Part I: Clinical Conditions, Diseases and Syndromes

Chapter 1

Infections of the Respiratory Tract and Associated Structures

ANTIBIOTICS are commonly unnecessarily prescribed for respiratory infections entirely due to viral infection. Recent research indicates that procalcitonin levels of > 0.25 μg/L are associated with bacterial infections, while lower levels are unlikely to be found if bacterial infection is present.

COUGH is the presenting symptom in 6% of new episodes of illness in the UK and is responsible for 0.1% of ambulatory care visits in the USA. It is a common symptom of upper respiratory infections, occurring in 81% of patients with influenza A, in parainfluenza, rhinovirus infections and rotaviral respiratory tract infection. With influenza B, incidence of cough as a symptom varies with age: 99% in young adults, 86% in pre-school children, 61% in school-age children, and 60% in older adults. Infections with adenovirus 3, 4, 7, 14 and 16 are associated with cough in only about 7% of patients, and echovirus 9 in 15%. Cough is, of course, a prominent and invariant feature of whooping cough. Productive cough is common in pneumonia, but shows variability with agent: 73% with *Mycoplasma*, 69% in pneumococcal, 47% in psittacosis, 44% in legionellosis (persisting several weeks). Respiratory syncytial virus infections are associated with cough in 80% of patients with pneumonia and 63% of bronchiolitis cases. Cough in tuberculosis is usually productive and persisting for several weeks. Paragonimiasis is associated with the production of tenacious brown or red sputum in 30% of cases. Cough also occurs in a number of intestinal infections: 39% of cases of typhoid fever, 25% of travellers' diarrhoea, 19% of cholera, 17% of *Escherichia coli* infections, 13% of salmonellosis, 12% of *Shigella* infections and 8% of *Aeromonas hydrophila* infections. A dry cough is noted in 41% of cases of acute schistosomiasis, while ascariasis is also associated with cough. Systemic viral infections associated with cough include atypical measles, measles and rubella. Cough may also be due to chemical exposure or associated with protein energy malnutrition.

Treatment:

Mild Cases (Respiratory Rate < 50-70/min): honey; 'cough potion' (spearmint + amaranth +ammonium chloride) + paracetamol if axillary temperature > 39°C + salbutamol if > 1 y and wheezing

Moderate Cases (Respiratory Rate 50-70/min): as above + penicillin (50,000 U/kg/d i.m.) or cotrimoxazole

Severe Cases (Respiratory Rate > 70/min): single dose of antibiotic and hospital admission

ACUTE RESPIRATORY ILLNESS: Acute respiratory disease due to a variety of viral agents is probably the commonest human disease.

Agents: adenovirus, parainfluenza, influenza, echovirus, reovirus, coxsackie A21, B1-5, respiratory syncytial virus, *Mycoplasma pneumoniae, Coxiella burnetii,* etc

Diagnosis: EIA (sensitivity 90%) or DFA (sensitivity 80%) and viral culture (shell vial assay sensitivity 95%, extended culture sensitivity 54%) of nasopharyngeal aspirate or cytobrush nasopharyngeal swab (sensitivity ≈ 70% for nasopharyngeal aspirate); serology

Treatment:

Viruses: non-specific

M.pneumoniae, C.burnetii: tetracycline

UPPER RESPIRATORY TRACT INFECTION, COMMON COLD, FEVERISH COLD: commonest contagious disease; 31% of acute illness in the USA and 5% of new episodes of illness in the UK; causes 12% of fever in returned travellers to Australia; transmission by airborne droplets and by touching contaminated objects; incubation period 1-4 d

Agents: rhinovirus (bronchitis-like cold; incubation period 2 d; duration of illness 10 d; cough in 60%, malaise in 25%, fever in 15%), coronavirus (incubation period 3 d; duration of illness 7 d; malaise in 45%, cough in 35%, fever in 20%), influenza A (usually with fever; winter), B (usually with fever; winter), C, parainfluenza (in 30% of infections), echovirus 4, 7 (in 14% of infections), 8, 11 (in 9% of infections), 19, 20, 22, 25, 30, respiratory syncytial virus (bronchitis-like cold; in 80% of pneumonia and 53% of bronchiolitis cases due to this agent), *Rotavirus* (in 33% of infections in patients < 6 mo and 19% > 6 mo), adenovirus (bronchitis-like cold), coxsackievirus A10, 21, 24, B3-5, human metapneumovirus (15% of cases in children; mild to severe); also *Mycoplasma pneumoniae* (atypical pneumonia-like disease)

Diagnosis: mild to moderate dry cough and chest discomfort, mild malaise, stuffy nose, sneezing, sore throat; viral culture of nasal swab, throat swab, sputum, faeces; immunofluorescence of pharyngeal aspirate; ELISA (antigen) on nasopharyngeal secretions; complement fixation, haemagglutination inhibition, neutralisation; PCR

Respiratory Syncytial Virus: acute wheezing common; lymphocytosis with neutropenia, becoming neutrophilia if secondary bacterial infection

Treatment: paracetamol, hydration, oral (not < 12 y, diabetes, heart disease, hypertension, prostatic hypertrophy, hyperthyroidism) or topical decongestant (not < 6 mo) for not more than 5 d, antihistamines, steam inhalations, nasal saline irrigation, ipratropium bromide 21 µg/spray 4 sprays into each nostril or 42 µg/spray 2 sprays into each nostril to 3-4 times daily reducing as rhinorrhoea improves for up to 4 d

Prophylaxis: α_2-interferon spray 5 MU daily for 7 d; experimental vaccines and antiviral drugs

Upper Respiratory Tract Infection Symptoms also occur in 62% of cases of travellers' diarrhoea, in *Norovirus* infections and poliomyelitis and in < 10% of *Haemophilus influenzae* conjunctivitis.

Coryza: watery discharge from nose, becoming purulent; no systemic symptoms; course 7-10 d; RSV infection in 30% of cases; common with influenza A, influenza B (in 91% of infected young adults, 72% of infected pre-school children and 66% of infected school-age children), influenza C, parainfluenza, measles, rubella and infections with adenovirus 3, 4, 7, 14, *Mycoplasma hominis*; occurs also in a few patients with intestinal infections: 10% of *Shigella* infections, 8% of *Salmonella*, 6% of *Aeromonas hydrophila* and 4% of cholera and enterotoxigenic *Escherichia coli* infections

Rhinitis

Agents: coronavirus, rhinovirus, influenza, parainfluenza, respiratory syncytial virus, enteroviruses, adenovirus, reovirus; also 10-25% of cases of infectious mononucleosis and in primary amoebic meningoencephalitis

Diagnosis: viral culture of nasal swab, washings; serology; exclude CSF leak

Treatment: paracetamol, hydration, oral (not < 12 y, diabetes, heart disease, hypertension, prostatic hypertrophy, hyperthyroidism) or topical decongestant (not < 6 mo) for not more than 5 d, antihistamines, steam inhalations, nasal saline irrigation, ipratropium bromide 21 µg/spray 4 sprays into each nostril or 42 µg/spray 2 sprays into each nostril to 3-4 times daily reducing as rhinorrhoea improves for up to 4 d

Rhinosporidiosis

Agent: *Rhinosporidum seberi*

Diagnosis: microscopy of infected material from nose, pharynx, larynx, eye, lacrimal sac, skin; histology of polyps

Treatment: natamycin

Nasopharyngitis: 4% of new episodes of illness in the UK

Agents: parainfluenza 1, 2, *Haemophilus influenzae, Streptococcus pyogenes, Streptococcus pneumoniae*

Diagnosis: culture of nasopharyngeal swab, nasal swab, throat swab

Treatment: amoxycillin, cefuroxime axetil, cefpodoxime, erythromycin

Resistant *Streptococcus pneumoniae:* clindamycin, grepafloxacin, levofloxacin, sparfloxacin, trovafloxacin

Rhinoscleroma (Scleroma Nasi): a granulomatous disease of the nasopharynx characterised by the formation of hard, crusted, patchy or nodular lesions; endemic in northern and central Africa, S E Asia, Central America

Agent: believed to be caused by *Klebsiella pneumonia subsp rhinoscleromatis*

Diagnosis: clinical; culture of pus from sinus

Treatment: cotrimoxazole for 1 mo to several mo; surgery where indicated

Oronasopharyngeal Histoplasmosis

Agent: *Histoplasma capsulatum*

Diagnosis: intracellular, oval yeast cells in mononuclears on biopsy; fungal culture of biopsy or swab at 25°C and 35°C; hypochromic anemia and leucopenia; in children, lymphocytosis with atypical mononuclears

Treatment: amphotericin B, ketoconazole

Nasopharyngeal and Oronasal Leishmaniasis

Agents: *Leishmania braziliensis* (espundia; severe form of leishmaniasis that may occur months or years after the cutaneous form of the disease, characterised by erosive lesions that may cause extensive destruction of nasopharyngeal tissues; usually fatal if untreated), *Leishmania mexicana* (rare; lesions on mucous membranes)

Diagnosis: examination of smears of tissue or aspirate from lesion; culture of tissue or exudate; IFA, ELISA

Treatment: sodium stibogluconate

Nasopharyngeal Myiasis: infestation of nares and/or pharynx by larvae of certain flies

Agents: *Chrysomya bezziana, Chrysomya megacephala, Cochliomyia hominivorax, Cochliomyia macellaria, Oestrus ovis, Lucilia sericata, Rhinoestrus purpureus, Wohlfahrtia vigil*

Diagnosis: pain, purulent nasal discharge, nasal obstruction; may be extensive tissue destruction; sometimes fatal
Treatment: removal
HALZOUN (MARRARA): acute oedematous condition of upper respiratory tract
Agents: usually *Linguatula serrata* (nasopharyngeal); also *Fasciola hepatica* (pharynx) and *Limnatis nilotica* (larynx or trachea)
Diagnosis: direct visualisation
Treatment: levamisole
LAGOCHILASCARIASIS: infestation of tonsils and nose; occasional metastatic abscesses; Brazil, Colombia, Costa Rica, Mexico, Tobago, Trinidad, Venezuela
Agent: *Lagochilascaris minor*
Diagnosis: usually detected by migration of worms through mouth or nose or by visualisation during tonsillectomy
Treatment: levamisole 150 mg orally 8 hourly for 8 d, then 150 mg orally 12 hourly for 3 days of the week for 12 w (child: 150 mg orally 8 hourly for 15 d)
CATARRH
Agents: measles, rubella, other viruses, *Bordetella pertussis*
Diagnosis: viral culture of throat swab, bacterial culture of nasopharyngeal swab plated directly to charcoal agar; serology
Treatment: hydration, steam

Bordetella pertussis: erythromycin

ACUTE SINUSITIS: symptoms < 4 w; mainly maxillary; 0.5% of new episodes of illness in UK; 0.2% of ambulatory care visits in USA; viral sinusitis in 39%, and bacterial sinusitis in 0.5-2.5%, of patients (5-15% of children) with common cold
Agents: 20-36% *Streptococcus pneumoniae,* 15-30% *Haemophilus influenzae* (nontypeable strains; 13% of sphenoid), 9-15% rhinovirus, 9% α-streptococci, 7-19% *Moraxella catarrhalis*, 5-10% anaerobes, 3% *Streptococcus viridans*, 3% β-haemolytic streptococci not group A (including *Streptococcus milleri*, group C also frontal), 2-9% Gram negative enteric bacteria, 2-5% influenza virus, 2-3% *Streptococcus pyogenes*, 1-6% *Staphylococcus aureus* (56% of sphenoid), 1% *Pseudomonas aeruginosa* (increased in AIDS), 1% parainfluenza 2, 1% parainfluenza 3; adenovirus (2% in children), *Legionella pneumophila* (in AIDS), measles (in 2% of cases), *Capnocytophaga*, *Salmonella* (in renal transplant recipients), *Chlamydophila pneumoniae*, *Moraxella lacunata, Pasteurella multocida, Haemophilus aprophilus*, *Haemophilus paraprophilus*; no growth in 20-25% of cases; may be initial manifestation of *Acanthamoeba* infection in AIDS
Diagnosis (Bacterial): persistent mucopurulent nasal discharge (> 7 d), postnasal drainaage, anosmia, nasal congestion, prolonged fever, facial pain, headache, cough, tenderness over sinuses (especially unilateral maxillary tenderness), tenderness on percussion of maxillary molar or premolar teeth that cannot be attributed to a single tooth, headache, daark circles under eyes, periorbital edema, lymphoid hyperplasia, purulent material in pharynx, poor response to decongestants; in children, also irritability, vomiting, gagging on mucus, prolonged cough; culture of maxillary sinus aspirate; serology; microimmunofluorescent antibody to *Chlamydophila pneumoniae* (IgG and IgM in paired sera 6-8 w apart)
Differential Diagnosis: dental neuralgia (careful dental examination), temperomandibular neuralgia (location of pain, careful history and observation), trigeminal neuralgia (pain over fifth cranial nerve distribution only), migraine (history of similar pain on previous occasions), temporal arteritis (location of pain and tenderness), erysipelas (swelling and stippling of skin surface), nasal diphtheria (extremely rare), typhoid fever (extremely rare)
Treatment: oxymetazoline, tramazoline or xylometazoline 2-3 drops into each nostril 2-3 times daily for 5 d; pseudoephedrine; paracetamol ± codeine

Pseudomonas aeruginosa: ticarcillin + gentamicin ± surgical drainage

Legionella pneumophila: erythromycin, fluoroquinolone

Other Bacteria: amoxycillin 15 mg/kg to 500 mg orally 8 hourly for 5-7 d

Amoxycillin Resistant or Unresponsive: amoxycillin-clavulanate 22.5/3.2 mg/kg to 875/125 mg orally 8 hourly

Penicillin Hypersensitive: cefuroxime 10 mg/kg to 500 mg orally 12 hourly for 5-7 d, cefaclor 375 mg orally 12 hourly (child: 10 mg/kg to 250 mg orally 8 hourly) for 5-7 d, doxycycline (not < 8 y) 2.5 mg/kg to 100 mg orally daily for 5-7 d, levofloxacin 500 mg daily

CHRONIC SINUSITIS: symptoms persist > 8 w; 1.7% of ambulatory care visits in USA
Agents: 31% *Prevotells* (71% of sphenoid), 22% anaerobic streptococci (57% of sphenoid), 21% other streptococci, 16% *Fusobacterium* (57% of sphenoid), 16% *Pseudomonas aeruginosa,* 16% *Haemophilus influenzae*, 10% *Staphylococcus aureus,* 10% *Moraxella catarrhalis*; various fungi (acute (fulminant), chronic (indolent) invasive, fungus ball, allergic fungal sinusitis;

25% *Aspergillus* (*A.flavus*—frequently pansinusitis, especially in cancer patients—*A.fumigatus, A.niger, A.oryzae*), 23% *Curvularia*, 16% *Bipolaris* (predominant agent in allergic fungal sinusitis), 12% *Fusarium,* 9% *Penicillium*, 8% *Alternaria*, 4% *Cladosporium*, 1% *Drechslera*, 1% *Exserohilum*, 1% *Mortierella hyaline;* also *Acremonium, Chaetoconidium, Coniothyrium, Chrysosporium, Geotrichum, Paecilomyces, Scedosporium prolificans, Schizophyllum*, *Pseudallescheria boydii* in immunocompromised); *Klebsiella pneumoniae* 14% of sphenoid, *Escherichia coli* 14% of sphenoid, *Pseudomonas aeruginosa* 14% of sphenoid; 25-60% no growth

Diagnosis: computed tomography, nasal cytology, nasal-sinus biopsy, tests for immunodeficiency, cystic fibrosis, ciliary dysfunction

Bacterial: culture of antral washings

Fungal:

Acute: 70% in diabetics; also in chronic renal failure or diarrhoea, immunosuppressive states secondary to chemotherapy, hematological disorders, transplantation, AIDS; cranial nerve deficit, proptosis, facial swelling, palatal ulcer, coma, stupor; pale to red to black necrotic areas involving turbinates or septum; microscopy, culture and histology of biopsy; radiographic evaluation with CT and MRI

Chronic Invasive: immunocompetent and atopic hosts; microscopy, culture and histology of biopsy

Fungus Ball: no symptoms, rhinorrhoea, nasal obstruction, facial fullness; X-rays or CT scan, microscopy and culture

Allergic: nasal obstruction, polyposis, history of multiple sinus procedures; polyposis, allergic mucin and thick, tenacious debris on nasal endoscopy; type I hypersensitivity confirmed by history, skin testing or serology; characteristic CT scan (complete unilateral or bilateral opacification of multiple paranasal sinuses; sinus expansion and erosion of a wall of involved sinus; scattered areas of intrasinus high attenuation amid mucosal thickening on noncontrasted CT); histologic evidence of eosinophilic mucus without evidence of fungal invasion into sinus tissue; positive fungal stain or culture of sinus contents removed intraoperatively or during endoscopy

Treatment: rule out allergy and structural abnormalities

Bacterial: surgical debridement; antibiotics as for acute infections; nebulised culture-specific antibiotics

Fungal:

Acute and Chronic Invasive: radical debridement + amphotericin B (***Pseudallescheria boydii:*** azole); intranasal amphotericin B 20 ml of 100 mg/L solution twice daily

Fungus Ball: complete removal via curettage with adequate ventilation

Allergic: surgery + oral prednisone + topical nasal steroids + nasal irrigations; fungal directed immunotherapy

Prophylaxis (*Aspergillus* Rhinosinusitis in Neutropenics): amphotericin B nasal spray, oral fluconazole

SORE THROAT: 6% of patients in general practice; 46% tonsillar adenitis, 15% pharyngitis, 14% tonsillitis, 3% acute laryngitis, 3% globus hystericus, 2% stomatitis (1% due to drugs), 1% chronic laryngitis, 1% quinsy, 1% myasthenia of larynx, 0.5% dysphagia, 0.5% infected tonsillar remnant, 0.5% postcricoid carcinoma, 0.5% aphthous ulcer, 0.5% submandibular calculus

Agents: see categories below; sore throat is also a symptom in 67% of cases of mycobacterial thyroiditis and 69% of thyroiditis due to other bacteria, in 36% of *Shigella* infections, 33% of Rocky Mountain spotted fever, 25% of cases of traveller's diarrhoea, 22% of cases of salmonellosis, 22% of Korean hemorrhagic fever cases, 12% of *Aeromonas hydrophila* infections, 10% of Norwalk gastroenteritis cases, 8% of enterotoxigenic *Escherichia coli* infections, 4% of cholera cases, and in cases of Lassa fever, reovirus infections, acute infectious nonbacterial gastroenteritis, aseptic meningitis, dengue, Ebola haemorrhagic fever, Marburg virus disease, measles, St Louis encephalitis, botulism, syphilis, toxic shock syndrome and toxoplasmosis

Diagnosis: clinical; see categories below

Treatment: see categories below

Aboriginals: single dose benzathine penicillin

ACUTE THROAT INFECTIONS (PHARYNGITIS AND TONSILLITIS): incidence 30-40/1000; mainly in children and young adults; 3% of new episodes of illness in UK (streptococcal 0.04%); 1.7% of ambulatory care visits in USA (streptococcal 0.3%)

Agents:

Acute Exudative Tonsillitis: 35% no pathogen found; 23% viruses other than adenovirus (50% of echovirus 9 infections, 10% with exudate; 72% of influenza A cases; 25% of parainfluenza cases; in 60% of cases of pneumonia and 32% of cases of bronchiolitis due to respiratory syncytial virus; *human herpesvirus* 1; *Epstein-Barr virus* (in 66-85% of cases of

infectious mononucleosis), 19% adenovirus (types 1-4, 5, 7, 14, 16; white spots may be present), 19% β-haemolytic streptococci other than *Streptococcus pyogenes* (mainly 'large colony' group C; groups B and G cause mild and self-limiting infections), 14% more than 1 agent, 12% *Streptococcus pyogenes* (streptococcal pharyngitis, septic angina, septic sore throat, streptococcal angina, streptococcal sore throat; infection is of pharynx, nasopharynx, nasal cavities and paranasal sinuses, not tonsils, at least in earlier stages), 5% *Mycoplasma pneumoniae*

Non-exudative Pharyngitis and Tonsillitis: enteroviruses, influenza B (in 100% of infected young adults, 78% of infected school-age children, 59% of infected pre-school children, 28% of infected older adults), rhinovirus, coxsackievirus (A1-6, 8-10, 16, 21, B2, 3, 5; herpangia; febrile in children), *Streptococcus pyogenes, Neisseria gonorrhoeae* (frequently asymptomatic but may be associated with inflammation and discharge), *Corynebacterium ulcerans, Arcanobacterium haemolyticum* (often with rash), *Mycoplasma pneumoniae*, *Chlamydophila pneumoniae,* diphtheria (uncommon in Australia; causes fever ± exudate ± pseudomembrane), mixed anaerobes (necrotising ulcerative pharyngitis, fusospirochaetal angina, fusospirochaetal pharyngitis, Plaut angina, pseudomembranous angina, ulceromembranous angina, ulceromembranous pharyngitis, Vincent's angina), *Haemophilus influenzae, Actinomyces pyogenes, Candida albicans; Capnocytophaga* and *Fusobacterium* in neutropenics; 1 case due to *Cryptococcus neoformans* in patient with leukemia; agranulocytosis, leukemia and a variety of irritant chemical and physical agents may also mimic acute throat infection

Diagnosis: sore throat with pain on swallowing, fever, headache; *Streptococcus pyogenes* more likely in children 4-15 y and in febrile patients with exudative tonsillitis and cervical lymphadenopathy; herpangia and exanthem in coxsackievirus, echovirus 16, 17; many rapid commercial test kits for *Streptococcus pyogenes* (throat swab) sensitivity 76-95%, specificity 93-97%; Gram stain and Albert or Neisser stain, bacterial and viral culture of throat and tonsils; viral and mycoplasmal serology; microimmunofluorescent antibody or PCR-EIA for *Chlamydophila pneumoniae*; differential white cell count; blood cultures and excisional biopsy in neutropenics

Treatment: paracetamol, aspirin (adults) or ibuprofen; dexamethasone 10 mg single oral or i.m. dose; oral hydration; empirical treatment for streptococci is indicated for follicular tonsillitis with fever and local lymphadenitis, existing rheumatic heart disease, *Streptococcus pyogenes* prevalent in family or community, scarlet fever, quinsy

Streptococci: phenoxymethylpenicillin 10 mg/kg to 500 mg orally 12 hourly for 10 d; ampicillin, amoxycillin or amoxycillin-clavulanate should not be used as they are not superior to penicillin and are more likely to produce a rash, especially with *Lymphocryptovirus* infection, but also with other viruses

Remote Areas, Poorly Compliant, Intolerant of Oral Therapy: benzathine penicillin (3-6 kg: 225 mg; 6-10 kg: 337.5 mg; 10-15 kg: 450 mg; 15-20 kg: 675 mg; > 20 kg: 900 mg) i.m single dose

Penicillin Hypersensitive: roxithromycin 300 mg orally daily (child: 4 mg/kg to 150 mg orally 12 hourly) for 10 d

Recurrent or Treatment Failure: clindamycin 150 mg orally 6 hourly (child > 8y: 8-16 mg/kg daily in 3-4 divided doses) for 9 d, or amoxycillin-clavulanate

Neisseria gonorrhoeae: ceftriaxone 250 mg i.m. in lignocaine hydrochloride 1% as single dose or ciprofloxacin 500 mg orally in a single dose (not children or pregnant) + (if chlamydial infection is not ruled out) azithromycin 1 g orally in single dose or doxycycline 100 mg orally twice daily for 7 d (not < 8 y or pregnant)

Anaerobes: penicillin + metronidazole

Corynebacterium, Arcanobacterium haemolyticum: erythromycin 250 mg 4 times daily for 10 d

Mycoplasma pneumoniae, Chlamydophila pneumoniae: doxycycline 100 mg twice daily for 10 d, roxithromycin

***Human herpesvirus*:** famciclovir 500 mg orally 12 hourly for 7-10 d, valaciclovir 500 mg orally 12 hourly for 7-10 d, aciclovir 200 mg orally 5 times daily for 7-10 d

Frequent, Severe Recurrences: famiclovir 500 mg orally 12 hourly, valaciclovir 500 mg orally 12 hourly, aciclovir 200 mg orally 8 hourly or 400 mg orally 12 hourly

Cryptococcus neoformans:

Mild: fluconazole 800 mg orally or i.v. initially, then 400 mg daily for 10 w

More Severe: amphotericin B desoxycholate 0.7 mg/kg i.v. daily for 2-4 w ± flucytosine 25 mg/kg i.v. or orally 6 hourly for 2-4 w; if clinical improvement after 2 w, change to fluconazole 800 mg orally initially then 400 mg daily for 8 w

Secondary Prophylaxis in HIV Infection: fluconazole 200 mg orally daily or itraconazole 200 mg orally daily

Other Viruses and Other Agents: saline gargles

Peritonsillar Abscess (Quinsy)

Agents: 30% *Peptostreptococcus,* 28% *Streptococcus pyogenes,* 16% *Peptococcus,* 9% *Fusobacterium,* 5% *Streptococcus pneumoniae,* 5% microaerophilic streptococci, 2% *Bacteroides fragilis,* 2% *Haemophilus influenzae,* 2% *Propionibacterium*; also *Corynebacterium ulcerans*, *Actinomyces pyogenes*

Diagnosis: Uni-Gold Streptococcal A Test and culture of deep swab of abscess

Treatment: surgical drainage or aspiration; benzylpenicillin 30 mg/kg to 1.2 g i.v. 6 hourly + metronidazole 12.5 mg/kg to 500 mg i.v. or 10 mg/kg to 400 mg orally 12 hourly till significant improvement then amoxycillin + clavulanate 22.5 + 3.2 mg/kg to 875 + 125 mg orally 12 hourly; clindamycin 10 mg/kg to 450 mg i.v. or orally 8 hourly or lincomycin 15 mg/kg to 600 mg i.v. 8 hourly till significant improvement then clindamycin 10 mg/kg to 450 mg orally 8 hourly

Scarlet Fever (Canker Rash, Febris Rubra, Febris Scarlatinae, Fothergill Disease, Scarlatina, Scarlatina Anginosa): affects mainly children 6 mo to 3 y; latent period 1-2 d, incubation period 2-3 d, infectious period 14-21 d, interepidemic period 3-6 y

Agent: *Streptococcus pyogenes* producing erythrogenic toxin

Diagnosis: acute streptococcal infection (pharyngitis, wound infection, burn infection, puerperal fever) associated with skin rash (characteristically, punctate and erythematous) and 'strawberry' or 'raspberry' tongue ± conjunctivitis, rhinitis; desquamation of skin usually occurs; may be other toxic manifestations, including liver involvement; arthritis may occur; severity varies widely but, in general, disease is mild today; culture of nasal swab, throat swab; blood cultures; moderate neutrophilia

Treatment: penicillin, erythromycin, clindamycin

Diphtheria (Diphteritis): acute infectious disease involving the upper respiratory tract and, sometimes, skin; clinical manifestations primarily those of exotoxin; endemic and epidemic, world-wide; last reported case in Australia in 1993; tonsillar diphtheria (most common form, in which membrane is confined mainly to tonsils), pharyngeal (Bretonneau angina, Bretonneau diphtheria, Bretonneau disease, diphtheria cyanache, faucial diphtheria, malignant angina; uncommon form, occurring especially in persons without tonsils, in which membrane extends beyond faucial pillars; generally more severe than tonsillar form); 8% larynx (diphtheric laryngitis, garrotilla morbus suffocans; form that begins either in larynx—with frequent involvement of tonsils, nasopharynx or nose—or in trachea or bronchi; most common in children 2-5 y; relatively high rate of suffocation), nasal (membranous rhinitis; uncommon; relatively mild; membrane limited to mucosa of anterior nares) and nasopharyngeal (severe form with membrane formation on nasal, tonsillar and pharyngeal tissues), pharyngotracheobronchial diphtheria and tracheobronchial diphtheria, in which membrane extends into tracheobronchial airways, causing increased risk of suffocation; myocarditis in 10% of cases, mortality 50%; bronchopneumonia in 8%, mortality 70%; bulbar paralysis in 4%, mortality 20%; peripheral nerve palsies in 2%, mortality 15%; latent period 2-5 d, incubation period 2-5 d, infectious period 14-21 d, interepidemic period 4-6 years

Agent: *Corynebacterium diphtheriae*

Diagnosis: sore throat, fever, malaise, headache, chills; death may result from either myocarditis or asphyxia

Tonsillar Diphtheria: pseudomembranous tonsillitis, cervical lymphadenopathy and a nasal watery discharge; occasionally complicated by otitis media or peritonsillar abscess

Severe Pharyngeal Diphtheria (Malignant Diphtheria, Diphtheria Gravis) and Nasopharyngeal Diphtheria: marked toxemia and massive swelling of neck ('bullneck'), sometimes followed by endocarditis

Albert's or Neisser stain, culture of blood agar, Tinsdale agar and Loeffler's medium of throat membrane fragments or throat swab in which membranous structure is sampled, and nasal swab; isolates of *Corynebacterium diphtheriae* and *Corynebacterium ulcerans* should be tested for toxin production

Treatment: antitoxin (500-1000 U/kg in nasal or mild pharyngeal, 1500 U/kg in moderately severe pharyngeal, 2000 U/kg in severe pharyngeal, 2500 U/kg in laryngobronchial) (always preceded by tests for allergy to horse serum and desensitisation if necessary) + procaine benzylpenicillin 1.2 MU/d (child: 25 000-50 000 U/kg/d) or parenteral erythromycin 40-50 mg/kg/d to maximum 2 g/d until patient can swallow comfortably, then oral erythromycin or phenoxymethylpenicillin 125-250 mg 4 times daily for total 14 d; endotracheal intubation for maintenance of airways; steroids for impending airways obstruction

Carriers: erythromycin 500 mg orally 6 hourly (child: 30-40 mg/kg daily in 3 divided doses) for 7 d, procaine penicillin 600 000 U (child: 12 500-25 000 U/kg) i.m. 12 hourly for 10 days + surveillance

Prophylaxis: highly effective live vaccine; hyperimmune immunoglobulin; isolation of cases until negative cultures of 2 samples at least 24 h apart after completion of antimicrobial therapy

Close Contacts: benzylpenicillin (< 6 y: 600 000 U; > 6 y: 1.2 MU) i.m. single dose or erythromycin (child: 40 mg/kg/d; adult: 1 g/d) for 7-10 d

Oropharyngeal Candidiasis

Agent: *Candida albicans*

Diagnosis: swab culture

Treatment:

Mild: miconazole 2% gel 50 mg (child < 1 y: 25 mg) orally 6 hourly for 1-2 w; amphotericin B 10 mg lozenge or 100 mg/mL suspension 1 mL orally 6 hourly for 1-2 w; nystatin 1 lozenge 100 000 U dissolved slowly in mouth 6 hourly for 7-14 d, or 1 mL 100 000 U/mL suspension orally 6 hourly for 7-14 d if lozenge not tolerated, clotrimazole 10 mg troche 5 times daily; gentian violet paint; cleaning of dentures and correction of poor fits if present

Severe (Immunocompromised including AIDS): fluconazole 3 mg/kg to 50 mg orally daily for 10-14 d or itraconazole 100 mg (10 mL) oral suspension daily for 10-14 d or miconazole 2% gel 2.5 mL orally 6 hourly for 10-14 d or nystatin liquid 100 000 U/mL 1 mL orally 6 hourly for 10-14 d, then fluconazole 50 mg orally daily or 150 mg weekly if frequent recurrences

Failure of Response: Does patient have diabetes mellitus? Is patient receiving oral antibiotics? Would eradication of gastrointestinal reservoir help? Is there a defect in immunity or any history of treatment with immunosuppressive drugs?

Prophylaxis (Immunosuppressed Patients): clotrimazole 10 mg 8 hourly as a lozenge; fluconazole 400 mg orally or i.v. daily

Pharyngoconjunctival Fever: occurs in children; associated with swimming pools

Agent: adenovirus 3, 4, 7, 14

Diagnosis: fever, sore throat, upper respiratory tract symptoms, conjunctivitis; viral culture of nasopharyngeal swab, conjunctival swab or scraping, faeces; serology

Treatment: non-specific

Acute Laryngitis: 0.8% of new episodes of illness in UK

Agents: parainfluenza 1 and 3, respiratory syncytial virus, adenovirus, influenza B, 4% of hospitalised measles cases

Diagnosis: hoarseness, barking or brassy cough without stidor in absence of lower respiratory tract signs; serology

Treatment: non-specific

Acute Laryngeal Dyspnea: includes croup (acute laryngotracheobronchitis), acute epiglottitis and supraglottitis, laryngeal diphtheria; may also be due to angioneurotic oedema, foreign body or other laryngeal irritant, acute retropharyngeal abscess, papillomata of larynx, large infected prolapsing tonsils, peritonsillar abscess

Agents:

Croup: 80% viral (parainfluenza 1, 2, 3, influenza A (11% of total cases) and B, respiratory syncytial virus, adenovirus, enteroviruses, rhinovirus, measles virus, human metapneumovirus), 20% bacterial (*Streptococcus pneumoniae*, other streptococci, *Staphylococcus aureus, Corynebacterium diphtheriae*)

Acute Epiglottitis: *Haemophilus influenzae* (usually type b; also acute obstructive laryngotracheal infection), *Haemophilus parainfluenzae, Haemophilus paraprophilus, Streptococcus pneumoniae* (10% of adult cases), *Streptococcus pyogenes,* group C *Streptococcus* (single case)

Supraglottitis: *Haemophilus influenzae, Neisseria meningitidis* (0.3% of meningococcal infections)

Diphtheria: *Corynebacterium diphtheriae*

Diagnosis:

Croup: coryzal prodrome, hoarseness or husky voice, barking or brassy cough, inspiratory stridor ± sonorous rhonchi and coarse crepitation, variable airway obstruction; viral culture of nasal washings

Acute Epiglottitis and Supraglottitis are life-threatening situations which will usually be diagnosed clinically; typically children 2-7 y and adults; fever, sore throat, shortness of breath, rapid onset of dysphagia, pooling of secretions and drooling, sudden deterioration and death due to airway obstruction; note that fatal reactions have occurred on attempting to take swabs or even on examination of the oropharynx in acute epiglottitis; also that isolation of *Haemophilus influenzae* from throat swabs rarely implies acute epiglottitis; counterimmunoelectrophoresis or latex agglutination of serum may provide a diagnosis, while blood cultures are positive in 79-90% of cases immunofluoresecence of pharyngeal aspirate or nasopharyngeal swab; Gram stain and Albert's or Neisser stain, bacterial and viral culture of laryngeal swab, nasal washings, nasopharyngeal aspirate; serology

Treatment:

Croup: usually self-limiting, lasting 2-7 d

Moderate to Severe: dexamethasone 0.3 mg/kg orally, prednis(ol)one 1 mg/kg orally, budesonide 2 mg by nebuliser

Significant Airway Obstruction or Fatigue: hospitalisation; dexamethasone 0.6 mg/kg orally or i.m. or prednis(ol)one 1 mg/kg orally + nebulised adrenaline 0.05 mL/kg/dose to 0.5 mL of 10 mg/mL solution diluted up to 3 mL with sodium chloride 0.9% solution or 0.5 mL/kg/dose to 5 mL of 1 mg/mL solution ± nebulised budesonide 2 mg/4 mL; tracheostomy or intubation if needed

Bacterial: erythromycin or penicillin + streptomycin

Epiglottitis and Supraglottitis: hospitalisation; intermittent positive pressure breathing with mask or bag or tracheostomy; ceftriaxone 25 mg/kg to 1 g i.v. once daily for 5 d or cefotaxime 25 mg/kg to 1 g i.v. 8 hourly for 5 d or (if severe penicillin hypersensitivity) chloramphenicol 50 mg/kg to 1 g i.v. immediately, followed by 25 mg/kg to 1 g i.v. 8 hourly

Diphtheria: antitoxin + parenteral penicillin

Prophylaxis

***Haemophilus influenzae* type b:** given to index case before discharge, and within 7 d to all household contacts of index case, including incompletely immunised children < 4y and any immunocmpromsed child; also adults and children at day care centres with 2 or more cases of invasive disease in 60 d period and with incompletely immunised children; rifampicin 20 mg/kg to maximum 600 mg (child < 1 mo: 10 mg/kg) orally daily for 4 d (not pregnant; give ceftriaxone 1 g in lignocaine hydrochloride 1% i.m. as single dose); vaccine to index case under 2 y even if previous immunisation and to unvaccinated contacts < 5 y; all children should be routinely vaccinated beginning at 2 mo (95-100% efficacy; swelling, redness and pain at injection site in 5-30%, fever and irritability uncommon, serious reactions rare; contraindicated if anaphylaxis to vaccine components or previous dose and serious illnesses)

Neisseria meningitidis: ceftriaxone 250 mg (< 15 y: 125 mg) i.m. as single dose (preferred if pregnant), ciprofloxacin 500 mg orally as single dose (not < 12 y; preferred for women taking oral contraceptive), rifampicin 10 mg/kg (< 1 mo: 5 mg/kg) to 600 mg orally 12 hourly for 2 d (not pregnant, alcoholic, severe liver disease; preferred for children); vaccines (quadrivalent polysaccharide, quadrivalent conjugate, and serogroup conjugate) available

Acute Tracheitis: secondary bacterial infection following primary viral respiratory infection, most commonly parainfluenza

Agents: *Staphylococcus aureus, Haemophilus influenzae, Streptococcus pyogenes, Moraxella catarrhalis, Acinetobacter calcoaceticus, Bordetella bronchiseptica* (rare), 1 case of *Corynebacterium pseudodiphtheriticum*

Diagnosis: URTI with stridor, fever and variable degree of respiratory distress; Gram stain and culture of tracheal aspirate

Treatment: humidification, endotracheal intubation or tracheostomy; amoxycillin-clavulanate

Upper Airways Aspergillosis: necrotising bronchitis, mass in trachea, laryngitis, epiglottitis

Agents: *Aspergillus* species

Diagnosis: fibreoptic examination; micro and culture of biopsy

Treatment: amphotericin B; excision possibly helpful; removal of infected suture essential for bronchial stump aspergillosis

Whooping Cough: world-wide; acute tracheobronchitis, mainly in children, sometimes in elderly whose immunity has waned; also common cause of persistent cough in adults; ≈ 4000 notified cases/y in Australia (≈ 32% in New South Wales); incidence 0.8/100 000 in USA; 0.3% of new episodes of illness in UK; death rate from 0.003/1000 infants in USA to 5/1000 in Guatemala; case-fatality rate 0.5-15% (29% pneumonia, 4% seizures, 0.4% encephalopathy; all < 1 y, unvaccinated; ≈ 300,000 deaths in children worldwide in 2000); complications include inguinal or umbilical hernia, rectal prolapse, mucosal hemorrhage, petechiae, pneumothorax (rare), subcutaneous emphysema (rare), subdural haematoma (rare), convulsions, paralysis, deafness, blindness, aphasia, mental retardation, bronchopneumonia, atelectasis, ? bronchiectasis; respiratory transmission; incubation period 5-10 d, latent period 6-7 d, infectious period 21-28 d, interepidemic period 2-5 years

Agents: *Bordetella pertussis* (pertussis, chin cough, morbus cucullaris; acute respiratory disease, common in childhood), *Bordetella parapertussis* (parapertussis; less common and usually mild respiratory disease), *Bordetella bronchiseptica* (uncommon acute tracheobronchitis); parainfluenza 4 and adenovirus may produce a similar syndrome

Diagnosis: initial stage of mild upper respiratory symptoms, followed by a second stage of paroxysmal coughing, with each paroxysm ending (but not invariably, especially in infants) in an inspiratory 'whoop' and post-tussive vomiting, and a long period of convalescence; fever usually absent or of low grade; may be transiently indistinguishable from adenoviral respiratory diseases; cough ≥ 14 d duration (CDC definition) has 100% sensitivity but only 35% specificity; spasmodic cough ≥ 21 d (WHO definition) has 80% sensitivity but only 41% specificity; ≥ 14 d cough + lymphocytosis has sensitivity 84%,

specificity 67%, predicted value positive 68%; culture of nasopharyngeal swab plated directly to charcoal agar + antibiotics (overall sensitivity 53%, specificity 100%; the organism does not survive transport in Stuart's medium even for a few minutes; the chance of isolating the organism falls rapidly from 93% at time of onset to zero at > 4 w after onset); serology (IgA or rise in IgG or IgM); PCR on nasopharyngeal swab or aspirate; direct fluorescent microscopy of organisms in sputum (sensitivity 63%, specificity 86%); ELISA (IgG for filamentous haemagglutinin sensitivity 88-89%, detects both *Bordetella pertussis* and *Bordetella parapertussis*; IgG for pertussis 100% sensitive in unvaccinated children, specificity 97%; IgA); neutropenia becoming lymphocytosis

Treatment: mainly supportive, but clarithromycin 7.5 mg/kg to 500 mg orally twice daily for 7 d (not < 1 mo), azithromycin 10 mg/kg to 500 mg initially then 5 mg/kg to 250 mg orally daily for further 4 d (< 6 mo: 10 mg/kg to 500 mg orally daily for 5 d), erythromycin 10 mg/kg to 250 mg orally 6 hourly for 7 d (not < 1 mo), erythromycin ethyl succinate 10 mg/kg to 400 mg orally daily for 7 d (not < 1 mo), or cotrimoxazole 4/20 mg/kg to 160/800 mg orally 12 hourly for 7 d may shorten the course of the disease if treatment is initiated very early and may limit spread to susceptible contacts

Prophylaxis: vaccine (3 doses) 70% effective; 50% minor complications (40% swelling, 35% redness, 35% irritability, 30% pain, 25% fever $\geq$ 38°C, 15% anorexia, 15% drowsiness, 5% fever $\geq$ 39°C, 1% fever $\geq$ 40°C), 0.03% moderate complications, 0.003% severe complications (70-2000/M persistent screaming, 60-300/M collapse or shock, 40-700/M convulsions $\pm$ fever), 0.0006% encephalitis (males predominate; not related to age at immunisation, size of dose or whether first or subsequent dose; manifestations: changes in consciousness, convulsions, paresis; mortality $\approx$ 15%; permanent sequelae $\approx$ 30%); paracetamol 15mg/kg at time of vaccination and every 4-6 h for 48-72 h reduces incidence of fever and seizures; further immunisation contraindicated if collapse or shock within 48 hours, persistent screaming episode or uncontrollable crying lasting $\geq$ 3 h within 48 hours, temperature $\geq$ 40.5°C within 48 h, convulsions $\pm$ fever within 3 d, alteration in consciousness or neurologic abnormality within 7 days, systemic allergic reaction, thrombocytopenia or hemolytic anemia following previous immunisations or if neurologic disease; duration of immunity 6 y; new acellular vaccine 87% fewer febrile episodes, 75% fewer hypotonic-hyporesponsive episodes; cost effective

Chemoprophylaxis: contacts with index case who are infants < 1 y regardless of immunisation status, children 1-2 y who have received < 3 doses of vaccine, women in last month of pregnancy, or who attend or work in a childcare facility; as for treatment

TRACHEOBRONCHITIS

Agents: parainfluenza 1, 2, 3, influenza A, B, adenovirus 1, 2, 3, 4, 5, 7; also *Bordetella* (see **WHOOPING COUGH**), *Mycoplasma pneumoniae*, *Aspergillus* (ulcerative and plaque-like in AIDS patients; see **UPPER AIRWAYS ASPERGILLOSIS**)

Diagnosis: bronchoscopy; serology; culture of biopsy

Treatment: steam, hydration

EPIDEMIC INFLUENZA: 20% of acute illness ($\approx$ 20 000 deaths/y) in USA, 0.9% of new episodes of illness in UK; causes 5% of fever in returned travellers to Australia; attack rate 34%, case-fatality rate 0.9%; particularly severe in those in third trimester of pregnancy, in elderly, in patients with underlying cardiovascular disease, renal disease, metabolic diseases such as diabetes mellitus, anemia, and in immunosuppression; initial pneumonitis often progresses to secondary bacterial pneumonia, often due to *Haemophilus influenzae* but particularly severe form due to *Staphylococcus aureus*; common complications include pneumonia, otitis media, tracheobronchitis and acute sinusitis; others include Reye's syndrome, myocarditis, pericarditis, myositis, myoglobinuria, encephalitis, transverse myelitis, Guillain-Barré syndrome, rhabdomyelitis, respiratory transmission; incubation period 1-4 d

Agents: 70% influenza A (world-wide epidemics and pandemics), 27% influenza B (smaller epidemics), 3% influenza C (local outbreaks, often inapparent); 'influenza-like illness' also occurs with infections due to adenovirus, enteroviruses, parainfluenza, hepatitis C, Q fever, Rift Valley fever, Ross River virus, lymphocytic choriomeningitis virus, and in malaria, perfringens poisoning (mild, lasting 24 h), rabies, staphylococcal food poisoning, as well as in rifampicin overdosage

Diagnosis: abrupt onset of fever, chills, severe myalgia, severe arthralgia, anorexia, severe headache, severe malaise, severe nonproductive cough, severe chest discomfort, fatigue lasting 2-3 w; viral culture of oropharyngeal or nasopharyngeal swab or garglings, sputum, serum (lung tissue post mortem) in chick embryo amnion, human, monkey, pig or calf kidney cells; serology (complement fixation test, microagglutination, indirect fluorescent antibody titre, passive hemagglutination, hemagglutination inhibition antibody, neutralisation, ELISA (antibody), radioimmunoassay); sensitivity of rapid commercial kits 51-96% (greater with nasopharyngeal specimen), specificity 52-100% (influenza A and B); relative or absolute lymphocytosis with neutropenia, becoming neutrophilia if secondary bacterial infection

Treatment:

Influenza (High Risk Individual in Context of Proven Influenza Epidemic and Within 48 Hours of Onset of Illness): zanamivir 10 mg by inhalation 12 hourly for 5 d or until 48 h after recovery (not < 7 y) or oseltamivir (≤ 15 kg: 30 mg; 16-23 kg: 45 mg; 24-40 kg: 60 mg; > 40 kg: 75 mg) orally twice daily for 5 d (influenza A and B)

Q fever: doxycycline 100 mg orally 12 hourly for 14 d (not < 8 y), chloramphenicol 12.5 mg/kg to 500 mg orally or i.v. 6 hourly for 14 d

Others: symptomatic

Prophylaxis (Influenza A and B): vaccination + rimantidine most cost-beneficial; killed vaccine administered parenterally 77-91% efficacy in children 1-15, 70-90% in adults < 65 y, 50-80% in ≥ 65 y, rare systemic reactions, duration of immunity 1-3 y; persons at increased risk (aged ≥ 50 y; children 6-59 months; residents of nursing homes and other chronic care facilities; ≥ 6 mo with chronic disorders of pulmonary (including asthma) or cardiovascular systems (not including hypertension); ≥ 6 mo who have required regular medical follow-up or hospitalisation during preceding year for chronic metabolic diseases (including diabetes mellitus), renal dysfunction, haemoglobinopathies or immunodeficiency caused by medications or HIV; aged 6 mo - 18 y and receiving long term aspirin therapy; ; ≥ 6 mo with any condition that can compromise respiratory function or handling of respiratory secretions or increases risk for aspiration, cognitive dysfunction, spinal cord injuries, seizure disorders or other neuromuscular disorders; women who will be pregnant during the influenza season) and groups with potential of nosocomially transmitting influenza to high-risk patients (physicians, nurses and other personnel in both hospital and outpatient care settings, including emergency response workers; employees of nursing homes and chronic care facilities who have contact with patients or residents; employees of assisted living and other residences for persons in groups at high risk; persons who provide home care to persons in groups at high risk; individuals who live with or care for high-risk individuals, including healthy household contacts and caregivers for children age 0-59 mo) should be immunised each year, 1-2 mo before expected epidemic; also consider for overseas travellers; group vaccination of school-aged children highly cost effective; not recommended if < 6 mo age; 6 mo - 3 y: 2 x 0.25 mL doses split virus; 3-8 y: 2 x 0.5 mL doses split virus;
≥ 9 y: 1 x 0.5 mL dose whole or split virus; side effects: pain at injection site; fever, malaise, myalgia mainly in previous recipients;fever, rash and seizures in children 6-23 mo; Guillain-Barre syndrome 1/1M; allergic reactions to eggs or other components; increased side effects in asthmatic children, ? systemic lupus erythematosus; decreased response in malignancy patients on therapy, patients with chronic renal failure, and transplantation patients (particularly if azotemic), and in patients with systemic lupus erythematosus or with rheumatic diseases receiving corticosteroids; exercise improves response; cost saving relative to oseltamivir or supportive care; live attenuated vaccine administered intranasally (5-8 y: 1 or 2 doses; 9-49 y: 1 dose; efficacy 86-93% in healthy children, 71-85% in healthy adults) may be given to those not on above list (not immunosuppressed, pregnant or with prior history of Guillain-Barre syndrome); amantadine and rimantidine give similar, but probably inferior, protection (influenza A only); oseltamivir (≤ 15 kg: 30 mg; 16-23 kg: 45 mg; 24-40 kg: 60 mg; > 40 kg: 75 mg) orally once daily during influenza season (≥ 13 y; 84% efficacy; cost saving relative to supportive care alone); zanamivir 10 mg 2 inhalations twice daily (not < 5 y) to prevent spread within families

Acute Chest Infections

Agents

<4 y: 33% respiratory syncytial virus, 13% influenza A and B, 9% parainfluenza 1, 2 and 3, 5% adenovirus, 5% *Mycoplasma pneumoniae*, 2% coronavirus, 2% *Simplexvirus*, 8% mixed infections, 25% unknown

4-8 y: peak incidence; 'acute wheezy chest' (acute diffuse bronchitis with airway obstruction), segmental pneumonia, acute bronchiolitis; agents as for conditions listed

Diagnosis: acute wheezing common with respiratory syncytial virus; Gram stain, bacterial and viral culture and immunofluorescence of sputum, pharyngeal aspirate and nasopharyngeal aspirate; Becton Dickinson Directigen RSV on nasopharyngeal wash or aspirate sensitivity 93-97%, specificity 90-97%; serology

Treatment: ampicillin, cotrimoxazole; humidified oxygen; bronchoscopic suction or tracheostomy

Bronchitis: 2% of new episodes of illness in UK; 9-30 M cases in USA; acute bronchitis (0.4% of ambulatory care visits in USA) develops as a sequel to an acute upper respiratory infection, usually of viral origin; in chronic bronchitis (1.4% of ambulatory care visits in USA), there is almost daily production of sputum for 3 consecutive months over 2 consecutive years; 90% of chronic obstructive pulmonary disease (fourth leading cause of death in USA); acute exacerbations are common

Agents: viruses (*influenza A* and *B*, *respiratory syncytial virus*), nontypeable *Haemophilus influenzae* (13% of acute exacerbations of chronic obstructive pulmonary disease), *Streptococcus pneumoniae* (6% of exacerbations of chornic

obstructive pulmonary disease), other streptococci, *Staphylococcus aureus, Moraxella catarrhalis* (4% of acute exacerbations of chronic obstructive pulmonary disease), *Escherichia coli* (in newborn and recurrent exacerbations of chronic), *Klebsiella pneumoniae, Pseudomonas aeruginosa* (6% of acute exaacerbations of chronic obstructive pulmonary disease), *Chlamydophila pneumoniae, Bordetella pertussis, Bordetella bronchiseptica, Streptobacillus moniliformis, Corynebacterium diphtheriae, Mycoplasma pneumoniae*, *Candida albicans*, mixed anaerobes

Diagnosis:

Acute: productive cough with sputum, restrosternal pain on coughing, fever; purulent sputum usually indicates secondary bacterial infection

Acute Exacerbation of Chronic: change in sputum colour, consistency and quality; increasing cough, often with development of dyspnoea; chest tightness; general fatigue; Gram stain, bacterial culture of sputum

Chlamydophila pneumoniae: culture, serology, PCR-EIA

Treatment: usually not required for acute bronchitis consequent on viral infection

***Haemophilus influenzae, Streptococcus pneumoniae*, Empirical Treatment of Acute Exacerbation of Chronic With Increased Dyspnoea and Increased Sputum Purulence and Volume**: povidone iodine gargles may be as effective as antibiotics; amoxycillin 15 mg/kg to 500 mg orally 8 hourly for 5 d, doxycycline 4 mg/kg to 200 mg orally statim followed by 2 mg/kg to 100 mg orally daily for 5 d (not < 8 y, pregnant or breastfeeding); if amoxycillin resistant *Haemophilus influenzae* isolated, amoxycillin-clavulanate 500/125 mg orally 8 hourly (< 40 kg: 40/10 mg/kg daily in 3 divided doses) for 10-14 d; if unsatisfactory clinical response, ensure optimal physiotherapy and bronchodilator use, review diagnosis and perform chest X-ray

Resistant *Streptococcus pneumoniae:* clindamycin, grepafloxacin, levofloxacin, sparfloxacin, trovafloxacin

Chlamydia, Mycoplasma: tetracycline

Bordetella: erythromycin

Other Bacteria: amoxycillin-clavulanate or cefuroxime + bromohexine or N-acetylcysteine

Prophylaxis: oxytetracycline

Bronchiectasis

Agents: viruses, *Haemophilus influenzae, Streptococcus pneumoniae*, *Pseudomonas aeruginosa*

Diagnosis: Gram stain and culture of sputum

Treatment:

Pseudomonas aeruginosa: oral ciprofloxacin + inhaled tobramycin

Others: ampicillin, tetracycline, erythromycin

Acute Bronchiolitis and Bronchopneumonia: infants < 6 mo

Agents: respiratory syncytial virus (in 84% of cases), parainfluenza 1 and 3, influenza A and B, human metapneumovirus (in 59-68% of cases), *Streptococcus pneumoniae,* coliforms, *Mycoplasma pneumoniae, Bordetella bronchiseptica*

Diagnosis: expiratory wheezing (more common with respiratory syncytial virus) ± fine crepitation ± tachypnoea, air trapping or chest wall retraction; no significant response to bronchodilator; immunofluorescent smear of pharyngeal aspirate; bacterial and viral culture of nasopharyngeal aspirate, pharyngeal swab and sputum (lung, trachea, blood post mortem); ELISA, RIA, serology; PCR

Treatment: clarithromycin; dexamethasone 1 mg/kg single oral dose if < 2 y

Prevention (Respiratory Syncytial Virus): humanised monoclonal antibody (palivizumab)

Bronchopulmonary Candidiasis

Agent: *Candida albicans*

Diagnosis: lower lobe consolidation with repeated isolation of *Candida albicans* from sputum or single isolation from uncontaminated bronchial specimen; serology (immunodiffusion, latex agglutination, counterimmunoelectrophoresis)

Treatment: nystatin aerosols + amphotericin B

Pneumonia: fifth leading cause of death, first among infectious diseases; 3% of acute illnesses in USA (≈ 45,000 deaths/y; 0.5% of ambulatory care visits); 0.1% of new episodes of illness in UK; 20/1000 in < 1 y, 40/1000 in 1-5 y (90% viral)

Agents: mainly indigenous flora; 35-75% unknown aetiology, 6% aspiration, 3% postobstructive, 1% noninfectious; *Mycoplasma pneumoniae* (Eaton agent pneumonia, Eaton pneumonia, *Mycoplasma* pneumonia, mycoplasmal pneumonia, pleuropneumonia-like-organism pneumonia, PPLO pneumonia; 33% of community acquired bacterial pneumonia, 1% of community acquired pneumonia requiring ICU admission; deaths related to ineffective initial therapy, non-pneumonia related complications; world-wide, sporadic, endemic and occasionally epidemic), *Streptococcus pneumoniae* (320,000-620,000 hospitalisations/y in USA in > 65 y; 36% of community acquired and 50% of hospital-acquired bacterial pneumonia in

adult; common, world-wide; increased risk in AIDS, immunosuppressive therapy, severe combined immunodeficiency, nephrotic syndrome, myeloma, chronic lymphocytic leukemia, common variable immunodeficiency, X-linked agammaglobulinemia; mortality rate from 1% in patients
20 y treated with penicillin to 70% in patients > 70 y not treated), *Chlamydiophila psittaci* from birds, *Chlamydophila pneumoniae* 9% of community acquired pneumonia, *Chlamydia trachomatis* usual cause in infants
< 20 w during spring, summer and autumn, *Haemophilus influenzae* (7% of community acquired bacterial pneumonia; nontypeable strains in adults suffering from some predisposing respiratory tract disease such as chronic bronchitis or with chronic alcoholism or malignancy or B cell disease or not otherwise predisposed, and in children, either primary (type b; 4 mo – 4 y; rates greatly decreased with Hib immunisation) or secondary to fibrocystic disease; rates greatly decreased with Hib immunisation), Gram negative bacilli (5% of community acquired pneumonia; increased risk in neutropenia, chronic granulomatous disease; coliforms result of antibiotic treatment or aspiration and in neutropenics; *Klebsiellla* 12% of nosocomial pneumonia; *Klebsiella pneumoniae* 10% of community acquired bacterial pneumonia requiring ICU admission, with 46% of these fatal, lower respiratory tract infection common, necrotising pneumonia caused by certain biochemically atypical strains uncommon, adult mortality rate 25-50%; *Enterobacter* 9% of nosocomial pneumonia; *Serratia* 6% of nosocomial pneumonia; *Escherichia coli* 6% of nosocomial pneumonia, common in neonatal; *Proteus* 4% of nosocomial pneumonia; *Pseudomonas* 17% of nosocomial pneumonia; *Pseudomonas aeruginosa* as for coliforms but mucoid strains in cystic fibrosis, 10% of ventilator associated pneumonia, rare cases of necrotising community-acquired pneumonia in immunocompetenet, adult mortality rate 35-80%; *Burkholderia cepacia*, *Stenotrophomonas maltophilia* following hospitalisation and antibiotic therapy; *Stenotrophomonas maltophilia* 15% of ventilator associated pneumonia; *Acinetobacter baumannii* 27% of ventilator associated pneumonia), *Staphylococcus aureus* (3% of community acquired bacterial pneumonia, 8% of community acquired pneumonia requiring ICU admission, with 50% fatal in these cases; 13% of nosocomial pneumonia; 24% of ventilator associated pneumonia; secondary to viral infection and in neutropenia and chronic granulomatous disease; adult mortality rate 10-20%; enterotoxin B aerosol possible biowarfare agent), *Legionella pneumophila* (from soil, water-cooling equipment; 3% of pneumonia cases (0-50% of nosocomial, with 40% mortality); ≈ 300 notified cases/y in Australia; incidence 0.2/100,000 in USA; incubation period 2-10 d; immunocompromised patients (AIDS, chemotherapy, radiation therapy, corticosteroids, underlying immune deficiencies), dialysis patients, late middle-aged to elderly males, chronic underlying disease (organic heart disease, lung disease, renal disease, diabetes), alcoholics and smokers; 5% of community acquired pneumonia requiring ICU admission (20% mortality)), *Legionella micdadei* (Pittsburgh pneumonia, nosocomial pneumonia, particularly in renal transplant and bone marrow transplant recipients), *Streptococcus pyogenes* (in neutropenics), other streptococci (30% of community acquired pneumonia requiring ICU admission, with 19% of these fatal; *Streptococcus agalactiae* (neonates), *Streptococcus milleri,* group C *Streptococcus* (mainly *Streptococcus equisimilis*) rare secondary to tonsillitis and bronchitis, viridans streptococci in neutropenia and chronic granulomatous disease), *Staphylococcus epidermidis* (relatively common nosocomial in neonates), *Mycobacterium tuberculosis* (increased risk in AIDS, immunosuppressive therapy, severe combined immunodeficiency), anaerobes (87% of cases of aspiration pneumonia—50% alone, 50% in combination with aerobes; also necrotising pneumonia—6% mortality; 34% *Fusobacterium nucleatum,* 31% *Prevotella melaninogenica,* 26% microaerophilic streptococci, 21% *Bacteroides fragilis*, 19% *Peptostreptococcus*, 16% *Prevotella oralis*, 15% *Peptococcus*; also *Bacteroides ureolyticus,* other *Prevotella*), uncommon cases due to actinomycetes, *Bordetella bronchiseptica, Haemophilus parainfluenzae,* anthrax (from cattle, swine, horses, wool, hides), *Brucella* (abattoir workers, veterinarians), *Coxiella burnetii* (from goats, cattle, swine), melioidosis (travel to SE Asia, S America), plague (from squirrels, chipmunks, rabbits, rats), tularemia (from rabbits, squirrels, infected fleas or ticks), leptospirosis (from rats, dogs, cats, cattle, swine), *Neisseria meningitidis* (6% of meningococcal infections; occasionally arising as result of spread from meningococcal nasopharyngitis; increased risk in nephrotic syndrome, myeloma, lymphocytic leukemia, immunosuppressive therapy, AIDS, common variable immunodeficiency, X-linked agammaglobulinemia), *Neisseria mucosa*, *Neisseria sicca, Moraxella catarrhalis*, *Chromobacterium violaceum* (in 33% of infections due to this agent), *Clostridium botulinum*, *Vibrio vulnificus* (in drowning victim), *Acinetobacter* (multiple clinical risk factors, especially cigarette smoking and alcoholism; 66% mortality), enterococci, *Corynebacterium pseudodiphtheriticum* (in trauma and immunodeficient), *Salmonella* (in renal transplant recipients), *Actinobacillus actinomycetemcomitans*, *Alcaligenes faecalis*, *Achromobacter xylosoxidans*, *Erwinia herbicola, Aeromonas hydrophila, Pasteurella multocida* (chronic), *Haemophilus aprophilus*, *Streptobacillus moniliformis, Veillonella parvula* (rare), *Enterococcus*, *Listeria monocytogenes*, *Ureaplasma urealyticum*, pertussis, *Rhodococcus equi* in immunocompromised, *Lactobacillus* (ventilator associated); also in 52% of cases of Q fever (febrile, sudden onset); viruses (influenza common in adults, infrequent in children; influenza A and B 47% of community acquired viral pneumonia (10% of total cases in season; influenza A 1% of total adult cases, influenza B 3%; influenza B in 3% of infected pre-school children and 1% of infected young adults; *human human cytomegalovirus* 26% of community acquired viral pneumonia, in AIDS, bone marrow and organ

transplant recipients and others with impaired cell-mediated immunity; parainfluenza 21% of community acquired viral pneumonia; parainfluenza 1, 0.5% of cases in adults; parainfluenza 3, 4%; common in children, 19% of cases in infants; respiratory syncytial virus 3% of community acquired viral pneumonia (increased risk in AIDS, immunosuppressive therapy, severe combined immunodeficiency); adenovirus (1, 2, 3, 5, 7, 21) 3% of adult cases, 2-24% in children; varicella-zoster 0.5% of adult cases, in impaired cell-mediated immunity and normal adults; *Simplexvirus* in impaired cell-mediated immunity; measles; coxsackievirus A7, A9, B1; echovirus 9, 11 (exanthem); parvovirus B19; Mimivirus; rarely other viruses); *Aspergillus* and *Candida* (long-term intravenous catheterisation and broad spectrum antibiotics, neutropenia, chronic granulomatous disease), *Coccidioides immitis* (may present with interstitial granulomatous dermatitis), *Cryptococcus neoformans* (increased risk in AIDS, immunosuppressive therapy, severe combined immunodeficiency), *Histoplasma capsulatum, Mucor, Curvularia lunata* (rare); *Pneumocystis jiroveci* (3-4% of community acquired pneumonia; 0.5% of adult cases; increased risk in AIDS, immunosuppressive therapy, severe combined immunodeficiency), *Paragonimus, Toxoplasma*, *Strongyloides stercoralis* (AIDS, immunosuppressive therapy, severe combined immunodeficiency), other parasites; predisposing factors include congenital anomalies (cleft palate, tracheoesophageal fistula, sequestration of lung), congenital or acquired immune defects, alteration in level of consciousness (seizures, stroke, anesthesia, intoxication, trauma), depressed pulmonary clearance (cigarette smoke, hypoxemia, acidosis, ethanol, uremia), steroids and immunosuppressive agents, mechanical obstruction

Diagnosis: chills, fever, headache, malaise, fatigue, cough (bacterial: productive; viral: non-productive, hoarse, paroxysmal), tachypnea ± chest wall retraction, fine to medium crepitation (rales) on auscultation; evidence of pulmonary infiltration or consolidation on chest X-ray; sputum Gram stain and culture low diagnostic yield **Bacterial**: causes 6% of fever in returned travellers to Australia; sudden onset, severe toxicity, signs of consolidation on physical common, rigours common, high fever (> 39°C), purulent sputum with neutrophils and abundant bacteria on Gram stain, pleuritic chest pain common, white cell count elevated with immature neutrophils, consolidation on X-ray; blood cultures; aspartate and alanine aminotransferase (levels increased with *Legionella, Chlamydia psittaci, Coxiella burnetii*), serum phosphorus (slightly decreased with *Legionella*), erythrocyte sedimentation rate or C-reactive protein (highly elevated in legionnaires disease)

***Streptococcus pneumoniae*:** abrupt onset of variable fever of 38-41°C usually sustained, severe rigours, usually single, shaking chills at onset, productive cough, pleuritic chest pain, productive cough of mucopurulent or rusty (bloody) sputum, shortness of breath, hypoxia, tachypnea, malaise, nausea, vomiting, headache; preceding upper respiratory infection common; herpes labialis frequent; diminished breath sounds, dullness to percussion, crackling, bronchial breath sounds; massive consolidation of entire lung; multilobar involvement in 10-30%; pleural effusion uncommon; empyema in 2%, pericarditis, atelectasis, lung abscess other complications; Gram stain (Gram positive diplococci), semi-quantitative microscopy-directed culture and coagglutination (sensitivity 82-93%, specificity 89%) of carefully collected sputum; rapid immunochromatographic membrane test on urine (sensitivity 66-70%, specificity 90-100%); counterimmunoelectrophoresis (serum sensitivity 45-80%, urine sensitivity 50-66%, sputum sensitivity 27-100%, pleural fluid sensitivity 100%); ELISA; blood urea

≥ 7 mmol/L in 55% of cases, liver function tests abnormal in 24%, serum sodium ≤ 130 mmol/L in 23%, serum albumin ≤ 2.5 g/dL in 41%, white cell count ≥ 15,000/ µL with left shift in 40%

Other Streptococci: hectic fever of 40°C or higher, multiple rigours, productive cough, pleuritic chest pain; purulent sputum, may be blood-streaked, Gram positive cocci in chains in Gram stain; white cell count 20,000-30,000/ µL with left shift; pleural effusion and empyema common; often follows influenza

Legionnaires' Disease (Broad Street Pneumonia, Legionellosis, Legionnaires Pneumonia): world-wide; ≈ 250 notified cases/y in Australia; often derived from showers and water cooling towers, also other industrial, commercial, hospital and domestic environmental sources; no person-to-person transmission; incubation period 2-10 d; risk factors older age, male, heavy smoker, underlying disease associated with immunodeficiency; characterised by extensive inflammation of pulmonary alveolar tissue, often hemorrhagic, with many intra- and extracellular bacilli present in alveoli and respiratory bronchioles; clinical manifestations range from nonprogressive pneumonia with a minimum of extrapulmonary involvement to severe pneumonia with rapidly progressive pulmonary infiltration, severe hypoxia and respiratory failure, with, in many cases, multi-organ dysfunction, including neurological symptoms with frequent central nervous system abnormalities, renal involvement (hematuria, oliguria, proteinuria, renal failure), severe myositis (elevated creatine kinase and lysine dehydrogenase), anemia, hepatic abnormalities (elevated aspartate aminotransferase and bilirubin), high frequency of band neutrophils, and gastrointestinal symptoms; presence of prodromal 'viral-like' illness, dry cough, confusion, diarrhoea, lymphopenia without neutropenia, hyponatremia most useful symptoms; flu-like symptoms, malaise, fever of 39.5-41°C, multiple rigours, shaking chills, nonproductive cough, pleuritic chest pain, tachypnea, rales, sputum mucoid (if present) with rare polys and mononuclear cells and no bacteria on stain, myalgias and arthralgias, watery diarrhoea in 50%, abdominal distension, abdominal pain, nausea and vomiting, relative bradycardia, headache,

confusion, disorientation, delirium, hepatomegaly, dense airspace opacification of upper and lower lobes, patchy infiltrates to frank consolidation on X-ray; culture of sputum, bronchoalveolar lavage, bronchoscopy material, transtracheal aspirate, lung tissue, pleural fluid or blood on charcoal yeast extract agar with and without decontamination with KCl-HCl (sensitivity 80%, specificity 100% but ≈ 1/3 of laboratories incapable of growing organism; turnaround time 3-5 d); detection of specific antigen in respiratory secretions or urine; direct fluorescent (within first 9 d of therapy; sensitivity 25-75%, specificity > 95%; turnaround time 12 h) and indirect fluorescent antibody testing (rise in titre to at least 1:128; sensitivity 60-80%; results may be delayed > 2 mo) of transtracheal aspirate, fresh lung scrapings; radioimmunoassay or enzyme immunoassay of urine (early in disease; sensitivity 85%, specificity 100%; *Legionella pneumophila* serotype 1 only; 24 h turnaround time; positive for days to weeks after initiation of antibiotics); 4X serum antibody rise on complement fixation test (other than serogroup 1; sensitivity 40-60%, specificity 96-99%; turnaround time 24 h) or by direct immunofluorescent antibody test or microagglutination (serogroup 1); immunoalkaline phosphatase staining of lung tissue; polymerase chain reaction of respiratory specimens; blood urea ≥ 7 mmol/L in 58% of cases, liver function tests abnormal in 79%, serum sodium ≤ 130 mmol/L in 53% (syndrome of inappropriate ADH secretion), serum albumin ≤ 2.5 g/dL in 47%, white cell count ≥ 15,000/μL in 84% (mean 18,000/μL, 78% neutrophils, 15% lymphocytes, 7% monocytes, 50% with left shift), pO_2 53 mm Hg; lumbar puncture studies normal

Staphylococcus aureus: more common in neonates and infants < 12 mo; hectic or sustained fever of 39-41°C, multiple rigours, productive cough, pleuritic chest pain; purulent sputum, may be blood-streaked; Gram positive cocci in clusters on Gram stain; white cell count > 15,000/μL with left shift; affects infants, elderly, debilitated, may follow influenza; alveolar disease, pneumatocoeles, empyema, nonspecific pulmonary infiltrate, massive consolidation, lung abscess common; counterimmunoelectrophoresis of pleural fluid (sensitivity 86%)

***Staphylococcus aureus* Enterotoxin B:** incubation period < 4 h; fever (up to 41.1°C) myalgias, headache; respiratory symptoms (dry, non-productive cough, dyspnea, orthopnea, chest pain, crackles) begin ≈ 10 h after exposure; detection of toxin with ELISA or PCR on urine within several hours or in nasal swabs within 24 h

Klebsiella pneumoniae: fever of 38-39°C, multiple rigours, productive cough, pleuritic chest pain; mucopurulent sputum, may be bloody, Gram negative bacilli with thick capsules in Gram stain; white cell count 20,000-40,000/μL with left shift; affects upper lobes, dense infiltrate, abscesses, heavy exudate in lung parenchyma causing downward bulging of horizontal pulmonary fissure, cavitation in 3-5 d of infection; seen in diabetics, alcoholics and patients with chronic lung disease; counterimmunoelectrophoresis of serum (sensitivity 100%), pleural fluid (sensitivity 50%)

Anaerobes: 74% suspected aspiration, 70% pulmonary infection characterised by parenchymal necrosis, 57% subacute or chronic presentation, 53% putrid discharge; fever variable, often low grade, rigours infrequent, productive cough; sputum purulent and foul-smelling, with mixed flora on Gram stain; white cell count variable; associated with periodontal disease and altered state of consciousness; consolidating infiltrate in right lower lobe or upper lobes; lung abscess, empyema common; pulmonary specimens should be obtained by percutaneous transtracheal aspiration, direct lung puncture or double catheter and bronchial brush bronchoscopic specimen; pleural specimens should be obtained by thoracentesis

Pseudomonas aeruginosa: counterimmunoelectrophoresis of serum (sensitivity 100%)

Chlamydophila pneumoniae: mild; mean white cell count ≈ 9100/μL; isolation, microimmunofluorescent antibody, PCR-EIA

Chlamydia trachomatis: conjunctivitis, tachypnea, inspiratory crackles, failure to thrive; diffuse interstitial infiltrates with hyperaeration, peribronchial thickening, scattered areas of atelectasis

Haemophilus influenza: consolidative pneumonia and pleural involvement; isolation from pleural fluid

Other Gram Negative Bacilli: usually high fever, may be absent in elderly, debilitated; multiple rigours; productive cough; purulent sputum, Gram negative bacilli in Gram stain; white cell count variable; affects infants, elderly, debilitated, alcoholics, diabetics, those on antibiotics, steroids or immunosuppressive agents, ventilators; chest CT to exclude underlying fungal cause

Pulmonary Anthrax: incubation period 1-60 d; at first (1-6 d post-exposure), mild signs of upper respiratory tract involvement (fever and chills, malaise, fatigue and lethargy in all, minimal nonproductive cough in 90%, nausea or vomiting in 90%, dyspnea in 80%, sweats, often drenching, in 80%, mild chest discomfort or pleuritic pain in 70%, myalgias in 60%, headache in 50%, confusion in 40%, abdominal pain in 30%, sore throat in 20%, rhinorrhea in 10%; tachycardia, high hematocrit, low albumin and sodium); then, after a few days, several hours to days of improvement, followed by abrupt development of severe respiratory distress, hypoxia, dyspnea, cyanosis, stridor, high temperature, profuse sweating, with shock and death usual within 24-36 h; mediastinal widening with pleural effusions but without infiltrates on

X-ray (computed tomography if inconclusive); Gram stain and culture of nasopharyngeal swab within 48 h of exposure, sputum, pleural fluid later; blood cultures; PCR of pleural fluid or blood if available; ELISA, Western blot, toxin detection, chromatographic assay, fluorescent antibody test; 86% case-fatality rate

Pneumonic Plague: incubation period 1-6 d; severe, rapidly progressing pneumonia; fever, dyspnea, chest pain, cough with bloody, watery or purulent sputum, nausea, vomiting, diarrhoea, abdominal pain, hypotension, altered mentation, oliguria, rarely cervical buboes; WCC 10,000-20,000/μl with neutrophils predominant and toxic granulations; elevated liver enzyme levels; coagulopathy; disseminated intravascualr coagulation in severe cases; culture of blood, sputum or aspirates; direct fluorescent antibody staining, dipstick antigen detection tests; rapid monoclonal antibody test (sensitivity 100%, specificity 100%, positive predictive value 91%, negative predictive value 87%)

Tularemia: severe atypical pneumonia often confused with legionellosis; incubation period 1-14 d followed by influenza-like illness with fever (38-40°C), chills, rigours, myalgias, anorexia, sore throat, cough (usually non-productive), pleuritic chest pain, substernal tightness, dyspnea and pharyngitis; parenchymal infiltrates with patchy, ill-defined and multi-lobar opacities in 74%, pulse-temperature dissociation in nearly half, erythema nodosum, erythema multiforme or maculopapular, vesicular or urticarial rash in 35%, pleural effusions in 20-55%; leucocytosis in 25-42%, elevated transaminase levels, hyponatremia, elevated creatine phosphokinase level, pyuria, myoglobinuria; 35% fatality rate untreated; smear and culture positive in 5%; blood cultures often give false negative; serology, ELISA, immunofluorescence, PCR, antigen skin testing

Mycoplasmal: abrupt or slow onset, with malaise in 74-89% of cases and headache in 60-84%, followed a few days later by fever of 38-40°C in 96-100%, rales/wheezes in 80-84%, chilliness in 58-78%, sore throat in 53-71%, myalgias in 45%, chest discomfort in 42-69%, nasal stuffiness in 29-69%, cervical adenopathy in 18-27%, pharyngeal erythema without exudate in 12-73%, occasional rigours and paroxysmal cough, nonproductive in 93-100%; sputum mucoid if present, with rare polys and no bacteria in Gram stain; complications include skin rashes (usually maculopapular or urticarial, also Stevens-Johnson syndrome and erythema nodosum), otitis (including bullous hemorrhagic otitis), urethritis, glomerulitis, pleurisy, pneumothorax, hyperlucent lung syndrome, lung abscess, anemia (including hemolytic), thrombocytopenia, pericarditis, myocarditis, encephalitis/meningitis in 1/1000 cases (60% encephalitis/meningoencephalitis in slightly older patients; 10% mortality, 20% long term neurological morbidity; aseptic meningitis in younger age group; complete recovery with no neurological sequelae), poliomyelitis-like syndrome, Guillain-Barré syndrome, brain stem syndrome/cerebellar ataxia, psychosis; may be severe and rapidly progressive in children with sickle cell disease; incubation period 12-21 d; children and young adults (4-20 y); community acquisition; person-to-person transmission; 10-25% mild pleural effusion; physical unimpressive though X-ray shows patchy nodular infiltrates, bronchopneumonia often involving a single lower lobe, plate-like atelectasis or hilar adenopathy; lobar consolidation (alveolar-filling disease) rare; may have bullous myringitis; may be suggested by lack of response to penicillins and cotrimoxazole; bedside cold agglutination test 50% sensitivity but ≈ 100% specificity; rising titre of cold agglutinins (sensitivity 50%, specificity 50%); complement fixation test (2-3 w post onset; commercially available; 4X rise sensitivity 54%, not completely specific—may cross-react with *Legionella*); early IgM-ELISA (sensitivity 90%, specificity 75%); culture of bronchoalveolar lavage; all methods lack sensitivity and, except for the ELISA and bedside cold agglutination test if positive, are too slow to influence therapy; a commercially available DNA-RNA probe is very specific but sensitivity has varied between 22% and 100%); neutropenia with relative lymphocytosis becoming neutrophilia; white cell count > 15,000/μL in 87% of cases; myelocytes, metamyelocytes and plasmocytosis; raised ESR; hemolytic anemia occasionally; blood urea ≥ 7 mmol/L in 16%; serum sodium ≤ 130 mmol/L in 5%; serum albumin never < 2.5 g/dL

Differential Diagnosis: psittacosis, Q fever, viral pneumonia (adenovirus, rhinovirus, influenza B, parainfluenza 1, 2 and 3, enteroviruses, respiratory syncytial virus) and, occasionally, legionnaires disease (indirect immunofluorescence for antibody) and tularemia pneumonia (4X rise in direct agglutination test) may give similar symptoms; the 'group' term 'primary atypical pneumonia' is used but serves no useful purpose; other conditions that may mimic include *Pneumocystis jiroveci* pneumonia (in patients with failure of the immune system due to AIDS, steroidal drugs or bone marrow depression), multiply resistant *Streptococcus pneumoniae, Pseudomonas* pneumonia (in granulocytopenia), *Haemophilus influenzae* pneumonia (in hypogammaglobulinemia), respiratory syncytial virus (ELISA for IgG and IgM antibodies), *human human cytomegalovirus* (4X rise in complement fixation test titre), *Ureaplasma urealyticum* (ELISA for IgG, IgM and IgA), *Chlamydia trachomatis* (rise in titre on serial microimmunofluorescence tests)

Ventilator Associated: quantitative endotracheal aspirate (10^5 cfu/ml; sensitivity 93%, specificity 80%) or bronchoalveolar lavage fluid culture; direct E-Test

Viral: incubation period 1-3 d; all ages; person-to-person transmission; underlying disease, smoking, alcohol in some cases; upper respiratory symptoms; pleural effusion rare; gradual onset, myalgia prominent, mild to moderate toxicity,

minimal physical findings (consolidation rare), involvement on X-ray out of proportion to symptoms (usually patchy consolidation at bases of lungs, but also hyperexpansion, parahilar peribronchial infiltrates, atelectasis, hilar adenopathy; lower lobe and perihilar infiltrates in atypical measles and pneumonic infiltrate in one lobe in 2/3 of respiratory syncytial virus cases), rigours uncommon, low grade fever; sputum mucoid (if present) with mononuclear cells and rare bacteria on Gram stain; pleuritic chest pain uncommon; white cell count normal; complement fixation test for influenza A and B, parainfluenza 1 and 3, respiratory syncytial virus, adenovirus; also hemagglutination inhibition, neutralisation, ELISA; viral culture and immunofluorescence of nasopharyngeal aspirate, sputum, throat swab, lung biopsy

Influenza: fever of 39.5-40.5°C, rigours uncommon, nonproductive, hacking cough; headache, photophobia, myalgia, gastrointestinal complaints; sputum scant, may be bloody, rare polys and no bacteria in Gram stain; white cell count 10,000-15,000/μL; seen in patients with chronic lung and heart disease, pregnancy; profound dyspnea, cyanosis; seen in autumn and winter; adult mortality rate 80-90%; viral culture

Adenovirus: most common in < 18 mo; acute onset, high fever (> 39°C), rigours rare, persistent cough, sputum scant with no organisms or polys in Gram stain; associated with lethargy, diarrhoea, pharyngitis, severe conjunctivitis; epidemic in closed populations (up to 10% of military recruits infected; types 4 and 7; 90% of pneumonia hospitalisations); dyspnea, tachypnea, diffuse wheezing, crackles; diffuse bilateral infiltrates, interstitial and peribronchial, with hyperinflation and lobar collapse and hilar adenopathy, on X-ray; pleural effusions extremely rare; may progress to hepatosplenomegaly, myocarditis, nephritis, hematological abnormalities and a disseminated intravascular coagulation-like picture; mortality rate (type 7) ≈ 60% in immunocompromised and ≈ 20% in young infants; sequelae (bronchiolitis obliterans, bronchiectasis, unilateral hyperlucent lung) associated with abnormal pulmonary function in up to 60%; white cell count < 10,000/μL; direct fluorescent antibody staining of tracheal or nasopharayngeal aspirate

Echovirus: low grade fever, rigours rare, cough variable, sputum scant with no organisms or polys in Gram stain; white cell count < 10,000/μL; rash may be present; seen in summer

Respiratory syncytial virus: more common in winter; fever of 38-40°C in 60%, rigours rare, cough variable, frequent wheezing, sputum scant with no organisms or polys in Gram stain; white cell count 10,000-20,000/μL; seen primarily in children; X-ray changes often more severe than in other viral; direct fluorescent staining or ELISA on tracheal or nasopharyngeal aspirate; culture of tracheal aspirate

Parainfluenza: fever of 38-40°C, rigours rare, cough variable, may have 'croup'; sputum scant with no organisms or polys in Gram stain; white cell count < 10,000/μL; seen primarily in children; direct fluorescent antibody staining of tracheal or nasopharyngeal aspirate

Varicella: early in disease; fever up to 40.5°C; rigours rare, cough harsh and nonproductive; sputum scant, though may be bloody, no organisms in Gram stain; white cell count < 10,000/μL; rare in children; affects 15-30% of adults with varicella; nodular densities on X-ray, later calcify

Differentiation From Secondary Bacterial Pneumonia In Varicella: latter usually children < 7 y, late in disease, white cell count elevated with left shift, positive sputum and (occasionally) blood cultures, segmented or lobar infiltrate or consolidation

Human human cytomegalovirus: culture of tracheal aspirate

Pneumocystis jiroveci: Wright-Giemsa, Papanicolaou, methenamine silver staining, direct immunofluorescence of induced sputum (sensitivity 30-90%), bronchoalveolar lavage (sensitivity 98-100%), pulmonary biopsy (sensitivity 90-95%)

Paragonimus: Far East, Latin America; incidence 5M/y; abnormal chest X-ray (infiltration, cavities, pleural effusion) in 88% of cases; ova in sputum or feces; complement fixation test

Differential Diagnosis: pulmonary infarction, acute bronchitis, pulmonary tuberculosis, congestive heart failure, lung abscess

Treatment: supplemental oxygen, analgesia for pleuritic chest pain, bronchodilators to treat airflow limitation or to improve mucociliary clearance, physiotherapy, hydration, electrolytes, nutrition, control of co-morbidities as required

Community Acquired

Birth to 1 w: benzylpenicillin 60 mg/kg i.v. 12 hourly for 7 d + gentamicin (< 30 w gestation: 2.5-3 mg/kg; > 30 w gestation: 3.5 mg/kg) i.v. daily for 7 d

1 w to < 4 mo

Afebrile and Mildly to Moderately Ill: azithromycin 10 mg/kg orally daily for 5 d or clarithromycin 7.5 mg/kg orally 12 hourly for 7 d (not < 1 mo) or erythromycin 10 mg/kg orally or i.v. 6 hourly for 7-14 d (not < 1 mo) or erythromycin ethyl succinate 20 mg/kg orally 6 hourly for 7-14 d (not < 1 mo)

Febrile or *Chlamydia* Excluded: benzylpenicillin 30 mg/kg i.v. 6 hourly for 7 d

Severe Disease: cefotaxime 25 mg/kg i.v. 8 hourly for 7 d

4 mo to < 5 y

Mild: amoxycillin 25 mg/kg orally 8 hourly for 7 d

Moderate: benzylpenicillin 30 mg/kg i.v. 6 hourly for 7 d [if hospitalisation difficult, procaine penicillin (3 - < 6 kg: 250 mg; 6 - < 10 kg: 375 mg; 10 - < 15 kg: 500 mg; 15 - < 20 kg: 750 mg) i.m. daily for 5 d]

Severe:

Tropical Australia with Diabetes, Cystic Fibrosis, Congenital Heart Disease: meropenem 25 mg/kg to 1 g i.v. 8 hourly

Others: cefotaxime 25 mg/kg i.v. 8 hourly for 7 d, ceftriaxone 25 mg/kg i.v. daily for 7 d + di/flucloxacillin 50 mg/kg i.v. 6 hourly for 7 d

5-15 y

Mild: amoxycillin 25 mg/kg to 1 g orally 8 hourly for 7 d + clarithromycin 7.5 mg/kg to 250 mg orally 12 hourly for 7 d or roxithromycin 4 mg/kg to 150 mg orally 12 hourly for 7 d

More Serious:

Tropical Australia with Diabetes, Cystic Fibrosis, Congenital Heart Disease: meropenem 25 mg/kg to 1 g i.v. 8 hourly + clarithromycin 12.5 mg/kg to 500 mg orally 12 hourly for 7 d or roxithromycin 4 mg/kg to 150 mg orally 12 hourly for 5 d

Others: benyzlpenicillin 30 mg/kg to 1.2 g i.v. 6 hourly for 7 d [if hospitalisation difficult, procaine penicillin (3 - < 6 kg: 250 mg; 6 - < 10 kg: 375 mg; 10 - < 15 kg: 500 mg; 15 - < 20 kg: 750 mg) i.m. daily for 5 d] + clarithromycin 12.5 mg/kg to 500 mg orally for 7 d or roxithromycin 4 mg/kg to 150 mg orally 12 hourly for 5 d

Adult: calculate PSI score: to patient age in years (male) or patient age in years - 10 (female), add (for each listed condition): 30 if neoplastic disease, arterial pH < 7.35; 20 if liver disease, acutely altered mental state, respiratory rate ≥ 30/min, systolic blood pressure < 90 mm Hg, serum urea ≥ 11 mmol/L, serum sodium < 130 mmol/L; 15 if temperature < 35°C or ≥ 40°C; 10 if nursing home patient, congestive cardiac failure, cerebrovascular disease, chronic renal disease, pulse rate ≥ 125/min, serum glucose ≥ 14 mmol/L, hematocrit < 30%, pO_2 < 60 mmHg or O_2 ≤ 90% saturation, pleural effusion on chest X-ray

PSI Score ≤ 70: 30 d mortality 0.1-0.6%; treat as outpatient with amoxycillin 1 g orally 8 hourly for 7 d (procaine penicillin 1.5 g i.m. daily if oral therapy unsuitable) + doxycycline 200 mg orally first dose then 100 mg daily for further 5 d or roxithromycin 300 mg orally daily for 5 d

Non-immediate Penicillin Hypersensitivity: replace amoxycillin with cefuroxime 500 mg orally 12 hourly for 7 d

Immediate Penicillin Hypersensitivity: moxifloxacin 400 mg orally daily for 7 d as single drug

PSI Score 71-130: 30 d mortality 0.9-9.3%; treat in ward or as hospital in home

Tropical Australia with Diabetes, Alcoholism, Chronic Renal Failure or Chronic Lung Disease: gentamicin 4-6 mg/kg i.v. daily + ceftriaxone 2 g i.v. daily

Others: benzylpenicillin 1.2 g i.v. 6 hourly or amoxy(ampi)cillin 1 g i.v. 6 hourly until significant improvement then amoxycillin 1 g orally 8 hourly for total 7 d + doxycycline 100 mg orally daily for further 7 d or clarithromycin 500 mg orally 12 hourly for 7 d or roxithromycin 300 mg orally daily for 5 d

Non-immediate Penicillin Hypersensitivity: replace penicillin with ceftriaxone 1 g i.v. daily or cefotaxime 1 g i.v. 8 hourly until significant improvement then cefuroxime 500 mg orally 12 hourly for total 7 d

Immediate Penicillin Hypersensitivity: moxifloxacin 400 mg orally daily for 7 d

PSI Score > 130: 30 d mortality 27%; consider ICU admission

Non-tropical Regions: azithromycin 500 mg i.v. daily or erythromycin 0.5-1 g i.v. 6 hourly (preferably through central line) + ceftriaxone 1 g i.v. daily or cefotaxime 1 g i.v. 8 hourly or [benzylpenicillin 1.2 g i.v. 4 hourly + gentamicin 4-6 mg/kg i.v. daily (adjust dose for renal function)]

Immediate Penicillin Hypersensitivity: azithromycin or erythromycin + moxifloxacin 400 mg i.v. daily

Tropical Australia With Diabetes, Alcoholism, Chronic Renal Failure or Chronic Lung Disease: meropenem 25 mg/kg to 1 g i.v. 8 hourly or imipenem 25 mg/kg to I g i.v. 6 hourly + azithromycin 500 mg i.v. daily or erythromycin 500 mg to 1 g i.v. 6 hourly (preferably through central line)

Aspiration Pneumonia: benzylpenicillin 30 mg/kg to 1.2 g i.v. 6 hourly + metronidazole 12.5 mg/kg to 500 mg i.v. or 10 mg/kg to 400 mg orally 12 hourly till significant improvement then amoxycillin-clavulanate 22.5/3.2 mg/kg to 875/125 mg orally 12 hourly

Immediate Penicillin Hypersensitivity: clindamycin 10 mg/kg to 450 mg i.v. or orally 8 hourly or lincomycin 15 mg/kg to 600 mg i.v. 8 hourly till significant improvement then clindamycin 10 mg/kg to 450 mg orally 8 hourly

Gram Negative Suspected (e.g, Alcoholic): metronidazole 12.5 mg/kg to 500 mg i.v. or 10 mg/kg to 400 mg orally 12 hourly + ceftriaxone 25 mg/kg to 1 g i.v. daily or cefotaxime 25 mg/kg to 1 g i.v. 8 hourly; piperacillin-tazobactam 100/12.5 mg/kg to 4/0.5 g i.v. 8 hourly or ticarcillin-clavulanate 50/1.7 mg/kg to 3/0.1 g i.v. 6 hourly as single agent

Hospital-acquired

Low Risk of Multidrug Resistant Organisms:

Mild: amoxycillin-clavulanate 22.5/3.2 mg/kg to 875/125 mg orally 12 hourly for 7 d or if unable to take oral therapy benzylpenicillin 30 mg/kg to 1.2 g i.v. 6 hourly + gentamicin 4-6 mg/kg (< 10 y: 7.5 mg/kg; child ≥ 10 y: 6 mg/kg) i.v. daily (adjust dose for renal function)

Penicillin Hypersensitive (Not Immediate) or Creatinine Clearance < 20 mL/min): cefuroxime 10 mg/kg to 500 mg orally 12 hourly for 7 d

Immediate Penicillin Hypersensitivity: moxifloxacin 400 mg orally daily for 7 d (adults only)

Moderate or Severe: ceftriaxone 25 mg/kg to 1 g i.v. daily, cefotaxime 25 mg/kg to 1 g i.v. 8 hourly, ticarcillin-clavulanate 50 + 1.7 mg/kg to 3 + 0.1 g i.v. 6 hourly, benzylpenicillin 30 mg/kg to 1.2 g i.v. 6 hourly + gentamicin 4-6 mg/kg (< 10 y: 7.5 mg/kg; child ≥ 10 y: 6 mg/kg) daily (adjust dose for renal function)

Immediate Penicillin Hypersensitivity: moxifloxacin 400 mg orally or i.v. daily for 7 d (adults only)

Diabetes, Coma, Renal Failure or Head Injury: di(flu)cloxacillin 50 mg/kg to 2g i.v. 6 hourly + gentamicin (< 10 y: 7.5 mg/kg; child ≥ 10 y: 6 mg/kg; adult: 4-6 mg/kg) i.v. daily

MRSA Proven: vancomycin 20 mg/kg to 1 g i.v. 12 hourly

High Risk of Multidrug Ressitant Organisms: gentamicin (< 10 y: 7.5 mg/kg; child ≥ 10 y: 6 mg/kg; adult: 4-6 mg/kg) i.v. daily + piperacillin-tazobactam 100/12.5 mg/kg to 4/0.5 g i.v. 8 hourly or ticarcillin-clavulanate 50/1.7 mg/kg to 3/0.1 g i.v. 6 hourly or (if penicillin hypersensitive) cefepime 50 mg/kg to 2 g i.v. 12 hourly; if high prevalence of MRSA, add vancomycin 20 mg/kg to 1 g i.v. 12 hourly; if indicated by susceptibility testing, imipenem 25 mg/kg to 1 g i.v. 6 hourly or meropenem 25 mg/kg to 1 g i.v. 8 hourly; if immunosuppressed, on high-dose steroids, diabetic, with malignancy or end-stage renal failure, history of smoking or excessive alcohol usage, or known local prevalence of hospital-acquired *Legionella*, add erythromycin 10 mg/kg to 0.5-1 g i.v. 6 hourly or ciprofloxacin 10 mg/kg to 400 mg i.v. or 500-750 mg orally 12 hourly

Streptococcus pneumoniae: broad spectrum cephalosporin + vancomycin until sensitivities available

Penicillin MIC < 2 mg/L: benzylpenicillin 30 mg/kg to 1.2 g i.v. 6 hourly until significant improvement, then amoxycillin 25 mg/kg to 1 g orally 8 hourly for total 7 d

Penicillin Hypersensitive (Not Immediate): ceftriaxone 25 mg/kg to 1 g i.v. daily until significant improvement, then cefuroxime 10 mg/kg to 500 mg orally 12 hourly for total 7 d

Immediate Penicillin Hypersensitivity: moxifloxacin 400 mg orally or i.v. daily for 7 d

Penicillin MIC ≥ 2 mg/L: vancomycin

Other Streptococci, *Neisseria meningitidis*: penicillin, erythromycin; drainage of purulent material from pleural space

***Haemophilus influenzae*:** amoxycillin 25 mg/kg to 1 g orally 8 hourly for 7-14 d, benzylpenicillin 30 mg/kg to 1.2 g i.v. 6 hourly for 7-14 d, amoxycillin-clavulanate 22.5 + 3.2 mg/kg to 875 + 125 mg orally 12 hourly for 7-14 d, cefotaxime 25 mg/kg to 1 g i.v. 8 hourly for 7-14 d, ceftriaxone 25 mg/kg to 1 g i.v. daily for 7-14 d, cefuroxime 10 mg/kg to 500 mg orally 12 hourly for 7-14 d, doxycycline 2.5 mg/kg to 100 mg orally 12 hourly for 7-14 d (not < 8 y)

Staphylococcus aureus: di(flu)cloxacillin 50 mg/kg to 2 g i.v. 6 hourly for 4-6 w, cephalothin 50 mg/kg to 2 g i.v. 6 hourly for 4-6 w, cephazolin 50 mg/kg to 2 g i.v. 8 hourly for 4-6 w; substitute vancomycin 25 mg/kg (< 12 y: 30 mg/kg) to 1 g i.v. over 60 min 12 hourly (monitor blood levels and adjust dose accordingly) for 4-6 w if methicillin resistant suspected or proven or if severe penicillin hypersensitivity

Staphylococcus aureus **Enterotoxin B:** supplemental oxygen, hydration, pain relievers

Mycoplasma pneumoniae, ***Chlamydophila pneumoniae***, ***Chlamydophila psittaci:*** doxycycline 200 mg orally first dose then 100 mg orally daily for 14 d (not in pregnant or children < 14 y), clarithromycin 7.5 mg/kg to 250 mg orally 12 hourly for 14 d, roxithromycin 300 mg orally daily (child: 4 mg/kg to 150 mg orally 12 hourly) for 4 d

Moraxella catarrhalis: amoxycillin-clavulanate 500/125 mg orally 8 hourly (< 40 kg: 40/10 mg/kg/d in 3 equally divided doses) for 7-10 d, erythromycin 500 mg i.v. 6 hourly (child: 50 mg/kg/d to maximum 2 g/d i.v. in divided doses) for 10 d

Anaerobes:

Mild: amoxycillin-clavulanate 500/125 mg orally 8 hourly (child: 40/10 mg/kg/d to maximum 1.5/0.375 g/d in 3 equally divided doses) for 7-10 d; ampicillin-sulbactam

Moderate to Severe: benzylpenicillin 1.2 g i.v. 4 hourly (neonates: 60 mg/kg/d in 3 or 4 divided doses; child < 45 kg: 150 mg/kg/d in 6 divided doses) for 10-14 d ± metronidazole 500 mg i.v. infused over 20 min 8 hourly for 1-2 d then 200-400 mg orally 8 hourly or 0.5-1 g rectally 8 hourly for 10-14 d; clindamycin 600 mg i.v. diluted in 100 mL and infused over at least 30 min 8 hourly (child: 15-25 mg/kg/d to maximum 1.8 g i.v. in 3 or 4 divided doses) then 150-300 mg orally 6 hourly

Legionella pneumophila**:** azithromycin 500 mg i.v. or orally daily or doxycycline 100 mg i.v. or orally 12 hourly or erythromycin 7.5 mg/kg to 500 mg to 1 g i.v. (preferably through central line) 6 hourly or 500 mg orally 6 hourly or erythromycin ethyl succinate 800 mg orally 6 hourly + (very severe cases requiring ICU) ciprofloxacin 400 mg i.v. or 750 mg orally 12 hourly or rifampicin 7.5 mg/kg to 600 mg i.v. or orally daily for 7-14 d if immunocmpetent or 14-21 d if immunocompromised

Chromobacterium violaceum: chloramphenicol

Francisella tularensis**:** streptomycin or gentamicin for 10 d

Vibrio vulnificus**:** doxycycline 100 mg orally or i.v. twice daily + ceftazidime 2 g i.v. 3 times a day or ciprofloxacin 400 mg twice a day for 3 d or gentamicin

Pseudomonas aeruginosa: gentamicin 4-6 mg/kg (< 10 y: 7.5 mg/kg; child ≥ 10 y: 6 mg/kg) i.v. daily (adjust dose dor renal function) + piperacillin 50-75 mg/kg to 3-4 g i.v. 6 hourly or cefepime 50 mg/kg to 2 g i.v. 12 hourly or ceftazidime 50 mg/kg to 2 g i.v. 8 hourly or ciprofloxacin 10 mg/kg to 400 mg i.v. or 15 mg/kg to 750 mg orally 12 hourly for 14-21 d

Burkholderia cepacia: imipenem

Burkholderia pseudomallei: cotrimoxazole + ceftazidime or meropenem or imipenem

Stenotrophomonas maltophilia**:** cotrimoxazole

Enterobacter, Serratia: gentamicin 5 mg/kg i.v. daily (child: 7.5 mg/kg/d i.v. in 1-3 divided doses) + meropenem 10 mg/kg to 500 mg i.v. 8 hourly or ciproflxacin 5 mg/kg to 200 mg i.v. 8 hourly for 7-14 d

Acinetobacter baumannii: meropenem 25 mg/kg to 1 g i.v. 8 hourly; colistin

Other Aerobic Gram Negative Bacilli (Including *Klebsiella pneumoniae*): cefotaxime 25 mg/kg to 1 g i.v. 8 hourly for 7-14 d, ceftriaxone 25 mg/kg to 1 g i.v. daily for 7-14 d, gentamicin 4-6 mg/kg (< 10 y: 7.5 mg/kg; child ≥ 10 y: 6 mg/kg) daily (adjust dose for renal function) for 7-14 d, piperacillin-tazobactam 100 + 12.5 mg to 4 + 0.5 g i.v. 8 hourly for 7-14 d, ticarcillin + clavulanate 50 + 1.7 mg/kg to 3 + 0.1 g i.v. 6 hourly for 7-14 d, ciprofloxacin 10 mg/kg to 400 mg i.v. or 15 mg/kg to 750 mg orally 12 hourly for 7-14 d, meropenem 12.5 mg/kg to 500 mg i.v. 8 hourly for 7-14 d

Corynebacterium pseudodiphtheriticum: vancomycin ± tobramycin

Rhodococcus equi: vancomycin ± imipenem for at least 3 w, then oral rifampicin + macrolide or tetracycline for at least 2 mo

Anthrax: ciprofloxacin 10 mg/kg to 400 mg i.v. every 12 h or doxycycline 2.5 mg/kg to 100 mg i.v. every 12 h (not < 8 y) + rifampicin, vancomycin, benzylpenicillin, clindamycin, chloramphenicol, imipenem, amoxy/ampicillin or clarithromycin for 14-21 d then ciprofloxacin 15 mg/kg to 500 mg orally 12 hourly or doxycycline 2.5 mg/kg to 100 mg orally 12 hourly (not < 8 y) or amoxycillin 15 mg/kg to 500 mg orally 8 hourly for total 60 d

Plague: gentamicin 4-7.5 mg/kg i.v. daily, doxycycline 5 mg/kg to 200 mg i.v. then 2.5 mg/kg to 100 mg i.v. twice daily (not < 8 y), ciprofloxacin 15 mg/kg to 400 mg i.v. twice daily, chloramphenicol 25 mg/kg i.v. 4 times a day

Lactobacillus: vancomycin i.v. for 14 d

Influenza A: amantidine or rimantidine

Adenovirus: ribavirin i.v. loading dose 30 mg/kg/d then 15 mg/kg/d in divided doses every 6 h

Pneumocystis jiroveci:

Mild to Moderate (PaO_2 > 70 mm Hg, Alveolar-Arterial Gradient > 35 mm Hg, Oxygen Saturation > 94%): cotrimoxazole 5 + 25 mg/kg to 7 + 35 mg/kg orally 8 hourly for 21 d or (if sulphamethoxazole contraindicated) dapsone 1-2 mg/kg to 100 mg orally daily + trimethoprim 5 mg/kg to 300 mg orally 8 hourly for 21 d or (if hypersensitive to cotrimoxazole) atovaquone 750 mg orally 12 hourly for 21 d

Severe: cotrimoxazole 5 + 25 mg/kg orally or i.v. 6 hourly for 21 d or pentamidine 4 mg/kg to 300 mg i.v. daily for 21 d if unresponsive + prednis(ol)one 1 mg/kg to 40 mg orally 12 hourly for 5 d then daily for 5 d then 0.5 mg/kg to 20 mg daily for 11 d in HIV

Paragonimus: praziquantel, bithionol

Prophylaxis:

Streptococcus pneumoniae: 23-valent polysaccharide vaccine 80% efficacy; fever 4%, severe systemic reaction 0.01%, risk of Arthus reaction with second dose; duration of immunity 3-8 y, cost-benefit ratio 0.13-0.77 for all adults, 0.38-2.32 for high risk adults (those with cardiovascular disease and chronic pulmonary disease entailing increased morbidity from respiratory infections, alcoholism, cirrhosis of liver, CSF leaks, HIV infection, lymphoma, leukemia, diabetes mellitus, Hodgkin's disease, immunosuppression, multiple myeloma, generalised malignancy, chronic renal failure, postrenal transplant, postsplenectomy, skull fractures with recurrent pneumococcal meningitis, splenic dysfunction, otherwise healthy adult ≥ 65 y); also consider for children ≥ 2 y with anatomic splenectomy or functional asplenia associated with sickle cells, CSF leaks, immunosuppression, nephrotoxic syndrome, splenectomy

***Haemophilus influenzae* type b:** given to index case before discharge, and within 7 d to all household contacts of index case, including incompletely immunised children < 4 y and any immunocmpromsed child; also adults and children at day care centres with 2 or more cases of invasive disease in 60 d period and with incompletely immunised children; rifampicin 20 mg/kg to maximum 600 mg (child < 1 mo: 10 mg/kg) orally daily for 4 d (not pregnant; give ceftriaxone 1 g in lignocaine hydrochloride 1% i.m. as single dose); vaccine to index case under 2 y even if previous immunisation and to unvaccinated contacts < 5 y; all children should be routinely vaccinated beginning at 2 mo (95-100% efficacy; swelling, redness and pain at injection site in 5-30%, fever and irritability uncommon, serious reactions rare; contraindicated if anaphylaxis to vaccine components or previous dose and serious illnesses)

Neisseria meningitidis: ceftriaxone 250 mg (< 15 y: 125 mg) i.m. as single dose (preferred if pregnant), ciprofloxacin 500 mg orally as single dose (not < 12 y; preferred for women taking oral contraceptive), rifampicin 10 mg/kg (< 1 mo: 5 mg/kg) to 600 mg orally 12 hourly for 2 d (not pregnant, alcoholic, severe liver disease; preferred for children); vaccines (quadrivalent polysaccharide, quadrivalent conjugate, and serogroup conjugate) available

Ventilator-associated Pneumonia: chest physiotherapy

Anthrax (Post-exposure): doxycycline 2.5 mg/kg to 100 mg orally twice daily for 60 d (not < 8 y), ciprofloxacin 15 mg/kg to 500 mg orally twice daily for 60 d, amoxycillin 15 mg/kg to 500 mg orally 3 times daily for 60 d; consider 3 doses of anthrax vaccine 0, 2 and 4 w after exposure

Tularemia (Post-exposure): doxycycline 2 mg/kg to 100 mg orally 12 hourly for 14 d

Plague (Postexposure): doxycycline 2.5 mg/kg to 100 mg orally 12 hourly (not < 8 y), ciprofloxacin 15 mg/kg to 500 mg orally 12 hourly

Asplenic and Postsplenectomy: pneumococcal, meningococcal, Hib and standard schedule immunisation (including annual influenza); antibiotic prophylaxis in asplenic children < 5 y, children < 5 y with sickle cell anaemia, for at least 2 y following splenectomy and patients with severe underlying immunosuppression: amoxycillin 125 mg orally 12 hourly (< 2 y: 20 mg/kg orally daily) or phenoxymethylpenicillin 250 mg (< 2 y: 125 mg) orally 12 hourly or if penicillin hypersensitive roxithromycin 4 mg/kg to 150 mg orally daily or erythromycin 250 mg orally daily or erthryomycin ethyl succinate 400 mg orally daily

Cirrhotic Patient with Gastrointestinal Bleeding: norfloxacin 400 mg orally commencing 1 h before endsocopy and then 12 hourly for 1-2 d or if oral therapy not feasible ciprofloxacin 400 mg i.v. at time of induction and then 12 hourly for 1-2 d

Necrotising Pneumonia: extensive destruction of lung tissue resulting in formation of multiple small abscess cavities; often fatal

Agents: *Pseudomonas aeruginosa, Klebsiella pneumoniae, Proteus mirabilis,* other Enterobacteriaceae, anaerobes, Panton-Valentine leukocidin positive strains of *Staphylococcus aureus* (young patients)

Diagnosis: culture of lung aspirate

Treatment: broad spectrum penicillin + aminoglycoside

Cystic Fibrosis (Mucoviscoidosis): patients often suffer from chronic bacterial pulmonary infection

Organisms: *Pseudomonas aeruginosa* in 30-40% of patients (colonisation to severe necrotising bronchopneumonia; mucoid strains in chronic infection), *Burkholderia cepacia* in 10-40% (associated with accelerated lung disease, sepsis and necrotising pneumonia), *Haemophilus influenzae* and *Staphylococcus aureus* common; also, *Stenotrophomonas maltophilia, Pseudomonas alcaligenes, Achromobacter xylosoxidans, Acinetobacter baumanii, Ralstonia, Pandoraea, Mycobacterium abscessus,* fungi and yeasts

Diagnosis: sputum culture

Treatment:

Haemophilus influenzae: amoxycillin-clavulanate 500/125 mg orally 8 hourly (< 40 kg: 40/10 mg/kg orally daily in divided doses) + probenecid 500 mg orally 6 hourly (child: 10-15 mg/kg orally daily in divided doses); in penicillin allergy: erythromycin 500 mg orally 6 hourly (child: 50 mg/kg orally daily in divided doses) ± rifampicin 600-1200 mg (child: 15-20 mg/kg) orally daily in divided doses, or cotrimoxazole 160/800 mg (6 w - 5 mo: 20/100 mg; 6 mo - 5 y: 40/200 mg; 6-12 y: 80/400 mg) orally 12 hourly; ceftazidime 150 mg/kg to maximum 6 g i.v. daily in divided doses for 2 weeks; aztreonam (1 w - 2 y: 30 mg/kg; > 2 y: 50 mg/kg) i.v. 6 hourly ± amikacin 1.5 mg/kg i.v. daily in 2 or 3 divided doses

***Pseudomonas aeruginosa*:**

First Isolate: colistin 1 MU inhaled twice daily + oral ciprofloxacin for 3 w

Second Isolate: colistin 2 MU inhaled 3 times daily + oral ciprofloxacin for 3 w

Third Isolate Within 6 mo: colistin 2 MU inhaled 3 times daily + oral ciprofloxacin for 3 mo

Chronic Infection: chronic suppressive inhalation therapy with colistin 1 MU twice daily or tobramycin 80 mg twice daily, alternated monthly

Acute Exacerbation:

First Line: ciprofloxacin

Second Line: ticarcillin 200-300 mg/kg i.v. daily in 4-6 equally divided doses or piperacillin 100-300 mg/kg/d to 16 g i.v. in 3 divided doses + tobramycin (pediatric: 6-7.5 mg/kg/d i.v. in 3-4 divided doses daily; adults: 8-10 mg/kg/d i.v. in 3-4 divided doses daily)

Third Line: piperacillin-tazobactam or ticarcillin-clavulanate + tobramcyin

Fourth Line or Penicillin Hypersensitive: ceftazidime 100-150 mg/kg/d to 2 g (paediatric) or 3 g (adult) 3 times daily + tobramycin

Fifth Line: aztreonam + tobramycin

Sixth Line: imipenem or meropenem 25-40 mg/kg to 2 g i.v. 8 hourly

Seventh Line: high dose ceftazidime + tobramycin + oral chloramphenicol or trimethoprim or doxycycline

clarithromycin and azithormycin lead to improvement in respiratory function through inhibition of alginate production by mucoid strains; possible benefit of piroxicam (NSAID)

Burkholderia cepacia: tobramycin aerosol + i.v. meropenem + i.v. ceftazidime, chloramphenicol, cotrimoxazole or aztreonam; amiloride aerosol + tobramycin aerosol

Stenotrophomonas maltophilia: cotrimoxazole, doxycycline, timentin

Achromobacter xylosoxidans: colistin, minocycline, imipenem, meropenem, piperacillin, piperacillin-tazobactam

Acinetobacter baumanii: polymyxin B, sulbactam

Staphylococcus aureus: cloxacillin/flucloxacillin 2 g i.v. 4 hourly (< 2 y: ¼ dose; 2-10 years: ½ dose) + fusidic acid 500 mg orally 8 hourly (child: 50 mg/kg orally daily in divided doses) + probenecid 500 mg orally 6 hourly (child: 10-15 mg/kg orally daily in divided doses) for 14 d; in persistent infection, methicillin 500 mg by inhalation 12 hourly may be added; in penicillin allergy, use rifampicin 500 mg orally 12 hourly (child: 15 mg/kg orally daily in divided doses) + fusidic acid

Mycobacterium abscessus: dependent on susceptibility tests

Prophylaxis: *Haemophilus influenzae* type b conjugate vaccine (diphtheria toxoid conjugate) at 18 mo or older

Neonatal Pneumonia

Agents: *Streptococcus pneumoniae*, *Staphylococcus aureus*, *Streptococcus agalactiae* (early onset; 75% mortality), *Ureaplasma urealyticum, Simplexvirus* (onset days 3-14)

Diagnosis: chest X-ray; Gram stain and culture of gastric aspirate, pleural fluid or lung aspirate

Staphylococcus aureus: alveolar disease, consolidation, presence of air bronchograms and pleural effusions on X-ray

Herpes: prominent hila with central interstitial infiltrate on X-ray; thrombocytopenia, evidence of disseminated intravascular coagulation, elevated liver function tests, lymphoid pleocytosis in CSF; vesicular skin lesions may be present; antigen tests and culture

Treatment:

Ureaplasma urealyticum: erythromycin

Other Bacteria: benzylpenicillin 60-120 mg/kg/d i.v. in 4-6 divided doses for 7-10 d + cloxacillin

Herpes: aciclovir

Primary Pneumonia in Infants (Eosinophilic Pertussoid Syndrome of Infancy): interstitial pneumonia affecting 1-2% of infants aged 1-4 mo (50% with conjunctivitis); transmitted from infected mothers during parturition; similar symptoms in AIDS

Agent: *Chlamydia trachomatis*; note that *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Staphylococcus aureus* may also cause pneumonia in infants

Diagnosis: no or low grade fever, no rigours, somewhat pertussis-like staccato paroxysmal cough with wheezing but without an inspiratory whoop; no bacteria on Gram stain of sputum; absolute increase in eosinophils in blood smear; diffuse interstitial infiltrates and hyperinflation, peribronchial thickening and scattered areas of atelectasis on X-ray; immunofluorescence; serology (complement fixation test; IgM or high sustained IgG)

Treatment: erythromycin base or ethylsuccinate 50 mg/kg/d orally in 4 divided doses for 14 d

Tuberculous Pneumonia: occurs especially in impaired cell-mediated immunity and in 4% of tuberculous patients with underlying neoplasia (100% mortality in these cases)

Agent: *Mycobacterium tuberculosis*

Diagnosis: remittent or intermittent fever of 38-38.5°C, rigours rare, cough variable, usually productive; white cell count < 10,000/μL; seen in children and the elderly; may be rapidly progressive; exposure to known tuberculosis source; upper lobe infiltrate; Ziehl-Neelsen stain and mycobacterial culture of sputum; PCR (sensitivity 90%, specificity 99.6%)

Treatment: rifampicin 10 mg/kg to 600 mg orally 1 h before breakfast daily or 15 mg/kg to 600 mg orally 3 times weekly for 6 mo + isoniazid 10 mg/kg to 300 mg orally daily or 15 mg/kg to 600 mg orally 3 times weekly for 6 mo [+ pyridoxine 25 mg (breastfed baby: 5 mg) with each dose] + ethambutol 15 mg/kg orally daily or 30 mg/kg orally 3 times weekly (not < 6 y) for 2 mo or until known to be susceptible to rifampicin and isoniazid (to 6 mo) + pyrazinamide 25 mg/kg to 2 g orally 8 daily or 50 mg/kg to 3 g orally 3 times a week for 2 mo or 6 mo if not known to be suceptible to rifampicin and isoniazid

Prophylaxis: isoniazid 10 mg/kg to 300 mg orally daily for 6-9 mo in recent tuberculin converters, children with positive tuberculin reactions, persons with inactive tuberculosis who are immunosuppressed (HIV, long-term corticosteroids, immunosuppressive or cytotoxic drugs, radiotherapy)

Diffuse Interstitial Pneumonia

Agents: 36% *Pneumocystis jiroveci* (occurs in 85% of AIDS patients; associated with corticosteroids in 77% of non-AIDS patients; also in other adults with an impaired immune response, especially chemotherapeutically immunosuppressed, T cell deficiency; also plasma cell pneumonia in newborn infants); Gram negative enteric and non-fermentative aerobic bacilli (in granulocytopenia), *Streptococcus pyogenes, Staphylococcus aureus* (in granulocytopenia), *Nocardia asteroides* (in T cell deficiency), *Mycobacterium* (in T cell deficiency; *M.avium-intracellulare* hot tub lung in immunocompetent), *Rhodococcus equi* (in immunocompromised patients), *Aspergillus* (in granulocytopenia), *Mucor* (in granulocytopenia), *Absidia, Rhizopus, Candida, Cryptococcus neoformans* (in T cell deficiency and AIDS), *Histoplasma capsulatum, Coccidioides immitis, human human cytomegalovirus* (≈ 50% of cases in allogenic bone marrow transplant recipients), *human herpesvirus 3*, *Simplexvirus* (in T cell deficiency), *Strongyloides stercoralis, Toxoplasma gondii,* ? *Mycoplasma*, ? *Ureaplasma*; 27% due to underlying disease (particularly lymphomas, sarcoidosis); also due to radiation and chemotherapeutic agents

Diagnosis: history as to underlying disease, radiation therapy and pulmonary toxic medications; Gram-Weigert, Gram, Ziehl-Neelsen, Giemsa, methenamine-silver and toluidine blue O stains and KOH preparation of induced sputum and bronchoalveolar

lavage (sensitivity 89%; Ringer's solution most suitable; can be performed despite bleeding tendencies but yield may not be as good as from biopsy; complications rare; contraindicated in severe hypoxemia), transtracheal aspiration (useful initial step in evaluation that bypasses oropharyngeal contamination; occasional bleeding), open biopsy (requires general anaesthesia; because of large sample obtained, gives highest yield; < 10% delayed pneumothorax), transbronchial biopsy (low morbidity, but limited sample; results superior to simultaneous brushing; 10% pneumothorax incidence), transtracheal bronchial brushing (limited sample; may be attempted after platelet transfusion; some complication in almost 20% of patients), percutaneous needle aspiration (reliable in diagnosing pneumocystosis in leukemic children, most of whom are in remission; limited sample; pneumothorax in 25% of patients), percutaneous trephine biopsy (limited sample; bleeding may be difficult to control; pneumothorax in up to 66% of attempts), fibreoptic bronchoscopy (relatively well tolerated but oropharyngeal contamination confuses results; occasional bleeding and pneumothorax if brushing also performed), or cutting needle biopsy (for more peripheral solid lesions rather than diffuse disease; complications greater in diffuse disease); blood culture; antibody serology for *human human cytomegalovirus*, *Aspergillus*, *Toxoplasma*, *influenza virus, parainfluenza virus, adenovirus, human herpesvirus 3*, *Simplexvirus*, *Mycoplasma*, *Pneumocystis jiroveci* (indirect fluorescent antibody test; restricted availability; suggests the diagnosis if positive but gives many false negatives and should not be relied on clinically), *Legionella*; cryptococcal antigen determination on serum; H&E and methenamine-silver stains of lung biopsy sections

Pneumocystis jirovecí: severe dyspnea on exertion, low grade fever, non-productive cough, malaise and cyanosis; usually in patients with CD4 counts < 200 cells/μL; chest X-ray shows diffuse bilateral interstitial infiltrates; gallium scan shows diffuse bilateral pulmonary disease; in immunompromised, pneumonic exudate contains lymphocytes, macrophages and possibly eosinophils but not polymorphs; arterial blood gas analysis shows arterial pO_2 of < 70 mm Hg or low respiratory diffusing capacity (< 80% of predicted value) or an increase in alveolar-arterial O_2 gradient; Wright-Giemsa, Papanicolaou, methenamine silver staining, direct immunofluorescence of induced sputum (sensitivity 30-90%), bronchoalveolar lavage (sensitivity 98-100%), brush biopsy of bronchus or needle biopsy of lung (sensitivity 90-95%); counterimmunoelectrophoresis; indirect fluorescent antibody titre

Treatment:

***Pneumocystis jirovecí*:**

Mild to Moderate: cotrimoxazole 5/25 mg/kg to 320/1600 mg orally 8 hourly for 3 w; if cotrimoxazole undesirable, trimethoprim 5-7.5 mg/kg to 300 mg orally 12 hourly for 3 w + dapsone 1-2 mg/kg to 100 mg orally daily for 3 w; atovaquone 750 mg orally twice daily with meals for 21 d

Severe: cotrimoxazole 5/25 mg/kg to 320/1600 mg i.v. 6 hourly until improvement occurs, then oral cotrimoxazole as above; if no response to, or intolerant of, cotrimoxazole, consider desensitisation or use pentamidine isethionate 4 mg/kg daily to 300 mg by i.v. infusion over 1-2 h for 3 w or 600 mg in 6 mL of water as an aerosol 20 min daily for 21 d; eflornithine 400 mg/kg daily i.v. in 4 divided doses for 10 days, then 300 mg/kg daily in 4 divided doses for 4 d, then 300 mg/kg daily orally thereafter; trimetrexate 30 mg/m^2 of body surface as i.v. bolus daily for 21 d + calcium folinate (leucovorin) 20 mg/m^2 of body surface as i.v. bolus 6 hourly for 23 d + sulphadiazine 1 g orally 6 hourly for 6 d; clindamycin 600 mg i.v. 6 hourly for 3 w or 600 mg i.v. as a loading dose followed by 300-450 mg orally 6 hourly for 3 w + primaquine 15 mg base orally once daily for 3 weeks; if significant hypoxia (especially in HIV), prednisolone 1 mg/kg to 40 mg orally or i.v. for 5 d, then 1 mg/kg to 40 mg daily for 5 d, then 0.5 mg/kg to 20 mg daily for 11 d

Maintenance Therapy and Primary Prophylaxis in HIV/AIDS (CD4 Count < 200/μL): cotrimoxazole 80/400 or 160/800 mg orally daily or 160/800 mg orally 3 times weekly, dapsone 100 mg orally 3 times weekly, pentamidine 300 mg i.v. or aerosolised every 2-4 w

Bacterial: depending on specific agent (*Rhodococcus equi*:: rifampicin + erythromycin)

Cryptococcus neoformans:

Mild: fluconazole 20 mg/kg to 800 mg orally or i.v. initially, then 10 mg/kg to 400 mg orally daily for at least 4 w

More Severe: amphotericin B desoxycholate 0.7 mg/kg i.v. daily for 2-4 w ± flucytosine 25 mg/kg i.v. or orally 6 hourly for 2 w; if clinical improvement after 2 w, change to fluconazole as for **Mild**

Secondary Prophylaxis in HIV Infection: fluconazole 200 mg orally daily or itraconazole 200 mg orally daily

Other Fungal:

Non-neutropenic with Milder Disease: voriconazole 200 mg orally 12 hourly, itraconazole 7.5 mg/kg to 300 mg orally 12 hourly for 3 d then 5 mg/kg to 200 mg 12 hourly

Immunocompromised: voriconazole 6 mg/kg i.v. 12 hourly for 2 doses then 4 mg/kg 12 hourly for at least 7 d then 4 mg/kg to 200 mg orally 12 hourly, amphotericin B desoxycholate 1 mg/kg i.v. daily

Simplexvirus: famciclovir 500 mg orally 12 hourly for 7-10 d, valaciclovir 500 mg orally 12 hourly for 7-10 d, aciclovir 200 mg orally 5 times daily for 7-10 d

Frequent, Severe Recurrences: famiclovir 500 mg orally 12 hourly, valaciclovir 500 mg orally 12 hourly, aciclovir 200 mg orally 8 hourly or 400 mg orally 12 hourly

Human herpesvirus 3: famciclovir 500 mg orally 8 hourly for 7-14 d, valaciclovir 1 g orally 8 hourly for 7-14 d, aciclovir 800 mg orally 5 times daily for 7-14 d

Severe or Unable to Take Oral Therapy: aciclovir 10 mg/kg i.v. 8 hourly for 7-14 d (adjust dose for renal function)

Human human cytomegalovirus: valganciclovir 900 mg orally 12 hourly for 14-21 d then 900 mg orally daily, ganciclovir 5 mg/kg i.v. twice a day for 2-3 w then 10 mg/kg i.v. 3 times a week or 5 mg/kg i.v. 5 times a week during continued immunosuppression, foscarnet 90 mg/kg i.v. 12 hourly for 2-3 w then 90-120 mg/kg i.v. 5 times weekly (adjust dose according to creatinine clearance), cidofovir 5 mg/kg i.v. weekly for 2 w (+ probenecid; not if proteinuria > 2+ or creatinine clearance < 55 mL/min) then as above every 2 w

Other Viral: non-specific

Toxoplasma gondii: sulphadiazine 1-1.5 g orally or i.v. 6 hourly for 3-6 w then 500 mg orally 6 hourly or 1 g orally 12 hourly + pyrimethamine 50-100 mg orally loading dose then 25-50 mg daily for 3-6 w (continue if necessary)

Sulphadiazine Hypersensitive: substitute clindamycin 600 mg orally or i.v. 6 hourly for 3-6 w (treatment) or 600 mg orally 8 hourly (maintenance) for sulphadiazine

Strongyloides stercoralis: thiabendazole

Prophylaxis:

***Pneumocystis jiroveci* in AIDS Patients with Rapid Fall in Number of $CD4^+$ Cells, $CD4^+$ 20-30%, $CD4^+$ Total Count < 200/μL, Fever or Thrush, or to Prevent Recurrence of Infection:** cotrimoxazole 80/400-160/800 mg orally once daily or 160/800 mg orally twice daily on 3 days of week or 12 hourly twice weekly; dapsone 100 mg orally 3 times a week; pentamidine isethionate 300 mg i.v. or in 6 mL of water as a 20 minute aerosol from nebuliser producing droplet size ≤ 2 μm every 2-4 w; clindamycin + primaquine; atovaquone 1500 mg daily; pyrimethamine + sulphadiazine; dapsone 100 mg orally twice a week + trimethoprim 300 mg orally twice a week; pyrimethamine-sulphadoxine (Fansidar) 25/500 mg orally weekly; immunologic monitoring; zidovudine

Human human cytomegalovirus: exclusive use of *human human cytomegalovirus*-seronegative blood products; gangiclovir 5 mg/kg i.v. every 12 h for 5-7 d, then 5-6 mg/kg i.v. daily for 5 d/w from engraftment until day 100 after haematopoietic stem cell transplantation

Toxoplasma gondii: cotrimoxazole 1 double strength tablet orally daily or 1 single strength tablet orally daily or 1 double strength tablet orally 3 times/w to seropositive allogenic adult or adolescent hematopoietic stem cell transplant recipients as long as on immunosuppressive therapy and to HIV/AIDS patients with CD4 count < 200/μL

Giant Cell Pneumonia

Agent: measles virus; occurs in 4-75% of measles cases, causing 75% of measles deaths overall and 100% of deaths in patients < 5 y

Diagnosis: patchy consolidation at bases of lungs; viral culture and cytology of throat swab; serology (complement fixation test, hemagglutination inhibiton)

Treatment: non-specific

Fungal Pneumonia: usually in immunosuppressed patients (aspergillosis, zygomycosis and cadidiasis especially in neutropenics; aspergillosis in 4% of bone marrow transplant recipients; cryptococcosis, ? histoplasmosis especially in impaired cell-mediated immunity; coccidioidomycosis (8% of symptomatic infections) risk factors diabetes, smoking, older age,) but may occur in general population (32% of *Aspergillus* isolates from sputum and 66% from bronchial washings are associated with pulmonary infiltration; 40-45% of these cases are in non-immunocompromised patients, 20-40% of whom have invasive pulmonary aspergillosis); necrotising bronchopneumonia in 35% of patients with pulmonary aspergillosis, hemorrhagic infarction in 30%, miliary microabscesses in 10%, lobar pneumonia in 10%, bronchitis in 10%, focal abscesses in 5%, solitary abscess in 5%

Agents: isolates of *Blastomyces dermatitidis, Coccidioides immitis, Histoplasma capsulatum* and *Sporothrix schenckii* are always significant; isolates of *Absidia, Aspergillus (Aspergillus fumigatus, Aspergillus flavus,* occasionally other *Aspergillus* species; most common cause of community acquired pneumonia (often with concurrent gram negative bacilli) in stem cell transplant recipients with graft versus host disease), *Candida*, *Cryptococcus neoformans*, *Mucor*, *Rhizopus* and *Rhizomucor*

may be significant, especially in leukemics; also *Trichosporon, Fusarium, Penicillium* and *Torulopsis* in cancer patients, and *Drechslera, Geotrichum, Pseudallescheria boydii, Scedosporium prolificans* and *Cunninghamella* in disseminated infections
Diagnosis: wet mount KOH phase contrast microscopy and fungal culture of bronchoalveolar lavage (100% sensitivity in diffuse pulmonary disease due to *Aspergillus* but not effective in patients with focal pulmonary lesions), Gomori methenamine silver sections and culture of lung biopsy; immunodiffusion; precipitin (positive in 90% of aspergilloma cases, 60-75% of allergic bronchopulmonary aspergillosis, rare in other circumstances); halo sign on CT indicative of invasive aspergillosis
Treatment:

Cryptococcus neoformans:

Mild: fluconazole 800 mg orally or i.v. initially, then 400 mg daily for 10 w

More Severe: amphotericin B desoxycholate 0.7 mg/kg i.v. daily for 2-4 w ± flucytosine 25 mg/kg i.v. or orally 6 hourly for 2-4 w; if clinical improvement after 2 w, change to fluconazole 800 mg orally initially then 400 mg daily for 8 w

Secondary Prophylaxis in HIV Infection: fluconazole 200 mg orally daily or itraconazole 200 mg orally daily

Others: amphotericin B (not *Pseudallescheria boydii, Scedosporium prolificans*; disseminated aspergillosis: 0.5-1 mg/kg/d i.v. to total 2-8 g; blastomycosis: 0.5-1 mg/kg/d i.v. to total 1.5-2 g; coccidioidomycosis: 1-1.5 mg/kg/d i.v. to total 1.5-2 g; histoplasmosis: 0.6 mg/kg/d i.v to total 2-2.5 g; consider administration through a percutaneous endobronchial catheter, combined with systemic administration, if this seems necessary; may be combined with flucytosine 10-20 g/d), voriconazole 6 mg/kg i.v. 12 hourly for 2 doses then 4 mg/kg 12 hourly for at least 7 d then 4 mg/kg to 200 mg orally 12 hourly, itraconazole + flucytosine, miconazole; early surgical resection in symptomatic aspergilloma, asymptomatic aspergilloma with reasonable complication, mucormycosis with persistent cavitations after treatment, and scedesporosis; decortication desirable in extensive pleural disease; interferon-gamma in pulmonary aspergillosis in chronic granulomatous disease

TROPICAL EOSINOPHILIC PNEUMONIA (TROPICAL PULMONARY EOSINOPHILIA, FRIMODT-MOLLER SYNDROME, TROPICAL EOSINOPHILIA, TROPICAL EOSINOPHILIC ASTHMA, TROPICAL EOSINOPHILOSIS, WEINGARTEN DISEASE, WEINGARTEN SYNDROME)

Agents: *Wuchereria bancrofti, Brugia malayi, Brugia pahangi,* animal filaria; *Corynebacterium pseudotuberculosis* may cause similar syndrome
Diagnosis: chronic pulmonary infiltration and opacities, cough, dyspnea, asthma with nocturnal wheezing, X-ray; marked blood eosinophilia; microfilariae present in lung tissue but absent from peripheral blood; high IgE; positive filarial serology (filaria-specific IgG and IgE)
Treatment: diethylcarbamazine

PNEUMONITIS

Agents: *respiratory syncytial virus* (6-12 mo; in 25% of cases; wheezing common), parainfluenza, influenza A and B, adenovirus, *measles virus*, varicella, *human metapneumovirus* (in 17% of cases); *Rhodococcus equi* (in immunodeficient hosts exposed to animals), *Yersinia pestis, Francisella tularensis,* anaerobes (3% mortality), *Mycoplasma pneumoniae* (in immunodeficient), *Haemophilus influenzae*, *Burkholderia pseudomallei, Mycobacterium szulgai, Mycobacterium xenopi, Nocardia asteroides,* 12% of Rocky Mountain spotted fever cases; *Cryptococcus neoformans* (chronic; can lead to fatal meningitis), *Candida albicans;* migrating larvae of *Ascaris lumbricoides,* hookworm, *Strongyloides stercoralis*; *Acanthamoeba*
Diagnosis: immunofluorescence of nasopharyngeal aspirate; viral culture of throat swab, nasopharyngeal aspirate; Gram stain and culture of sputum, bronchial washing, open lung biopsy, transtracheal aspirate; serology; observation of larvae in sputum; *Strongyloides stercoralis* gives an initial neutrophilia becoming leucopenia with 40% eosinophilia
Treatment:

Respiratory Syncytial Virus, Influenza, Parainfluenza: ribavirin aerosol
Other Viruses: non-specific
Rhodococcus equi: erythromycin + rifampicin + surgery
Francisella tularensis: streptomycin, tetracycline
Mycoplasma pneumoniae*, *Nocardia asteroides: minocycline
Haemophilus influenzae: amoxycillin-clavulanate
Anaerobes: clindamycin, metronidazole

Burkholderia pseudomallei: tetracycline 40-50 mg/kg orally daily in 4 divided doses for 60-150 d, cotrimoxazole 4/20-8/40 mg/kg (child: 6/30 mg/kg) daily orally in 2 divided doses, chloramphenicol 40-100 mg/kg (child: 50-75 mg/kg) daily orally in 4 divided doses

Mycobacterium szulgai: ethambutol 25 mg/kg to 1 g orally daily + rifampicin 600 mg daily + ethionamide 500 mg - 1 g orally daily in 3 divided doses or streptomycin 15 mg/kg i.m. daily or cycloserine 500 mg orally daily in 2 divided doses

Mycobacterium xenopi: isoniazid 300-450 mg orally daily as a single dose + rifampicin 600 mg orally daily + streptomycin 15 mg/kg i.m. daily

Cryptococcus neoformans*, *Candida albicans:

Mild: fluconazole 800 mg orally or i.v. initially, then 400 mg daily for 10 w

More Severe: amphotericin B desoxycholate 0.7 mg/kg i.v. daily for 2-4 w ± flucytosine 25 mg/kg i.v. or orally 6 hourly for 2-4 w; if clinical improvement after 2 w, change to fluconazole 800 mg orally initially then 400 mg daily for 8 w

Secondary Prophylaxis in HIV Infection: fluconazole 200 mg orally daily or itraconazole 200 mg orally daily

Larvae: pyrantel embonate, thiabendazole, mebendazole

Acute Empyema: 50% mortality in hospital-acquired cases

Agents: *Staphylococcus aureus* (25-35% in adults, 75-90% in children), anaerobes (15-35% in adults, 1% in children; *Peptostreptococcus*, *Bacteroides, Prevotella, Fusobacterium,* rare cases of *Clostridium perfringens), Streptococcus pneumoniae* (12-38% in adults, 2-5% in children), other streptococci (3-5% in adults, 2% in children; *Streptococcus pyogenes*, *Streptococcus milleri,* enterococci, *Streptococcus canis*), *Haemophilus influenzae* (0-5% in adults, 1% in children), other Gram negative bacilli (15-30% in adults, 2% in children; *Klebsiella-Enterobacter, Escherichia coli, Pseudomonas aeruginosa, Proteus, Acinetobacter calcoaceticus, Serratia marcescens*; uncommonly *Actinobacillus actinomycetemcomitans, Pseudomonas alcaligenes*; rare cases of *Capnocytophaga, Eikenella corrodens, Erwinia herbicola, Actinomyces pyogenes, Candida*; also in tuberculosis

Diagnosis: associated with pneumonia, thoracic surgery, tumour, spontaneous pneumothorax, lung or subdiaphragmatic abscess, bronchiectasis, asthma, foreign body, dental extraction, tonsillectomy; fever in 80%, dyspnea in 60%, chest pain in 50%, weight loss in 25%, chills in 25%, haemoptysis in 15%, night sweats in 12%; chest X-ray (presence of pleural effusions on an earlier film; extension of the air-fluid level to the chest wall; extension of the lesion across fissure line; a tapering border of the air-fluid pocket; location of the air pocket in the posterior costophrenic sulcus; a cavity of unequal dimensions); Gram, fungal and acid-fast stains and culture of aspirated pus from loculated empyema; total ($\geq 2500/\mu L$) and differential (polys predominate = bacterial, lymphs predominate = fungal, tuberculosis) white cell count, biochemistry (protein ≥ 3 g/dL and ratio of pleural fluid to serum content 0.5, glucose 50% that of serum, LDH ≥ 200 IU and ratio of pleural fluid to serum content 0.6, specific gravity ≤ 1.018, pH ≤ 7.2), Gram, fungal and acid-fast stains and culture of pleural fluid in nonloculated empyema

Treatment: open drainage +

Pseudomonas: ticarcillin + gentamicin

Other Bacteria: chloramphenicol

Candida: amphotericin B + flucytosine

Chronic Empyema

Agents: may be due to any of the organisms causing acute empyema, but is frequently due to, or complicated by, various fungi (mainly those causing fungal pneumonia)

Diagnosis: as for **Acute Empyema**

Treatment: surgery + appropriate antimicrobial

Pulmonary Abscess: primary in oral sepsis and decreased cough reflex (alcohol, anesthesia, drugs, seizures, neurologic disorders, coma), esophageal disorders (diverticula, achalasia, strictures, motility disorders, cancer) with oral sepsis, endobronchial obstruction (cancer, foreign body) and in postnecrotising pneumonia; opportunistic in newborn (prematurity, congenital abnormalities of the heart or lung), elderly (blood dyscrasias, cancer of the lung and oropharynx, treatment with steroids, postoperatively), and nosocomial; hematogenous in septicemia and pulmonary infarct (bland or septic)

Agents: 85-90% anaerobes (60-75% only; 50% *Fusobacterium nucleatum,* 45% *Prevotella melaninogenica,* 40% *Peptostreptococcus,* 25% *Peptococcus,* 20% *Eubacterium,* 15% *Bacteroides fragilis*, 10% *Propionibacterium*; other *Bacteroides*, other *Prevotella, Bifidobacterium adolescentis*), 23% *Staphylococcus* and *Streptococcus*, 10% *Pseudomonas aeruginosa*, 8% *Klebsiellla,* 4% *Haemophilus influenzae* (18% of non-bacteremic invasive *Haemophilus influenzae* infections in older children

and adults); *Mycobacterium tuberculosis*, *Chromobacterium violaceum* (in 22% of infections due to this organism), *Rhodococcus equi*, *Capnocytophaga*, *Salmonella* (in renal transplant recipients), *Lactobacillus* (extremely rare), *Selenomonas sputigena, Legionella, Nocardia, Entamoeba histolytica* (amoebic abscess of lung or pleura is commonly secondary to an amoebic liver abscess that ruptures through the diaphragm into the lung, but may arise in the mesenteric blood vessels or lymphatics)

Diagnosis: cavitary lesion on chest X-ray (may also be due to tuberculosis, fungi including histoplasmosis, blastomycosis, coccidioidomycosis and aspergillosis, primary or metastatic carcinoma, infected cyst, infected bullae, nontuberculous granulomatous disease, extension of a subphrenic process, pulmonary infarction); culture of biopsy; fever (average minimum 38.8°C rectally) in 95%, leucocytosis (average ≈ 15,000/μL) in 90%, anemia (average haematocrit 35%) in 90%, aspiration in 75%, weight loss (average 9 lb) in 55%

Treatment: benzylpenicillin 600 mg i.v. 4-6 hourly (child: 100-120 mg/kg/d in 4-6 divided doses) for 10-14 d + metronidazole 500 mg i.v. 12 hourly (child: 20 mg/kg/d to 1 g in 3 divided doses) for 1-2 d then 400 mg orally (child: 20 mg/kg/d to 800 mg/d in 2 divided doses) or 1 g rectally 12 hourly (child: 80 mg/kg/d to 2 g in 2 divided doses) for total 10-14 d; clindamycin 600 mg i.v. slowly 8 hourly (child: 30 mg/kg/d to 1.8 g/d in 3 divided doses), then 300 mg orally 6 hourly (child: 20-40 mg/kg/d to 1.2 g in 4 divided doses) for total 10-14 d; substitute cefotaxime 1 g (child: 50 mg/kg to 1 g) i.v. 8 hourly or ceftriaxone 1 g (child: 100 mg/kg to 1 g) i.v. once daily if Gram negative bacilli suspected; aggressive expectoration, chest physiotherapy, postural drainage; surgery (drainage of empyema secondary to lung abscess if tube drainage is inadequate; to differentiate lung abscess from carcinoma if other approaches are unsuccessful; life-threatening hemoptysis)

Pseudomonas aeruginosa: oral ciprofloxacin for 12 w

Pulmonary Gangrene

Agents: *Bacteroides*, *Peptostreptococcus*

Diagnosis: culture of biopsy

Treatment: chloramphenicol

***Respiratory Syncytial Virus* Infections**: conditions include bronchitis, cold, croup, bronchiolitis, pneumonia and pneumonitis; major cause of lower respiratory tract infection in young children; most frequent nosocomial infection on pediatric wards

Agent: respiratory syncytial virus

Diagnosis: culture, EIA (Vidas sensitivity 93%, specificity 94%), direct immunofluorescence (sensitivity 66%, specificity 73%) of nasopharyngeal aspirate in first 3-4 d

Treatment: ribavirin aerosol

Bornholm Disease (Epidemic Pleurodynia)

Agent: *coxsackievirus B1-5*, *echovirus 6*

Diagnosis: viral culture of throat and nasal swabs, faeces and CSF in tissue culture, suckling mice; serology (neutralisation); biochemistry normal; no neutrophilia

Treatment: non-specific

Ornithosis (Bedsonia Pneumonia, Papageienkronkheit, Parrot Fever, Psittacosis, Psittacosis Pneumonia): ≈ 80 notified cases/y in Australia (≈ 80% in Victoria); incidence 0.05/100,000 in USA; incubation period 6-15 d; adults; person-to-person transmission rare; transmitted by excreta of infected birds, usually psittacines; usually acute pneumonitis but has been associated with embolisms and infective endocarditis

Agent: *Chlamydia psittaci*

Diagnosis: variable fever, infrequent rigours, productive cough with pleuritic chest pain; upper respiratory symptoms present or absent; pleural effusion rare; sputum mucoid, bloody, no bacteria on stain; headache, myalgias prominent; macular rash, splenomegaly may be present; patchy abnormal densities in lower segments of lower lobes; exposure to parrots or turkeys; complement fixation; culture of sputum; direct fluorescent antibody staining of respiratory secretions or tissue; microimmunofluorescence; PCR; abnormal liver function tests in 50% of cases, serum sodium ≤ 130 mmol/L in 44%, serum albumin ≤ 2.5 g/dL in 44%, blood urea ≥ 7 mmol/L in 11%; white cell count ≥ 15,000/μL in 83% of cases

Treatment: doxycycline 200 mg orally at once, then 100 mg orally daily for 14 d (not in children), roxithromycin for 14 d

Prevention and Control: eliminate contact with infected birds

Q fever: case-fatality rate < 1%; incubation period 14-35 d; adults; work in abattoir or on farm; ≈ 500 notified cases/y in Australia (≈ 57% in Queensland)

Agent: *Coxiella burnetii*

Diagnosis: pleural effusion rare; chest X-ray normal or patchy consolidation at bases of lungs; inflammatory apical lung disease by radioactive isotope scan; indirect immunofluorescent antibody titre; complement fixation test (phase 2, second to fourth weeks); culture of blood, urine

Treatment: doxycycline 100 mg orally 12 hourly for 14 d (not < 8 y), chloramphenicol 12.5 mg/kg to 500 mg orally or i.v. 6 hourly for 14 d

Prophylaxis (Postexposure): doxycycline 2.5 mg/kg to 100 mg orally 12 hourly

Pulmonary Tuberculosis (Complicated Primary Tuberculosis, Fibrocaseous Pulmonary Tuberculosis, Koch Disease, Post-Primary Pulmonary Tuberculosis, Secondary Pulmonary Tuberculosis): infectious disease of the lung; may arise either by direct extension of a poorly localised 'primary tuberculous infection' or by reactivation of a quiescent lesion resulting from such an infection; if poorly localised, primary infection may occasionally progress to other areas of the lung (progressive primary pulmonary tuberculosis), sometimes leading to cavitation or extrapulmonary dissemination; in most cases, however, primary tuberculous infection heals, with or without calcification, or remains quiescent; when such a primary focus is reactivated, or if exogenous superinfection occurs, characteristic inflammatory reaction takes place with tubercle formation, tissue necrosis (caseation), cavitation, fibrosis and, sometimes, calcification; pulmonary tuberculosis may lead to any of the following conditions: infiltrative tuberculosis of the lung, nodular tuberculosis of the lung (tuberculoma), tuberculosis of the lung with cavitation, tuberculous pneumonia, bronchial tuberculosis (endobronchial tuberculosis, tuberculosis of the bronchus, tuberculous bronchitis), tuberculous bronchiectasis, tuberculous pneumothorax, tuberculous pleuritis (pleural tuberculosis, tuberculosis of the pleura, tuberculous pleurisy), tuberculous emphysema; 85-90% of tuberculosis cases (+ 2% pleural)

Agents: *Mycobacterium tuberculosis*, *Mycobacterium bovis* (from raw cow's milk; now virtually eliminated in many countries); *Mycobacterium kansasii, Mycobacterium avium-intracellulare* (cavitary and nodular disease in immunocompromised, diffuse pulmonary disease (hot tub lung) in immunocompetent), *Mycobacterium fortuitum* (emerging pathogen in AIDS), *Mycobacterium chelonae, Mycobacterium szulgai, Mycobacterium xenopi* and, infrequently, *Mycobacterium gordonae, Mycobacterium malmoense, Mycobacterium scrofulaceum, Mycobacterium simiae* cause clinically indistinguishable conditions

Diagnosis: unresolved pneumonia, persistent cough, unexplained fever; contact; epidemiological history; unilateral or bilateral upper lobe or apical or multiple infiltration ± cavitation or consolidation or calcification (*Mycobacterium fortuitum* and *Mycobacterium chelonae*: 71% patchy, 38% bilateral, 17% cavitating, 8% empyema, 8% middle lobe infiltrate); nontuberculous mycobacterial infections (especially those caused by *Mycobacterium kansasii* and *Mycobacterium intracellulare*) have a more indolent course and are more common in older white males with underlying disease; Ziehl-Neelsen stain (specificity 99.9%; 46% of *Mycobacterium tuberculosis*, 22% of other *Mycobacterium* positive; 59% abundant organisms in culture, 50% few organisms in culture positive; 57% cavitating, 32% non-cavitating positive) and culture of voluntary or induced sputum (positive in 85-90% of cases), laryngeal swab or aspirate, bronchial swab or lavage, gastric lavage, pleural fluid or pus (Bactec: 95% smear positive specimens culture positive in 5-8 d, 72% smear negative specimens culture positive in 4-17 d, sensitivity testing 4-7 d with 91% agreement with conventional, identification of 99-100% of *Mycobacterium tuberculosis* in
5 d; conventional: 91% smear positive specimens culture positive in 18-19 d, 89% smear negative specimens culture positive in 18-43 days, sensitivity testing 14-32 d); DNA probe; tuberculin test; interferon gamma assay, ELISPOT; *Mycobacterium tuberculosis* gives anemia (acute hemolytic in miliary tuberculosis), raised ESR and neutrophilia, becoming lymphocytosis in the acute disseminated stage and monocytosis during healing; *Mycobacterium kansasii* gives severe anemia, leucopenia with white cell count < 500/μL, gross thombocytopenia

Differential Diagnosis: blastomycosis (skin lesions often present), histoplasmosis (culture and serology helpful), coccidioidomycosis (history of residence or travel to endemic areas), lung abscess (location and predisposing factors different; cavity usually thick-walled with air-fluid level), cavitating bronchogenic carcinoma (history, cytology and biopsy of tissue)

Treatment: vitamin A, zinc

Mycobacterium tuberculosis, Mycobacterium bovis, Mycobacterium xenopi: isoniazid 10 mg/kg to 300 mg orally once daily or 15 mg/kg to 600 mg orally 3 times weekly for 6 mo [+ pyridoxine 25 mg (breastfed baby 5 mg) orally with each dose] + rifampicin 10 mg/kg to 600 mg orally once daily 1 h before breakfast or 15 mg/kg to 600 mg orally 3 times a week for 6 mo + pyrazinamide 25-35 mg/kg to 2 g orally once daily or 50 mg/kg to 3 g orally 3 times weekly for 2 mo (6 mo if not known to be susceptible to isoniazid and rifampicin) + ethambutol 15 mg/kg orally daily (not < 6 y or plasma creatinine > 160 μM/L; regular ocular monitoring) or 30 mg/kg orally 3 times weekly for 2 mo or until known to be susceptible to isonazid and rifampicin (to 6 mo)

Mycobacterium kansasii: isoniazid 10 mg/kg to 300 mg orally daily + rifampicin 10 mg/kg to 600 mg orally twice daily + ethambutol 15 mg/kg orally (not < 6 y) daily for 18 mo and 12 mo negative sputum cultures

Mycobacterium szulgai: rifampicin + ethambutol + ethionamide or streptomycin

Mycobacterium fortuitum*, *Mycobacterium chelonae: 2 of clarithromycin, doxycycline, ciprofloxacin, cotrimoxazole orally for 6-12 mo

Mycobacterium avium-intracellulare: ethambutol 15 mg/kg orally daily or 25 mg/kg orally 3 times weekly (not < 6 y) + clarithromycin 12.5 mg/g to 500 mg orally 12 hourly daily or 3 times weekly or azithromycin 10 mg/kg to 500 mg orally daily or 10 mg/kg to 600 mg orally 3 times weekly + rifampicin 10 mg/kg to 600 mg orally daily or 3 times weekly or rifabutin 5 mg/kg to 300 mg orally daily

Prophylaxis (Treatment of Latent Infection):

Mycobacterium tuberculosis: isoniazid 10 mg/kg to 300 mg orally daily for 9 mo if tuberculin skin test > 5 mm in patient who has not had BCTG and no evidence of active disease [+ pyridoxine 25 mg (breastfed baby: 5 mg) with each dose]

***Mycobacterium avium* complex in HIV Infection (CD4 Cell Count < 50/μL):** azithromycin 1.2 g orally weekly or clarithromycin 500 mg orally 12 hourly or rifabutin 300 mg orally daily

Pulmonary Histoplasmosis: clinical state varies from asymptomatic (usually in acute, 20% of chronic) to tuberculosis-like to widespread ulceration; pericarditis, mediastinal granuloma, mediastinal fibrosis, histoplasmoma rare complications; chronic infection with structural defect (males over 50 y; underlying chronic bronchitis and/or emphysema; respiratory insufficiency usual cause of death; mortality 55% untreated, 30% treated)

Agent: *Histoplasma capsulatum*

Diagnosis: cough, malaise, easy fatigability, weight loss, low grade fever; chest pain, deep and aching, suggestive of carcinoma, and hemoptysis (usually in cavitary disease) in ≈ 1/3 of chronic cases; dyspnea with progression; chest X-ray mimics tuberculosis; fungal culture of sputum at 25°C and 37°C; histoplasmin skin test of no diagnostic help; complement fixation test diagnostic in 35%, not helpful in determining prognosis or need for treatment

Treatment: patients with chronic disease and patients with acute disease and a good history of exposure to the organism, acute ill with an illness of several weeks duration, a chest X-ray with diffuse involvement, or a positive culture or fourfold or higher rise in the complement fixation test should be treated with amphotericin B or ketoconazole

Pulmonary Cryptococcosis: next to meningitis, most common clinical manifestation of cryptococccal infection

Agent: *Cryptococcus neoformans*

Diagnosis: fever in 66% of cases, chest pain in 45%, weight loss in 35%, dyspnea in 25%, night sweats in 25%, cough in 15%, haemoptysis in 7%, 15% asymptomatic; chest X-ray (predilection for lower lung fields; lesions range from solitary mass to diffuse infiltrates or scattered miliary nodules; cavitation, calcification, hilar lymphadenopathy, pulmonary collapse unusual); microscopy and culture of bronchoalveolar lavage (100% positive), open-lung biopsy (100% positive), pleural fluid (50% positive), sputum (35% positive), bronchoscopy (35% positive)

Treatment: indicated if progression of chest X-ray findings, symptoms of increasing severity, stable disease in patient who is susceptible to dissemination (eg., malignancy, corticosteroid therapy); not indicated in asymptomatic carriers (eg., isolation of organism from sputum of patients with chronic bronchitis)

Mild: fluconazole 800 mg orally or i.v. initially, then 400 mg daily for 10 w

More Severe: amphotericin B desoxycholate 0.7 mg/kg i.v. daily for 2-4 w ± flucytosine 25 mg/kg i.v. or orally 6 hourly for 2-4 w; if clinical improvement after 2 w, change to fluconazole 800 mg orally initially then 400 mg daily for 8 w

Secondary Prophylaxis in HIV Infection: fluconazole 200 mg orally daily or itraconazole 200 mg orally daily

Bagassosis and Farmer's Lung

Agents: *Saccharopolyspora rectivirgula, Aspergillus fumigatus, Aspergillus niger, Aspergillus terreus, Aspergillus flavus, Aspergillus clavatus, Aspergillus nidulans, Penicillium, Coniosporum corticale, Mucor, Candida, Curvularia lunata* (rare)

Diagnosis: recurrent bouts of symptoms of acute bronchitis or pneumonia, with pulmonary infiltrates and eosinophilia in all cases, asthma in 95%, haemoptysis (blood-tinged) in 85%; bronchograms demonstrating proximal saccular bronchiectasis; serum precipitins (positive in 90%); skin test (types I and III; positive in 95% of cases of allergic bronchopulmonary aspergillosis); RAST test (positive in nearly all cases of allergic bronchopulmonary aspergillosis); organism cultured from sputum in 60% of cases

Allergic Bronchopulmonary Aspergillosis: double immunodiffusion (sensitivity > 10 μg/mL), ELISA (sensitivity 10-1000 ng/mL), immunoCAP (sensitivity > 0.35 kUA/L), Western blot (sensitivity 100-2000 ng/mL)

Differential Diagnosis: cystic fibrosis, tuberculosis, cancer, eosinophilic pneumonia, mucous plug, atelectasis, bronchiectasis

Treatment: prednisolone 0.5 mg/kg daily as a single dose for 2 w or until complete clearing of chest X-ray, then 0.5 mg/kg orally on alternate days for 2-3 mo then, monitoring IgE antibodies, taper off dose as appropriate; repeat chest X-ray 4 monthly X 6, 6 monthly X 4, then yearly if no exacerbations; serum IgE monthly for 2 y, then bimonthly; pulmonary function tests yearly; resume prednisolone therapy if significant worsening of symptoms, chest X-ray or pulmonary function tests, or significant increase in total serum IgE

'Coin Lesions'

Agent: *Dirofilaria immitis*

Diagnosis: primarily radiological; contact with dogs; rarely, microfilaria seen in sputum

Treatment: none required, as adult worms do not survive in humans

Hemoptysis

Agents: may occur in acute pneumonia (17% of *Legionella* cases, 16% of *Streptococcus pneumoniae*, 3% of *Mycoplasma pneumoniae*), in 73% of cases of *Paragonimus (P.africanus, P.westermani)* infections, 11% of psittacosis cases and 3% of brucellosis, also in pulmonary tuberculosis, invasive aspergillosis, *Ascaris lumbricoides* infection, strongyloidiasis, Crimean-Congo hemorrhagic fever, echinococcosis, other infections and conditions unrelated to infection (eg., carcinoma, rupture of blood vessels due to trauma or inherent fragility)

Diagnosis: micro and culture of sputum; serology (complement fixation test); isolation of virus from blood; examination of stools for ova and parasites

Paragonimus: pneumonitis, cough, hemoptysis, chest pain, pleurisy, low grade fever, breathlessness, epilepsy, possible development of bronchiectasis and lung abscesses; may simulate tuberculosis or coexist with it; metastatic lesions in other organs, including bone; geographic history (*Paragonimus* common in Far East; also in W Africa and Central S America); dietary history (eating undercooked or raw crabs or shrimp); abnormal chest X-ray (infiltration, cavities, pleural effusion) in 80% of cases; ova in aspirate, puncture, biopsy, stool, sputum; eosinophilia; hemoglobin may be decreased; serology by complement fixation test

Treatment:

Paragonimus: praziquantel 25 mg/kg orally 8 hourly for 2 consecutive days (90% cure rate), bithionol 30-50 mg/kg orally on alternate days for 10-15 d

Others: dependent on agent; resection of nodules essential for management of invasive aspergillosis

Hantavirus Pulmonary Syndrome: severe pulmonary illness; case-fatality ratio 40-50%; carried by deer mouse (*Peromyscus maniculatus*) and other rodents; Argentina, Brazil, Canada, Chile, Panama, Paraguay, Peru, USA (especially Southwest)

Agent: *sin nombre virus, New York virus, Bayou virus, Black Creek Canal virus, Andes virus*

Diagnosis: 3-4 d prodrome of fever, myalgia, malaise, nausea, vomiting, abdominal pain, occasional dizziness and vertigo; then tachypnea, tachycardia, hypotension, hypoxemia, interstitial pulmonary markings, pulmonary edema, severe respiratory compromise; bilateral infiltrates; thrombocytopenia, immunoblasts, haemoconcentration; serology

Treatment: supportive

Otitis media: 2% of new episodes of illness in UK; 2.6% of ambulatory care visits in USA; 5-7M cases/y in US; $\approx$ 15% of infants have an attack by 6 mo, $\approx$ 75% by 2 y (25-30% $\geq$ 3 attacks by this age), $>$ 90% by 7 y; hearing loss and impaired language development may occur as sequelae

Agents: 66% mixed bacterial and viral, 30-45% *Haemophilus influenzae* (5-10% of isolates type b), 28-55% *Streptococcus pneumoniae,* 5-10% *Moraxella catarrhalis*, anaerobes, *Pseudomonas aeruginosa* (chronic and complicating endotracheal intubation and mechanical ventilation), *Streptococcus pyogenes*, *Staphylococcus aureus*, *Neisseria meningitidis* (1% of meningococcal infections), other *Neisseria* species (in infants); typically with viral coinfection: respiratory syncytial virus (in 39% of infected pre-school children; treatment failure in 30% of cases with bacterial coinfection), adenovirus (in 32% of infected pre-school children; treatment failure in 25% of cases with bacterial coinfection), influenza A (in 28% of infected pre-school children), influenza B (in 17% of infected pre-school children, 9% of infected school-age children), parainfluenza (in 16% of infected pre-school children), enteroviruses (in 16% of infected pre-school children; treatment failure in 17% of cases with bacterial coinfection), rhinovirus (in 10% of infected pre-school children; treatment failure in 78% of cases with bacterial coinfection), measles (in 4-22% of measles cases), echovirus 9 (in 10% of cases), *human human cytomegalovirus* (treatment failure in 17% of cases with bacterial coinfection); also *Corynebacterium bovis* (rare), *Mycobacterium tuberculosis* (chronic draining), Gram negative enteric bacilli (nosocomial), *Moraxella lacunata*, *Achromobacter xylosoxidans* (nosocomial and community acquired chronic), *Haemophilus haemoglobinophilus, Streptococcus canis, Mycoplasma pneumoniae* (bullous

myringitis); male sex, family members with acute otitis media, child care outside home, parental smoking, not being breastfed, and pacifier use risk factors.

Diagnosis: acute onset of pain in ear, tugging of ear lobes, fever, otorrhoea, vertigo, disturbed sense of balance, feeding difficulties, night waking; pneumatic otoscopy (effusion characterised by bulging of the tympanic membrane, limited or absent movement of the tympanic membrane, air-fluid level behind the tympanic membrane or perforation of the tympanic membrane with otorrhoea; inflammation characterised by distinct erythema of the tympanic membrane or distinct otalgia); culture of ear swab if eardrum ruptured, otherwise tympanocentesis specimen; serology

Treatment: paracetamol 20 mg/kg for pain relief; topical benzocaine; laser-assisted myringotomy

Acute Bacterial with Systemic Features or Child < 6 mo:

Child < 2 y, Treated with Antibiotics within Previous 3 mo or Attending Day Care or If Unresponsive to Amoxycillin: amoxycillin-clavulanate 22.5 + 3.2 mg/kg to 875 + 125 mg orally 8 hourly for 5-7 d

Others: amoxycillin 15 mg/kg to 500 mg orally 8 hourly for 5 d or 30 mg/kg to 1 g orally 12 hourly for 5 d

Penicillin Hypersensitive: cefuroxime 10 mg/kg to 500 mg orally 12 hourly for 5 d, cefaclor 10 mg/kg to 250 mg orally 8 hourly for 5 d; cotrimoxazole 4/20 mg/kg to 160/800 mg/kg orally 12 hourly for 7-10 d

Remote Areas: procaine penicillin 50 mg/kg to 1.5 g i.m. once daily for 5 d, bicillin i.m. on days 1 and 3 or daily for 2-5 d

Chronic Suppurative: suction under direct vision or dry mopping with rolled tissue spears or equivalent 6 hourly until ear canal dry; oral antibiotics as above + dexamethasone 0.05% + framycetin 0.5 % + gramicidin 0.05% ear drops 3 drops instilled into ear 6 hourly for 7 d

Streptococcus: phenoxymethylpenicillin 500 mg orally 6 hourly (child: 75 mg/kg orally daily in 3 divided doses) for 7-10 d

Haemophilus*, *Moraxella*, *Neisseria: amoxycillin-clavulanate 500/125 mg orally 8 hourly (< 40 kg: 40/10 mg/kg daily in 3 divided doses) for 10 d, cotrimoxazole 160/800 mg (6 w - 5 mo: 20/100 mg; 6 mo - 5 y: 40/200 mg; 6-12 y: 80/400 mg) orally 12 hourly for 7-10 d, cefaclor 250-500 mg orally 8 hourly (child: 40-60 mg/kg orally daily in 3 divided doses) for 7-10 d

Corynebacterium bovis: erythromycin + rifampicin

Mycobacterium tuberculosis: isoniazid 10 mg/kg to 300 mg orally once daily or 15 mg/kg to 600 mg orally 3 times weekly for 6 mo [+ pyridoxine 25 mg (breastfed baby 5 mg) orally with each dose] + rifampicin 10 mg/kg to 600 mg orally once daily 1 h before breakfast or 15 mg/kg to 600 mg orally 3 times a week for 6 mo + pyrazinamide 25-35 mg/kg to 2 g orally once daily or 50 mg/kg to 3 g orally 3 times weekly for 2 mo (6 mo if not known to be susceptible to isoniazid and rifampicin) + ethambutol 15 mg/kg orally daily (not < 6 y or plasma creatinine > 160 μM/L; regular ocular monitoring) or 30 mg/kg orally 3 times weekly for 2 mo or until known to be susceptible to isonazid and rifampicin (to 6 mo)

Other bacteria: ticarcillin + gentamicin

Viruses: non-specific, but pneumococcal infection may supervene

Chronic (> 6 w) Discharging: ciprofloxacin or (dexamethasone 0.05% + framycetin 0.5% + gramicidin 0.005%) ear drops 3 drops 6 hourly until middle ear free of discharge for at least 3 d; at least daily wash with water, acetic acid 0.25% or povidone iodine 0.5% solution until cured; 4 times daily ear toilet with rolled paper spears repeating until ear is dry), followed each time by acetic acid 1% drops or by boric acid drops in acetic acid

Prophylaxis: identification and correction of underlying causes and risk factors (smoke exposure, group child care, allergic rhinitis, adenoid disease, cleft palate, Down syndrome); insertion of typanostomy tubes; amoxycillin 10-20 mg/kg orally in 2 divided doses or sulphisoxazole 80-100 mg/kg orally daily in 2 divided doses; acetic acid ear drops; polymyxin and neomycin ear drops; intranasal virosomal influenza vaccine

Neisseria meningitidis: ceftriaxone 250 mg (< 15 y: 125 mg) i.m. as single dose (preferred if pregnant), ciprofloxacin 500 mg orally as single dose (not < 12 y; preferred for women taking oral contraceptive), rifampicin 10 mg/kg (< 1 mo: 5 mg/kg) to 600 mg orally 12 hourly for 2 d (not pregnant, alcoholic, severe liver disease; preferred for children); vaccines (quadrivalent polysaccharide, quadrivalent conjugate, and serogroup conjugate) available

Mastoiditis: formerly worldwide in childhood but now, due to effective treatment of otitis media, almost eliminated in developed countries

Agents: *Haemophilus influenzae* (3% of non-bacteremic invasive *Haemophilus influenzae* infections in older children and adults), *Staphylococcus aureus*, anaerobes, *Burkholderia cepacia* (occasional), *Streptococcus pneumoniae, Streptococcus pyogenes, Pseudomonas,* anaerobes

Diagnosis: otitis media + pain and tenderness over mastoid process; otoscopy; computed tomography; culture of surgical specimen

Treatment:

Acute: amoxycillin 200 mg/kg i.v. daily in divided doses + cloxacillin/flucloxacillin 200 mg/kg i.v. daily in divided doses; dicloxacillin; cefuroxime; surgery for abscess or osteomyelitis

Chronic: ceftazidime + clindamycin; tobramycin + ticarcillin-clavulanate; surgery required

Prophylaxis (Otitis-Prone Child): sulphamethoxazole 25 mg/kg orally daily at bedtime