the most prevalent histological subtype was squamous cell carcinoma. The study also reported on the safety of the procedure, with a complication rate of 2.16%. (11)

From a survey done in Nigeria to assess the knowledge, Attitude and practice of medical doctors on usage of bronchoscopy; there was a limited perception about practice of bronchoscopy and the under utility of bronchoscopy among them. Approximately 60% of the respondents were unaware of the safety and low death rate of bronchoscopy, despite the fact that over 90% of them thought the treatment was useful. Only 8.4% had training in FOB, and procedures were rarely performed (1-5 cases per month). The major challenges identified included the unavailability of training programs and the lack of FOBs for adequate training of doctors. The study also highlighted the need for increased awareness among medical practitioners regarding its potential applications particularly in the management of conditions like bronchial asthma and COPD. (12)

Another study done in tertiary care centre in Nigeria with the aim of assessing the utility of FOB in African resource-poor settings like Nigeria shows only 163 FOBs were done over a course of four years and only 99 patients' data was analysed because of incompleteness in the remaining 64 patients. It provides an update after similar researches done in Nigeria two and three decades back. The mean age of patients were 54.8 years with males accounting more than half of the cases. Their finding shows suspected Bronchial cancer as the most common indication (33%), followed by pleural effusion (19.1%) with a diagnostic yield of 51% for lung cancer and 57% for pleural effusion. The overall FOB diagnostic yield is 62%, showcasing improvements from earlier studies. Specificities of washing cytology and bronchial brushing to exclude bronchial cancer were 83%, and 90.9% respectively, with sensitivities of 59%, and 64.3% respectively. The identified complications were epistaxis and desaturation in 2 patients each and Serious complication occurred in 1 patient which was cardiac arrest but there was no mortality. FOB proves valuable in excluding lung cancer and diagnosing tuberculosis, particularly in smear-negative cases. The study identifies challenges, including limited availability of bronchoscopes and the need for enhanced capacity, training, and support for FOB in low-income settings. (13)

From a recent study in Ghana done in 2019, only 33 cases of bronchoscopy were done over a two years period with mean age of 43 years. The most common indication was suspected lung malignancy which accounts for almost half of the cases followed by infection, trauma and other

indications. Abnormal bronchoscopic findings were noted in 75.8% of cases, predominantly in the right main bronchus. Additional finding that was not described on most other studies was the average duration of the procedure which on this study was 32 minutes. And they didn't report any case of complication and mortality concluding it as a safe but under practiced procedure in developing African nations. (14)

A study conducted in Tanzania over a 5-year period analysed 451 patients who underwent FOB. Majority were male with a mean age of 54 years. The number of bronchoscopies increased annually. Lung tumors were the main indication for FOB (67.6% of cases). Other indications included bronchiectasis, unexplained haemoptysis, mediastinal mass, cavitary lung diseases, and others. Of the 174 patients who had tissue biopsy, adenocarcinoma (33.9%) was the most common lung cancer diagnosed. Other findings included nonspecific inflammation, squamous cell carcinoma, and small cell carcinoma. And out of 291 patients who had fluid sampling for cytology the main finding was showed nonspecific inflammation and malignancy was detected in only 9.6% of samples. From the bacteriologic samples gram-positive cocci were predominantly seen and TB was detected in 10.7% of samples tested with the GeneXpert MTB/RIF technique. (15)

Suspected malignancy was the main reason for bronchoscopy, according to a retrospective study conducted over a seven-year period in Egypt that involved 3660 diagnostic bronchoscopies. The study also reports an overall diagnostic yield of 67%, with a higher yield (70%) for malignancy detection which reaches to 94% when there is macroscopically visible tumor. Their findings align with Western reports, emphasizing the significance of FOB in diagnosing various pulmonary diseases. Furthermore, the study explores the sensitivity of different bronchoscopic modalities, revealing higher rates for (EBBx) compared to washings and brushings. A substantial percentage of patients had infections of the Candida species and bacterial pneumonia, particularly those with underlying medical problems such diabetes and immunosuppression. The research offers significant understanding of the heterogeneous diagnostic environment of bronchoscopy in this area, highlighting the vital function of this procedure in identifying lung pathology. (16)

Bronchoscopy in Ethiopia

There are only two studies in Ethiopia related to FOB. The first one was a four-year retrospective survey done four decades back in our hospital, TASH, to see the utility and diagnostic yield of FOB identified that 218 procedures were performed in 199 patients with some of the procedures being a repeat one. The age of the individuals on whom FOB was done ranges from 14 years to 70 years and males account for the majority. They undergo biopsies for 57 patients and half of the results (28/57) were normal while the remaining half shows malignancies (primary lung cancer in 21 patients and secondaries in 3 patients, and inflammatory changes were seen in 5 patients). The overall diagnostic yield was only 21% with the justification they made being rarity of lung cancer in Ethiopia by that time, limited imaging techniques (there were no lung CT scan, angiography or mediastinoscopy modalities and limited availability of laboratory services like bacteriology and cytology). The only identified complication was haemoptysis which occurred on one patient after transbronchial biopsy. (4)

Another unpublished 1-year retrospective survey done in our hospital, TASH, which was done a decade ago to assess the indications and diagnostic yield of FOB on 141 patients undergoing FOB in 2013. The average age was 44 years, with males accounting for majority of the cases.

Indications for FOB included lung mass (54%), TB (13%), and pleural effusion with suspected underlying lung cancer (9%). 75 patients underwent transbronchial and/or endobronchial biopsies and from these almost half of them were diagnostic, with 68% of those were found to have malignancies and 21% of the biopsies had inconclusive results. The overall diagnostic yield was 48% for histopathology diagnosis and 33% for bronchoalveolar lavage (BAL) alone, increasing to 75% when combining the two techniques together excluding the overlap. This diagnostic yield was higher than a previous study done at TASH four decades ago, which had an overall diagnostic yield of only 21%. (5)

Diagnostic yield of bronchoscopy

A study in USA aimed to assess the factors influencing the diagnostic yield of flexible fibreoptic bronchoscopy (FOB) in cases of solitary pulmonary nodules (SPNs). The study analysed bronchoscopies performed over 4 years on 177 patients with pulmonary nodules. Among the 177 patients, there were 151 malignant lesions. The diagnostic efficacy of FOB was higher (64%) for malignant lesions than for benign lesions (35%). Lesion size and location was identified as the strongest determinants of diagnostic yield in bronchoscopy, with lesions smaller than 2 cm, especially located in the outer third of the lung, had a lower diagnostic yield and alternative diagnostic approaches may be more suitable in such cases. Lesions located centrally (central one-third of the chest based on chest CT scan findings) had a higher diagnostic yield (82%) as compared to the 53% yield in peripheral lesions (peripheral one-third). all worked together to increase bronchoscopy yield. The overall diagnostic yield has increased while using bronchial Washing, brushing, and transbronchial biopsy suggesting their complementary roles in enhancing bronchoscopy outcomes. (17)

Another, larger prospective study on patients from 15 different centres in USA with 22 physicians and done using the AQuIRE (ACCP Quality Improvement Registry, Evaluation, and Education) registry done to assess the diagnostic yield of FOB for peripheral lesions. The overall diagnostic yield of FOB for peripheral lesions was 53.7% and its sensitivity for lung cancer was higher 60-74%. The diagnostic yield varied depending on techniques. Their data also revealed that advanced imaging and guidance with electromagnetic navigation (EMN) were associated with lower diagnostic yields, while the use of peripheral transbronchial needle aspiration (TBNA) was linked to improved diagnostic yield. In general, factors like TBNA, larger lesion size, non-upper lobe location, and tobacco use increased the diagnostic yield. Complications occurred in 2.2% (13 of 581) of subjects, which include pneumothorax, bleeding, and respiratory issues and smaller lesion size was found to be associated with increased risk of complications. What makes this study unique was its involvement of multiple centres despite significant variations existed between centres and physicians regarding lesion size biopsied, tissue sampling methods, anesthesia methods and their diagnostic yields. (18)

Prospective research done at a tertiary care centre in China from 1995 to 1997 period with the aim of investigating the diagnostic yield of different bronchoscopic sampling methods for the diagnosis of lung cancer collect data form 100 consecutive bronchoscopies during the study period and analysed participants' age, gender, bronchoscopic findings, TNM staging, radiological results, histological typing, and finally their diagnostic yield. Results indicated that the diagnostic yield of biopsy for lung ca was 78%, while it was 69% for BAL, and 62% for brushing. But since they have done BAL on all the 100 patients while biopsy and brushing are not on some patients, the overall diagnostic yield of BAL was found to be superior than the

others and the cumulative diagnostic yield with all the three techniques for confirming lung cancer was 85% and the remaining 15% of patients with suspected lung ca will rely on other possible diagnostic modality. Additionally diagnostic yield of BAL was not significantly affected by the age, gender, location of the tumor making it a beneficial diagnostic sampling method according to their study. But additional studies may be needed for its confirmation since their sample size is also relatively small. (19)

Another study in Singapore done retrospectively on 503 patients diagnosed with lung cancer to assess the diagnostic yield of different bronchoscopic sampling methods highlights the diagnostic yield of FOB in the diagnosis of lung cancer. The study found that the overall diagnostic yield of FOB in the diagnosis of lung cancer was 71.2%. Those with cancers visible through endoscopy had a greater overall diagnostic yield (83.2%) than those whose malignancies were not visible through endoscopy (43.6%). Furthermore, compared to bronchial washings and brushings, endobronchial biopsies produced a higher diagnostic yield in patients with visible central tumors. The diagnostic yield of transbronchial biopsy (TBB), blind brushing, and bronchoalveolar lavage (BAL) in patients with endoscopically non-visible peripheral malignancies was also included in the study BAL was found to be the most effective procedure for non-visible tumors, with a 35.5% yield. The study came to the conclusion that, for patients with lung cancer, the diagnostic yield of various bronchoscopic sampling techniques depends on whether the tumors were visible under a bronchoscope and where those lesions are located; it is not dependent on the lobar distribution for tumors that are not visible under a bronchoscope. The study also discovered that, since transbronchial needle aspiration (TBNA) has been demonstrated to boost diagnostic yield, the diagnostic yield of flexible bronchoscopy operations may have been higher had TBNA been used. (20)

From a study done in Toulouse, France, in 2017 by reviewing retrospectively all the patients who are diagnosed with lung cancer, and who underwent FOB as first line diagnostic method. Bronchoscopy including more modernized methods like (ENB) electromagnetic navigation bronchoscopy and radial-probe EBUS (RP-EBUS) were used to diagnose lung cancer in 89% of the individuals (333/377). RP-EBUS was done under general anesthesia for majority of patients and had a diagnostic yield of 76%. Adenocarcinoma was the main malignancy identified accounting for 54% followed by squamous and then small cell carcinoma. Cases that were not diagnosed by bronchoscopy were identified using CT-guided biopsy (6%), surgery and other and there were patients who were treated without confirmatory histology. (21)

Usage and safety of bronchoscopy in special group of population

A study conducted in the San Antonio Military Health System in USA reviewed 73 bronchoscopies performed on patients aged 85 years and older, comparing their outcomes with a control group of patients aged 65 to 79 years focusing on procedural complications, diagnostic yield, and subsequent treatment. While patients aged 85 and older had more comorbidities, there was no difference in anaesthesia utilization also. Malignancy was the most common diagnosis, with comparable diagnostic yields across the age groups. The study concluded that despite concerns, FOB is as safe and useful in the very elderly (aged 85 and older) as it is in the elderly population aged 65 to 79 years. Further studies are needed to explore the risk of FOB in high-risk patients and the role of general anaesthesia in these cases**.** (22)

From a study done in Turkiye, to assess the safety and utility of FOB on patients aged 75years or more a total of 272 individuals underwent bronchoscopy operations over two years period,

additionally they also try to assess the role of Charlson Comorbidity Severity Index (CCSI) for predication of complications if any. The mean age was 78.5±3.8 years with males accounting the majority of patients; and most of the patients have one or more comorbidity and were taking one or more medications. They described its safety with the overall complication rate of 5.8% with similar complication rate being seen among both patient groups with low and high Charlson Comorbidity Severity Index (CCSI). Only one patient experienced respiratory acidosis and hypoxia, necessitating non-invasive mechanical ventilation and there was no mortality. The drawbacks of the study were aside from the CCSI they don't include the types of medicines taken for the comorbidities, nutritional condition, body mass index, and, other potential factors which may contribute for the complication rate. (23)

The routine use of bronchoscopy in COVID-19 patients has been advised against due to its aerosol-generating nature. From a review of 9 retrospective and 3 prospective studies on utility, diagnostic yield and safety of FOB in COVID-19 patients involving 1,345 COVID-19 patients on whom 2,245 bronchoscopies were done, unlike in no COVID patients most of the indications were therapeutic (62%) while 38% were diagnostic. Notably, BAL sample detected the virus in 33.1% of cases on whom nasopharyngeal PCR results were negative. Antibiotics were adjusted in a significant portion of patients based on bronchoscopic findings. Most patients tolerated the procedure well, but those on non-invasive ventilation had a 60% intubation rate post-procedure. Importantly, with proper protective measures, the risk of SARS-CoV-2 transmission to healthcare workers was low. The review suggests that bronchoscopy can be beneficial for both diagnostic and therapeutic purposes in COVID-19 patients with low transmission rate when precautions are taken. (24)

In conclusion, most of the literatures from developing countries show a lower clinical usage of FOB in their clinical practices despite it be a safe procedure even in older aged individuals.

4. Objectives of the study

4.1.General objective

To assess the overall indication, diagnostic efficacy and safety of fibreoptic bronchoscopy (FOB) in patients at Tikur Anbessa Specialized Hospital between December 2021 and November 2023.

4.2.Specific objectives

To determine the number of FOB procedures done.

To assess the indications for performing FOB procedures conducted at Tikur Anbessa Specialized Hospital between December 2021 and November 2023.

To assess the overall diagnostic efficacy of FOB in terms of identifying specific respiratory conditions or diseases.

To analyse the safety or complications associated with FOB procedures during the specified timeframe.

5. Research Methods and materials

5.1.Study Area

The study is conducted in the Tikur Anbessa specialized hospital (TASH), which is found in the capital city of Ethiopia, Addis Ababa. It is the largest specialized hospital in Ethiopia and a referral center for patients from all over the country. The pulmonary and Critical care division is staffed with eight consultant seniors who possess speciality in Internal Medicine and have undergone additional sub-speciality training in Pulmonary and Critical Care Medicine (PCCM). Additionally, the unit comprises two second-year and four first-year PCCM fellows. Bronchoscopy is a crucial competency that PCCM fellows are required to master before completing their training, alongside other essential requirements. The bronchoscopy team operates within the pulmonology division, with procedures conducted by senior PCCM fellows under the supervision of senior consultants. Each procedure is further supported by two well trained nurses.

5.2.Study Period

The study is conducted from November 2023 to February 2024. It includes all patients who have undergone FOB from December 2021 to November 2023.

5.3.Study Design

The study is an institution-based retrospective cross-sectional study done in Tikur Anbessa specialized hospital.

5.4.Study Population

5.4.1. Source population

All patients age ≥14 years who underwent FOB in Tikur Anbessa specialized hospital during the study period. Since patients who are 14 years old or more are seen in adult clinics and are included.

5.4.2. Study population

All patients who undergone FOB in Tikur Anbessa specialized hospital during the study period and fulfil the inclusion criteria

5.5.Sample size

Sample size determination is not needed since all patients who undergone FOB in the study period are included as one of the study's objectives is to see the overall usage of FOB during the study period. The rationale behind the selection of the December 2021 to November 2023 time frame is based on the fact that our hospital's electronic medical record system was implemented five years ago, a year prior to the onset of the COVID-19 pandemic. During the interim period, there was a noteworthy disruption in bronchoscopy services. We assumed that including time frames preceding the designated period might not yield real-time data due to the aforementioned interruptions. Furthermore, considering the likelihood of a substantial recovery and stabilization phase in the healthcare system and medical practices following the impact of COVID-19, evaluating the efficacy of bronchoscopy during this specified period is anticipated to offer valuable insights into how the medical community has adjusted and incorporated diagnostic tools in the post-pandemic landscape

6. Study variables

- ✓ Usage of bronchoscopy

- ✓ Diagnostic yield/efficacy
- ✓ Complications/safety of bronchoscopy

- Age
- Sex
- Smoking history
- Comorbidities
- HIV status
- Bronchoscopic sampling methods
- Suspected disease condition
- Platelet count
- Coagulation profile
- And if findings are suggestive of malignancy
    - Tumor visibility
    - Location
    - Size

7. Eligibility criteria

7.1. Inclusion criteria

All patients age ≥14 years who underwent FOB in Tikur Anbessa specialized hospital during the study period. Since patients who are 14 years old or more are seen in adult clinics and are included.

7.2. Exclusion criteria

Patients who undergo FOB but the bronchoscopy reports are completely lost

NB- data from patients with incomplete bronchoscopic and or pathologic reports are included with its limitation.

8. Operational definitions

- Fiberoptic Bronchoscopy (FOB): A medical procedure that utilizes a thin, flexible tube with a light and camera to visualize the inside of the airways and lungs, as well as used to collect tissue samples or perform therapeutic intervention when indicated.
- Diagnostic efficacy (diagnostic yield): The proportion or percentage of FOB procedures that successfully identify a specific suspected respiratory condition or disease based on the samples or observations taken during the procedure.
- Usage of FOB: The overall usage, and practical value or benefit derived from performing FOB in terms of its contribution to patient diagnosis, management, or treatment decisions.
- Indications for FOB: suspected medical conditions which are not yet confirmed that prompted clinicians to recommend or perform FOB on a patient during the study period.
- Complications: Any unintended or adverse events, reactions, or outcomes associated with the FOB procedure as recorded in the patient's medical records.
- Therapeutic Interventions: Medical procedures or treatments performed during the FOB procedure to address identified abnormalities, such as clearing airway obstructions or administering medications directly.

- Lung Cancer: A malignant tumor that originates in the tissues of the lungs, characterized by uncontrolled growth of abnormal cells which may form masses or nodules within the lung tissue, potentially impairing normal lung function and sometimes may be visible on bronchoscopy

9. Data collection and procedures

Data was collected after obtaining waiver from the Institutional Review Board. Structured questionnaires were developed with Kobo toolbox software by the primary investigator and used for data collection, which is conducted by the primary investigator and two other trained clinicians. The questionnaire includes the sociodemographic data, smoking status, HIV status, comorbidities, bronchoscopic findings and laboratory findings from pathology, cytology and microbiology. The questionnaire was pre-tested on ten patients and amendments were done when found necessarily. The primary investigator supervises the process of data collection for accuracy. The data collected is a secondary data from the patient's medical records, bronchoscopy reports and pathology reports.

10.Data processing and data analysis

After the data is revised and checked for correctness and consistency, it was transported in excel format and entered into the SPSS Version 26 software. The data is then summarized by tables and graphs for each variable. Measured variables are expressed by descriptive statistics in terms of frequency, mean, percentage and standard deviation.

11.Ethical clearance

Waiver was obtained from the Institutional Review Board (IRB) of the Department of Internal Medicine, College of Health Sciences, Addis Ababa University. All data and information collected during this research were anonymised.

12. Quality Assurance

Data is collected with a pretested structured questionnaire by the primary investigator and two trained clinicians. The quality of the data is assessed by the primary investigator for accuracy and completeness. A pre-test was done before starting official data collection to clarify any queries on the check list.

13.Results

13.1. Patient socio-demographic characteristics

In this study, a total of 227 bronchoscopies were conducted over a span of two years. , Complete records were available for 205 of these procedures for the analysis. Among these, 107 (52.2%) were male. The median age of individuals undergoing Flexible Bronchoscopy (FOB) was 43 years, spanning an age range of 14 to 81 years, with a mean age of 43.63 (± 16.43) years.

Table 1: **Patient Socio-demographic characteristics**

Variables	Frequency	Percentage
Male	107	52.2
Female	98	47.8

Age		
<18	Male-3 Female-6 Total-9	1.46 2.93 4.39
[18-30)	Male-18 Female-17 Total-35	8.78 8.29 17.07
[30-40)	Male-31 Female-20 Total-51	15.12 9.76 24.88
[40-50)	Male-19 Female-16 Total-35	9.27 7.80 17.07
[50-60)	Male-16 Female-15 Total-31	7.80 7.32 15.12
[60+	Male-20 Female-24 Total-44	9.76 11.70 21.46
Address		
Addis Ababa	75	36.6%
Out of Addis Ababa	130	63.4%

13.2. Disease Risk Factors/comorbid disease Conditions

Among those 205 patients, the HIV serostatus is determined in 108 cases (52.68%), from these 11 (10.2%) were HIV positive. Smoking status was known in 177 (86.35%), from these 22 (12.43%) were smokers. From those patients with smoking history half of them (11) are current smokers and the remaining half (11) are ex-smokers. And the average amount of cigarette smoked was 18.41(± 17.03) pack years. The occupational status of the majority of patients is not mentioned 149 (72.68%) while it was mentioned in 55 (26.83%) of patients. A total of 167 cases (81.46%) had INR determination and from them 164 (98.2%) had INR of <2. And the remaining 3 (1.8%) has an INR of 2-3. A total of 196 (95.6%) of the cases has known platelet number before the procedure (i.e., has CBC determination) and from those with CBC determination, the platelet count was >50,000 in 194 (98.97%) patients.

Table 2: Disease Risk Factors and comorbid disease Conditions

Smoking condition	Frequency	Percentage
Unknown/Not Documented	28	13.65
Known smoking status	177	86.35
From those with known status (177)		
Yes	22	12.43
No	155	87.57
From those who are smokers (22)		

Current smokers	11	50
Ex-smokers	11	50
INR Value		
<1.2	59	28.78
1.2-2	105	51.22
2-3	3	1.46
not done	38	18.54
Platelet count		
<50,000	2	1.02
50,000-100,000	11	5.61
>=100,000	183	93.37
Comorbid diseases		
None	100	48.78
HTN	29	14.15
Bronchiectasis	24	11.71
DM	14	6.83
Asthma	12	5.85
HIV	12	5.85
TB	4	1.95
COPD	3	1.46
Others	51	24.88

About half of the cases whom underwent FOB has one or more comorbidities 105 (51.2%), the major comorbidity identified was HTN which is seen in 29 (14.15%), followed by bronchiectasis in 24 (11.71%), DM in 14 (6.83%), while asthma and HIV were seen in 12 (5.85%) of patients each. Tumors including benign and malignant ones were seen in 10 patients which include lymphomas, lung cancer, breast cancer, meningioma and other soft tissue tumors. Four individuals previously diagnosed with TB underwent bronchoscopy due to a lack of significant improvement or the recurrence of symptoms. Among them, two were confirmed to have TB through molecular testing, while the remaining two were clinicaly diagnosed. One patient clinically diagnosed with disseminated TB to the lung and pericardium, but was not improved and FOB was also normal then later found to have right atrial mass on echocardiography, and cardiac angiosarcoma with pericardial and lung metastasis was the consideration but patient lost follow-up before diagnosis was settled. The bronchoscopy on the

other clinically diagnosed case was similarly due to lack of improvement and then determined to be adenocarcinoma of the lung after TBBx pathology analysis. Among the confirmed tuberculosis cases, one experienced symptom recurrence and FOB showed inflammatory changes of the mucosa with increased secretion, BAL culture showed bacterial superinfection, while the other patient was found to have atelectasis.

Pre procedure sputum molecular test for Tuberculosis by GeneXpert MTB/RIF assay was done in our hospital for 163 (79.52%) of patients and it was negative in 161 (98.77%) and positive in 2 (1.23%) of the tested cases. While 40 of the total cases (19.51%) had no determination.

13.3. Bronchoscopy indications and findings

From all the FOBs done 190 (92.68%) has a first time FOB while it was a second time in 15 (7.32%) of the cases. FOB without EBUS was done in 186 (90.73%) while EBUS was done on the remaining 19 (9.27%) of the cases.

The commonest preprocedural consideration or the indication for FOB was suspected mass or malignancy which is seen in 94 (45.85%) of cases, followed by Tuberculosis accounting for 58 (28.29%), and then airway inspection 28 (13.66%) which are done for a number of considerations including to see complications after lung surgery, treatment response, for those with persistent cough, to take BAL samples for dried sputum, tracheal structural diseases (tracheal stenosis, tracheoesophageal fistula, vocal cord inspection, tracheal, suspected polyp). Haemoptysis was the indication in 17 (8.29%), sarcoidosis in 11 (5.37%), recurrent pneumonia in 7 (3.41%), foreign body in 6 (2.93%). There are also other indications including aspergilloma, suspected metastasis, suspected fungal infections, eosinophilic pneumonia and others. There are also cases with more than one pre-FOB consideration like suspected cancer and TB for example. From those 94 cases with suspected malignancy, the tumor was visible in 34 (36.17%), while it was not directly visible in 60 (63.83%). But there were indirect signs such as narrowed segment from external compression. And the commonest site was right upper lobe in 16 patients, left upper in 12 patients, left lower in 4, and right middle in 2 patients.

13.4. Gross bronchoscopic findings

In the presented data, mucosal abnormalities and inflammatory changes were the most commonly seen gross bronchoscopic findings, accounting for 61 (29.76%) of cases. The second most common category was normal findings, comprising 60 (29.27%) of the cases. Endobronchial mass or tumor and extrinsic compression/narrowed segment were also notable in 34 (16.59%) and 29 (14.15%), respectively. In cases where endobronchial ultrasound (EBUS) was involved, lymphadenopathies (LAPs) were detected in 13 cases comprising 6.34% of all the findings but it is the commonest finding of EBUS comprising 13/19 (68.42%) of the findings. Increased secretion was seen in 19 (9.27%) and other less common identified conditions or pathologies were categorized as "Others" representing 19 (9.27%) of the cases and these include bleeding in 7(3.41%), foreign body in 3 (1.46%), tracheal stenosis in 5 patients, while vocal cord partial paralysis, tracheal polyp, and other remaining findings were in 1 patient each. Overall, these results highlight the diverse nature of bronchoscopic findings, ranging from inflammatory changes to structural abnormalities, with mucosal abnormalities being the most prevalent. The described mucosal abnormalities include erythematous airway and friable mucosa.

Table 3: Bronchoscopy indications and Gross findings

Variable	Frequency	Percentage
Preprocedural consideration/Indication		
Lung mass/suspected malignancy	94	45.85
TB	58	28.29
Other	18	8.78
airway inspection	28	13.66
Hemoptysis	17	8.29
Sarcoidosis	11	5.37
Pneumonia/recurrent	7	3.41
Foreign body	6	2.93
General Gross bronchoscopic findings		
Mucosal abnormalities/inflammatory changes	61	29.76
Normal	60	29.27
Endobronchial mass/tumor	34	16.59
Extrinsic compression/narrowed segment	29	14.15
LAPs (if it was EBUS)	13	6.34
increased secretion	19	9.27
Others	19	9.27

13.5. Safety of bronchoscopy

From the total 205 case 12 (5.85%) had minor complication and 2 cases (0.98%) had pneumothorax as a major complication. The remaining 191 (93.17%), are free of complications. Among the documented complications, minor bleeding form biopsy site, hypertension (HTN), and hypoxemia were each identified in 1.95% of instances (4 cases each). Additionally, pneumothorax was observed in 0.98% (2 instances). Two of the HTN cases were immediately corrected spontaneously while 1 patient needed 5mg of hydralazine and the other was corrected by administration of 5mg of diazepam. The minor bleedings have resolved by local adrenaline flushing. The hypoxemias also corrected with supplemental intranasal oxygen

for few minutes. The 2 patients with pneumothorax were transferred to ER and chest tube was inserted. Both of these patients were females with the age of 49 and 50 years and had no comorbidity and the pneumothorax occurred following transbronchial biopsy for suspected lung cancer and the other for suspected TB. The gross bronchoscopy finding on one of the patients was normal while it only shows increased secretion on the other one.

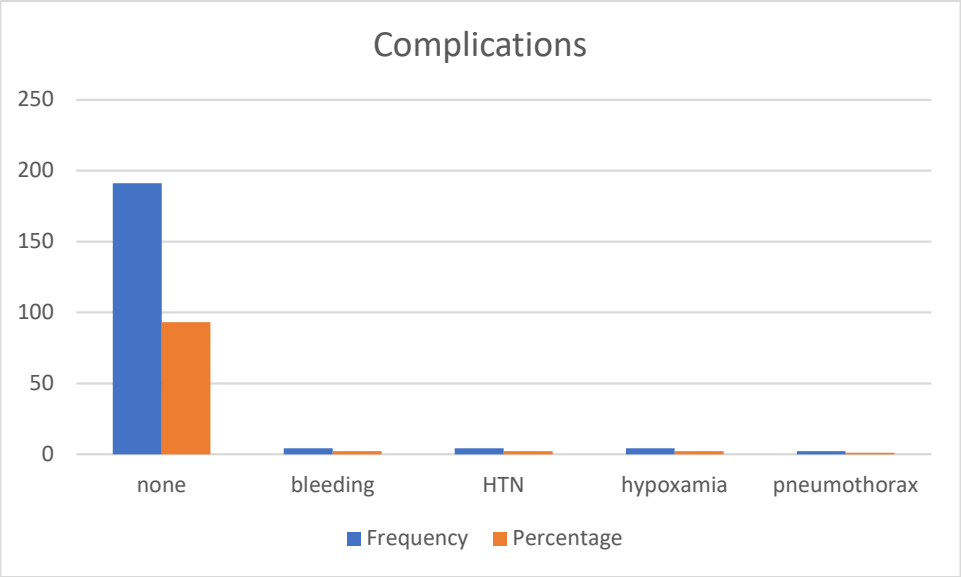


Figure 1: Complications of bronchoscopy

13.6. Samples taken during bronchoscopy and their respective results

13.6.1. Total tests sent from the collected samples

Out of the 205 FOBs conducted, specimen was collected from 178 cases for analysis. A total of 185 fluid samples (comprising 161 BAL, 19 EBUS TBNA, and 5 blind TBNA) were sent for 322 tests, and an additional 77 biopsies (53 TBBx, 21 EBBx, 3 Brush Bx) were sent for pathology, resulting in a cumulative total of 399 diverse tests conducted across all specimen types. From these 399 tests, the predominant diagnostic modality was GeneXpert (GxPert), accounting for 140 tests (35.09% of the total tests done), followed closely by cytology with 138 tests (34.59%). Pathology examinations were performed on 77 samples (19.30%), while culture and Gram stain analyses contributed to 23 (5.76%) and 18 (4.51%) tests, respectively. Fungal stain analysis constituted a smaller proportion with 3 tests (0.75%). In total, 399 diagnostic tests were conducted across these different modalities, encompassing a comprehensive approach to bronchoscopic investigations. See Figure 9-2 and Table 9-4.

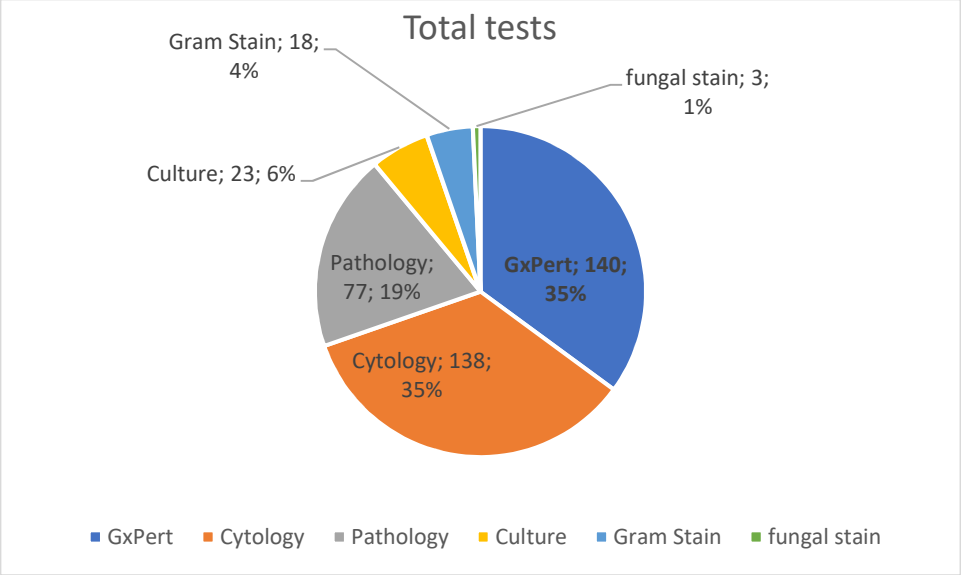


Figure 2: The overall test count from the collected samples (the percentage represents the proportion of tests relative to the total number of tests, i.e., 399).

13.6.2. Biopsy samples

From the 53 Transbronchial biopsy (TBBx) samples which all sent for pathology examination, results were found in 48 of them. In 11/48 (22.9%) cases the analysis shows positive results for malignancy or exhibited granuloma formation (8 and 3 instances respectively. Two of them were noncaseating and their final diagnosis was sarcoidosis; and 1 of them was caseating granuloma and the diagnosis was TB. In another 29 (54.71%) cases, the result was negative for malignancy. Additionally, the results of 8 cases (16.67%) were suspicious for malignancy. In 5/53 (10.41%) of cases results were either not found or were lost during the diagnostic process.

(The identified carcinomas include: 2 Adenocarcinoma, 3 SCC, 1 carcinoid, 1 NSCLC, 1 undifferentiated, 2 non-caseating granuloma (sarcoid), 1 caseating granuloma (TB))

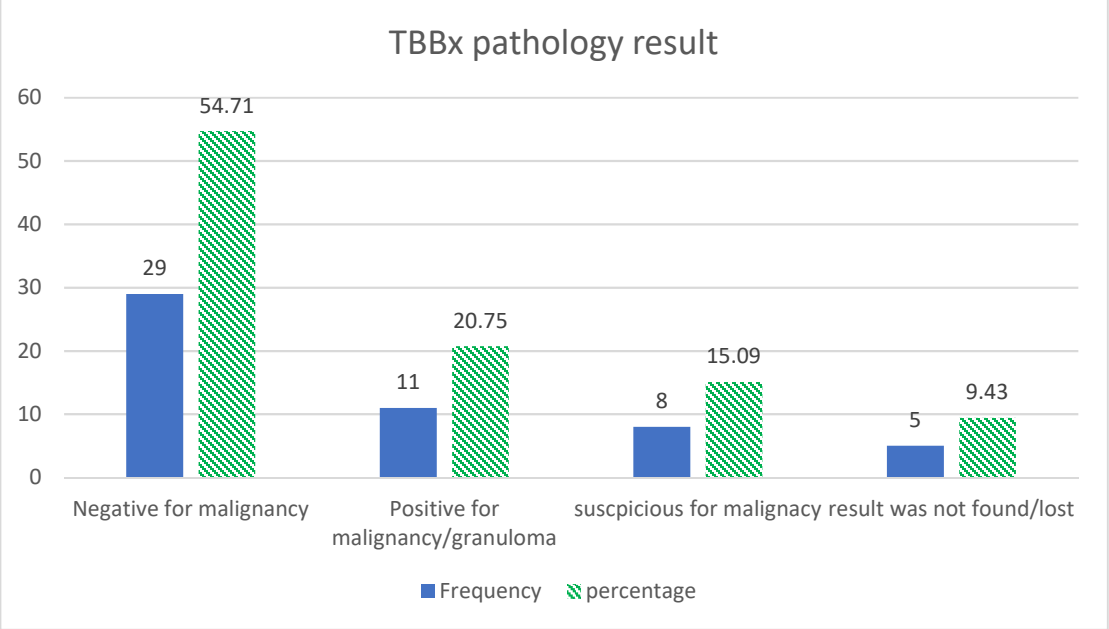


Figure 3: Trans Bronchial Biopsy (TBBx) pathology result

From the 21 endobronchial biopsies, a substantial majority of cases, accounting for 71.43% (15 instances), tested positive for malignancy or exhibited granulomatous formations. In contrast, 19.05% (4 instances) yielded negative results for malignancy. A smaller subset, comprising 9.52% (2 instances), reported that results were either not found or were lost during the diagnostic process. (The identified carcinomas include: 8 adenocarcinoma, 2 NSCLC, 2 SCLC, 1adenosquamous, 1 undifferentiated ca, 1 caseating granuloma (TB))

There were 3 brush biopsy samples 1 of them showing adenocarcinoma, the other result was negative for malignancy and the third one's result was lost.

13.6.3. EBUS guided samples

From 19 EBUS guided TBNA, 3 results were lost, 3 show granuloma (2 TB, and 1 sarcoid), 3 show suspicious for malignancy, 3 suggest lymphoma, 7 were negative.

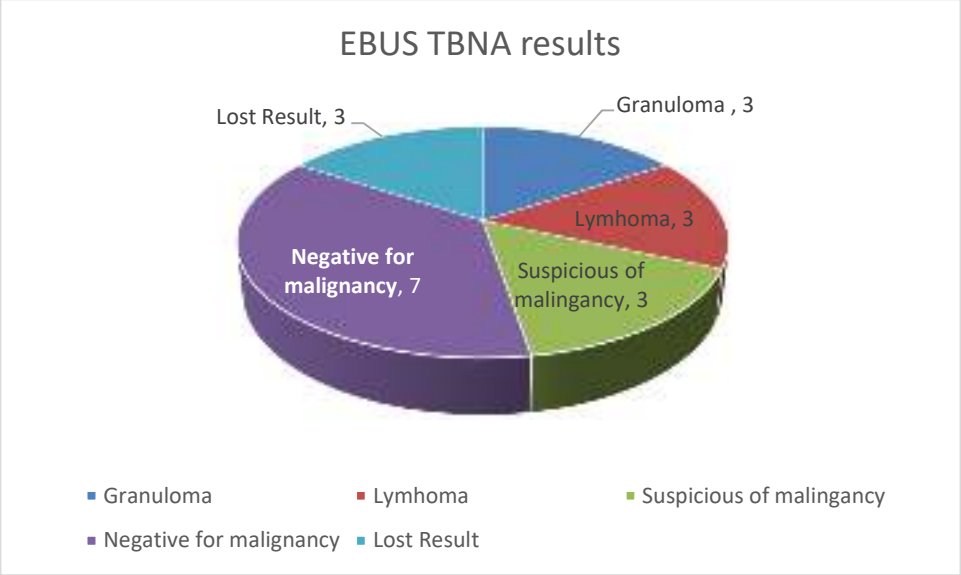


Figure 4: EBUS guided TBNA samples

Table 4: Samples obtained during the procedure and the corresponding tests requested

(The percentage denotes the ratio of tests per total bronchoscopies conducted, i.e., 205)

Variable	Frequency	Percentage
Sample taken during the procedure		
BAL (Bronchoalveolar Lavage)	161	78.54
TBBx (Transbronchial Biopsy)	53	25.85
EBBx (Endobronchial Biopsy)	21	10.24
Brush Bx (Brush biopsy)	3	1.46
Blind TBNA (Transbronchial Needle Aspiration)	5	2.44
EBUS guided sampling	19	9.27
None	27	13.17
Sample sent for tests		
Pathology	77	43.41
GeneXpert	140	68.29
Cytology	138	67.32
Culture	23	11.22

Gram Stain	18	8.78
Fungal stain	3	1.46
none	27	13.17

13.7. Final diagnosis (histological/cytological/microbiological diagnosis)

The most prevalent final diagnosis is lung cancer, comprising 23.41% (48 instances) of cases. Following closely, tuberculosis (TB) was diagnosed in 14.63% (30 instances), representing a significant portion of the cases. Other prevalent conditions include normal findings, accounting for 24.39% (50 instances), and a category labeled as "Other," representing 15.12% (31 instances) of cases which includes lung secondaries, atelectasis, and vocal cord paralysis among others. Sarcoidosis was identified in 5.36% (11 instances), bronchiectasis in 2.92% (6 instances), and carcinoid tumor and tracheal stenosis each in 2.43% (5 instances) of cases. Aspergiloma was diagnosed in 1.95% (4 instances). A cluster of pulmonary conditions, including pneumonias (eosinophilic, necrotizing, HP), and lung abscess collectively accounted for 7.31% (15 instances) of diagnoses. This diverse array of final diagnoses underscores the complexity of pulmonary pathology encountered during bronchoscopic assessments.

Table 5: The final working diagnosis of patients whom undergone FOB

Value	Frequency	percentage
Normal	50	24.39%
Lung cancer	48	23.41%
TB	30	14.63%
Other	31	15.12%
Sarcoidosis	11	5.37%
Bronchiectasis	6	2.93%
Carcinoid tumor	5	2.44%
tracheal stenosis	5	2.44%
Aspergiloma	4	1.95%
pneumonias (eosinophilic, necrotizing, HP) & lung abscess	15	7.32%
Sum	205	100.00%

From those 48 lung cancer cases, a total of 30 cases were confirmed by FOB pathology and histology samples only. Adenocarcinoma was the most prevalent subtype, accounting for 43.3% of cases (13 cases). Squamous Cell Carcinoma (SCC) constituted 20.0% (6 cases). Small Cell Lung Cancer (SCLC) was identified in 13.3% (4 cases). Non-Small Cell Lung Cancer

(NSCLC) was present in 16.7% (5 cases). Adenosquamous and undifferentiated types each constituted 3.3% of the cases, with 1 instance each.

From those 30 cases of TB, 13 were diagnosed by GeneXpert MTB/RIF, 2 were diagnosed by pathology showing caseating granuloma. But only 24 of the suspected 58 TB cases are diagnosed to have TB. The remaining 6 were not suspected before the FOB.

Table 6: histologic types of diagnosed lung cancers

Total no of lung cancer	**48**	
FOB diagnosed lung cancer	30	
Type of lung ca.	Frequency	Percent
Adenocarcinoma	13	43.3%
SCC	6	20.0%
SCLC	4	13.3%
NSCLC	5	16.7%
Adenosquamous	1	3.3%
Undifferentiated	1	3.3%
Total	30	100.0%

All sarcoid suspected (11 cases) cases were found to be sarcoidosis. 45.45% of them (5 cases) are confirmed with pathology showing non-caseating granuloma.

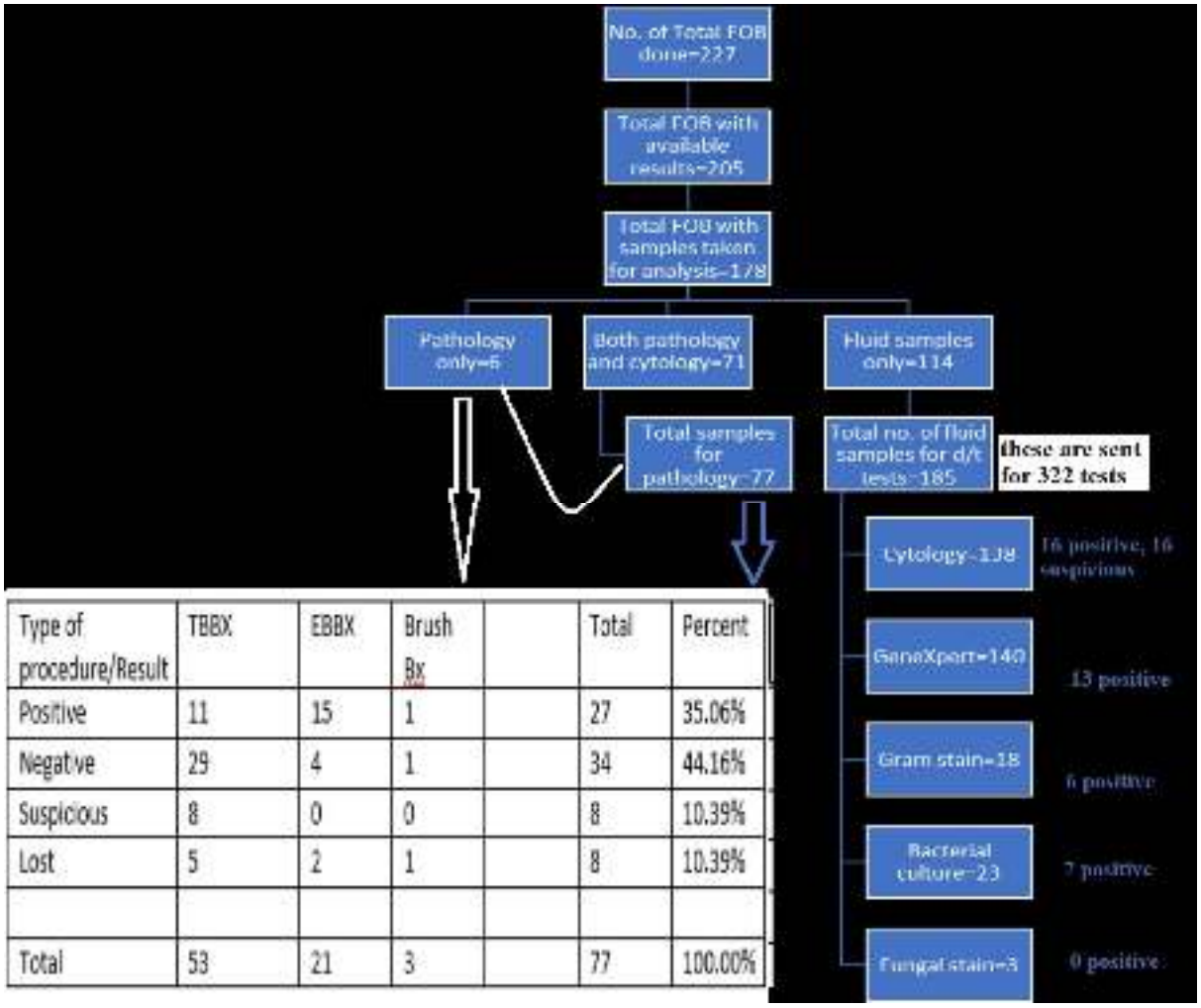
13.8. Diagnostic yield

There were 155 positive diagnoses out of 205 cases giving an overall diagnostic yield of 75.6%. From 77 total biopsies (53 tbbx and 21 ebbx, 3 brush biopsies), 8 results were lost, 27 had positive results, 8 suspicious for malignancy, and the remaining 36 were negative. The diagnostic yield is calculated on those found results excluding the lost ones (5 results from TBBx, 2 results from EBBx and 1 reuslt form brush biopsy). So, the diagnostic yield is calculated on 48 TBBX, 19 EBBX, and 2 Brush biopsy cases). This makes the diagnostic yield of TBBx, EBBX, and brush biopsy to be 20.83% (11/48), 78.94% (15/19), 50% (1/2) respectively. The overall diagnostic yield of biopsy is then 39.13% (27/69) and when those suspicious of malignancy are also included, it become 47.82%.

Cytology has the lowest diagnostic yield for lung cancer that only 16 of the 138 samples were positive for malignancy (11.59%) and additional 11.59% of cases were suspicious. From a total of 322 fluid samples 17 test results were lost and from the remaining 305 tests only 42 had positive finding making its overall diagnostic yield to be 13.77% (42/305).

The diagnostic yield of FOB in general for lung cancer is 51.06% (48 of 94 suspected cases), and this diagnosis is made either by pathology samples confirming the diagnosis or by visual features during FOB with ruling out of other likely causes.

There were 34 cases of macroscopically visible tumors on bronchoscopy, 21 was biopsied, and 19 results are retrieved while 2 were lost and 14 results were positive. The diagnostic yield for TB is 41.38% (24 of the 58 suspected became positive)**.** The diagnostic yield for Sarcoid is 45.45% (5/11).



Type of procedure/Result	TBBX	EBBX	Brush Bx		Total	Percent
Positive	11	15	1		27	35.06%
Negative	29	4	1		34	44.16%
Suspicious	8	0	0		8	10.39%
Lost	5	2	1		8	10.39%
Total	53	21	3		77	100.00%

Figure 5: Flow diagram of FOBs done, Samples obtained during the procedure and the corresponding positive tests, which are used to calculate the diagnostic yields

14.Discussion

On this 2-year retrospective survey, 205 of the FOBs done in TASH are analysed; 97 cases in 2022 and 108 cases in 2023. In this study, we found that 52.2 % of patients whom underwent FOB were male and the overall mean age was 43.6 years which was similar to the studies in Kenya by Bashir et al., Nigeria by Adewole et al., Tanzania by Ndilanha et al., Saudi Arabia by Qanash et al. in which the mean ages were ranging from 51.3 years in Kenya to 54.8 years in Nigeria. (8, 13, 15, 25)

The HIV serostatus of 52.68% patients was known and from those 10.18% were positive in our study while 74% of participants in South African study by Ajayi et al. has known HIV serostatus and 29% of them were HIV positive. This difference may be an indicator of the difference in HIV prevalence in these countries. (11)

Despite lack of evidence for routine determination of platelet count and coagulation profiles, 95.6% of the cases have CBC determination while 81.46% had INR determination. A similarly overutilization of INR determination was seen in Kenya by Bashir et al. (75.9%) while most of the other studies didn't comment on it. But the British Thoracic Society recommends these tests to be done only when there is a suspicion that the test results may be abnormal. (3, 25)

The most common indication for FOB in our study was suspected mass or malignancy which was seen in 45.85% of cases, followed by Tuberculosis accounting for 28.29%, and then airway inspection 13.66%. it is in consistent with the study done in Ghana by Issaka et al., which shows suspected lung cancer as the commonest indication (48.5%) but lower than form Tanzanian study by Ndilanha et al., in which 67.6% of the indications were for lung cancer. And it was a little bit higher from the one seen in Kenya by Bashir et al., (35.7%). The possible explanation for this is that they may be using FOB with a focus on lung cancer diagnosis than other disorders (14, 15, 25)

Pre-procedure sputum GeneXpert MTB/RIF was noted that 79.51% of the cases had it even if there was no consideration of TB. It may be reasonable to consider Tuberculosis in the differential diagnosis in countries like ours but it may also cause a burden by causing scarcity of the test for other patients in need as we recently saw in our country's setting.

The complication rate in our study is 6.83% (14 cases) and most of which (12 cases) are minor complications while only 2 cases (0.98%) had pneumothorax as a major complication and there was no death. While the complication rate was 2.2% from AQuIRE study in USA from which the commonest were pneumothorax, and the complication rate was 3.2 % in Kenya. A lower complication rate of 1.3% was seen in another study in USA by Pue et al.; the explanation for it could be the fact that only a minority of patients had undergone biopsy and the rate of complication specifically on those who underwent biopsy was 6.8%. But an old study from USA by Dreisin et al. in 1978 shows a significantly higher rate of complication (11%) with 1 death, but it was done about 5 decades back and it may suggest the advancement of expertise and the bronchoscopic materials in the current era. In our hospital, those minor complications were managed promptly on the table within the bronchoscopy room while the 2 patients experiencing pneumothorax required a brief ER admission followed by successful and timely management of the complication. It is noteworthy that both these instances of pneumothorax occurred following blind transbronchial biopsy, underscoring the potential advantages of employing ultrasound guidance or fluoroscopy in such procedures. In general, the rate of complications depends on the type of sample done during the procedure and numbers also vary when late complications are included or not. (18, 25-27)

The overall diagnostic yield of FOB in our study is 75.6% which is exactly similar to the unpublished previous study in our hospital which was done 10 years back by Fahmi et al (75%)., but significantly higher than the one done by Teklu B. 4 four decades back (21%) and the one done in Nigeria by Adewole, et al. (62%). Our result is almost similar to the one we saw on Egypt which was 78.6% and Kenyan study by Bashir et al, which was 81.9%. Similarly, the diagnostic yield for malignancy where there was a visible endobronchial tumor was 73.68% which needs some improvement to meet the British Thoracic society's recommendation of attaining diagnostic yield of 85% when there is visible endobronchial tumor. But it is not far from the target and is comparable with results from Singapore by Liam et al. and Kenya by Bashir et al. in which they achieved diagnostic yield of 83.2% and 87.2% respectively when tumor is visible. It is also higher when compared to the study by Adewole, et al. which show diagnostic yield of 54.5% on visible tumors. But is relatively low as compared with studies done in Egypt by Mohamed et al, 94.7%, and Halima et al, 95%. This indicates that there is a room for further improvement. (3, 13, 16, 20, 25, 28)

Cytology has the lowest diagnostic yield for lung cancer that only 16 of the 138 samples were positive for malignancy (11.59%) and additional 11.59% of cases were suspicious. From a total of 322 fluid samples 17 test results were lost and from the remaining 305 tests only 42 were positive making its diagnostic yield to be 13.77% (42/305). A similarly low diagnostic yield for malignancy from fluid samples is seen in Tanzania by Ndilanha et al. and India by Roth et al., that only 9.6% and 6.9% of fluid samples were positive for malignancy respectively. But it was significantly low as compared with the study in Spain by de Gracia et al. which was 33%. This may be due to higher fluid volume (100ml) in their study. Another possible reason for the limited diagnostic yield in our study might be the failure to wedge the bronchoscope adequately into the affected bronchus. This, coupled with the small fluid sample size we are obtaining (10-20ml), could contribute to the reduced effectiveness in obtaining accurate diagnostic results. (10, 15, 29)

Adenocarcinoma was the most prevalent subtype, accounting for 43.3% of cases, which is similar to the findings seen in Tanzania (Ndilanha et al.), France (Mhanna et al.), Kenya (Bashir et al.) in which Adenocarcinoma was the commonest accounting for 33.9%, 54% and 45% respectively. But it is in disagreement with the studies in India (Kshatria et al.), Egypt (Halima et al.) and Saudi Arabia (Alamoudi et al.) which show the commonest histology to be squamous cell carcinoma accounting for 44%, 34.2%, and 61% respectively followed by adenocarcinoma, which occurs in 24% and 17% in India and Egypt. But the second most common histology in Saudi Arabia was small cell carcinoma (22%) followed by adenocarcinoma (13%). This difference is mainly explained by the difference in the proportion of smokers that half of the patients (49% in Egypt and 50% in Saudi Arabia) were smokers while 12.43% are smokers in our study indicating a four-fold difference. These strengths the fact that smoking predisposes for squamus and small cell carcinomas as (7, 15, 21, 25, 28)

The proportion of smokers (current and ex-smokers) among patients with malignancy was 31.25% (15/48) which is similar to the study in Kenya by Bashir et al. which was 36.3% but significantly lower than the Saudi Arabian study by Alamoudi et al., which was 84%, but the main difference we saw was more than 50% of the participants in the Saudi Arabian study were smokers while only 12.43% are smokers in our study. But among those smoker patients, 68.18% (15/22) were diagnosed with lung cancer and the commonest being squamous cell carcinoma on those smokers in our study. So, our study shows that a significant proportion of patients diagnosed with lung cancer are never smokers 68.75% (23/48) which shows risk factors other than smoking are playing a major role in the development of lung cancer.

From the total of 399 tests (77 pathology samples and 322 fluid samples), 25 of the results were not found (8 from pathology samples and 17 from fluid samples) making the loss rate to be 6.27% (25/399). There is also a similar result in Tanzania that 35 of 451 test results (7.7%) were lost. (15)

15.Limitations of the study

Due to its Retrospective Nature, the study relies on existing medical records, and there were some missing data specially on patients smoking condition which prevents us from doing a reliable comparison on corelation of lung cancer diagnosis and smoking condition and there are some missing data on pathology reports. And as it a Single-Center Study, conducted solely at Tikur Anbessa Specialized Hospital, limiting the generalizability of findings to other settings

or populations. The diagnostic yield and usage, safety might vary based on the expertise of the bronchoscopists and the study might not evaluate other potential confounding factors especially for suspected lung cancers since comprehensive evaluations including physician assessed pre-test cancer probabilities are recorded adequately on patient medical records.

16. Conclusion

Our study shows that the commonest indication for FOB is workup of suspected mass. FOB in TASH has a better yield compared to other reports from Africa. The highest yield as expected was when there was a visible mass and coupled with endobronchial sampling. Cytology from fluid analysis has the lowest yield for malignancy. The practice of FOB in TASH is a safe procedure and even though rare, blind transbronchial biopsy has a risk of pneumothorax. The commonest histologic type of lung cancer identified is Adenocarcinoma but it was squamous cell carcinoma among smokers.

17.Recommendations

Indications for FOB can be broaden to include therapeutic indications for advanced malignancies. There is also a need to enhance the diagnostic yield of cytology from fluid analysis for less invasive diagnosis of lung cancer. Utilizing brush biopsy alongside other sampling techniques may further enhance diagnostic yield.

Utilization of fungal studies from FOB samples is very low for a referral hospital with the highest cases of hematologic and solid malignancies.

Measures need to be implemented to minimize sample loss during pathologic examination, emphasizing the importance of obtaining adequate samples and facilitating communication with pathologists to improve diagnostic yields.

Given the demonstrated safety and efficacy of FOB as a diagnostic method, its application is recommended for any patient who may benefit from it.

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19.Annex

Addis Ababa University College of Health Science

School of Medicine Department of internal medicine

Questionnaire

Title of the study: A survey on the clincal usage, Safety and diagnostic efficacy of Fiberoptic bronchoscopy in Tikur Anbessa Specialized Hospital: Retrospective study from Dec, 2021 to Nov, 2023

I- Socio-demographic Information:

1. MRN (Medical Record Number): _____
2. Age: _____
3. Sex:
    A. Male
    B. Female
4. Adress A. Addis Ababa

    B. Out of Addis Ababa

II- Disease Risk Factors/comorbid disease Conditions:

5. PICT (HIV status):
    A. Not Documented
    B. Positive
    C. Negative
6. Smoking History:
    A. Unknown/Not Documented
    B. No
    C. Yes

        5.1. if yes, Quantify it (in pack years) _____

        5.2. current smoker___ ex-smoker___

7. Occupational History
    A. Not mentioned
    B. Mentioned (specify)_____

8. Coagulation profile- since only INR is included on most bronchoscopy charts (INR)
    A. <1.2
    B. 1.2-2
    C. 2-3
    D. >3
9. Platelet count

A. <20,000
B. 20,000-50,000
C. 50,000-100,000
D. >100,000

10. Problem Lists (Choose all that apply):
    A. Asthma
    B. COPD
    C. TB
    D. HIV
    E. HTN
    F. DM
    G. Bronchiectasis
    H. Others: _____
11. Sputum G-Xpert Result:
    A. Positive
    B. Negative
    C. Not Done

III- Bronchoscopy Related:

12. Previous Bronchoscopy (i.e., is it a repeat one)?
    A. Yes
    B. No
13. What Procedure is done?
    A. Bronchoscopy
    B. EBUS (Endobronchial Ultrasound)
14. Pre-procedure diagnostic consideration/Indication for Bronchoscopy (Choose all that apply):
    A. Lung mass/suspected malignancy
    B. TB
    C. Pleural effusion
    D. Pneumonia/recurrent
    E. Sarcoid
    F. Hemoptysis
    G. Foreign body
    H. Airway inspection
    I. Other: _____
    - If the answer for Q-13 is "A" (i.e., if the indication is suspected malignancy or lung mass)
        14.1. Is the tumor visible,
            A. yes
            B. no
        14.2. Where is the exact location (which lobe)?
            A. Right upper
            B. Left upper
            C. Right middle
            D. Left lower

E. Right lower

14.3. What is its size
   A. <=1cm
   B. 1- <=2cm
   C. 2- <=3cm
   D. >3cm

14.4. What is the CT scan report of the location of the tumor?
   A. not done/not documented
   B. central 2/3
   C. peripheral 1/3
   D. involves both central and peripheral areas

15. Gross Bronchoscopic Findings (Choose all that apply):
   A. Endobronchial mass/tumor
   B. Extrinsic compression/narrowed segment
   C. Mucosal abnormalities/inflammatory changes
   D. Normal
   E. Not Documented
   F. Increased secretions
   G. LAP (if it was EBUS)
   H. Others: _____

16. Complications (Choose all that apply):
   A. None
   B. Pneumothorax
   C. Bleeding
   D. Hypoxemia
   E. HTN
   F. Other: _____

IV- Pathology- Histology/Cytology samples and results:

17. Sample/Specimen Collected (choose all that are collected):
   A. BAL (Bronchoalveolar Lavage)
   B. Blind TBNA (Transbronchial Needle Aspiration)
   C. EBUS guided sampling (EBUS guided TBNA)
   D. TBBx (Transbronchial Biopsy)
   E. EBBx (Endobronchial Biopsy)
   F. Brush Bx (Brush biopsy)
   G. None

18. Sample Sent For (select all that apply):
   A. Pathology
   B. Cytology
   C. GXpert
   D. Gram Stain
   E. Culture

F. None
G. Other: _____

19. Pathology Result
    19.1. from TBBx (if it was sent:
        A. Negative
        B. Result was not found or lost
        C. Suspicious for malignancy
        D. Positive
            If Positive, specify type:
                A. SCC
                B. Adenocarcinoma
                C. Small cell carcinoma
                D. Undifferentiated
                E. Granuloma (specify) Caseating__ Non-caseating__
                F. Normal
                G. Others (specify)_____

    19.2. from EBBx (if it was sent):
        A. Negative
        B. Result was not found or lost
        C. Suspicious for malignancy
        D. Positive
            If Positive, specify type:
                A. SCC
                B. Adenocarcinoma
                C. Small cell carcinoma
                D. Undifferentiated
                E. Granuloma (specify) Caseating__ Non-caseating__
                F. Normal
                G. Others (specify)_____
    19.3. From Brush Bx (if it was sent):
        A. Negative
        B. Result was not found or lost
        C. Suspicious for malignancy
        D. Positive
        If Positive, specify type:
                A. SCC
                B. Adenocarcinoma
                C. Small cell carcinoma
                D. Undifferentiated
                E. Granuloma (specify) Caseating__ Non-caseating__
                F. Normal
                G. Others (specify)_____

20. Pathology result
    19.1 Cytology result from blind TBNA including G-Xpert and culture (if sent):

A. Malignancy (specify): _____
B. Negative for malignancy
C. TB
D. Other Bacterial: _____
E. Fungal
F. MTB not detected
G. Suspicious for malignancy
H. Result was not found or lost
I. Culture has no growth
J. Other: _____

19.2 Cytology result from EBUS guided TBNA including G-Xpert and culture (if sent):

A. Malignancy (specify): _____
B. Negative for malignancy
C. TB
D. Other Bacterial: _____
E. Fungal
K. MTB not detected
L. Suspicious for malignancy
M. Result was not found or lost
N. Culture has no growth
F. Other: _____

19.3 Cytology result from BAL/bronchial wash including G-Xpert and culture (if sent):

A. Malignancy: _____
B. Negative for malignancy
C. TB
D. Other Bacterial (specify): _____
E. Fungal
F. MTB not detected
G. Suspicious for malignancy
H. Result was not found or lost
I. Culture has no growth
J. Other: _____

21. Final Diagnosis:
A. Normal
B. Lung Cancer
C. TB
D. Sarcoid
E. Interstitial Pneumonia
F. Bronchiectasis
G. Carcinoid tumor
H. Other: _____

22. Mode of reaching to final diagnosis
A. FOB (guided) samples
B. CT guided Samples
C. Other