BTS Guideline for Diagnostic Flexible Bronchoscopy in Adults

August 2013

Appendix 3 Evidence Tables

- Complications
- Sedation
- Specific conditions
- Infection
- ITU
- Disinfecting
- Diagnostic accuracy
- Patient satisfaction

http://www.brit-thoracic.org.uk/Guidelines/Bronchoscopy-Guidelines.aspx

STUDY IDENTIFICATION / CITATION					TYPE	QUALITY RATING	BIAS	POPULATION CHARACTERISTICS		INTERVENTION	COMPARISON	FOLLOW UP	OUTCOMES	EFFECT SIZE	FUNDING	COMMENTS
AUTHORS	TITLE	YEAR	JOURNAL	CITATION				NUMBER	PATIENT CHARACTERISTICS							
Van Zwam, J. P.Kapteijns, E. F. G.Lahey, S.Smit, H. J. M.	Flexible bronchoscopy in supine or sitting position: A randomized prospective analysis of safety and patient comfort	2010	Journal of Bronchology	29-32	RCT	+	Unknown	N=107 randomised. 4 excluded 1 svt after la 1 no researcher 2 unclear on randomisation position. N=103. Supine: n=46 Sitting: n=57	Supine: Age 64+/-14, Males 28 Females 18, FEV1 2.6L (89% predicted), duration 8.2+/-3.7min, tumour =24,pneumonia=9, other =17 Sitting: Age 63+/-12, Males 28 Females 29, FEV1 2.2L (81% predicted), duration 9.1+/-3.8min, tumour =28,pneumonia=12, other =13	Comfort and safety of bronchoscopy in supine versus sitting position	Desaturation (with and without prophylactic supplemental O2) and comfort (dyspnoea, fear, cough comfort) in sitting and supine positions	Up to 30 min before discharge	Oxygen Saturation and Visual Severity scales for comfort	SaO2>95% in 83% of patients 24% received prophylactic oxygen 52% had SaO2 decrease>4% Oxygen decline of >4% more common in sitting position than supine (35% vs. 68%, RR1.94); if exclude prophylactic oxygen 26% vs. 64%,RR 2.46 Oxygen desaturation <90% more common in sitting position 17% vs. 32%, RR1.88 No difference in cardiac arrhythmia between groups No significant difference in patient tolerance for sitting or supine position	Not reported	
J. S. Park, C. H. Lee, J. J. Yim, S. C. Yang, C. G. Yoo, H. S. Chung, Y. W. Kim, S. K. Han, Y. S. Shim and D. K. Kim	Impact of antibiotic prophylaxis on post bronchoscopy fever: a randomised controlled study	2011	International Journal of Tuberculosis & Lung Disease	528-536	RCT	_	neg	143 72 prophylaxis 71 control 67 and 64 respectively after withdrawals	44 had TB (38.6%) 32 vs. 25% lung cancer	Prophylactic antibiotics (augmentin) 30 minutes prior to FOB temp measured 4 hourly 37.8 within 24 hours Blood cultures and chest x-ray daily if fever	Fever	24 hours	Primary: frequency of fever and pneumonia secondary: change in white cell count, CRP	Incidence	Unknown	Fever 25.4% vs. 26.6% prophylactic vs. control pneumonia 1.5% vs. 4.7% peak frequency at 7 hours
McCain, T. W.Dunagan, D. P.Adair, N. E.Chin, R., Jr.	Prospective randomized trial comparing oxygen administration during nasal flexible bronchoscopy : oral vs. nasal delivery	2001	CHEST	1671-4	RCT	_	Observer bias. unable to blind if oral or nasal delivery. difficult to be sure which direction	N=97 nasal O2 52, oral O2 45	Not recorded, hospital based	Symptom questionnaire premed and IV sedation transnasal bronchoscopy supplemental O2, either oral or nasal at 2l/min to SaO2 94%, increased by 2l every min to max 8L/min	Nasal vs. oral Between treatments	During FOB Not specified but probably no longer than end of procedure	Average O2 sats, lowest O2 sats and maximum O2 flow during FOB O2 saturations and oxygen flow rates, patient factors	Average O2 sats, lowest O2 sats were similar between two groups as were max flow rates. No difference in O2 delivery relative to nasal disease/ congestion	Not provided	Nasal vs. oral no diff in sats but nasal easier
Peacock, A. J.Benson-Mitchell, R.Godfrey, R.	Effect of fibreoptic bronchoscopy on pulmonary function	1990	THORAX	38-41	Cohort	+	Yes	N=31 (21 patients , 10 controls)	N=21 17M 16 COPD with mean FEV1 2.18L; rest fibrosing lung disease FEV1 2.25. mean age 59 (36-75). FOB indicated as part of care e.g.? ca but no obstructing lesion. History asthma and recent infection excluded. 10 controls (6M) non smokers; normal PFT and no allergy or respiratory	Effects of each part of the procedure on spirometric measurements were studied in patients with lung disease and in normal nonsmokers.	Effect of nasopharyngeal anaesthesia on PFTs Effect of major airway anaesthesia on PFTs Effect of bronchoscopy insertion on PFTs Effect of anaesthesia/	20 minutes post FOB	FEV1, Peak inspiratory flow, peak expiratory flow, FVC, SaO2	Topical lignocaine to nasopharynx in 10 controls caused no change in PFTs. When applied to the major airways lignocaine produced a significant fall in FEV (10.2 norm 10.8% pat), FVC (6.5 and 9.1 respiratory), PEF (13.5 and 10.9), and PIF (19.3 and 8.4) in both norm and normal pat subjects (gives CI). Insertion of FOB	Not reported	Fall in PFT after LA most significant rather than FOB insertion

									disease mean age 22(21-23) FEV1 3.9.		bronchoscope insertion on SaO2			caused further fall but only significant in normals PEF(33.1) and pIF(32.9). Fn improved after removal of FOB except FEV1 8%. Control PEF and PIF still reduced(17 and 15%). No effect of small and large FOB. Pattern of fall same for fibrosis. No significant change of art o2 sats. 1. significant change in %FEV1 and %FVC compared to baseline following installation of local anaesthesia and following insertion of bronchoscope in both patients and controls ($p<0.05$) 2. Significant % change from baseline in PEF/PIF in patients and controls ($p<0.05$) following anaesthesia and insertion that remained significantly reduced in controls only following removal of bronchoscope 3. No significant change in SaO2 in patient or controls with anaesthesia or insertion.		
Sharma, S. K.Pande, J. N.Sarkar, R.	Effect of routine fiberoptic bronchoscopy and bronchoalveolar lavage on arterial blood gases	1993	Indian Journal of Chest Diseases & Allied Sciences	03-Aug	Cohort	_	No	N=21	Group 1, n=10, mean age 46 yrs (18-65) 90% Male Indications: Unexplained haemoptysis, suspected cancer Group 2: n=11, 82% Male, mean age 49yr (26-70) Indications: Bilateral diffuse lung diseases including sarcoid, IPF, Collagen vascular disease, military TB and lymphagitis Exclusions: PaO2 <60mmHg, recent MI, cardiac arrhythmia or CCF, hypotension or circulatory failure, FEV1<1000ml	Severity of hypoxaemia during bronchoscopy and BAL	Serial changes in paO2 and paCO2 in Gp 1 and Gp 2.	30 minutes	paO2 and paCO2	Group 1 Group 2 pO2 PCO2 pO2 PCO2 Pre bronch 73+/-12 37+/-9 74+/-8 36+/-4 Premedication 68+/-12 39+/-4 70+/-10 37+/-8 Insertion 71+/-20 35+/-6 63+/-9 36+/-10 During FOB/BAL 60+/-10 35+/-6 58+/-10 37+/-7 Removal 53+/-12 35+/-5 56+/-8 37+/-4 30mins post 57+/-6 37+/-7 63+/-11 38+/-3	Not reported	
Payne, C. B., Jr.Goyal, P. C.Gupta, S. C.	Effects of transoral and transnasal fiberoptic bronchoscopy on oxygenation and cardiac rhythm	1986	ENDOSCOPY	01-Mar	Cohort	_	No	n=20	100% males, Age 57.7 yrs, Range 25-86 Excluded if on oxygen, thrombocytopaenia, uraemia, severe asthma, haemoptysis, bleeding diathesis Transnasal n-8, transoral n=12	Effect of transnasal and transoral fibreoptic bronchoscopy on cardiac rhythm and oxygenation	Holter ECG and ABG between transnasal and transoral approach	Not recorded	Holter rate and rhythm 12hours before and after and during FOB. ABGs one hour before premed, when inserted and 5mins and 2hours post FOB. In n=13 samples obtained when FOB removed.	PaO2 values for transnasal significant higher $p<0.05$ than oral. No diff in cardiac arrhythmia between groups, 60% prevalence of minor arrhythmia w 5% new. Lower PaO2 in oral group but no diff in sats or arrhythmia Transoral Transnasal PaO2 69.6 +/- 6.6 70.4 +/- 13.7 PaCO2 37.7 +/- 2.6 39.8 +/- 3.4 pH 7.44 +/- 0.03 7.43 +/- 0.03 SaO2 93.6 +/- 1.5 92.8 +/- 3.4 No differences in cardiac rhythm	Not recorded	
Meghjee, S. P.Marshall, M.Redfern, E. J.McGivern, D. V.	Influence of patient posture on oxygen saturation during fibre-optic	2001	RESPIRATORY MEDICINE	05-Aug	Cohort	+	Yes	Supine Group 1 (n=20, 5 withdrawn) Semi recumbent Group 2 (n=18, 5 withdrawn)	Group 1 Group 2 Age FEV1 Age FEV1 F 67.8 [9.1] 1.37 [0.51] 74.8 [4.6] 1.17 [0.42] M 59.6 [12.6] 2.24 [0.85] 68.9 [8.53] 2.00 [0.61]	Effect of posture on hypoxaemia during bronchoscopy and influence of supplemental oxygen	Peak, trough and plateau oxygen saturation in different postures, and	During FOB	Measured peak, trough and plateau sats. During sedation, intro of FOB to	Trough arterial oxygen saturations fall significantly with sedation in both groups ($p<0.001$) but no significant difference in saturations between the	Not reported	

	bronchoscopy										in relation to sedation and presence of bronchoscope		trachea, adding supplementary O2 and changing position.	supine and semi recumbent group. Supplemental oxygen associated with significant increase in oxygen saturations in both postures (p<0.001). Similar results demonstrated using peak and plateau saturations but data not shown. Confidence intervals included in bar charts not numerically		
Bechara, R.Beamis, J.Simoff, M.Mathur, P.Yung, R.Feller-Kopman, D.Ernst, A.	Practice and complications of flexible bronchoscopy with biopsy procedures	2005	Journal of Bronchology	139-142	Cohort	+	Yes	300	18 years or over Median age 66.4 (38-88) 60% males 82% white Hispanic 1.7% Black 14% Asian 1.3% 6% non smokers; 60.3% previous 33.7% current 67% respiratory disease 15.7% lung Cancer 6% dermatological disease 25.7% Endocrine disease 4.7% autoimmune 22.7% neuromuscular 59% cardiovascular 11.4% CNS Capable of giving informed consent Able to attend follow up meetings Life expectancy of at least 6 weeks Suspected of having bronchogenic cancer or history of completely resected stage 1 or 2 cancers with symptoms suggesting recurrence.	Complication rate of FOB	AF system in WL mode versus AF mode	5-14 days post procedure visit	Complication rate	300 sample size for 80% power for 20% or greater difference in sensitivity for AF FOB.	Not stated	Multicentre prospective US study. Higher mortality but previous studies retrospective and may be underestimates due to under reporting and non inclusion
Georgiades, G.Myrianthefs, P.Venetsanou, K.Kythreoti, A.Kyroudi, A.Kittas, C.Baltopoulos, G.	Temperature and serum proinflammatory cytokine changes in patients with NSCLC after BAL	2003	LUNG	35-47	Cohort	+	Yes	30 patients 15 healthy volunteers	Patients: mean age 63, 57% male, 88% smokers, average 55 pack years, 57% cardiorespiratory comorbidity Undergoing FOB for haemoptysis+/- radiographic abnormalities Controls: mean age 37, 53% male, 80 smokers, average 25 pack years, no comorbidity or symptoms 30 adults requiring FOB and BAL for diagnostic purposes: minor haemoptysis and radiographic change, suspected to have lung cancer. 15 healthy controls Exclusions: <18; recent or current infection; known or suspected diffuse inflammatory lung disease; using immunomodulatory drugs oral or inhaled steroids. Patients: mean age 63, 57% male, 88% smokers, average 55 pack years, 57% cardiorespiratory comorbidity Undergoing FOB for haemoptysis+/- radiographic abnormalities Controls:	Effect of BAL on body temperature and serum cytokines	Differences in clinical examination, axillary temperature, haemodynamics, gas exchange at baseline, 4h and 24 hr post BAL. Differences in CXR from baseline and at 24h post BAL Differences in total WBC and differential, blood cultures and serum proinflammatory cytokines at baseline, 4h and 24h	24hours	Differences in clinical examination, axillary temperature, haemodynamics, gas exchange at baseline, 4h and 24 hr post BAL. Differences in CXR from baseline and at 24h post BAL Differences in total WBC and differential, blood cultures and serum proinflammatory cytokines at baseline, 4h and 24h	No change in lung sounds No change in oxygen saturations or haemodynamics at 4 or 24h compared with baseline No new radiological findings at 24h compared with baseline Significant increase in body temperature at 4 and 24h compared with baseline (p<0.05, absolute values not given) Significant increase in serum TNFalpha at 4 and 24h after BAL, and in IL6 at 4h after BAL (p<0.05) No significant change in total or differential WBC between baseline, 4h or 24hr (no data provided) No significant changes seen in controls	Not described	None had additional lung sounds,SaO2 or haemodynamic change. BAL associated with stat significant increase in temp 36.6% 1 degree 4(13.3% 38 degree. and systemic production of TNF, IL6 not IL1. Only those with rise in temp have increased CKs BAL associated with systemic inflammatory effects and increase in temp

									mean age 37, 53% male, 80 smokers, average 25 pack years, no comorbidity or symptoms							
Smith, M. J.Dhillon, D. P.Hayler, A. M.Holt, D. W.Collins, J. V.	Is fibreoptic bronchoscopy in patients with lung cancer and hepatic metastases potentially dangerous?	1985	British Journal of Diseases of the Chest	368-73	Case-controlled	++	Yes	18 9 hepatomagaly and/or liver dysfunction. 9 controls	Cases Mean age 64=/-4 Males 7/9. Lung cancer (8/9 oat cell), liver dysfunction Controls Mean age 63.8=/-2.6 males 7/9 Lung cancer (4/9 oat cell), no liver dysfunction	lignocaine levels and time to reach peak Effect of liver dysfunction on liignocaine toxicity at bronchoscopy	Current or past liver dysfunction versus no dysfunction	6hrs	Total dose, peak plasma levels, time to peak concentration, % in toxic range	Mean lignocaine dose admin similar in all groups. A,, 325 f 25 mg; A, 3 10 & 10 mg; B 323 + 18 mg. The maximum total dose given to any patient was 410 mg. Over 75% of the total dose was administered within the first 10 minutes None had plasma levels>4. Well below critical toxicity levels. Used 5mg/kg in our patients	Augustus Newman Foundation	
Lin, C. C.Wu, J. L.Huang, W. C.	Pulmonary function in normal subjects after bronchoalveolar lavage	1988	CHEST	1049-1053	Case-controlled	++	Yes	9 FOB only; 9 FOB +25 degree BAL; 9 FOB +37 degree BAL N=27	25-35 year olds presented to outpatient clinic with non specific complaints and all examination, CXR and PFT normal.	Effect of BAL & BALF temp on PFTs	Change in spirometry/ABG before and after BAL stratified by BALF temperature	<24hours	PFTs and ABG	No change in PFTs (FEV1, FVC, PEFR) after bronchoscopy, BAL @25C or 37C Bronchoscopy associated with significant decrease in pa02 94.4+/-4.75 to 85.5+/-7.48, p<0.02 BAL fluid at 25C significantly decreases paO2 – 95.4+/-6.9 to 67.0+/-12.8, p<0.001 BAL fluid at 37C significantly decreases paO2 – 92.3+/-5.5 to 77.4+/-10.6, p<0.001 Significant change in FEF and RV for BALF at 25C but not bronchoscopy or BALF 37C	Not reported	BAL is safe. Causes desaturation but no diff in PFT unless 25 degree. But unusual premed
Van Vyve, T.Chanez, P.Bousquet, J.Lacoste, J. Y.Michel, F. B.Godard, P.	Safety of bronchoalveolar lavage and bronchial biopsies in patients with asthma of variable severity	1992	American Review of Respiratory Disease	116-21	Case-controlled	+	Yes	N=75, 50 cases, 25 controls	50 asthmatics age 18-71 mean 34+/-14 (ATS criteria and 15% reversibility) no current smokers or 2 yrs ex. Excluded if taken theophlline 48hrs before beta agonists withheld for 8hrs. FEV1<35% excluded due to highest risk of complication with BAL Bx. 25 normal non smoking 18-76 44+/- 16 mean. Normal PFTs no allergic disease/asthma. Characteristics of asthma patients: Aas 1 n=6 age 45+/-14 3M 3F FEV1 83+/-2.9; Aas2 n=23 age 30+/-12 8M 15F FEV1 82.1+/-14.2; Aas3 n=12 age 34+/-13 7M 5F FEV1 69.1+/-17.6; Aas4 n=6 age 40+/-17 5M 1F fev1 65+/-19.7; Aas 5 n=3 age 25+/-10 2F 1M fev1 51.5+/-20.5. none had taken steroids in last 2 months. 26 allergics. Mild asthma (n=6) age 45+/-14, M:F 3:3, FEV1 83.0+/-2.9 moderate asthma (n=23), age 30+/-12, M:F 8:15, FEV1 82.1+/-14.2 mod severe asthma (n=12),	Safety of BAL and biopsy in severe asthma, and whether nebulised bronchodilator premedication is required	SaO2 over time in asthma/ controls SaO2 over time according to asthma severity Change in FEV1 pre and post bronchoscopy	3 hours plus phone contact	saturations throughout. PFT before and 5 minutes post.	Tolerance excellent with mild asthma symptoms in 2 with mild-mod Aas2-3 did not require cessation and resolved with neb post fob. 3 patients 2asthmatic and 1 control developed fever and resolved. BAL recovery: 93.5+/-32.8ml 37.5%+/-13.3% in asthmatics vs. 124.2+/-16.8ml (49.6+/-7%) in controls p=0.0008 Asthmatics: Art sats decreased significant from 97(91-99)% T1 to 92(79-98)% T8 after through vs. and procedures. Increased back to 96(85-98%) 5 min after fob but significant lower than at start. No correlation with asthma score, pft,fev1 symptom score or b2 use. Significant correlation between fall in sats and fall in fev1 p=0.0465. No diff in sats fall if FEV1< or >60% or aas< or>4. Controls: significant fall 97% to 93% T1 vs. T8 especially with bal biopsy and increased back to baseline. No diff between asthmatic and controls PFTs: asthmatics: decrease in FVC 86.2+/-14.6% to 64+/-17.1% p=0.0001 FEV1 75.6+/-	Grant no 89 MRD4 from the Fonds Special de Maladies Respiratoires	

									age 34+/-13, M:F 7:5, FEV1 69.1+/-17.6 Severe asthma (n=6), Age 40+/-17, m:f 5:1, FEV1 65.0 +/-19.7 Very severe asthma (n=3), age 25+/-10, M:F 2:1, FEV1 51.5+/-20.5 No prior oral or inhaled steroids for 2 months (except very severe group) Controls age 18-76, median 44, nonsmokers, normal PFTS					16.8% to 55.3+/-17.2 p=0.0002 no decrease in ratio. Fall in fev1 not correlated with basal fev1 or aas score. Falls in fvc,fev1 and fef25-75 were 30.6+/-15.5% , 29.4+/-13.1% and 34.7+/-18.5% respiratory and no different. No correlation with basal fev1, symptom score, aas score and b2 consumption. No difference in falls if fev1< or >60%. Controls: FVC decreased significant 99.6+/-14.3% to 82.3+/-19% p=0.0125 fev1 decreased 97.1+/-14% to 80.3+/-16.2% p=0.0071 ratio no decrease. Percentage falls greater in asthmatics than controls p=0.0121, 0.0124 0.0217 FVC fev1 fef25-75.		
Huang, J. C. T.Bassett, M. A.Levin, D.Mantilla, T.Ghio, A. J.	Acute phase reaction in healthy volunteers after bronchoscopy with lavage	2006	CHEST	1565-1569	Qualitative research	+	Yes	28	(14 men and 14 women; mean age, 24.8 4.8 years). The average height was 169.4 9.2 cm, and the average weight was 74.3 14.1 kg. The average duration of bronchoscopy was 19.3 3.1 min.	Acute phase response after and 24hrs post FOB	None	24hours post FOB	Changes in blood cell values Fe ferritin fibrinogen CRP	Data are expressed as mean SD except where specified otherwise. The two-tailed paired t test was used to evaluate for significant changes immediately after and 24 h after the procedure, adjusted for multiple comparisons using the Bonferroni correction. To determine acute phase reactants associated with changes in WBC count, stepwise multiple linear regression was used to correlate changes in WBC count after the procedure (dependent variable) with changes in CRP, fibrinogen, iron, ferritin, and iron saturation (independent variables). Only linear terms of the independent variables were considered. Both R2 and forward elimination (exit of 0.10) model selection procedures were used to screen the independent variables for significant associations with the dependent variable.	Not known	WBCs, primarily neutrophils, increased by approximately 50%. Fibrinogen increased by 25% while CRP increased by more than sevenfold. Serum ferritin increased by 25% while serum iron, total iron-binding capacity, and transferrin saturation decreased, indicating dysregulation of iron homeostasis. There were no changes in IL-8, ACE, sICAM-1, or nitrite/nitrate plasma levels. Conclusions: Bronchoscopy with BAL induces a variety of acute phase responses that includes peripheral neutrophilia, dysregulation of iron homeostasis, and increased levels of fibrinogen and CRP. Human research that employs BAL may need to consider the biological effects induced by the procedure-related acute phase response.
Matsushima , Y.Jones, R. L.King, E. G.Moysa, G.Alton, J. D.	Alterations in pulmonary mechanics and gas exchange during routine fiberoptic bronchoscopy	1984	CHEST	184-8	Qualitative research	+	Yes	N=35. 15 FOB via ETT. 15 transnasal FOB 5 ETT	Males 13/15 Age 57+/-14 %FEV1 60.4 +/-14.1 Pa02 66.0+/- 7.7 VC 2.96+/-0.97 FRC 2.57 +/-0.74 IM atropine and pethidine, 10% lidocaine spray, 1% lidocaine solution,PFTs in sitting position (pre) and supine (during bronch)	Changes in pulmonary function associated with FOB transnasally and to determine whether the changes in pulmonary function could account for the decrease in Pa02	Measurements are made before examination, during and after	5 min post	VC, FIF, FEV1, SaO2. FRC Change in pulmonary function associated with fibreoptic bronchoscopy transnasally	Decreased VC after ETT and transnasal as well as fEv1. 30% increase FRC. No change PaO2 Control Insertion After exam Removal FEV1 1.93+/-0.78,5.5+/-16.8,81.9+/-21.7,87.0+/-22.6 FEF25-75 1.74+/-1.51,84.6+/-20.6,89.1+/-34.2,81.9+/-35.4 FRC 2.82+/-1.3,116.9+/-21.1, -,100.1+/-15.1 VC 2.89+/-0.9, 87.7+/-9.6, 82.1+/-14.8,87.6+/-8.4 PaO2 70.4+/-12.5,98.0+/-	Not reported	

														12.8,89.7+/-18.9,90.2+/-9.9		
Dweik, R. A.Mehta, A. C.Meeker, D. P.Arroliga, A. C.	Analysis of the safety of bronchoscopy after recent acute myocardial infarction	1996	CHEST	825-8	Qualitative research	_	Yes	N=20	14M 6F mean age 63.8 All had MIs within 30days of FOB. 8CABG 2PTCA. Mean 11.7days between AMI and FOB. 14 performed in ICU 6 bronch 1 theatre. 14/21 mechanically ventilated. Indication 10 pulmonary infiltrates'; 6haemop; 4atelect; bronchopleural fistula 1. 21 examinations; 12 BAL; 2TBB 3EBB 4Brushings.	Safety of FOB after recent MI	None	Till discharge or death	Complications	No procedure was terminated prematurely 5 deaths – 1 death 4 hrs post procedure (active ischaemia known) , 4 deaths 6-15 days post procedure (from VF, ARDS) No reported new ischaemic events or arrhythmia in the 24hr post procedure	Not known	Bronchoscopy within 30 days of AMI appears safe in the absence of active ischaemia Not in modern era, antiplatelet agents.
Schiffman, P. L.Westlake, R. E.Fourre, J. A.Leonard, E. T.	Arterial oxygen saturation and cardiac rhythm during transoral fiberoptic bronchoscopy	1982	Journal of the Medical Society of New Jersey	723-6	Qualitative research	_	No	N=55 (5 dropouts, n=50)	Consecutive patients Transoral approach Group A (no supplemental oxygen, n=38) Group B (supplemental oxygen, n=12) Age GpA 50.9+/-16.8 vs. GpB 53.4 +/-18.5 p=ns Haematocrit GpA 38.4 +/-6.8% vs. GpB 35.4+/-8.7% No history coronary ischaemia or infarction, in sinus rhythm Performed with IM atropine, meperidine and topical cocaine via ET tube (not GA)	Effect of arterial saturation on cardiac rhythm	None	Not stated	ECG, SaO2, pH, pO2 and pCO2	GpA GpB Initial O2 sat 93.4+/-3.0 95.7+/-2.7 Lowest O2 sat 88.0+/-4.0 94.0 +/-2.7 Sinus tachycardia 55% 58% Sinus bradycardia 5% 8% VEs 8% 8% Atrial Ectopics 5% 8% No p-values provided	Not reported	
Cole, P.Turton, C.Lanyon, H.Collins, J.	Bronchoalveolar lavage for the preparation of free lung cells: technique and complications	1980	British Journal of Diseases of the Chest	273-8	Qualitative research	_	Yes	N=120	N=6 (recurrent infection 1, IPF 2, Ca 3) n=30 (not reported, patient acceptability cohort) N=42 (not reported, morbidity cohort) Omnopon and atropine premed Patients attending clinic for chronic pulmonary infections The procedure was considered to be contraindicated under the following circumstances: 1. 'Respiratory risk', defined as: a. Severe ventilatory defect (FEV1 < 1.0 liters). b. Hypoxaemia at rest (Pao~ < 70 mmHg = 9.3 kPa). 2. 'Cardiac risk', defined as: a. Myocardial infarction within the previous six months. b. Unstable angina pectoris. c. Left or right ventricular failure.	Effect of BAL on gas exchange, acceptability and morbidity Affect on pulmonary gas exchange 6 patients only Morbidity Patient acceptability 30 patients only Cell yields	None	For FOB only	Complication rate	Mean baseline paO2 (11.2kPa) fell following lavage by a mean of 3.0kPa to 8.2kPa, and remained low 120 minutes post procedure. Mean PaCo2 did not change significantly during and following lavage Mean acceptability score was 5.3 [as expected]. Only 6.7% found the experience unacceptable Respiratory distress 3/120 (2.5%) procedure terminated prematurely 2.5% pallor, LOC, bradycardia and hypotension (vasovagal) 8/42 (19%) patients fever, 6 (14%)with radiographic shadowing	Not known	
Cordasco, E. M., Jr.Mehta, A. C.Ahmad, M.	Bronchoscopically induced bleeding. A summary of nine years' Cleveland clinic experience and review of the	1991	CHEST	1141-7	Qualitative research	_	Yes	6,969 FOBs and 3,096 bronchoscopically guided biopsies were performed from 1981 to 1989.	Retrospective cases identified according to presence of bleeding and notes reviewed to better define the patient population most prone to bleeding, factors predisposing to this	to better define the patient population most prone to bleeding, factors predisposing to this complication and management of bronchoscopically	None	Not stated	Bleeding rate	%	Not known	Degree of bleeding related to type of Biopsy performed TBB>EBBx FOB low0.5% high 1.3% yearly FOB/TBB low 1% high 2.8% NO DEATHS NO COMMON UNDERLYING DISEASE OR CONDITION PREDISPOSED TO BLEEDING.

	literature								complication and management of bronchoscopically induced hemorrhage,	induced hemorrhage,						Low incidence of haemorrhage and low mortality. Screen for coagulation disorders and Rx with platelet>50,000 Immunosuppressed high risk as are Ca.
Nayci, AliAtis, SibelDuce, MeltemNassBayindir, SuzanTamer, LuluferOzturk, Candan	Bronchoscopy is associated with decreased mesenteric arterial flow	2008	CRITICAL CARE MEDICINE	2517-22	Qualitative research	+	Yes	N=47	32M 15F. Age 56.2+/-12(27-70). 4(8.5%) smokers. Final diagnosis after FOB Lung cancer, n (%) 34 (72.3) Metastatic cancer, n (%) 3 (6.3) Tuberculosis, n (%) 2 (4.3) Idiopathic interstitial pneumonia, n (%) 3 (6.3) Others, n (%) 5 (10.6) excluded from the study for the following reasons: body temperature _37.3°C,radiologic evidence of pneumonic consolidation, positive hepatitis B virus, hepatitis C virus, human immunodeficiency virus findings, use of immunosuppressive agents, corticosteroids and antibiotics (including antituberculosis chemotherapy), unstable circulation, mechanical ventilation, discharge or surgical/ diagnostic procedures within 24 hrs of FOB.	Does Fibreoptic bronchoscopy cause mesenteric ischaemia and bacterial translocation?	None	3 days	Superior mesenteric artery Doppler sonography, oxidative stress, antioxidant status, arterial blood gas analysis, blood cultures pre-bonchoscopy and post-bronchoscopy (1hr, 4hr, 24hr)	Fever (T>37.5C) in 19.1% within 24 hours, resolved within 3 days Bacteria detected in blood cultures in 10.6% 60% of isolates were gram negative organisms bacteraemia was rarely associated with fever PaO2 decreased compared with Vaseline by 21.8% +/-1.5%. PaCO2, pH and HCO3 did not change compared to baseline Doppler flow volume (FV) decreased by 38.8+/-14.9% of baseline , despite normal arterial BP. FV decreased by <50% in 31.2% of patients, 50-59% in 21.2%, 60-69% in 8.5% and >70% in 2.1% Markers of oxidative stress (neutrophil activation and lipid peroxidation) increased and reached a peak at 1 hr post bronchoscopy (p=0.0001) and remained significantly elevated to 4 hours (p=0.037). Antioxidant status decreased (glutathione and catalase levels) in the first hour (p=0.0001) remaining low at 4 hours (p=0.0001) and 24 hours (p=0.003). There was a positive correlation between SMA FV and change in PaO2 (r=0.71, p=0.0001)	Not reported	FOB is associated with decreased mesenteric blood flow which may put patient at risk of mesenteric ischaemia and bacterial translocation. Hypoxia correlates with this reduction
Bj,x00F,rtuft, O.Brosstad, F.Boe, J.	Bronchoscopy with transbronchial biopsies: measurement of bleeding volume and evaluation of the predictive value of coagulation tests	1998	EUROPEAN RESPIRATORY JOURNAL	1025-7	Qualitative research	_	Yes	51 patients 104 TBB	63F 41M Mean age 50, range 25-78 Consecutive TBBs Single lung transplantation 24 Bilateral lung transplantation 3 Heart–lung transplantation 2 Sarcoidosis 7 Fibrosing alveolitis 6 Carcinomatosis 2 Lymphangioleiomyomatosis 2 Fibrosis due to radiation therapy or nitrofurantoin 2 Uncertain diagnosis 3 All patients had platelet, bleeding time PT APTT. None had renal liver disease bleeding tendency or anticoagulation.	Bleeding volume	1) to quantify prospectively the bleeding associated with bronchoscopy and TBB; 2) to evaluate the capacity of coagulation tests such as bleeding time, platelet count, prothrombin time (PT) and activated partial thromboplastin time (aPTT) to predict clinically significant bleeding; and 3) to compare bleeding volume in TBB performed in patients with and without	During FOB	Bleeding volume, PT, APTT, bleeding time, platelet count	Mean bleeding volume 7+/-10ml (range 0-61ml) Eight patients clinically significant bleeding (>20ml) 7.7% (22-61ml) No difference in bleeding volume between transplant and non-transplant patients [0-61ml] vs. [0-44ml] No coagulation test can predict bleeding risk. None – serious or life threatening (no hypotension, intubation, transfusion) No correlation between bleeding time and volume	Congress Chairmans Award ERS	No correlation between coagulation tests and the likelihood of bleeding following TBB. This indicates that normal coagulation test results do not guarantee that bleeding will not occur. As withKozak ppr. Bleeding associated with TBB usually minimal <20ml. Although probably underestimated due to haemorrahge into lung; coughing up loss in suction system etc. Definition of significant bleeding is variable. Life threatening bleeding after TBB is rare

											lung transplants.					
Alamoudi, O. S.Attar, S. M.Ghabrah, T. M.Kassimi, M. A.	Bronchoscopy, indications, safety and complications	2000	SAUDI MEDICAL JOURNAL	1043-7	Qualitative research	_	Yes	160 consecutive FOBs. 36 excluded due to insufficient data. 124	Consecutive FOBs over 3 years in Western Saudi Arabian Teaching Hospital (60 FOBs/year). 69% male Mean age 49.9+/-17.7 45%Saudis 14% current smokers 17% Ex-smokers 57% No comorbidities 18.5% COPD 10.5% Diabetes	Complication rate of FOB	None	Until Discharge - no time frame given	Complication rate	Numbers and percentage	Unknown	To use as reference for FOB safety.
Katz, A. S.Michelson, E. L.Stawicki, J.Holford, F. D.	Cardiac arrhythmias. Frequency during fiberoptic bronchoscopy and correlation with hypoxemia	1981	ARCHIVES OF INTERNAL MEDICINE	603-6	Qualitative research	_	Yes	50	53 +/- 18 years (mean +/- SD	Cardiac rhythm	None	FOB	Cardiac rhythm and saturations	%	Grant 820, Division of Chronic Diseases, University of Pennsylvania	AE/VE preprocedure 12% AE/VE during or post procedure 80% (p<0.001) Major cardiac arrhythmia (atrial: 5 or more ectopics/ SVT, or ventricular: 5 or more VE, multiform ectopic beats, couplets or VT) 4% pre-procedure, 40% during or post procedure p<0.001 10% ventricular ectopics (inc 1 couplets and 1 nonsustained VT) vs. 1 patient pre-bronchoscopy, p=0.004 Atrial arrhythmias 32% (1 with PAF, 1 with PAT) vs. 1 patient pre-bronchoscopy, p=0.001 Atrial arrhythmias occur at widely differing stages of the procedure, ventricular arrhythmias mainly on passage through vocal cords Arterial oxygen saturation remained below prebronchoscopy levels post procedure for 1hr or more in 68%, 2hrs 58%, >3hrs 30%. Maximum ventricular arrhythmia correlated with minimum oxygen saturation, p<0.001. No significant association for atrial arrhythmias. No association with length of procedure, amount topical anaesthesia or medical history
Davies, L.Mister, R.Spence, D. P.Calverley, P. M.Earis, J. E.Pearson, M. G.	Cardiovascular consequences of fibreoptic bronchoscopy	1997	EUROPEAN RESPIRATORY JOURNAL	695-8	Qualitative research	_	Yes	45 unselected	45 unselected pat(26M 19F). Median age 65(17-81). Mean FEV1 78%(28-122) mean smoking duration 43(0-155) pack yrs. Indication 50% haemoptysis; 32% shadowing on CXR 18% cough sob. 4 non smokers 21ex.	The purpose of this study was to investigate the cardiovascular consequences of FOB, to determine whether they were confined to patients with a previous history of cardiac disease, and whether they could be predicted and observed by routine screening and monitoring methods.	None	Duration of FOB	Change in HR BP and ECG	Statistical comparisons were performed with nonparametric techniques using Wilcoxon or Kruskal Wallis methods via the Microstat 1 package. A p-value of less than 0.05 was considered significant.	Not known	CARDIOVASC STRESS ESP HYPERTENSION COMMON AND CAN CONTRIBUTE TO CARD CHANGES ESP ELDERLY AND THOSE W CVD. The magnitude of change could not be predicted from the resting FEV1, baseline Sa,O2, ECG or cuff blood pressure at the onset of the procedure. In most patients, there were no ECG abnormalities observed during these hypertensive episodes but multichannel recordings did show that 21% of patients over 60 yrs of age developed potentially serious, albeit transient, cardiac ischaemic events/rhythm disturbances. 6 of the 7 (86%) patients developing cardiac stress in this study, there was no history of ischaemic heart disease, and in 5 of the 7

																(71%) resting ECGs were normal.
Yildiz, PinarOzg,x00Fc,I, AkifYilmaz, Veysel	Changes in oxygen saturation in patients undergoing fiberoptic bronchoscopy	2002	CHEST	1007-8	Qualitative research	_	Indeterminable	N=44	33 Males, mean age 51+/-17 Transnasal, low to mod IM midazolam Teaching hospital	changes in oxygen saturation during bronchoscopy	between pO2and SaO2	not recorded	SaO2/ ABG before and after FOB Age, gender, primary disease, presence of effusion/ atelectasis, duration and basal SaO2	No difference in SaO2 values between ABG and oximetry before and after SaO2 significantly decreased after FOB (96.5+/-1.0 to 91.6+/-3.6, p<0.001) and desaturation <90% was detected in 50%	Not recorded	
Hue, S. H.	Complications in transbronchial lung biopsy	1987	KOREAN JOURNAL OF INTERNAL MEDICINE	209-13	Qualitative research	_	Yes	N=68	All males Age 41-50 4 51-60 24 61-70 30 71-80 9 <80 1 Mean 62 32 Caucasian 31 Black 5 other pack year History 0-10 4 11-20 21 21-30 38 >30 5	Adverse events	None	FOB	Adverse events	%	Unknown	
Lukomsky, G. I.Ovchinnikov, A. A.Bilal, A.	Complications of bronchoscopy: comparison of rigid bronchoscopy under general anesthesia and flexible fiberoptic bronchoscopy under topical anesthesia	1981	CHEST	316-21	Qualitative research	_	Yes	N=2143 patients (1146 flexible and 3449 rigid procedures)	Not fully reported Mean Age 53 Tumours 38%, nonspecific inflammatory 37%, asthma 4%, pleural 8%, Haemoptysis 5%, others 8%	Complications of bronchoscopy	Major vs. minor complications	24hrs	Minor, major or fatal complications	Complications overall in 5.4% Minor complications (5.1%) - anaesthetic related (n=6) - laryngospasm (n=3) - nasal haemorrhage (n=4) - tachycardia (n=13) - laryngitis (n=1) - hypoxaemia (n=1) - haemorrhage after biopsy (n=5) - bronchospasm after anaesthesia (n=12) Major complications 0.3% - exacerbation of asthma, pneumonia, drug reaction	Not recorded	Complications divided as related to anaesthesia or bronchoscopic procedure. Divided as major or minor. FOB: 62 (5.4%) complications. 59 (5.1%) minor. 25 (2.2%) related to anaesthesia(dizzy, nausea, tachycardia 13; vomiting,hypotonia 3; psychomotor excitation 2; faint 1; laryngospasm 1; bronchospasm 1 34 (2.9%) due to FOB. major 0.3% RB: 173 (5%) complications. 125 3.6% minor. 63 1.8% related to anaesthesia. major 48 1.4% 16 0.46% related anaesthesia
Pue, C. A.Pacht, E. R.	Complications of fiberoptic bronchoscopy at a university hospital	1995	CHEST	430-2	Qualitative research	_	Indeterminable	N=4273	Not reported Tertiary care university hospital	Indications and complications of fibreoptic bronchoscopy	Indication, and severity of complication according to diagnostic or therapeutic bronchoscopy	4 hours post FOB	Diagnostic procedures (suspected infection 52%, abnormal CXR 17%, haemoptysis 4%, ILD 3%, staging 2%), therapeutic procedures 10.4%, research 3.3% BAL in 2493, TBB in 173	Fatalities 0% Major complications 0.53% - pneumotnorax 0.16% (TBB 4%) - haemorrhage >50ml 0.12% (TBB 2.8%) - respiratory failure 0.2% (TBB 0%) Minor complications 0.79% (laryngospasm 0.6%, vomiting 0.1%, vasovagal 0.05%, epistaxis 0.02%, bronchospasm 0.02%)	Not reported	
Prickett, C.LeGrand, P.	Complications of fiberoptic bronchoscopy in a community hospital	1984	Alabama Medicine	25-Jul	Qualitative research	_	No	N=122	Age 16-73 Pulmonary infiltrate n=50, haemoptysis n=26, mass/nodule n=18, atelectasis n=10, therapeutic n=6, hilar adenopathy n=3, pleural effusion n=3, cough n=2, misc n=4	complication rate: major and minor Major complication: haemoptysis>50cc; pneumothorax require ICD; pneumonia and seizure. Minor: fever resolving in 48hrs; pneumothorax not require drain.	None	Not reported	Major and minor complications, mortality	Mortality 1/122 =0.8% Major complication 3/122 (2.5%) - seizure n=1, pneumonia n=1, haemoptysis>50ml n=1, pneumothorax with ICD n=0 Minor complication 15/122 (12.3%) - fever n=14, pneumothorax without ICD n=1	Not reported	

Weiss, S. M.Hert, R. C.Gianola, F. J.Clark, J. G.Crawford, S. W.	Complications of fiberoptic bronchoscopy in thrombocytopenic patients	1993	CHEST	1025-8	Qualitative research	+	Yes	N=47 (66 procedures with BAL)	Mean age 34 (7-56); 26M 21F; 8AML;10ALL; 15CML;3HD; 6NHDetc.38 allogenic transplant, 5 pretransplant, 4 autogenic. Mean time post transplant 91 median 57 (0-1041) 10 days pretransplant. CXR focal infiltrates 19 diffuse 41 none 6.median platelet 37(8-400).PT13.1mean 63(11.4-19.7).APTT 30.7(20.8-46.5).N2 33(8-151).Cr1.2(0.6-5).MAP91(57-128).HR110(72-160). 89% post BMT. Diagnosis in 47% after BAL. 58/66 88% platelet <100. 51/66 77% require supplementary O2. 43/66 65% transnasal,17(26%) ETT, 6(9%) transoral. Those with Platelet<100 64% transnasal 9% oral 28% ETT.	Complication rate in thrombocytopenic patients	Complication rate by absolute count and route of bronchsocopy	24hrs	Nature of pulmonary disease, description of CXR, O2 sats, supplementary O2, HR, BP, platelet, clottongN2 and ceat resorded, examined 24hour for focal radiological changes and 4 and 24hrs for bleeding, haemodynamically unstable and desaturations O2 sats. If required intervention+ severe.	Complications: 7/58(12%) 4epistaxis;2 haemoptysis 2 bradycardia; 1hypotension. 1 haemoptysis severe >150ml but B4 FOB. Thrombocytopenic transnasal minor bleeding in 3/37(8%). 1/8 non thrombocytopenic had haemoptysis (13%).all self limiting and minimal except one: life threatening oral route platelet<18. Required intubation and platelet had life threatening epistaxis B4 FOB. No fever or desaturation and 4 hours. No change in CXR at 24hrs. 2/16 bradycardia in intubated who were not premed with atropine.Clotting,plt,Cr no diff between those with and without complications.	not recorded	FOB and BAL safe and efficacious despite thrombocytopenia. 12% complication with platelet<100. Intensity not related to platelet count or renal fn, Specific diagnosis in 22/47 (47%) and no change in radiology, haemodynamics or respiratory at 4 and 24 hrs. Only 1/58(2%) sever bleeding require intubation and transfusion despite oral approach. Transnasal 0nly 3/37 thrombocytopenic had epistaxis which was self limiting not higher than oral route. Used smaller FOB and anaesthesia nasal with cocaine vasoconstrictor to limit. No suction till in airway to limit post FOB fever therefore had impact. FOB BAL relatively safe despite thrombocytopenia. Routine platelets not necessary. Transnasal as safe with appropriate precautions (ot use if epistaxis and use of cocaine and lignocaine and small scope 4.9mm). Caution to do FOB in those with recent epistaxis and haemorrhage
Jones, A. M.O'Driscoll, R.	Do all patients require supplemental oxygen during flexible bronchoscopy?	2001	CHEST	1906-9	Qualitative research	+	Yes	1,051 underwent bronchoscopy without routine O2 supplementation 252 had an episode of desaturation <90% 1051 patients from 2261 FOBs performed. 1074 FEV1 recorded pre FOB and 23 on LTOT excluded	77% performed to investigate suspected cancer/ haemoptysis FEV1<0.5L 14, FEV10.5-1.0L 196, FEV1 1.0-1.5L 297, FEV1 1.5-2.0L 253, FEV1 >2.0L 291 21% not sedated 72% 1-5mg midazolam 6% 6-10mg midazolam <1% >10mg midazolam	Requirement for supplemental oxygen and the effect of IV midazolam therapy on oxygenation during bronchoscopy for patients with a known FEV1	None	During FOB	FEV1, SaO2<90%, dose of IV midazolam and need for supplemental O2	Statistical analysis of differences between groups of patients with different levels of FEV1 was performed using the x2 test.	Not known	Nice graph – could use figure 1. Our data suggest that the majority of our patients (86%) do not require routine oxygen supplementation. This is especially true if they have an FEV1 level . 1.5 L 9.6% of patients had a momentary fall in oxygen saturation but did not receive supplementary oxygen. ALSO LOOK AT GOPEL LETTER
Pirozynski, M.Sliwinski, P.Zielinski, J.	Effect of different volumes of BAL fluid on arterial oxygen saturation	1988	EUROPEAN RESPIRATORY JOURNAL	943-7	Qualitative research	+	Yes	N=21 consecutive patients 7 controls 7 BAL-100 7 BAL-200 BAL 100: five aliquots 20ml BAL 200: ten aliquots 20ml Control: diagnostic bronchoscopy alone	BAL-100 5x20ml: n=7 5M 2F age 33.7+/-2.5 6sarcoidosis 1COPD BAL-200 n=7 3M 4F. Age 40+/-4 5 sarcoid; 1TB 1malig Control n=7 6M 1F age 50+/- 8.3 3malig 1TB 2COPD 1Pneum	Effect of FOB and BAL on saturations and to compare change of sats induced by different BAL volumes	change in SaO2 during bronchoscopy and BAL/ BAL volume	5mins or 2hours in n=5 who desaturated	Saturations post BAL, by volume	FOB causes desataturation in all groups. Mean max desataturation 4.4%. older and poorer PFTs BAL steady decline in Sats over 2-5mins post instillation of first saline. Slight hr response but no symptoms.5 patient's profound desataturation prolonged 10-30mins. BAL-100 mean max desataturation 5% BAL-200 12-15% p<0.05vs 100 and controls.	Not reported	
Ernst A, Eberhardt R, Wahidi M, Becker HD, Herth FJ.	Effect of routine clopidogrel use on bleeding complications after transbronchial biopsy in humans.	2006	Chest	734-7	Qualitative research	+	Yes	N=604	The mean age of the patients was 57.8 years (range 44 to 78 years), 68% were men, and 407 patients (67%) were smokers. The groups did not differ significantly at baseline	Bleeding rates on clopidogrel	Bleeding complications in patients undergoing TBLB with and without clopidogrel	Not reported	Bleeding rates	All values are presented as means and SDs, numbers, or percentages. Statistically significant differences between patient groups were determined using a _2 test; _ was set at 0.05. Statistical software (SPSS 11.0; SPSS; Chicago, IL) was used for the analysis. An interim analysis was planned for 6 months after	Not reported	

														the study was begun.		
Lombardi, C.Lanzani, G.Spedini, C.	Efficacy and safety of flexible fibreoptic bronchoscopy in the elderly	1993	European Journal of Medicine	315	Qualitative research	_	Yes	N=823 from 1891 (selected from total population on basis of age >65)	Gp1 (young elderly, range 65-74, mean age 69.2) n=576, Gp2 (old elderly, range 75-84, mean age 80.5) n=247 Indications included haemoptysis, abnormal CXR, foreign body aspiration (similar in each group) Premed atropine/ diazepam and topical anaesthesia	Efficacy and safety of bronchoscopy in the elderly	Diagnosis and complications according to age	Not applicable	Indications. tolerance, major and minor complications and diagnosis.	Indication including haemoptysis, abnormal CXR suggesting collapse, consolidation, hilar paratracheal shadow aspiration f body. younger patients had poorer tolerance whilst only 10% older group defined fob as unpleasant. Vagal reactions 4, dysrrhymia 1AF, not prevalent in one group over other. No deaths. <65 year old 37 3.4% minor complications; 65-74 22 3.8% >75yold 8 3.2%. high diagnostic value for malignant disease in haemoptysis 14.5% younger 26.9% older 10.9% youngest group. In older group epidermoid and small cell more prevalent 12.75 and 2.9% vs. 6.7% and 1.2% in contrast with adenocarcinoma 0.98% vs. 2.4%. tb more prevalent in elderly 2.6% vs. 5.9% vs. 2.4% <65. NO P VALUES. Major Complications (not defined) Vagal reactions 4cases AF 1 case No difference between the young and old group No deaths Minor Complications (not defined) <65yr 3.4%, 65-74YR 3.8%, >75yr 3.2% Diagnoses: Malignant Disease – <65 10.9% 65-74 14.5% >75 26.9% TB – <65 2.4% 65-74yr 2.6% >75yr 5.9%	Not reported	FOB well tolerated in elderly and provides useful diagnostic info.
Ouellette, D. R.Diaz, J.	Elevation of the double product during flexible bronchoscopy: Effects of uncontrolled hypertension and the use of beta-blockade	2008	Journal of Bronchology	73-77	Qualitative research	+	Yes	N=263	Therapeutic or transplant bronchoscopy excluded. Age 61+/-15, M:F 138:125 Meperidine, midazolam, morphine to n=91 Meperidine, midazolam n=147 Midazolam, morphine n=19 meperidine morphine n=1 midazolam alone n=5 Prebronchoscopy: mean SBP 131+/-18, mean HR 78+/-15 During bronchoscopy: mean SBP 141+/-22, mean HR 89+/-17, mean maximum double product 12500+/-3250 mmHg/min	Effect of FOB on cardiovascular parameters and whether this differs if you have prebronchoscopy elevated BP or on Beta Blockers Fibreoptic bronchoscopy increases risk of silent ischaemia	Compare haemodynamic changes before and during bronchoscopy, and compare these changes with threshold levels associated with silent ischaemia Compare haemodynamic changes in pre-bronchoscopy normal & elevated systolic BP (with and without beta blockers)	Not recorded	Age, sex, pre-bronchoscopy systolic and diastolic BP and HR, maximum systolic BP associated with maximum double product, maximum diastolic BP associated with maximum double product, premedication administered, sedatives administered, antihypertensive taken and occurrence of complications	Normal Prebronchoscopy SBP: n=162 (n=86 antihypertensive, beta blockers n=49) age 59+/-15, M:F 81:81 mean PSBP120+/-11; mean PHR 77+/-13 mean maximal SBP 130+/-19, mean maximal HR 87+/-16, mean difference in double product 2230+/-2350 Elevated Prebronchoscopy SBP: n=101 (n=76 antihypertensive, beta blockers n=36) age 65+/-13, M:F 57:44 mean PSBP 148+/-12; mean PHR 79+/-17 mean maximal SBP 157+/-18, mean maximal HR 91+/-19, mean difference in double product 2660+/-2580 Significant differences seen between NSBP and ESBP groups for age[p=0.003], any antihypertensive use[p<0.001], mean PSBP [p<0.001], and mean maximum SBP [p<0.001], only. No difference in beta blocker use No beta blockers: n=178 age 58+/-	Not reported	

														15, M:F 87:91 mean PSBP 130+/-18; mean PHR 80+/-15 mean maximal SBP 139+/-22, mean maximal HR 92+/-17, mean difference in double product 2500+/-2440 Beta blocker use: n=85 age 68+/-11, M:F 51:34 mean PSBP 132+/-18; mean PHR 73+/-15 mean maximal SBP 143+/-24, mean maximal HR 82+/-17, mean difference in double product 2170+/-2450 Significant differences seen between no beta blocker use and beta blocker use for age[p<0.001], prebronchoscopy HR [p<0.001], mean maximum HR [p<0.001]. No complications were reported		
Taher, M. A.Kamash, F. A.Al-Momani, J. A.	End-tidal carbon dioxide monitoring during flexible fiberoptic bronchoscopy	2006	Pakistan Journal of Medical Sciences	149-153	Qualitative research	+	Yes	N=200	M 119 F81 Age 53+/-15 (13-90) Asian IV diazepam 10mg, atropine IM 0.5mg Lung Cancer 38.5%, TB15%, bronchiectasis 12% Baseline: SpO2 95.2+/-4.2; ETpCO2 28.14+/-4.5	The utility of capnographic monitoring during bronchoscopy	ET-Pco2 and Spo2 in patients subjected to FFB while receiving supplemental oxygen at different stages of FOB	Not recorded	Mean SpO2, mean ETpCO2	Pre-bronch ETpCO2 28.74+/-4.5mmHg Post bronch ETpCO2 27.95+/-5.27 mmHg, p=0.01	Nil reported	How stat significant ?clinical relevance
Haynes, J.Greenstone, M. A.	Fibreoptic bronchoscopy and the use of antibiotic prophylaxis	1987	BRITISH MEDICAL JOURNAL CLINICAL RESEARCH ED.	1199	Qualitative research	_	Yes	N=73	Respiratory disease requiring bronchoscopy (7 had taken recent antibiotics)	Positive blood cultures before and after FOB	Bacteraemia pre and post bronchoscopy	10 minutes post bronchoscopy	Positive blood cultures	4/73 patients positive blood cultures prior to bronchoscopy 1/22 patients positive blood culture 1-2mins post bronchoscopy 1/51 patients positive blood culture up to 10min post bronchoscopy Of 292 blood culture bottles inoculated, 8 (2.7%)gave positive results, organisms commonly from skin/ environment. No significant difference between the number of positive cultures obtained before/after bronchoscopy (p>0.5)	Not known	We did not find any difference between the number of positive cultures obtained before bronchoscopy and the number obtained during the procedure. The number and nature of isolates were entirely consistent with our usual experience of contaminated blood cultures. antibiotic prophylaxis is not warranted in patients at risk of endocarditis when undergoing fibreoptic bronchoscopy. Furthermore, we believe that there is insufficient evidence to justify the use of such prophylaxis in patients undergoing nasal intubation.
Markou, N. K.Kanakaki, M. C.Boutzouka, E.Damianos, A.Ikonomou, A.Myriantheus, P.Baltopoulos, G.	Fluctuations in gas exchange and cardiovascular parameters during flexible bronchoscopy	1999	Journal of Bronchology	241-246	Qualitative research	+	Yes	N=22	Non intubated. age 35-82. Clinically stable and ambulatory. Referred by oncology for fob because of abnormal findings on CXR (14), haemoptysis with normal CXR (6) or restaging after small cell chemo (2). 18 smoked >20 pack years, only one non smoker. None chronic respiratory failure or on LTOT. Lowest PaO2 prior to FOB 64mmHg. 10 had symptoms compatible with chronic bronchitis. Only 9 had spirometry available: 3 normal 2	Effect of FOB on gas exchange and cardiovascular parameters (SaO2, PaO2, PaCO2, HR, CI, BP)	Different stages of FOB. T1 preinsertion; T2 FOB over VC; T3 after brushing/Biopsy; T4 10 minutes post FOB. Each variable (paO2, SaO2, paCO2, HR, BP, CI) is measured over time and compared to baseline.	Not specified	PaO2, PaCO2, SaO2, non-invasive monitoring of HR, rhythm, BP and cardiac index	1. Significant decrease in PaO2 during bronchoscopy (p<0.02) 2. No significant changes in SaO2, systolic or diastolic BP and PaCO2 (P>0.05) 3. HR significantly increased during bronchoscopy (P<0.03) 4. No rhythm disturbances noted 5. Cardiac index was significantly elevated by 17% (p<0.04)	Not reported	FOB causes PaO2 fall at VC and rise in HR and CI without clinical compromise,

									mild 4 moderate obstruction (?by what criteria; what symptoms). 12 taking anti BP meds 2 had previous mi; 3 in AF on digoxin; 4 heart failure. Diagnostic bronchoscopy, ECOG 0/1 Smokers n=18 Spirometry n=9 (3 normal, 6 AFO, 13 unknown) 3 AF, 19 SR Premed atropine/ morphine local anaesthetic non-invasive monitoring of HR, rhythm, BP and cardiac index							
Lundgren, R.x00E,ggmark, S.Reiz, S.	Hemodynamic effects of flexible fiberoptic bronchoscopy performed under topical anesthesia	1982	CHEST	295-9	Qualitative research	+	Yes	N=10 with restrictive lung disease (IPF 5, sarcoid 3, scleroderma 1, asbestosis 1) Medically optimal, haemodynamically stable	Male 50%, mean age 63.8yrs Mean pO2 75.4mmHg, mean pCO2 40.4mmHg University hospital	Fibreoptic bronchoscopy and right heart catheter, invasive BP monitoring	Effect of bronchoscopy under topical anaesthesia on central haemodynamics, ECG and blood gases in patients with restrictive lung disease	I hr	Mean arterial pressure, heart rate, mean pulmonary arterial occlusion pressure [MPAOP], cardiac index, paO2	Marked increase in MAP, HR, MPAOP and cardiac index during anaesthesia and passage thru larynx Remain high until anaesthesia completed During BAL, MAP, HR, CI still elevated but MPAOP returns to baseline Significant decrease in paO2 with suctioning and remained low No changes in paCO2 15min after completion all parameters normalised except HR and paO2 No cardiac dysrhythmias. ST-T segment depression seen in 3 patients (laryngeal anaesthesia/ suctioning)	Swedish National Association against Heart & Chest Disease. Medical Faculty University of Umea	Anaesthesia and passage through larynx. Marked increase in 43% HR, 30% MAP, 86% mean pulmonary art occlusion pressure, 18% CI. BAL: as above but MPAOP baseline Suction: as above plus significant desaturation. 4 ST-T depression. no arrhythmias
Colt, H. G.Matsuo, T.	Hospital charges attributable to bronchoscopy-related complications in outpatients	2001	RESPIRATION	67-72	Qualitative research	+	Yes	660 patients 1009 FOBs	Consecutive outpatient FOBs. All patients(n = 1,009) 58+/-16 51/49% M/F FOB only (n = 740)(73%)59+/-16 48/52% M/F FOB plus TBB(n = 216)(21%) 55+/-16 57/43% M/F FOB plus brachytherapy (n = 53) (5%) 67+/-8 74/26 44.7% lung mass 17.2% infection	Complications	None	2 hours post FOB until discharged or admitted	need for aerosolized bronchodilator treatment of bronchospasm, endotracheal intubation for respiratory failure, need for tube thoracostomy for iatrogenic pneumothorax, intravenous fluid resuscitation for hypotension or vasovagal reactions, hypoxemia, defined as a persistent transcutaneous oxygen saturation below 85% despite supplemental oxygen, hospitalization.	Number and percentage	Not known	Outpatient flexible bronchoscopy is an extremely low-risk procedure when performed by experienced bronchoscopists in a setting where routine safety precautions are employed, FFB-related complications occurred in only 5% of all patients undergoing FFB, and the rate of hospitalization was only 0.5% overall. Reported complication rates depend on whether studies are prospective or retrospective in nature, which procedure-related adverse events are actually designated as complications, the patient population and the types or numbers of procedures performed.
Milam, M.	Immediate	1989	CHEST	477-9	Qualitative	+	Yes	N=253, 46 dropouts	Diagnosis: cancer 57	Diagnostic value	None	Not	Diagnostic	Immediate CXR 130(63).	Not	Immediate CXR rarely

G.Evins, A. E.Sahn, S. A.	chest roentgenography following fiberoptic bronchoscopy				research			N=207 studied	(28%) infection 37 (18%), sarcoid 29(14%), bronchitis 18(9) none 30(14) other 36(17). 163(79) washings or BAL, 104(50) brushings, 98(47) TBB 50(24) endobronchial Biopsy, 14(7) TBNA. Immediate CXR 130(63).	and therapeutic implications of the immediately postbronchoscopic chest roentgenogram		reported	value i.e. CXR changes. Therapeutic influence i.e. change in subsequent management Immediate post bronch CXR	114(88) no change, 10(8) increased alveolar infiltrate 9 had BAL 1 large bleed 300-500ml after Biopsy, 2(2) volume loss/expansion, 4(3) other(increased pleural effusion,, pneumothorax 10% no Rx resolved spontaneously, resolution pneumothorax from c line, increased fluid in cavity). All TBB or TBNA.	reported	provides diagnostic info. Any change did not affect Management.
Yigla, M.Oren, I.Bentur, L.Solomonov, A.Elias, N.Altshuler, R.Rubin, A. E.Lejbkowicz, F.	Incidence of bacteraemia following fibreoptic bronchoscopy	1999	EUROPEAN RESPIRATORY JOURNAL	789-91	Qualitative research	+	Yes	N=200 consecutive patients (103 inpatients, 97 outpatients)excluded if current infection/ febrile illness or antibiotics within 1 week	103 hospitalised 97ambulatory). Current infection, fever or antibiotic in last week excluded. 119(59.5%) FOB for malignancy; 20 recurrent pneumonia; 14 haemoptysis; 13 stridor; 8 diffuse infiltrates; 6 bronchiectasis; 5 atelectasis/f body; FOB + Bx+brushing+washing 90(45%) brush+lavage 57(28%) lavage 39(19.5%)or fluoroscopic TBBx+brush+lavage 11(5.5%). 3 no specimens. mean age 54+/-24; (6m-94). 29(14.5%) children 171(85.5%) adults.152(76%) Males 48(24%) female. 48(24%) cardiac disease but not valvular.33(16.5%) malignancy; 17(8.5%) impaired immunity (DM; steroids; chemo radiotherapy); 16(8%) CLD; 5(2.5%) renal fail; 3(1.5%) PUD; 2(1%) Collagen vascular disease; 76(38%) no comorbidities.	Rate of bacteraemia post FOB	None	Not recorded, possibly <1hr	Aerobic and anaerobic cultures immediately and 20m post bronchoscopy Aerobic and anaerobic cultures from BAL	70 normal FOB 130 abnormal (50 inflamed mucosa; 49 endobronchial lesion; 31 external pressure) 26(13%) positive BC post FOB decreased to 13(6.5%) true bacteraemia in two BC bottles i.e. 20 min later. 6 coagulase neg staph;2 coagulase pos staph 2 non haemolytic streptococcus 1 klebsiella BAL normal flora in 120 potentially pathogenic bacteria in 80. 17/26 positive BC lavage normal. 9 pos but different from BC.	Not recorded	6.5% bacteramia rate post FOB BUT majority hospitalised patient; only 4 hours no assessment of fever, symptoms requiring Antibiotic
Facciolongo, N.Patelli, M.Gasparini, S.Agli, L. LazzariSalio , M.Simonassi , C.Del Prato, B.Zanoni, P.	Incidence of complications in bronchoscopy. Multicentre prospective study of 20,986 bronchoscopies	2009	MONALDI ARCHIVES FOR CHEST DISEASE	Aug-14	Qualitative research	+	Yes	Prospective multicentre study 20,987 FOBs	10,658 Explorative (50.7%) 10, 328 non(5520 Biopsy; 26.3% 1660 TBB7.9% 1127 BAL 5.37% 930 TBNA 4.43% 1091 therapeutic stent laser argon.19453 LA(92.72%) rest GA.	We defined a "complication" as any adverse event directly correlated with the endoscopic procedure performed. The complications were classified as: complications that occurred during the preparation for the examination (local anesthesia and pre-medication, if any), complications that occurred during the endoscopic procedure and the delayed complications that occurred within 2 hours of the end of the procedure. We defined the oxyhaemoglobin	Explorative vs. non explorative FOBs	48 hours	We defined a "complication" as any adverse event directly correlated with the endoscopic procedure performed. The complications were classified as: complications that occurred during the preparation for the examination (local anesthesia and pre-medication, if any), complications	Database coded SPSS Chi squared	Not known	Overall incidence of complication 1.08% and mort 0.02%. IS A SAFE PROCEDURE.

										desaturation during the bronchoscopy procedure as a 6 point percentage drop in the oxyhaemoglobin saturation from that recorded at the beginning of the procedure. We define haemorrhage as bleeding caused by procedure. We distinguish: mild haemorrhage < 50 ml and severe haemorrhage > 50 ml.			that occurred during the endoscopic procedure and the delayed complications that occurred within 2 hours of the end of the procedure. We defined the oxyhaemoglobin desaturation during the bronchoscopy procedure as a 6 point percentage drop in the oxyhaemoglobin saturation from that recorded at the beginning of the procedure. We define haemorrhage as bleeding caused by procedure. We distinguish: mild haemorrhage < 50 ml and severe haemorrhage > 50 ml.			
Sharif-Kashani, P. Shahabi, N. Behzadnia, Z. Mohammad-Taheri, D. Mansouri, M. R. Masjedi, L. Zargari and L. Salimi Negad	Incidence of fever and bacteriemia following flexible fiberoptic bronchoscopy: a prospective study	2010	ACTA MEDICA IRANICA	385-383	Qualitative research	+	Yes	N=85	Bronchoscopy for different indications under LA only (immune suppression inc DM, current antibiotics or infection, fever >38C or steroids excluded) males 81%, Age 57+/-28 (range 34-90), smokers 67%, n=57 acute respiratory disorders, 28 chronic respiratory disorders Biopsy, brush & wash in n=69 TBB, brush wash in n=16 Blood cultures pre-bronch, and immediate + 20m post bronch	Incidence and species responsible for bacteraemia after fibreoptic bronchoscopy	None	24 hours after FOB	Incidence of bacteraemia/ fever	Pre-bronch cultures: 0% bacteraemia Post bronch cultures: 8.2% bacteraemia True bacteraemia 1% (i.e. in two cultures) Fever >38C (n=9) 10.5% (only two patients with positive blood cultures) Organisms isolated were coagulase neg staph (4), coagulase positive staph (1), citrobacter (1), strep viridans (1)	Not reported	Fever in 9 (10.5%) cases in first 24 hours. 1 bacteraemia
D'Ippolito, R.Foresi, A.Castagnetti, C.Gesualdi, S.Castagnaro, A.Marangio, E.Olivieri, D.	Indications for flexible fiberoptic bronchoscopy and its safety in the very elderly	2007	MONALDI ARCHIVES FOR CHEST DISEASE	23-Sep	Qualitative research	_	Yes	301	Group 1 (Age <75 years): n=245, mean age 64.7+/-6.8, Males 164, BMI 26.6+/-4.7, current/ ex-smoker 72.2%, FEV1 74.5+/-23.2%predicted, or 1.92+/-0.72L Group 2 (Age >75 years): n=191, mean age 81.6+/-5.4, Males 112, BMI 24.2+/-3.9, current/ ex-smoker 59.2%, FEV1 70.5+/-23.3%predicted, or 1.63+/-0.57L	Retrospectively examine indications and freq of adverse events of FOB in very elderly.	Age less than and over 75	24 hours post FOB	Adverse events by looking at charts: desaturation< 90% arrhythmia, bronchospasm fever MI pneumothorax.	No significant difference in the indication for bronchoscopy between the two groups (p=ns) No significant difference in the sampling methods between the two groups(p=ns) No significant differences in adverse events between the two groups - requirement for O2 35% - hypertension 4% - hypotension 0.5% - bleeding 2-3% - bronchospasm 0.8-1.6% - fever 10% Data was	Not known	Indications for FOB did not vary remarkably with age. This retrospective study conducted in a university hospital clearly shows that FOB is safe and adverse events are uncommon and generally not severe. Transient fever is a relatively frequent adverse event, whereas other minor or major adverse events are less frequent and not associated with the patients' age. These results in "octogenarians" should help quash any

														presented as mean ± SD. Differences between groups (age <75 years or =>75 years) were examined by unpaired Student's t test, by Fisher's Exact Test, and by $\chi 2$ for trends. A p value of 0.05 was considered to indicate statistical significance.		reluctance to consider FOB even in the very elderly.
Ibrahim, Abdulsalam S.Allangawi, Mona H.Sattar, Hisham A.Mobyed, Hassan S.Almohammed, Ahmed A.	Indications, diagnostic yields and complications of transbronchial biopsy over 5 years in the State of Qatar	2005	SAUDI MEDICAL JOURNAL	641-5	Qualitative research	_	Yes	1006 adult FOBs TBB in 85 (8.4%) Data for 71 Transbronchial biopsies were performed under fluoroscopic guidance in 19 (26.7%) cases, while they were unguided in 52 (73.2%) cases.	35 (49%) patients in-patient departments, 4 (6%) patients from ICU, and 32 (45%) patients from out-patient departments. Pre-medications were used in 32/71 (45%) cases. 42 males and 29 females), with an average age of 44 years (SD +14.7 years), and an age range of 18-85 years. Most for TB	Complications	None	2 hours post FOB	Complications	Number %	Not known	Younger age group and main indication infection/TB
Inoue, H.Aizawa, H.Takata, S.Koto, H.Matsumoto, K.Shigyo, M.Hara, N.	Ipratropium bromide protects against bronchoconstriction during bronchoscopy	1994	LUNG	293-8	Qualitative research	_	Yes	29	17 males, 12 females suspected lung cancer excluded if asthma, chronic bronchitis or emphysema, tumour obstructing airway Pentazocine premedication, lidocaine local anaesthesia Divided into three groups n=11 IM atropine n=9 nebulised ipratropium(total 0.08mg) n=9 4 puffs of placebo	To determine whether inhaled ipratropium could help to prevent bronchoconstriction during bronchoscopy and to evaluate this anticholinergic in comparison to intramuscular atropine.	To determine whether inhaled ipratropium could help to prevent bronchoconstriction during bronchoscopy and to evaluate this anticholinergic in comparison to intramuscular atropine.	Post FOB	The measurements of FEV1 and PEFR were made at the following stages: (1) before the premedication, at baseline value; (2) 15 minutes after premedication; (3) after topical anesthesia; and (4) immediately after completion of bronchoscopy. Each measurement was made in triplicate, and the best FEV1 value was chosen for analysis.	The 3 groups did not differ in terms of age sex and smoking history. No significant differences in terms of baseline pulmonary function. There were no significant differences in pulmonary function obtained after premedication with atropine, ipratropium or placebo, compared with baseline. In placebo group after topical lidocaine, FEV1 and PEFR decreased significantly compared with baseline ($p<0.05$) and bronchoscopy produced further decreases. In atropine group, significant decreases in FEV1 and PEFR occurred after local anaesthesia ($p<0.01$) and decreased further immediately after bronchoscopy. In the ipratropium group, FEV1 and PEFR did not change significantly from baseline with local anaesthesia but FEV1 was significantly lower than baseline immediately following bronchoscopy ($p<0.01$) FEV1 and PEFR were significantly greater after anaesthesia in the ipratropium group compared with atropine and placebo groups ($p<0.05$) No significant side effects from anticholinergics except for dry mouth with atropine All pulmonary function values were expressed as a percentage of change from baseline. Data are reported as mean + standard error of the mean (SEM). The statistical significance of changes from baseline within a treatment group	Not known	[no figures for % fall from baseline or SD. Bar charts with error bars provided] Not clear what clinical benefit inhaled ipratropium provides FOB and lignoaine decreases PEFR and FEV1

														was assessed by the paired t test. One-way analysis of variance was used to evaluate differences among the treatment groups after anesthesia and after bronchoscopy. Mean values among groups at each stage were compared to the unpaired t test. The probability value of p < 0.05 was accepted as statistically significant.		
Izbicki, GabrielShitrit, DavidYarmolovsky, AlexBendayan, DanielleMiller, GalitFink, GershonMazar, AsherKramer, MordechaiR.	Is routine chest radiography after transbronchial biopsy necessary?: A prospective study of 350 cases	2006	CHEST	1561-4	Qualitative research	+	Yes	350 consecutive TBB	Indications for FB with TBB were suspected cancer (n 96, 27.4%); lung or heart-lung transplantation (n 91, 26%); persistent infiltrates (n 63, 18%); interstitial lung disease (n 42, 12%); suspected sarcoidosis (n 33, 9.4%); suspected tuberculosis (n 14, 4%); and others (n 11, 3.2%). One hundred twenty-two patients (34.8%) were considered immunosuppressed at the time of the procedure, most of them (75%) because of treatment after lung or heart-lung transplantation.	The presence (or absence) and extent of pneumothorax (expressed as a percentage of the thoracic volume) were recorded, in addition to the clinical management (hospitalization, chest tube) if necessary	None	2 hours post FOB	Presence of pneumothorax	Pearson correlation coefficient (r) and the significance for it (p values) were calculated between the variables. The significance of differences in the distribution of the categorical variables between patients with or without pneumothorax was analyzed by 2 test or Fisher exact test, as appropriate. Student t test was used to evaluate differences in continuous variables between two groups. A series of multivariate stepwise logistic regression models were fitted to the data in order to predict the presence of pneumothorax after bronchoscopy. Odds ratios and 95% confidence intervals were estimated from the model: p 0.05 was considered statistically significant.	Not known	Routine CXR after bronchoscopy with TBB is necessary only in patients with symptoms suggestive of pneumothorax.
Chhajed, P. N.Rajasekaran, R.Kaegi, B.Chhajed, T. P.Pflimlin, E.Leuppi, J.Tamm, M.	Measurement of combined oximetry and cutaneous capnography during flexible bronchoscopy	2006	EUROPEAN RESPIRATORY JOURNAL	386-90	Qualitative research	_	Yes	114 4 earlobe fell off and 11 sats artifacts due to coughing movement therefore not included. 99	70 males, 40 females Mean age 61+/-15yr Malignancy 38%, Infiltrates 28%, haemoptysis 8%, ILD 8%, sarcoid 5%, stent inspection 4%, cough 3%, lung surgery 2%, other 3 Mean dose midazolam 0.06+/-0.03mg/kg	Combined oximetry and Pc,CO2 were prospectively measured	None	During FOB only	Combined oximetry and Pc,CO2	Mean peak PcCO2 6.11+/-1.19kPa was significantly higher than mean baseline PcCO2 4.78+/-1.06kPa (p<0.0001). Peak PcCO2 recorded at a mean 13+/-7min. Mean rise in procedure was 1.26+/-0.7kPa. Mean PcCO2 at end of procedure 5.85+/-1.19kPa. Baseline SaO2 97+/-2. Lowest mean SaO2 93+/-4. Mean PcCO2 measured at lowest SaO2 was 5.85+/-1.86kPa and mean peak PcCO2 subsequently recorded was 6.78+/-1.72kPa Peak PcCO2 significantly associated with higher baseline PcCO2 (p<0.0001) and lowest SaO2 (p=0.016). Change in PcCO2 was significantly associated with baseline PcCO2 (p=0/024) and lowest SaO2 (p=0.016) Lowest baseline Sa02 (p=0.003, OR 0.6) and peak PcCO2 (p=0.041, OR1.1) were significantly associated with significant hypoxaemia No relationship with age and midazolam dose, severity of COPD with	Not known	

														PcCO2 mean+/-SD. Multivariate analysis was performed using analysis of covariance to examine peak Pc,CO2, change in Pc,CO2 from baseline, and change in Pc,CO2 adjusted for baseline Pc,CO2 during bronchoscopy as dependent factors versus patient age, dose of midazolam (mg/kg-1), baseline Pc,CO2 and lowest Sp,O2 as independent factors.		
Belen, J.Neuhaus, A.Markowitz , D.Rotman, H. H.	Modification of the effect of fiberoptic bronchoscopy on pulmonary mechanics	1981	CHEST	516-9	Qualitative research	_	No	33	23 male 10 female Mean age 51 (22-70) Patients undergoing diagnostic FOB whilst in patients Clinically stable Randomly assigned to atropine isoproterenol or no premedication. 22 airway obstruction. No difference between groups	Lung function pre and post FOB	Difference in lung function between atropine isoproterenol or no premedication and lidocaine following FOB	4 hours post FOB	Changes in FEV1 FVC PEFR	Mean percentage change Comparison by t test	Not stated	Demonstrates adverse effects of Lignocaine and FOB on lung function
Maranetra, N.Pushpakom, R.Bovornkitti, S.	Oxygen desaturation during fibreoptic bronchoscopy	1990	JOURNAL OF THE MEDICAL ASSOCIATION OF THAILAND	258-63	Qualitative research	_	No	N=100	M:F 69:31 Age 17-84yrs, median 58yrs Requiring diagnostic bronchoscopy (Lung cancer , n=62; pulmonary TB, n=11; pneumonitis, n=18; bronchiectasis, n=9) Excluded if Po2 <50, paCO2 >60, platelets<60, recent myocardial insufficiency Performed under IM atropine, topical lidocaine	Deterioration in arterial saturation during bronchoscopy	Comparison of saturation by posture, heart rate, intervention, airflow obstruction, baseline hypoxia	Not recorded	Heart rate, oxygen saturations, peak flow	Baseline hypoxaemic patients experience greatest decline in saturation (p<0.05). Non-hypoxaemic patients at baseline experienced significant desaturation in sitting position compared with hypoxaemic patients (p<0.01)	Not reported	
Fang, Wen-FengChen, Yung-CheChung, Yu-HsiuWoon, Wei-TongTseng, Chia-ChenChang, Hsueh-WenLin, Meng-Chih	Predictors of oxygen desaturation in patients undergoing diagnostic bronchoscopy	2006	Chang Gung Medical Journal	306-12	Qualitative research	_	Yes	137 randomly selected	Undergoing FOB	predictors of oxygen desaturations during FOB	None	During FOB	Alterations in oxygen flow, changes in SpO2,	The Student t test or Wilcoxon rank sum test was used to compare continuous variables, and the 2 test or Fisher exact test was used for categorical variables. A p value of < 0.05 was considered statistically significant.	Not known	Need for O2 preprocedure was predictive of higher rate of desaturation (73.9% vs. 50%, p=0.036). Procedure type was the most important predictor of desaturation (lavage 88.9%, wash 43.8%, brush 15.3%, biopsy 10%) Low PEFR preprocedure seemed predictive of high rates of desaturation in patients undergoing lavage/ wash
Um, Sang-WonChoi, Chang-MinLee, Choon-TaekKim, Young WhanHan, Sung KooShim, Young-SooYoo, Chul-Gyu	Prospective analysis of clinical characteristics and risk factors of post bronchoscopy fever	2004	CHEST	945-52	Qualitative research	+	Yes	N=801 excluded if immune drugs, HIV+, T>37.5, intubated/ ventilated, therapeutic bronch, antibiotics in last 3d. Therefore n=518	Table 2—Demographic Characteristics and Baseline Pulmonary Function Tests* Characteristics Non fever Group Fever Group p Value Age, yr 56.4 0.6 54.2 3.1 0.05 Male/female sex, No. 318/174 19/7 0.05 Smoker/nonsmoker, No. 262/230 15/11 0.05 Pack-years 15.2 0.9 16.7 3.8 0.05 FEV1, predicted % 87.1 1.1 83.4 2.5 0.05 FVC, predicted % 88.2 0.8 86.2 3.4 0.05	Incidence, clinical characteristics, and possible risk factors of fever following FOB	Yes, fever	24hrs	FBC, Spirometry, CXR, sputum cultures, cytology, CT scans	5% developed post bronchoscopy fever (n=26) mean peak t 38.5C +/-0.1 (37.8-39.9) with onset 8.7+/-1.1hrs, duration 14+/-3.1hrs. Bacteraemia 0% CXR infiltrate 5.3% Additional symptoms of cough (42.3%), sputum production (38.5%), chills (34.6%) and dyspnoea (3.1%). Significant increase in total WBC and neutrophils at time of fever compared with baseline On univariate analysis, abnormal radiology (p=0.034) or bronchoscopy	Not reported	

									FEV1/FVC, % 72.2 0.5 71.1 1.9 0.05 Non fever (n=492) Fever (n=26) M/F 318/174 19/7 Smoker/ non S 262/230 15/11 Pack years 15.2+/-0.9 16.9+/-3.1 FEV1 87.1+/-1.1 83.4+/-2.5 FER 77.2+/-0.5 71.1+/-1.9 All p>0.05. Korean University Hospital					findings (p=0.04), duration >10min (p=0.001), performance of wash/ lavage (p=0.004) or biopsy (p=0.001), presence of mod-severe bleeding (p<0.001), and diagnosis of TB (p=0.023) were associated with risk of post bronch fever. On multivariate analysis only diagnosis of TB on BAL (RR 3.32 CI 1.12-9.80, p=0.03) and severity of bleeding (RR3.23 CI 1.14-9.12, p=0.027) were independent predictors of fever		
Kanemoto, KoujiSatoh, HiroakiIshikawa, HiroichiIshikawa, ShigemiOhtsuka, MorioSekizawa, Kiyohisa	Prospective study of fever and pneumonia after flexible fiberoptic bronchoscopy in older people	2006	JOURNAL OF THE AMERICAN GERIATRICS SOCIETY	827-30	Qualitative research	_	Yes	358 165(46.1%) patients aged 70 and older.	Age 70+: 46.1%, Age 76 (70-89), M125 F40, Indication – mass 67%, Abnormal bronchoscopy 38.2%, wash & Lavage n=83 Age<70: 53.9%, M136 F57, Age 59 range 19-69, Indication –mass 67%, abnormal bronchoscopy 67%, Wash & Lavage n=97 66% for mass/nodule no difference in ><70 No difference in procedures performed. Diagnosis of cancer more common over 70	Adverse events of FOB were defined as events occurring during or within 72 hours of the FOB, even if there was no apparent causal relationship to FOB. Chest radiographs, white blood cell counts, and C-reactive protein (CRP) were obtained before each bronchoscopy and 2 days after the procedure. Additional studies were performed if there were symptoms and signs of pneumonia. Fever was considered to be an elevation of axillary body temperature of 381C or greater. Postbronchoscopic pneumonia was defined as development of a new or progressive infiltrate on chest radiograph with peripheral leukocytosis and elevation of CRP after the procedure.	The frequency of fever and pneumonia after FOB in older people and to evaluate increased risk for these two adverse events with increasing age.	72HOURS	Fever and pneumonia	Statistical significance was determined using the chi-square test, with statistically significant results reported as Po.05.	Not known	Increasing age is not associated with increasing fever and pneumonia after the procedure and provide an evidence that chronological age should not be considered a limiting factor in the decision of whether to perform FOB when it is clinically indicated.
Milman, N.Faurschou, P.Grode, G.x00F,rgensen, A.	Pulse oximetry during fibreoptic bronchoscopy in local anaesthesia: frequency of hypoxaemia and effect of oxygen supplementation	1994	RESPIRATION	342-7	Qualitative research	+	Yes	N= 160 consecutive Allocated at random into 4 groups each of n=40.	M:F 108:52 Median age 62 yrs (range 25-80) Indications were local or diffuse pulmonary lesions, or normal CXR with symptoms. Performed under local anaesthesia with atropine diazepam premed and IV midazolam Gp 1 M:F 28:12 Age 56+/-14 FEV12.3+/-1.1 (no O2 supplement) Gp 2aM:F 27:13 Age 60+/-12 FEV1 2.2+/-1.1 (2l/min nasal catheter in nostril) Gp2b M:F 23:17 Age 61+/-13	Frequency of hypoxaemia during FOB Effect of different doses of O2 supplementation Comparison of two oxygen catheters	Comparison of variable before during and after bronchoscopy according to method of O2 supplementation	Not recorded	Saturation, ABG, pulse rate	Gp1 Significant fall in mean and trough Sao2 during bronchoscopy and remained low after (80% SaO2<90, 35% SaO2 <85, tachycardia >120 20%, bradycardia <50 0%) Gp2a Significant rise in mean SaO2 during bronchoscopy followed by significant fall post bronchoscopy. Trough SaO2 remained constant throughout. (28% SaO2<90, 2.5% SaO2<85, tachycardia >120 23%, bradycardia <50 2.5%) Gp2b Significant rise in mean and trough SaO2	Not reported	

									FEV1 2.2+/-1.0 (2l/min posterior soft palate) Gp3 M:F 28:12 Age 62+/-11 FEV1 2.2+/-0.7 (3l/min posterior soft palate) Gp 1 CXR local (73%), diffuse (20%), normal (7%) TBB (58%) BAL 15% Gp2a CXR local (62%), diffuse (26%), normal (12%) TBB (49%) BAL 15% Gp2b CXR local (61%), diffuse (28%), normal (11%) TBB (20%) BAL 0% Gp3 CXR local (68%), diffuse (16%), normal (16%) TBB (34%) BAL 21%					during bronchoscopy followed by a significant fall post bronchoscopy (13% SaO2<90, 0% SaO2<85, tachycardia >120 15%, bradycardia <50 2.5%) Gp 3 Similar to group 2balthough significantly higher trough levels (13% SaO2<90, 2.5%SaO2<85, tachycardia >120 10%, bradycardia <50 0%)		
Arai, T.Hatano, Y.Komatsu, K.Takada, T.Miyake, C.Harioka, T.Reshad, K.	Real-time analysis of the change in arterial oxygen tension during endotracheal suction with a fiberoptic bronchoscope	1985	CRITICAL CARE MEDICINE	855-8	Qualitative research	_	Yes	12	Males 50%, age 24-71, FEV1 43-94%predicted Diagnoses: Malignancy 2, TB 7, Haemopneumothorax 2, Middle lobe syndrome 1 lobectomy 5, pneumonectomy 3, decortication 2, thymomectomy 1, bullectomy 1	Change in PiO2 and PaO2 by suction	Endotracheal suction for 1 minute comparing a) without O2 supplementation b) O2 delivered through a high frequency jet ventilator HFJV c) O2 at 10L/min through suction adaptor.	Through procedure only	Changes in PiO2 and PaO2	Linear regression analysis before and at end of suctioning	Unknown	Small study and in intubated patients. However demonstrates that suctioning reduced PaO2 and increased Heart rate
Romagnoli, M.Vachier, I.Vignola, A. M.Godard, P.Bousquet, J.Chanez, P.	Safety and cellular assessment of bronchial brushing in airway diseases	1999	RESPIRATORY MEDICINE	461-6	Qualitative research	+	Yes	25 asthmatics 19 chronic bronchitics/COPD 26 healthy controls	Asthma (n=25), chronic bronchitis (n=19), healthy controls (n=26) Asthma: median age 53, range 23-75, males 64%, airflow obstruction with 12% reversibility and 200mls, Non-smokers. Chronic Bronchitis: median age 56yrs, range 42-75, males 84%, median 61 pack years (range 30-150). Asthma and associated features excluded. Healthy Controls: median age 51, range 25-78, 81% male, non-smokers, normal lung function	safety of FOB in asthmatics and CB. Cellular yield and viability of BEC in these groups Is bronchial brushing safe in variable severity asthma and chronic bronchitis	asthmatics vs. CB vs. healthy at different stages of FOB none for safety	3 hours plus telephone contact	symptoms; saturations; yield and viability of BEC FEV FVC pre and post	No participant demonstrated symptoms or significant bleeding (requiring cold saline/ adrenaline). No asthma exacerbations. Minimum (p=ns) fall in arterial oxygen saturation compared with healthy controls.	not recorded	well tolerated in asthmatics mild-mod and CBs
Humbert, M.Robinson, D. S.Assoufi, B.Kay, A. B.Durham, S. R.	Safety of fibreoptic bronchoscopy in asthmatic and control subjects and effect on asthma control over two weeks	1996	THORAX	664-9	Qualitative research	+	Yes	Study 1 21 asthmatics (29 recruited) Study 2 15 asthmatics 10 controls	Young age	Changes in the asthmatic subjects were compared with those in normal control subjects in order to detect immediate effects of sedation (as opposed to bronchospasm) on peak flow rates and FEV1. We have also documented the effect of bronchoscopy on PEFR, asthma symptoms, -and	Asthmatics vs. healthy controls	2 hours post FOB Symptom diary 2 weeks pre and post FOB	Asthma symptoms were assessed daily and recorded on a diary card for two weeks before and after the bronchoscopy using a daily symptom score which assessed sleep, chest tightness, wheeze,	Data are presented as medians with range. Comparison between time points or groups was by the Mann-Whitney U test with Bonneferoni's correction for multiple comparisons where appropriate. The daily asthma symptom score, medication use, and morning PEFR for each day over the two weeks before and after the bronchoscopic examination were analyzed by analysis of variance (ANOVA) to detect significantly different time	Not known	In all cases the procedure was clinically well tolerated. There was no difference in the effect of the bronchoscopy on PEFR between asthmatic and control subjects, suggesting that falls in PEFR may reflect sedation rather than bronchospasm. In addition, we have shown that asthma symptom scores, rescue salbutamol intake, and morning PEFR were not altered up to two weeks after the procedure. Occasional individual patients did show an increase in symptom score, PEFR variability, or D agonist

										bronchodilator requirements in the two weeks after the procedure.			cough, sputum production, and dyspnoea (DASS, table 1), rescue P agonist use, and morning and evening PEFR as the best of three prebronchodilator readings.	points for the asthmatic subjects in the second study. Comparison between the maximal fall in PEFR in asthmatic subjects included in study 1 (bronchoalveolar lavage and bronchial biopsy specimens) and study 2 (bronchial biopsy specimens only) was by the Mann-Whitney U test. Correlations between the fall in PEFR associated with bronchoscopy and baseline FEV1 and bronchial responsiveness in both study groups were sought using Spearman's rank correlation.		use in the two weeks after the procedure when compared with the run-in period, but some also showed an improvement in the measures which suggests that this may reflect the variable nature of asthma rather than an effect of bronchoscopy per se.
Elston, W. J.Whittaker, A. J.Khan, L. N.Flood-Page, P.Ramsay, C.Jeffery, P. K.Barnes, N. C.	Safety of research bronchoscopy, biopsy and bronchoalveolar lavage in asthma	2004	EUROPEAN RESPIRATORY JOURNAL	375-7	Qualitative research	+	Yes	159 (273 bronchoscopies)	84 males, 75 females FEV1 53-120%predicted, median 88% median age 27 (range 18-52) BAL n=228 (48 post allergen challenge) EBB n=48 84M 75F FEV1 53-120% (88 median) 18-52yo median 27 recruited for 6 studies and had 273 FOBs 228 EBBx and BAL (48 post allergen). 45 EBBx alone. London Chest Brompton. Eligibility: 18-52 history of asthma; rev airflow obstruct; PC20<8 mild asthma w allergen History. PC20 measured in 3 studies other had to be less than 4.	Adverse events in asthmatic patients undergoing bronchoscopy	None	For duration of study	Adverse events	%	Variable	Overall complications 4% with EBB alone, 14% with BAL. Commonest complications - fever/flulike illness 3% - bronchospasm prediscarge 2% - Worsening asthma post discharge 2% Acceptable safety profile in mild-mod asthmatics. Largest series. Well tolerated by majority most minor with no specific |Rx. 2 require hospitalisation for pneumonitis and require Antibiotic discharged in 2days
Hern,x00E,ndez Blasco, L.nchez, Hernndez, I. M.Villena Garrido, V.de Miguel Poch, E.Nu,x00F,ez Delgado, M.Alfaro Abreu, J.	Safety of the transbronchial biopsy in outpatients	1991	CHEST	562-5	Qualitative research	+	Yes	169 patients 184 TBBs	The population ranged in age from 15 to 82 years, with a mean of 55 ± 15 years; 123 were male patients (73 %), and 46 were female patients (27 %). 42%of the TBBs were performed in patients older than 60 years of age.	safety of FOB with TBB in non hospitalized patients	None	FOB and phone call 72hours later	Adverse events Significant hemoptysis as the emission of more than 100 ml of blood with cough during or after the FOB and moderate hemoptysis when the quantity collected varied between 20 and 100 ml. Parenchymal hemorrhage was considered as such when at the end of four hours' observation, there was evidence by means of fluoroscopy or the CXR of a newly detected infiltrate	%	Not known	In TBB in non hospitalized patients is a technique with a low incidence of complications within our population; we do not believe that hospitalization of the patient is necessary just to perform FOB; we consider that a minimum observation period of several hours is advisable, as well as subsequently performing a chest roentgenogram

													located in the area where the TBB was carried out, whether it was associated with hemoptysis or not. The diagnosis of postbronchoscopic pneumonia was established in the presence of acute febrile disease with purulent sputum and lung condensation, localized in the area where the samples of the TBB were taken and with an onset in the 72 hours following the procedure. It was considered that the patient presented significant chest pain when it was of new occurrence during the procedure and it was referred to the site where the TBB sample was taken, whether or not it presented pleuritic features.			
Mehta, N. L.Harkin, T. J.Rom, W. N.Graap, W.Addrizzo-Harris, D. J.	Should renal insufficiency be a relative contraindication to bronchoscopic biopsy?	2005	Journal of Bronchology	81-83	Qualitative research	+	Yes	1170 bronchoscopies, n=72 BUN>30mg/dl (~10.7mmol/l) , Creat >2mg/d l (~177umol/l) N=7 (28% ESRF), n=18 (72% uraemic)	All HD patients had dialysis within 24 hrs bronchoscopy and had DDAVP 5 year retrospective chart review Haemodialysis patients 6 of 7 pts had biopsy (BUN 31-65mg/l, Creat 5.2-18.7mg/l)), 1/7 TBNA (BUN 32mg/l, creat 4.3mg/l) Non-dialysis patients 12/18 had biopsy (BUN 20-69mg/l, Creat 0.9-2.5mg/l), 4TBNA (BUN 20-62mg/l, Creat 1.1-4.5mg/l) and biopsy + TBNA (n=2, BUN 30-35mg/l, creat 1.4-1.5mg/l)	Renal insufficiency and complications from bronchoscopic biopsy	No comparisons	Not recorded	Complications of biopsy/ TBNA	Haemodialysis group – no complications Non-dialysis – 2 complications (1 minor [ceased with adrenaline and wedging bronchoscope], 1 major haemorrhage[unrecognised previously suspected coagulopathy]) Overall complication rate 2/25 = 8% Major 4%, minor 4%	Not reported	

Diette, G. B.Wiener, C. M.White, P., Jr.	The higher risk of bleeding in lung transplant recipients from bronchoscopy is independent of traditional bleeding risks: results of a prospective cohort study	1999	CHEST	397-402	Qualitative research	+	Yes	720 FOBs 697 had data (96.8%). When questionnaires performed 608 FOBs 521(85.7%) eligible and 451(86.6%) completed forms pre and post (qnaires).	Eligible all adults>18 undergoing FOB. Exclusions: Non English speaking; mechanically ventilated; unable to communicate or died within 48hrs of FOB. 38FOBs in 15 patients who had lung transplants 8 single (6 COPD 2IPF) 7 double (4CF 1PH 1Eisen 1COPD) 2wks to 19months post transplant. Transplant recipients white younger and aspirin use compared to other FOBs(stat significant). No abnormal clotting. Only 6 patients had history of previous heavy bleeding post surgery(1 transplant).	Bleeding risk	Post transplant FOBs vs. non transplant	FOB	Outcome measures: 3 markers of bleeding during and post: 1. Patient self reporting increased/new haemoptysis post FOB; 2. physician reported bloody secretion volume ml in fluid trap at end or 3. early termination for bleeding. Patients answered questionnaire 24hrs before and then 48hrs after and rated symptoms 4 point scale.	Stats chi test t test logistic regression etc.	Not known	Transplant pat more likely to bleed. Not explained by clotting asp use or TBB.
Hendy, M. S.Bateman, J. R.Stablefort h, D. E.	The influence of transbronchial lung biopsy and bronchoalveolar lavage on arterial blood gas changes occurring in patients with diffuse interstitial lung disease	1984	British Journal of Diseases of the Chest	363-8	Qualitative research	_	Yes	26 10 TBB and BAL without O2 10 TBB and BAL with supplementary O2 6 TBB only without O2	Mean age of 58 (range 31-83) years and 18 were male. The first ten patients had both transbronchial biopsy and bronchoalveolar lavage performed breathing room air alone during the bronchoscopy procedure. Their diagnoses were sarcoidosis in three, cryptogenic fibrosing alveolitis in two, and one each with bird fancier's lung, rheumatoid lung, asbestosis, pneumoconiosis and progressive systemic sclerosis. Their mean resting Pao2 was 9.49 kPa (range 7.38-12.69). Ten further patients also had transbronchial biopsy and bronchoalveolar lavage performed but, in addition, were given supplementary oxygen via nasal catheters at a rate of 4 litres/min before, during and for 30 minutes after the procedure. Their diagnoses were cryptogenic fibrosing alveolitis in four, sarcoidosis in three, and one each with progressive systemic sclerosis, silicosis and asbestosis. Their mean resting Paop was 10.09 kPa (range 6.49-13.89). The remaining six patients underwent transbronchial biopsy alone breathing room	Blood gas variations and requirements for supplementary oxygen in patients with lung disease having FOB and TBB.	with or without O2	FOB	Fall in PaO2	numerical	Not known	All patients showing significant falls in PaO2. Those five patients having the combined procedures, breathing room air, with basal Paog levels of greater than 8.5 kPa had a mean fall in Pao2 of 17.5% (1.34 kPa). Thus all of our patients, during the combined procedures, either developed hypoxia or had their hypoxaemia exacerbated. Our results indicate that transbronchial biopsy and bronchoalveolar lavage may be performed together in patients with diffuse interstitial lung disease without an important fall in the arterial oxygen tension only if oxygen is started prior to bronchoscopy and continued for 30 minutes after completion of the procedure. The routine administration of oxygen by nasal catheters to patients undergoing transbronchial biopsy alone or with bronchoalveolar lavage would therefore seem to be reasonable, as it prevents falls in the arterial oxygen tension and may thereby reduce related complications

									air. Their diagnoses were cryptogenic fibrosing alveolitis in three, sarcoidosis in two and alveolar carcinoma in one. Their mean resting Pa02 was 8.88 kPa (range 6.30-10.89).Ra							
Burns, D. M.Shure, D.Francoz, R.	The physiologic consequences of saline lobar lavage in healthy human adults	1983	American Review of Respiratory Disease	695-701	Qualitative research	_	Yes	19 subject and 6 controls	11 male 14 female 18-41 years Non smokers No occupational exposure, history of wheezing, pneumonia or respiratory complaints Normal ABGs, Spirometry CXR and perfusion scans	Acute pathophysiological consequences of lobar and segmental lavage as measured by ABGs lung function, spirometry, CXR and V/Q scans.	lavaged non lavaged controls 3 with 3 without supplementary O2 lavaged without supplementary O2 saline at RT(6) lavaged with supplementary O2 Saline at RT (7) lavaged with supplementary O2 saline at 38 (6) Supplementary O2 15L/min	24 hrs after FOB	Acute pathophysiological consequences of lobar and segmental lavage as measured by ABGs lung function, spirometry, CXR and V/Q scans.	Percentage change	NIH	Need supplemental O2 when performing lavage with saline warmed to body temp and continued for 8 hours
Hehn, Boyd T.Haponik, EdwardRubin, Haya R.Lechtzin, NoahDiette, Gregory B.	The relationship between age and process of care and patient tolerance of bronchoscopy	2003	JOURNAL OF THE AMERICAN GERIATRICS SOCIETY	917-22	Qualitative research	+	Yes	1358 Age >70, 219 (16.1%) 515 patient satisfaction	Age 18-29: n=135, 8.7% male, 52% white, 31% HIV, 67% immunocompromised, 5% solid transplant, 6% COPD, <1% IHD, 7% ILD Age 30-39: n=271, 21% male, 40% white, 50% HIV, 7% immunocompromised, 9% solid transplant, 2% COPD, 0% IHD, 4% ILD Age 40-49: n=257, 50% male, 45% white, 35% HIV, 61% immunocompromised, 6% solid transplant, 6% COPD, 1% IHD, 13% ILD Age 50-59: n=212, 55% male, 64% white, 11% HIV, 39% immunocompromised, 9% solid transplant, 22% COPD, 8% IHD, 9% ILD Age60-69: n=274, 54% male, 72% white, 2% HIV, 30% immunocompromised, 11% solid transplant, 37% COPD, 10% IHD, 14% ILD Age 70-79:n=179, 55% male, 79% white, 0% HIV, 11% immunocompromised, 0% solid transplant, 28% COPD, 13% IHD, 7% ILD Age>80: n=30, 67% male, 79% white, 0% HIV, 0% immunocompromised, 0% solid transplant, 47% COPD, 23% IHD, 3% ILD	Determine the extent to which older persons tolerate FB by symptoms, satisfaction and safety	Indication, sampling procedure and adverse events by age	FOB with questionnaire 48hours post FOB	Patients were divided into the following age groups for the purposes of this study; 18 to 29, 30 to 39, 40 to 49, 50 to 59, 60 to 69, 70 to 79, and 80 years and older. To determine whether there was an apparent threshold for care and outcomes. Measures of the processes of care included the primary indication for FOB, medication used, and FOB sampling technique. Outcomes included pain control during FOB, the patient's willingness to return, and adverse events: list of 12 items with accompanying definitions: respiratory failure, aspiration of gastric	Primary indication changed significantly with age. Evaluation of SPN [p<0.001), mass (p<0.001), nodes (p<0.001) increasingly common with age, whereas evaluation of focal/ diffuse infiltrates were commoner in younger patients (p=0.014 and p<0.001, respectively) TBNA and TBLB performed more commonly in older patients, but differences not significant following stratification for indication Mean fentanyl and mean midazolam dose decreased with increasing age (p<0.001). No significant difference in lidocaine dose. No differences in reported pain control and ~90% of all age groups would return for further exam Adverse events significantly greater with increasing age (p<0.001). Respiratory complications were infrequent (excluding desaturation); bronchospasm 0.5%, laryngospasm 0.2%, pneumothorax 1.2% [increased incidence age >70, p=0.01. No association with COPD], haemoptysis 2.4%. Non-respiratory adverse events also infrequent. Transient hypotension 1.8% (increasing with age, p<0.01), cardiac arrhythmia 1.0% (not increased with age, p=0.12), deaths 0.1% (no	John Hopkins Medicine	Figure 2, table 2 and 3?

													contents, bronchospasm, laryngospasm, epistaxis, hemoptysis, oxygen desaturation, arrhythmia, hypotension, death, pneumothorax or pneumomediastinum, or other events not listed.	association with age) This study described baseline patient characteristics using the proportion of categorical or ordinal values and means for continuous variables. Means are reported as standard deviation. Statistical significance was determined by using the chi-square test, chi-square for trend, Cuzik nonparametric test for trend, and multivariate analysis with statistically significant results reported as P<0.05		
Attaran, D.Towhidi, M.Amini, M.Toosi, M.	The relationship between peak expiratory flow rate before bronchoscopy and arterial oxygen desaturation during bronchoscopy	2008	ACTA MEDICA IRANICA	95-98	Qualitative research	_	Yes	66 consecutive patients referred for FOB enrolled in study	Consecutive patients referred for FOB 35 male 21 female Median age 53 (14-82)	Is there a relationship between PEFR and incidence of hypoxia during FOB	No	2 hours post FOB	Relationship between pre FOB PEFR% and degree of ABG desaturation during and after FOB	p<0.05 considered statistically significant. Chi squared and correlation coefficient	Unknown	Lower PEFR increases risk of hypoxia... However only 14 in sustained hypoxia group.
Milman, N.Faurschou, P.Munch, E. P.Grode, G.	Transbronchial lung biopsy through the fibre optic bronchoscope. Results and complications in 452 examinations	1994	RESPIRATORY MEDICINE	749-53	Qualitative research	+	Yes	1144 consecutive patients had 1239 fobs. 405 patients (35%) had TBBx at 452 FOBs (i.e. 47 re FOBs).	Male 236 Female 169 Median age 59, range 19-86 FEV1<1.01 in 5% (median 0.71, 0.5-0.91) FEV1 <50% predicted in 16% (median 41%, 21-49) Excluded if respiratory insufficiency with PaO2 <8KPa, unstable cardiac function, coagulation defects. Performed with oral diazepam/ atropine premed and 2-4mg iv midazolam under fluoroscopic guidance. Includes both diffuse and focal lung disease	Diagnostic yield and complications of TBB	Complications between focal and diffuse disease, malignant and nonmalignant aetiology	24 hours	Complications and diagnostic yield	Localised Pulmonary Lesions (n=279, 307 bronchoscopies) - overall diagnostic yield 55.2% (malignancy 45.5%; non-malignant 65.4%) - diagnostic yield >4 biopsies 70%; ≤4 biopsies 52% (p<0.05) - diagnostic yield decreases with smaller size (p=0.09) and distance from the carina (p<0.02) Diffuse Pulmonary Lesions (n=126, 145 bronchoscopies) - overall diagnostic yield 66.7% (malignant 73.3%, non-malignant 78.5%) - diagnostic yield >4 biopsies71%; ≤4 biopsies 65% (p=0.11) Complications of TBB seen in 6% (n=27) - Major bleeding 0.2% - Pneumothorax 5.8% (localised 4.3%, diffuse 9.0%), unrelated to number of biopsies - Intercostal drainage 3.8% (localised 2.0%, diffuse 7.6%)	Not reported	
Alzeer, Abdulaziz H.Al-Otair, Hadil A.Al-Hajjaj, Mohammed S.	Yield and complications of flexible fiberoptic bronchoscopy in a teaching hospital	2008	SAUDI MEDICAL JOURNAL	55-9	Qualitative research	+	Yes	720 patients 13 (1.8%) incomplete data 707	Consequent FOBs over 3 years in Saudi University Hospital. Mean age 42+/-18 452 (63.9%) males	Complication rate of FOBs	None	Not stated	Complication rate	Percentage	Unknown	Younger patients and less cancer. Like previous Saudi data healthier subjects with less comorbidity

STUDY IDENTIFICATION / CITATION					Study Type	Quality Rating	POPULATION CHARACTERISTICS		INTERVENTION	COMPARISON	FOLLOW UP	OUTCOMES	EFFECT SIZE	FUNDING	COMMENTS
Author	Title	Year	Journal Title	Pages			NUMBER	PATIENT CHARACTERISTICS							
Ameer, B. Burlingame, M. B. Harman, E. M.	Systemic absorption of topical lidocaine in elderly and young adults undergoing bronchoscopy	1989	PHARMACOTHERAPY	74-81	Qualitative research	++	19 patients; 5 'young' - 30-50 years; 14 'elderly' - 60-75 years.	Young' vs. 'elderly' - age 41.6 vs. 66.6, male 80% vs. 86%, body weight 64.1kg vs. 79.9kg	Relationship of age and plasma lidocaine concentration in patients undergoing bronchoscopy. Premedication with im atropine and codeine followed by topical lidocaine. 4% lidocaine gargle; 2% lidocaine spray to oropharynx; 2% lidocaine gel to nose; 1% lidocaine to bronchial tree.	Young' versus 'Elderly'	Until 240mins post lidocaine	Dose of lidocaine administered; plasma lidocaine concentration; signs of toxicity	Similar overall amounts of lidocaine administered ('young' vs. 'elderly') 19.01mg/kg vs. 17.15mg/kg; mild objective and subjective findings of possible toxicity were not related to plasma concentration and not different between groups (nausea/vomiting, drowsiness, lightheadedness, occasional ectopics, shortness of breath). Mean maximum lidocaine concentration 3.04 vs. 2.40microg/ml, ns. No plasma concentrations in excess of 5microg/ml.	Not stated	High overall doses of lidocaine administered appear equally safe for patients aged 30-50 years and 60-75 years. Mean maximum lidocaine concentrations were seen (3.04, 2.40microg/ml). No plasma concentrations in excess of 5microg/ml. If lidocaine gargle is assumed not to be absorbed, mean total dose was 10.6mg/kg.
Antoniades, N. Worsnop, C.	Topical lidocaine through the bronchoscope reduces cough rate during bronchoscopy	2009	Respirology	873-6	RCT	++	18 - lidocaine; 32 - placebo (saline)	All consecutive patients undergoing diagnostic flexible bronchoscopy at a tertiary institution in Australia were eligible for the study. Mean age 65.5 (lidocaine), 61.6 (placebo). Male 44% (lidocaine), 58% (placebo).	Bronchoscopy with either lidocaine or placebo (normal saline) to larynx, vocal cords and tracheobronchial tree. All patients had topical lidocaine gel to nose and 6 sprays of co-phenylcaine spray to oropharynx	Between treatment and placebo	Until end of bronchoscopy	Primary outcome not defined. Frequency of cough and stridor measured using recorder. VAS assessment of amount of coughing and cough interference with bronchoscopy (separately by doctor and nurse). Sedation requirement (midazolam and fentanyl).	Significant changes - cough rate decreased from 27.50/min (placebo) to 12.20 (lidocaine); stridor rate reduced from 0.80 (placebo) to 0.22 (lidocaine). VAS-assessed cough scores were lower for lidocaine, as assessed by nurses and doctors. Less midazolam required for lidocaine arm (2.1mg vs 3.4mg) and less fentanyl required for lidocaine arm (81.9mg vs 98.4mg).	Not stated	Airway local anaesthesia with lidocaine is associated with a significant improvement in cough and stridor rate. Lower doses of midazolam and fentanyl are needed when lidocaine is used.
Atassi, K. Mangiapan, G. Fuhrman, C. Lasry, S. Onody, P. Housset, B.	Prefixed equimolar nitrous oxide and oxygen mixture reduces discomfort during flexible bronchoscopy in adult patients: a randomized, controlled, double-blind trial	2005	CHEST	863-8	RCT	++	206 patients, 103 in each arm. Power calculations suggested that 240 patients were required, but recruitment rate led to earlier trial stoppage.	Adult patients were recruited in a tertiary care hospital. Patients were excluded for any of the following: (1) absence of indication for BAL or bronchial biopsy leading to a FB duration too short to assess all parameters of patient stress; (2) respiratory failure; (3) low performance status; (4) inability to answer the questionnaire; (5) pregnant or breeding women; and (6) contraindication to nitrous oxide usage. Mean age ~54 years old, and ~68% were in-patients	Randomized, double-blind study of 50%/50% nitrous oxide/oxygen mix vs. 50%/50% nitrogen/oxygen at 9-12L/min via facemask with a one-way valve for bronchoscope introduction. Administration of the gas started 3 min before the procedure and ended with the removal of the bronchoscope. All procedures were performed 10 min after local anesthesia similar in both groups and using 2% xylocaine nebulisation in the oropharynx and nasal fossae and instillation on vocal cords and in the tracheobronchial tree not exceeding a total dose of 400 mg. Nasal introduction of the endoscope was the first approach.	Between treatment and placebo	Until 30 mins post-bronchoscopy	The primary outcome pulse rate and BP (?systolic) during the procedure. Secondary outcomes were self-assessed pain using a 10cm visual analog scale (VAS) and patient assessment of willingness to undergo repeat procedure, nasal pain, cough and most painful part of procedure.	A small (?5-10mmHg) but significant increase in BP (?systolic) was observed only in the control group (p=0.003), while pulse rate values did not differ between the two groups. VAS-assessed pain was lower in the N2O group (20mm vs. 25mm p=0.02). Nose pain and cough were also significantly reduced by N2O. 87.2% (control) and 92.2% (N2O group) would undergo another flexible bronchoscopy under similar conditions (not significant).	Air Liquide Sante´ Internatio nal grant	Small (~5-10mm Hg) reduction in systolic blood pressure, but not heart rate, associated with use of 50%/50% N2O/oxygen mix compared with 50%/50% nitrogen/oxygen mix. Small reduction in VAS-assessed overall pain, and nasal pain + cough, but clinical significance unclear.
Bosslet GT, Devito ML, Lahm T, Sheski FD, Mathur PN	Nurse-administered propofol sedation: feasibility and safety in bronchoscopy.	2010	Respirology	315-321	Qualitative research	+	498/588 patients undergoing bronchoscopy (subset who had nurse-administered propofol sedation (NAPS))	All patients who underwent NAPS between July 2006 and June 2008 in one institution. Average age 53; average weight 80kg. 84% ASA I or II, 16% ASA III, <1% ASA IV or V.	Sedation for bronchoscopy using NAPS. All patients were sedated by a non-anaesthetic nurse who had been trained in propofol use to achieve moderate sedation. Patients received nasal cannula oxygen 4L/min, 1-2mg midazolam iv, fentanyl 25-50microg iv, then bolus of propofol (20-40mg), followed by boluses of 10-20mg iv every minute to achieve moderate sedation.	No comparisons.	Bronchoscopy record only analysed	Adverse events, propofol dose, procedure time	Average propofol dose 242mg (10-1320mg range), 3.1mg/kg (0.1-20mg/kg), 0.15mg/kg/min (0.01-1.21). Average procedure time 25 min. Total adverse events attributed to sedation - 6.4%; minor = 5.2% (hypoxaemia 3.8%, hypotension 1%, wheezing 0.2%, cough 0.2%), major = 1.2% (bronchospasm 0.2%, hypoxia/respiratory failure 0.8% [2 required ICU admission; 2 required intubation during procedure; 1 required admission for observation], stridor 0.2%)	Not stated	Nurse administered propofol sedation for bronchoscopy, after a formal training course, appears to be associated with reasonable adverse event profile.

Clark, G. Licker, M. Younossian, A. B. Soccal, P. M. Frey, J. G. Rochat, T. Diaper, J. Bridevaux, P. O. Tschopp, J. M.	Titrated sedation with propofol or midazolam for flexible bronchoscopy: a randomised trial	2009	EUROPEAN RESPIRATORY JOURNAL	1277-83	RCT	++	84 patients randomised to midazolam (41 patients) and propofol (43 patients)	Patients attending for diagnostic bronchoscopy at two centres in Switzerland. Mean age 55.2-57.9 years, male 63-72%. Exclusion criteria included the following items: psychological disorders, female patients of child-bearing age, hypersensitivity or allergy to soya, anaesthetic drugs or benzodiazepine, severe chronic obstructive pulmonary disease, unstable haemodynamic status and any signs of systemic or pulmonary infection. Other exclusions were patients with predictable difficult upper airways (Mallampati classification score of III or IV).	Lidocaine administered topically to pharynx (?dose), upper airways (?dose) and intravenously (50mg). Oxygen was only administered if saturations <92%. Sedation given by 40mg propofol (propofol randomised arm) or 2mg midazolam (midazolam randomised arm), with boluses of 20mg propofol or 2mg midazolam >= 2mins apart until electroencephalographic bispectral index (BIS) was between 70-85, at which point bronchoscopy started.	Between treatments	Until 24 hours post bronchoscopy	Primary outcome - time delay from end of procedure until recovery of BIS >90. Secondary outcomes - patient's subjective tolerance (measured on 10cm VAS at 1 hour and 24 hours post bronchoscopy, for domains 'global tolerance', 'pain', 'nausea', 'breathlessness' and 'cough'), operator evaluation of patient tolerance (VAS-assessed 'global tolerance'), recovery of neuropsychometric capacities using a continuous performance test (CPT) performed 15mins and 60mins post-bronchoscopy and cardiopulmonary AE rate	Recovery time (to BIS >90) was significantly (p=0.001) faster for propofol (5.4+/-4.7mins) versus midazolam (11.7+/-10.2mins). No significant differences between groups for adverse events (including hypotension), although two patients in midazolam group required ventilatory support due to desaturation, and an obese patient with moderate COPD required intubation. All CPT variables favoured propofol at 15 mins, and reaction time and incorrect responses remained significantly improved at 1 hour for propofol. Operator VAS-assessment of 'global tolerance' was comparable but patient assessment favoured propofol, reaching significance in a number of domains. Patient cough assessment was similar in both arms.	Lancardis Foundatio	For short bronchoscopy procedures (12.2-12.4mins mean), propofol sedation is associated with a more rapid recovery (as measured by BIS>90 and neuropsychometric testing) than midazolam when sedation is titrated to a BIS of 70-85. Adverse event rates were similar, although a greater proportion of patients had profound sedation following midazolam.
Clarkson, K. Power, C. K. O'Connell, F. Pathmakanthan, S. Burke, C. M.	A comparative evaluation of propofol and midazolam as sedative agents in fiberoptic bronchoscopy	1993	CHEST	1029-31	RCT	++	41 patients; 20 (midazolam); 21 (propofol)	All had asthma; mean age 49.4 (propofol), 51.2 (midazolam). Smoking status not discussed.	Sedation with midazolam (2mg bolus + 1mg aliquots as required) vs. propofol (2mg/kg followed by infusion of 5-10mg/kg/h). All patients had premedication with glycopyrrolate 10 microg/kg iv and 5mg nebulised terbutaline. 4 puffs of 10% lidocaine to nares and oropharynx and lidocaine via bronchoscope to supraglottic regions and below.	Between treatment	Until 90 mins post bronchoscopy	Primary outcome not stated. Time to achieve sedation, recovery time to recall name and dates; alertness scored using digital symbol substitution test (DSST).	Time to sedation - midazolam 179.4s vs. propofol 125.4s (p<0.001); recovery time 6.3min (midazolam) vs. 2.3min (propofol), p<0.045; DSST significantly improved at both 30 min and 90 min for propofol arm.	Not stated	Propofol appears to be superior to midazolam in this group of patients, offering rapid sedating effects and recovery time. Patients were not sedated to a well defined level (ptosis only), and high midazolam doses appeared to be used limiting definitive conclusions.
Cowl CT, Prakash UB, Kruger BR	The role of anticholin-ergics in bronchoscopy. A randomized clinical trial	2000	Chest	188-192	RCT	++	217 patients	Well matched; mean age 62.9-64.9; mean dose of lidocaine 15.1-16.1ml; midazolam dose 1.6-1.9mg	Elective outpatient bronchoscopy. Placebo-controlled, double-blinded study comparing premedication with atropine 0.01mg/kg or glycopyrrolate 0.005mg/kg or saline IM given 15-45 mins prior to procedure). Lidocaine topical anaesthesia, light sedation with midazolam, and all patients intubated during procedure.	Between treatment and placebo	Latest - following day	Secretion control VAS, patient and bronchoscopist; effectiveness of cough suppression VAS, patient, bronchoscopist and anaesthetist; overall patient comfort VAS, patient, bronchoscopist, anaesthetist; ordinal assessment of secretions (dry/moist/wet) by bronchoscopist	No significant benefit to any agent reported by bronchoscopist/anaesthetist/patient for secretion control/cough suppression/overall patient comfort, apart from patient assessment of secretion control for glycopyrrolate, but this was not a consistent pattern. 5 episodes of tachycardia, not seen with placebo.	Not stated	No beneficial effect of glycopyrrolate or atropine in a well-conducted RCT using clinically-meaningful outcomes.

Crawford, M. Pollock, J. Anderson, K. Glavin, R. J. MacIntyre, D. Vernon, D.	Comparison of midazolam with propofol for sedation in outpatient bronchoscopy	1993	BRITISH JOURNAL OF ANAESTHESIA	419-22	RCT	++	21 patients in each arm (propofol vs. midazolam	42 patients having bronchoscopy. Midazolam:Propofol - age 63.5:63.9; weight 54.85:63.65; males 9:16	Double-blinded allocation to iv propofol (infusion) or midazolam (boluses). Topical lidocaine as per protocol. Bronchoscopists and patients well blinded to drug. Sedated until had closed eyes but were rousable to command.	Between treatment	60 mins post bronchoscopy	Primary outcome not stated. No power calculation. 10cm anxiety VAS, effects on systolic arterial pressure and oxygen saturation. Memory tested using Warrington Memory Recognition Tests (short term recall, out of 25); motor reaction timer and finger-nose testing also used, all before and 60 min after the end of the procedure.	No differences in mean greatest or mean least systolic BP during procedure. No differences in mean least oxygen saturation (83% propofol; 86% midazolam) - oxygen not routinely administered unless Sats <85%. Median time to recovery was midazolam-10min, propofol-5min ($p<0.01$). All propofol patients had recovered to pre-bronchoscopy levels, for memory and motor reaction times by 60mins, but midazolam group was significantly worse. VAS anxiety scores similar in both groups. A questionnaire was also undertaken, stating similar levels of satisfaction by patients for both regimes, although this is not clarified further.	Not stated	Propofol is associated with a faster recovery to baseline state than midazolam, on multidimensional testing, although both were associated with a similar level of anxiolysis and intraprocedural oxygen saturations and systolic blood pressure.
de Padua, AI de Castro, M Schmidt, A Coutinho Neto, J Terra Filho, J Martinez, JA	Clonidine as a pre-anesthetic agent for flexible bronchoscopy	2004	RESPIRATORY MEDICINE	746-51	RCT	++	22 in placebo; 20 in clonidine arm	42 patients having bronchoscopy; mean age 50.5 (placebo), 46.0 (clonidine), Male/Female 16/6 (placebo), 15/5 (Clonidine)	Premedication with clonidine (3microg/kg) or placebo iv 15 mins prior to bronchoscopy, followed by topical anaesthesia only	Placebo comparison	1 hour after end of bronchoscopy	Primary outcome not stated. No power calculation. Blood pressure (BP), heart rate (HR), plasma norepinephrine (nor) and cortisol levels were measured before, during, and 1 h after FOB. Comfort was assessed by the examiner and by the patients using a visual numerical scale (0–10).	Placebo group showed significant increases in systolic BP, HR, and noradrenaline levels during FOB (SBP 125 mmHg vs. 145 mmHg; HR 74bpm vs. 85bpm; noradrenaline 316.2pg/dl vs. 483.1pg/dl), whereas clonidine group did not display such changes. Comfort VAS similar.	Not stated	iv clonidine blunts haemodynamic responses to bronchoscopy, but this is not associated with changes in physician or patient-assessed comfort.
De, S.	Assessment of patient satisfaction and lidocaine requirement during flexible bronchoscopy without sedation	2009	Journal of Bronchology	176-179	Qualitative research	+	70 consecutive patients, Indian, mean age 49.48, 49 male, 21 female. Biopsies undertaken In 27 patients.	70 consecutive patients, Indian, mean age 49.48, 49 male, 21 female. Biopsies undertaken In 27 patients. Excluded those who had had previous bronchoscopy	Consecutive patients undergoing flexible bronchoscopy without sedation, using lidocaine topical anaesthesia (15% lidocaine spray, 4% lidocaine to nose, 2% lidocaine jelly to scope, 4% lidocaine to cords and 2% lidocaine in airways).	No comparisons	1 hour post bronchoscopy	VAS patient assessment of cough, pain, nausea, choking sensation and overall discomfort (none=0-10mm, mild=20-30mm, moderate=40-50mm, severe=60-70mm, worst possible=80-100mm (sic) - not clear if this scale translation was presented to patients). Willingness to return for repeat bronchoscopy. Total lidocaine dose.	Mean dose of lidocaine 7.44 +/- 2.09 mg/kg. No correlation between lidocaine dose and VAS score ($p<0.05$). Only 27.1% would definitely be prepared to have a repeat bronchoscopy and 45.7% would probably return. In each VAS category, the most common response was moderate cough, no pain, mild nausea, severe choking and mild overall discomfort, although data only presented in bar chart format as a percentage.	Not stated	In this small study of unsedated bronchoscopy patients, only 27% of patients would definitely return for a further bronchoscopy if required. A large range of VAS acceptability scores was seen, with moderate cough, no pain, mild nausea, severe choking sensation and mild discomfort being the most common VAS responses, but study size and lack of comparison limits conclusions.
Diaz-Fuentes, G. Dalvi, A. Blum, S. Sanchez, S. Sy, S. Sy, E.	Requirement of sedation during flexible bronchoscopy among substance and nonsubstance users	2006	Journal of Bronchology	58-60	Cohort	+	50 in each arm (substance users vs. nonsubstance users)	Substance user vs. nonsubstance user - Male/Female 32/18 vs. 25/25; Age significantly different - majority 18-40 vs. >65.	Retrospective cohort study. Patients with a history of substance user (heroin and/or cocaine) vs. matched patients (having bronchoscopy same or next day). Level of sedation routinely to Ramsay 3-4. Given poor age matching, patients allocated to three age groups.	'History of substance use' vs. no such history	Until end of bronchoscopy	Sedation requirements to produce Ramsay 3-4. 100mg parenteral meperidine assumed to be equivalent to 10mg morphine.	Substance-users had increased opioid and benzodiazepine doses used, significant for all age ranges, with opioid mean (substance user vs. nonsubstance user) 20 vs 7mg $p<0.001$; benzodiazepine 8.7mg vs. 3mg $p<0.001$	Not stated	Substance misusers are likely to need higher doses of sedation to achieve the same level of sedation during bronchoscopy

Dreher, M Ekkernkamp, E Storre, JH Kabitz, H-J Windisch, W	Sedation during flexible bronchoscopy in patients with pre-existing respiratory failure: Midazolam versus Midazolam plus Alfentanil	2010	RESPIRATION	307-14	Cohort	+	15 in each arm (midazolam vs. midazolam+alfentanil)	Hospitalised patients with pre-existing stable respiratory failure requiring bronchoscopy. Respiratory failure defined as PaO2 <60 mm Hg and/or PaCO2 >45 mm Hg on air. Midazolam:Midazolam/Alfentanil - male&female 10&5/12&3; age 63.4:58.7; pCO2 41.2:45.7 mm Hg; pO2 55.0:48.0	Sedation with midazolam or midazolam/alfentanil for patients with type 1 or 2 respiratory failure	Bronchoscopy with 2mg iv midazolam (initial dose) compared with bronchoscopy with 2mg iv midazolam (initial dose) + 0.5mg iv alfentanil. Not sedated to a defined level. This followed local anaesthesia with oxybuprocaine (dose and protocol not specified).	Until none of the following - increased amount of oxygen supply compared to pre-intervention conditions, pH <7.35, change in PaCO2 >10 mm Hg compared with pre-intervention values or an ALDRETE score <9.	Doctor and patient VAS assessment of global tolerance, nausea, ease of introduction, asphyxia, cough and pain. Tolerance score defined as mean of global tolerance and mean of 5 other sensations. ASA grade used for overall physical status. ALDRETE score used to assess recovery after bronchoscopy. ABG and transcutaneous pCO2 monitored (primary endpoint). Secondary endpoints - need for prolonged monitoring (defined on basis of pH, change in pCO2 and ALDRETE score), patients' tolerance score, time until ALDRETE score >=9	Importantly, midazolam group received a median of 4mg of midazolam vs. 2mg for midazolam/alfentanil arm. No significant difference between pCO2 during bronchoscopy. Oxygen saturations in midazolam/alfentanil group started lower, and remained lower during bronchoscopy. No consistent differences in rate of recovery or time taken to reach ALDRETE score >=9. Prolonged monitoring for 1 patient only (midazolam/alfentanil arm). Patient and physician VAS assessment was improved in all domains for midazolam/alfentanil, reaching significance for patients for asphyxia and pain, and reaching significance for doctors in all domains other than ease of introduction	Open research grant from Breas Medical AB, Molnlycke, Sweden and from Respironics Inc., Pittsburgh, Pa., USA. Furthermore, this study was supported by Radiometer, Copenhagen, Denmark.	In a small cohort study of patients with either type 1 or 2 respiratory failure, there was no clear worsening of peak pCO2 during bronchoscopy when alfentanil was added to midazolam, although there was a significant increase for both groups (change of approximately 9-11mm Hg (interpreted from graph; numerical data not given)). Despite a lower median dose of midazolam in the midazolam/alfentanil arm (2mg vs. 4mg), patient and physician VAS satisfaction assessments (multiple domains) were improved for midazolam/alfentanil, reaching significance for a number. Results should be tempered by lack of placebo group, and cohort nature of study.
Efthimiou, J. Higenbottam, T. Holt, D. Cochrane, G. M.	Plasma concentrations of lignocaine during fibreoptic bronchoscopy	1982	THORAX	68-71	Qualitative research	+	41 patients; 10 volunteers.	41 patients - no liver disease, with normal haematological and biochemical bloods. 10 volunteers - no further details.	Patient study - Plasma lidocaine concentrations until 180 mins post bronchoscopy. Patients received premedication with omnopon and atropine im. 32 patients received 10% lidocaine spray to nose; 9 patients received 2% lidocaine gel. Lidocaine (1% or 4%) 'spray as you go' was recorded. Volunteer study (no bronchoscopy) - 5 volunteers gargled+drank 4% lidocaine solution; 5 volunteers had 10% lidocaine spray (both giving similar dose of 6.8mg/kg). Separately, 5 volunteers received nasal 10% lidocaine and a different five received 2% lidocaine gel (both of similar dose of 2.2mg/kg) Bloods taken until 2 hours afterwards.	Plasma lidocaine concentrations	Until 3 hours post bronchoscopy - patients, and until 2 hours post lidocaine - volunteers	Dose of lidocaine administered; plasma lidocaine concentration	Patient study - mean total dose of 623mg, 9.3mg/kg, giving an average peak plasma concentration of 2.9mg/L. Two patients had levels >5mg/L, but were asymptomatic. Peak concentrations only correlated with dose, and smoking/sputum volume/% predicted FEV1 did not influence peak plasma concentrations. Average time to peak was ~45mins. Volunteer study - 4% lidocaine gargle+swallow associated with higher peak plasma concentration than 10% aerosol (2.4mg/L vs. 1.9mg/L, p<0.05); Lidocaine aerosol 10% to nose gave higher peak plasma levels than 2% lidocaine gel (0.8 vs 0.52mg/L, p<0.05).	Not stated	A mean total dose of lidocaine of 9.3mg/kg is not associated with any signs of lidocaine toxicity and gives a mean plasma concentration of 2.9mg/L. Two patients had concentrations >5mg/L, but had no symptoms of toxicity. 4% Lidocaine gargle+swallow gives higher peak concentrations than the same dose of 10% aerosol spray to oropharynx. 2% lidocaine gel gives lower peak serum concentration than the same dose of 10% lidocaine spray to the nose.

Fox, BD Krylov, Y Leon, P Ben-Zvi, I Peled, N Shitrit, D Kramer, MR	Benzodiazepine and opioid sedation attenuate the sympathetic response to fiberoptic bronchoscopy. Prophylactic labetalol gave no additional benefit. Results of a randomized double-blind placebo-controlled study	2008	RESPIRATORY MEDICINE	978-83	RCT	+	120 patients randomised with 60 in each arm	Adult patients attending for bronchoscopy at a day unit with mean age 59.6 vs. 57.4 (placebo vs labetalol), mixture of diagnostic and interventional (brachytherapy catheter, balloon airway dilatation, endobronchial laser, foreign body removal, stent insertion) bronchoscopies. Exclusion criteria were inability or refusal to give informed consent, bronchoscopy through an artificial airway, intolerance or allergy to the study drug, bradycardia or hypotension at screening, pregnancy, concomitant treatment with diltiazem or verapamil and intention to use propofol as the sedative agent for bronchoscopy.	Participants randomized to either labetalol 10 mg iv or equal volume of saline 0.9% solution iv as placebo, given with premedication prior to bronchoscopy. All patients received supplemental oxygen by nasal cannula and premedication with alfentanil 500mcg and midazolam as required. Topical anaesthesia was achieved with lidocaine gel to the nose, and lidocaine 2% solution given down bronchoscope with the spray-as-you-go technique. Additional midazolam/alfentanil was given as required.	Between treatment and placebo	Until end of bronchoscopy	Primary outcome measures were the HR, SBP, DBP and RPP during and after FOB as compared to baseline values. Secondary outcome measures were hypoxemia, total doses of sedative drugs received, and scores of patient tolerance of the procedure. The bronchoscopist evaluated the patient's tolerance of the procedure using 10 cm VAS immediately after finishing the procedure. After recovery, patients rated the bronchoscopy for pain, recall and satisfaction on a 10 cm VAS.	In the placebo group, there was no rise in HR, SBP, DBP or RPP, and there was no difference between the placebo and labetalol groups.	None	No apparent rise in rate-pressure product, heart rate, systolic or diastolic blood pressure even in control arm (who received a mean (+/-SD) dose of midazolam of 6.8mg (+/-3.6mg), with alfentanil 630mcg (+/-290mcg) (similar to labetalol group). No significant changes with labetalol. Overall, underlying sedation regime more likely to be important.
Frey, W. C. Emmons, E. E. Morris, M. J.	Safety of high dose lidocaine in flexible bronchoscopy	2008	Journal of Bronchology	33-37	Qualitative research	++	154 patients	154 patients, mean age 64.7 years, 60% males, mean length of bronchoscopy was 33.5mins.	5-10ml 4% lidocaine via nebuliser; 10-20ml 2% nasal lidocaine gel. Supplemental oxygen 2L/min. iv midazolam and fentanyl to achieve 'conscious sedation'. 1% lidocaine as 5ml aliquots to vocal cords and carina. Monitoring of arrhythmias. Blood at 45 mins for serum lidocaine and blood methaemoglobin levels.	No comparisons	2 hours post bronchoscopy	Assessment for complications, including arrhythmias. Serum lidocaine levels and methaemoglobin levels at 45 mins.	Euphoria/dizziness in 84 patients (62.2%). No arrhythmias or seizures. Mean lidocaine usage 15.4mg/kg. Mean serum lidocaine level was 1.55microg/mL, mean blood methaemoglobin level 0.69%. One patient had serum lidocaine levels >5microg/mL	No outside funding	With a mean lidocaine dose of 15.4mg/kg, there were no serious adverse events, although 62.2% of patients had euphoria or dizziness. Mean serum lidocaine level was 1.55microg/mL, mean blood methaemoglobin level 0.69%.
Gonzalez, R. De-La-Rosa-Ramirez, I. Maldonado-Hernandez, A. Dominguez-Cherit, G.	Should patients undergoing a bronchoscopy be sedated?	2003	ACTA ANAESTHESIOLOGICA SCANDINAVICA	411-5	RCT	+	9 patients in each arm (sedation vs. non-sedation)	18 patients with pneumonia, undergoing BAL. Patients who couldn't be oxygenated to saturations >=90% with facial mask oxygen excluded. Mean age 40 (sedation), 6 (non-sedation). Male/female 7/2 (sedation), 6/3 (non-sedation). An unusually high number of patients with AIDS (8, total), and leukemia/lymphoma (4, total)	Bronchoscopy following protocolised lidocaine airway anaesthesia. Although 'single blinded' not clear that patients had a sham bolus followed by maintenance infusion. Propofol arm given at 0.5-1.0mg/kg bolus followed by as required 20mg bolus to maintain sedation to a set level ('the patient opened his eyes if there was tactile stimulation').	Placebo comparison	6 hours post bronchoscopy	Primary outcome not stated. No power calculation. Stopped early due to interim analysis. Pain, cough and sensation of asphyxiation evaluated on a VAS. Degree of amnesia (3 point scale), degree of global acceptance (4 point scale), preparedness to have another bronchoscopy (3 point scale). All measured at 1 hour and 6 hours post bronch, but unclear which was used for analysis.	The patients in sedation group (mean dose propofol given 133mg) had less cough (VAS 5 vs. 7, $P < 0.05$), pain (VAS 0 vs. 5 $P < 0.01$) and sensation of asphyxiation (VAS 0 vs. 7, $P < 0.01$). Global tolerance to the procedure was significantly better in the group under sedation ($P < 0.01$). These patients had total amnesia to the procedure ($P < 0.0001$), thus is more probable that will accept another bronchoscopy in the future ($P < 0.01$). There was a significant rise in heart rate and blood pressure in the patients without sedation. There were no differences in oxygen saturation ($P = 0.75$).	Not stated	In a small group of patients, VAS assessed measures of tolerability, and questionnaire assessment of preparedness to have further bronchoscopy was improved with iv propofol + topical lidocaine vs. topical lidocaine alone.

Greig, J. H. Cooper, S. M. Kasimbazi, H. J. Monie, R. D. Fennerty, A. G. Watson, B.	Sedation for fibre optic bronchoscopy	1995	RESPIRATORY MEDICINE	53-6	RCT	++	34 - midazolam; 33 - midazolam+alfentanil; 35 - alfentanil	103 patients randomised. Further characteristics not given.	Double-blind allocation to sedation with either midazolam (titrated to weight - 2/3/4mg; additional boluses as required) + placebo OR alfentanil 0.5mg (additional 0.25mg boluses as required) + placebo (titrated to weight) OR midazolam (titrated as above; additional boluses as required) + alfentanil 0.5mg. Level of sedation not protocolised. Lidocaine given in protocolised manner. Patients not routinely given oxygen.	Between treatment	2 hours post bronchoscopy	No power calculation. No primary outcome specified. Cough rate; additional aliquots of lidocaine; duration of procedures; recovery time; patient and physician VAS assessed discomfort.	Mean sedation given - M/P M=5.7mg, M/A M=4.5mg A=0.5mg, P/A A=0.66mg; Duration - M/P=5.5min, M/A=7.5min, P/A=5.9min. Coughs/min - M/P=2.45, M/A=1.72, P/A=1.42 (M/P vs. P/A p=0.0053; other values not given). More lidocaine used for M/P than other groups, p<0.005. No significant differences in VAS scores. Minimum & fall in O2 saturations M/P 9.6%, M/A 13.5%, P/A 8.6% (M/A vs. P/A p=0.033). 'Immediate' recovery time for all regimes.	Not stated	Use of alfentanil in sedation regime is associated with a lower cough rate and requirement for lidocaine, although this does not correspond to an improvement in patient satisfaction (but study power may be limited). Dual agent (M/A) sedation is associated with greater fall in oxygen saturations, although lack of defined level of sedation and baseline patient characteristics hampers interpretation of this finding.
Hasmoni, Mohd Hadzri MMed*; Rani, Mohammed Fauzi Abdul FRCP*; Harun, Roslan MRCP, PhD†; Manap, Roslina Abdul MMed, MRCP†; Tajudin, Nor Adina Ahmad MMed†; Anshar, Fauzi Md. MRCP†	Randomized-controlled Trial to Study the Equivalence of 1% Versus 2% Lignocaine in Cough Suppression and Satisfaction During Bronchoscopy	2008	Journal of Bronchology & Interventional Pulmonology	78-82	RCT	++	32 patients 1% lidocaine; 29 patients 2% lidocaine	61 patients; 1% vs. 2% lidocaine: 59.0 vs. 59.2; Male: 68.7% vs. 58.6%; body weight: 52.7 vs. 53.5kg; duration: 22.8 vs. 23.1mins; baseline cough severity similar.	Lidocaine 10% x 5 sprays to oropharynx, 5ml lidocaine 2% to nose; oxygen via nasal cannula at 2-5L/min; 1-2mg iv midazolam. Study intervention - 1% vs. 2% lidocaine local delivered as 'spray as you go', 2ml each time - 4x to vocal cords, 1x to carina, 1x each upper lobe bronchus, with extra aliquots as required.	Between treatment	Until 'fully alert and conscious'	Cough count, physician VAS assessment of tolerance and cough; patient VAS assessment of tolerance and cough; total dose of lidocaine; extra aliquots of lidocaine	1% vs. 2% - cough count 287 vs. 304 (ns), total lidocaine dose 161mg vs. 340mg (p<0.001), total volume of lidocaine 16.1 vs. 17.0ml (ns), total midazolam dose 2.0 vs. 2.0mg (ns). No significant differences for any VAS score - physician tolerance VAS 2.2 vs. 1.1; physician cough VAS 2.35 vs. 2.4; patient tolerance VAS 0.75 vs. 1.1; patient cough VAS 2.0 vs. 3.9 (lower is better for all VAS scales).	Not stated	Subjective and objective patient and physician assessment of cough amelioration with either 1% or 2% 'spray as you go' lidocaine reveals no benefit to 2%, but an increase of total dose from 3.5 mg/kg to 6.5mg/kg for 2% (without adverse event).
Hatton, M. Q. Allen, M. B. Vathenen, A. S. Mellor, E. Cooke, N. J.	Does sedation help in fibreoptic bronchoscopy?	1994	BMJ	1206-7	RCT	++	Study 1 - 50 phenoperidine+ droperidol arm, 51 placebo. Study 2 - 51 midazolam arm, 30 placebo.	Patients undergoing bronchoscopy. Characteristics and selection techniques unclear. Mean age in each group 61-64.	Bronchoscopy following iv atropine 600microg, topical lidocaine (technique not specified). Patients given supplemental oxygen. Drug or placebo given to produce 'light sedation' (not further defined)	Placebo comparison	6 hours post bronchoscopy	Primary outcome not stated. No power calculation. Discomfort VAS - patients, doctors and nurses. Willingness to repeat VAS (patient). Ease of procedure VAS (doctor).	Study 1 - phenoperidine/droperidol vs. placebo - VAS comfort of procedure; doctor 11 vs. 22 (sig), nurse 12 vs. 20 (sig), patient 45 vs. 45 (not sig). VAS willingness to repeat 46 vs. 24 (sig). Ease of procedure 11 vs. 22 (sig). Study 2 - midazolam vs. placebo - VAS comfort of procedure; doctor 11 vs. 14 (not sig), nurse 20 vs. 36 (not sig), patient 30 vs. 36 (not sig). VAS willingness to repeat 19 vs. 8 (not sig). Ease of procedure 19 vs. 30 (sig).	Not stated	Sedation with phenoperidine/droperidol is associated with a greater ease of bronchoscopy for physicians. For midazolam, patient assessed comfort was not improved, nor was overall willingness to repeat, although patients were not sedated to a clearly defined level, and study included no power calculation to determine number of required patients. Phenoperidine and droperidol is associated with increased reluctance to undergo further bronchoscopies.
Houghton, Catherine M. Raghuram, Ananthnakrishnan Sullivan, Paul J. O'Driscoll, Ronan	Pre-medication for bronchoscopy: a randomised double blind trial comparing alfentanil with midazolam	2004	RESPIRATORY MEDICINE	1102-7	RCT	++	69 patients, 40 randomised to alfentanil arm, 29 randomised to midazolam. Unclear why uneven recruitment given that randomisations were done in blocks of 20 (ten of each in a block).	Patients requiring flexible bronchoscopy at a university hospital, having a variety of wash, brush, biopsy and BAL. No other patient characteristics given.	Comparison of sedation for bronchoscopy with either alfentanil or midazolam. Patients were given a starting dose of 0.5–1 mg of iv alfentanil or 2.5–5 mg of iv midazolam by an independent non-blinded physician. Incremental doses were given as needed to optimise patient comfort on the instruction of the blinded operator. Patients received topical nasal lidocaine gel and topical 2% lidocaine applied to the vocal cords and bronchial tree.	Between treatment	Until 24 hours post bronchoscopy	No power calculations. 7-point Likert scale for patient assessment of discomfort, same scale for bronchoscopist, ease of procedure recorded on 6-point Likert scale, patient cough level documented on 5-point Likert scale, same nose-throat-lung discomfort score at 24 hours and asked about drowsiness, cough, nose soreness, throat soreness, feeling sick and vomiting (non/mild/moderate/severe), willingness to have procedure again on 4-point Likert scale. Safety judged by level of desaturation and amount of topical anaesthesia.	Difficult to be certain about relevance of outcomes due to lack of primary outcome, power calculation and multiple comparisons. No difference in patient or physician (Likert-assessed) scores of discomfort or physician Likert-assessment of procedure ease immediately post-procedure but some scores (nasal and throat) were possibly lower with possible higher drowsiness assessment for midazolam arm 24-hours post procedure. This should be interpreted with caution given differential drop-out rates and multiple comparisons being performed. Physician-assessed cough Likert score reported as being significantly lower for alfentanyl (2 vs 2.5). No difference in mean minimum oxygen saturation (91.2% with alfentanil and 90.8% with midazolam) and mean amount of topical 2% lignocaine used (18.6mls with alfentanil and 18.5 mls with midazolam).	Not stated	Alfentanil may be associated with less physician-assessed cough than midazolam, but this did not manifest as improved ease of procedure or patient assessment of procedure, but conclusions are limited due to study limitations.

Hwang, J. Jeon, Y. Park, H. P. Lim, Y. J. Oh, Y. S.	Comparison of alfentanil and ketamine in combination with propofol for patient-controlled sedation during fiberoptic bronchoscopy	2005	ACTA ANAESTHESIOLOGICA SCANDINAVICA	1334-8	RCT	++	138 patients - propofol/alfentanil sedation; 138 patients - propofol/ketamine sedation	Propofol/Alfentanil vs. Propofol/Ketamine - age 57.4 vs 58.3; weight 60.2 vs. 60.6kg; gender 90/48 vs. 88/50; time to start of procedure 2.1 vs. 2.1mins	Double blinded patient-controlled sedation with either propofol/alfentanil mixture or propofol/ketamine mixture for bronchoscopy, with supervision by nurse anaesthetists. The sedation agent was given as a loading dose, followed by maintenance infusion; bolus doses controlled by patients with 1 min lock-out. All patients received 0.03mg/kg iv midazolam, and had 4ml 2% lidocaine to vocal cords, with further as required aliquots of 2ml. Patients received 2L/min supplemental oxygen.	Between treatment	When 'fully awake'	No power calculation; primary outcome - patient VAS assessed satisfaction with sedation; secondary outcomes - amnesia, sedation time, sedation level, injection pain and safety.	Satisfaction in P/K group VAS 9.5 vs. 9.0 (p<0.05); Amnesia in PK group 82% vs. 61% (p<0.01); sedation levels similar (although not statistically evaluated); sedation time similar (not evaluated statistically); systolic blood pressure and heart rate had fallen for P/A group prior to procedure after sedation (SBP prior 128.5 mm Hg, with sedation 116.0 mm Hg p<0.05; HR prior 87.2, with sedation 83.8 p<0.05). Significant fall in oxygen saturations prior to procedure P/K - 98% -> 87%, p<0.01; P/A 98% -> 88%, p<0.01.	Not stated	Sedation (loading, maintenance infusion and patient-controlled boluses) with P/K is associated with a slightly higher level of patient satisfaction than P/A when bronchoscopy is undertaken supervised by a nurse anaesthetist. Amnesia scores are high for both regimes, but slightly higher for P/K. Both regimes are associated with oxygen saturations <90% prior to bronchoscopy, despite supplemental oxygen
Isaac, P. A. Barry, J. E. Vaughan, R. S. Rosen Newcombe, M. R. G.	A jet nebuliser for delivery of topical anaesthesia to the respiratory tract. A comparison with cricothyroid puncture and direct spraying for fibreoptic bronchoscopy	1990	ANAESTHESIA	46-48	RCT	+	Cricothyroid puncture - 26 patients, compared with nebuliser group A - 22 patients. Nebuliser group B (identical treatment to group A, but on different day) - 26 patients, compared with spray-as-you-go group - 24 patients.	Cricothyroid puncture vs. nebuliser group A vs. nebuliser group B vs. spray-as-you-go group - age 58.7 vs. 59.7 vs. 53.4 vs. 59.3; weight 66.4 vs. 65.7 vs. 73.2 vs. 71.8	Single blinded allocation to either cricothyroid injection (4ml 4%) or spray-as-you-go (10 sprays of 10% to tongue, then 4ml 4% to cords) or nebulised (4ml 4%) lidocaine All groups given 2ml aliquots of lidocaine 2% as required. Patients given 1mg oral lorazepam and 0.6mg im atropine 1 hour prior. Amethocaine lozenge (60mg) shortly prior bronchoscopy. Thalamonal (fentanyl 50microg and droperidol 2.5mg/ml) given at 1.5ml per 50kg body weight.	Between two treatment groups	To 4 hours post bronchoscopy	Primary outcome not stated; no power calculation. Physician (blinded) VAS assessed overall conditions, conditions above cords and from cords to carina. Patients VAS assessed discomfort.	Cricothyroid vs. nebuliser A - physician (blinded) VAS assessed overall conditions (higher better), conditions above cords and from cords to carina 75, 83, 85 vs. 43, 57, 44 p<0.002; patient VAS assessed discomfort (higher worse) 51 vs. 53 ns. Spray-as-you-go vs. nebuliser B - physician (blinded) VAS assessed overall conditions (higher better), conditions above cords and from cords to carina 66, 71, 69 vs. 75, 81, 68 ns; patient VAS assessed discomfort (higher worse) 42 vs. 27 p<0.05.	Not stated	In a relatively small single-blinded study in which patients weren't sedated to a defined level, cricothyroid injection of lidocaine is associated with an improved physician assessment of bronchoscopy conditions, when compared to nebulised lidocaine, but patient assessment is similar. Nebulised lidocaine appears to be associated with a similar physician assessment of bronchoscopy conditions as spray-as-you-go, but spray was rated worse by patients.
Keane, D. McNicholas, W. T.	Comparison of nebulized and sprayed topical anaesthesia for fibreoptic bronchoscopy	1992	EUROPEAN RESPIRATORY JOURNAL	1123-5	RCT	+	54 patients total; random allocation to nebulised lidocaine (30) or sprayed lidocaine (24).	Nebulised vs. spray: age 57 vs 60; sex M:F 15/15 vs. 10/14; smokers 9/30 vs. 11/24; asthma 13/30 vs. 14/24	Airway anaesthesia randomised to either sprayed or nebulised lidocaine. Nebulised group given 2.5ml 4% lidocaine over ~10mins. Spray group given similar amount (100mg) using xylocaine spray to oropharynx and hypopharynx. All patients received same premedication - 0.6mg atropine im; iv diazepam 10-20mg (sedation level not defined) and 5ml lidocaine gel to nose (100mg). All patients had further bronchoscope-delivered lidocaine onto vocal cords (40mg), trachea (20mg), each main bronchus (2*20mg).	Between treatment	Not clear how long recording went on for during bronchoscopy, but no follow-up after bronchoscopy.	Cough frequency, prior to and after passage of vocal cords.	No power calculation. Groups not very well matched in terms of smoking/asthma/COPD status, although no formal statistical comparison. No significant differences between either group, overall, prior to bronchoscope passage through vocal cords and after passage through cords.	Not stated	In a small randomised study, there was no significant difference in cough count for patients receiving either lidocaine nebulised or in a spray fashion to the upper airways, although unclear how long cough frequency went on being evaluated during bronchoscopy. All patients also received protocolised nasal lidocaine gel and spray-as-you-go lidocaine to bronchial tree. Groups were not statically compared to evaluate whether pre-existing smoking/COPD/asthma co-morbidities are comparable in two groups.
Kortilla, K et al.	Effect of Age on Amnesia and Sedation Induced by Flunitrazepam during local anaesthesia for bronchoscopy	1978	BJA	1211-1218	Qualitative research	+	79 patients; 19 patients less than 40 years old; 26 patients 40-59 years old; 19 patients 60-69 years old; 15 patients >70 years old	Outpatient bronchoscopies, each patient received 0.01mg/kg flunitrazepam, topical lidocaine, iv atropine.	Effect of age on sedation and recovery	Between 4 different age groups	Until day after bronchoscopy	Bronchoscopist VAS assessed efficiency of anaesthesia, patient cooperation, patient VAS assessed procedure pleasantness. Recall assessment. Evaluation of motor and coordination recovery. Serum drug concentration.	Topical anaesthesia efficacy and patient acceptability similar. In older patients, amnesic action started earlier and persisted longer than younger patients. Significantly worse motor coordination for patients >60 years old 2 hours after sedation.	Flunitrazepam provided by Roche, Switzerland	Older patients have more profound amnesia and take longer to recover from flunitrazepam in this qualitative study.

Lane, S. J.	Evaluation of the efficacy of nebulised lignocaine as adjunctive local anaesthesia for fibreoptic bronchoscopy; a randomised, placebo-controlled study	2006	IRISH MEDICAL JOURNAL		RCT	++	83 patients randomised to either nebulised normal saline, nebulised 60mg lidocaine or nebulised 120mg lidocaine.	Mean age 55-61.2 in the three arms. Not stated relevant indication for bronchoscopy, or whether inpatient/outpatient.	83 patients randomised to either nebulised normal saline, nebulised 60mg lidocaine or nebulised 120mg lidocaine. Unclear how randomised and also whether each arm had equal chance of being chosen. Patients received incremental iv midazolam, and importantly some received iv fentanyl (with differential rates in each group). Patients also received topical 50mg of topical lidocaine as a 'laryngopharyngeal' spray, cricothyroid 4mls 4% lidocaine and direct application of 4ml 4% to vocal cords (total of 290mg lidocaine). Study unclear as to whether 3ml or 5ml of nebulised solution was given. All bronchoscopy via mouth. Patients given 10mg sublingual diazepam and nebulised salbutamol/ipratropium bromide prior.	Between treatments and placebo	Until end of bronchoscopy	Primary outcome unclear. Bronchoscopist and nursing staff used VAS-assessed ease of procedure and cough	No additional topical lidocaine administered in any group. 45% of patients received fentanyl in saline arm, 37.5% in 60mg lidocaine arm and 21% in 120mg lidocaine arm and this may cause significant confounding. No difference in VAS assessed ease of procedure or perception of cough.	Not stated	No - significant methodological limitations (randomisation unclear, no power calculation, lack of stated primary outcome, variably reported amounts of volume of solution for nebulising) and confounding with differential use of fentanyl means that any results lack relevance.
Langmack EL, Martin RJ, Pak J, et al	Serum lignocaine concentrations in asthmatics undergoing research bronchoscopy	2000	Chest	1055-1060	Qualitative research	++	51 patients	Patients with asthma, mean age 33.5 undergoing research bronchoscopy into airways inflammation in asthma (involving, variably, BAL, endobronchial biopsy and endobronchial brushings). M:F 21:30; weight 75.7kg. Baseline FEV1 % pred - 79%	Serum lidocaine concentrations post airway anaesthesia. Patients received 0.4mg atropine iv, 4% lidocaine spray to nose and throat until gag reflex extinguished. iv midazolam and fentanyl as required 'to achieve conscious sedation'. 2-3ml of 2% viscous lidocaine to nose. 2-6ml 1% lidocaine to larynx. 2ml aliquots of 1% lidocaine to bronchial tree, as required.	No comparisons	24 hours post bronchoscopy	Monitoring for clinical evidence of toxicity; total dose of lidocaine administered (excluding nasal gel); blood taken 30 mins after completion of upper airway anaesthesia and 30 mins post bronchoscopy completion.	No signs of toxicity during 24 hours post procedure. Mean total dose lidocaine 600mg (highest 880mg). Mean total dose 8.2mg/kg. Highest serum lidocaine concentration 3.2mg/L. Mean concentration 30 mins post upper airway anaesthesia 1.26mg/L; mean concentration 30 mins post bronchoscopy completion 1.29mg/L. Concentration correlated with total dose administered (but r value only 0.34-0.37).	Supported by NHLBI grants HL36577 (Drs. Kraft and Martin) and HL03343 (Dr. Kraft), and the American Lung Association Asthma Research Center Award (Drs. Kraft and Martin).	A mean total dose of lidocaine of 8.2mg/kg appears safe, being not associated with any signs of toxicity, and giving serum lidocaine concentrations of 1.26-1.29mg/L (range up to 3.2mg/L). Whilst there is a correlation between concentration and total dose administered, this is relatively poor with a r value of only 0.34-0.37.
Lo YL, Lin TY, Fang YF, Wang TY, Chen HC, Chou CL, Chung FT, Kuo CH, Feng PH, Liu CY, Kuo HP	Feasibility of bispectral index-guided propofol infusion for flexible bronchoscopy sedation: a randomized controlled trial.	2011	PLoS One	e27776 9	RCT	+	500 patients randomised to clinically-judged midazolam sedation (250) or BIS-guided propofol sedation	BIS-guided propofol sedation vs. clinically-judged midazolam sedation - age 59.9 vs. 61.9; ASA score <3 60.4% vs. 56.2%; male 59.7 vs. 55.8%	Topical anaesthesia with lidocaine; BIS-guided propofol group - alfentanil 4-5microg/kg bolus following an initial administration of 0.5mg/kg propofol; propofol boluses of 10-20mg until BIS index reached 70. Propofol infusion 3-12mg/kg/h used to keep BIS 65-75. Midazolam clinically-guided group - alfentanil as above following 2mg midazolam bolus. 1mg/min boluses until moderate sedation (purposeful response to verbal or tactile stimulation)	Between treatment	Up to day 3-5	Primary outcomes - safety (hypoxia/hypotension). Secondary outcomes - recovery time, patient tolerance and cooperation	Propofol (BIS guided) vs. midazolam (clinically guided); dose - 199 vs. 6.8mg; alfentanil dose - 325 vs. 350mg; time to induction - 3.4 vs. 5.3mins, p<0.001; procedure time - 26 vs. 26mins; time to orientation - 11.5 vs. 30.0mins, p<0.001; time to ambulation 30.0 vs. 55.6mins, p<0.001; no. of patients having SpO2 episode <90% - 39.9% vs. 35.7%, ns; patients having MAP <60mmHg - 4.5 vs. 1.6%, ns; patients having SBP <90mmHg - 7.4 vs. 4.4%, ns, although mean lowest SBP, DBP and MAP were lower for propofol, p<0.001. 1 episode of massive bleeding, and 1 episode of pneumothorax in propofol group with 1 patient requiring flumazenil in control group. Patient VAS assessment of global tolerance, cough, dyspnoea and scope insertion significantly better for propofol, with no significant difference for pain, or of acceptability of nebulised anaesthetic. Patient movement and cough causing procedural interference was significantly improved for propofol.	This study was supported by a grant from the Chang Gung Medical Research Program (CMRPG3 80251).	BIS-guided propofol sedation has a similar safety profile to clinically-guided midazolam sedation, although mean lowest SBP, DBP and MAP were lower for propofol although unclear what, if any, treatment was required (paper mentions "proper treatment" but excludes vasopressor usage). No change in oxygenation indices. Physician assessment of cough/movement interference on bronchoscopy significantly better with propofol, and patient assessment of tolerance, cough, dyspnoea and scope insertion significantly better for propofol. Significantly improved time to induction, orientation and ambulation for propofol.

Maguire, G. P. Rubinfeld, A. R. Trembath, P. W. Pain, M. C.	Patients prefer sedation for fibreoptic bronchoscopy	1998	Respirology	81-5	Cohort	+	74 patients surveyed (36-sedation, 38-no sedation).	Sedation/no sedation: subjects-12/13; age-60/55	Sedation for bronchoscopy	Sequential parallel group design (different days of the week), comparing iv diazepam sedation with no sedation after protocolised topical lidocaine. Diazepam 5-20mg used to induce drowsiness or no response to voice. Same bronchoscopist, but no comment about other staff.	1 month post bronchoscopy	Patient comfort (6 point scale - extremely painful/painful/uncomfortable/not distressing/pleasant) and desired sedation (3 point scale - no change/increased sedation/general anaesthetic) for repeat bronchoscopy assessed post-bronchoscopy and at 1 month. Time spent in recovery room.	Sedation group rated bronchoscopy as more comfortable (p=0.01), and were also more likely to want no change to sedation if bronchoscopy repeated (p<0.01), with more pronounced effects at 1 month. Sedation associated with prolonged recovery room stay (76.1min vs. 19.2min, p<0.001).	Not stated	In a small cohort study, more patients found bronchoscopy comfortable who had been sedated than not. More patients (~90%) wanted no change to their bronchoscopy preparation for the sedation arm than in the non-sedated arm (~72% - data interpreted from bar chart).
Mainland, P. A. Kong, A. S. Chung, D. C. Chan, C. H. Lai, C. K.	Absorption of lidocaine during aspiration anesthesia of the airway	2001	JOURNAL OF CLINICAL ANESTHESIA	440-6	RCT	++	Stage 1 (lidocaine solutions of varying concentrations) - 48 patients total (15 in 1% 0.2ml/kg arm[A]; 16 in 1.5% 0.2ml/kg arm[B]; 16 in 2.0% 0.2ml/kg arm[C1]). Stage 2 (included assessment of plasma concentration) - 48 patients total (of whom 33 agreed to blood sampling for lidocaine levels; 16 patients in 2% 0.2ml/kg arm[C2]; 16 in 1% 0.3ml/kg arm[D]; 16 in 2% 0.3ml/kg arm[E])	Age & weight & M:F: A - 51.2 & 51.7kg & 7:8; B - 60.8 & 56.1kg & 14:2; C1 - 61.6 & 55.8kg & 9:7; C2 - 59.1 & 51.3kg & 12:4; D - 61.6 & 57.9kg & 11:5; E - 60.4 & 52kg & 9:7)	Bronchoscopy after im meperidine 1mg/kg and atropine 0.01mg/kg 40-60 mins prior. 5% cocaine solution to nose using swab. Lidocaine solution trickled on back of patient's tongue with bronchoscopy 2 mins after topical anaesthesia. Additional supplementary 2% lidocaine via bronchoscope to airway as required.	Between treatment	Until end of bronchoscopy or 30 mins post last dose lidocaine (whichever later)	No power calculation. Dose of lidocaine administered. Ability to bronchoscope without supplementary lidocaine. In a subset, arterial blood samples (for lidocaine concentration) taken at 0, 2, 4, 6, 8, 10, 12, 15, 20, 25, 30 mins after start of instillation of lidocaine.	80/96 required no further lidocaine to bronchoscope to carina. 9/96 required no further lidocaine to complete entire bronchoscopic examination. Peak lidocaine concentration range was 8-20 mins for the 4 patients who required no further lidocaine and had blood samples taken. In patients who had supplementary doses, time to peak post last dose was 0-27.5mins (median 5mins). For patients in Stage 2, total lidocaine dose (median[range] mg/kg) and maximum plasma concentrations (median[range] microg/ml): C2 - 6.12 [4.68-7.64], 2.84 [1.07-4.08]; D - 4.00 [3.00-6.81], 2.44 [1.52-3.55]; E - 7.13 [6.00-9.93], 3.08 [0.8-6.29], with only two patients having levels >5microg/ml in group E, but no patients displayed signs of toxicity.	Not stated	Lidocaine doses of up to 7.13mg/kg are associated with a median peak lidocaine concentration of 3.08microg/ml, although significant variability between patients exists and unclear how much swallowed. Time to peak plasma concentration varies, but is seen by 30 mins post last dose.

Malik, Javid Ahmad Gupta, Dheeraj Agarwal, Ashutosh N. Jindal, Surinder K.	Anticholinergic premedication for flexible bronchoscopy: a randomized, double-blind, placebo-controlled study of atropine and glycopyrrolate	2009	CHEST	347-54	RCT	+	1000 patients undergoing diagnostic flexible bronchoscopy, 339 atropine arm, 336 glycopyrrolate arm, 325 placebo arm. No power calculation stated.	Mean age 48.8-50.4, male 66.4-70.8%, variety of operators. All inpatients and outpatients >15 years of age were eligible. Patients who had previously participated in any similar study, patients undergoing brachytherapy or therapeutic bronchoscopy for removal of secretions, patients with a history of glaucoma or prostatic disorders, patients with <90% baseline oxygen saturation on finger pulse oximetry, patients using oxygen supplementation, and intubated patients were excluded.	Patients received either atropine 0.01mg/kg, glycopyrrolate 0.005mg/kg or placebo 2ml normal saline IM 20-40 mins prior to bronchoscopy. Unclear how patients were randomised. Patients also received iv midazolam 0.07mg/kg, titrated as required to achieve 'light sedation'. Nebulised lidocaine 4% was used for airway anaesthesia, but amount not stated. Not stated whether further upper airway topical anaesthesia used, although 5ml 2% lignocaine said to be instilled into trachea via spray-as-you-go and additional boluses 'as required' in a non-protocolised manner. Additional doses not reported in study.	Between treatment and placebo	Until 2 hours post-bronchoscopy	10cm VAS-assessed (by patient and bronchoscopist) secretions, cough and patient discomfort. Oxygen desaturation, procedure time and adverse events were compared.	Glycopyrrolate (p=0.02), but not atropine, (p=0.064) was associated with reduced bronchoscopist-reported airway secretions after adjusting for covariates (unadjusted VAS-scores - atropine 26.38 (+/-25.75 SD), glycopyrrolate 26.34 (+/-30.27 SD), placebo 31.51 (+/-32.12 SD). Neither drug was independently associated with patient-reported airway secretions, cough or discomfort. Atropine was associated with longer procedure time (p=0.042), but the effect was small (unadjusted values - atropine 12.45mins (+/-4.38 SD), glycopyrrolate 11.14mins (+/-4.01 SD), placebo 11.50mins (+/- 4.69 SD). Anticholinergics, particularly atropine, were significantly associated with a rise in heart rate and blood pressure.	Not stated	Bronchoscopist-reported airway secretions may be reduced by glycopyrrolate, but is not associated with reduction in cough, discomfort, oxygen desaturation. Anticholinergics, particularly atropine, are associated with greater haemodynamic fluctuations.
Maltais F, Laberge F, Laviolette M	A randomized, double-blind, placebo-controlled study of lorazepam as premedication for bronchoscopy	1996	Chest	1195-98	RCT	++	49 - placebo arm; 51 - lorazepam arm	Placebo/Lorazepam: Age-59 vs. 63; Sex - 32/17 vs. 37/14; duration - 7 vs. 6.9. Excluded those having BAL/TBB, those >80yrs.	Premedication with placebo or lorazepam (po) 1.5hr prior to bronchoscopy. No data on amount of lidocaine used.	Placebo comparison	Day after bronchoscopy	Primary outcome not stated. No power calculation. Patient assessment of bronchoscopy (very easy/easy/difficult/very difficult) tolerance, level of sedation (appropriate/excessive/insufficient), willingness to undertake second bronchoscopy (yes/only with physician insistance/no, never again), recollection of procedure (clear/indistinct/not at all)	No differences between groups immediately after bronchoscopy, but at 24 hours more placebo patients reported that the procedure was difficult or very difficult (65.3% - placebo, 38.0% - lorazepam, p<0.005) and more placebo patients would be reluctant to have a repeated bronchoscopy (p<0.005).	Not stated	Pre-medication with lorazepam is associated with a more favourable recall of bronchoscopy at 24 hours, but not immediately post bronchoscopy. Without lorazepam, 55.1% were prepared to undergo repeat bronchoscopy, with a further 38.8% agreeing only with physician insistence
Martin KM, Larsen PD, Segal R, Marsland CP.	Effective nonanatomical endoscopy training produces clinical airway endoscopy proficiency	2004	Anaesthesia and Analgesia	938-44	Qualitative research	+	43 volunteers, 3 withdrew prior to course, 1 unwilling to undergo bronchoscopy	Volunteers from Department of Anaesthesia; further details not given	Data from course evaluating efficacy of training techniques for bronchoscopy. All volunteers given 5microg/kg glycopyrrolate iv. No sedation. Airway anaesthesia with 2% viscous gargle, 2% aerosolised solution, 10% spray and 2% spray-as-you go lidocaine.	None	Until after bronchoscopy	Relevant outcomes - VAS assessment of local anaesthetic. Side effects. Total dose of lidocaine.	3 volunteers couldn't be bronchoscoped due to gag reflex. Median dose of lidocaine (range) - 720mg (490-980mg), 9.6mg/kg (7.14-14.77mg/kg). Median VAS of 'being topicalised' was 5 (anchored to tolerable). 92% (36/39) reported subjective changes, which were possible side effects of LA, including mood elevation (17/39), impaired cerebration (15/39), visual changes (2/39), mood depression (17/39). Objective effects attributed to lidocaine - single involuntary limb movement for two patients who received 9.7 and 13.4mg/kg. Tremulousness in patient who received 10.2mg/kg	Financial support was received from the Wellington Anaesthesia Trust.	For volunteers given a median of 9.6mg/kg lidocaine (range 7.14-14.77), subjective probable lidocaine side effects, including mood elevation, depression, impaired cerebration and visual changes, are common in this study, although patients also received iv glycopyrrolate. Objective side effects, including tremulousness and single involuntary limb movements were seen in 3/39.

Matot, I. Kuras, Y. Kramer, M. R.	Effect of clonidine premedication on haemodynamic responses to fibreoptic bronchoscopy	2000	ANAESTHESIA	269-74	RCT	++	62 patients (25 - control; 25 - 150microg clonidine; 12 - 300 microg clonidine)	(Control; clonidine 150microg; clonidine 300microg) - mean age 59; 64; 63, female/male 11/14; 9/16; 5/7.	Double-blinded allocation to placebo or oral clonidine 150microg or 300microg 90 mins prior to bronchoscopy. Topical anaesthesia with lidocaine. Sedation with iv meperidine (50mg), iv midazolam (2mg, titrated).	Placebo comparison	Until awake	Primary outcome not stated. No power calculation. Outcomes measured - BP, oximetry, ECG, time to awakening, nausea, vomiting, pruritus and mouth dryness.	Significant increases in blood pressure and heart rate in the control group. Clonidine 150 mg blunted the haemodynamic response to fibreoptic bronchoscopy ($p<0.05$). Significant decreases in systolic blood pressure (<90 mmHg) were observed in all patients premedicated with 300 mg clonidine. Throughout the study nine patients (75%) in the 300 mg clonidine group were treated at least once for hypotension, and recruitment to this arm was stopped early. Compared with the control group, time to awakening was significantly longer only in patients premedicated with 300 mg clonidine. Side effects of clonidine 150microg not found, and not commented on for 300microg.	Not stated	Oral clonidine blunts haemodynamic responses to bronchoscopy, but is associated with significant hypotension at higher doses.
Milman, N. Laub, M. Munch, E. P. Angelo, H. R.	Serum concentrations of lignocaine and its metabolite monoethylglycinexylidide during fibre-optic bronchoscopy in local anaesthesia	1998	RESPIRATORY MEDICINE	40-3	Qualitative research	+	16 patients	11 women, 5 men. Median age 63. Undergoing bronchoscopy for evaluation of 'pulmonary lesion'	Relationship between lidocaine dose and serum lidocaine concentration and serum monoethylglycinexylidide (MEGX). Premedication with po diazepam and im atropine. Lidocaine aerosol spray to nose, oropharynx and larynx. Cocaine via bronchoscope to vocal cords, rima glottidis and trachea. Protocolised administration of lidocaine solution to airway.	None	Until 120min post lidocaine spray	Serum lidocaine and MEGX concentrations measured at 0,5,10,20,30,60,120min post lidocaine spray	Total lidocaine dose 2.4-8.0 mg/kg (1.6-6.6 mg/kg spray, 0.8-2.5 mg/kg solution). Serum lidocaine peak seen at 20 mins, MEGX concentrations continued to rise even at 120 mins. No patients had peak levels in toxic range and no toxic effects seen. No/very poor correlation between lidocaine dose in mg or mg/m2 and serum lidocaine concentration. Weak correlation between lidocaine dose in mg/kg and serum lidocaine concentration.	Not stated	Lidocaine doses of up to 8mg/kg were not associated with toxic effects or toxic serum concentrations in this small study, although topical cocaine may have influenced lidocaine absorption. Lidocaine peak concentrations were seen at 20 mins, and MEGX concentrations continued to rise at 120 mins.
Putinati, S. Ballerin, L. Corbetta, L. Trevisani, L. Potena, A.	Patient satisfaction with conscious sedation for bronchoscopy	1999	CHEST	1437-40	RCT	++	100 patients; 50 in nonsedation group (lidocaine spray/atropine im), 50 in sedation group (lidocaine spray/atropine im/diazepam iv)	Patients undergoing BAL and TBB excluded. 54 outpatient bronchoscopies, 46 inpatient bronchoscopies. Sedation vs. nonsedation - M/F 41/9 vs. 38/12; age 61 vs. 62. Baseline anxiety VAS score similar 40.57 vs. 40.63	Bronchoscopy with or without sedation with diazepam iv. Diagnostic bronchoscopy; patients randomised to nonsedation (lidocaine spray 300mg total/atropine 0.5mg im) or sedation (lidocaine spray/atropine im/diazepam iv titrated to mental-alertness-drowsiness index of 3) group. Diazepam dose varied 5-15mg.	Between treatment	Until 3 hours post bronchoscopy (sedation group)	Patients and physicians performed multiple VAS assessments (global tolerance, ease of introduction, vomiting, asphyxia, cough and pain), the mean of which was used for assessment. Patients' VAS assessments were performed either immediately (nonsedation) or after three hours (sedation). Respiratory and haemodynamic monitoring	Sedation vs. nonsedation: Patient tolerance VAS - 14.75 vs. 22.86, $p<0.05$; physician assessment of tolerance VAS - 11.83, 13.95, ns). 6 nonsedation procedures were unable to be completed due to patient intolerance.	Not stated	In a well-matched randomised study (lidocaine dose, patient characteristics), there was a significant patient preference for sedation vs. no sedation, although the effect was small and a non-validated composite score was used.
Randell, T. Yli-Hankala, A. Valli, H. Lindgren, L.	Topical anaesthesia of the nasal mucosa for fibreoptic airway endoscopy	1992	BRITISH JOURNAL OF ANAESTHESIA	164-7	Qualitative research	+	31 patients	15 females; 16 males. Mean age 35 years. 'Healthy unpremedicated volunteers'.	Evaluation of four different types of nasal anaesthesia, in random order on separate days followed by bronchoscope insertion into oropharynx. Spray group - 5x10mg xylocaine into nostril; EMLA group - 1ml EMLA cream applied to nostril using syringe, followed by deep breathing and blowing nose; Swab group - 3 cotton swabs, each soaked in 4% lidocaine inserted (2 to depth of 2-2.5cm, 1 to depth of 1.5cm) for 3 mins; Gel group - 2.5ml 2% lidocaine injected into nostril using syringe.	Comparison between each group	Follow-up ceased when questionnaire completed	Patient VAS assessment of anaesthetic application; patient VAS assessment of efficacy of anaesthesia; physician VAS assessment of patient tolerance; physician VAS assessment of 'suitability' of technique	Patient assessment of application of spray significantly worse (~1.5 VAS) than application of other 3 techniques (~6.5 VAS, $p<0.001$). Patient assessment of anaesthesia of EMLA and swabs significantly worse (~4.5 VAS) than spray and gel (~7 VAS, $p<0.001$). Physician assessment of tolerance worst for swab (~6 VAS), and significantly improved for EMLA (~7.5 VAS), spray (~8 VAS) and gel (~8 VAS), $p<0.05$; physician assessment of suitability of technique worst for EMLA (~6 VAS) versus others (~8 VAS), $p<0.001$	Not stated	In a small volunteer study of nasal anaesthesia techniques, lidocaine gel outperforms lidocaine spray, lidocaine-soaked swabs and EMLA cream considering patient assessment of application and anaesthesia, and physician preference.

Schlatter L, Pflimlin E, Fehrke B, Meyer A, Tamm M, Stolz D.	Propofol versus propofol plus hydrocodone for flexible bronchoscopy: a randomised study.	2011	ERJ	529-537	RCT	++	154 patients - propofol/saline arm; 146 patients - propofol/hydrocodone arm.	300 patients total. Propofol/Saline vs. Propofol/Hydrocodone: Age 61.8 vs. 64.4; Males 58% vs. 49%; Weight 71.8kg vs. 69.4kg.	Sedation for bronchoscopy with either propofol (10-20mg iv boluses)+saline placebo (iv) or propofol+hydrocodone (4mg iv) until onset of ptosis. All patients given oxygen at 4L/min via nasal cannula. Nasal 2% lidocaine gel. 3ml 1% lidocaine to cords, trachea and main bronchi, with boluses as required.	With placebo	24 hours post procedure	Primary end-point - physician cough VAS score; Other end-points - patient cough VAS score, discomfort VAS score, haemodynamic monitoring, subjective and objective measures of patients' readiness for discharge at 2 hours.	P+H associated with lower cough score by physician (2.0 vs. 2.5 p=0.011), patient at 2 hours (3.0 vs. 4.0 p=0.025) and nurse (2.0 vs. 2.25 p=0.031). Patient discomfort score at 2 hours lower in group receiving opiate (0.5 vs. 0.5 p=0.037). At 24 hours, cough and discomfort scores no longer significantly different. Time until discharge similar. Lower propofol dose required when with hydrocodone - 200mg vs. 260mg, p<0.0001. Similar lidocaine requirements. Haemodynamic parameters similar; mean lowest oxygen saturation and maximum oxygen requirement similar. No difference in complications, although oxygen desaturation <=90% fairly common - 36% vs. 29% (P/S vs. P/H), chin support requirement 36% vs. 26%; requirement for ITU in one patient having P/H.	Clinic of Pulmonary Medicine and Respiratory Cell Research, University Hospital Basel, Basel, Switzerland. D. Stolz was supported by a grant from the Swiss National Foundation (PP00P3_128412/1).	Cough suppression with P/H is more effective than P/S, and is associated with a lower dose of propofol, with a similar rate of adverse events. 32% of all patients had oxygen desaturation <=90% at some point during bronchoscopy and 31% needed chin support at some point. Low cough scores were seen despite a relatively low dose of lidocaine given (90mg).
Schwarz Y, Greif J, Lurie O, Tarrasch R, Weinbroum AA	Dextromethorphan premedication reduces midazolam requirement: objective and subjective parameters in peribronchoscopy	2007	Respiration	314-319	RCT	_	60 consecutive patients	DM vs. placebo; M/F - 14/15 vs. 11/19; age - 61.8 vs. 57.7	Double blinded premedication with DM 90mg vs. placebo, given 90 mins prior to bronchoscopy. All patients - 4ml 4% lidocaine nebulised, lidocaine gel to nostril and 2ml 1% lidocaine as required to bronchial tree. Midazolam 1mg iv, titrated (not to set point).	With placebo	Next morning	Vital signs, patient VAS - pain, cough, emotional reaction, complaints, expectoration, fear, feeling of unpleasantness and stress levels, level of communication, cooperation and level of information about procedure. Physician VAS - patient cooperation, communication, wakefulness, patient stress, patient cough, patient sputum. Volume of lidocaine	Significantly lower requirement for midazolam (3.1 vs. 4.2mg, p<0.01) and lidocaine (1.4 vs. 4.3ml, p<0.00001) in DM group. DM vs. placebo - less pain (VAS 1.3 vs. 2.3, p<0.00005); lower anxiety levels postprocedure (VAS 4.7 vs. 7, p<0.00001); score of complaints (VAS 1.1 vs. 3.6, p<0.0001); stress level during procedure (VAS 2.3 vs. 3.2, p<0.005); level of fear of procedure (VAS 2.4 vs. 3.3, p<0.0005); unpleasantness of procedure (VAS 1.9 vs. 3.1, p<0.00005); cough (1.5 vs. 3.2, p<0.05). Physician assessment found patients to be more cooperative in DM arm, and patients in DM group were significantly less awake after procedure.	Not stated	Small study suggesting benefit for dextromethorphan as a premedication to reduce midazolam/lidocaine requirement while improving patient perception of cough, pain, fear and tolerance. Lack of detailed information about characteristics of population e.g. co-morbidities, and lack of sedation to a defined level means that conclusions are limited.
Silvestri, Gerard A. Vincent, Brad D. Wahidi, Momen M. Robinette, Emory Hansbrough, James R. Downie, Gordon H.	A phase 3, randomized, double-blind study to assess the efficacy and safety of fospropofol disodium injection for moderate sedation in patients undergoing flexible bronchoscopy	2009	CHEST	41-7	RCT	_	256 randomised total 153 randomised to fospropofol 6.5mg/kg 103 randomised to fospropofol 2mg/kg	Patients >= 18 years old undergoing bronchoscopy by physicians without anaesthetic support, who did not have a predicted difficult airway (Malampatti IV or Malampatti III with thyromental distance <=4cm).	Intravenous fospropofol randomised to either 6.5 or 2mg/kg (with routine intravenous fentanyl 50microg and topical lidocaine for both arms)	Comparison between two arms (fospropofol 6.5mg/kg or 2mg/kg)	Until ready for discharge post-bronchoscopy	Primary - Modified Observer's Assessment of Alertness/Sedation success (3 consecutive scores <= 4 after fospropofol). Secondary - Treatment success (bronchoscopy completion without alternative sedation or mechanical ventilation); proportion willing to be retreated; proportion who did not recall being awake during bronchoscopy; patients requiring supplementary fentanyl; number of supplemental fospropofol doses; level of sedation; time to sedation; time to full alertness; safety	Primary outcome (6.5mg/kg vs. 2mg/kg); Sedation success rates were 88.7% and 27.5%, respectively (p < 0.0001). Secondary outcomes (6.5mg/kg vs. 2mg/kg); Treatment successes (91.3% vs 41.2%, respectively; p < 0.001), willingness to be treated again (94.6% vs 78.2%, respectively; p < 0.001), absence of procedural recall (83.3% vs 55.4%, respectively; p < 0.001).Median time to full alertness was slightly longer for the 6.5 mg/kg dose (5.5 vs 3.0 min, respectively). The proportion of patients requiring supplemental therapy with analgesics (16.7% vs 37.3%, respectively) and the use of alternative sedative medications (8.0% vs 58.8%, respectively) were lower for patients in the 6.5 mg/kg dose group (all comparisons, p < 0.001).	Industry grant	Fospropofol, at a dose of 6.5mg/kg, may have a role as a sedative for bronchoscopy, although transient side effects (such as paraesthesia and pruritus) are common. Hypoxaemia and hypotension are also seen. Further studies comparing fospropofol with commonly-used agents are required.

Stolz, D. Chhajed, P. N. Leuppi, J. D. Brutsche, M. Pflimlin, E. Tamm, M.	Cough suppression during flexible bronchoscopy using combined sedation with midazolam and hydrocodone: a randomised, double blind, placebo controlled trial	2004	THORAX	773-6	RCT	++	120 patients, 60 in two arms.	120 consecutive patients undergoing diagnostic flexible bronchoscopy, with mean age 62 years, having a variety of BAL, brushings, endobronchial and transbronchial biopsies and TBNA.	Sedation and cough suppression during flexible bronchoscopy with either 5mg iv hydrocodone and titrated iv midazolam or placebo and titrated iv midazolam. Both groups received topical lidocaine (nebulised 4ml 4% lidocaine, 4x sprays of 2% lidocaine to nasopharynx, 3x sprays of 2% lidocaine in oropharynx, 3ml 1% lidocaine to vocal cords and spray-as-you-go aliquots of 3ml 1% lidocaine to tracheobronchial tree. All patients had supplemental nasal cannula oxygen at 4l/min (increased to 6l/min as required).	Between treatment (iv hydrocodone) and placebo (iv saline)	Until 2 hours post-bronchoscopy	Physician and nurse assessment of cough (10cm VAS) and patient assessment of tolerability (10cm VAS, performed 2 hours post-bronchoscopy).	VAS-assessment of perception of cough by bronchoscopist and nurse was significantly lower in the hydrocodone group (median 3 (range 0–10) and 3 (0–10)) than in the placebo group (6 (0–10) and 6 (0–10)), respectively (p = 0.001). Patients' VAS-assessment of tolerance (2 hours post bronchoscopy) was also significantly better with hydrocodone than with placebo (2 (0–8) v 3 (0–9), p = 0.043).	Not stated	Bronchoscopist and nurse perception of cough and patient assessment of bronchoscopy tolerability are significantly improved by addition of hydrocodone (to midazolam) for flexible bronchoscopy
Stolz, D. Kurer, G. Meyer, A. Chhajed, P. N. Pflimlin, E. Strobel, W. Tamm, M.	Propofol versus combined sedation in flexible bronchoscopy: a randomised non-inferiority trial	2009	EUROPEAN RESPIRATORY JOURNAL	1024-30	RCT	+	200, 100 randomised to each arm.	Consecutive patients attending for bronchoscopy, 33% for infection, 31% for malignancy.	Sedation with either 5mg iv hydrocodone + titrated iv midazolam vs. titrated iv propofol.	Between treatment comparison.	Until leaving bronchoscopy recovery area.	Primary - mean lowest arterial oxygen saturation and patient-assessed VAS of readiness-for-discharge (although this is not what stated in ISRCTN99754241) Secondary - haemodynamic parameters, procedural complications, patient cough, fear and discomfort VAS assessment	Non-inferiority of propofol for mean lowest arterial oxygen saturation and readiness-for-discharge at 1 hour (with possible suggestion of benefit). Non-inferiority for haemodynamic parameters and procedural complications.	Not stated	Propofol is not associated with increasing episodes of desaturation compared with midazolam and hydrocodone. Possible earlier readiness-for-discharge with propofol, but this is patient reported and needs validation, particularly with reference to physician/nursing concordance.
Stolz, D Chhajed, PN Leuppi, J Pflimlin, E Tamm, M	Nebulized lidocaine for flexible bronchoscopy: a randomized, double-blind, placebo-controlled trial	2005	CHEST	1756-60	RCT	++	150 consecutive patients, 75 in each arm	Tertiary care university hospital; 150 patients (93 men; age, 20-89 years); excluded intubated patients and those receiving propofol and patients requiring EBUS.	4 mL of 4% lidocaine (160 mg) or 4 mL of saline solution as placebo via nebulisation over 15mins immediately before bronchoscopy. All received nasal 10% lidocaine sprays x4 and oropharynx sprays x2. Lidocaine administered via bronchoscope was measured, and as a minimum was usually, 3ml 1% lidocaine to cords, trachea and right and left main bronchi. All received combined sedation with 5mg iv hydrocodone, 2mg midazolam with 1-2mg intermittent boluses as required. Bronchoscopy was performed transnasally with supplemental oxygen at 4-6L/min via nasal cannulae.	Treatment vs. placebo	Until 2-3 hours post bronchoscopy	Primary outcome was supplemental lidocaine doses (lidocaine only received via bronchoscope). Secondary outcomes - Bronchoscopists (immediately post-bronchoscopy) and patients (2-3 hours post-bronchoscopy) charted their perception of cough on a 10cm visual analogue scale (VAS). Patients also recorded their discomfort related to the procedure on a 10cm VAS.	Primary outcome (supplemental lidocaine dose) was the same (158mg vs. 157mg lidocaine (intervention vs. placebo). There were no significant differences in cough VAS score (patient and physician assessment) and discomfort VAS score (patient assessment). The average midazolam dose was 5mg vs. 4.9mg. Total lidocaine dose (including nebulised) of 318mg vs. 157mg (treatment vs. placebo), p<0.001	Not stated	Nebulised 4% lidocaine does not decrease the requirement for spray-as-you-go topical lidocaine, and does not improve physician cough VAS assessment or patient 2-3 hour cough or discomfort VAS assessment.
Vesco, D. Kleisbauer, J. P. Orehek, J.	Attenuation of bronchofiberscopy-induced cough by an inhaled beta 2-adrenergic agonist, fenoterol	1988	American Review of Respiratory Disease	805-6	RCT	++	40 patients; 20 to placebo arm, 20 to fenoterol arm.	Placebo vs. fenoterol - Male 16 vs. 17, Smokers 15 vs. 13, age 61.1 vs. 58.3	Premedication with fenoterol inhaler 2 puffs (total 400 microg) vs. placebo. All patients received premedication with 0.5mg im atrpine and 100mg hydroxyzine, followed by inhaler 50mins later. Routine lidocaine anaesthesia with 1 puff 5% lidocaine to each nostril and 4 puffs to oropharynx. 2% 2*2ml boluses injected into trachea through bronchoscope via vocal cords. Additional 2% 2ml lidocaine given to airways as required.	With placebo	First 5 mins of bronchoscopy	Number of coughs for 5 mins having inserted bronchoscope through cords.	Significantly lower cough rate for patients receiving fenoterol vs. placebo (~35 vs. ~55, p<0.01 - data interpreted from graph). More patients receiving fenoterol did not receive additional lidocaine (10 vs. 3, p<0.02). Smokers coughed more than non smokers (48 vs. 33.6, p<0.01).	Not stated	In a small randomised study, fenoterol was associated with a significantly reduced cough rate and need for additional lidocaine, although characteristics of asthma, COPD and FEV1/FVC not given -> overall conclusions limited.
Webb, A. R. Fernando, S. S. D. Dalton, H. R. Arrowsmith, J. E. Woodhead, M. A. Cummin, A. R. C.	Local anaesthesia for fibreoptic bronchoscopy: Transcricoid injection or the 'spray as you go' technique?	1990	THORAX	474-477	RCT	+	35 patients in each group (cricothyroid vs. spray-as-you-go)	Patients undergoing diagnostic bronchoscopy (not for haemoptysis with a normal chest radiograph, abnormal clotting or stridor). Spray vs. cricothyroid - 18 vs. 23 males; age 62.5 vs. 62.2; alfentanil 10.37microg/kg vs 10.44microg/kg.	All patients had 5ml 2% lidocaine gel to nose. Cricothyroid arm had 5ml 2% lidocaine given as bolus through 21G needle while sitting up. Spray-as-you-go group had 4ml 4% lidocaine to vocal cords in 2 aliquots, with a further 2ml 2% lidocaine to each main bronchus. Patients sedated with iv alfentanil and iv glycopyrrolate.	Between treatment	Until discharge from bronchoscopy recovery	Primary end-point not specified. No power calculation. Cough count after inserting bronchoscope through vocal cords. Duration of bronchoscopy. Assessment of bleeding from puncture site. Patient bronchoscopy tolerability VAS, discomfort of cricothyroid injection.	Faster to cross vocal cords for cricothyroid - 1.35mins vs. 2.69mins (p<0.01). Time to complete bronchoscopy similar. More patients in cricothyroid group required further boluses (15 vs. 8, p<0.05) although total doses lower for cricothyroid (322mg vs. 451mg p<0.001). Cough rate lower in cricothyroid group (3.56 vs. 5.89, p<0.05). No signficant differences between patient tolerability VAS. Small amounts of blood in trachea in 23/30, not interfering with bronchoscopy. 17/30 found cricothyroid 'not unpleasant'.	Not stated	Cricothyroid anaesthesia is associated with a lower cough rate once bronchoscope has been passed through vocal cords. Actual bronchoscopic passage of vocal cords is faster with cricothyroid, but this doesn't include consideration of total procedure time, including cricothyroid. Cricothyroid associated with lower total dose of lidocaine, although 4% lidocaine used for vocal cords in 'spray arm'. No significant differences between patient tolerability VAS. Small amounts of blood in trachea in 23/30, not interfering with bronchoscopy.

Webb, A. R. Woodhead, M. A. Dalton, H. R. Grigg, J. A. Millard, F. J.	Topical nasal anaesthesia for fibreoptic bronchoscopy: patients' preference for lignocaine gel	1989	THORAX	674-5	RCT	+	16 patients given spray lidocaine to nose, 20 patients given gel lidocaine to nose.	Consecutive patients undergoing routine diagnostic bronchoscopy.	Block randomisation of patients for method of anaesthetising nasal passages. Gel arm - 5ml lidocaine gel into each nostril, massaged subsequently. Spray arm - 80mg 4% lidocaine and 20mg 10% lidocaine into each nostril (taking total dose to 200mg for both groups). Alfentanil and glycopyrrolate sedation. Lidocaine solution spray-as-you-go to vocal cords, trachea and bronchial tree.	Between treatment	Post bronchoscopy	Primary outcome not stated; no power calculation. Patient VAS assessment of unpleasantness of passage of bronchoscope through nose. Questionnaire on comfort.	Gel vs. spray - topical anaesthetic 'unpleasant' - 3/20 vs. 14/16, p=0.0001 (most common reasons - bad taste, discomfort or pain during application). VAS 1.4 vs. 1.9, ns.	Not stated	Nasal lidocaine gel is less unpleasant than nasal lidocaine spray, although both are equally effective in a small non-blinded trial.
Williams, T. Brooks, T. Ward, C.	The role of atropine premedication in fiberoptic bronchoscopy using intravenous midazolam sedation	1998	CHEST	1394-8	RCT	++	50 in each arm	93 outpatients. Mean ages 63.7 (atropine), 63.9 (placebo). Well matched.	Double-blinded allocation to premedication with either IM atropine 0.6mg or IM saline 30-60 mins prior to sedation with iv midazolam until lightly asleep	Placebo comparison	End of bronchoscopy	Primary outcome not stated. No power calculation. Outcomes measured - PEFR pre-medication and pre-bronchoscopy, three-point grading of pharyngeal secretions, three-point grading of tracheobronchial secretions, bleeding, saline use and local anaesthetic use	Study may lack power to detect some effects, but no significant effects with bronchodilatation, secretions, saline use, bleeding, desaturation and arrhythmias. More local anaesthetic used in placebo group (mean 357mg vs. 331mg, p=0.02).	Not stated	No clear benefit to atropine usage other than slightly decreasing lidocaine usage (357mg placebo, 331mg atropine). More patients with atropine developed a tachycardia, although not significant
Xue, Fu S. Liu, He P. He, Nong Xu, Ya C. Yang, Quan Y. Liao, Xu Xu, Xiu Z. Guo, Xin L. Zhang, Yan M.	Spray-as-you-go airway topical anesthesia in patients with a difficult airway: a randomized, double-blind comparison of 2% and 4% lidocaine	2009	ANESTHESIA & ANALGESIA	536-43	RCT	++	52 adult patients; 26 randomised to 4% lidocaine and 26 randomised to 2% lidocaine	Patients included if anaesthetist (not involved with study) determined that awake fibreoptic intubation required based on clinical predicts or history of difficult intubation. Exclusions included history of hepatic, renal and coagulation diseases, respiratory tract pathology, pregnancy and those recieving opioids or sedatives. 52 patients, mean age 37.9-38.5 years.	Atropine 10 microg/kg was administered IV and the posterior pharynx was anesthetized with 5 intraoral sprays using 10% lidocaine; each depression of the release button delivered 0.1 mL (10 mg). In the operating room, patients received fentanyl 1.5 microg/kg IV and midazolam to achieve anxiolysis as defined by an Observer's Assessment of Alertness/Sedation Scale (OAA/S) of 14 –16. Both arms received lidocaine spray-as-you-go with bronchoscope and epidural catheter in a repetitive protocolised fashion until adequate topical anaesthesia (one arm - 2% lidocaine, other arm - 4% lidocaine). Awake fiberoptic orotracheal intubation was performed after adequate topical anaesthesia.	Between treatments	Until after endotracheal intubation	Time for each airway spray and total times for all airway sprays During each airway spray, an independent investigator unaware of the patient's group assignment, observed and scored a patient's comfort using a 4-point scale. Total dose of lidocaine (including 50 mg used for intraoral sprays) were noted. Side effects were noted. After insertion of ETT, an independent blinded investigator scored patient's reaction using a modified 6-point scale. Cough severity was rated on a 4-point scale. Serial blood samples were obtained for analysis of plasma lidocaine concentrations.	Except for the total dose and plasma concentrations of lidocaine, there were no significant differences in any of the observed variables between groups. All patients exhibited excellent or acceptable intubating conditions. Total dosages of lidocaine were significantly smaller in 2% lidocaine arm (3.4+/-0.6 mg/kg) than in 4% lidocaine arm (7.1+/-2.1 mg/kg). The plasma lidocaine concentrations in all observed points after the supraglottic sprays were larger in 4% lidocaine arm than 2% lidocaine arm. 1 patient, who had received 7.5mg/kg of lidocaine in 4% lidocaine group reported dizziness, shivering and tinnitus without hypotension after the endotracheal spray, with a plasma lidocaine concentration of 2.8microg/ml. Most peaks seen aout 20 mins post last spray.	Not stated	For patients mildly sedated (to achieve anxiolysis) undergoing awake fibreoptic oral intubation, comparable topical anaesthesia can be obtained with either 2% or 4% lidocaine, although 4% lidocaine use is associated with significantly higher plasma lidocaine concentrations.
Zainudin, B. M. Rafia, M. H. Sufarlan, A. W.	Topical nasal anaesthesia for fibreoptic bronchoscopy: lignocaine spray or gel?	1993	SINGAPORE MEDICAL JOURNAL	148-9	RCT	+	Lidocaine spray arm - 25 patients; Lidocaine gel arm - 30 patients.	55 consecutive patients, 39 males, 16 females, mean age 49.6	Spray group - received 100mg 10% lidocaine solution to right nostril, with bronchoscopic lubrication by water soluble gel. Gel group - received 100mg (5ml of 2% lidocaine) to right nostril. All patients - protocolised lidocaine to upper airway and respiratory tract. im pethidine 50-75mg, atropine 0.6mg 30 pre bronchoscopy.	Between treatment	30 mins post bronchoscopy	No primary endpoint; no power calculation. Questionnaire - Most unpleasant part of procedure, pain of nasal anaesthesia, bronchoscopist's assessement of overall tolerance	Significantly more patients found nasal anaesthesia to be worse part of procedure for spray group (9 vs. 3, p=0.04); significantly more patients had pain/discomfort with nasal anaesthesia for spray group (18 vs. 6, p<0.001). Bronchoscopists' assessments of tolerance was similar.	Not stated	Lidocaine gel is associated with less pain/discomfort than lidocaine spray in a small unblinded randomised study.

STUDY IDENTIFICATION / CITATION					TYPE	QUALITY RATING	POPULATION CHARACTERISTICS		INTERVENTION	COMPARISON	OUTCOMES	EFFECT SIZE	FUNDING	COMMENTS
AUTHORS	TITLE	YEAR	JOURNAL	CITATION			NUMBER	PATIENT CHARACTERISTICS						
Loddenkemper, R.Schaberg, T.Mai, J.	Bronchial evaluation of peripheral localised lung lesions: Accuracy of different biopsy techniques	1983	European Journal of Respiratory Diseases	461-464	Qualitative research	_	30 patients	Patients with peripheral, bronchoscopically invisible tumours.	Diagnostic accuracy of fluoroscopically guided bronchoscopy for peripheral lung lesions.	Observation study	Diagnostic yield. Poorly defined study, although the study explains that those patients with negative results from this procedure (50%) had a diagnosis made through non EBUS TBNA, percutaneous needle aspiration and resection of lesion.	Not stated	Not reported	Poorly defined study, although the study explains that those patients with negative results from this procedure (50%) had a diagnosis made through non EBUS TBNA, percutaneous needle aspiration and resection of lesion.
Velardocchio, J. M.Boutin, C.Irisson, M.	Broncho alveolar lavage in diffuse lung diseases, comparison with transbronchial and thoracoscopic lung biopsy	1983	European Journal of Respiratory Diseases	457-458	Qualitative research	_	32 patients	Probable diagnosis of diffuse lung disease	Qualitative research	Diagnosis of diffuse lung disease	Diagnostic rate	TBLB diagnostic in 4 out of 7 patients with sarcoidosis.	Not reported	The study showed that TBLB was diagnostic in 4 out of 7 patients with sarcoidosis.
Hsu, C.	Cytologic diagnosis of lung tumors from bronchial brushings of Chinese patients in Hong Kong	1983	ACTA CYTOLOGICA	641-6	Qualitative research	_	1016 patients	The diagnostic yield from cytology (brushings and washings).	Qualitative research – Brushings and washings during FB.	The diagnostic yield from cytology (brushings and washings).	Diagnostic accuracy	Bronchial washings and brushings yielded a positive result of malignancy in 15.5% and 24% respectively. Combining techniques gave a yield of 32. Cytology was positive in 204 out of 245 histologically confirmed cases.	Not reported	This study demonstrates that bronchial washings and brushings yielded a positive result of malignancy in 15.5% and 24% respectively. Combining techniques gave a yield of 32. Cytology was positive in 204 out of 245 histologically confirmed cases. This study however is limited to a Chinese population (cases were exclude on this basis).
Buccheri, G.Barberis, P.Delfino, M. S.	Diagnostic, morphologic, and histopathologic correlates in bronchogenic carcinoma. A review of 1,045 bronchoscopic examinations	1991	CHEST	809-14	Qualitative research	+	1045 patients with a suspected diagnosis of lung cancer	Median age, 63 years; range, 34 to 87 years; and M/F sex ratio, 8/1 (930 male patients and 115 female patients). In all, 782 pathologic diagnoses were available. Figure 2 shows the overall	Qualitative research	Correlation between tumour location and histology The use of different diagnostic techniques	Forceps biopsies were positive in 79% of the 841 performed biopsies (64% of the entire sample); brushings were positive in 38 percent of 372 biopsies (14% of all patients); and washings were positive in 32% of 1,009 biopsies (31% of 1,045). More than one positive finding occurred in 309 bronchoscopies out of 1 ,045 (30%).	Forceps biopsies, brushings, and washings were positive in 79%, 38%, and 32% of the obtained specimens, respectively. Bronchoscopically, squamous and small-cell carcinomas were more often visualized as central tumor-like lesions, which were better diagnosed by forceps biopsies. Adenocarcinomas, on the contrary, were more frequently peripheral and showed infiltrative, compressive, or nonspecific findings. In these latter tumors, cytology studies were more fruitful. Large-cell anaplastic carcinomas	Not reported	The authors conclude that squamous cell and small cell cancers were more often located centrally and therefore visible endoscopically, furthermore, forceps biopsy gives the highest yield and therefore several samples should always be taken.

											had an intermediate behaviour.			
Cox, I. D.Bagg, L. R.Russell, N. J.Turner, M. J.	Relationship of radiologic position to the diagnostic yield of fiberoptic bronchoscopy in bronchial carcinoma	1984	CHEST	519-22	Qualitative research	_	100 patients with a diagnosis of lung cancer	Of the 100 patients in the series, 33 had hilar masses, 45 had perihilar masses, and 22 had peripheral masses on the basis of their radiologic classification.	Qualitative research	The use of bronchoscopy in diagnosing tumor when divided into peripheral, hilar and perihilar in position on chest radiograph.	Diagnostic accuracy overall of 73%	At bronchoscopy without fluoroscopy, only eight (36 percent) of 22 radiologically peripheral tumors were diagnosed, compared with 31 (94 percent) out of 33 hilar tumors (p less than 0.001) and 34 (76 percent) out of 45 perihilar tumors (p less than 0.01).	Not reported	The diagnostic yield was lower in peripheral tumors and in these cases fluoroscopic guidance may be useful.
Aleva, R. M.Kraan, J.Smith, M.ten Hacken, N. H.Postma, D. S.Timens, W.	Techniques in human airway inflammation: quantity and morphology of bronchial biopsy specimens taken by forceps of three sizes	1998	CHEST	182-5	Qualitative research	_	30 patients	Non-asthmatic subjects	Qualitative research	A comparison of 3 different sized biopsy forceps on the size and quality of mucosal samples.	Specimen quality with different sized forceps	Bronchial biopsy specimens obtained with forceps type FB-35C and FB-21C were equal in size, but the FB-35C biopsy specimens showed more damage and crush artifacts, whereas biopsy specimens obtained with forceps type FB-21C had more intact basement membrane, more sub mucosal depth, and well-preserved morphology.	Not reported	This is a study of the best size of forceps to use, the results are inconclusive. The size of biopsy sample was significantly different between 2 of the forceps only, furthermore this did not affect the quality of immunostaining. The authors conclude that the largest forces produce the same size material as the medium sized forceps but the quality of the material is better, however larger studies are required.
Chau, C. H.Yeu, W. W.Wong, P. C.Lee, J.Wong, C. F.	Usefulness of collecting routine cytologic specimens during fiberoptic bronchoscopy for endoscopically visible and nonvisible lung carcinoma	1997	CHEST	522-3	Qualitative research	_	329 diagnosed lung cancers		Qualitative research	Usefulness of collecting cytological samples in the diagnosis of lung cancer	Diagnostic yield	The increase in yield when routine cytology examination of bronchial washings and brushings was practiced in addition to transbronchial forceps biopsies was found to be 34.5%, 34.2%, and 29.1%.	Not reported	The authors conclude that cytological procedures do significantly increase the yield in endoscopically invisible tumours and should therefore be collected.
Potdar, P. V.Jain, K.Prabhakaran, L.Kamat, S. R.	Value of bronchoalveolar lavage in interstitial lung diseases	1989	JOURNAL OF THE ASSOCIATION OF PHYSICIANS OF INDIA	444-7	Qualitative research	+	58 patients with interstitial lung disease and 30 controls		Qualitative research	Use of BAL in diagnosing interstitial lung disease	Overall and differential cell counts between group		Not reported	BAL is an additional useful tool in the diagnosis of ILD, but can not be used to differentiate between ILDs and can not stage the disease.
van der Drift, Miep A.van der Wilt, Gert-JanThunnissen, Frederik B. J.	A prospective study of the timing and cost-effectiveness of bronchial washing during bronchoscopy	2005	CHEST	394-400	Diagnostic Accuracy	+	281 patients in total. 137 patients with endobronchial malignancy	Mean age 65.6 years; age range 38 to 88 years; 147 men and 74 women	Diagnostic Accuracy	Bronchial washings prior or after biopsies and brushings	Difference in the diagnostic yield for washings before or after biopsies and brushings. Washings before biopsy and brushing (strategy I) and	The diagnostic yield of strategy I was 72% for visible tumors and 36% for nonvisible tumors. For strategy II, the diagnostic yield was 74% for visible tumors and in 42% for nonvisible tumors. The	Not reported	The study showed that there was no difference in diagnostic yield for washings before or after bronchoscopy and brushings. The additional yield for washings and brushings was relatively low.

M.Janssen, Julius P.	for pulmonary malignant tumors										after biopsy and brushing (strategy II)	comparison of strategies I and II for both visible and nonvisible tumors revealed that 176 cases were concordant (80%); in 19 cases (9%) the cytologic analysis of washings in strategy I was positive for malignancy and negative in strategy II. In 26 cases (12%) washings in strategy II were positive and negative in strategy I (p = 0.37). An analysis of the diagnostic yield of both washings in visible tumors and nonvisible tumors showed no significant difference.		The study included a cost-effectiveness analysis and concluded that it is cost-effective to use washings and brushings, particularly if their analysis is confined to when biopsy is negative
Bungay, H. K.Pal, C. R.Davies, C. W.Davies, R. J.Gleeson, F. V.	An evaluation of computed tomography as an aid to diagnosis in patients undergoing bronchoscopy for suspected bronchial carcinoma	2000	CLINICAL RADIOLOGY	554-60	Diagnostic Accuracy	+	62	46 men, 16 female, mean age 70 years (49-86)	Diagnostic Accuracy	the use of CT in guiding the diagnostic accuracy of bronchoscopy	The use of CT in guiding the diagnostic accuracy of bronchoscopy	Diagnostic accuracy 82%	Not reported	100% suspected of having bronchogenic carcinoma This study predates the recommendation of performing a CT prior to bronchoscopy, which most units do currently.
Puar, H. S.Young, R. C., Jr.Armstrong, E. M.	Bronchial and transbronchial lung biopsy without fluoroscopy in sarcoidosis	1985	CHEST	303-6	Diagnostic Accuracy	+	68 patients with clinical and radiological evidence of sarcoidosis underwent TBLB between 1979 and 1981 in a single institution	22 men and 45 women; 12 patients radiographic stage 1, 41 patients stage 2, 7 stage 3 and 7 stage 4.	Diagnostic Accuracy	Transbronchial lung biopsy	Evaluation of endobronchial and transbronchial biopsy in patients with a clinical diagnosis of sarcoidosis	76% of patients with sarcoidosis had non-caseating granulomata demonstrated on transbronchial or endobronchial biopsy.	Not reported	This is a single center experience of TBLB in patients with various radiographic stages of sarcoidosis and without fluoroscopy. Only 1 patient had a pneumothorax requiring intercostal drainage. Sensitivity of the technique in patients with a high pre-test probability of sarcoid was 76%
Matsuda, M.Horai, T.Nakamura, S.Nishio, H.Sakuma, T.Ikegami, H.Tateishi, R.	Bronchial brushing and bronchial biopsy: comparison of diagnostic accuracy and cell typing reliability in lung cancer	1986	THORAX	475-8	Diagnostic Accuracy	+	443		Diagnostic Accuracy	Bronchial brushings and bronchial biopsy	The diagnostic accuracy of bronchial brushing and biopsy in patients diagnosed with lung cancer	Brushing had a sensitivity of 90%, while biopsy had a sensitivity of 65%	Not reported	The relatively low yield of 65% from bronchial biopsy in this study may be explained by the fact that only 1 bronchial biopsy was taken per patient.
Cazzato, S.Zompatori, M.Burzi, M.Baruzzi, G.Falcone, F.Poletti, V.	Bronchoalveolar lavage and transbronchial lung biopsy in alveolar and/or ground-glass opacification	1999	MONALDI ARCHIVES FOR CHEST DISEASE	115-9	Diagnostic Accuracy	+	36	17 male, 19 female, mean age 53 years	Diagnostic Accuracy	Utility of BAL and TBLB in the diagnosis of GGS	The diagnostic accuracy of BAL and TBLB in ground glass shadowing	The diagnostic yield for TBLB for GGS only is 36%	Not reported	100% of patients with ground glass shadowing (GGS) on HRCT TBLB and BAL combined give a high diagnostic yield in GGS. In areas of consolidation the yield of TBLB is higher compared to BAL alone. The diagnostic yield for TBLB for GGS only is 36% compared to 95% for consolidation. The

														authors conclude HRCT is udeful in predicting the diagnostic accuracy of TBLB and BAL.
Rennard, S. I.Spurzem, J. R.	Bronchoalveolar lavage in the diagnosis of lung cancer	1992	CHEST	331-2	Diagnostic Accuracy	_	35 patients with lung cancer		Diagnostic Accuracy	Bronchoalveolar lavage	To determine if bronchoalveolar lavage is useful in diagnosing malignancy	BAL was positive in 24 (68.6%) of patients who already had a histological diagnosis of lung cancer. 6/50 BAL samples in patients with Hodgkin's disease demonstrated Reed Sternberg cells and 7/20 breast cancer patients demonstrated malignant cells on BAL.	Not reported	Insufficient data on the characteristics of patients included in the study. This retrospective review demonstrated that BAL was positive in 24 (68.6%) of patients who already had a histological diagnosis of lung cancer. Its role in the primary diagnosis of lung cancer is not clarified by this study.
Lachman, M. F.Schofield, K.Cellura, K.	Bronchoscopic diagnosis of malignancy in the lower airway: A cytologic review	1995	ACTA CYTOLOGICA	1148-1151	Diagnostic Accuracy	+	269 bronchoscopic specimens over a six year period.		Diagnostic Accuracy	Bronchoscopy brushings	The utility of bronchial brushings in increasing diagnostic yield during bronchoscopy		Not reported	The authors conclude that brushings in addition to biopsies during bronchoscopy increases the diagnostic sensitivity of the procedure from 82% to 92%.
Chechani, V.	Bronchoscopic diagnosis of solitary pulmonary nodules and lung masses in the absence of endobronchial abnormality	1996	CHEST	620-5	Diagnostic Accuracy	+	49 patients (51 procedures)		Diagnostic Accuracy	The use of bronchoscopic procedures in the diagnosis of SPNs with fluoroscopic guidance	To determine the diagnostic yield of individual sampling techniques and the additive yield of these techniques	Overall diagnostic yield 73%.Bronchial washings were diagnostic in 35%, brushings in 52%, TBLB 57% an TBNA 51%.	Not reported	The authors conclude that FOB is useful in the diagnosis of SPNs, however diagnostic yield is affected by location, size and character of lesion and that bronchial washings are the least useful procedure.
Bango, A.Luyando, L.Pandiella, J. R.Molinos, L.Ramos, S.Escudero, C.Martinez, J.	Bronchoscopic needle aspiration and biopsy of paratracheal tumors and hilar and mediastinal lymph nodes: Security yield and cost-effectiveness	2003	Journal of Bronchology	183-188	Diagnostic Accuracy	+	58 patients	45 Male, 13 Female	Diagnostic Accuracy	Bronchoscopic needle aspiration	To determine the diagnostic yield of bronchoscopic needle aspirated histology and cytology needles in para-tracheal tumours and hilar and mediastinal lymph nodes	Bronchoscopic needle aspiration had a diagnostic yield of 86% and sensitivity of 94%, with a specificity of 100%	Not reported	Bronchoscopic needle aspiration is a useful technique to diagnose paratracheal/hilar and mediastinal tumours and avoided a surgical procedure in 67%.
Boghani, A.Sambare, D.	Brush cytology as a diagnostic aid for bronchogenic carcinoma	1991	Indian Journal of Chest Diseases & Allied Sciences	19-23	Diagnostic Accuracy	+	125 patients		Diagnostic Accuracy	Diagnostic yield of bronchial brushings	The utility of bronchial brushings in diagnosing lung cancer		Not reported	Of the 125 patients 74 were suspected of having a diagnosis of lung cancer. The authors conclude that their yield for endobronchial visible tumours was 82% (including cases of adenoma and dysplasia) with bronchial brushing and that it is therefore a useful diagnostic

														tool45 of 109
Bilaçeroğlu S, Perim K, Günel O, Cağirici U, Büyükşirin M	Combining transbronchial aspiration with endobronchial and transbronchial biopsy in sarcoidosis	1999	MONALDI ARCHIVES FOR CHEST DISEASE	217-23	Diagnostic Accuracy	++	74	Mean age 36.7 years, range 19-64. 29 females.	Diagnostic Accuracy	Diagnostic utility of using TBNA, EBB and TBLB for stage I and II disease and EBB and TBLB in stage III disease.	Diagnostic utility of using TBNA, EBB and TBLB for stage I and II disease and EBB and TBLB in stage III disease.	Of all 3 techniques used in combination 90% TBNA alone 53% EBB 52% TBLB 64%	Not reported	74 patients suspected of having sarcoidosis undergoing flexible bronchoscopy The used of combined techniques in sarcoid leads to a higher diagnostic yield. EBB+TBLB gives a higher diagnostic yield in stage III compared to their use in stage I and II, therefore all 3 techniques should be used in stage I and II.
Bilaçeroğlu S, Bilaçeroğlu S, Günel O, Cağirici U, Perim K	Comparison of endobronchial needle aspiration with forceps and brush biopsies in the diagnosis of endobronchial lung cancer	1997	MONALDI ARCHIVES FOR CHEST DISEASE	13-17	Diagnostic Accuracy	++	151	122 males, mean age 51+/-6 years 29 females, mean age 46+/-7 years	Diagnostic Accuracy	The comparisons of the diagnostic utility of endobronchial needle aspiration (EBNA) using a TBNA needle, forceps biopsy (FB) and brush biopsy (BB) in suspected endobronchial lung cancer lesions.	A comparison of EBNA, Forceps biopsy and brush biopsy in the diagnosis of lung cancer	Patients were divided in to 2 groups, group 1: those who underwent EBNA and BB and group 2: those who had EBNA and FB. In group1 diagnostic yield was higher with both techniques (96%) compared to either technique alone (EBNA 90% *vs.* BB 66%). In group 2, once again diagnostic yield was higher using both techniques (100%), compared to EBNA alone (92%) or FB alone (78%).	Not reported	151 suspected of lung cancer with an endobronchial lesion EBNA is a useful diagnostic technique where FB may be difficult to perform (by worsening respiratory distress, or cause crush artifact). However, it is not a widely used technique in the UK.
Lundgren, R.Bergman, F.Angstr,x00F,m, T.	Comparison of transbronchial fine needle aspiration biopsy, aspiration of bronchial secretion, bronchial washing, brush biopsy and forceps biopsy in the diagnosis of lung cancer	1983	European Journal of Respiratory Diseases	378-85	Diagnostic Accuracy	+	59 patients	48 Male:11 Female Age 42-77 years	Diagnostic Accuracy	A comparison of diagnostic yield from transbronchial fine needle aspiration, aspiration of bronchial secretions, bronchial washings, forceps biopsy and brush biopsy.	To determine the differences in diagnostic yield TBNA, bronchial washings, aspiration of bronchial secretions, biopsy and brushing	88% combining all procedures. CI not reported.	Not reported	This study demonstrates that the combination of a forceps biopsy and bronchial washing produces significantly more sensitive in diagnosing lung cancer than any other combination of procedures or single method alone ($p<0.05$)
Mazuranic, I.Ivanovi-Herceg, Z.	Complementariness of the radiological finding and transbronchial lung biopsy for definitive diagnosis of diffuse interstitial lung	1996	Radiology and Oncology	89-94	Diagnostic Accuracy	+	52 cases	27 women and 25 men, age 16-76	Diagnostic Accuracy	Diagnostic yield from TBLB	Diagnostic yield from TBLB	51% of samples were adequate in diagnosing diffuse interstitial lung disease.	Not reported	52 patients suspected of diffuse interstitial lung disease. This is a difficult study to interpret. All the patients were anaesthetized for a rigid bronchoscopy and flexible bronchoscopy. The result are difficult to interpret, the results seem to suggest that TBLB would allow a

	diseases													diagnosis of interstitial lung disease in 51% of the patients.
Bilagerou, S.Kumcuo,lu, Z.Alper, H.Osma, E.Ca,irici, U.x00Fc,nel, O.Bayol, U.Celikten, E.Perim, K.x00F,se, T.	CT bronchus sign-guided bronchoscopic multiple diagnostic procedures in carcinomatous solitary pulmonary nodules and masses	1998	RESPIRATION	49-55	Diagnostic Accuracy	+	92 patients	74 male, 18 females, mean age 51 years (range 32-78)	Diagnostic Accuracy	The use of CT bronchus sign to guide bronchoscopy and the use of combined diagnostic techniques.	This study prospectively investigated the use of the CT bronchus sign (i.e. a bronchus directly leading to a peripheral pulmonary lesion, in the diagnostic yield of solitary pulmonary lesions	In patients with CT bronchus sign the overall diagnostic yield was 68% and 44% in those without the bronchus sign.	Not reported	The combination of multiple diagnostic procedures increases diagnostic yield during bronchoscopy. The use of the CT bronchi's sign may increase this yield further.
Zellweger, J. P.Leuenberger, P. J.	Cytologic and histologic examination of transbronchial lung biopsy	1982	European Journal of Respiratory Diseases	94-101	Diagnostic Accuracy	+	167 patients	43 females, 124 males aged 22-77	Diagnostic Accuracy	Transbronchial lung biopsy (TBLB)	The diagnostic accuracy of TBLB in diffuse interstitial lung disease	The diagnostic yield was 62.3% of cases, diagnostic yield was highest in diffuse orders such as sarcoidosis and lowest in those with solitary pulmonary nodules.	Not reported	The diagnostic yield in the study was 62.3%. In this study TBLB provided samples of lung parenchyma in 85.6%, the diagnostic in the population was 62.3%. The histological diagnostic yield was higher in diffuse interstitial infiltrates (75.6%) and sarcoidosis (73.5%). The complication rate of the procedure was low (3.6%) with bleeding and pneumothorax being most common.
Popovich, J., Jr.Kvale, P. A.Eichenhorn, M. S.Radke, J. R.Ohorodnik, J. M.Fine, G.	Diagnostic accuracy of multiple biopsies from flexible fiberoptic bronchoscopy. A comparison of central versus peripheral carcinoma	1982	American Review of Respiratory Disease	521-3	Diagnostic Accuracy	+	46 patients	26 patients with centrally visible measures and 20 peripheral nodules.	Diagnostic Accuracy	The number of biopsies taken by cup-shaped forceps required for a diagnosis of cancer.	The diagnostic yield from 6 consecutive forceps biopsies in patients with suspected lung cancer	For central lesions the diagnostic yield was 73% and 36% for peripheral lesions. In central lesions 73% of diagnoses were achieved with one biopsy for peripheral lesions diagnosis was only achieved in 45% with 1 biopsy.	Not reported	The authors conclude the probability of a positive biopsy result with 2 biopsies is 93% and increases to 99% with four biopsies.
Jay, S. J.Wehr, K.Nicholson, D. P.Smith, A. L.	Diagnostic sensitivity and specificity of pulmonary cytology: comparison of techniques used in conjunction with flexible fiber optic bronchoscopy	1980	ACTA CYTOLOGICA	304-12	Diagnostic Accuracy	+	224 consecutive patients.	224 patients with clinical or radiological signs suggestive of lung cancer	Diagnostic Accuracy	Cytologic examinations: bronchial washings, brushings and pre and post bronchoscopy sputa.			Not reported	31% of patients suspected of lung cancer had a final diagnosis of lung cancer.

Popp, W.Rauscher, H.Ritschka, L.Redtenbacher, S.Zwick, H.Dutz, W.	Diagnostic sensitivity of different techniques in the diagnosis of lung tumors with the flexible fiberoptic bronchoscope.	1991	CANCER	72-5	Diagnostic Accuracy	+	186 patients between 1987 and 1988 from a single European center with suspected primary or secondary lung tumours were included.		Diagnostic Accuracy	Bronchoscopic biopsies and brushings	This study compared the diagnostic yield of forceps biopsy histology, forceps biopsy imprint cytology and brushing histology in the diagnosis of lung tumours	For central tumours sensitivity of malignant lesions was 92.9% for biopsy and 78.8% for brushings. For peripheral lesions the sensitivity of brushings were 82.8% and forceps biopsy 80.5%. For all 3 methods the diagnostic accuracy was 97.3% (specificity 100%). Individually: diagnostic sensitivity for imprint cytology was 84.9%, 80.6% for brushings and 62.9% for histology sections.	Not reported	Single center retrospective study of 186 patients which demonstrated that forceps biopsy was superior to brushings for central tumours. The greatest yield (97%) was obtained by combining the techniques with imprint cytology
Pedersen, U.Balle, V. H.Greisen, O.	Diagnostic value of brush biopsy in suspected bronchial carcinoma with the use of the flexible fibre bronchoscope	1981	Clinical Otolaryngology & Allied Sciences	329-33	Diagnostic Accuracy	+	125 patients underwent bronchoscopy, 62 had lung cancer	86 men, 46 were over the age of 60	Diagnostic Accuracy	Analysis of bronchial brushings in patients with suspected lung cancer referred for bronchoscopy. Procedures were carried out under general anaesthesia via an endotracheal tube.	The diagnostic yield of brush biopsied in patients with suspected lung cancer	Of the 62 patients that appeared to have lung cancer 58% of patients had positive brush biopsies. The authors suggest that the use of brushings may increase diagnostic yield.	Not reported	Procedures were performed under general anaesthesia and so the results may not be considered to be valid when the procedure is performed under sedation. This guideline is not addressing the yield of flexible bronchoscopy performed under general anaesthesia.
Cetinkaya, ErdoganYildiz, PinarAltin, SedatYilmaz, Veysel	Diagnostic value of transbronchial needle aspiration by Wang 22-gauge cytology needle in intrathoracic lymphadenopathy	2004	CHEST	527-31	Diagnostic Accuracy	++	60	36 female, 24 male, mean age 39 (SD+/- 16 years)	Diagnostic Accuracy	TBNA	The diagnostic yield of TBNA in mediastinal or hilar adenopathy	Diagnostic accuracy 75%	Not reported	This study demonstrates TBNA is a safe and effective means of diagnosing intrathoracic lymphadenopathy.
Baaklini, W. A.Reinoso, M. A.Gorin, A. B.Sharafkaneh, A.Manian, P.	Diagnostic yield of fiberoptic bronchoscopy in evaluating solitary pulmonary nodules	2000	CHEST	1049-54	Diagnostic Accuracy	++	177 solitary pulmonary nodules	All male, mean age 65 years (range 41-83)	Diagnostic Accuracy	The use of bronchoscopy (including biopsy, brushing, washings) in the diagnosis of solitary pulmonary nodules (SPNs).	Diagnostic yield of biopsies, brushings and washings in SPN.	Overall diagnostic yield was 60%, 64% for malignancies and 35% for benign lesions.	Not reported	Not reported The diagnostic yield for SPNs is significantly affected by size of lesion (strongest predictor) and distance from hilum.
Liam, C. K.Pang, Y. K.Poosparajah, S.	Diagnostic yield of flexible bronchoscopic procedures in lung cancer patients according to	2007	SINGAPORE MEDICAL JOURNAL	625-31	Diagnostic Accuracy	+	503		Diagnostic Accuracy	All bronchoscopic procedures including bronchial biopsies, brushings,	Diagnostic yield of several bronchoscopic procedure including biopsies, brushings, washings and lavage	When tumour was visible the yield from biopsy was 78%, from washings was 28% and brushings was 54%	Not reported	Retrospective single center study of diagnostic yield from bronchoscopic techniques confirms that yield in higher when tumour is visible

	tumour location									lavage and washings				
Rhee, C. K.Kang, H. H.Kang, J. Y.Kim, J. W.Kim, H. Y.Park, A. S.Moon, S. H.Lee, S. H.	Diagnostic yield of flexible bronchoscopy without fluoroscopic guidance in evaluating peripheral lung lesions	2010	Journal of Bronchology	317-322	Diagnostic Accuracy	_	93		Diagnostic Accuracy	Transbronchial biopsy, bronchial brushings and washings for peripheral lung lesions	The use of TBLB, bronchial brushings and washings for peripheral lung lesions	Overall sensitivity was 65% (68% for malignant lesions)	Not reported	41% were malignant. The sensitivity of bronchoscopy for peripheral lesions in this study was 65%. Yield was higher in lesions greater than 2cm. However, this is lower than would be expected for percutaneous needle biopsy. It is unclear whether the patients in this study would have been suitable for percutaneous biopsy.
Shorr, A. F.Torrington, K. G.Hnatiuk, O. W.	Endobronchial biopsy for sarcoidosis: a prospective study	2001	CHEST	109-14	Diagnostic Accuracy	+	34 in the final cohort included in the analysis	For the 34 subjects, the mean age was 37.9 and 58.8% were males. Most patients (64.7%) were African American. Stage I CXR was seen in 23 patients. Stage II and stage III CXRs were seen in 9 patients and 2 patients, respectively	Diagnostic Accuracy	Endobronchial biopsy in patients with sarcoidosis	The use of endobronchial and transbronchial biopsy in patients with sarcoidosis	Sensitivity of endobronchial biopsy was 62%. Sensitivity of transbronchial biopsy was 59%. The combination had a sensitivity of 79%.	Not reported	The protocol for endobronchial biopsies included 4 specimens from abnormal areas and 2 from the main carina. In patients with normal-appearing airways, four specimens were taken from a secondary carina and two were taken from the main carina. Endobronchial abnormalities predicted positive endobronchial biopsies. However, in 3 of the 10 patients with normal airway appearance, a positive endobronchial biopsy was obtained. The authors conclude that endobronchial biopsy should be routinely performed in patients with suspected sarcoidosis, regardless of positive endobronchial appearances.
Boonsarngsuk, V.Raweelert, P.Sukpraprut, A.Chaiprasithikul, R.Kiatboonsri, S.	Factors affecting the diagnostic yield of flexible bronchoscopy without guidance in pulmonary nodules or masses	2010	SINGAPORE MEDICAL JOURNAL	660-665	Diagnostic Accuracy	+	330 patients with pulmonary masses/nodules	Age - 60.2 +/- 13 years. 63% male	Diagnostic Accuracy	Analysis to determine what factors determine bronchoscopic yield.	Analysis to determine what factors determine bronchoscopic yield.	Diagnostic yield with bronchoscopy was 55.8%	Not reported	The authors conclude that if a lesion is less than 4cm and CT does not demonstrate sub segmental or large airway involvement an alternate method to non-guided bronchoscopy should be used.
Stjernberg N, Björnstad-Pettersen H, Truedsson H	Flexible fiberoptic bronchoscopy in sarcoidosis	1980	Acta Medica Scandinavica	397-9	Diagnostic Accuracy	+	29	14 female 15 male aged 22 - 70. 13 Stage I sarcoid, 13 Stage II, 3 stage III.	Diagnostic Accuracy	TBLB and mucosal biopsy in patients with sarcoid	The utility of TBLB and mucosal biopsy in the diagnosis of sarcoidosis	Sensitivity of mucosal biopsy, TBLB and their combination was 41%, 43% and 52% respectively.	Not reported	Single center retrospective study of patients with a diagnosis of sarcoidosis. Sensitivity of TBLB was 41% and increased to 52% when combined with mucosal biopsy. Analysis according to disease limited by small

														numbers in each group.
Sarkar, S. K.Sharma, T. N.Kumar, P.Gupta, P. R.Jain, N. K.Mathur, B. B.	Flexible fiberoptic bronchoscopy in the diagnosis of pulmonary pathology	1983	JOURNAL OF THE INDIAN MEDICAL ASSOCIATION		Diagnostic Accuracy	_	250	49 females and 201 males, aged 25 - 60 years.	Diagnostic Accuracy	Fibreoptic bronchoscopy	Diagnostic yield	Reported as 97.27%. No CI reported	Not reported	The study reports the first 250 cases in the institution with a heterogeneous case mix and no gold standard for diagnosis reported
Popp, W.Merkle, M.Schreiber , B.Rauscher, H.Ritschka, L.Zwick, H.	How much brushing is enough for the diagnosis of lung tumors?	1992	CANCER	2278-80	Diagnostic Accuracy	+	270 patients with malignant lung tumours undergoing bronchoscopy		Diagnostic Accuracy	Bronchial brushings	To determine how many bronchial brushings are required to obtain a good diagnostic yield for diagnosing lung cancer	1st brushing was 72.6%, 2nd brushing was 77%. Sensitivity of combining 4 brushings was 89.6%	Not reported	Retrospective study of 270 patients undergoing bronchial brushings. Yield from brushings improved with number of brushes, although no improvement was seen above 4 brushes.
Piaton, E.Grillet-Ravigneaux, M. H.Saugier, B.Pellet, H.	Prospective study of combined use of bronchial aspirates and biopsy specimens in diagnosis and typing of centrally located lung tumours	1995	BMJ	624-7	Diagnostic Accuracy	+	1128	874 men; 254 women aged 65-3 (SD 13.7)	Diagnostic Accuracy	Cytological and histological samples from bronchoscopy	To determine the diagnostic accuracy of bronchial aspirates	Sensitivity of cytology was 90.4% whilst sensitivity for histology was 85%	Not reported	574 patients had a final diagnosis of lung cancer (51%). This was a large prospective multicenter study and demonstrated high yields for both cytology and histology samples. Exact concordance between cytology and biopsy was observed in 87% of patients
Lyall, J. R.Summers, G. D.O'Brien, I. M.Batemen, N. T.Pike, C. P.Braimbridge, M. V.	Sequential brush biopsy and conventional biopsy: direct comparison of diagnostic sensitivity in lung malignancy	1980	THORAX	929-31	Diagnostic Accuracy	+	116	90 male with mean age 61, 26 female with mean age 62	Diagnostic Accuracy	Bronchial brushings via fibreoptic bronchoscopy and biopsies via rigid bronchoscope	Comparison of brush and forceps biopsy in the diagnosis of lung cancer	Cytology 82% and histology 50%	Not reported	All procedures were carried out under general anaesthesia. Bronchial biopsies were undertaken via a rigid bronchoscope. This does not reflect current clinical practice
Piaton, E.Djelid, D.Duvert, B.Perrichon, M.Saugier, B.	Sequential use of bronchial aspirates, biopsies and washings in the preoperative management of	2007	CytoJournal		Diagnostic Accuracy	+	Combined cytology and biopsy samples were obtained in 334 patients. Cases were included until a total of 200 cases with lung cancer were	288 men and 46 women (mean age = 65.0 ± 11.5 years)	Diagnostic Accuracy	Bronchial biopsies as well as bronchial washings before and after biopsies	To assess the diagnostic values of bronchial brushings in suspected lung cancer	Sensitivity of biopsies alone was 82%. Bronchial washings before biopsy had a sensitivity of 84% while washings after biopsy had a sensitivity of 79%	Not reported	Single center retrospective study. It showed that there was no difference in the sensitivity of bronchial washings according to whether they were performed before or after the biopsy

	lung cancers						found							
Wasserman n, K.Gassanov, N.Atay, Z.Topalidis, T.Dienes, H. P.Mathen, F.	The impact of cytology on the bronchoscopic diagnosis of lung cancer	2004	Journal of Bronchology	154-159	Diagnostic Accuracy	+	156 in total, 95 with central tumours	47 women, 109 men	Diagnostic Accuracy	Sensitivity of histologic and cytological techniques of bronchoscopy in patients with peripheral and central lung cancers	To determine the use of brush biopsy in the diagnosis of lung cancer	93.7% for combined cytology and histology techniques in patients with central tumours. Sensitivity for forceps biopsy alone was 68% in patients with central tumours	Not reported	The yield from bronchoscopic biopsies is low and may reflect that many central tumours in the study were not visible. Importantly, this study was able to analyze NSCLC sub-typing with bronchoscopic techniques and compare to surgical pathology in 44 patients. This demonstrated that bronchoscopic histology and cytology was correct for NSCLC subtype in only 60% of cases.
Levy, H.Horak, D. A.Lewis, M. I.	The value of bronchial washings and bronchoalveolar lavage in the diagnosis of lymphangitic carcinomatosis	1988	CHEST	1028-30	Diagnostic Accuracy	_	12	10 women and 2 men. Mean age 58	Diagnostic Accuracy	Bronchoalveolar lavage and transbronchial lung biopsy	The use of BAL in diagnosing lymphangitis carcinomatosis	BAL had sensitivity of 100% (5/5); Sensitivity of TBLB was 44% (4//9)	Not reported	This small retrospective study of patients with lymphangitis suffers with selection bias. It may that only those patients in whom BAL was likely to succeed underwent the procedure. In addition, the small sample size means that conclusions regarding safety and efficacy of bronchoscopy in patients with lymphangitis are difficult to draw.
Yigla, M.Nagiv, D.Solomonov, A.Malberger, E.Ben-Izhak, O.Rubin, A. H. E.Keren, R.	Timing of collecting bronchoscopic cytologic specimens in endobronchial malignant neoplasms	2002	Journal of Bronchology	272-275	Diagnostic Accuracy	+	54	38 men, 16 women, age 65 +/- 19 years	Diagnostic Accuracy	Yield of bronchoscopic biopsy combined with brushings and washings pre and post biopsy	This study compared the diagnostic yield of bronchial washings pre and post forceps biopsy	Combined cytology and histology yield was 89% whether cytology samples were taken before or after biopsy. 95% CI not provided.	Not reported	The study demonstrates that brushing and washings do not add significantly to diagnostic yield. There is no difference if brushings or washings are performed before or after biopsy
Anders, G. T.Johnson, J. E.Bush, B. A.Matthews, J. I.	Transbronchial biopsy without fluoroscopy. A seven-year perspective	1988	CHEST	557-60	Diagnostic Accuracy	++	112 TBLB with fluoroscopy 135 TBLB without fluoroscopy	Mean age 52.3 years, 57% male		TBLB with or without fluoroscopy	A comparison of the complication rate in performing TBLB with and without fluoroscopy	Diagnostic yield using fluoroscopy 76.7% and 70.3% without fluoroscopy.	Not reported	The diagnostic yield and complication rates with and without fluoroscopy is similar, however, when diagnosing defined peripheral lesions (ie neoplasms) fluoroscopy may be of use.
Mitchell, D. M.Mitchell, D. N.Collins, J. V.Emerson,	Transbronchial lung biopsy through fibreoptic bronchoscope in	1980	BRITISH MEDICAL JOURNAL	679-81	Diagnostic Accuracy	++	79 patients with sarcoidosis, 50 of who underwent	40 men, 39 women		Transbronchial lung biopsy	A comparison of TBLB, endobronchial and Kveim test in the diagnosis of sarcoidosis	Sensitivity of TBLB (42 patients) was 88%. Sensitivity of endobronchial biopsy in 22 patients was 77%	Not reported	Informative early study showing that TBLB has a high yield in patients with sarcoidosis. Yield was higher in patients with abnormal

C. J.	diagnosis of sarcoidosis						bronchoscopy							lung parenchyma on chest radiograph
Milman, N.Faurschou, P.Munch, E. P.Grode, G.	Transbronchial lung biopsy through the fibre optic bronchoscope. Results and complications in 452 examinations	1994	RESPIRATORY MEDICINE	749-53	Diagnostic Accuracy	+	405	236 men, 169 women; median age 59 years (19 - 86)		Transbronchial lung biopsy	The utility of TBLB in the diagnosis of diffuse and localized lung disease	In localised disease, sensitivity was 55%; In diffuse disease sensitivity was 67%. 69% had localized pulmonary lesions and 31% had diffuse lesions	Not reported	This large retrospective study adds to the evidence that TBLB has a good yield in patients with diffuse lung disease. The retrospective case series means that the results may be subject to some selection bias.
Mitchell, D. M.Emerson, C. J.Collins, J. V.Stablefort h, D. E.	Transbronchial lung biopsy with the fibreoptic bronchoscope: analysis of results in 433 patients	1981	British Journal of Diseases of the Chest	258-62	Diagnostic Accuracy	+	433	two-thirds male, mean 52 years (range 6 - 80)	Diagnostic Accuracy	Transbronchial lung biopsy	A retrospective review of TBLB procedures in patients undergoing bronchoscopy	In 183 patients with diffuse shadows, TBLB provided a diagnosis in 61%	Not reported	183 patients had bilateral diffuse shadows TBLB had a yield of 77% in patients with sarcoidosis but only 40% in patients with fibrosing alveolitis. The procedure was safe with 1 patient requiring a drain for pneumothorax and 7 patients experienced significant bleeding of 50-100mls.
Descombes E, Gardiol D, Leuenberger Ph	Transbronchial lung biopsy: an analysis of 530 cases with references to the number of samples	1997	Monaldi Arch Chest Disease	324-329	Diagnostic Accuracy	++	516 patients, 530 TBLB	Age range 14-87	Diagnostic Accuracy	The use of TBLB in diagnosing parenchymal lung disease.	The use of TBLB in diagnosing parenchymal lung disease.	Overall diagnostic yield for diffuse infiltrates was 50%. This was higher in hypersensitivity pneumonitis (92%); sarcoid II-III (75%) and pneumoconiosis (54%). For localised lesions the diagnostic yield was 29%, (56% in stage I sarcoid).	Not reported	100% of patients with diffuse lung infiltrates, localized lung lesions or hilar lymphadenopathy. The study demonstrated that the final diagnosis was made in 89% of patients using TBLB, diagnosis could not be made in 11%. There was good clinic-pathological correlation in 42%. The authors suggest that TBLB is useful for diagnosing chronic diffuse infiltrates and localised lung lesions and that the higher the number of samples the better the diagnostic yield. they suggest 5-6 samples are taken in diffuse disease and 7-10 in localised disease, although there is an increased risk of complications.
Cetinkaya, ErdoganYildiz, PinarKadakal, FigenTekin, AliSoysal, FusunElibol, SenemYilmaz, Veysel	Transbronchial needle aspiration in the diagnosis of intra-thoracic lymphadenopathy	2002	RESPIRATION	335-8	Diagnostic Accuracy	+	28	17 male, 11 female, mean age 36 years (range 14-70)	Diagnostic Accuracy	The use of TBNA in the diagnosis of intrathoracic lymphadenopathy	The use of TBNA in the diagnosis of hilar or mediastinal lymphadenopathy	100% for TB 87.5% for sarcoidosis 50% for lymphoma	Not reported	100% with intra-thoracic lymphadenopathy TBNA is a useful diagnostic tool for intra-thoracic lymphadenopathy with an overall diagnostic yield of 69%. This is particularly true for TB and sarcoidosis.

McDougall, J. C.Cortese, D. A.	Transbronchoscopic lung biopsy for localized pulmonary disease	1981	Seminars in Respiratory Medicine	30-34	Diagnostic Accuracy	_	130	130 patients with lung cancer and no endobronchial lesion visible at bronchoscopy.	Diagnostic Accuracy	Biopsy and brushings of peripheral lung cancers under fluoroscopic guidance	The diagnostic accuracy of peripheral lung lesions using TBLB and brushings	62% of patients had a diagnosis with biopsy or brushings. 95% CI not reported	Not reported	The study is of patients with bronchoscopically inaccessible lung lesions and demonstrates a sensitivity of 62% which is lower than would be expected from percutaneous lung biopsy, which is the preferred investigation
Mak, V. H.Johnston, I. D.Hetzel, M. R.Grubb, C.	Value of washings and brushings at fibreoptic bronchoscopy in the diagnosis of lung cancer	1990	THORAX	373-6	Diagnostic Accuracy	+	680		Diagnostic Accuracy	Bronchial biopsy, washings and brushings	To determine the optimal combination of bronchoscopic techniques in diagnosing lung cancer	When endobronchial tumour was visible (125 cases) biopsy was positive in 76%, washings in 50% and brushings in 52%. When combined yield was over 95%	Not reported	This retrospective study suggests that biopsy, brushings and washings should all be performed to maximize yield in patients with visible tumour. The number of biopsy specimens taken was not reported. The retrospective design means that there is a possibility of selection bias where brushings may only be taken when biopsies were felt to be of low quality.

STUDY IDENTIFICATION / CITATION					TYPE	QUALITY RATING	BIAS	POPULATION CHARACTERISTICS		INTERVENTION	COMPARISON	FOLLOW UP	OUTCOMES	EFFECT SIZE	FUNDING	COMMENTS
AUTHORS	TITLE	YEAR	JOURNAL	CITATION				NUMBER	PATIENT CHARACTERISTICS							
Gibson, S. P.Weir, D. C.Burge, P. S.	A prospective audit of the value of fibre optic bronchoscopy in adults admitted with community acquired pneumonia	1993	RESPIRATORY MEDICINE	105-9	Qualitative research	+	Yes	55	Patients with lobar consolidation who were treated for community acquired pneumonia.	Underlying abnormalities eg carcinoma in patients presenting with pneumonia.	No specific comparisons.	Not reported	Underlying abnormalities eg carcinoma in patients presenting with pneumonia.	5 patients out of 50 had abnormal bronchoscopy showing endobronchial abnormalities. Four of these proved to be carcinomas and the remaining had fibrous stenosis of trachea. All patients with abnormal bronchoscopy were older than 50 years and were current of ex smokers.	Not reported	Early bronchoscopy to identify underlying structural abnormalities can be considered in subjects with community acquired pneumonia who are older than 50 years old and are either current or ex smokers.
Fleury-Feith, J.Van Nhieu, J. T.Picard, C.Escudier, E.Bernaudin, J. F.	Bronchoalveolar lavage eosinophilia associated with Pneumocystis carinii pneumonitis in AIDS patients. Comparative study with non-AIDS patients	1989	CHEST	1198-201	Qualitative research	+	Yes	22 HIV infected patients with PCP, 29 HIV infected patients with pneumonitis for some other cause (i.e. not PCP related) and 18 non HIV immunocompromised patients with PCP.	Immunocompromised status due to HIV or other reason with or without PCP infection. No subject demographic data given.	Bronchioalveolar lavage differential count for white cells.	BAL differential cell count between the three groups.	Not reported	BAL differential cell count between the three groups.	In AIDS patients with PC pneumonitis, the cell populations were 59.3 ± 4.5 percent alveolar macrophages (AM), 19.6± 2.5 percent lymphocytes, 14.6 ±4.4 percent polymorphonuclear cells (PMN), and 10.3 ± 3.6 percent eosinophils. In HIV infected patients without PC pneumonitis, they were 76.5±3.3 percent AM, 13±2.1 percent lymphocytes, 9.2±0.3 percent PMN, and 0.6 ±0.2 percent eosinophils, and in non-HIV-infected, immunocompromised patients with PC pneumonitis, they were 43.9±5.7 percent AM, 30.2±4.3 percent lymphocytes, 20.4±4.7 percent PMN, and 0.9±0.4 percent eosinophils.	Not reported	No subject demographic data given. No details about how the patients were diagnosed to have PCP. Study suggests raised eosinophil counts in those HIV infected subjects who have PCP infection. Subjects immunocompromised due to other reasons but with PCP infection fail to show this raised eosinophil counts.
Chung, H. S.Lee, J. H.	Bronchoscopic assessment of the evolution of endobronchial tuberculosis	2000	CHEST	385-92	Qualitative research	+	Yes	One hundred fourteen patients were enrolled in this study, out of 1,938 patients with pulmonary tuberculosis from January 1992 to December 1997	EBTB was diagnosed in all patients by bronchoscopy. The diagnostic criteria of active EBTB were as follows: (1) certain endobronchial lesions existed on bronchoscopy,and (2) tuberculosis was proven by bronchoscopic biopsy of these lesions.	Evolution of these changes over period of time in spite of treatment.	Comparisons between different types of endobronchial appearances and outcomes	up to 9 months	Relationship between endobronchial appearances and eventual outcomes such as endobronchial stenoses etc.	Twenty-two of the 34 cases of actively caseating EBTB changed into the fibrostenotic type, and the other 12 healed without sequelae. Seven of the 11 cases of edematous-hyperemic EBTB changed into the fibrostenotic type, and the other 4 healed. Nine of the 11 cases of granular EBTB, 6 cases of nonspecific bronchitic EBTB, and 2 cases of ulcerative EBTB resolved completely. However, the other two cases of granular EBTB changed into the fibrostenotic type. Seven cases of fibrostenotic EBTB did not improve despite antituberculosis chemotherapy. These various changes in bronchoscopic findings occurred within 3 months of treatment. In 10 cases of tumorous EBTB, 7 progressed to the fibrostenotic type. In addition, new lesions appeared in two cases, and the size of the initial lesions	not reported.	The therapeutic outcome of each subtype of EBTB can be predicted by follow-up bronchoscopy during the initial 3 months of treatment, with the exception of the tumorous type. In tumorous EBTB, close and long-term follow-up is advisable because the evolution of the lesions during treatment is very complicated and bronchial stenosis may develop at a later time.

													increased in another two cases, even at 6 months after treatment.			
DiTomasso, J. P.Ampel, N. M.Sobonya, R. E.Bloom, J. W.	Bronchoscopic diagnosis of pulmonary coccidioidomycosis. Comparison of cytology, culture, and transbronchial biopsy	1994	Diagnostic Microbiology & Infectious Disease	83-7	Qualitative research	+	Yes	54	All patients with the diagnosis of pulmonary coccidioidomycosis who underwent bronchoscopy were retrospectively studied. A total of 54 patients with culture-positive pulmonary coccidioidomycosis were identified, 19 of whom were infected with HIV.	Comparison of Cytology, Culture, and Transbronchial Biopsy in patients with diagnosis of pulmonary coccidioidomycosis in endemic area.	Comparison of Cytology, Culture, and Transbronchial Biopsy	Not reported	Comparison of Cytology, Culture, and Transbronchial Biopsy. Cytologic examination of bronchial wash or BAL fluid revealed the presence of C. immitis in 19 of the 54 patients. The difference in results, positive in 42% of HIV-infected patients compared with 31% of patients without HIV infection, are not statistically significant (P = 0.627, ×2 test). Cultures: Coccidioides immitis grew and was definitively identified in bronchial wash or BAL fluids 6-80 days after bronchoscopy. The median time for the culture to be identified as positive for C. immitis was 25 days. TBB: Simultaneous transbronchial biopsy specimens were obtained in seven instances among HIVinfected patients and in one instance in a patient without HIV infection. In all eight instances, microscopic examination of the specimens revealed the presence of C. immitis.	Cytologic examination of bronchial wash or BAL fluid revealed the presence of C. immitis in 19 of the 54 patients. The difference in results, positive in 42% of HIV-infected patients compared with 31% of patients without HIV infection, are not statistically significant (P = 0.627, ×2 test). Cultures: Coccidioides immitis grew and was definitively identified in bronchial wash or BAL fluids 6-80 days after bronchoscopy. The median time for the culture to be identified as positive for C. immitis was 25 days. TBB: Simultaneous transbronchial biopsy specimens were obtained in seven instances among HIVinfected patients and in one instance in a patient without HIV infection. In all eight instances, microscopic examination of the specimens revealed the presence of C. immitis.	Not reported	Results indicate that the rate of cytologic identification of C. immitis using high-quality respiratory specimens, either bronchial wash or BAL fluid, is 30%--45%. Culture of the same fluid appears to be more sensitive than cytologic examination in establishing this diagnosis
Deshmukh, V. S.Athavale, A. U.Bhaskar, M. A.	Bronchoscopy in pulmonary hydatidosis: Retrospective analysis	2009	Journal of Bronchology	172-175	Qualitative research	+	Yes	14	Retrospective analysis of data. Patients suspected and eventually diagnosed with pulmonary hydatidosis were included in the	Bronchoscopic appearances in patients with pulmonary hydatidosis.	Between radiological appearances and bronchoscopic features.	Not reported.	Bronchoscopic appearances.	No p values provided. The most common FB finding was a white glistening membrane with the appearance of tender coconut,(9 of 14 cases). No	Not reported	The most common FB finding was a white glistening membrane with the appearance of tender coconut,(9 of

									study. Seven patients of each sex with a mean age of 36 years represented these cases. All 14 patients were symptomatic, with cough and chest pain being the most common complaints; hemoptysis was noted in 9 patients.					white membranes were observed in the remaining 5 cases. Three of these patients had mucoid secretions on FB, whereas 2 had normal endobronchial examinations. On cytologic examination with hematoxylin and eosin stains, bronchial washing material showed no evidence of cuticular particles, degenerated scoleces, or hooklets in any of these cases. Twelve of these 14 patients underwent surgical resection (9 lobectomy, 2 cyst enucleation, and 1 pneumonectomy). Histopathologic examination of the lung/cyst specimen in these 12 cases showed 2 cases of unruptured pulmonary hydatid (uncomplicated), 1 case of pleural hydatid, and 9 cases of ruptured hydatid. Of these 9 cases of ruptured hydatid, 2 cases each of associated bacterial infection, fungal colonization, and tuberculous granuloma were noted.		14 cases). No white membranes were observed in the remaining 5 cases. Three of these patients had mucoid secretions on FB, whereas 2 had normal endobronchial examinations. On cytologic examination with hematoxylin and eosin stains, bronchial washing material showed no evidence of cuticular particles, degenerated scoleces, or hooklets in any of these cases. Twelve of these 14 patients underwent surgical resection (9 lobectomy, 2 cyst enucleation, and 1 pneumonectomy). Histopathologic examination of the lung/cyst specimen in these 12 cases showed 2 cases of unruptured pulmonary hydatid (uncomplicated), 1 case of pleural hydatid, and 9 cases of ruptured hydatid. Of these 9 cases of ruptured hydatid, 2 cases each of associated bacterial infection, fungal colonization, and tuberculous granuloma were noted.
Baughman, R. P.Dohn, M. N.Loudon, R. G.Frame, P. T.	Bronchoscopy with bronchoalveolar lavage in tuberculosis and fungal infections	1991	CHEST	92-97	Qualitative research	_	Indeterminable	91 patients in total.	Retrospective analysis of data. No subject demographic data available. Some patients were on steroids, some had immunosuppression due to AIDs or transplant, others had cancer or no risk factors.	Role of bronch in diagnosis of above.	The diagnostic yield of sputum samples is compared with that of BAL for the above conditions	Not specified.	Positive smear and culture rates for M.TB and Fungal infections, comparing sputum with BAL samples	For TB, sputum was smear positive in 6/47 (34%) and culture positive in 24/47 (51%), while bronchoscopy was smear positive in 34/50 (68%) and culture positive in 46/50 (92%). For fungal infections, no sputum was smear positive and only 1/22(5%) was culture positive, while bronchoscopy was smear positive in 14/41 (34%) and culture positive in 35/41 (85%)	Not specified, .	Bronchoscopy with BAL carries a high diagnostic yield when TB is suspected, and should be carried out where sputum smear is negative. When fungal infections are suspected, bronchoscopy is an essential investigation, as sputum has a low positivity rate
Dasgupta, K. S.Mundada, P. S.Soni, N.	Diagnostic role of fibreoptic bronchoscopy in pulmonary tuberculosis	2000	Indian Journal of Otolaryngology and Head and Neck Surgery	347-349	Qualitative research	+	Yes	104	Patients suspected to have pulmonary tuberculosis by clinical and radiological examination with sputum bacteriology negative were selected for the study between 1995 to 1997. There were 78 males and 26 females aged between 18-65 yrs. Radiologically, upper lobe infiltration was present in 62 patients (59.62%) and advanced	Smear and culture positivity. Also presence of granulomas on biopsies.	No comparisons made. Just frequencies given of positive results.	Not reported.	Smear positivity, Culture positivity, Biopsies showing granulomata.	No p values provided. Out of 104 patients, smears were positive (ZN staining) in 28.84% along with cultures. In smear negative patients, cultures were positive in a further 26.92%. Biopsies showed granulomas in 3.84%	Not reported	Overall diagnostic yield for TB 69.22%.Out of 104 patients, smears were positive (ZN staining) in 28.84% along with cultures. In smear negative patients, cultures were positive in a further 26.92%. Biopsies showed granulomas in 3.84%

									disease in form of cavitation, pleural effusion and consolidation was seen in remaining 42 patients (40.38%).							
al-Kassimi, F. A.Azhar, M.al-Majed, S.al-Wazzan, A. D.al-Hajjaj, M. S.Malibary, T.	Diagnostic role of fibreoptic bronchoscopy in tuberculosis in the presence of typical X-ray pictures and adequate sputum	1991	Tubercle	145-8	Qualitative research	_	Indeterminable	82	No demographic data available. Hospital based study in people suspected to have TB based on CXR or sputum.	If FBB contributes to diagnosis in subjects with CXR suggestive of TB if they are able to provide sputum samples	No comparison as such. Just to identify if flexible bronch adds anything in subjects with CXR suggestive of TB if they are able to provide sputum samples.	Not specified	Proportion of patients in which FBB contributed to making the diagnosis.	Not specified.	Not specified.	Retrospective analysis in 82 subjects suspected to have TB based on CXR. 40 were eventually positive for TB on microbiological ground. FOB exclusive means in 11/27 subjects in sputum producing group and 10/13 who were unable to provide sputum suggesting that it is still a useful procedure in patients if they are able to provide a sputum sample.
de Gracia, J.Curull, V.Vidal, R.Riba, A.Orriols, R.Martin, N.Morell, F.	Diagnostic value of bronchoalveolar lavage in suspected pulmonary tuberculosis	1988	CHEST	329-32	Qualitative research	+	Yes	20	Bronchoalveolar lavage was performed in 20 cases (nine percent), 12 males and eight females aged 17 to 71 years (mean age, 42 ± 18 years), which constituted the study group. Indications for bronchoscopy in this group were three negative consecutive early morning sputum or gastric aspirate smears for acid-fast bacilli prior to the exploration, plus one of the following three requisites: (a) negative Lowenstein cultures (b) lack of material (sputum or gastric aspirate (c) suspected neoplasm and (d) severe illness. No patient had been treated with antituberculosis medication or was under treatment at the time of bronchoscopy.	Yield of different bronchoscopic samples in patients with pulmonary TB	Diagnostic sensitivity of different bronchoscopic procedures. BAL was positive in 15/17 (88%), Bronchial wash in 9/17(53%), post bronchoscopy sputum in 6/13 (46%), combined 16/17 (94%)	Not reported.	Diagnostic sensitivity of different bronchoscopic procedures. BAL was positive in 15/17 (88%), Bronchial wash in 9/17(53%), post bronchoscopy sputum in 6/13 (46%), combined 16/17 (94%)	no p values provided. Diagnostic sensitivity of different bronchoscopic procedures. BAL was positive in 15/17 (88%), Bronchial wash in 9/17(53%), post bronchoscopy sputum in 6/13 (46%), combined 16/17 (94%)	not reported	Bronchoscopy may be required in selected cases for the diagnosis of PT. However, it should be accompanied by BAL, bronchial washings and post-bronchoscopy sputum smears. Diagnostic sensitivity of different bronchoscopic procedures. BAL was positive in 15/17 (88%), Bronchial wash in 9/17(53%), post bronchoscopy sputum in 6/13 (46%), combined 16/17 (94%)
Fujii, H.Ishihara, J.Fukaura, A.Kashima, N.Tazawa, H.Nakajima, H.Ide, H.Takahashi, T.	Early diagnosis of tuberculosis by fibreoptic bronchoscopy	1992	Tubercle & Lung Disease	167-9	Qualitative research	+	Indeterminable	67	Retrospective study of patients who were diagnosed of tuberculosis.	Results of sputum microscopy, sputum culture, bronchial wash microscopy and culture and bronchial biopsies in patients with TB.	No comparisons as such.	Not reported.	Results of sputum microscopy, sputum culture, bronchial wash microscopy and culture and bronchial biopsies in patients with TB.	Sputum provided diagnosis of TB in 56 subjects out of 67. 22 of these were positive on smear and culture and 34 were smear negative but culture positive. 11 remaining subjects who were sputum smear and culture negative were all diagnosed by bronchoscopy (7 by brushing, 1 on biopsy, 1 on washing alone and 2 on both brushing and washing).	Not reported	Retrospective analysis of patients found to have TB. So study open to bias. Sputum provided diagnosis of TB in 56 subjects out of 67. 22 of these were positive on smear and culture and 34 were smear negative but culture positive. 11 remaining subjects who were sputum smear and culture negative were all diagnosed by bronchoscopy (7 by brushing, 1 on biopsy, 1 on washing alone and 2

																on both brushing and washing). Results would suggest that bronchoscopy useful in subjects who are smear and culture negative on sputum examination where TB is suspected.
Gracia, J. D.Miravitlles, M.Mayordomo, C.Ferrer, A.Alv,x00E,rez, A.Bravo, C.Vendrell, M.	Empiric treatments impair the diagnostic yield of BAL in HIV-positive patients	1997	CHEST	1180-6	Qualitative research	+	Yes	Two groups of patients: Group 1: HIV positive and with no empirical treatment before BAL. N = 22 Group 2: HIV positive and empirical treatment given before BAL. N = 101	Patients were HIV positive in both groups. They had respiratory symptoms and/or chest x rays showing infiltrates.	BAL with prior empiric treatment sensitivity versus BAL without prior empiric treatment sensitivity.	BAL with prior empiric treatment sensitivity versus BAL without prior empiric treatment sensitivity.	Not reported	Sensitivity of BAL with prior empiric treatment and BAL without prior empiric treatment.	Sensitivity of BAL was much higher in the group without prior empiric treatment (91%) as compared to those with prior empiric treatment (64%)	Not reported	Empiric treatment in HIV patients reduce the sensitivity of BAL from 91% to around 64%
Flatauer, F. E.Chabalko, J. J.Wolinsky, E.	Fiberoptic bronchoscopy in bacteriologic assessment of lower respiratory tract secretions. Importance of microscopic examination	1980	JAMA	2427-9	Qualitative research	+	Indeterminable	69	Patients considered to either have lower respiratory tract infection (n=8) or not (n=61).	Presence of microorganisms on staining in group with LRTI.	No specific comparisons made.	Not reported	Presence of microorganisms on staining in group with LRTI.	7 out of 8 patients considered to have LRTI had microorganisms on staining.	Not reported	Study has only 8 subjects with LRTI of which 7 had organisms on staining. It is not certain how applicable the findings would be in general due to such a limited number of subjects. In subjects who were not considered to have LRTI, the study unsurprisingly showed no organisms. Thus it can be argued that it has good negative predictive value.
Cantral, D. E.Tape, T. G.Reed, E. C.Spurzem, J. R.Rennard, S. I.Thompson, A. B.	Quantitative culture of bronchoalveolar lavage fluid for the diagnosis of bacterial pneumonia	1993	AMERICAN JOURNAL OF MEDICINE	601-7	Qualitative research	+	Yes	All patients undergoing FOB with BAL from February 28, 1989, to September 4, 1989 were prospectively studied. During that period, BAL was performed 357 times in 225 patients (128 male, 97 female). Bacterial cultures were not performed for 18 of these specimens, and 1 result was unavailable for analysis. Thus, 338 BALs were included in the study.	Age and co-morbidities not mentioned as such. Indications for FOB grouped under few main categories.	Usefulness of quantitative culture on FOB for diagnosis of pneumonia.	Sensitivity and area under the curve for different levels of CFU/ml in patients who were diagnosed as having pneumonia based on: radiological signs + fever + leucocytosis and either good response to Abx or +ve blood cultures or autopsy samples confirming pneumonia.	not reported	Sensitivity and area under the curve.	The area under the ROC curve for all patients was 0.94 (95% confidence interval [CI], 0.90 to 0.98), for intubated patients 0.96 (95% CI, 0.93 to 0.99); and for those receiving antibiotics 0.88 (95% CI, 0.80 to 0.96). Since the predictive value of a test depends on the estimated disease prevalence, the positive and negative predictive values were calculated for a range of values for disease prevalence.	Not reported	Important study. Lacking in details about patient selection e.g. how many HIV subjects and how many of them on retrovirals, CD4 counts etc.
Levy, H.Horak, D. A.Tegtmeier, B. R.Yokota, S. B.Forman, S. J.	The value of bronchoalveolar lavage and bronchial washings in the diagnosis of invasive pulmonary aspergillosis	1992	RESPIRATORY MEDICINE	243-8	Qualitative research	+	Yes	Retrospective analysis of the role played by bronchoscopy in making the diagnosis on invasive aspergillosis. Total of 300 patients included in the study.	343 sequential bronchoscopies in 300 febrile, immunocompromised patients with new pulmonary infiltrates where bronchial washings or bronchoalveolar lavage (BAL) specimens were submitted for paired	Role of bronchial washings or BAL cytology, transbronchial lung biopsy histology, open lung biopsy percutaneous fine needle aspiration culture and cytology, and autopsy results in	No comparisons as such.	Not reported	Role of bronchial washings or BAL cytology, transbronchial lung biopsy histology, open lung biopsy percutaneous fine needle	Bronchoalveolar lavage cytology showed aspergillus in 19 specimens (invasive pulmonary aspergillosis in 16), cultures yielded aspergillus in 41 (invasive pulmonary aspergillosis in ten), with both tests positive in nine. Cytology sensitivity was 64.0%, specificity 99" 1%, positive	Not reported	When characteristic hyphae are visualized in BAL specimens from immunosuppressed patients with compatible clinical data, due to high specificity it is advisable to treat for presumptive

									fungal culture and cytologic examination.	making a diagnosis of invasive aspergillosis.			aspiration culture and cytology, and autopsy results in making a diagnosis of invasive aspergillosis.	predictive value 84.2%, and negative predictive value 97.2%. Culture sensitivity was 40.0%, specificity 90.3%, positive predictive value 24.4%, and negative predictive value 95.0%. Concordant cytology and culture sensitivity was 32-0%, specificity 99'7%, positive predictive value 88.9%, and negative predictive value 94.9%.		invasive pulmonary aspergillosis.
Saglam, L.Akgun, M.Aktas, E.	Usefulness of induced sputum and fibreoptic bronchoscopy specimens in the diagnosis of pulmonary tuberculosis	2005	JOURNAL OF INTERNATIONAL MEDICAL RESEARCH	260-5	Qualitative research	_	Indeterminable	55 total. 28 males, 27 females.	Suspected to have pulmonary TB based on radiology. Mean age 35.8 (range 15-49). No mention of any risk factors for developing TB.	Yield of induced sputum or flexible bronch.	Yield of induced sputum or flexible bronch.	Not reported.	Percentage of patients with positive smear or culture.	26 out of 55 patients smear positive on BAL, 21 on induced sputum. Sensitivity of induced sputum reported as 63% and for BAL 67%. Combined induced sputum and BAL sensitivity of 86%	Not reported.	Not enough detail about patients such as any risk factors. No mention about recruitment i.e. whether consecutive patients or not. Not enough detail about how the bronch was carried out.
Feinsilver, S. H.Fein, A. M.Niederman, M. S.Schultz, D. E.Faegenburg, D. H.	Utility of fiberoptic bronchoscopy in non resolving pneumonia	1990	CHEST	1322-6	Qualitative research	+	Indeterminable	35 consecutive patients	Age range was 44-90, 23 males and 12 females. 22 were smokers, 11 COPD, 5 immunocompromised	Diagnostic yield of bronchoscopy in non resolving pneumonia	No specific comparisons	6 months	Ability to make a specific diagnosis with bronchoscopy in patients with non resolving pneumonia	Out of 14 patients who had a specific diagnosis, 12 (86%) was made on fiberoptic bronchoscopy	Not reported	Retrospective study, which does not look into the wider population of all patients with non resolving pneumonia. Nevertheless, Fiberoptic bronchoscopy was shown to be useful in making a specific diagnosis in non resolving pneumonia, especially in nonsmokers, less than 55 years of age, with persistent, multilobar infiltrates
Rouby, J. J.Rossignon, M. D.Nicolas, M. H.Martin de Lassale, E.Cristin, S.Grosset, J.Viars, P.	A prospective study of protected bronchoalveolar lavage in the diagnosis of nosocomial pneumonia	1989	ANESTHESIOLOGY	679-85	Qualitative research	_	Indeterminable	29 controls, 30 pneumonia (PM proven)	Controls - 29 with no lung disease, ventilated for 14 days. Pneumonia - 30 all of whom died of pneumonia, PM proven. Patients chosen after screening process of 343 patients, followed by allocation to control or case.	Protected catheter aspiration (no FOB) at bedside twice weekly in controls and once in the pneumonia group	No comparison	Diagnostic only	Microbiological diagnosis	Sensitivity of BAL for HAP = 80%, specificity 66%. 73% of cases, bacteria isolated from pneumonia group at BAL agreed with PM lung culture (partial 16%, total 57%). 7 episodes of minor haemoptysis. In control group, 19 true negatives and 10 false positives. Pneumonia group - 24 true positives, 6 false negatives.	Not stated	Suggested relatively high sensitivity of blind catheter aspirate - but high false positive rate in control group, and large selection of patients. Good gold standard of autopsy in all pneumonia patients. Microbiological positivity not defined with reference to cfu/ml
Abramson, M. J.Stone, C. A.Holmes, P. W.Tai, E. H.	The role of bronchoalveolar lavage in the diagnosis of suspected opportunistic pneumonia	1987	Australian & New Zealand Journal of Medicine	407-12	Qualitative research	+	No	50 consecutive subjects with pneumonia who have immunosuppression. Exclusion criteria not specified.	Average age 47 years (range not provided), 36 males and 14 females. Ethnicity not provided. Range of different causes for immunosuppression but mainly due to chemotherapy and/or steroids.	BAL, TBB, proximal wash and brush.	Comparison with historical data from open lung biopsy in similar patients. No adjustment made for the fact that open bx is performed in subjects who have already had repeated antibiotic	Diagnostic only	Microbiological diagnosis	41 out of 56 procedures provided a +ve yield. Greatest for BAL and TBB. Lesser for proximal wash and brush.	Not stated	Provides and approximate idea about the sensitivity of BAL / TBB / Proximal wash or brush. No information about use of preceding antibiotic trials.

											trials and this one is performed "early" although again not clear if any empirical antibiotics used before bronchoscopy.					
Albelda, S. M.Talbot, G. H.Gerson, S. L.Miller, W. T.Cassileth, P. A.	Role of fiberoptic bronchoscopy in the diagnosis of invasive pulmonary aspergillosis in patients with acute leukemia	1984	AMERICAN JOURNAL OF MEDICINE	1027-34	Qualitative research	+	No	19	Subjects diagnosed as having invasive pulmonary aspergillosis in setting of acute leukemia (incl CML in blast crisis). 27 subjects diagnosed with this of which 19 underwent bronchoscopy. Rest were treated emperically with antifungal drugs. No demographic data for subjects in the study.	Washing, brushing, Bx and TBB	No comparisons as such. Lists the percent of +ve results of washing, brushing, bronchial biopsies and transbronchial biopsies.	Diagnostic only	Microbiological diagnosis	Less than half were positive (44 percent +ve overall with bronch, washings or brushings +ve in 39, and biopsies in 23%). Hence even if bronch negative, if high suspicion of invasive aspergillosis, to treat.	Not stated	Lists the percent of +ve results of washing, brushing, bronchial biopsies and transbronchial biopsies.
Bachh, A. A.Gupta, R.Haq, I.Varudkar, G. H.	Diagnosing sputum/smear-negative pulmonary tuberculosis: Does fibre-optic bronchoscopy play a significant role	2010	Lung India	58-62	Qualitative research	+	No	75	Age range 16-75. Mean Age 43.2 +/- 14.63. Three negative sputa for AFBs. CXR suggestive of TB. 66.7 % males, rest females. Mean duration of illness 2.2 months.	Positive cultures and microscopy results of bronchoscopic samples.	Comparison between pre-bronchoscopy sputum culture and yield of bronchoscopy.	Diagnostic only	Microbiological diagnosis	Bronchoscopy yield significantly higher than pre-bronchoscopic culture (McNemar test p = 0.005). Total yield of bronch = 83.33% (50/60 subjects), Bronch only diagnostic method in 66%. Bronch microscopy for AFB or granulomata possible in 48.33%	Not stated	Provides useful measure of the likely sensitivity of flexible bronchoscopy in cases where the sputum is negative for AFBs / culture.
Miro, A. M.Gibilara, E.Powell, S.Kamholz, S. L.	The role of fiberoptic bronchoscopy for diagnosis of pulmonary tuberculosis in patients at risk for AIDS	1992	Chest	1211-14	Qualitative research	_	No	26	18 HIV positive, other just with risk factors for HIV and compared with control group.	Yield of Sputum, BAL, Bronchial wash / brush, and TBB in high risk / HIV positive group compared to control.	Yield of Sputum, BAL, Bronchial wash / brush, and TBB in high risk / HIV positive group compared to control.	Diagnostic only	Microbiological diagnosis	Smear positivity in HIV/at risk group: 23 % +ve on sputum, 26% positive on washings, 30% for combined sputum BAL and bronchial washings, 37% if bronchial washings and TBB added (p = NS). Culture positivity in HIV/at risk group: 77% on sputum, 95% for BAL / wash, and 100% for BAL + TBB. Granulomata seen in 9% of this group compared to 63% of control group (p <0.05).	Not stated	Authors suggest TBB not useful. Not sure why people with HIV +ve status combined with those with "risk factors". Small numbers. Note the argument for saying that TBB not useful on microscopy in HIV+ve at odds with other published data involving larger numbers
McLeod, D. T.Neill, P.Gwanzura, L.Latif, A. S.Emmanuel, J. C.Nkanza, N.Lucas, S. B.	Pneumocystis carinii pneumonia in patients with AIDS in Central Africa	1990	RESPIRATORY MEDICINE	225-8	Qualitative research	_	Yes	35	Title of study says patients with AIDS but in methodology, it is mentioned HIV positive with no details as to whether patient met criteria for AIDS.	Prevalence of PCP	Prevalence of PCP	Diagnostic only	Microbiological diagnosis	Tuberculosis was the commonest pulmonary complication occurring in 12 (32%) patients. It was diagnosed primarily on the ZN stain of the lavage fluid or the typical histological appearances. The two post-mortem Tru-cut specimens were not sent for culture but histologically numerous acid and alcohol fast bacilli were seen with poor granuloma formation and much necrosis. M. tuberculosis was cultured on four occasions: the remaining six plates were overgrown by Aspergillus fumigatus. Kaposi's sarcoma was found in seven (16%) patients. Bacterial infection was found in 18 (49%) patients	Not stated	PCP seems to be present in lesser percentage of patients in this study as compared to others done in Europe. However study not clear about type of patients included i.e. whether they had AIDS or merely were HIV positive.

														and was often found in association with other diseases. P. carinii was found in eight (22%) patients. Fungal infections were fotmd in two patients: invasive A. fumigatus in one and Penicillium italicum in the other.		
Malin, A. S.Gwanzura , L. K.Klein, S.Robertson , V. J.Musvaire, P.Mason, P. R.	Pneumocystis carinii pneumonia in Zimbabwe	1995	Lancet	1258-61	Qualitative research	+	No	64	Entry criteria included meeting each of the following: (i)age 18-65; (ii) chest radiographic appearance of bilateral pulmonary infiltration (at least three zones overall) in the absence of cavitation; (iii) three sputum samples smear-negative for AFB. (iv) no response to intravenous benzylpenicillin (8-16 mega units/day);	Prevalence of PCP or TB in the above patient group.	None.	Diagnostic only	Microbiological diagnosis	21 patients (33%) had PCP and 24 (39%) had tuberculosis; 6 of these had both infections. 5 patients had Kaposi's sarcoma (KS) associated with PCP, tuberculosis, or another infection, in 1 patient KS was the only finding, and in 21 no pathogen was identified.	Not stated	Study suggests a significant proportion to have PCP as cause of pneumonia. However there is selection bias involved due to including patients who were unresponsive to penicillin only and the actual prevalence in patients with HIV alone would likely be lesser than that suggested in this study. Study does not report what proportion of patients if any met the AIDS defining criteria. Study done before the advent of antiretroviral treatment and findings may not be applicable to current cohort of HIV patients who are on antiretroviral treatment and present with pneumonia.
Rano A, Agusti C, Jimenez P, et al.	Pulmonary infiltrates in non-HIV immunocompromised patients: a diagnostic approach using non-invasive and bronchoscopic procedures.	2001	Thorax	379-87	Qualitative research	+	No	200	Patients included in the study belonged to four divergent groups—group 1: solid organ transplant (21 renal, 11 cardiac, 14 liver, and six pancreaticorenal) recipients; group 2: haematopoietic stem cell transplant (HSCT) recipients (n=53); group 3:patients with haematological malignancies treated with chemotherapy (n=68); and group 4: patients requiring chronic treatment with corticosteroids (minimum 30 mg prednisone daily for the previous 30 days before inclusion) or immunosuppressive agents (azathioprine or cyclophosphamide; n=27).	Bacterial. Fungal and mycobacterial infection as diagnosed by. FBAS, TBAS, and BAL specimens	Comparison of non invasive vs bronchoscopy.	Diagnostic only	Microbiological diagnosis	Non-invasive techniques led to the diagnosis of pulmonary infiltrates in 41% of the cases in which they were used; specifically, the diagnostic yield of blood cultures was 30/191 (16%); sputum cultures 27/88 (31%); NPW 9/50 (18%); and TBAS 35/55 (65%). Bronchoscopic techniques led to the diagnosis of pulmonary infiltrates in 59% of the cases in which they were used: FBAS 16/28 (57%), BAL 68/135 (51%), and PSB 30/125 (24%). The results obtained with the divergent techniques led to a change in antibiotic treatment in 93 cases (46%)	Not stated.	Bronchial aspirates (FBAS and TBAS) and mm BAL have the highest diagnostic yield
Jensen, B. N.Gerstoft, ,jlyng, N.Backer, V.Paaske, M.Gomme,	Pulmonary pathogens in HIV-infected patients	1990	SCANDINAVIAN JOURNAL OF INFECTIOUS DISEASES	413-20	Qualitative research	++	No	102	The following inclusion criteria had to be met: 1) symptoms indicative of pulmonary disease, i.e. cough, dyspnea or fever, (2) abnormal chest	Microbiological agents isolated on bronchoscopic samples in patients with HIV and their correlation with	None	Diagnostic only	Microbiological diagnosis	PC was recovered in 61 patients, either alone (n=43) or in combination with other pathogens: CMV (n=9), cryptosporidium (n=4), and bacteria (n= 5).	Not stated	In more than 75% of the patients, microorganisms identified were responsible for the pulmonary

G.Skinh,j, P.									roentgenogram or, if normal, abnormal CT scanning of the chest, and (3) evidence of HIV infection confirmed by serology (enzyme-linked immunosorbent assay and Western blot)	clinical features.				22 of the bronchoscopies revealed the following bacteria: 1: Legionella pneuniophila antigen was positive in 3 patients. 2: Cultures positive for Haemophilus influenzae in 7, Streptococcus pneumoniae in 6, Staphylococcus aureus in 4, Pseudomonas aeruginosa in 3, Streptococcus pyogenes in 2, Mycobacterium avium-intracellulare in 1, Branhamella catarrhalis in 1. In 5 patients more than one bacteria were cultured. In 12/22 patients only bacterial pathogens were recovered. CMV was isolated in 17 patients. Histological examination revealed inclusion bodies only in 2/17 patients. In others it was of doubtful significance. In 17 patients no microbiological pulmonary diagnosis was obtained.		Symptoms leading to bronchoscopy. Mainly PC and bacterial pathogens, both of which are treatable, were responsible for these infections. Pulmonary infections of clinical relevance besides PCP and bacterial infections were rare (3%. 95 percent confidence limit 1-8%).
Golden, J. A.Hollander, H.Stulbarg, M. S.Gamsu, G.	Bronchoalveolar lavage as the exclusive diagnostic modality for Pneumocystis carinii pneumonia. A prospective study among patients with acquired immunodeficiency syndrome	1986	Chest	18-22	Qualitative research	++	No	40	Patients with AIDS who have respiratory symptoms and suspected to have PCP pneumonia.	Sensitivity of BAL as the sole procedure in making a diagnosis of PCP pneumonia.	Comparisons with results obtained in other studies using transbronchial biopsies or surgical biopsies in similar patients	Diagnostic only	Microbiological diagnosis	BAL was diagnostic in 36 of 37 patients with a sensitivity of 97 percent and one possible false-negative result.	Not stated.	BAL has very high sensitivity and has lower complication rates as compared with TBB. This study suggests that it may be the favored technique for making the diagnosis of PCP in patient with AIDS but whether this could be applied to other situations such as patients with HIV alone or those with other causes of immunocompromisation, is not answered by this study.
Heurlin, N.Elvin, K.Lidman, C.Lidman, K.Lundbergh, P.	Fiberoptic bronchoscopy and sputum examination for diagnosis of pulmonary disease in AIDS patients in Stockholm	1990	SCANDINAVIAN JOURNAL OF INFECTIOUS DISEASES	659-64	Qualitative research	+	No	68	64 males, mean age 39(range 23-73), all HIV positive, 21 meeting the CDC definition of AIDS. All patients had symptoms of respiratory disease.	Yield of different bronchoscopic methods such as TBB, BAL and brushing in making a diagnosis in these patients.	No specific comparisons made.	Diagnostic only	Microbiological diagnosis	Clinical diagnosis was made before the bronchoscopy. This was made as lower respiratory tract disease was obtained in 68/82 episodes (83 %). Of these the specific diagnosis made was: 1: PC pneumonia (PCP) in 54/82. 2: Bacterial pneumonia in 7/82 episodes (9%). 3: Disseminated CMV infection with suspected CMV pneumonia in 2. 4: Disseminated Mycobacterium aviumi intracellulare infection, tuberculosis, Kaposi's sarcoma (KS) and pulmonary edema was the diagnosis in 1 episode each. On bronchoscopy the final diagnosis was made in 59/82 episodes. In 2 of these there were 2 eiological agents identified. BAL was the best method for providing diagnosis in infections. PCP was detected in 94% of cases	Not reported.	BAL was the method that gave the best result for infectious agents, 52/58 (90%), while KS (n= 1) was diagnosed by histopathological examination of TBB. PCP was detected in 51/54 episodes (94 %), where PCP became the clinical diagnosis; by BAL in 44/47 episodes, by TBB in 22/31 and by brushing in 12/33 (36%).

														where this diagnosis was made clinically.		
Orenstein, M.Webber, C. A.Cash, M.Heurich, A. E.	Value of bronchoalveolar lavage in the diagnosis of pulmonary infection in acquired immune deficiency syndrome	1986	Thorax	345-9	Qualitative research	++	No	54	Patients with PCP, mainly patients with AIDS or risk factors for AIDS.	Role and yield of different bronchoscopic procedures in diagnosis of PCP.	Between yields of BAL, bronchial washings, brushings and TBB	Diagnostic only	Microbiological diagnosis	Fifty three of the 54 patients with P carinii pneumonia were diagnosed by bronchoalveolar lavage, which thus had a diagnostic sensitivity of 98%. In the single patient with negative results from lavage open lung biopsy was diagnostic. In patients with P carinii proved by bronchoalveolar lavage the organism was also found in 29 of 39 transbronchial biopsy specimens, 40 of 53 bronchial washings, and 20 of 48 brushings. Of the 10 negative transbronchial biopsy specimens, six were inadequate with no identifiable alveoli. Bronchoalveolar lavage was exclusively positive in seven of 53 patients (13%) with P carinii. Complications of bronchoalveolar lavage were minimal and consisted of transient increase in fever in five patients and hypoxaemia in five. Two pneumothoraces requiring chest tubes were observed but both patients had also had transbronchial biopsy performed.	Not reported.	BAL very sensitive and safe method. 2 pneumothoraces occurred and both patients had TBB.
Lewin, S. R.Hoy, J.Crowe, S. M.McDonald , C. F.	The role of bronchoscopy in the diagnosis and treatment of pulmonary disease in HIV-infected patients	1995	Australian & New Zealand Journal of Medicine	133-9	Qualitative research	+	No	41	Patients were HIV positive and had bronchoscopy to investigate pulmonary symptoms with or without CXR changes. All patients with suspected PCP had produced at least three PC-negative induced sputum specimens prior to FFB and had either failed to improve or had deteriorated during a therapeutic trial of conventional anti-PCP treatment.	To evaluate the usefulness of flexible fibreoptic bronchoscopy (FFB), bronchoalveolar lavage (BAL), transbronchial biopsy (TBB) and bronchial brushings (BB) in the diagnosis of pulmonary disease in HIV-infected patients and to examine the effect of FFB on changes in therapy and survival.	none	Diagnostic only	Microbiological diagnosis	Definitive diagnoses made at FFB included Kaposi's sarcoma (KS) (n = 9), invasive aspergillosis (n = 5), PCP (n = 4), Mycobacterium uvium complex (MAC) pneumonia (n = 2), cytomegalovirus (CMV) pneumonia (n = l), Cryptococcus neoformans pneumonia (n= l), microsporidium (n = 1) and Pseudomonas aeruginosa pneumonia (n = 1). TBB and BB did not provide a diagnosis for diseases not seen macroscopically at FFB or diagnosed by BAL. FFB findings altered diagnosis in 21/42 (50%) presentations and changed therapy in 26/42 (62%) cases.	Not reported	FFB together with BAL altered the working diagnosis and changed therapy in a significant number of patients. TBB and BB should not be routinely performed.
Malabonga, V. M.Basti, J.Kamholz, S. L.	Utility of bronchoscopic sampling techniques for cryptococcal disease in AIDS	1991	Chest	370-2	Qualitative research	+	No	11	Patients had AIDS and were diagnosed as having cryptococcal pneumonia.	Role of different bronchoscopic techniques in making a diagnosis of cryptococcal pneumonia.	Between BAL, TBLBx and brushings.	Diagnostic only	Microbiological diagnosis	The diagnosis was made in all 11 patients from specimens obtained via fiberoptic bronchoscopy (ten) and/or double-lumen catheter lavage (one). Direct stains of BAL were positive in nine of 11 patients. Transbronchial biopsies were positive (special histologic stains) in six of eight patients; bronchial washings were positive (direct smear) in seven of ten patients, the bronchial brushings were positive on stain in six of nine patients, and in one patient, a Wang	Not reported	BAL and bronchial washings appear to have a combined sensitivity on smear equal to that of TBLBx and superior to that of TBLBx fungal culture.

														transbronchial needle aspirate was positive on stain. Fungal cultures were positive on the BAL in seven of 11 patients, and on the bronchial washings in four of ten patients; the TBLBx culture samples were all negative (zero of three). The serum cryptococcal antigen titer was elevated (median = 1:1024) in all eight patients in which it was assayed.		
Dugan, J. M.Avitabile, A. M.Rossman, M. D.Ernst, C. S.Atkinson, B. F.	Diagnosis of Pneumocystis carinii pneumonia by cytologic evaluation of Papanicolaou-stained bronchial specimens	1988	DIAGNOSTIC CYTOPATHOLOGY	106-12	Qualitative research	_	Indeterminable	58	immunocompromised patients clinically suspected to have an opportunistic lung infection	methenamine silver (Grocott) and Papanicolaou stains	Between methenamine silver (Grocott) and Papanicolaou stains	Diagnostic only	Microbiological diagnosis	The sensitivity of diagnosing PCP by Papanicolaou-stained bronchial wash/lavage and bronchial brushings by identifying alveolar casts is 83% and 14%, respectively, when compared with Grocott staining of the same specimen	Not reported	P. carinii pneumonia can be diagnosed on bronchial wash/lavage or brushing specimens by identifying alveolar casts with or without encysted sporozoites on Papanicolaou-stained cytologic material. Bronchial wash/lavage specimens provide a sensitivity of 83% and a specificity of 100%, with the sensitivity of transbronchial biopsy being 82%. Bronchial brush cytology demonstrates low sensitivity for PCP.
Hartman, B.Koss, M.Hui, A.Baumann, W.Athos, L.Boylen, T.	Pneumocystis carinii pneumonia in the acquired immunodeficiency syndrome (AIDS). Diagnosis with bronchial brushings, biopsy, and bronchoalveolar lavage	1985	Chest	603-7	Qualitative research	_	Indeterminable	40	Male homosexual patients who were "suspected" to have AIDS and PCP pneumonia. It is not explained how this diagnosis of AIDS was confirmed or why this diagnosis of PCP was suspected i.e. whether the CXR was abnormal or if there were any respiratory symptoms. Age range: 21-53 years.	The yield of different bronchoscopic procedures in making the diagnosis of PCP pneumonia.	Between different bronchoscopic procedures.	Diagnostic only	Microbiological diagnosis	Yield of biopsies was 66%, BAL was positive in 69% and bronchial brushing was positive in 64%	Not reported	Study suggests good yield from all three bronchoscopic tools. Not enough information available about patient selection and how the diagnosis of AIDS or PCP pneumonia was made.
Jaiswal, A. K.Kulpati, D. D.Jain, N. K.Singh, M. M.	Role of bronchoscopy in the early diagnosis of suspected smear negative cases of pulmonary tuberculosis	1989	Indian Journal of Tuberculosis	233-36	Qualitative research	+	No	50	Patients who are suspected to have pulmonary TB but either unable to provide sputum or who had three negative smears for TB.	Diagnostic yield of bronchoscopy in patients who are suspected to have pulmonary TB but either unable to provide sputum or who had three negative smears for TB.	none	Diagnostic only	Microbiological diagnosis	Twenty patients had Bronchoscopically visible abnormalities eg hyperemia with oedema, stenosis of ulceration. Positive smears were obtained in 28% of bronchial aspirates and 28 % of post bronchoscopy sputum. Biopsies were performed in 20 subjects with endobronchial abnormalities and 2 out of these showed caseating granulomas. The combined yield of bronchial aspirate, post bronch sputum and biopsies in making a diagnosis within 4 days was 42%. Culture positivity was as follows: Bronchial aspirate = 32%, Post-Bronchoscopy sputum = 14% and biopsy in 5%. Pre-bronch sputum was culture positive in 14% of cases and exclusively so in	Not reported	Bronchoscopy can be useful in making an early diagnosis in patients who are suspected to have pulmonary TB and are smear negative on sputum or cannot provide sputum. Study slightly limited by inadequate details of subject selection i.e. whether any immunocompromised patients were included, and demographic details e.g. the age of subjects, the duration of symptoms, and also whether any empirical treatments had been given before the

														4% of cases.		bronchoscopy was performed.
Ortqvist, A.Kalin, M.Lejdeborn, L.Lundberg, B.	Diagnostic fiberoptic bronchoscopy and protected brush culture in patients with community-acquired pneumonia	1990	Chest	576-82	Qualitative research	_	Indeterminable	24	Belonging to following three groups: 1: Severely ill or Immunocompromised group. N = 6 2: Early therapy failure group. N = 7 3: Late therapy failure group. N = 11 Immunocompromised group did not have HIV patients ("excluded due to technical reasons".)	Role of bronchoscopy in establishing the microbiological cause of pneumonia.	none	Diagnostic only	Microbiological diagnosis	An etiologic diagnosis was obtained in 19 Of 24 patients (79 percent). Bacterial pneumonia was diagnosed in 17 patients, in eight cases caused by S pneumoniae. In one patient, a viral etiology only could be demonstrated and in another, a bronchial tumor was diagnosed.	Not reported	Study has some major shortcomings in patient inclusion of exclusion criteria such as lack of clarity about the nature of immunosuppression or how were the severely ill patients defined (? CURB score or some other score). It does seem to suggest that bronchoscopy can be useful in establishing the underlying microbiological cause of pneumonia. It is not clear if the identified microbiological cause responded to treatment which would be important to establish causality.
Jimenez, P.Meneses, M.Saldias, F.Vel,squez, M.	Pneumococcal antigen detection in bronchoalveolar lavage fluid from patients with pneumonia	1994	Thorax	872-4	Qualitative research	++	No	72	subdivided into following 4 groups (including control group) based on initial bronchoscopy: (1)Patients with Pneumococcal pneumonia: N=24 (2) Pneumonia of other known aetiology: N = 18. (3) Pneumonia of unknown aetiology: N = 17 (4) A control group of 13 patients with interstitial lung disease underwent fibreoptic bronchoscopy as part of their routine investigations.	Value of rapid detection of pneumococcal antigen in BAL fluid from patients with pneumonia.	Presence of pneumococcal antigen in the above 4 groups.	Diagnostic only	Microbiological diagnosis	In patients with pneumococcal pneumonia, antigen was detected by countercurrent immunoelectrophoresis in 50% and by latex agglutination in 54% of cases. In patients with pneumonia of unknown aetiology pneumococcal antigen was detected by latex agglutination in 53% of cases. Antigen was not detected in patients with pneumonia of other known aetiology or in control patients, yielding a specificity of 100%.	Not reported	In patients with pneumococcal pneumonia requiring bronchoscopy detection of pneumococcal antigen in BAL fluid may be used to rapidly and accurately confirm the aetiology. In nearly half the cases of pneumonia of unknown aetiology antigen can be detected, suggesting that Streptococcus pneumoniae is a major causative agent in such patients.
Charoenratanakul, S.Dejsomritrutai, W.Chaipraset, A.	Diagnostic role of fiberoptic bronchoscopy in suspected smear negative pulmonary tuberculosis	1995	RESPIRATORY MEDICINE	621-3	Qualitative research	+	No	40	aged 16-78 years (mean 65 years) suspected to be smear negative pulmonary tuberculosis were recruited to the study. They had minimal infiltrations on chest roentgenogram.	FOB Lavage / biopsy	overall diagnostic yields	Diagnostic only	Microbiological diagnosis	Bronchoscopic procedures provided overall diagnostic yields in 19 patients (47.5%). Of these, 13 (32.5%) cases of tuberculosis were diagnosed. The BAL smears were positive AFB in three patients (7.5%), BAL cultures were positive for Mycobacterium tuberculosis in six patients (15%) and TBB revealing granuloma in seven patients (17.5%). Non-tuberculosis conditions were diagnosed bybronchoscopic method in six patients (15%) including adenocarcinoma, Pneumocystis carinii pneumonia and bacterial pneumonia	Not reported	Bronchoscopic procedures provided overall diagnostic yields in 19 patients (47.5%). Of these, 13 (32.5%) cases of tuberculosis were diagnosed. The BAL smears were positive AFB in three patients (7.5%), BAL cultures were positive for Mycobacterium tuberculosis in six patients (15%) and TBB revealing granuloma in seven patients (17.5%). Non-tuberculosis conditions were diagnosed bybronchoscopic method in six patients (15%) including

																adenocarcinoma, Pneumocystis carinii pneumonia and bacterial pneumonia
Liam, C. K.Chen, Y. C.Yap, S. F.Srinivas, P.Poi, P. J.	Detection of Mycobacterium tuberculosis in bronchoalveolar lavage from patients with sputum smear-negative pulmonary tuberculosis using a polymerase chain reaction assay	1998	Respirology	125-29	Qualitative research	+	No	44	Patients who were undergoing FOB for suspected pulmonary TB because of: (I): a history of coughing for 2 weeks or more associated with evening fever and recent weight loss; (II) chest radiographic abnormalities consistent with tuberculosis; and (III): an induration of 10mm or more to the Mantoux tuberculin skin test. All M. tuberculosis genome in BAL specimens of patients who have clinically active pulmonary TB but whose sputum specimens were smear-negative for AFB. Patients had at least three consecutive sputum smears which were negative for AFB.	Clinical utility of the same PCR assay in detecting M. tuberculosis genome in BAL specimens of patients who have clinically active pulmonary TB but whose sputum specimens were smear-negative for AFB.	No comparisons as such except the positive PCR in the patient group with TB and the control group.	Diagnostic only	Microbiological diagnosis	Fifty-five (80.9%) of a total of 68 BAL specimens from the 44 patients with clinically active pulmonary TB tested positive for mycobacterial DNA by PCR. The assay was positive in two of 45 BAL specimens from 35 control subjects. The PCR assay gave a positivity rate of 80.9% (55 of 68) compared with 8.8% of smear examination and 7.4% of culture for detecting M. tuberculosis in BAL specimens.	Not reported	PCR assay was more sensitive than smear and culture in detecting M. tuberculosis in BAL specimens of patients with sputum smear-negative pulmonary TB. However note that patients in the study were already on anti TB treatment so this may not be the case on first presentation.

TREATMENT OF LOBAR COLLAPSE

STUDY IDENTIFICATION / CITATION					STUDY TYPE	QUALITY RATING	BIAS	POPULATION		INTERVENTION	COMPARISON	FOLLOW UP	OUTCOMES	EFFECT SIZE	FUNDING	COMMENTS
Authors	Title	Year	Journal	Citation				Number of patients	Patient Characteristics							
Haenel, J. B. Moore, F. A. Moore, E. E. Read, R. A.	Efficacy of selective intrabronchial air insufflation in acute lobar collapse	1992	AMERICAN JOURNAL OF SURGERY	501-5	Qualitative research	minus	no	17	Surgical intensive care, 13 patients admitted with acute trauma (9 who had undergone operation) and 4 elderly post operative patients who were all suffering with lobar collapse. 5 had hypoxaemia, 2 had progressive lobar collapse, 10 failed to respond to other treatments. 12 intubated at baseline, other 5 not.	FOB, mucus plug removal and selective intrabronchial air insufflation using Ambu Bag, pressure gauge and 3-way stopcock.	Nil - case series	Period on ICU only	"Treatment success" - not clearly defined	Total reversal of lobar collapse (? How measured) in 14 (82%) with 10 achieving full expansion and 4 partial expansion.	Not stated	Small case series, very weak evidence suggesting FOB with selective intrabronchial air insufflation may be useful to treat lobar atelectasis
Harada, K. Matsuda, T. Saoyama, N.	Re-expansion of refractory atelectasis using a bronchofiberscope with a balloon cuff	1983	CHEST	725-728	Qualitative research	minus	no	15	Patients with atelectasis, some post-operatively. Unclear how many patients were on ICU.	FOB and balloon cuff, via which air insufflated	Nil - case series	Immediate outcomes only	Treatment success (assumed radiological)	14/15 successfully responded to treatment, 6 with recurrent atelectasis who all responded to a second treatment	Not stated	Very weak case series suggesting possible role for selective intrabronchial air insufflation for patients with lobar collapse.
Tsao, T. C. Tsai, Y. H. Lan, R. S. Shieh, W. B. Lee, C. H.	Treatment for collapsed lung in critically ill patients. Selective intrabronchial air insufflation using the fiberoptic bronchoscope	1990	CHEST	435-8	Qualitative research	minus	no	12	12 heterogeneous patients admitted to the medical or surgical ITU (8 receiving MV), with atelectatic lung segments.	FOB, suction then air introduced by Ambu bag to re-inflate the lung	Nil - case series	Short term radiographic outcome	Unclear	Complete CXR resolution in 12/14 procedures. Partial re-expansion in 2/14. Two cases died 24 and 26 hours after the procedure.	Not stated	Small case series evidence only of re-expansion using FOB
Jaworski, A. Goldberg, S. K. Walkenstein, M. D. Wilson, B. Lippmann, M. L.	Utility of immediate postlobectomy fiberoptic bronchoscopy in preventing atelectasis	1988	CHEST	38-43	RCT	plus	Not blinded and no information on allocation concealment - therefore this bias potentially makes the two treatments more similar	20, 10 in each arm	Consecutive patients undergoing lobectomy and initially post op on ICU, ventilated	FOB with suction of all lobes and instillation of 30-50mls saline on side of lobectomy.	Standard care, non FOB	To discharge	ABGs, FVC, need for further bronchoscopy, radiology, ICU and hospital stay	No difference between groups in any outcome measure	Not stated	No information on randomisation type or allocation concealment, not blinded, no power calculation. Small study which gives weak evidence only of lack of difference between the two techniques.
Lee, T. S. Wright, B. D.	Selective insufflation of collapsed lung with fiberoptic bronchoscope and Swan-Ganz catheter	1981	INTENSIVE CARE MEDICINE	241-3	Qualitative research	minus	indeterminable	3	3 cases of atelectasis	FOB and Swan Ganz catheter to insufflate and re-expand the lung	Nil	Short term only	"Success" of procedure	All 3 demonstrated good lung expansion after insufflation of air using a syringe via the SGC	Not stated	Weak evidence for the use of bronchoscopy in lobar collapse in ICU

USE OF BRONCHOSCOPY IN ICU FOR DIAGNOSIS OF VAP AND INVESTIGATING AETIOLOGY OF HAEMOPTYSIS

STUDY IDENTIFICATION / CITATION					STUDY TYPE	QUALITY RATING	BIAS	POPULATION		INTERVENTION	COMPARISON	FOLLOW UP	OUTCOMES	EFFECT SIZE	FUNDING	COMMENTS
Authors	Title	Year	Journal	Citation				Number of patients	Patient Characteristics							
Croce, M. A. Fabian, T. C. Shaw, B. Stewart, R. M. Pritchard, F. E. Minard, G. Kudsk, K. A. Baselski, V. S.	Analysis of charges associated with diagnosis of nosocomial pneumonia: can routine bronchoscopy be justified?	1994	Journal of Trauma-Injury Infection & Critical Care	721-7	Economic Evaluation	minus	N/A	107	MV trauma patients with suspected VAP	Routine sputum aspirates versus PSB and BAL via FOB in MV trauma patients with suspected VAP	Cost analysis only - ICU environment in the USA	N/A	Total cost from procedure and antibiotic treatment quantified. For Sputum total cost = $302,830, PSB=$176,947, BAL=$129,239.	N/A	Not stated	Cost analysis of VAP diagnosis and management using sputum versus bronchoscopic techniques (total costs including microbiology testing and antimicrobial therapy) suggests that bronchoscopic diagnosis may be cheaper overall. No gold standard for diagnosis, USA data and >15 years old therefore applicability to guideline unclear.
Dupree, H. J. Lewejohann, J. C. Gleiss, J. Muhl, E. Bruch, H. P.	Fiberoptic bronchoscopy of intubated patients with life-threatening hemoptysis	2001	WORLD JOURNAL OF SURGERY	104-7	Qualitative research	minus	no	7	MV patients with haemoptysis, five women and two men with a mean age of 67.14 years (range 60–77 years).	FOB with instillation of cold adrenaline-saline solution	Nil - case series	Length of MV	Control of bleeding	6/7 controlled with FOB intervention, 1 died of haemorrhage. Required a total of 5.9 treatments per patient.	Not stated	Small case series with weak evidence suggesting FOB may be useful in the treatment of massive haemorrhage in ITU.
Gruson, D. Hilbert, G. Valentino, R. Vargas, F. Chene, G. Bebear, C. Allery, A. Pigneux, A. Gbikpi-Benissan, G. Cardinaud, J. P.	Utility of fiberoptic bronchoscopy in neutropenic patients admitted to the intensive care unit with pulmonary infiltrates	2000	CRITICAL CARE MEDICINE	2224-30	Qualitative research	minus	indeterminable	93	Consecutive patients admitted to the ICU with neutropenia who had febrile non-cardiogenic respiratory failure. 36 initially receiving non-invasive ventilation and 42 undergoing MV.	FOB for diagnosis of radiological infiltrate	Nil	To discharge or death	Unclear - both microbiological diagnosis and survival	46/93 FOBs diagnostic of infection (49%) - higher yield in those with chemotherapy induced rather than stem cell transplantation. 16 (17%) complications and two required intubation. ICU mortality = 71%, ventilated mortality rate = 93%.	Not stated	Very high mortality in highly sick population. Non-comparative study suggesting little change in management and no change in outcome with FOB in these patients. Total of 26 (28%) had antibiotic change and, overall, therapy changed in 26/42 (62%) with proven pneumonia on basis of FOB result.
Khalil, A. Soussan, M. Mangiapan, G. Fartoukh, M. Parrot, A. Carette, M. F.	Utility of high-resolution chest CT scan in the emergency management of haemoptysis in the intensive care unit: severity, localization and aetiology	2007	BRITISH JOURNAL OF RADIOLOGY	21-5	Qualitative research	minus	no	80	Consecutive patients with haemoptysis on respiratory ICU. Mean age 56 years over a 2-year period. HRCT and bronchoscopy compared in patients with haemoptysis on the ICU.	HRCT	Bronchoscopy	Immediate diagnosis only	Diagnosis of localisation (side) of bleeding and aetiology of bleeding.	Number of lobes correlated with daily volume of haemoptysis. Bleeding site identified with FOB in 71 (89%) versus 64 (80%) HRCT, no statistical difference (P>0.3). Two together diagnosed site of bleeding in 96%. Cause identified by FOB in 2 patients, versus 49 via HRCT.	Not stated	Evidence that bronchoscopy should not be used in the diagnosis of causes of haemoptysis in the ICU and that HRCT is better.

Pincus, P. S. Kallenbach, J. M. Hurwitz, M. D. Clinton, C. Feldman, C. Abramowitz, J. A. Zwi, S.	Transbronchial biopsy during mechanical ventilation	1987	CRITICAL CARE MEDICINE	1136 - 1139	Qualitative research	minus	no	13	Intubated patients with progressive lung infiltrate	TBBx at bronchoscopy in MV patients, under fluoroscopy	No comparisons - case series	Immediate complications	Diagnosis, complications	TBBx established diagnosis in 6 (46%). In others, diagnosed IPF in 3, lupus pneumonitis in 1 and NSIP in 3. TBBx considered helpful in treatment in all patients. Complications - 2 PTx requiring drainage, 1 haemorrhage, 1 arrhythmia. No deaths attributed to procedure	Not stated	Significant harm from TBBx in ventilated patients, retrospective so weak evidence
Potgieter, P. D. Hammond, J. M.	Etiology and diagnosis of pneumonia requiring ICU admission	1992	CHEST	199-203	Qualitative research	minus	indeterminable	178	88% - intubated patients, tracheal aspirate microbiology conducted at intubation. If negative and condition worsening at 48 to 72 hours, or if immunocompromised, FOB PSB performed.	FOB and PSB specimens taken, TBBx if condition permitted.	Nil	Diagnostic study, no follow up	Microbiological diagnostic yield	Diagnosis in 121/178 (68%) by sputum or tracheal aspirate, in 96/178 (54%) by blood culture, 6/40 by serology and 7/35 by FOB, 2/2 by OLB. 24 patients not responding to therapy underwent FOB, diagnosis made (true positive) in 4 (3 brush, 1 TBBx) and one incorrect by TBBx. 6 patients with immune compromise had FOB - 3/6 diagnosed.	Not stated	Primary purpose of paper was to compare diagnostic strategies used on ICU. No convincing gold standard, FOB in selected patients only.
Rabbat, A. Chaoui, D. Lefebvre, A. Roche, N. Legrand, O. Lorut, C. Rio, B. Marie, J. P. Huchon, G.	Is BAL useful in patients with acute myeloid leukemia admitted in ICU for severe respiratory complications?	2008	LEUKEMIA	1361-7	Qualitative research	minus	indeterminable	175, 121 underwent bronchoscopy	Patients with AML (73) or lymphoid malignancy (102) on ICU with progressive infiltrates, intubated in 88%.	Bronchoscopy and BAL	Nil	No follow up long term	Diagnostic yield	Diagnostic yield 25/53 (47%) in AML and 34/68 (50%) in lymphoid malignancy. Significant change to management in 9/53 (17%) AML, 24/68 (35%) in lymphoid malignancy (p=0.039). Life threatening complications in 12/121 (10%). 4 cases of bleeding, with one death due to bleeding.	Not stated	Poor diagnostic yield of FOB in AML, better in lymphoid. High complication rate in sick patient population
Rodriguez de Castro, F. Sole-Violan, J. Aranda Leon, A. Blanco, Lopez, J. Julia-Serda, G. Cabrera Navarro, P. Bolanos Guerra, J.	Do quantitative cultures of protected brush specimens modify the initial empirical therapy in ventilated patients with suspected pneumonia?	1996	EUROPEAN RESPIRATORY JOURNAL	37-41	Qualitative research	plus	yes	110	MV patients, suspected pneumonia, immune competent. Diagnosis of suspected pneumonia on standard criteria. 45% received antibiotics before inclusion, but stopped for >48hours in all but 12 cases.	Bronchoscopy and PSB for diagnosis of pneumonia	Nil	Not stated	Microbiological diagnostic yield, and effect of antibiotic therapy	Pneumonia final diagnosis in 45/110 (41%). Pneumonia excluded in 47 and uncertain in 18. PSB revealed significant bacterial growth in 33/45 patients with final diagnosis of pneumonia (73%). In final diagnosis not pneumonia, PSB sterile in 40/47, and growth <10^3 in 7. 40/110 (36%), initial therapy considered accurate (because no pneumonia, or PSB revealed organisms already treated by regimen started, 7 vs 33). Therapeutic plans changed on basis of PSB	Not stated	Assessment of clinical change according to PSB result, prospective. 15% of all cases changed management on basis of PSB. In those with final diagnosis of pneumonia, PSB changed management in 38%.

														alone 17/110 (15%) overall, which is 38% of the 45 patients with final diagnosis of pneumonia.		
Rouby, J. J. Rossignon, M. D. Nicolas, M. H. Martin de Lassale, E. Cristin, S. Grosset, J. Viars, P.	A prospective study of protected bronchoalveolar lavage in the diagnosis of nosocomial pneumonia	1989	ANESTHESIOLOGY	679-85	Qualitative research	minus	indeterminable	29 controls, 30 pneumonia (PM proven)	Controls - 29 with no lung disease, ventilated for 14 days. Pneumonia - 30 all of whom died of pneumonia, PM proven. Patients chosen after screening process of 343 patients, followed by allocation to control or case.	Protected catheter aspiration (no FOB) at bedside twice weekly in controls and once in the pneumonia group	No comparison	Diagnostic only	Microbiological diagnosis	Sensitivity of BAL for HAP = 80%, specificity 66%. 73% of cases, bacteria isolated from pneumonia group at BAL agreed with PM lung culture (partial 16%, total 57%). 7 episodes of minor haemoptysis. In control group, 19 true negatives and 10 false positives. Pneumonia group - 24 true positives, 6 false negatives.	Not stated	Suggested relatively high sensitivity of blind catheter aspirate - but high false positive rate in control group, and large selection of patients. Good gold standard of autopsy in all pneumonia patients. Microbiological positivity not defined with reference to cfu/ml
Souweine, B. Veber, B. Bedos, J. P. Gachot, B. Dombret, M. C. Regnier, B. Wolff, M.	Diagnostic accuracy of protected specimen brush and bronchoalveolar lavage in nosocomial pneumonia: impact of previous antimicrobial treatments	1998	CRITICAL CARE MEDICINE	236-44	Qualitative research	minus	no	52	63 suspected episodes of VAP in 52 patients, MV and VAP on clinical criteria. 35 of these episodes were subsequently ascribed to VAP. Divided in to 3 groups - no previous antibiotic treatments = 12; current = antibiotic treatment initiated >72 hrs earlier = 31; recent antibiotic group (new antibiotic treatment class started within the last 24 hrs), n = 20.	Bronchoscopic BAL, PSB, and intracellular organism (ICO) count	Nil - comparisons made between 3 groups by antibiotic status	Until microbiological diagnosis only	Microbiological positivity - BAL, PSB and/or ICO above a defined threshold	Using a threshold of 5% ICO in BAL, PSB threshold of 10^3 colony-forming units (cfu)/mL, BAL threshold of 10^5 cfu/mL; Sensitivities - 0.71, 0.88, and 0.71 (no antibiotic treatment group); 0.5, 0.77, and 0.83 (current antibiotic group); and 0.67, 0.40, and 0.38 (recent antibiotic group). Specificity was consistently >or=to0.9. In the recent antibiotic group, protected specimen brush and bronchoalveolar lavage cultures had lower sensitivities ($p < .05$), and the best threshold values for these two tests were 10^2 cfu/mL and 10^3 cfu/mL, respectively.	Not stated	Good comparison of diagnostic thresholds in different clinical circumstances, good gold standard for VAP diagnosis. BAL and PSB effective in those on antibiotics already, but less so if different/new antibiotic started within 24 hours of bronchoscopy.
Timsit, J. F. Misset, B. Renaud, B. Goldstein, F. W. Carlet, J.	Effect of previous antimicrobial therapy on the accuracy of the main procedures used to diagnose nosocomial pneumonia in patients who are using ventilation	1995	CHEST	1036-40	Qualitative research	minus	no	161	MV, VAP suspected	Samples taken via FOB - comparison of PSB culture, BAL culture and BAL microscopy	65 patients on antibiotics in last 3 days for other reasons, compared with 96 patients off antibiotics for at least the last 3 days	N/A - Microbiology diagnostic study only	Microbiological outcome	On vs off antibiotics: PSB culture sens 74% vs 70%, spec 88% vs 88%. BAL culture sens 79% vs 82%, spec 88% vs 81%. BAL microscopy sens 56% vs 63%, spec 100% vs 97%.	Not stated	Weak evidence informing the clinician that bronchoscopic guided BAL or PSB samples taken while on antibiotics appears to have a reasonable diagnostic yield, with no significant changes in sensitivity or specificity related to antibiotic usage.

Timsit, J. F. Misset, B. Francoual, S. Goldstein, F. W. Vaury, P. Carlet, J.	Is protected specimen brush a reproducible method to diagnose ICU-acquired pneumonia?	1993	CHEST	104-108	Qualitative research	plus	yes	26	MV patients with suspected VAP	PSB done twice, via FOB	Same PSB done twice and internally compared	N/A - Microbiological diagnosis only	Diagnostic yield according to >10^3 cfu/ml	No adverse events. Discordant results according to 10^3 cfu/ml threshold in 16.7% of cases (sensitivity 67% and 54%). Discrepancy statistically higher in confirmed pneumonia (certain and probable) than excluded pneumonia	Not stated	Weak evidence suggesting poor reproducibility of PSB if cut-off of 10^3 cfu/ml is used
Sanchez-Nieto, J. M. Torres, A. Garcia-Cordoba, F. El-Ebiary, M. Carrillo, A. Ruiz, J. Nunez, M. L. Niederman, M.	Impact of invasive and noninvasive quantitative culture sampling on outcome of ventilator associated pneumonia: A pilot study	1998	AMERICAN JOURNAL OF RESPIRATORY AND CRITICAL CARE MEDICINE	371-376	RCT	plus	Small numbers and no power calculation make the negative result difficult to interpret	51, 24 randomised to invasive sampling (PSB and BAL), and 27 randomised to quantitative endotracheal aspiration.	51 patients on MV for > 72 hours, with suspected VAP	Invasive diagnostic method = PSB and BAL via FOB; non-invasive method = quantitative Endotracheal aspirate (QEA)	Between invasive and non-invasive diagnostic techniques	During hospital stay	Patient outcomes including mortality, frequency of antitbiotic changes and microbiological diagnosis	Invasive group - 16 (67%) BAL positive, 14 (58%) PSB positive, 16 (67%) QEA positive. Non-invasive group - QEA positive in 20 (74%). Antibiotics modified in 10 (42%) invasive versus 4 (16%) non-invasive. Mortality crude = invasive 11/24 (46%) versus 7/27 (26%), adjusted was 29% and 10%. No difference in duration of MV and total stay on ICU	Supported by Fundació Privada Clínic per a la Recerca Biomèdica /Comissió Interdepartamental per a la Recerca i Tecnologia , CIRIT (GRQ94-9103); SEPAR (Iniciación a la Investigación) 1994.	Prospective randomised - but no power calculation, no confidence intervals, small numbers and no primary outcome measure. Suggestion of no difference in techniques - but not enough numbers (authors label this a pilot study). Good agreement between invasive and non-invasive methods

USE OF BRONCHOSCOPY IN ICU FOR DIAGNOSIS OF VAP AND INVESTIGATING AETIOLOGY OF HAEMOPTYSIS – Systematic reviews and meta-analyses

STUDY IDENTIFICATION / CITATION					STUDY TYPE	QUALITY RATING	BIAS	MAIN RESULT	HOW PRECISE ARE THE RESULTS
Authors	**Title**	**Year**	**Journal**	**Citation**					
Berton, D. C. Kalil, A. C. Cavalcanti, M. Teixeira, P. J. Z.	Quantitative versus qualitative cultures of respiratory secretions for clinical outcomes in patients with ventilator-associated pneumonia	2012	Cochrane Database of Systematic Reviews		Systematic Reviews and Meta-analyses	plus plus		No statistically significant differences in mortality rates comparing quantitative versus qualitative cultures (RR = 0.91, 95% CI 0.75 to 1.11). The analysis of all five RCTs showed there was no evidence of mortality reduction in the invasive group (BAL, PSB [blinded and via bronchoscope], mini BAL and blinded bronchial sampling) versus the non-invasive group (endotracheal aspirate) (RR = 0.93, 95% CI 0.78 to 1.11). There were no significant differences between the interventions with respect to the outcomes assessed.	Narrow confidence intervals reported

USE OF BRONCHOSCOPY IN ICU FOR DIAGNOSIS OF VAP AND INVESTIGATING AETIOLOGY OF HAEMOPTYSIS – Studies of diagnostic accuracy

STUDY IDENTIFICATION / CITATION					STUDY TYPE	QUALITY RATING	BIAS	POPULATION		TEST	GOLD STANDARD	Sensitivity	Specificity	PPV	NPV	LR		
Authors	Title	Year	Journal	Citation				Number of patients	Patient Characteristics									
Baigelman, W. Bellin, S. Cupples, L. A. Berenberg, M. J.	Bacteriologic assessment of the lower respiratory tract in intubated patients	1986	CRITICAL CARE MEDICINE	864-8	Diagnostic Accuracy	minus	yes	12	MV patients, infiltrate of <72 hours duration	Routine tracheal suction (RTS) via suction catheter, bronchoscopic PSB sampling and bronchoscopic suction.	No gold standard - three techniques are compared	Culture results agreed 100% between bronchoscopic suction and RTS techniques in all patients. 1/12 bronchoscopic PSB samples didn't detect all pathogens detected by other techniques. No clinical gold standard	n/a	n/a	n/a	n/a	Not stated	Not stated as results compared between PRB, bronchoscopic aspiration and catheter-based tracheal suction. Routine tracheal suctioning gives similar bacteriological information as bronchoscopic PSB or suctioning in a very small study of VAP.
Barreiro, B. Dorca, J. Manresa, F. Catala, I. Esteban, L. Verdaguer, R. Gudiol, F.	Protected bronchoalveolar lavage in the diagnosis of ventilator-associated pneumonia	1996	EUROPEAN RESPIRATORY JOURNAL	1500-1507	Diagnostic Accuracy	plus plus	yes	93 patients, 102 episodes of suspected VAP	Suspected VAP on standard clinical criteria	Protected BAL	Compared to final clinical diagnosis. Microbiological diagnosis validated by comparing to PSB sample	Quantitative PBAL (>=10^4 CFU/ml) sens=87%, ICO (intracellulaire organisms) sens 75%	BAL spec 91%, ICO spec 98%	BAL PPV 87%, ICO PPV 96%	BAL NPV 91%, ICO NPV 86%.	n/a	Not stated	35/102 diagnosed with VAP by clinical criteria (34%) Non-comparative study (although microbiological diagnosis verified by PSB) but good clinical gold standard. Lower sensitivity if pt already on antibiotics, but only marginal decrease.
Casetta, M. Blot, F. Antoun, S. Leclercq, B. Tancrede, C. Doyon, F. Nitenberg, G.	Diagnosis of nosocomial pneumonia in cancer patients undergoing mechanical ventilation: a prospective comparison of the plugged telescoping catheter with the protected specimen brush	1999	CHEST	1641-5	Diagnostic Accuracy	plus	yes	42	MV patients, suspected VAP with known cancer	Blind plugged telescopic catheter (PTC)	Bronchoscopic PSB	PTC sensitivity 67%	PTC specificity 93%	PTC PPV 71%	PTC NPV 91%	n/a	Not stated	Not applicable - Bronchoscopic PSB taken as reference standard Good concordance of bronchoscopic PSB and blind PTC (although improved sensitivity of PSB) but no gold clinical standard
Humphreys, H. Winter, R. Baker, M. Smith, C.	Comparison of bronchoalveolar lavage and catheter lavage to confirm ventilator-associated lower respiratory tract infection	1996	JOURNAL OF MEDICAL MICROBIOLOGY	226-31	Diagnostic Accuracy	minus	yes	66 patients, 79 paired samples in these patients in total	Clinical suspicion of ventilator-associated LRTI, in MV patients	Catheter lavage blind	FOB BAL	Not stated	Not stated	Not stated	Not stated	Not stated	Not stated	Not stated as no other gold standard Weak evidence that CL and BAL similar in diagnostic yield - no gold standard of diagnosis of infectious ventilator-associated lower respiratory tract infection.

Jorda,R. Parras, F. Ibanez, J. Reina, J. Bergad,J. Raurich, J. M.	Diagnosis of nosocomial pneumonia in mechanically ventilated patients by the blind protected telescoping catheter	1993	INTENSIVE CARE MEDICINE	377-82	Diagnostic Accuracy	plus	yes	40 patients with clinically diagnosed nosocomial pneumonia, immunocompetent.	ICU patients, mechanically ventilated (19 neuro injury, 9 polytrauma, 11 acute respiratory failure, 1 peritonitis). Immunocompetent. Clinical course of nosocomial pneumonia. Avg age 44 yrs, avg from intubation 8.2 days.	Non-bronchoscopy protected telescope catheter lavage	Bronchoscope protected catheter lavage	21/34 (62%) versus 22/34 (65%) using bronchoscopy	False positives not stated	Not stated	Not stated	n/a	Not listed	34/40 = 85% combined micro and clinical diagnosis Randomised trial of diagnostic efficacy - all patients underwent same procedures in order decided randomly. Demonstrates comparable diagnostic yields using bronchoscopic and non-bronchoscopic techniques, but poor gold standard
Jourdain, B. Novara, A. Joly-Guillou, M. L. Dombret, M. C. Calvat, S. Trouillet, J. L. Gibert, C. Chastre, J.	Role of quantitative cultures of endotracheal aspirates in the diagnosis of nosocomial pneumonia	1995	AMERICAN JOURNAL OF RESPIRATORY & CRITICAL CARE MEDICINE	241-6	Diagnostic Accuracy	plus	yes	39 patients (57 bronchoscopies)	VAP defined as PSB >=10^3 cfu/ml or BAL >=5% of cells contained intracellular bacteria. Mean age 59. MV for at least 48 hours; new and persistent infiltrate on CXR; purulent tracheal aspirates; off antibiotics or no change to antibiotics for past 3 days; likely to tolerate bronchoscopy	Endotracheal aspirate (EA)	Bronchoscopic BAL and PSB	EA operating characteristics varied with cutoff - sensitivity 90% at 10^3 cfu/ml, 21% at 10^7 cfu/ml, specificity 26% 10^3 cfu/ml, 92% 10^7 cfu/ml, Best threshold 10^6 cfu/ml, sensitivity 68% (CI 55 to 80), specificity 84% (CI 72 to 93).	Specificity 84% with best cutoff	PPV 68%	NPV 84%	Not given	Not stated	33% (19) In this comparative study of EA vs. BAL and PSB, there is poor microbiological concordance between each modality and relatively poor sensitivity and specificity of EA leading the authors to suggest that bronchoscopic techniques for VAP diagnosis are best.
Kirtland, S. H. Corley, D. E. Winterbauer, R. H. Springmeyer, S. C. Casey, K. R. Hampson, N. B. Dreis, D. F.	The diagnosis of ventilator-associated pneumonia: a comparison of histologic, microbiologic, and clinical criteria	1997	CHEST	445-57	Diagnostic Accuracy	plus	no	40 (specimens lost in one, therefore results from 39 reported)	All died while mechanically ventilated, mean age 66 years, mean length of MV = 14 days. Collection of ALL specimens within 1 hour of death.	Postmortem FOB (protected spec brush, BAL) versus open lung biopsy versus catheter aspirate of tracheal secretions versus clinical criteria diagnosing pneumonia (temperature 48 hours prior to death, WCC >15,000, bacteria in sputum, worsened radiology, worsened gas exchange)	Postmortem diagnosis - not validated	Lung biopsy - sensitivity 11% FOB guided PSB - sens 33% Tracheal FOB guided PSB, sens = 50% Blind PSB, sens 22% Distal airway BAL, sens = 11%	Lung biopsy - spec 93% FOB guided PSB - spec 63% Tracheal FOB guided PSB, spec 59% Blind PSB, spec 77% Distal airway BAL, spec 80%	Lung biopsy PPV 33% FOB guided PSB PPV 21% Tracheal FOB guided PSB, PPV 25% Blind PSB, PPV 22% Distal airway BAL, PPV 14%	Lung biopsy - NPV 78% FOB guided PSB - NPV 76% Tracheal FOB guided PSB, NPV 81% Blind PSB, NPV 77% Distal airway BAL, NPV 75%	n/a	Funded by the Edward H. Morgan Fund for Clinical Research in Pulmonary Disease, Virginia Mason Research Center, Seattle.	14/39 with histologically proven pneumonia, at postmortem (36%) Not data on living patients, gold standard not validated, possibility that tracheal bacteria are washed in to distal airway as adopted proximal to distal approach. Significance of any findings unclear.
Lambert, R. S. Vereen, L. E. George, R. B.	Comparison of tracheal aspirates and protected brush catheter specimens for identifying pathogenic bacteria	1989	AMERICAN JOURNAL OF THE MEDICAL SCIENCES	377-82	Diagnostic Accuracy	minus	yes	22	Mechanically ventilated, suspected VAP (new radiographic infiltrates and fevers, antibiotic treatment for <24 hours).	Tracheal aspirate - Gram stain, culture and antibody coating of bacteria by fluorescence microscopy	Quantitative culture of PSB (>=10^3 defined as positive)	Gram stain and culture of tracheal aspirate 100% (16/16) assuming FOB PSB is gold standard	True negative = 2/6 = 33%	Not given	Not given	Not given	Not given	16/22 defined as >= 10^3cfu/ml on PSB Weak data on the use of tracheal aspirate instead of PSB via

	in mechanically ventilated patients								Followed up to discharge or death - final diagnosis determined by clinical course. Mean age 60.2 years, 27 mean days on ventilator, 18% (4/22) survival to discharge. 10/22 treated with antibiotics at inclusion for < 24 hours.									bronchoscopy on ICU ventilated patients - prolonged ventilation
Leal-Noval, S. R. Alfaro-Rodriguez, E. Murillo-Cabeza, F. Garnacho-Montero, J. Rey-Perez, J. Munoz-Sanchez, M. A.	Diagnostic value of the blind brush in mechanically ventilated patients with nosocomial pneumonia	1992	INTENSIVE CARE MEDICINE	410-4	Diagnostic Accuracy	plus	yes	37 patients with suspected VAP	MV for more than 3 days, clinical and radiological diagnosis of NP. Avg age 34 years, MV duration 10 days. 78% (28) received antibiotics 48 hours prior to collection of BBs.	BB (blind brush via ETT) = cytology brush protected by double sheath balloon tipped catheter, via ETT.	FOB PSB - randomised order in each patient, <30 mins apart	Not given	Not given	Not given	Not given	Not given	Not given	Not given	13 (35%) patients with VAP confirmed on the basis of >10^3cfu/ml on PSB via FOB Suggestion of high degree of agreement between techniques - higher complications from FOB versus protected brush. When compared to FOB PSB, 3 false negatives and 3 potential false positives with blind brush.
Marquette, C. H. Herengt, F. Mathieu, D. Saulnier, F. Courcol, R. Ramon, P.	Diagnosis of pneumonia in mechanically ventilated patients: Repeatability of the protected specimen brush	1993	American Review of Respiratory Disease	211-214	Diagnostic Accuracy	plus	yes	22	MV patients, suspected VAP. Mean age 63. Reasons for ventilation - n=9 COPD exacerbation, n=2 multiorgan failure associated with sepsis, n=2 acute cardiac failure, n=4 coma, n=3 postoperative respiratory failure, n=1 multitrauma, n=1 miscellaneous	5 repeated protected specimen brushes taken in the same patient consecutively, via FOB, with an evaluation of reproducibility	Internal reproducibility only	n/a	n/a	n/a	n/a	n/a	Supported by Grant 90 SP/1 from the Comite National contre les Maladies Respiratoires et la Tuberculose	Not reported - no gold standard Study of repeated PSB in same patient, at same time. Good repeatability for qualitative microbiology, but poorer repeatability for quantitative microbiology with 14% of patients having values varying around the conventional 10^3 cfu/ml threshold.

Marquette, C. H. Herengt, F. Saulnier, F. Nevierre, R. Mathieu, D. Courcol, R. Ramon, P.	Protected specimen brush in the assessment of ventilator-associated pneumonia. Selection of a certain lung segment for bronchoscopic sampling is unnecessary	1993	CHEST	243-7	Diagnostic Accuracy	plus	yes	39 examinations in 34 patients	Mechanically ventilated patients - 34 consecutive, 5 patients studied twice (> 8 days between two FOB episodes in these cases). Mean MV days = 11. Pneumonia diagnosed on established (4 point) clinical criteria, 7 received no prior antibiotics, remaining 27, antibiotics withheld for 24 hours prior to FOB.	Protected specimen brush (PSB) taken in non-radiographic involved area on CXR. Order determined by random number sequence.	PSB taken in a radiographically-involved area on CRA	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported Reasonable agreement between PSB conducted in involved and non-involved areas of VAP on chest radiograph.
Pham, L. H. Brun-Buisson, C. Legrand, P. Rauss, A. Verra, F. Brochard, L. Lemaire, F.	Diagnosis of nosocomial pneumonia in mechanically ventilated patients. Comparison of a plugged telescoping catheter with the protected specimen brush	1991	American Review of Respiratory Disease	1055-61	Diagnostic Accuracy	plus	yes	55	78 episodes of suspected VAP, MV patients.	PTC and PSB taken in random order, and PTC samples randomised to blind or FOB directed.	Compared to a composite outcome that defines definite and probable pneumoniae (partly based on results of sampling techniques).	Overall operating characteristics - PTC sens 100% spec 82.2, PSB 64.7 and 93.5.	Overall operating characteristics - PTC sens 100% spec 82.2, PSB 64.7 and 93.5.	Not stated	Not stated	Not stated	Plastimed laboratories and Henri Mondor hospital	Patients with clinical suspicion of VAP are included Suggests simpler method (PTC) as good or better than PSB. Confusing difference between false negatives and positives, use of FOB makes apparently no difference. Sensitivity and specificity should be viewed with caution as each test contributes to the diagnosis of pneumonia.
Swanson, J. M. Wood, G. C. Croce, M. A. Mueller, E. W. Boucher, B. A. Fabian, T. C.	Utility of preliminary bronchoalveolar lavage results in suspected ventilator-associated pneumonia	2008	Journal of Trauma - Injury, Infection and Critical Care	1271-1277	Diagnostic Accuracy	plus	yes	474 BALs in 176 patients	Trauma ICU patients with suspected VAP	pBAL (preliminary BAL) reported at 24 hours - this examined the colony count to determine whether preliminary results significant	fBAL (final BAL) reported at 72 to 96 hours. Also compared pBALs to historical controls managed according to fBALs	Not discussed	Not discussed	100%	95%	Not stated	Not stated	n/a Suggests that pBAL can be used as a marker for no VAP for early discontinuation of antibiotics.
Torres, A. El-Ebiary, M. Padro, L. Gonzalez, J. De la Bellacasa, J. P. Ramirez, J. Xaubet, A. Ferrer, M. Rodriguez-Roisin, R.	Validation of different techniques for the diagnosis of ventilator-associated pneumonia: Comparison with immediate postmortem pulmonary biopsy	1994	AMERICAN JOURNAL OF RESPIRATORY AND CRITICAL CARE MEDICINE	324-331	Diagnostic Accuracy	plus	yes	30	MV patients who died - all treated with antibiotics. MV for more than 72 hours in the respiratory ICU. Mean 4+/- 2 antibiotics for a mean period of 9+/-7 days. Mean age 52.	Post mortem bilateral PSB, BAL, bronchial aspirates (FBAS) and percutanous lung aspirates (PLNA). PSB performed in either lower lobe or area of maximal CXR changes. BAL from same areas, with 2*50ml aliquots (first return discarded). Bilateral blind needle aspiration biopsies, guided by light of bronchoscope (same region as PSB/BAL).	Compared to gold standard of lung biopsy histology (not culture) at mini thoracotomy post mortem	Sensitivity - PSB 36, BAL 50, FBAS 44, PLNA 25.	Specificity - PSB 50, BAL 45, FBAS 48, PLNA 79.	Not reported	Not reported	Not reported	Supported in part by a grant from SEPAR-Rousel, 1990	60% (18/30) Small study comparing BAL, PSB, FBAS and PLNA, suggesting high specificity but low sensitivity of PLNA with modest sensitivities for BAL and FBAS with modest specificities.

Bello S, Tajada A, Chacón E, Villuendas MC, Senar A, Gascón M, Suarez FJ	Blind" protected specimen brushing versus bronchoscopic techniques in the aetiological diagnosis of ventilator-associated pneumonia.	1996	ERJ	1494-9	Diagnostic Accuracy	plus	yes	74 patients, 88 episodes suspected VAP	MV, clinically suspected VAP	Blind bronchial brush	FOB brush and FOB BAL	In group without antibiotic pre-treatment; Blind brush - 66% (54-77%) FOB brush - 59% (47-72%) FOB BAL - 56% (46-67%)	In group without antibiotic pre-treatment; Blind brush - 91% (71-99%) FOB brush - 95% (77-100%) FOB BAL - 95% (77-100%)	Not stated	Not stated	Not stated	Supported by grant FISS 92/1054	Not applicable - no gold standard applied High concordance: PSB-BF and BAL; 84% for PSB-nonBF and BAL; 85% for PSB-nonBF and PSB-BF; and 85% for PSB-nonBF combined with both bronchoscopic techniques. The diagnostic yields in suspected VAP were 66, 59 and 56% for PSB-nonBF, PSB-BF and BAL, respectively. Group with non-suspected VAP also assessed - With PSB-BF sterile cultures were obtained in 20 procedures (91%); with BAL in 19 (86%); and with PSBnonBF in 17 (77%). When comparing these findings, no significant differences were found.
Pugin, J. Auckenthaler, R. Mili, N. Janssens, J. P. Lew, P. D. Suter, P. M.	Diagnosis of ventilator-associated pneumonia by bacteriologic analysis of bronchoscopic and nonbronchoscopic "blind" bronchoalveolar lavage fluid	1991	American Review of Respiratory Disease	1121-9	Diagnostic Accuracy	plus	yes	28 patients (6 studied twice, 3 studied 3 times, 40 samples in total)	MV patients, at high risk of VAP	Non-bronchoscopic BAL - blind catheter via ETT	FOB and BAL diagnostic yield, correlation with clinical score for pneumonia and bacterial index from samples (log of the number of bacteria per ml of aspirated fluid)	Using BI cutoff of 5, sens and spec of bronchoscopic BAL was 100%, for non-bronchoscopic BAL, sens and spec were 73% and 96%.	See above	See above	n/a	n/a	Not stated	13/28 = 46% on clinical criteria Good gold standard (clinical score of pneumonia). Very high sensitivity and specificity reported for bronchoscopic BAL, and reasonably high (but lower) reported for 'blind' BAL. Reasonable to conclude that, in a small sample size, 'blind' BAL has reasonable diagnostic yield in suspected VAP.

Torres, A. Puig de la Bellacasa, J. Rodriguez-Roisin, R. Jimenez de Anta, M. T. Agusti-Vidal, A.	Diagnostic value of telescoping plugged catheters in mechanically ventilated patients with bacterial pneumonia using the Metras catheter	1988	American Review of Respiratory Disease	117-20	Diagnostic Accuracy	plus	yes	25	MV patients with suspected bacterial pneumonia	Metras catheter and telescoping plugged catheter	Bronchoscopy and telescoping plugged catheter and endotracheal aspirate	Endotracheal aspirate demonstrated positive bacteriology in all 18 confirmed with pneumonia, but 5 false positives (28%) in those without. FB positive in 66% (true positives) and MC positive in 61% (true positives). No false positives with either technique in non-pneumonia. Overall, EA sensitivity 100%, NPV 100%, specificity 29%, PPV 78. TPC with FOB sens 66%, NPV 54%, specificity 100%, PPV 100%. TPC via MC - sensitivity 61%, NPV 50%, specificity 100%, PPV 100%.	See above	See above	See above	n/a	Not stated	18/25 = 72% High specificity of both bronchoscopy and metras catheter guided diagnostic samples. However, gold standard of diagnosis of pneumonia (clinical features, bacteriology) was variable, with 10 confirmed at autopsy and 8 on the basis of 'response to therapy'.
Casetta, M. Blot, F. Antoun, S. Leclercq, B. Tancrede, C. Doyon, F. Nitenberg, G.	Diagnosis of nosocomial pneumonia in cancer patients undergoing mechanical ventilation: a prospective comparison of the plugged telescoping catheter with the protected specimen brush	1999	CHEST	1641-5	Diagnostic Accuracy	plus	yes	42	MV patients, suspected VAP with known cancer	Blind plugged telescopic catheter (PTC)	Bronchoscopic PSB	PTC sensitivity 67%	PTC specificity 93%	PTC PPV 71%	PTC NPV 91%	n/a	Not stated	Not applicable - Bronchoscopic PSB taken as reference standard Good concordance of bronchoscopic PSB and blind PTC (although improved sensitivity of PSB) but no gold clinical standard

MONITORING

STUDY IDENTIFICATION / CITATION					STUDY TYPE	QUALITY RATING	BIAS	POPULATION		INTERVENTION	COMPARISON	FOLLOW UP	OUTCOMES	EFFECT SIZE	FUNDING	COMMENTS
Authors	Title	Year	Journal	Citation				Number of patients	Patient Characteristics							
Kim, Y. H. Suh, G. Y. Kim, M. H. Park, H. Y. Kang, E. H. Koh, W. J. Chung, M. P. Kim, H. Kwon, O. J. Kim, K.	Safety and usefulness of bronchoscopy in ventilator-dependent patients with severe thrombocytopenia	2008	Anaesthesia & Intensive Care	411-7	Qualitative research	minus	no	37, one group only	Ventilated patients with severe thrombocytopaenia (plts <50) undergoing bronchoscopy. Mean plt count 27.3, haematological malignancy in 21 (56.7%), severe sepsis 5 (13.6%), post liver transplant (4) and autoimmune (4 = 10.8%).	Low platelet count (plts < 50)	Non comparative study	Immediate outcomes only (bronchoscopy safety)	Mortality, clinical decline, physiological changes, diagnostic usefulness, safety	2 died within 24 hours of procedure. No change in remaining patients in oxygenation, organ failure or SAPS II. Lung compliance decreased 2 hours post bronchoscopy, recovered by 24 hours. Bronchoscopy diagnostically helpful in 14 (37.8%). Those receiving plt transfusion had lower plts counts (23.5 versus 31.5). Mild tachycardia during procedure (mean pulse 116). Treatment modified on basis of brochoscopy result in 14 (37.8%) of patients. Overall survival out of ICU = 18/37 (48.6%). Two deaths associated with the procedure (5.4%) (progressive sepsis and progressive hypoxaemia due to alveolar hasemorrhage). No major bleeding except single death - tracheobronchial bleeds in 12 (32.4%) not requiring further treatment.	Not stated	Very weak data suggesting bronchoscopy may be safe in those with low platelet counts on the ICU. However, 19 patients received platelet transfusion prior to bronchoscopy, 8 received FFP, 4 cryoprecipitate
Steinberg, K. P. Mitchell, D. R. Maunder, R. J. Milberg, J. A. Whitcomb, M. E. Hudson, L. D.	Safety of bronchoalveolar lavage in patients with adult respiratory distress syndrome	1993	American Review of Respiratory Disease	556-61	Qualitative research	plus	yes	110	110 patients (25%) of 438 ARDS patients within study period. MV patients, diagnosed with ARDS on standard criteria. Excluded if PaO2 <80mmHg on FiO2 of 1.0, hypotension, IHD, raised IPC or ETT <7mm diameter.	FOB via ETT - 4.8mm bronchoscope, paralysed as required. 150ml BAL fluid in 30mls aliquots.	Physiological parameters pre and post BAL	1 hour post procedure	Physiological parameters (PF ratio, MAP, HR, peak inspiratory pressure, thoracic compliance, saturations) and complications	No statistically significant differences in physiological parameters pre and post procedure, except for small drop in saturations (96.8 to 95.6, statistically significant, clinically not considered significant). In total, 5 (4.5%) had desaturation <90% and 1 (0.9%) desaturation to <80%. No bleeding events, one pneumothorax, no deaths.	Not stated	Well conducted case series assessing physiological change in ARDS during FOB and BAL. In selected patients, procedure appears safe with non-significant drop in saturations overall only, but only over short term (1 hour).
Bauer, T. T. Torres, A. Ewig, S. Hernandez, C. Sanchez-Nieto, J. M. Xaubet, A. Agusti,C. Rodriguez-Roisin, R.	Effects of bronchoalveolar lavage volume on arterial oxygenation in mechanically ventilated patients with pneumonia	2001	INTENSIVE CARE MEDICINE	384-93	RCT	plus plus		37 patients - 21 to low volume arm; 16 to high volume arm	Intubated MV patients with clinical suspicion of pneumonia on standard criteria	Bronchoscopic sampling for pneumonia using either large or small volume BAL using protected BAL catheter	Large volume BAL (5x 30mls) vs. small volume BAL (2 x 20mls)	24 hours	Ventilatory parameters	PF ratio decreased in all patients in the study at all time points except at 5 hours. Between 80-86% of baseline value of PF ratio. No significant differences between treatment groups in degree of reduction of PF ratio. MAP increased significantly in all patients (82 baseline to 99-103 mmHg depending on time), no difference between arms.	Not stated	Good evidence that BAL volume does not influence the degree of ventilatory change in these patients. Worsening of PF ratio and increases of MAP occurs in all patients. Decrease in O2 smaller in those with negative bacterial cultures or those with previous antibiotics.

Hilbert, G. Gruson, D. Vargas, F. Valentino, R. Favier, J. C. Portel, L. Gbikpi-Benissan, G. Cardinaud, J. P.	Bronchoscopy with bronchoalveolar lavage via the laryngeal mask airway in high-risk hypoxemic immunosuppressed patients	2001	CRITICAL CARE MEDICINE	249-55	Qualitative research	plus	yes	46	Immunosuppressed patients admitted to ICU, PF ratio <125, suspected pneumonia on clinical grounds	Induction, then insertion of an LMA. FOB via T-adaptor through LMA, 150mls 0.9% saline BAL	Nil - case series	8 hours post procedure	Safety outcomes, physiological outcomes, need for intubation, diagnostic yield (no gold standard)	Transient laryngospasm in 3 as bronchoscopy introduced, resolved with increased anaesthesia. No statistically significant changes in BP, HR, PF ratio or PaCO2 pre and post intervention overall. Individually cases: desaturation <90% in 6 (13%) during BAL but no patient required intubation to 8 hours post procedure. 7 (15%) had hypotension (MAP <60mmHg) for >120 seconds, all treated successfully with plasma expanders.	Not stated	Case series evidence that FOB can be conducted safely in hypoxic patients using LMA in preference to ETT. No incidences of intubation. Demonstrates procedure can be conducted via LMA if required in this patient population. Patients removed prior to entry to study if required intubation for other reasons, so limited applicability to intubated population.
Klein, U. Karzai, W. Zimmermann, P. Hannemann, U. Koschel, U. Brunner, J. X. Remde, H.	Changes in pulmonary mechanics after fiberoptic bronchoalveolar lavage in mechanically ventilated patients	1998	INTENSIVE CARE MEDICINE	1289-1293	Qualitative research	plus	yes	18	MV patients, critically ill, no inotropes, lobar atelectasis excluded. Mean age 41 years. Suspected nosocomial pneumonia, all pressure support ventilated. All patients sedated with fentanyl and droperidol, paralysed with pipecuronium.	Impact of BAL on respiratory mechanics. FiO2 increased to 1.0 during procedure, ventilator settings not changed. 5 x aliquots of 20mls saline in one subsegment	Nil - non comparative study	Immediate post intervention monitoring only	Pulmonary compliance and resistance, PaO2 and PaCO2	Compliance decreased post procedure by 23.5% 8 minutes after BAL, remained significantly below baseline at 60 and 180 minutes. Resistance increased by 21.8% at 8 mins, back to baseline at 60 minutes. Six patients, one third, of patients had >30% change in compliance and resistance. Va decreased by 25% after BAL, returned to near baseline at 180 minutes. One hour post procedure, O2 lower and CO2 higher than pre-procedure - CO2 from 34 at baseline to 44 at 8 mins, and PO2 109 at baseline to 153 at 8 mins (100% O2) and 91 at 60 mins. 3 hours post procedure, resistance back to baseline, compliance remained 10% below baseline. Haemodynamics not changed clinically significantly.	Not stated	Small study but close physiological monitoring. Evidence of worsened lung compliance and resistance after BAL, with reductions in gas exchange up to 1 hour post procedure. No haemodynamic changes, and no long term outcome reported

Maitre, B. Jaber, S. Maggiore, S. M. Bergot, E. Richard, J. C. Bakthiari, H. Housset, B. Boussignac, G. Brochard, L.	Continuous positive airway pressure during fiberoptic bronchoscopy in hypoxemic patients. A randomized double-blind study using a new device	2000	AMERICAN JOURNAL OF RESPIRATORY & CRITICAL CARE MEDICINE	1063-7	RCT	plus plus		30	Hypoxic patients requiring FOB (not ventilated) = PaO2 <=125mmHg on 10L/min oxygen. Excluded if acute MI within 1 week, pH <7.3, PaCO2 >60mmHg, PaO2 <=50mmHg on 10L/min O2, plts <30, SBP <80mmHg, coma or encephalopathy, need for TBBx.	CPAP during FOB - full face mask, allowing either oxygen or CPAP to be given via same set up. Physician and patient blinded to allocation (length of tubes allowed this). CPAP given and 2.5 to 7.5cmH2O, oxygen same in both groups.	Oxygen via same set up	6 hours post procedure	Primary = mean drop in oxygen saturations during bronchoscopy. Saturations during procedure, ABGs 15 minutes post procedure, proportion requiring ventilatory assistance	Higher saturations in CPAP group during and 30 minutes post procedure - 95.7% versus 92.6%, p=0.02. Difference persisted to 5 and 15 minutes. Lowest sats in oxygen group (88.6% versus 93.%5, p=0.002). 15 minutes post procedure change in PaO2 in CPAP group +10.5% SD 16.9, versus -15% SD 16.6, p=0.01). 5 in oxygen group versus none in CPAP group developed respiratory failure attributed to FOB and required ventilation (1 NIV, 4 mechanical) (p=0.030). Of patients who developed respiratory failure post bronchoscopy NOT attributed to FOB, 1 patient given CPAP post procedure in CPAP group (due to pre-existing atelectasis), and 2 given MV in oxygen group (haemothorax, laparotomy).	Not stated but thanks to "Vygon Laboratories for providing the necessary equipment."	Good evidence that CPAP during FOB for hypoxic patients reduces fall in SaO2 and reduces need for post procedure ventilatory support.
Papazian, L. Colt, H. G. Scemama, F. Martin, C. Gouin, F.	Effects of consecutive protected specimen brushing and bronchoalveolar lavage on gas exchange and hemodynamics in ventilated patients	1993	CHEST	1548-52	Qualitative research	plus	yes	12	Intubated, MV, invasively monitored with haemodynamic compromise. MV with PEEP of at least 10cm H2O, radial artery catheter and Swan-Ganz in situ, need for inotropic support, suspected NBP requiring FOB to diagnose. Excluded if SBP <60, or if FiO2 = 1.0. Mean age 63 years, 9 days post admission to ICU.	PSB and then BAL in all patients. All patients sedated, ventilated, paralysed, at least 8mm ETT. 6.3mm od Pentax scope used. BAL = 20mls x 5 aliquots of saline.	Nil	Physiological outcomes during and after the PSB / BAL. Compared to period before the intervention.	Physiological outcomes only	Moderate increases in MAP (81 vs 92, p<0.05) and mean PA pressure (29 vs 33, p<0.05) during FOB. No drop on PaO2 during procedure, decrease 1 hour post procedure compared to baseline (100mmHg versus 89mmHg, p<0.05). PaO2 returned to baseline 2 hours after BAL in 4 patients, 3 hours in 2 patients, 4 hours in 1 patient. PaO2 decreased compared to prior to procedure - increased intrapulmonary shunt at end of BAL. Moderate increase of PaCO2 after PSB and BAL (p<0.05). Sustained decrease of oxygen saturations from 10 to 60 minutes. Reduced SvO2 - moderate but statistically significant.	Not stated	Physiological description of effects of BAL and PSB in unwell ventilated patients - overall, no ill effects, but non clinically significant physiological changes including prolonged fall in PaO2.
Previgliano, I. J. Ripoll, P. I. Chiappero, G. Galindez, F. Germani, L. Gonzalez, D. H. Ferrari, N. Hlavnicka, A. Purvis, C.	Optimizing cerebral perfusion pressure during fiberoptic bronchoscopy in severe head injury: effect of hyperventilation	2002	Acta Neurochirurgica - Supplement	103-5	RCT	plus	No blinding for outcomes and multiple outcomes - likely type I error	34; 16 in routine care group (aiming to optimise cerebral perfusion pressure) and 18 in hyperventilation group	Severe closed head injury patients, GCS <8, requiring FOB and BAL	Hyperventilation via ventilator	Between treatment (compared with normal care optimising cerebral perfusion pressure)	Immediate outcomes	MAP, ICP, CPP, ET CO2, PaCO2, SpO2, RR and HR	In HVV group lower PaCO2 after bronchoscopy (31 vs 41, p<0.01) and change in intracranial pressure improved (-11 in normal group versus 6 in HVV, p=0.01).	Not stated	RCT, no details on allocation concealment, not blinded. Multiple outcomes and data points, no statistical correction. Moderate evidence that hyperventilation alleviates expected rise in ICP during FOB.

Trouillet, J. L. Guiguet, M. Gibert, C. Fagon, J. Y. Dreyfuss, D. Blanchet, F. Chastre, J.	Fiberoptic bronchoscopy in ventilated patients. Evaluation of cardiopulmonary risk under midazolam sedation	1990	CHEST	927-33	Qualitative research	plus	no	107	MV acutely ill patients	FOB using iv midazolam at 0.1mg/kg, FiO2 0.8. No topical local anaesthesia.	Nil - case series	Short term physiology only	Gas exchange differences pre and post procedure	PaO2 decline of 26%, mild increase in CO2. In 35%, O2 fell by more than 30%, more frequent in ARDS patients - large interperson variability. 10% decrease in SBP after sedation, followed by 10% rise and tachycardia during procedure. Increased cardiac output and wedge pressure during procedure in 31 with invasive monitoring. 14 patients with hypoxaemia lower than 60mmHg with FiO2 0.8 - presence of ARDS and "fighting the ventilator" associated in MVR.	Supported in part by a grant from the Faculte Xavier Bichat.	FOB in MV patients using midazolam associated with significant fall in PO2, but little change in cardiac parameters or CO2. Worse if "fighting ventilator" or ARDS.

MONITORING AND TREATMENT OF RAISED INTRACRANIAL PRESSURE

STUDY IDENTIFICATION / CITATION					STUDY TYPE	QUALITY RATING	BIAS	POPULATION		INTERVENTION	COMPARISON	FOLLOW UP	OUTCOMES	EFFECT SIZE	FUNDING	COMMENTS
Authors	**Title**	**Year**	**Journal**	**Citation**				**Number of patients**	**Patient Characteristics**							
Previgliano, I. J. Ripoll, P. I. Chiappero, G. Galindez, F. Germani, L. Gonzalez, D. H. Ferrari, N. Hlavnicka, A. Purvis, C.	Optimizing cerebral perfusion pressure during fiberoptic bronchoscopy in severe head injury: effect of hyperventilation	2002	Acta Neurochirurgica - Supplement	103-5	RCT	plus	No blinding for outcomes and multiple outcomes - likely type I error	34; 16 in routine care group (aiming to optimise cerebral perfusion pressure) and 18 in hyperventilation group	Severe closed head injury patients, GCS <8, requiring FOB and BAL	Hyperventilation via ventilator	Between treatment (compared with normal care optimising cerebral perfusion pressure)	Immediate outcomes	MAP, ICP, CPP, ET CO2, PaCO2, SpO2, RR and HR	In HVV group lower PaCO2 after bronchoscopy (31 vs 41, p<0.01) and change in intracranial pressure improved (-11 in normal group versus 6 in HVV, p=0.01).	Not stated	RCT, no details on allocation concealment, not blinded. Multiple outcomes and data points, no statistical correction. Moderate evidence that hyperventilation alleviates expected rise in ICP during FOB.
Bajwa, M. K. Henein, S. Kamholz, S. L.	Fiberoptic bronchoscopy in the presence of space-occupying intracranial lesions	1993	CHEST	101-3	Qualitative research	minus	yes	17 patients with known space occupying lesion (sol) before bronch, 12 with unknown sol, diagnosed after bronch	All 29 had lung ca, average age 57 +/- 3	Bronchoscopy done in the presence of raised intracranial pressure suggested on CT by oedema or midline shift.	Two groups are compared those that had raised ICP before bronchoscopy compared to those that did not know they had raised ICP. In the former they were treated with steroids (dex 16mg/d), however the latter had no treatment.	1 week	Any new neurological sequelae new symptoms	There were no subjective adverse effects	None	Study in a small number of patients retrospectively were reviewed showing that in 29 patients with SOL bronchoscopy did not cause adverse events. However several patients had seizures which were not attributed to the bronchoscopy but attributed to the SOL. In addition the 17 patients with a known SOL had been treated for raised ICP with steroids.
Kerwin, A. J. Croce, M. A. Timmons, S. D. Maxwell, R. A. Malhotra, A. K. Fabian, T. C.	Effects of fiberoptic bronchoscopy on intracranial pressure in patients with brain injury: a prospective clinical study	2000	Journal of Trauma-Injury Infection & Critical Care	878-82; discussion 882-3	Qualitative research	minus	yes	23 patients and 26 fobs.	21 males, 2 females. Prospective study over 14 months, patients had to be over 16 admitted with severe head injury and have ICP drains in place with a GCS<8. Bronchoscopy was performed for pneumonia or lobar atelectasis. Premedication morphine	Whether the raised ICP seen in bronchoscopy can be prevented	Those with raised ICP (>10) were compared against those with a normal ICP in a subgroup analysis	10 minutes for measurements and until discharge from ICU	Measured : ICP, MAP, Cerebral perfusion pressure. Complication rates Type of head injury	In 81% of patients ICP rapidly increased from 12.6 to 38 (means). It raised at least 50% in 885 of procedures and increased by at least 100% in 69% of procedures; it took an average of 13.9 minutes to return to baseline. Cerebral perfusion pressure was maintained throughout since MAP also increased, however it was raised disproportionately to the raised ICP. The patients with high ICP were given nebulised lidocaine however this did not blunt the elevation in ICP. There was no differences in the types of head injury in those had elevated ICP as a result of bronchoscopy and those with normal ICPs (however the figures	Not mentioned	Bronchoscopy raises the ICP and also the cerebral perfusion pressure. Patient were not monitored long enough to determine whether this was a proportionate rise. No known neurological damage occurred as a result of bronchoscopy. Limitations: Poor length of follow up, small study, scans were not repeated post bronchoscopy, patients were not given triple therapy to reduce ICP

									and midazolam					look very different) Two patients desaturated at bronchoscopy and this resolved post bronchoscope removal.		
Peerless, J. R. Snow, N. Likavec, M. J. Pinchak, A. C. Malangoni, M. A.	The effect of fiberoptic bronchoscopy on cerebral hemodynamics in patients with severe head injury	1995	CHEST	962-5	Qualitative research	plus	yes	15	Patients with severe head injury, ICP monitored, in whom bronchoscopy required for diagnosis of pneumonia or treatment of lobar collapse.	Bronchoscopy with anaesthetic and muscle relaxants as required to eliminate coughing	No direct comparisons (in patients, pre, post and during bronchoscopy only)	8 hours post procedure	Comparisons of pre, during and post bronchoscopy physiological comparisons (MAP, ICP, CPP and mean cerebral haemodynamic values 8 hours pre and post bronchoscopy)	Pre-bronchoscopy ICP 14.3 mm Hg (6 to 26 mm Hg). During bronchoscopy, mean increase in ICP of 13.5 mm Hg above basal values (p=0.0001 compared to baseline). At peak ICP, MAP increased from baseline 92.3 mm Hg (SD±16.1) to 111.5 mm Hg (±13.9). Mean CPP 83.7 mm Hg at peak ICP (range, 52 to 121 mm Hg) = 14.0% increase over baseline. ICP and MAP returned to basal levels following bronchoscopy with no patient having a clinically significant increase in ICP, and none demonstrated deterioration in GCS or neurologic examination findings post bronchoscopy.	Not stated	Evidence of raised ICP during bronchoscopy, but modest change in CPP and no sequelae post procedure from neurological standpoint 8 hours later.

VENTILATOR SETTINGS FOR BRONCHOSCOPY

STUDY IDENTIFICATION / CITATION					STUDY TYPE	QUALITY RATING	BIAS	POPULATION		INTERVENTION	COMPARISON	FOLLOW UP	OUTCOMES	EFFECT SIZE	FUNDING	COMMENTS
Authors	Title	Year	Journal	Citation				Number of patients	Patient Characteristics							
Antonelli, Massimo Pennisi, Mariano Alberto Conti, Giorgio Bello, Giuseppe Maggiore, Salvatore Maurizio Michetti, Vincenzo Cavaliere, Franco Proietti, Rodolfo	Fiberoptic bronchoscopy during noninvasive positive pressure ventilation delivered by helmet	2003	INTENSIVE CARE MEDICINE	126-9	Qualitative research	minus	indeterminable	4	Acute respiratory failure and suspected pneumonia	NPPV via helmet and FOB	Nil	Immediate	Arterial blood gas levels, pH, O2 saturation, respiratory rate, heart rate, mean ABP	Good tolerance, no deterioration in gas exchange, heart rate increase by 5%, MABP by 7%. No intubations required	Not stated	Small non comparative case series suggesting NPPV via helmet may be useful in hypoxic patients to avoid intubation post bronchoscopy
Antonelli, M. Conti, G. Riccioni, L. Meduri, G. U.	Noninvasive positive-pressure ventilation via face mask during bronchoscopy with BAL in high-risk hypoxemic patients	1996	CHEST	724-8	Qualitative research	minus	indeterminable	8	Consecutive immunosuppressed patients (40 SD 14 years) with suspected pneumonia, hypoxic non-acidotic with documented improvement in O2 using NPPV	NPPV via face mask to aid bronchoscopy	Nil	Immediate	Unclear, but PF ratio, CO2 level and O2 saturation during the procedure reported.	Significant increase in PF ratio and O2 saturations, and no increase in CO2 in all patients, presented graphically only, compared to baseline	Not stated	Small non comparative case series suggesting NPPV may be useful in hypoxic patients to avoid intubation post bronchoscopy.
Chiner, E. Sancho-Chust, J. N. Llombart, M. Senent, C. Camarasa, A. Signes-Costa, J.	Fiberoptic bronchoscopy during nasal non-invasive ventilation in acute respiratory failure	2010	RESPIRATION	321-326	Qualitative research	minus	indeterminable	35	Hypoxic patients requiring bronchoscopy	Non-invasive nasal ventilation	Nil	Immediate outcomes	Ventilatory parameters, need for intubation	Ventilatory parameters maintained, but 11% required intubation	Not stated	Non-comparative study suggesting ventilatory parameters are maintained using NIV, but significant requirement for intubation in hypoxic patients.

STUDY IDENTIFICATION / CITATION					TYPE	QUALITY RATING	POPULATION CHARACTERISTICS		INTERVENTION	COMPARISON	FOLLOW UP	OUTCOMES	EFFECT SIZE	FUNDING	COMMENTS
AUTHORS	TITLE	YEAR	JOURNAL	CITATION			NUMBER	PATIENT CHARACTERISTICS							
Wang, H. C.Liaw, Y. S.Yang, P. C.Kuo, S. H.Luh, K. T.	A pseudoepidemic of Mycobacterium chelonae infection caused by contamination of a fibreoptic bronchoscope suction channel	1995	EUROPEAN RESPIRATORY JOURNAL	1259-62	Qualitative research	+	123 patients that had had bronchoscopy screened 76/123 had bronchial washings 21 patients had AFB on smears 18 had m.chelonae subspecies chelonae on cultures of bronchial washings 18 case specimens 30 controls	All had bronchoscopy with same scope during Sept-Dec 1992 at same hospital in Taiwan Case - Isolates of Mycobacterium chelonae from bronchial washing specimens Controls - bronchial washing specimens sent for mycobacterial culture that did not yield chelonae	Investigate the outbreak and eradication of the source of the contamination	Compared environmental samples(below) with bronchoscope washings for same contaminant - local anaesthetic, 14 and 28 day old gluteraldehyde solution, hot and cold water taps in the room where bronchoscopes were cleaned, swab from the disinfection machine, samples of rinsing fluid from four already disinfected bronchoscopes	No further isolates of M chelonae identified in 12 months surveillance	No further positive m.chelonae contamination of bronchoscopes or suction channel. No further pseudo outbreaks Presence of M chelonae in samples taken for comparison	Presence of M chelonae in samples of rinsing fluid from suction channel of four bronchoscopes	Not discussed	Demonstrates how improper decontamination can lead to transmission of infection however some of the recommendations not valid in this country Extensive environmental, personnel and patient investigation to identify source of outbreak led to finding suction channel of bronchoscope to be source. Changes in cleaning by extensive suctioning and application of 70% alcohol through channel led to no further outbreaks
Campagnaro, R. L.Teichtahl, H.Dwyer, B.	A pseudoepidemic of Mycobacterium chelonae: contamination of a bronchoscope and autocleaner	1994	Australian & New Zealand Journal of Medicine	693-5	Qualitative research	+	65	Hospital based, all had bronchoscopy during study period Patient specimens contaminated with MCH	Contamination of bronchoscopes and microbiological specimens	AER BRONCHOSCOPE WATER SUCTION VALVE MCH contaminated specimens from 12 patients with clinical evidence of MCH for these patients	1 year	Samples of sterile saline flushed through bronchoscope and water from tanks of autocleaner and taps from endoscopy suite taken at time of outbreak with samples taken after changes to decontamination process	NOT ADDRESSED No values given. Article comments that no further bronchial wash specimen contamination has occurred since changes to decontamination process. It does not state how many specimens checked post changes	Not discussed	No negative cultures from equipment since changing cleaning methods and dismantling of valves.
Hagan, M. E.Klotz, S. A.Bartholomew, W.Potter, L.Nelson, M.	A pseudoepidemic of Rhodotorula rubra: a marker for microbial contamination of the bronchoscope	1995	Infection Control & Hospital Epidemiology	727-8	Qualitative research	_	11 cases	Hospital based Male 32-76 years 4 pts immunocompromised no pts had clinical history of infection or subsequent positive cultures all had bronchoscopy specimens yielding Rhodotorula rubra	If outbreak R rubra isolated from bronchoscopic specimens is from contaminated bronchoscope	Comparison with samples taken from tip of bronchoscope, connecting port to the wall suction, outside of bronchoscope, teaching head, inner channel, suction port, solutions used for local anesthesia, cleaning solution, and 70% alcohol used to flush the scope after	Follow-up of pt cultures but no time frame given	Article states no further isolates after cleaning methods changed, no dates or specimen no's given	Nil	Not discussed	Investigation of a pseudoepidemic of Rhodotorula rubra from contaminated bronchoscopes, 11 cases reported between Oct. 5th to Nov 22nd 1992. No evidence that remaining patients scoped in that time frame had positive BAL samples or if they did not have samples taken

										cleaning					
Hanson, P. J.Chadwick, M. V.Gaya, H.Collins, J. V.	A study of glutaraldehyde disinfection of fibreoptic bronchoscopes experimentally contaminated with Mycobacterium tuberculosis	1992	JOURNAL OF HOSPITAL INFECTION	137-42	Qualitative research	++	5 bronchoscopes	Bronchoscopes contaminated with Mycobaterium tuberculosis	Eradicating m.tb with glutaraldehyde from contaminated bronchoscope Cleaning and disinfecting methods for bronchoscopes	m.tb levels from cultures from bronchoscope after manual cleaning and 2,5,10,20,30,45 and 60 minutes after decontamination in Gluteraldehyde	N/A	Negative Mycobacterial count	Cleaning in neutral disinfection mean decreased levels of m.tb of 3.5 (SD=0.63, 95% CI=2.72-4.28) Mycobacterial counts at times specified above	MRC DoH KeyMed Surgicos Sanatoriu m Society	Demonstrates cleaning and disinfecting regime that is safe and practical but limited to 1 model of bronchoscope with old model of suction valve outdated study
Mehta, Atul C.Prakash, Udaya B. S.Garland, RobertHapo nik, EdwardMos es, LeonardScha ffner, WilliamSilve stri, Gerard	American College of Chest Physicians and American Association for Bronchology [corrected] consensus statement: prevention of flexible bronchoscopy-associated infection	2005	CHEST	1742-55	Consensus Statement.	++	N/A	N/A	Prevention of Flexible Bronchoscopy Associated Infection	N/A	N/A	N/A	N/A	Support provided by Olympus America,I nc and pentax Corporati on	Good recommendations for cleaning equipment and staff safety during bronchoscopy Recent paper (2005) Summary of data Provides recommendations based on clinical experience and consensus opinion.
Martin, M. A.Reichelder fer, M.	APIC guidelines for infection prevention and control in flexible endoscopy. Association for Professionals in Infection Control and Epidemiology, Inc. 1991, 1992, and 1993 APIC Guidelines Committee	1994	AMERICAN JOURNAL OF INFECTION CONTROL	19-38	Guideline	++	N/A	N/A	Guideline for infection prevention and control in flexible endoscopy	N/A	N/A	N/A	N/A	N/A	Literature review of cleaning/disinfecting bronchoscopes, staff protection and quality control measures in USA. Some recommendations are not generalisable to the UK
Uttley, A. H.Simpson, R. A.	Audit of bronchoscope disinfection: a survey of procedures in England and Wales and incidents of mycobacterial contamination	1994	JOURNAL OF HOSPITAL INFECTION	301-8	Survey questionnaire	+	253 questionnaires	Medical microbiologists and infection control directors throughout England and Wales	Assessment of cleaning /disinfection practices for bronchoscopes number and type of bronchoscopes, workload, staff training and other factors relating to infection control	N/A	N/A	N/A	N/A	Not discussed	Recommends several methods of reducing levels of mycobacterial contamination via bronchoscope. These recommendations are discussed in more recent studies Survey of practice. Whilst most of the points are valid, it recommends manual disinfection which is no longer recommended practice
Cooke, R. P.Whymant-Morris, A.Umasanka r, R.	Bacteria-free water for automatic washer-disinfectors: an	1998	JOURNAL OF HOSPITAL INFECTION	63-5	Qualitative research	+	53 outlet samples 60 BAL samples	Water samples from AWDS tank supply Water samples from AWDS outlet taps All broncheolar lavage	Water filtration system and weekly chemical disinfection of the filtration system	Total colony forming units (CFU'S) from 53 water samples	N/A	Bacteria free rinse water Presence of bacteria in samples	Presence or absence of bacteria in samples	Not disclosed	Study suggests not all water filtration systems produce bacteria free water due to the quality of mains water. This could be a source of

S.Goddard, S. V.	impossible dream?							samples Patient demographics/characteristics not discussed	eliminate the presence of bacteria in samples						contamination in endoscopy autodisinfectors Useful information however current guidelines for water sampling and standards of water supply not discussed
Wheeler, P. W.Lancaster, D.Kaiser, A. B.	Bronchopulmonary cross-colonization and infection related to mycobacterial contamination of suction valves of bronchoscopes	1989	JOURNAL OF INFECTIOUS DISEASES	954-8	Qualitative research	+	8 patients	Bronchial washings specimens contaminated with Mycobacterium	Source of contamination and how to prevent it	Compared mycobacterium levels from bronchoscopy channels of two bronchoscopes and eight suction valves which had been contaminated with M fortuitum and exposed to different types and methods of disinfection	Two years revealed no further episodes of mycobacterial cross contamination	Number of trials yielding positive cultures	None	Not discussed	Study recommends suction valves (non disposable) should be dismantled and manually cleaned prior to being autoclaved to prevent cross-contamination of mycobacterium Limited study, findings apply to this particular type of valve not to newer types more commonly used
Pappas, S. A.Schaaff, D. M.DiCostanzo, M. B.King, F. W., Jr.Sharp, J. T.	Contamination of flexible fiberoptic bronchoscopes	1983	American Review of Respiratory Disease	391-2	Qualitative research	+	187 patients	All patients had bronchoscopy during 11 month period from Sept 1981	Source of mycobacterium chelonei	Compared antimicrobial susceptibility pattern from case isolates versus other isolates within same hospital. Samples are compared with those taken from bronchoscopes, materials used during bronchoscopy and for cleaning and disinfection of the bronchoscopes	No follow-up discussed though describes outcome of two patients	Cultures from bronchoscopes, materials used during bronchoscopy, cultures during cleaning and disinfecting of bronchoscopes Patients positive for m chelonei	None available	Not discussed	Old paper. No improvement in contamination levels despite changes in decontamination methods. Found damage to bronchoscopes, the site of this damage was colonized with m.chelonei and pseudamonis aeruginosa. Unclear where the source of contamination originated.
Fraser, V. J.Jones, M.Murray, P. R.Medoff, G.Zhang, Y.Wallace, R. J., Jr.	Contamination of flexible fiberoptic bronchoscopes with Mycobacterium chelonae linked to an automated bronchoscope disinfection machine	1992	American Review of Respiratory Disease	853-5	Qualitative research	++	14 cases 13 controls	Case is defined as Mycobacterium chelonae isolated from specimen obtained by bronchoscopic washings Control is from M chelonae isolates obtained from elsewhere in the hospital all undergone flexible bronchoscopy or endoscopy between 5/12/1989 and 25/09/1990 in same hospital in Missouri	Contamination of flexible bronchoscopes with m.chelonae linked to auto-disinfector	Compared antimicrobial susceptibility pattern from case isolates versus other isolates within same hospital Comparisons are made between subspecies of isolates from all case patients with controls and samples taken from disinfectants, water, swabs from faucets, sinks and bronchoscopes, disinfectant machines from	Duration of follow-up not stated	Identical strain of m chelonae in case patients after specimens decontaminated and concentrated and the sediment used to prepare acid-fast smears and inoculated onto Lowenstein-Jensen egg-based medium, all examined twice weekly for 8 weeks. Acid fast organisms identified by conventional	No values or confidence intervals provided. Single strain of M chelonae identified in all case isolates, this species also isolated from rinse water collected from the disinfecting machine but not from any other samples taken. No controls matched the outbreak strain.	Grant from national institute of health	Well written paper, describes limitations of automated endoscope Reprocessor, however this is only 1 make/model of Reprocessor. Study identifies importance of adequate cleaning and disinfecting of bronchoscopes to irradicated contamination of m.chelonae. All pars of cleaning process should be monitored and sampled for possible sources of contamination

										bronchoscopy suite and anteroom where the bronchoscopes were disinfected		procedures (not described)			
Leers, W. D.	Disinfecting endoscopes: how not to transmit Mycobacterium tuberculosis by bronchoscopy	1980	CANADIAN MEDICAL ASSOCIATION JOURNAL	275-80	Qualitative research	_	2	Two patients who had bronchoscopy consecutively with the same bronchoscope, both had consolidation in lung	Methods of cleaning and disinfecting endoscopes	Discussion of different disinfectant agents	Not discussed	None	None	Not discussed	Discussion of disinfectant agents. Not appropriate for current cleaning/ disinfecting methods of bronchoscopes
Davis, D.Bonekat, H. W.Andrews, D.Shigeoka, J. W.	Disinfection of the flexible fibreoptic bronchoscope against Mycobacterium tuberculosis and M gordonae	1984	THORAX	785-788	Qualitative research	++	Bronchoscope contaminated on 12 different occasions: six times with M gordonae & six tims with M tuberculosis	Automatic aspiration adaptor cleaning brush manual suction adaptor distal tip of the bronchoscope and its suction channel	If aqueous gluteraldehyde (Cidex) and an iodophor (Prepodyne) eliminate Mycobacterium tuberculosis and M gordonae	Presence of M gordonae and M tuberculosis before contamination, after immersion in inoculating solution and after disinfection.	N/A	Negative cultures after either disinfection	All samples negative after either disinfection. Size of effect not measured. Some confounding factors discussed; delays in disinfecting may be longer than those in study properties of disinfectants failure of disinfection on damaged bronchoscope	Supported in part by the Veterans Administration	Shows suitability of 2 disinfectants. Indicates importance of mechanical cleaning. Discusses effect of disinfection on damaged bronchoscope. Discusses use of sterile water though this is not considered in methodology of study
Prakash, U. B.	Does the bronchoscope propagate infection?	1993	CHEST	552-9	Review paper	+	NA	NA	If bronchoscopes transmit infection	Review of evidence	NA	NA	NA	Not discussed	Study supports other research: rigorous cleaning and disinfecting of bronchoscopes prevents cross infection/contamination of organisms. Suggests rigorous adherence to sterilization and disinfection procedures.
Ramirez, J.Ahmed, Z.Gutierrez, C. N.Byrd Jr, R. P.Roy, T. M.Sarubbi, F. A.	Impact of atypical mycobacterial contamination of bronchoscopy on patient care: Report of an outbreak and review of the literature	1998	Infectious Diseases in Clinical Practice	281-285	Qualitative research	++	193 patient records screened.	All underwent standardised FB over 12 month period, were AFB smear-positive but culture-and PCR-negative bronchial washings	Source of the contaminant	Comparisons made with: lidocaine atomizer, bronchoscopy lens cleaner, various brushes used to clean bronchoscopes, suction and air delivery sites, water from a wall-mounted outlet that supplied water to the automated disinfection machine(ADM) and disinfection machine water reservoir	12 months Subsequent surveillance of next 133 bronchoscopy specimens	AFB smear positive cultures	Presence/absence of AFB smear positive cultures 14/193 patients had AFB identified in washings, 1/14 patient was culture positive Mtb. remaining 13 patients failed to yield mycobacterial organisms	Not discussed	Investigation of bronchoscopy environment, bronchoscopy equipment, rinse water and automated washer identified probable source of contamination from inlet hose and rinse water holding tank of the auto-disinfector
Hernandez,	In-use	2003	The Journal of	46-51	Qualitative	++	1 bronchoscope	The bronchoscope was	To determine the	The bronchoscope	N/A	If no growth	A _> 5 log reduction or	Funded	Study identified that 20 minutes

A.Martro, E.Puzo, C.Matas, L.Burgues, C.Vazquez, N.Castella, J.Ausina, V.	evaluation of Perasafe compared with Cidex in fibreoptic bronchoscope disinfection		hospital infection		research		contaminated 20 times	contaminated on 20 occasions, 10 with M tuberculosis 10 with M avium-intracellulare	efficacy of Perasafe in comparison with Cidex in the disinfection of bronchoscope previously contaminated with mycobacteria in sputum	was sampled for the presence of viable mycobacteria after contamination, after cleaning, after a 10 min disinfection period & after a 20 min disinfection period with Perasafe and the same with Cidex		detected or Log 10 reduction of _> 5 achieved for M avium-intracellulare aftet FB disinfection procedure	negative culture after disinfection	by Tedec-Meiji Farma S.A., Spain	disinfection with Peresafe or Cidex after good manual cleaning and dismantling of bronchoscope parts is effective in removing microorganisms and organic matter from contaminated bronchoscopes
Hanson, P. J.Jeffries, D. J.Batten, J. C.Collins, J. V.	Infection control revisited: dilemma facing today's bronchoscopists. [Erratum appears in BMJ 1988 Aug 6;297(6645):411].[Erratum appears in BMJ 1988 Sep 17;297(6650):73 1]	1988	BMJ	185-7	Review paper	+	NA	NA	Discussion of infection control practices for bronchoscopes	NA	NA	NA	NA	NA	Current guidelines already recommend routine practice that covers all the above
Machado, Alexandre P.Pimenta, Ana Teresa ManciniCont ijo, Paulo P.Geocze, StephanFisc hman, Olga	Microbiologic profile of flexible endoscope disinfection in two Brazilian hospitals	2006	ARQUIVOS DE GASTROENTER OLOGIA	255-8	Qualitative research	+	298 samples	Sample collected from biopsy channels of 40 bronchoscopes, 138 oesophagogastroduoden oscopes and 120 colonoscopes	Evaluation of decontamination processes for flexible endoscopes in two Brazillian hospitals	Compared levels of contaminated samples between 2 different hospitals cleaning practice for endoscopes samples taken after patient examination compared with samples taken after decontamination procedures have taken place	24, 48, 72 hours and 4 weeks	If decontaminatio n procedure reduced the levels of microorganisms found in samples taken after decontaminatio n procedure carried out	Samples post patient use gram –ve bacilli (n=142:56%. Gram +ve bacilli (n=26:10%). 48.32% (72 of 149 samples) post cleaning had microbial growth. Gram –ve bacilli (n=55:62%), gram +ve cocci (n=21:23%), gram +ve bacilli (n=8:9%), yeast cells (n=6:7%) 32% of samples taken after decontamination showed presence of microorganisms	National council of science and technolog y	Levels of mycobacterium in endoscopes cleaned in 2 Brazilian hospitals over a 3 year period. Inappropriate cleaning increased risk of positive cultures. Few bronchoscope samples included, possibly not transferable to bronchoscopy not new evidence
Carricajo, A.Vincent, V.Berthelot, P.Gery, P.Aubert, G.	Mycobacterial cross-contamination of bronchoscope detected by molecular techniques [5]	1999	JOURNAL OF HOSPITAL INFECTION	252-253	Qualitative research Case study	++	1	ICU, hospital based, 68 year female, bronchoscoped. diagnosis of TB	Risk of cross contamination of TB from patient to bronchoscope	Cultures from patient compared with cultures from bronchoscope after 2 wash cycles	Not reported	Microbiological surveillance and staining culture of bronchoscope after 1 wash cycle and again after 2nd cycle	Not available	Not disclosed	Limited study, only 1 participant. Study identifies a method of detecting mtb in contaminated bronchoscopes that may be useful in further studies. Microbiological surveillance proved isolates from bronchoscope and patient were identical
Maloney, S.Welbel, S.Daves, B.Adams, K.Becker,	Mycobacterium abscessus pseudoinfection traced to an automated	1994	JOURNAL OF INFECTIOUS DISEASES	1166-9	Qualitative research	+	18 case specimens from 16 case patients for all endoscopic procedures 16	All had endoscopy or flexible bronchoscopy all mycobacterium abscessus positive specimens during pre-epidemic and	If outbreak of m abscessus is related to contaminated automated endoscope washer	Proportion of endoscopy procedures with positive m.abscessus	Case samples & case patients pre-	Presence of identical banding patterns from cultures from	Fisher exact test, relative risk and 95% confidence intervals calculated m abscessus positive	Not discussed	Study may have had more validity if the same cultures were processed for bronchoscopy and endoscopy procedures as they were

S.Bland, L.Arduino, M.Wallace, R., Jr.Zhang, Y.Buck, G.et al.,	endoscope washer: utility of epidemiologic and laboratory investigation						case specimens from 15 case patients from bronchoscopy procedures	epidemic period		cultures pre epidemic compared with during epidemic case patient and environmental samples compared with samples taken pre-epidemic and from other hospital samples	epidemic period 1 Jan 1991 to 24 march 1992 and epidemic period 25 March to 30 June 1992, no follow up samples analysed	washer inlet water, holding tanks, flexible endoscopes, bronchoscopes, AER, machine filters, multiuse vials for anesthesia.	cultures significantly more likely during endoscopy procedures in the epidemic period compared to pre-epidemic (17/1009 vs 1/3712; P <.001) M abscessus positive cultures more likely during bronchoscopy than gastro-endoscopy more likely in flexible versus rigid bronchoscopes more likely in bronchoscopes disinfected in automated machines versus heat sterilization or manual disinfection		cleaned in the same manner. This may have further supported their evidence that AER was contaminant. Further limitation- does not explain why only one bronchoscope demonstrated m abscesus
Centers for Disease, Control	Nosocomial infection and pseudoinfection from contaminated endoscopes and bronchoscopes--Wisconsin and Missouri	1991	MMWR - Morbidity & Mortality Weekly Report	675-8	Qualitative research	+	1349 from hospital in Wisconsin 6470 from hospital in Missouri	Wisconsin: 240 patients undergoing endoscopic retrograde cholangiopancreatography (ERCP) 1109 patients undergoing other upper gastrointestinal procedures Missouri: M. chelonae positive cultures following bronchoscopy or endoscopy no demographics supplied	Outbreak of nosocomial acquired infection (Wisconsin) and pseudo infection (Missouri) linked to contamination of automated reprocessing machines	Wisconsin: Comparison of Pseudomonas Aeruginosa isolates recovered from reprocessing machine and from infected patients Missouri: Comparison of Mycobacterium chelonae isolates recovered from rinse water from automated reprocessing machines and from infected patients compared rates of infection pre and post changes in cleaning process	No follow-up discussed	Isolates from AER samples respiratory and biliary cultures from patients bronchial washings cultures from scopes Identical isolates recovered from patient and reprocessing machine	Not discussed	Not discussed	Helps identify further research
Bou, R.Aguilar, A.Perpi,x00F,x00E,n, J.Ramos, P.Peris, M.Lorente, L.x00Fa,iga, A.	Nosocomial outbreak of Pseudomonas aeruginosa infections related to a flexible bronchoscope	2006	JOURNAL OF HOSPITAL INFECTION	129-35	Qualitative research	++	67 17 cases / 50 non cases	Hospital ICU. 48 hrs mechanical ventilation. Case pt-p.aeruginosa pneumonia or tracheobronchitis. Non-case pt mechanical ventilation but no p.aeruginosa pneumonia or tracheobronchitis.	Risk factors for developing p.aeruginosa infection in mechanical ventilation patients in ICU	Compared isolates from patients and environment / patients sharing rooms and staff / patients undergoing bronchoscopy / length of mechanical ventilation Comparisons made between items sampled include; Water taps from ICU taps sinks horizontal surfaces in patients immediate area	3 months	Incidence of pseudomonas aeruginosa for study period compared with incidence after recommended changes made, including improvements in cleaning disinfection and maintenance of bronchoscopes	95% confidence interval for recent bronchoscopy and exposure to an infected patient. Risk ratios calculated 58.8% cases shared a room 18% non-cases shared a room 58.8% cases had bronchoscopy (RR 7.3, 95% CI 3.5-14.9, p=0.0001) Patients ventilated >7 days (RR 3.8, 95% CI 1.7-8.4, p=0.0003)	Not disclosed	Limited environmental sampling at outset of study. Well constructed study which supports evidence of possible cross-contamination of infections via bronchoscopes Thorough investigation excluding areas of possible sources of infection not covered by other articles

										inspiratory/expiratory circuits of ventilators humidifiers hand rub antiseptic solutions sterile water and saline used by the bronchoscope water used for manual cleaning and terminal rinsing of endoscopes					
DiazGranados, Carlos A.Jones, Marolyn Y.Kongphet-Tran, Thiphasone White, NancyShapiro, MarkWang, Yun F.Ray, Susan M.Blumberg, Henry M.	Outbreak of Pseudomonas aeruginosa infection associated with contamination of a flexible bronchoscope	2009	Infection Control & Hospital Epidemiology	550-5	Qualitative research	++	11 case patients 8 control patients 18 environmental surfaces 5 culture specimens from external surfaces of each bronchoscope	Case patients were all individuals exposed to a particular bronchoscope (B1) during cluster period, June - July 2007 with a culture of a bronchoscopically obtaind specimen that yielded P aeruginosa with a unique susceptability pattern Controls had p aeruginosa but did not meet above criteria	p.aeruginosa infection from contaminated bronchoscope	Compared cultures from bronchoscopes with positive culture for p.aeruginosa from case patients	Retrospective study, no follow up	Positive p.aeruginosa cultures from bronchoscope washings and swabs, bronchoscopy suite environment (sinks, surfaces). No further positive cultures once contaminated scope removed from service.	N/A	The Grady Memorial Hospital Epidemiology Laboratory	Well written paper. Outbreak of p.aeruginosa in patients after bronchoscopy and BAL. Microbiology indicated 1 bronchoscope as source of outbreak. When returned to manufacturers this scope was found to be damaged, limiting disinfectant process
Richardson, A. J.Rothburn, M. M.Roberts, C.	Pseudo-outbreak of Bacillus species: related to fibreoptic bronchoscopy	1986	JOURNAL OF HOSPITAL INFECTION	208-10	Qualitative research	+	14 bronchial washings: 6 from Oct 1984 - Jan 1985 8 from Mar 1985	All had bronchoscopy and washings in treatment room between Oct 1984-March 1985 All specimens from bronchial washings isolated Bacillus spp	Source of outbreak of Bacillus spp	First 6 samples compared with bronchoscopes, bronchial forceps, gluteraldehyde solution used for disinfecting bronchoscopes and sterile traps used for collecting bronchial washings also rooms and cupboards where bronchoscopes stored. Further 8 samples compared with tap water used to irrigate bronchoscopes after disinfection, suction ports on bronchoscope	No follow-up	Presence of Bacillus spp isolated from room and cupboards used to store bronchoscopes, also tap water and bronchoscope suction port.	Not discussed	Not discussed	Old paper. Cleaning methods and bronchoscopes no longer used in UK Letter is written in response to article by Goldstein & Abrutyn, describes findings from 1984/5 which predates current guidelines. Although it highlights important factors these are addressed in current guidelines when they are properly adhered to.
Goldstein, B.Abrutyn, E.	Pseudo-outbreak of Bacillus species: related to fibreoptic bronchoscopy	1985	JOURNAL OF HOSPITAL INFECTION	194-200	Qualitative research	++	8 case patients 14 controls	Hospital based. Had rigid or flexible bronchoscopy. Case pts +ve cultures from bronchoscopy Non-case pts –ve cultures from bronchoscopy	Pseudo-infection of bacillus spp from contaminated bronchoscopes	Pts with +ve cultures compared with pts with –ve cultures compared rates of +ve cultures between surgical,	7 days	Rate of +ve cultures for bacillus spp pre and post improved cleaning and dismantling of	Increase in +ve cultures from may-june compared with july-aug p= <0.05 rate of +ve cultures during outbreak compared with those post	Not disclosed	Well written paper Highlights importance of dismantling valves and effective decontamination practices ? Would support the use of single use valves many confounding factors considered

										pulmonary and ENT procedures		suction valves and borrowing equipment	intervention p=<0.01		but 1 constant, flexible bronchoscope loaned from pulmonary team to ENT, appeared to be source of contamination. Contaminated, poorly cleaned suction valve can lead to pseudo-infection.
Kolmos, H. J.Lerche, A.Kristoffersen, K.Rosdahl, V. T.	Pseudo-outbreak of pseudomonas aeruginosa in HIV-infected patients undergoing fiberoptic bronchoscopy	1994	SCANDINAVIAN JOURNAL OF INFECTIOUS DISEASES	653-7	Qualitative research	+	8	All had HIV. Washings for PCP, mycobacterium and fungi, all had positive pseudomonas aeruginosa sample from broncho-alveolar lavages between 5 and 20 february 1991	If pseudomonas aeruinosa came from contaminated bronchoscopes.	Compared microbiological BAL samples from Nov 1990-May 1991	3 months	Cultures from swabs from 2 bronchoscopes, rinse water and BAL's. Levels of mycobacteria in these samples over a 7 month period	N/A	Not disclosed	Small study outbreak of pseudomonas aeruginosa from contaminated bronchoscope channels Small study but supports other evidence
Kennedy, M.	Pseudoepidemic of Rhodotorula rubra in patients undergoing fiberoptic bronchoscopy	1990	Infection Control & Hospital Epidemiology	334	Qualitative research	+	N/A	N/A	Bronchoscope disinfection times when using gluteraldehyde	N/A	N/A	N/A	N/A	N/A	Dispute over length of bronchoscope contact time with 2% glutaraldehyde to irradicate mycobacterium. Argues against Hoffmans claims that 20 minutes is long enough Letter states concerns re times of immersion in disinfect and use of a reference. Reply notes other publications that corroborate the 20 minute immersion time suggested in the original article, and why reference 'Draft Guidelines for selection and use of disinfectants' was used
Hoffmann, K. K.Weber, D. J.Rutala, W. A.	Pseudoepidemic of Rhodotorula rubra in patients undergoing fiberoptic bronchoscopy	1989	Infection Control & Hospital Epidemiology	511-4	Qualitative research	++	56 30 positive samples for Rhodotorula rubra 26 negative samples for Rhodotorula rubra	All had FB and washings at North Carolina Hospital between March and June 1988	The source of comtamination of a pseudoepidemic of rhodotorula rubra	Comparisons are made between 30 environmental samples	No evidence of fungal pneumonia after 90 days. No additional cases identified over six month period after changes in decontamination process changed	Samples positive for R rubra	Positive cultures after control measures implemented compared with similar 3 month period: Outbreak 30/56 After control measures implemented 1/45 p <0.01	North Carolina Division of Health Services, Department of Human Resources	Out-dated cleaning methods. No longer use re-usable cleaning brushes and now use sterile rinse water. Good quality paper No new evidence
Sammartino, M. T.Israel, R. H.Magnussen, C. R.	Pseudomonas aeruginosa contamination of fibreoptic bronchoscopes	1982	JOURNAL OF HOSPITAL INFECTION	65-71	Qualitative research	+	19 bronchial washings during outbreak period 38 bronchial washings from preceding 8 months	Bronchial wash samples	To determine the source of outbreak of Pseudomonas aeruginosa	Retrospective analysis of number of positive p.aeruginosa washings during outbreak with number of positive p.aeruginosa pre	72 hours	Culture samples from bronchial washes, culture samples from various parts of bronchoscope. Signs, symptoms and CXR changes	Ps aeruginosa found in 11/19 (60.5%) of samples in outbreak period and 2/38 (5.2%) of samples taken in previous 8 months. P<0.001	Not discussed	Sampled cultures from all parts of bronchoscope pre and post changes in decontamination methods. Negative cultures found after cleaning bronchoscope with ethylene oxide gas sterilization. Pre dates automated washer

										outbreak Cultures from following compared: Insertion tube, inner channel of the insertion tube, inner and outer cannula of the aspiration adaptor, biopsy forceps, bronchial brush, normal saline, lidocaine jelly, "Betadine" disinfectant, isopropyl alcohol, disinfectant basin and the hands of the bronchoscopist and technician		of chest infection 72 hours post bronchoscopy Presence of Ps aeruginosa of the same serotype found in the aspiration-irrigation channel of the bronchoscope and the inner and outer cannula of the aspiration adaptor			decontamination Guidelines for decontamination have been reviewed and changed since this article. The methods used in this article are not now recommended
Hanson, P. J.Gor, D.Clarke, J. R.Chadwick, M. V.Gazzard, B.Jeffries, D. J.Gaya, H.Collins, J. V.	Recovery of the human immunodeficiency virus from fibreoptic bronchoscopes	1991	THORAX	410-2	Qualitative research	+	10	All had acquired immunodeficiency syndrome Bronchoscopes used for diagnostic bronchoscopy on patients with pulmonary manifestations of AIDS	Contamination of bronchoscopes from HIV infected patients	Compared isolates and swabs from 10 bronchoscopes after contamination with HIV, post detergent wash and post auto disinfection	No follow-up	Microbiological cultures viral swabs Detection of; HIV Streptococcus viridans Streptococcus epidermidis Pneumocystis carinii Neisseria spp Staphyloccocus aureus Coliform bacteria HBsAg	Mean ranges of bacteria and PC strep. viridans 3.64 (1.0-8.0) strep epidermidid 2.07 (1.7-2.6) p.carinii 1.18 (1.0-1.3) neisseria spp 3.53 (2.9-6.0) coliform bacteria 3.00 (-) Microorganisms were found on bronchoscopes tested immediately post bronchoscopy. No microorganisms were found after cleaning with neutral detergent or disinfection P values and confidence intervals not available due to small number of bronchoscopes tested	DOH, MRC, Keymed, Surgikos, Sanatorium Society	Small study numbers but highlights the essential practice of pre-cleaning bronchoscope after every procedure and not delaying this practice. Not all sampling techniques available for all scopes therefore some missing data. Detergent and disinfection cleaning removes all HIV from scopes
Mughal, M. M.Minai, O. A.Culver, D. A.Mehta, A. C.	Reprocessing the bronchoscope: The challenges	2004	Seminars in Respiratory and Critical Care Medicine	443-449	Qualitative research	++	N/A	N/A	Prevention of bronchoscopy induced infection	N/A	N/A	N/A	N/A	None discussed	Guidelines available but not always complied with which can lead to cross infection during bronchoscopy procedures. All health care personnel should be aware of guidelines and should adhere to them to prevent spread of infection to patients.
Whitlock, W. L.Dietrich, R. A.Steimke, E. H.Tenholder, M. F.	Rhodotorula rubra contamination in fiberoptic bronchoscopy	1992	CHEST	1516-9	Qualitative research	+	15	Bronchoscopic samples revealed Rhodotorula rubra	Source of contamination and methods of decontamination	Review of specimen handling and culture procedures within the microbiology laboratory. Cultures obtained from bronchoscopy suites desk top,	Three years	Recovery of R rubra in any of comparison cultures	No comparison cultures revealed R rubra	Not discussed	Disinfection protocol not in line with current guideline as it suggests manual disinfection.

										sinks, faucets, cleaning basins, disinfecting solutions, also with cultures from bronchoscope distal tip, suction port, and biopsy channel port, scrapings from the palms of the bronchoscopists					
Spach, D. H.Silverstein , F. E.Stamm, W. E.	Transmission of infection by gastrointestinal endoscopy and bronchoscopy	1992	ANNALS OF INTERNAL MEDICINE	117-128	Review paper	+	N/A	All had bronchoscopy or endoscopy	To determine common infecting microorganism in flexible endoscopy, circumstances of transmission and methods of risk reduction	N/A	N/A	N/A	N/A	Not disclosed.	Highlighted importance of manual cleaning and dismantling of scopes and accessories to reduce risk of contamination / cross infection. Also discussed various cleaning methods of endoscopes / bronchoscopes to eliminate a variety of contaminants. Highlights various sites on endoscopes and bronchoscopes that can harbor material. 4 issues remain regarding disinfecting of bronchoscopes including flaws in automated disinfectors, instrument design and lack of compliance with cleaning guidelines Review of literature, 265 articles from 1966 to 1992
Nelson, K. E.Larson, P. A.Schraufnagel, D. E.Jackson, J.	Transmission of tuberculosis by flexible fiberbronchoscopes	1983	American Review of Respiratory Disease	97-100	Qualitative research	+	20 patients from surveillance group, hospital A 3 patients from hospital B	Hospital A: all had bronchoscopy with same bronchoscope Hospital B:3 patients had bronchoscopy with same instrument	Efficacy of a variety of iodophors and other chemical disinfectants in killing mycobacterioum tuberculosis	Compared culture results from bronchoscopes after disinfection in various preparations and after 10, 20 and 30 minute soaks Hospital A: 1st patient had tuberculosis, the following 19 patients evaluated for tuberculosis Hospital B: cultures from bronchoscopic aspirates compared for tuberculosis	6 months	Bronchoscope post cleaning Mtb cultures. Clinical signs/symptoms of Mtb in patients. Sputum cultures zn stain. Skin tests for Mtb Hospital A & B if patients developed tuberculosis	N/A	Not discussed	Surveillance of Mtb cultures post bronchoscope disinfection in a variety of preparations, for various lengths of 'soak' time failed to irradicate Mtb from contaminated scopes. Study did not test channels, valves and accessory equipment for source of contamination

STUDY IDENTIFICATION / CITATION					TYPE	QUALITY RATING	POPULATION CHARACTERISTICS		INTERVENTION	COMPARISON	OUTCOMES	EFFECT SIZE	FUNDING	COMMENTS
AUTHORS	TITLE	YEAR	JOURNAL	CITATION			NUMBER	PATIENT CHARACTERISTICS						
Loddenkemper, R.Schaberg, T.Mai, J.	Bronchial evaluation of peripheral localised lung lesions: Accuracy of different biopsy techniques	1983	European Journal of Respiratory Diseases	461-464	Qualitative research	_	30 patients	Patients with peripheral, bronchoscopically invisible tumours.	Diagnostic accuracy of fluoroscopically guided bronchoscopy for peripheral lung lesions.	Observation study	Diagnostic yield. Poorly defined study, although the study explains that those patients with negative results from this procedure (50%) had a diagnosis made through non EBUS TBNA, percutaneous needle aspiration and resection of lesion.	Not stated	Not reported	Poorly defined study, although the study explains that those patients with negative results from this procedure (50%) had a diagnosis made through non EBUS TBNA, percutaneous needle aspiration and resection of lesion.
Velardocchio, J. M.Boutin, C.Irisson, M.	Broncho alveolar lavage in diffuse lung diseases, comparison with transbronchial and thoracoscopic lung biopsy	1983	European Journal of Respiratory Diseases	457-458	Qualitative research	_	32 patients	Probable diagnosis of diffuse lung disease	Qualitative research	Diagnosis of diffuse lung disease	Diagnostic rate	TBLB diagnostic in 4 out of 7 patients with sarcoidosis.	Not reported	The study showed that TBLB was diagnostic in 4 out of 7 patients with sarcoidosis.
Hsu, C.	Cytologic diagnosis of lung tumors from bronchial brushings of Chinese patients in Hong Kong	1983	ACTA CYTOLOGICA	641-6	Qualitative research	_	1016 patients	The diagnostic yield from cytology (brushings and washings).	Qualitative research – Brushings and washings during FB.	The diagnostic yield from cytology (brushings and washings).	Diagnostic accuracy	Bronchial washings and brushings yielded a positive result of malignancy in 15.5% and 24% respectively. Combining techniques gave a yield of 32. Cytology was positive in 204 out of 245 histologically confirmed cases.	Not reported	This study demonstrates that bronchial washings and brushings yielded a positive result of malignancy in 15.5% and 24% respectively. Combining techniques gave a yield of 32. Cytology was positive in 204 out of 245 histologically confirmed cases. This study however is limited to a Chinese population (cases were exclude on this basis).
Buccheri, G.Barberis, P.Delfino, M. S.	Diagnostic, morphologic, and histopathologic correlates in bronchogenic carcinoma. A review of 1,045 bronchoscopic examinations	1991	CHEST	809-14	Qualitative research	+	1045 patients with a suspected diagnosis of lung cancer	Median age, 63 years; range, 34 to 87 years; and M/F sex ratio, 8/1 (930 male patients and 115 female patients). In all, 782 pathologic diagnoses were available. Figure 2 shows the overall	Qualitative research	Correlation between tumour location and histology The use of different diagnostic techniques	Forceps biopsies were positive in 79% of the 841 performed biopsies (64% of the entire sample); brushings were positive in 38 percent of 372 biopsies (14% of all patients); and washings were positive in 32% of 1,009 biopsies (31% of 1,045). More than one positive finding occurred in 309 bronchoscopies out of 1 ,045 (30%).	Forceps biopsies, brushings, and washings were positive in 79%, 38%, and 32% of the obtained specimens, respectively. Bronchoscopically, squamous and small-cell carcinomas were more often visualized as central tumor-like lesions, which were better diagnosed by forceps biopsies. Adenocarcinomas, on the contrary, were more frequently peripheral and showed infiltrative, compressive, or nonspecific findings. In these latter tumors, cytology studies were more fruitful. Large-cell anaplastic carcinomas	Not reported	The authors conclude that squamous cell and small cell cancers were more often located centrally and therefore visible endoscopically, furthermore, forceps biopsy gives the highest yield and therefore several samples should always be taken.

												had an intermediate behaviour.		
Cox, I. D.Bagg, L. R.Russell, N. J.Turner, M. J.	Relationship of radiologic position to the diagnostic yield of fiberoptic bronchoscopy in bronchial carcinoma	1984	CHEST	519-22	Qualitative research	_	100 patients with a diagnosis of lung cancer	Of the 100 patients in the series, 33 had hilar masses, 45 had perihilar masses, and 22 had peripheral masses on the basis of their radiologic classification.	Qualitative research	The use of bronchoscopy in diagnosing tumor when divided into peripheral, hilar and perihilar in position on chest radiograph.	Diagnostic accuracy overall of 73%	At bronchoscopy without fluoroscopy, only eight (36 percent) of 22 radiologically peripheral tumors were diagnosed, compared with 31 (94 percent) out of 33 hilar tumors (p less than 0.001) and 34 (76 percent) out of 45 perihilar tumors (p less than 0.01).	Not reported	The diagnostic yield was lower in peripheral tumors and in these cases fluoroscopic guidance may be useful.
Aleva, R. M.Kraan, J.Smith, M.ten Hacken, N. H.Postma, D. S.Timens, W.	Techniques in human airway inflammation: quantity and morphology of bronchial biopsy specimens taken by forceps of three sizes	1998	CHEST	182-5	Qualitative research	_	30 patients	Non-asthmatic subjects	Qualitative research	A comparison of 3 different sized biopsy forceps on the size and quality of mucosal samples.	Specimen quality with different sized forceps	Bronchial biopsy specimens obtained with forceps type FB-35C and FB-21C were equal in size, but the FB-35C biopsy specimens showed more damage and crush artifacts, whereas biopsy specimens obtained with forceps type FB-21C had more intact basement membrane, more sub mucosal depth, and well-preserved morphology.	Not reported	This is a study of the best size of forceps to use, the results are inconclusive. The size of biopsy sample was significantly different between 2 of the forceps only, furthermore this did not affect the quality of immunostaining. The authors conclude that the largest forces produce the same size material as the medium sized forceps but the quality of the material is better, however larger studies are required.
Chau, C. H.Yeu, W. W.Wong, P. C.Lee, J.Wong, C. F.	Usefulness of collecting routine cytologic specimens during fiberoptic bronchoscopy for endoscopically visible and nonvisible lung carcinoma	1997	CHEST	522-3	Qualitative research	_	329 diagnosed lung cancers		Qualitative research	Usefulness of collecting cytological samples in the diagnosis of lung cancer	Diagnostic yield	The increase in yield when routine cytology examination of bronchial washings and brushings was practiced in addition to transbronchial forceps biopsies was found to be 34.5%, 34.2%, and 29.1%.	Not reported	The authors conclude that cytological procedures do significantly increase the yield in endoscopically invisible tumours and should therefore be collected.
Potdar, P. V.Jain, K.Prabhakaran, L.Kamat, S. R.	Value of bronchoalveolar lavage in interstitial lung diseases	1989	JOURNAL OF THE ASSOCIATION OF PHYSICIANS OF INDIA	444-7	Qualitative research	+	58 patients with interstitial lung disease and 30 controls		Qualitative research	Use of BAL in diagnosing interstitial lung disease	Overall and differential cell counts between group		Not reported	BAL is an additional useful tool in the diagnosis of ILD, but can not be used to differentiate between ILDs and can not stage the disease.
van der Drift, Miep A.van der Wilt, Gert-JanThunnissen, Frederik B. J.	A prospective study of the timing and cost-effectiveness of bronchial washing during bronchoscopy	2005	CHEST	394-400	Diagnostic Accuracy	+	281 patients in total. 137 patients with endobronchial malignancy	Mean age 65.6 years; age range 38 to 88 years; 147 men and 74 women	Diagnostic Accuracy	Bronchial washings prior or after biopsies and brushings	Difference in the diagnostic yield for washings before or after biopsies and brushings. Washings before biopsy and brushing (strategy I) and	The diagnostic yield of strategy I was 72% for visible tumors and 36% for nonvisible tumors. For strategy II, the diagnostic yield was 74% for visible tumors and in 42% for nonvisible tumors. The	Not reported	The study showed that there was no difference in diagnostic yield for washings before or after bronchoscopy and brushings. The additional yield for washings and brushings was relatively low.

M.Janssen, Julius P.	for pulmonary malignant tumors										after biopsy and brushing (strategy II)	comparison of strategies I and II for both visible and nonvisible tumors revealed that 176 cases were concordant (80%); in 19 cases (9%) the cytologic analysis of washings in strategy I was positive for malignancy and negative in strategy II. In 26 cases (12%) washings in strategy II were positive and negative in strategy I (p = 0.37). An analysis of the diagnostic yield of both washings in visible tumors and nonvisible tumors showed no significant difference.		The study included a cost-effectiveness analysis and concluded that it is cost-effective to use washings and brushings, particularly if their analysis is confined to when biopsy is negative
Bungay, H. K.Pal, C. R.Davies, C. W.Davies, R. J.Gleeson, F. V.	An evaluation of computed tomography as an aid to diagnosis in patients undergoing bronchoscopy for suspected bronchial carcinoma	2000	CLINICAL RADIOLOGY	554-60	Diagnostic Accuracy	+	62	46 men, 16 female, mean age 70 years (49-86)	Diagnostic Accuracy	the use of CT in guiding the diagnostic accuracy of bronchoscopy	The use of CT in guiding the diagnostic accuracy of bronchoscopy	Diagnostic accuracy 82%	Not reported	100% suspected of having bronchogenic carcinoma This study predates the recommendation of performing a CT prior to bronchoscopy, which most units do currently.
Puar, H. S.Young, R. C., Jr.Armstrong, E. M.	Bronchial and transbronchial lung biopsy without fluoroscopy in sarcoidosis	1985	CHEST	303-6	Diagnostic Accuracy	+	68 patients with clinical and radiological evidence of sarcoidosis underwent TBLB between 1979 and 1981 in a single institution	22 men and 45 women; 12 patients radiographic stage 1, 41 patients stage 2, 7 stage 3 and 7 stage 4.	Diagnostic Accuracy	Transbronchial lung biopsy	Evaluation of endobronchial and transbronchial biopsy in patients with a clinical diagnosis of sarcoidosis	76% of patients with sarcoidosis had non-caseating granulomata demonstrated on transbronchial or endobronchial biopsy.	Not reported	This is a single center experience of TBLB in patients with various radiographic stages of sarcoidosis and without fluoroscopy. Only 1 patient had a pneumothorax requiring intercostal drainage. Sensitivity of the technique in patients with a high pre-test probability of sarcoid was 76%
Matsuda, M.Horai, T.Nakamura, S.Nishio, H.Sakuma, T.Ikegami, H.Tateishi, R.	Bronchial brushing and bronchial biopsy: comparison of diagnostic accuracy and cell typing reliability in lung cancer	1986	THORAX	475-8	Diagnostic Accuracy	+	443		Diagnostic Accuracy	Bronchial brushings and bronchial biopsy	The diagnostic accuracy of bronchial brushing and biopsy in patients diagnosed with lung cancer	Brushing had a sensitivity of 90%, while biopsy had a sensitivity of 65%	Not reported	The relatively low yield of 65% from bronchial biopsy in this study may be explained by the fact that only 1 bronchial biopsy was taken per patient.
Cazzato, S.Zompatori, M.Burzi, M.Baruzzi, G.Falcone, F.Poletti, V.	Bronchoalveolar lavage and transbronchial lung biopsy in alveolar and/or ground-glass opacification	1999	MONALDI ARCHIVES FOR CHEST DISEASE	115-9	Diagnostic Accuracy	+	36	17 male, 19 female, mean age 53 years	Diagnostic Accuracy	Utility of BAL and TBLB in the diagnosis of GGS	The diagnostic accuracy of BAL and TBLB in ground glass shadowing	The diagnostic yield for TBLB for GGS only is 36%	Not reported	100% of patients with ground glass shadowing (GGS) on HRCT TBLB and BAL combined give a high diagnostic yield in GGS. In areas of consolidation the yield of TBLB is higher compared to BAL alone. The diagnostic yield for TBLB for GGS only is 36% compared to 95% for consolidation. The

														authors conclude HRCT is udeful in predicting the diagnostic accuracy of TBLB and BAL.
Rennard, S. I.Spurzem, J. R.	Bronchoalveolar lavage in the diagnosis of lung cancer	1992	CHEST	331-2	Diagnostic Accuracy	_	35 patients with lung cancer		Diagnostic Accuracy	Bronchoalveolar lavage	To determine if bronchoalveolar lavage is useful in diagnosing malignancy	BAL was positive in 24 (68.6%) of patients who already had a histological diagnosis of lung cancer. 6/50 BAL samples in patients with Hodgkin's disease demonstrated Reed Sternberg cells and 7/20 breast cancer patients demonstrated malignant cells on BAL.	Not reported	Insufficient data on the characteristics of patients included in the study. This retrospective review demonstrated that BAL was positive in 24 (68.6%) of patients who already had a histological diagnosis of lung cancer. Its role in the primary diagnosis of lung cancer is not clarified by this study.
Lachman, M. F.Schofield, K.Cellura, K.	Bronchoscopic diagnosis of malignancy in the lower airway: A cytologic review	1995	ACTA CYTOLOGICA	1148-1151	Diagnostic Accuracy	+	269 bronchoscopic specimens over a six year period.		Diagnostic Accuracy	Bronchoscopy brushings	The utility of bronchial brushings in increasing diagnostic yield during bronchoscopy		Not reported	The authors conclude that brushings in addition to biopsies during bronchoscopy increases the diagnostic sensitivity of the procedure from 82% to 92%.
Chechani, V.	Bronchoscopic diagnosis of solitary pulmonary nodules and lung masses in the absence of endobronchial abnormality	1996	CHEST	620-5	Diagnostic Accuracy	+	49 patients (51 procedures)		Diagnostic Accuracy	The use of bronchoscopic procedures in the diagnosis of SPNs with fluoroscopic guidance	To determine the diagnostic yield of individual sampling techniques and the additive yield of these techniques	Overall diagnostic yield 73%.Bronchial washings were diagnostic in 35%, brushings in 52%, TBLB 57% an TBNA 51%.	Not reported	The authors conclude that FOB is useful in the diagnosis of SPNs, however diagnostic yield is affected by location, size and character of lesion and that bronchial washings are the least useful procedure.
Bango, A.Luyando, L.Pandiella, J. R.Molinos, L.Ramos, S.Escudero, C.Martinez, J.	Bronchoscopic needle aspiration and biopsy of paratracheal tumors and hilar and mediastinal lymph nodes: Security yield and cost-effectiveness	2003	Journal of Bronchology	183-188	Diagnostic Accuracy	+	58 patients	45 Male, 13 Female	Diagnostic Accuracy	Bronchoscopic needle aspiration	To determine the diagnostic yield of bronchoscopic needle aspirated histology and cytology needles in para-tracheal tumours and hilar and mediastinal lymph nodes	Bronchoscopic needle aspiration had a diagnostic yield of 86% and sensitivity of 94%, with a specificity of 100%	Not reported	Bronchoscopic needle aspiration is a useful technique to diagnose paratracheal/hilar and mediastinal tumours and avoided a surgical procedure in 67%.
Boghani, A.Sambare, D.	Brush cytology as a diagnostic aid for bronchogenic carcinoma	1991	Indian Journal of Chest Diseases & Allied Sciences	19-23	Diagnostic Accuracy	+	125 patients		Diagnostic Accuracy	Diagnostic yield of bronchial brushings	The utility of bronchial brushings in diagnosing lung cancer		Not reported	Of the 125 patients 74 were suspected of having a diagnosis of lung cancer. The authors conclude that their yield for endobronchial visible tumours was 82% (including cases of adenoma and dysplasia) with bronchial brushing and that it is therefore a useful diagnostic

														tool98 of 109
Bilaçeroğlu S, Perim K, Günel O, Cağirici U, Büyükşirin M	Combining transbronchial aspiration with endobronchial and transbronchial biopsy in sarcoidosis	1999	MONALDI ARCHIVES FOR CHEST DISEASE	217-23	Diagnostic Accuracy	++	74	Mean age 36.7 years, range 19-64. 29 females.	Diagnostic Accuracy	Diagnostic utility of using TBNA, EBB and TBLB for stage I and II disease and EBB and TBLB in stage III disease.	Diagnostic utility of using TBNA, EBB and TBLB for stage I and II disease and EBB and TBLB in stage III disease.	Of all 3 techniques used in combination 90% TBNA alone 53% EBB 52% TBLB 64%	Not reported	74 patients suspected of having sarcoidosis undergoing flexible bronchoscopy The used of combined techniques in sarcoid leads to a higher diagnostic yield. EBB+TBLB gives a higher diagnostic yield in stage III compared to their use in stage I and II, therefore all 3 techniques should be used in stage I and II.
Bilaçeroğlu S, Bilaçeroğlu S, Günel O, Cağirici U, Perim K	Comparison of endobronchial needle aspiration with forceps and brush biopsies in the diagnosis of endobronchial lung cancer	1997	MONALDI ARCHIVES FOR CHEST DISEASE	13-17	Diagnostic Accuracy	++	151	122 males, mean age 51+/-6 years 29 females, mean age 46+/-7 years	Diagnostic Accuracy	The comparisons of the diagnostic utility of endobronchial needle aspiration (EBNA) using a TBNA needle, forceps biopsy (FB) and brush biopsy (BB) in suspected endobronchial lung cancer lesions.	A comparison of EBNA, Forceps biopsy and brush biopsy in the diagnosis of lung cancer	Patients were divided in to 2 groups, group 1: those who underwent EBNA and BB and group 2: those who had EBNA and FB. In group1 diagnostic yield was higher with both techniques (96%) compared to either technique alone (EBNA 90% *vs.* BB 66%). In group 2, once again diagnostic yield was higher using both techniques (100%), compared to EBNA alone (92%) or FB alone (78%).	Not reported	151 suspected of lung cancer with an endobronchial lesion EBNA is a useful diagnostic technique where FB may be difficult to perform (by worsening respiratory distress, or cause crush artifact). However, it is not a widely used technique in the UK.
Lundgren, R.Bergman, F.Angstr,x00F,m, T.	Comparison of transbronchial fine needle aspiration biopsy, aspiration of bronchial secretion, bronchial washing, brush biopsy and forceps biopsy in the diagnosis of lung cancer	1983	European Journal of Respiratory Diseases	378-85	Diagnostic Accuracy	+	59 patients	48 Male:11 Female Age 42-77 years	Diagnostic Accuracy	A comparison of diagnostic yield from transbronchial fine needle aspiration, aspiration of bronchial secretions, bronchial washings, forceps biopsy and brush biopsy.	To determine the differences in diagnostic yield TBNA, bronchial washings, aspiration of bronchial secretions, biopsy and brushing	88% combining all procedures. CI not reported.	Not reported	This study demonstrates that the combination of a forceps biopsy and bronchial washing produces significantly more sensitive in diagnosing lung cancer than any other combination of procedures or single method alone ($p<0.05$)
Mazuranic, I.Ivanovi-Herceg, Z.	Complementariness of the radiological finding and transbronchial lung biopsy for definitive diagnosis of diffuse interstitial lung	1996	Radiology and Oncology	89-94	Diagnostic Accuracy	+	52 cases	27 women and 25 men, age 16-76	Diagnostic Accuracy	Diagnostic yield from TBLB	Diagnostic yield from TBLB	51% of samples were adequate in diagnosing diffuse interstitial lung disease.	Not reported	52 patients suspected of diffuse interstitial lung disease. This is a difficult study to interpret. All the patients were anaesthetized for a rigid bronchoscopy and flexible bronchoscopy. The result are difficult to interpret, the results seem to suggest that TBLB would allow a

	diseases													diagnosis of interstitial lung disease in 51% of the patients.
Bilagerou, S.Kumcuo,lu, Z.Alper, H.Osma, E.Ca,irici, U.x00Fc,nel, O.Bayol, U.Celikten, E.Perim, K.x00F,se, T.	CT bronchus sign-guided bronchoscopic multiple diagnostic procedures in carcinomatous solitary pulmonary nodules and masses	1998	RESPIRATION	49-55	Diagnostic Accuracy	+	92 patients	74 male, 18 females, mean age 51 years (range 32-78)	Diagnostic Accuracy	The use of CT bronchus sign to guide bronchoscopy and the use of combined diagnostic techniques.	This study prospectively investigated the use of the CT bronchus sign (i.e. a bronchus directly leading to a peripheral pulmonary lesion, in the diagnostic yield of solitary pulmonary lesions	In patients with CT bronchus sign the overall diagnostic yield was 68% and 44% in those without the bronchus sign.	Not reported	The combination of multiple diagnostic procedures increases diagnostic yield during bronchoscopy. The use of the CT bronchi's sign may increase this yield further.
Zellweger, J. P.Leuenberger, P. J.	Cytologic and histologic examination of transbronchial lung biopsy	1982	European Journal of Respiratory Diseases	94-101	Diagnostic Accuracy	+	167 patients	43 females, 124 males aged 22-77	Diagnostic Accuracy	Transbronchial lung biopsy (TBLB)	The diagnostic accuracy of TBLB in diffuse interstitial lung disease	The diagnostic yield was 62.3% of cases, diagnostic yield was highest in diffuse orders such as sarcoidosis and lowest in those with solitary pulmonary nodules.	Not reported	The diagnostic yield in the study was 62.3%. In this study TBLB provided samples of lung parenchyma in 85.6%, the diagnostic in the population was 62.3%. The histological diagnostic yield was higher in diffuse interstitial infiltrates (75.6%) and sarcoidosis (73.5%). The complication rate of the procedure was low (3.6%) with bleeding and pneumothorax being most common.
Popovich, J., Jr.Kvale, P. A.Eichenhorn, M. S.Radke, J. R.Ohorodnik, J. M.Fine, G.	Diagnostic accuracy of multiple biopsies from flexible fiberoptic bronchoscopy. A comparison of central versus peripheral carcinoma	1982	American Review of Respiratory Disease	521-3	Diagnostic Accuracy	+	46 patients	26 patients with centrally visible measures and 20 peripheral nodules.	Diagnostic Accuracy	The number of biopsies taken by cup-shaped forceps required for a diagnosis of cancer.	The diagnostic yield from 6 consecutive forceps biopsies in patients with suspected lung cancer	For central lesions the diagnostic yield was 73% and 36% for peripheral lesions. In central lesions 73% of diagnoses were achieved with one biopsy for peripheral lesions diagnosis was only achieved in 45% with 1 biopsy.	Not reported	The authors conclude the probability of a positive biopsy result with 2 biopsies is 93% and increases to 99% with four biopsies.
Jay, S. J.Wehr, K.Nicholson, D. P.Smith, A. L.	Diagnostic sensitivity and specificity of pulmonary cytology: comparison of techniques used in conjunction with flexible fiber optic bronchoscopy	1980	ACTA CYTOLOGICA	304-12	Diagnostic Accuracy	+	224 consecutive patients.	224 patients with clinical or radiological signs suggestive of lung cancer	Diagnostic Accuracy	Cytologic examinations: bronchial washings, brushings and pre and post bronchoscopy sputa.			Not reported	31% of patients suspected of lung cancer had a final diagnosis of lung cancer.

Popp, W.Rauscher, H.Ritschka, L.Redtenbacher, S.Zwick, H.Dutz, W.	Diagnostic sensitivity of different techniques in the diagnosis of lung tumors with the flexible fiberoptic bronchoscope.	1991	CANCER	72-5	Diagnostic Accuracy	+	186 patients between 1987 and 1988 from a single European center with suspected primary or secondary lung tumours were included.		Diagnostic Accuracy	Bronchoscopic biopsies and brushings	This study compared the diagnostic yield of forceps biopsy histology, forceps biopsy imprint cytology and brushing histology in the diagnosis of lung tumours	For central tumours sensitivity of malignant lesions was 92.9% for biopsy and 78.8% for brushings. For peripheral lesions the sensitivity of brushings were 82.8% and forceps biopsy 80.5%. For all 3 methods the diagnostic accuracy was 97.3% (specificity 100%). Individually: diagnostic sensitivity for imprint cytology was 84.9%, 80.6% for brushings and 62.9% for histology sections.	Not reported	Single center retrospective study of 186 patients which demonstrated that forceps biopsy was superior to brushings for central tumours. The greatest yield (97%) was obtained by combining the techniques with imprint cytology
Pedersen, U.Balle, V. H.Greisen, O.	Diagnostic value of brush biopsy in suspected bronchial carcinoma with the use of the flexible fibre bronchoscope	1981	Clinical Otolaryngology & Allied Sciences	329-33	Diagnostic Accuracy	+	125 patients underwent bronchoscopy, 62 had lung cancer	86 men, 46 were over the age of 60	Diagnostic Accuracy	Analysis of bronchial brushings in patients with suspected lung cancer referred for bronchoscopy. Procedures were carried out under general anaesthesia via an endotracheal tube.	The diagnostic yield of brush biopsied in patients with suspected lung cancer	Of the 62 patients that appeared to have lung cancer 58% of patients had positive brush biopsies. The authors suggest that the use of brushings may increase diagnostic yield.	Not reported	Procedures were performed under general anaesthesia and so the results may not be considered to be valid when the procedure is performed under sedation. This guideline is not addressing the yield of flexible bronchoscopy performed under general anaesthesia.
Cetinkaya, ErdoganYildiz, PinarAltin, SedatYilmaz, Veysel	Diagnostic value of transbronchial needle aspiration by Wang 22-gauge cytology needle in intrathoracic lymphadenopathy	2004	CHEST	527-31	Diagnostic Accuracy	++	60	36 female, 24 male, mean age 39 (SD+/- 16 years)	Diagnostic Accuracy	TBNA	The diagnostic yield of TBNA in mediastinal or hilar adenopathy	Diagnostic accuracy 75%	Not reported	This study demonstrates TBNA is a safe and effective means of diagnosing intrathoracic lymphadenopathy.
Baaklini, W. A.Reinoso, M. A.Gorin, A. B.Sharafkaneh, A.Manian, P.	Diagnostic yield of fiberoptic bronchoscopy in evaluating solitary pulmonary nodules	2000	CHEST	1049-54	Diagnostic Accuracy	++	177 solitary pulmonary nodules	All male, mean age 65 years (range 41-83)	Diagnostic Accuracy	The use of bronchoscopy (including biopsy, brushing, washings) in the diagnosis of solitary pulmonary nodules (SPNs).	Diagnostic yield of biopsies, brushings and washings in SPN.	Overall diagnostic yield was 60%, 64% for malignancies and 35% for benign lesions.	Not reported	Not reported The diagnostic yield for SPNs is significantly affected by size of lesion (strongest predictor) and distance from hilum.
Liam, C. K.Pang, Y. K.Poosparajah, S.	Diagnostic yield of flexible bronchoscopic procedures in lung cancer patients according to	2007	SINGAPORE MEDICAL JOURNAL	625-31	Diagnostic Accuracy	+	503		Diagnostic Accuracy	All bronchoscopic procedures including bronchial biopsies, brushings,	Diagnostic yield of several bronchoscopic procedure including biopsies, brushings, washings and lavage	When tumour was visible the yield from biopsy was 78%, from washings was 28% and brushings was 54%	Not reported	Retrospective single center study of diagnostic yield from bronchoscopic techniques confirms that yield in higher when tumour is visible

	tumour location									lavage and washings				
Rhee, C. K.Kang, H. H.Kang, J. Y.Kim, J. W.Kim, H. Y.Park, A. S.Moon, S. H.Lee, S. H.	Diagnostic yield of flexible bronchoscopy without fluoroscopic guidance in evaluating peripheral lung lesions	2010	Journal of Bronchology	317-322	Diagnostic Accuracy	_	93		Diagnostic Accuracy	Transbronchial biopsy, bronchial brushings and washings for peripheral lung lesions	The use of TBLB, bronchial brushings and washings for peripheral lung lesions	Overall sensitivity was 65% (68% for malignant lesions)	Not reported	41% were malignant. The sensitivity of bronchoscopy for peripheral lesions in this study was 65%. Yield was higher in lesions greater than 2cm. However, this is lower than would be expected for percutaneous needle biopsy. It is unclear whether the patients in this study would have been suitable for percutaneous biopsy.
Shorr, A. F.Torrington, K. G.Hnatiuk, O. W.	Endobronchial biopsy for sarcoidosis: a prospective study	2001	CHEST	109-14	Diagnostic Accuracy	+	34 in the final cohort included in the analysis	For the 34 subjects, the mean age was 37.9 and 58.8% were males. Most patients (64.7%) were African American. Stage I CXR was seen in 23 patients. Stage II and stage III CXRs were seen in 9 patients and 2 patients, respectively	Diagnostic Accuracy	Endobronchial biopsy in patients with sarcoidosis	The use of endobronchial and transbronchial biopsy in patients with sarcoidosis	Sensitivity of endobronchial biopsy was 62%. Sensitivity of transbronchial biopsy was 59%. The combination had a sensitivity of 79%.	Not reported	The protocol for endobronchial biopsies included 4 specimens from abnormal areas and 2 from the main carina. In patients with normal-appearing airways, four specimens were taken from a secondary carina and two were taken from the main carina. Endobronchial abnormalities predicted positive endobronchial biopsies. However, in 3 of the 10 patients with normal airway appearance, a positive endobronchial biopsy was obtained. The authors conclude that endobronchial biopsy should be routinely performed in patients with suspected sarcoidosis, regardless of positive endobronchial appearances.
Boonsarngsuk, V.Raweelert, P.Sukpraprut, A.Chaiprasithikul, R.Kiatboonsri, S.	Factors affecting the diagnostic yield of flexible bronchoscopy without guidance in pulmonary nodules or masses	2010	SINGAPORE MEDICAL JOURNAL	660-665	Diagnostic Accuracy	+	330 patients with pulmonary masses/nodules	Age - 60.2 +/- 13 years. 63% male	Diagnostic Accuracy	Analysis to determine what factors determine bronchoscopic yield.	Analysis to determine what factors determine bronchoscopic yield.	Diagnostic yield with bronchoscopy was 55.8%	Not reported	The authors conclude that if a lesion is less than 4cm and CT does not demonstrate sub segmental or large airway involvement an alternate method to non-guided bronchoscopy should be used.
Stjernberg N, Björnstad-Pettersen H, Truedsson H	Flexible fiberoptic bronchoscopy in sarcoidosis	1980	Acta Medica Scandinavica	397-9	Diagnostic Accuracy	+	29	14 female 15 male aged 22 - 70. 13 Stage I sarcoid, 13 Stage II, 3 stage III.	Diagnostic Accuracy	TBLB and mucosal biopsy in patients with sarcoid	The utility of TBLB and mucosal biopsy in the diagnosis of sarcoidosis	Sensitivity of mucosal biopsy, TBLB and their combination was 41%, 43% and 52% respectively.	Not reported	Single center retrospective study of patients with a diagnosis of sarcoidosis. Sensitivity of TBLB was 41% and increased to 52% when combined with mucosal biopsy. Analysis according to disease limited by small

														numbers in each group.
Sarkar, S. K.Sharma, T. N.Kumar, P.Gupta, P. R.Jain, N. K.Mathur, B. B.	Flexible fiberoptic bronchoscopy in the diagnosis of pulmonary pathology	1983	JOURNAL OF THE INDIAN MEDICAL ASSOCIATION		Diagnostic Accuracy	_	250	49 females and 201 males, aged 25 - 60 years.	Diagnostic Accuracy	Fibreoptic bronchoscopy	Diagnostic yield	Reported as 97.27%. No CI reported	Not reported	The study reports the first 250 cases in the institution with a heterogeneous case mix and no gold standard for diagnosis reported
Popp, W.Merkle, M.Schreiber , B.Rauscher, H.Ritschka, L.Zwick, H.	How much brushing is enough for the diagnosis of lung tumors?	1992	CANCER	2278-80	Diagnostic Accuracy	+	270 patients with malignant lung tumours undergoing bronchoscopy		Diagnostic Accuracy	Bronchial brushings	To determine how many bronchial brushings are required to obtain a good diagnostic yield for diagnosing lung cancer	1st brushing was 72.6%, 2nd brushing was 77%. Sensitivity of combining 4 brushings was 89.6%	Not reported	Retrospective study of 270 patients undergoing bronchial brushings. Yield from brushings improved with number of brushes, although no improvement was seen above 4 brushes.
Piaton, E.Grillet-Ravigneaux, M. H.Saugier, B.Pellet, H.	Prospective study of combined use of bronchial aspirates and biopsy specimens in diagnosis and typing of centrally located lung tumours	1995	BMJ	624-7	Diagnostic Accuracy	+	1128	874 men; 254 women aged 65-3 (SD 13.7)	Diagnostic Accuracy	Cytological and histological samples from bronchoscopy	To determine the diagnostic accuracy of bronchial aspirates	Sensitivity of cytology was 90.4% whilst sensitivity for histology was 85%	Not reported	574 patients had a final diagnosis of lung cancer (51%). This was a large prospective multicenter study and demonstrated high yields for both cytology and histology samples. Exact concordance between cytology and biopsy was observed in 87% of patients
Lyall, J. R.Summers, G. D.O'Brien, I. M.Batemen, N. T.Pike, C. P.Braimbridge, M. V.	Sequential brush biopsy and conventional biopsy: direct comparison of diagnostic sensitivity in lung malignancy	1980	THORAX	929-31	Diagnostic Accuracy	+	116	90 male with mean age 61, 26 female with mean age 62	Diagnostic Accuracy	Bronchial brushings via fibreoptic bronchoscopy and biopsies via rigid bronchoscope	Comparison of brush and forceps biopsy in the diagnosis of lung cancer	Cytology 82% and histology 50%	Not reported	All procedures were carried out under general anaesthesia. Bronchial biopsies were undertaken via a rigid bronchoscope. This does not reflect current clinical practice
Piaton, E.Djelid, D.Duvert, B.Perrichon, M.Saugier, B.	Sequential use of bronchial aspirates, biopsies and washings in the preoperative management of	2007	CytoJournal		Diagnostic Accuracy	+	Combined cytology and biopsy samples were obtained in 334 patients. Cases were included until a total of 200 cases with lung cancer were	288 men and 46 women (mean age = 65.0 ± 11.5 years)	Diagnostic Accuracy	Bronchial biopsies as well as bronchial washings before and after biopsies	To assess the diagnostic values of bronchial brushings in suspected lung cancer	Sensitivity of biopsies alone was 82%. Bronchial washings before biopsy had a sensitivity of 84% while washings after biopsy had a sensitivity of 79%	Not reported	Single center retrospective study. It showed that there was no difference in the sensitivity of bronchial washings according to whether they were performed before or after the biopsy

	lung cancers						found							
Wasserman n, K.Gassanov, N.Atay, Z.Topalidis, T.Dienes, H. P.Mathen, F.	The impact of cytology on the bronchoscopic diagnosis of lung cancer	2004	Journal of Bronchology	154-159	Diagnostic Accuracy	+	156 in total, 95 with central tumours	47 women, 109 men	Diagnostic Accuracy	Sensitivity of histologic and cytological techniques of bronchoscopy in patients with peripheral and central lung cancers	To determine the use of brush biopsy in the diagnosis of lung cancer	93.7% for combined cytology and histology techniques in patients with central tumours. Sensitivity for forceps biopsy alone was 68% in patients with central tumours	Not reported	The yield from bronchoscopic biopsies is low and may reflect that many central tumours in the study were not visible. Importantly, this study was able to analyze NSCLC sub-typing with bronchoscopic techniques and compare to surgical pathology in 44 patients. This demonstrated that bronchoscopic histology and cytology was correct for NSCLC subtype in only 60% of cases.
Levy, H.Horak, D. A.Lewis, M. I.	The value of bronchial washings and bronchoalveolar lavage in the diagnosis of lymphangitic carcinomatosis	1988	CHEST	1028-30	Diagnostic Accuracy	_	12	10 women and 2 men. Mean age 58	Diagnostic Accuracy	Bronchoalveolar lavage and transbronchial lung biopsy	The use of BAL in diagnosing lymphangitis carcinomatosis	BAL had sensitivity of 100% (5/5); Sensitivity of TBLB was 44% (4//9)	Not reported	This small retrospective study of patients with lymphangitis suffers with selection bias. It may that only those patients in whom BAL was likely to succeed underwent the procedure. In addition, the small sample size means that conclusions regarding safety and efficacy of bronchoscopy in patients with lymphangitis are difficult to draw.
Yigla, M.Nagiv, D.Solomonov, A.Malberger, E.Ben-Izhak, O.Rubin, A. H. E.Keren, R.	Timing of collecting bronchoscopic cytologic specimens in endobronchial malignant neoplasms	2002	Journal of Bronchology	272-275	Diagnostic Accuracy	+	54	38 men, 16 women, age 65 +/- 19 years	Diagnostic Accuracy	Yield of bronchoscopic biopsy combined with brushings and washings pre and post biopsy	This study compared the diagnostic yield of bronchial washings pre and post forceps biopsy	Combined cytology and histology yield was 89% whether cytology samples were taken before or after biopsy. 95% CI not provided.	Not reported	The study demonstrates that brushing and washings do not add significantly to diagnostic yield. There is no difference if brushings or washings are performed before or after biopsy
Anders, G. T.Johnson, J. E.Bush, B. A.Matthews, J. I.	Transbronchial biopsy without fluoroscopy. A seven-year perspective	1988	CHEST	557-60	Diagnostic Accuracy	++	112 TBLB with fluoroscopy 135 TBLB without fluoroscopy	Mean age 52.3 years, 57% male		TBLB with or without fluoroscopy	A comparison of the complication rate in performing TBLB with and without fluoroscopy	Diagnostic yield using fluoroscopy 76.7% and 70.3% without fluoroscopy.	Not reported	The diagnostic yield and complication rates with and without fluoroscopy is similar, however, when diagnosing defined peripheral lesions (ie neoplasms) fluoroscopy may be of use.
Mitchell, D. M.Mitchell, D. N.Collins, J. V.Emerson,	Transbronchial lung biopsy through fibreoptic bronchoscope in	1980	BRITISH MEDICAL JOURNAL	679-81	Diagnostic Accuracy	++	79 patients with sarcoidosis, 50 of who underwent	40 men, 39 women		Transbronchial lung biopsy	A comparison of TBLB, endobronchial and Kveim test in the diagnosis of sarcoidosis	Sensitivity of TBLB (42 patients) was 88%. Sensitivity of endobronchial biopsy in 22 patients was 77%	Not reported	Informative early study showing that TBLB has a high yield in patients with sarcoidosis. Yield was higher in patients with abnormal

C. J.	diagnosis of sarcoidosis						bronchoscopy							lung parenchyma on chest radiograph
Milman, N.Faurschou, P.Munch, E. P.Grode, G.	Transbronchial lung biopsy through the fibre optic bronchoscope. Results and complications in 452 examinations	1994	RESPIRATORY MEDICINE	749-53	Diagnostic Accuracy	+	405	236 men, 169 women; median age 59 years (19 - 86)		Transbronchial lung biopsy	The utility of TBLB in the diagnosis of diffuse and localized lung disease	In localised disease, sensitivity was 55%; In diffuse disease sensitivity was 67%. 69% had localized pulmonary lesions and 31% had diffuse lesions	Not reported	This large retrospective study adds to the evidence that TBLB has a good yield in patients with diffuse lung disease. The retrospective case series means that the results may be subject to some selection bias.
Mitchell, D. M.Emerson, C. J.Collins, J. V.Stablefort h, D. E.	Transbronchial lung biopsy with the fibreoptic bronchoscope: analysis of results in 433 patients	1981	British Journal of Diseases of the Chest	258-62	Diagnostic Accuracy	+	433	two-thirds male, mean 52 years (range 6 - 80)	Diagnostic Accuracy	Transbronchial lung biopsy	A retrospective review of TBLB procedures in patients undergoing bronchoscopy	In 183 patients with diffuse shadows, TBLB provided a diagnosis in 61%	Not reported	183 patients had bilateral diffuse shadows TBLB had a yield of 77% in patients with sarcoidosis but only 40% in patients with fibrosing alveolitis. The procedure was safe with 1 patient requiring a drain for pneumothorax and 7 patients experienced significant bleeding of 50-100mls.
Descombes E, Gardiol D, Leuenberger Ph	Transbronchial lung biopsy: an analysis of 530 cases with references to the number of samples	1997	Monaldi Arch Chest Disease	324-329	Diagnostic Accuracy	++	516 patients, 530 TBLB	Age range 14-87	Diagnostic Accuracy	The use of TBLB in diagnosing parenchymal lung disease.	The use of TBLB in diagnosing parenchymal lung disease.	Overall diagnostic yield for diffuse infiltrates was 50%. This was higher in hypersensitivity pneumonitis (92%); sarcoid II-III (75%) and pneumoconiosis (54%). For localised lesions the diagnostic yield was 29%, (56% in stage I sarcoid).	Not reported	100% of patients with diffuse lung infiltrates, localized lung lesions or hilar lymphadenopathy. The study demonstrated that the final diagnosis was made in 89% of patients using TBLB, diagnosis could not be made in 11%. There was good clinic-pathological correlation in 42%. The authors suggest that TBLB is useful for diagnosing chronic diffuse infiltrates and localised lung lesions and that the higher the number of samples the better the diagnostic yield. they suggest 5-6 samples are taken in diffuse disease and 7-10 in localised disease, although there is an increased risk of complications.
Cetinkaya, ErdoganYildiz, PinarKadakal, FigenTekin, AliSoysal, FusunElibol, SenemYilmaz, Veysel	Transbronchial needle aspiration in the diagnosis of intra-thoracic lymphadenopathy	2002	RESPIRATION	335-8	Diagnostic Accuracy	+	28	17 male, 11 female, mean age 36 years (range 14-70)	Diagnostic Accuracy	The use of TBNA in the diagnosis of intrathoracic lymphadenopathy	The use of TBNA in the diagnosis of hilar or mediastinal lymphadenopathy	100% for TB 87.5% for sarcoidosis 50% for lymphoma	Not reported	100% with intra-thoracic lymphadenopathy TBNA is a useful diagnostic tool for intra-thoracic lymphadenopathy with an overall diagnostic yield of 69%. This is particularly true for TB and sarcoidosis.

McDougall, J. C.Cortese, D. A.	Transbronchoscopic lung biopsy for localized pulmonary disease	1981	Seminars in Respiratory Medicine	30-34	Diagnostic Accuracy	_	130	130 patients with lung cancer and no endobronchial lesion visible at bronchoscopy.	Diagnostic Accuracy	Biopsy and brushings of peripheral lung cancers under fluoroscopic guidance	The diagnostic accuracy of peripheral lung lesions using TBLB and brushings	62% of patients had a diagnosis with biopsy or brushings. 95% CI not reported	Not reported	The study lists 9 patients with bronchoscopically inaccessible lung lesions and demonstrates a sensitivity of 62% which is lower than would be expected from percutaneous lung biopsy, which is the preferred investigation
Mak, V. H.Johnston, I. D.Hetzel, M. R.Grubb, C.	Value of washings and brushings at fibreoptic bronchoscopy in the diagnosis of lung cancer	1990	THORAX	373-6	Diagnostic Accuracy	+	680		Diagnostic Accuracy	Bronchial biopsy, washings and brushings	To determine the optimal combination of bronchoscopic techniques in diagnosing lung cancer	When endobronchial tumour was visible (125 cases) biopsy was positive in 76%, washings in 50% and brushings in 52%. When combined yield was over 95%	Not reported	This retrospective study suggests that biopsy, brushings and washings should all be performed to maximize yield in patients with visible tumour. The number of biopsy specimens taken was not reported. The retrospective design means that there is a possibility of selection bias where brushings may only be taken when biopsies were felt to be of low quality.

STUDY IDENTIFICATION / CITATION					TYPE	QUALITY RATING	BIAS	POPULATION CHARACTERISTICS		INTERVENTION	COMPARISON	FOLLOW UP	OUTCOMES	EFFECT SIZE	FUNDING	COMMENTS
AUTHORS	TITLE	YEAR	JOURNAL	CITATION (PAGE)				NUMBER	PATIENT CHARACTERISTICS							
Coppolo, D. P.Brienza, L. T.Pratt, D. S.May, J. J.	A role for the respiratory therapist in flexible fiberoptic bronchoscopy	1985	Respiratory Care	323-7	Qualitative research	+	Yes	216 procedures 201 patients	139 men, mean age 64, mean pack years 51 62 women, mean age 59, mean pack years 52 All had bronchoscopy between Jan 1978-June 1982 via respiratory therapist system	Assessment of efficiency, safety and economy of a respiratory therapist team performing bronchoscopies	Results were compared to 3 published studies reporting on diagnostic and complication rates for FOB expense of respiratory therapist assisting physician during bronchoscopy compared with theoretical cost of bronchoscopy in operating room	48 hours	Complication rates Cost of time, staff, equipment	Diagnostic rates: 55% of endobronchial biopsies diagnostic (80% carcinoma) 59% transbronchial biopsies diagnostic For Tumour: Visible lesions 95.7% diagnostic Distal lesion 59.4% Complications: Pneumothorax – 0.5% Bleeding - 0.9% Respiratory arrest – 0 Death – 0 Fever – 8.8% Airway obstruction - 0 %	Not disclosed	The role of the assistant in doing biopsies during FOB is to assist the physician in handling the biopsy forceps and opening and closing it without compromising diagnostic accuracy of the procedure or increasing complication rates. Paper is old, but probably still valid that team approach to the procedure is best. Probably not generalisable evidence to UK practice.
De, S.	Assessment of patient satisfaction and lidocaine requirement during flexible bronchoscopy without sedation	2009	Journal of Bronchology	176-179	Qualitative research	+	No	70 patients Excluded patients who had previously had bronchoscopies Hospital based	All Indian Mean age 49.48 +/- 14.59 years (22-79) 49 male, 21 female	Patient comfort without sedation Amount of lidocaine required Level of acceptance of repeat bronchoscopy if required	None to address the clinical question, this is the limitation of the study. Intra comparisons were made to compared levels of discomfort vs amount of lidocaine used	1 hour post bronchoscopy	Pain, cough, amount of lidocaine used, nausea, choking, willingness to return for repeat procedure	Samples taken (lavage or brushings 61.4%) (biopsy 38.6%) Indications for bronchoscopy (infection 55.7%) (malignancy 28.6%) (miscellaneous 15.7&) Mean dose of lidocaine 7.44 +/-2.09 mg/kg (4.09-14.97 mg/kg), less when biopsies not performed (p=0.023, 95% CI 0.16-2.15) Patients who experienced more choking and pain less willing to repeat procedure (p=0.031-0.020)	Not disclosed but stated no conflicting interests	Although the procedure was relatively well tolerated, a comparison arm will be needed to measure effect size. The number of procedures is small and very few patients had biopsies taken, the majority of procedures were for possible infection. Would be useful to repeat study in several sites in UK with and without sedation and score anxiety levels.
Poi, P. J.Chuah, S. Y.Srinivas, P.Liam, C. K.	Common fears of patients undergoing bronchoscopy	1998	EUROPEAN RESPIRATORY JOURNAL	1147-9	Qualitative research	+	Yes	104	Sex Male (n=68) Female (n=36) Ethnic group Malay (n=23) Chinese (n=66) Indian (n=15) Status Inpatient (n=67) Outpatient (n=37) Referrals Medical (n=81) Nonmedical (n=23) Level of education	Surveyed all patients undergoing FB to record concerns and if their demographic features and knowledge/understanding of procedure contributed to their levels of fear and anxiety of	Compared demographic features between patients who were fearful of various aspects of the procedure such as nasal pain,	No follow up	Fear / No fear Information given Demographics	Fearful patients were significantly younger than those who were not afraid (t=2.082, p=0.037) Females were more fearful than males (p=0.038) Doctors explained indication for procedure more than how it would be performed (p=<0.001) Doctors explanation and patients	Not disclosed	Fear of bronchoscopy is independent of patient's demographic details and linked closely to information given prior to the procedure. Doctors explain 'why' but not 'how' the procedure is performed.

									Illiterate/primary (n=62) Lower/secondary (n=17) Upper secondary (n=18) Tertiary (n=7) 3.2	procedure.	breathing difficulties and bronchoscopy findings and those that were not fearful.			understanding of the why and how of bronchoscopy (r=0.8, p<0.001 and r=0.565, p=<0.001, respectively) 84 patients preferred to be sedated (equally divided between fearful and non-fearful patients) (p=0.386)		
Ackart, R. S.Foreman, D. R.Klayton, R. J.Donlan, C. J.Munzel, T. L.Schuler, M. A.	Fiberoptic bronchoscopy in outpatient facilities, 1982	1983	ARCHIVES OF INTERNAL MEDICINE	30-31	Qualitative research	+	Indeterminable	1428 bronchoscopies 1225 patients Dec 1975 – Jan 1982 1428	Age range 12-91 4% <20 26% 21-40 51% 41-60 19% >60 Male:Female 971:457	FB in the outpatient setting and safety as outpatient procedure	No comparison This is a retrospective audit report of FB done in the outpatient setting with associated complications.	No follow-up	Complication rate for out patient bronchoscopy	Minimal complications requiring hospital admission: 2/1428 – 1 for bleeding, 1 for bronchospasm No deaths reported	Not disclosed	This study is old now, but emphasize that FB in the outpatient setting is safe with low complication rates. Further studies including sedation in this setting with measured complication rates are required.
Lechtzin, NoahRubin, Haya R.White, Peter, Jr.Jenckes, MollieDiette, Gregory B.	Patient satisfaction with bronchoscopy	2002	AMERICAN JOURNAL OF RESPIRATORY & CRITICAL CARE MEDICINE	1326-31	Qualitative research	+	Yes	840 patients. 584 completed pre-survey, 514 completed post survey. 481 of 840 questionnaires analysed	Age 18->70 Male230:Female234 Race White277:Nonwhite164 Health status: poor/fair248:good169:excellent25 Inpatients204:outpatients 261 First bronchoscopy283:Had previous bronchoscopy175	Assessment of symptoms experienced and patient satisfaction with bronchoscopy Analysis of patient factors, procedure factors and process of care factors	All patients were exposed to the intervention. Compared levels of pain/discomfort during procedure, levels of medication used during procedure, waiting times of various intervals during their care and levels of information quality and quantity	48 hours	Patient willingness to return for repeat procedure	71% of the patients would definitely return, and 22% would probably return for a repeat FB. Better health status (odds ratio [OR] 1.4; 95% confidence interval [CI], 1.1–1.7), not being bothered by scope insertion (OR 2.0; 95% CI, 1.2–3.3), better rating of information quality (OR 1.2; 95% CI, 1.0–1.3), and better rating of physician quality (OR 1.1; 95% CI, 1.0–1.2) were associated with patients reporting that they would definitely return for a repeat FB.	Not disclosed	This study was conducted in the USA where health care provision differs from that of the NHS, but factors such as cost of travel did not influence decisions. Better communication and information regarding the procedure and upper airway anaesthesia would improve patient satisfaction and health status. Patient satisfaction measured as willingness to return for procedure can be heavily influenced by indication for FB. (patients more likely to return for cancer investigation – no matter how 'bad' the experience the first time round.
Hirose, TakashiOkuda, KentaroIshida, HirooSugiyama, TomohideKusumoto, SojiroNakashima, MasanaoYamaoka, ToshimitsuAdachi, Mitsuru	Patient satisfaction with sedation for flexible bronchoscopy	2008	Respirology	722-7	Qualitative research	+	Yes	190 29 excluded-didn't meet inclusion criteria 129 of 161 completed questionnaire	Male 93:Female 36 Age <60: 35, 61-70:39, 71-80:55 Inpatients 46:outpatients 83 Health status excellent:36, good:58, fair:35 First bronchoscopy 104: previous bronchoscopy 24 Mean age 64 (24-80)	Willingness to return was used as surrogate marker for satisfaction following a standardised flexible Bronchoscopy.	All patients were exposed to the intervention.	No follow-up	Examination time, lignocaine used, samples taken, willingness to return, satisfaction of spray, scope insertion, SOB, cough, chest pain, swallowing or	65.8% reported that they would return for a repeat FB (12.4% would definitely return and 53.4% would probably return) Examination time 5.07 2.16-11.88 <0.01 Lidocaine 1.86 0.84-4.10 0.12 Brush/curette 1.63 0.78-3.41 0.20 TBB 0.61 0.29-1.27 0.19 BAL 1.85 0.75-4.55 0.18 TBNA 1.49 0.55-4.04 0.43 Physician experience 2.56 0.89-7.34 0.07 Gender 3.04 1.37-6.76 <0.01 Age 1.11 0.53-2.33 0.78 02 used 0.56 0.27-1.17	Not disclosed	Male gender, shorter examination time, excellent physician quality and not being bothered by coughing, pharyngeal pain or swallowing pain were related to greater patient satisfaction. Again willingness to return for FB as surrogate marker for patient satisfaction needs careful interpretation.

													pharyngeal pain. Quality of nursing and medical care, privacy, waiting time	0.12 Complications 1.29 0.60-2.75 0.51 Admission status 0.95 0.45-2.04 0.90 Health status 1.25 0.55-2.86 0.60 Experience with FB 1.34 0.51-3.53 0.55 Spray 1.87 0.87-4.02 0.11 Scope insertion 2.23 0.95-5.25 0.06 SOB 6.39 0.80-51.23 0.05 Cough 4.87 1.07-22.25 0.03 Pharyngeal pain 3.09 1.42-6.72 <0.01 Chest pain 1.51 0.70-3.25 0.29 Swallowing pain 2.31 1.03-5.18 0.04 Information re FB 0.61 0.24-1.54 0.30 Physician quality 0.52 0.15-0.71 <0.01 Nursing quality 0.33 0.10-1.11 0.06 Institution assess. 0.52 0.19-1.39 0.19 Privacy 0.67 0.27-1.66 0.39 Waiting time 1.10 0.52-2.33 0.80		
Bernasconi, M.Chhajed, P. N.Muller, P.Borer, H. Mitsumune, TadahikoSenoh, EtsuoAdachi, Michifumi	Patients' satisfaction with flexible bronchoscopy in a hospital-based community practice	2009	RESPIRATION	440-445	Qualitative research	+	Yes	Over 2 years 230 FB, 172 eligible, 126 completed surveys	Mean age 65 (31-90) 39% female 57% inpatients	Hospital based, non-teaching hospital, all underwent FB with conscious sedation, IVI Midazolam, local anaesthetic with lidocaine 1% Similar indications for procedure	Patient satisfaction's evaluated, no direct comparison is made by altering the intervention	No information given	Satisfaction with: overall, information given, procedure, scope insertion, local anaesthetic, nursing, final information, state of health. Also anxiety prior to procedure, if fears were confirmed, side effects, willingness to return for repeat procedure if necessary	Preprocedure anxiety was reported by 26 of 51 patients (51%) and 24 of these patients (92%) rated their anxiety as unjustified after the procedure. Overall willingness to return for a flexible bronchoscopy if necessary was 98% (123/126). Mean age range 31-90, SD +/-13. Mean duration of procedure 25 mins, SD +/- 7 mins Mean sedation dose 3.7mg, SD +/- 2.45mg, proportionate to age p=<0.001 Mean lidocaine 21.5mls, SD +/- 9.5mls, proportionate to length of procedure, p=<0.005 Mean duration with/without TBNA=30/19mins, p=0.001 Patient satisfaction with/without TBNA=2.57/2.53, p=>0.05	Not disclosed	TBNA did not negatively influence patient satisfaction.
Mitsumune T, Senoh E, Adachi M.	Prediction of patient discomfort during fibreoptic bronchoscopy	2005	Respirology	92-6	Qualitative research	+	Indeterminable	120	Male 93:Female 27 Age 17-87 All had bronchoscopy (for first time) during Jan 1998-Dec 2001 in same health center in Japan	Standardised pre-procedure information and Flexible bronchoscopy. Assessed patient satisfaction by means of measuring anxiety pre-procedure,	All patients had standardised procedure. Compared characteristics of patients with lower levels of discomfort	2 hours post procedure	Willingness to return was used as surrogate marker for patient satisfaction levels of anxiety /discomfort	The bronchoscopists experience ($P = 0.001$) and the patient's anxiety level ($P < 0.001$) were variables that significantly influenced discomfort.	Not disclosed	Prolonged procedures, pre bronchoscopy anxiety and less experienced bronchoscopists all had the potential to increase discomfort and anxiety levels amongst some patients in this study. This in turn led to patient discomfort and unwillingness to repeat procedure. Pre procedure anxiety significantly increased

										willingness to return and level of discomfort during procedure recorded and 2 hours post procedure.	than those with higher levels Compared levels of anxiety pre procedure with discomfort during procedure All patient were exposed to the same intervention		of procedure on visual analogue scale			levels of discomfort during procedure
Samolski, D.Dure, R	Usefulness of flexible bronchoscopy outside the hospital setting	2010	Journal of Bronchology	218-222	Qualitative research	+	Indeterminable	33 procedures in 25 patients	All patients had bronchoscopy outside hospital environment	If bronchoscopy outside hospital setting is safe, useful, free of complications and well tolerated	No comparison, all procedures were in outside of hospital setting.	No follow up	Complication rates and patient satisfaction	No complications recorded, patients satisfied.	Not disclosed	small study based in Argentina. Bronchoscopies carried out in acute care facility or patients own home. Carefully selected patients. Study showed this could be safe and well tolerated although assessment of tolerance was flawed. Not generalisable to UK