UNIT 3 INFECTIONS

Structure

3.0 OBJECTIVES

After reading this unit, you should be able to

- Describe the pathogenesis of infections in the elderly
- Explain the approach to infections in the elderly
- Outline the principles of antimicrobial therapy in the elderly
- Discuss the immunisation in the elderly

3.1 INTRODUCTION

In this unit, we shall be reading about the general principles of infections, their management, and immunisation in the elderly. Discussion about the specific infections such as bronchopneumonia, urinary tract infection, infective endocarditis, etc, is beyond the scope of this chapter. These have been covered in the subsequent units of this course and the next course – MME 106 for a detailed discussion of the above said infections. The older people are more susceptible to infections and its complications. As there is an increase in the ageing population, it becomes essential to understand the unique features of infections in the elderly. Infections are among the most common causes of hospitalisation and mortality in community dwelling and institutionalised elderly. During hospitalisation for various problems, elderly are at increased risk of getting hospital acquired infections and it is associated with a higher mortality rate.

3.2 PREDISPOSING FACTORS IN THE ELDERLY

Let us read more about the factors which predispose elderly to infections.

1. Immunosenescence

We have read about the immunological changes of ageing in Unit 2 of Block 2 of MME 104. Waning of host immune function and defence system increase the risk of infections in older people. Immunosenescence is a state not only of reduced immunity but also of a dysregulated immune response. Body's immune response to infection is reduced by multiple complex pathways in older people. Both the innate and adaptive immune responses are altered and decreased. There is a dysregulated cytokine production with ageing. Ageing is associated with thymic involution and depressed T cell function. B cells produce low affinity antibodies which reduce the immunogenicity and protective effects of vaccination in older people.

2. Age related changes in organ specific defences

The age associated changes in the defence mechanisms of different organs that may predispose older people to infections are given in **Table 3.1**. Details of these changes have already been covered in unit 2 of block 2 of MME 104.

Table 3.1: Age associated changes in the defence mechanism of organs

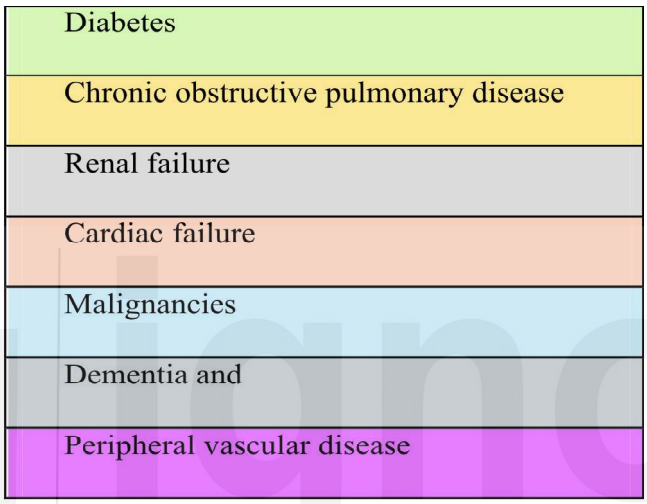
Organ	Age related changes	Effect
Skin	Epidermal and dermal atrophy leading to breach in skin integrity	Skin and soft tissue infections
Pharynx	Impaired cough reflex Abnormal swallowing mechanism	Aspiration
Bronchi	Sluggish mucociliary mechanism	Delayed clearance of Infection
Lungs	Reduced expiratory flow rate and tidal volume Increased residual volume Impaired function of alveolar macrophages	Impaired clearance of infection
Gastrointestinal tract	Loss of gastric acidity	Bacterial overgrowth
Kidney	Inability to maintain osmolality	Bacterial colonisation
Ureters	Inadequate peristalsis and incompetent vesicoureteral reflex	Reflux and ascending infection
Bladder	Impaired emptying capacity and defective surface mucin	Reflux and ascending infection
Hormones	Loss of effect of estrogen on mucosa and change in colonising flora	Urinary tract infection in women
Prostate and urethra	Prostatic hypertrophyUrethral strictures	Urinary tract infection in men

Think and Reflect

How do you think the comorbidities increase the incidence of infections in older people?

3. **Comorbidity**

In older people, Comorbidities decrease the innate immune response. Comorbidities increase the incidence of infection and mortality. Let us illustrate this with an example. Chronic obstructive pulmonary disease is a risk factor for lower respiratory tract infections in the elderly. COPD causes impaired mucociliary clearance, alveolar macrophage dysfunction, and impaired cough reflex, making them prone for lower respiratory tract infections. Hospitalisation for treating infections in older people is rather higher for those with comorbidities than for those who do not have them. Comorbidities that predispose the older people to infections are given in **Box 3.1.**



Box 3.1 : Comorbidities predisposing to infections

4. **Diminished mobility or immobility**

Edema of soft tissue will occur leading to skin and soft tissue infections. In bed ridden patients pressure ulcers and aspiration pneumonia are common and they lead to increased morbidity and mortality.

5. **Nutrition**

Protein energy malnutrition (PEM) is common in older people and is often an under recognised problem. PEM is associated with

- Delayed wound healing
- Formation of pressure ulcers
- Increased risk of nosocomial infections
- Increased length of hospital stay
- Increased mortality
- Poor response to vaccine

During Comprehensive Geriatric Assessment (CGA) of older people, nutritional assessment should be done and the malnourished and those who are at the risk of malnutrition are to be identified. Adequate nutrition should be encouraged and provided to them to prevent infections and their complications.

6. **Social and Environmental factors**

Those with lower economic status and those who live in old age homes and nursing homes are at increased risk of infections because of

- Crowding
- Poor nutritional status
- Exposure to smoke and pollution
- Inadequate vaccination

Check Your Progress 1

1. State any five, age related organ specific changes which make the elderly prone to infections.

Organ	Age related changes	Effect

2. Explain how the consequences of malnutrition are related to infections in the elderly?

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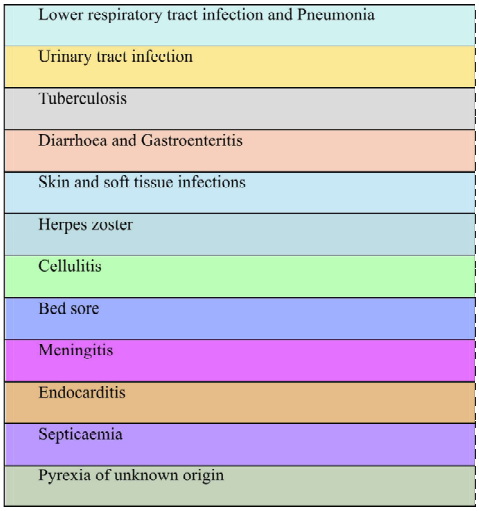
3.3 COMMON INFECTIONS AND SOURCES OF INFECTIONS IN THE ELDERLY

Some infections are more common in the elderly. Let us learn more about these. We shall also be learning about the sources of infections in elderly in this section.

Common infections in the elderly

The common infections that occur in the elderly are given in **Box 3.2**



Box 3.2 Common infections occurring in the elderly

Sources of infection

The source of infection has a great bearing in determining the subsequent course of event. The various sources of infection are discussed below.

1) Community Acquired Infection

Most infections are acquired in the community. The spectrum of community acquired infection can be very wide and is influenced by epidemiology of various diseases in a given geographic distribution. In general, community acquired infections are due to antibiotic sensitive organisms. Community acquired infection can be sporadic or of epidemic proportion.

2) Hospital Acquired Infection/Nosocomial Infection

Infection acquired during or as a result of hospitalization is termed as hospital acquired or nosocomial infection. Any infection appearing after 48 hours of hospitalization is considered as hospital acquired. The usual syndromes of nosocomial infection are pneumonia, urinary tract infection, bacteremia and wound infection. Common infectious organisms acquired in hospital are Staphylococcus aureus, E. coli, Pseudomonas, Klebsiella pneumoniae, Acinetobacter, Legionella, Candida and Aspergillus species. Hospital acquired infections are usually, due to multi-drug resistant strains, and are extremely difficult to treat, and are associated with extremely high cost implications.

3.4 CLINICAL PRESENTATION OF INFECTIONS IN ELDERLY

Did You Know?

Fever may not be present in serious infections in the elderly

You have already read about the varied clinical presentation of different diseases in elderly in the previous unit. Many older patients present with classical manifestations of disease and pose little problem in diagnosis. A large number of patients especially the frail ones, however, have atypical clinical and laboratory manifestations with no usual features of infection. Symptoms and signs which reflect the intensity of inflammation may be mild or absent. As a result, fever may not be present in serious infections and absence of fever often indicates poor prognosis. Frail older people rather have a lower mean basal temperature than the accepted normal basal temperature.

The accepted normal basal temperature is 98.6^{o}F (37^{O}C). Fever in frail older adults is defined as in **Box 3.3.**

A single oral temperature greater than 100^{o}F (>37.8^{o}C) or
Repeated oral temperatures greater than 99^{o}F (>37.2^{o} C) or
Repeated rectal temperatures greater than 99.5^{o}F (>37.5^{o}C) or
Increase in temperature greater than 2^{o}F (>1.1^{o}C) over baseline temperature

Box 3.3 : Criteria for fever in the frail elderly

Organ specific symptoms may also be mild in intensity. Unexplained, acute onset of shortness of breath may be the only symptom of pneumonia and abdominal sepsis may present with fever without any abdominal symptoms. Recent onset change in health and functional status may be the only manifestation of infection. Always remember to consider

infection, in an older patient presenting with recent onset of symptoms listed below in **Box 3.4**

Weakness, easy fatigability
Breathlessness
Anorexia, refusal of feeds and unexplained weight loss
Acute Confusional state
Avoidance of social contact and social isolation
Incontinence
Immobility
Falls and
Exacerbation or worsening of underlying comorbidity such as diabetes, cardiac failure, etc

Box 3.4 : Clinical presentation of infection in the elderly

Physical signs in older patients often are not diagnostic. Presence of multiple diseases causes additional problem in assigning significance to a physical sign. The laboratory manifestation of infection may also be subtle. Leucocytosis may be absent; and anaemia may be the only evidence of infection. Radiological features of tuberculosis in old age tend to be non-specific and widespread when compared to typical upper lobe fibro cavitary lesion in younger subjects. Higher risk of complications, slow resolution, and higher risk of death are the hallmarks of infectious disease in old age.

"Always remember to include infection in the differential diagnosis of ill-defined constellation of symptoms and signs in older people".

Points to Ponder

Why is it difficult to treat elderly ?

Answer

Symptoms and physical signs of infections are atypical in older people

Check Your Progress 2

1. How will you define fever in frail older people?

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2. Describe the atypical presentations/ symptoms of infection in older people?

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3.5 PRINCIPLES OF ANTIBIOTIC THERAPY

Age related changes in the organs and comorbidities alter the absorption, distribution, metabolism, and elimination of antibiotics in the elderly. The pharmacokinetic issues that have to be considered while prescribing antimicrobials are shown in **Table 3.2.**

Table 3.2 : Age related changes in the pharmacokinetics of drugs

Pharmacokinetics	Age related change	Effect
Absorption	↓ in gastric Ph ↓ in gastric motility ↓ in splanchnic blood flow ↓ in small bowel surface area	↓ or delayed absorption of orally absorbed drugs
Metabolism	↓ in hepatic flow ↓ in enzyme function	↓ metabolism of drugs cleared by liver ↑ halflife of drugs metabolised by liver
Distribution	↓ lean body mass ↑ in central adiposity ↓ total body water	↑ concentration of water -soluble drugs ↑ Halflife of lipid soluble drugs
Elimination	↓ Glomerular filtration rate	↑ Half-life of drugs cleared by kidneys

Older people usually take multiple medications and hence they are prone to develop adverse drug events. The adverse effects of the antimicrobials commonly used in the elderly are given in **Table 3.3.**

Table 3.3 : Adverse effects of Antimicrobial agents

Antimicrobial agent	Adverse effects
Azithromycin	Abdominal pain, diarrhoea, nausea, vomiting, vaginitis
Clarithromycin	Abdominal pain, diarrhoea, nausea, vomiting, CNS toxicity
Erythromycin	Diarrhoea, hepatotoxicity, QT prolongation, ototoxicity
Fluroquinolones	Peripheral neuropathy, tendon rupture, QT prolongation, CNS toxicity
Sulphonamides	Rash, Steven- Johnson syndrome, GI toxicity, bone marrow suppression
Tetracyclines	Photosensitivity, GI toxicity, CNS toxicity
Beta lactam antibiotics	Rash, hypersensitivity, CNS toxicity, bone marro suppression
Aminoglycosides	Nephrotoxicity
Isoniazid	Peripheral neuropathy
Rifampicin	Hepatotoxicity
Pyrazinamide	Hepatotoxicity, joint pain
Fluconazole	Hepatotoxicity
Acyclovir	Nephrotoxicity, CNS toxicity

As older people have multiple comorbidities, they take multiple medications at a time. This is called polypharmacy. Polypharmacy makes them prone for Drug-Drug and Drug-Disease interactions. The common drug – drug interactions involving the antimicrobials and other drugs used in elderly are given in the **Table 3.4.**

Table 3.4 : Drug-Drug interactions of Antimicrobials

Antimicrobial	Interacting drugs	Adverse events
Azithromycin	Antacids Digoxin	↑ peak concentration ↑ concentration of digoxin
Erythromycin	Oral anticoagulant Carbamazepine Digoxin HMG COA reductase inhibitors	↑ risk of bleeding ↑ carbamazepine toxicity ↑ digoxin toxicity ↑ risk of rhabdomyolysis
Fluroquinolones	Antacids Oral anticoagulants	↓ fluroquinolone effect ↑ prothrombin time
Metronidazole	Oral anticoagulants	↑ risk of bleeding
Nitrofurantoin	Fluroquinolone	↓ effect of nitrofurantoin
Cephalosporins	Aminoglycosides Furosemide	↑ nephrotoxicity ↑ nephrotoxicity
Vancomycin	Aminoglycosides	↑ nephrotoxicity and ototoxicity
Sulphonamides	Anti-diabetics	↑ risk of hypoglycemia
Linezolid	Selective serotonin reuptake inhibitors	↑ risk of serotonin syndrome
Acyclovir	Aminoglycosides	↑ nephrotoxicity
Fluconazole	Sulfonylureas Thiazides	↑ risk of hypoglycemia ↑ concentration of fluconazole

We have to adjust the antimicrobial dose in renal and hepatic impairment. Whenever a new drug is started in the elderly, we follow the" start low, go slow" rule. But this is not applicable while treating infections in older people. Early and aggressive antibiotic therapy is essential to prevent adverse outcomes. Antibiotics should be started early for all presumed infections. Once samples for microbiological investigations are sent, to avoid complications and mortality from delay in treatment, antibiotics should be started even before the results of investigations are available. Rapid administration of first dose of antibiotic in severe infections such as sepsis, pneumonia, and meningitis is essential. Initial therapy may be empirical. It is always advisable to start with broad-spectrum antimicrobial agent, which covers all possible organisms responsible for that condition. Specific narrow spectrum antibiotic should be instituted, only after obtaining a definitive microbiological diagnosis. In order to avoid inconsistency in absorption of oral drug administration, injectable antibiotics should be preferred for all serious infections. However, the duration of parenteral antibiotic should be short, and oral antibiotic should

Points to Ponder

Will you apply the rule of "Start Low, Go Slow" while treating infections in the elderly?

Answer

No. Early and aggressive treatment with antibiotics is warranted

be started early, to facilitate early mobilization and to avoid prolonged hospital stay.

When evaluating a patient with infection,

- The 1st step is identifying the site of infection and the most likely organism causing the infection.
- The 2nd step is assessing the severity of infection. The severity of infection influences the choice of antibiotic, dose, and route of administration.
- In general, parenteral administration of an empirical broad-spectrum antibiotic is preferred for severe infections.
- We must consider the pharmacokinetic changes and interactions in older people while starting antibiotics for them.
- Once the culture reports arrive, we must switch over to an antibiotic to which the identified pathogen is susceptible.

The suggested empirical antimicrobial agents for the treatment of common infections in older adults are given in **Table 3.5.**

Table 3.5 : Empirical antimicrobials for infections

Infection	Source	Place of therapy	Antimicrobial of choice
Acute Sinusitis	Community Acquired	Outpatient	Amoxycillin
Acute Bronchitis	Community Acquired	Outpatient	Amoxycillin-Clavulanate
Diarrhoea	Community Acquired	Outpatient	Fluroquinolone + ORS
UTI	Community Acquired	Outpatient	Fluroquinolone or Trimethoprim- Sulfoxazole
Cellulitis	Community Acquired	Outpatient	Amoxycillin-Clavulanate or Cephalexin
Pneumonia	Community Acquired	Inpatient	(Ceftriaxone + Azithromycin) or Respiratory fluroquinolone
Pyelonephritis	Community Acquired	Inpatient	3rd generation cephalosporin or Fluroquinolone
Intra-abdominal infection	Community Acquired	Inpatient	(Ampicillin+Gentamycin+Metronidazole) or Piperacillin- Tazobactam or Carbapenem
Acute bacterial meningitis	Community Acquired	Inpatient	Ceftriaxone + Vancomycin + Ampicillin
Native valve Infective endocarditis	Community Acquired	Inpatient	Penicillin + Nafcillin
Diabetic foot	Community Acquired	Inpatient	Piperacillin-Tazobactam or Ticarcillin-Clavulanate
Cellulitis	Community Acquired	Inpatient	Ampicillin-Sulbactam
Septic shock syndrome	Community Acquired	Inpatient	Carbapenem
Pneumonia	Hospital Acquired	Inpatient	Cefepime or Carbapenem or Piperacillin-Tazobactam
Catheter associated urosepsis	Hospital Acquired	Inpatient	Vancomycin + 3rd generation cephalosporin or Fluroquinolone
IV Line infection	Hospital Acquired	Inpatient	Vancomycin
Post-operative wound infections	Hospital Acquired	Inpatient	Vancomycin + 3rd generation cephalosporin

Colonisation without infection commonly occurs in older people, especially, skin and nasal colonisation and asymptomatic bacteriuria. Only those with symptoms and those who undergo surgical procedure should receive treatment. Asymptomatic colonisation should not be treated. It will lead to unnecessary use of antibiotics and antibiotic resistance. Swab cultures of pressure ulcers, and urine culture in those with indwelling catheter, are always positive and the results do not correlate with the clinically relevant cultures such as bone biopsy under a pressure ulcer and blood culture in those with indwelling catheter. Unnecessary Swab cultures of pressure ulcers, and urine culture in those with indwelling catheter, should be avoided. This will reduce the unnecessary use of antibiotic and antibiotic resistance.

Did You Know?

Colonisation without infection occurs in the skin, nasal cavity and urinary tract in the elderly and should not be treated with antibiotics

Multidrug resistant organisms

Older adults are at a higher risk of acquiring multi drug resistant organism than the younger people. The reasons are given in **Box 3.5**.

Residing in a long-term care facility, nursing home
Comorbidities such as diabetes, COPD, renal failure
Prolonged indwelling urinary catheters Intravascular devices
Recent hospitalisation
Recent antibiotic administration
Recent colonisation with multidrug resistant organism

Box 3.5 : Risk factors for acquiring MDR organisms in the elderly

The common multi drug resistant organisms include

- Methicillin resistant staphylococcus aureus (MRSA)
- Pseudomonas aeruginosa
- Antibiotic resistant Enterobacteriaceae
    1. Extended spectrum beta - lactamase positive strains (ESBL)
    2. Carbapenem resistant strains
- Acinetobacter spp

The clinician should consider the likelihood of antimicrobial resistance while treating the elderly with infections, especially in the acute care and long-term care setups. Hospitals and laboratories should provide the data on local susceptibility profile of common pathogens to the clinician. When we suspect an antimicrobial resistant pathogen, before the culture reports arrive, we should start the patient on combination therapy on empirical basis. Usually, combination therapy provides additive or synergistic effect, but the possibility of toxicity and cost are high. Once the culture reports are available, we should narrow down to the susceptible antimicrobial.

Think and Reflect

What is the commonest cause of FUO in elderly?

Check Your Progress 3

1. Enumerate any five drug-drug interactions between antimicrobial and other drugs in older people

Antimicrobial	Other drugs	Effect

2. Will you treat asymptomatic bacteriuria? Why?

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3.6 MANAGEMENT OF INFECTIOUS SYNDROME

Management of infectious syndrome includes the management of fever of unknown origin and treatment for the bacteremia and sepsis.

3.6.1 Fever of unknown origin

Fever of unknown origin is defined as fever of 101°F for at least 3 weeks, and fever which remains undiagnosed after 1 week of medical evaluation. The causes of FUO in older people are different from those of the younger making the diagnostic workup different in them. Around 35% of the FUO are due to infections. Among the infections, intra-abdominal abscess, infective endocarditis and tuberculosis are the common underlying causes. In contrast to younger people, older people, next to infections have connective tissue disorders as a frequent cause of FUO. Of the connective tissue disorders, temporal arteritis is the common cause of FUO in older people. Malignancy is seen in 20% cases of FUO in the elderly. Haematological malignancies and solid tumours can present as FUO in the elderly. In around 10% cases, no cause can be found even after a detailed evaluation. The evaluation of FUO in the elderly is based on the above causes. A thorough history, physical examination, basic blood investigations such as complete blood count, ESR, renal and liver function tests, thyroid function test, chest X ray, blood and urine culture should be done in all older patients with FUO. If the source remains obscure, do a CT or MRI abdomen to rule out abdominal abscess. Specific investigations to diagnose the cause have to be done accordingly.

3.6.2 Bacteremia and Sepsis

Among the elderly, bacteremia is common and it carries a poor prognosis. Usually, it arises from the gastrointestinal or genitourinary source. So, the causative organism is mainly a gram-negative rod. The usual clinical presentation of sepsis such as fever chills or diaphoresis are absent. The initial management consists of broad coverage of microbials. It is necessary to cover MRSA, Gram negative rods, enterococci and other resistant organisms. Mortality is greatly reduced if the initial antibiotic covers the organism that is isolated.

3.7 IMMUNISATION IN THE ELDERLY

Despite the reduced response to vaccination in older people, the risk of infections, associated complications and mortality are lower in those who are vaccinated than among those who are unvaccinated.

Points to Ponder

Why is vaccination advocated in older people?

Answer

Though the response to vaccination is reduced in older people, it reduces the infection associated complications and mortality. So, vaccination is advocated in older people

Pneumococcal vaccine

Pneumococcal vaccine is recommended for older people aged 65 and above and patients under the age of 65 with comorbidities. Two types of vaccines are available

1. 23 valent polysaccharide vaccine (PPSV23)
2. 13 valent pneumococcal conjugate vaccine (PCV13)

Advisory committee on immunisation practices' recommendations for pneumococcal vaccination is given in **Box 3.6.**

1. For Pneumococcal vaccine naïve persons aged 65 and above - PCV13 followed by PPSV23, 6 to 12 months later
2. For Persons who have received PPSV23 first at the age of 65 and above – Give PCV13, 1 year later
3. For Persons who have received PPSV23 before the age of 65 and who are now 65 - Give PCV13. There should be at least 1-year duration from the 1st dose of PPSV23. Then give PPSV23, 6 TO 12 months later. There should be a minimum interval of 5 years between the two doses of PPSV23.

Box 3.6 : ACIP Recommendations for pneumococcal vaccination in the elderly

Influenza Vaccine

Influenza vaccination reduces the respiratory illness, hospitalisation and mortality in older people. Three vaccines are available. Influenza vaccine contains killed influenza virus with the efficacy rate of 60% for illness and 50- 60 %for mortality.

1. Trivalent inactivated vaccine (IIV3) – Contains components of H1N1, H3N2 and B strains
2. Quadrivalent inactivated vaccine (IIV4)- Contains an additional Strain in addition to the above strains
3. High dose influenza vaccine – (IIV3-HD)

ACIP recommends Influenza vaccination annually for older people prior to the influenza season. High dose influenza vaccine is shown to be more effective in older people than the standard dose vaccine.

Herpes Zoster vaccine

Herpes zoster infection reactivation and post herpetic neuralgia are common in older people. Zoster vaccine reduces the risk of infection by 50% and post herpetic neuralgia by 60%. ACIP recommends Zoster vaccine for all above 60 years of age.

Tetanus, Diphtheria and Pertussis vaccine

Older people are associated with the sub protective levels of tetanus antibody. For those who have received less than three doses of tetanus immunisation or those who

are uncertain about the tetanus immunisation should receive a complete vaccine series. A booster dose at 10-year interval, or more frequently with injuries is advised.

Pertussis protection wanes with age. All adults including those who are aged 65 and above should receive an acellular pertussis formulation. This can be given as TdaP during the scheduled tetanus booster.

Check Your Progress 4

1. A 76 old male, a known DM, CAD pt presented with H/o breathlessness on exertion, and fever for the past 4 days. Subsequently, he developed loss of appetite and he refused feeds. His family has brought him to you for abnormal behaviour and incontinence for the past 1 day. Clinical examination revealed tachypnea, dehydration, disoriented, PR-102, RR-25, BP- 130/80, RS- Diminished air entry, and crepitations in the Rt base. What is your diagnosis and the management strategy?

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2. You are sitting in your outpatient clinic. A 67-year-old female, a known HT, Asthmatic comes to your clinic and wants to have a pneumococcal vaccine. What enquires will you make and what advice will you give?

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3.8 LET US SUM UP

You have learnt that older adults are at increased risk of infections, because of the presence of waning immunity, multiple comorbid illnesses, functional limitations and frailty. Older people with infections frequently present in an atypical fashion**.** Colonisation without infection occurs in older people. Asymptomatic colonisation should not be treated.

You have learnt that specific infectious syndromes are severe in older people, and you have also learnt about the principles of antibiotic therapy in the elderly. Early, aggressive antibiotic therapy is essential to prevent adverse outcomes.

You have also learnt that the response to vaccination is poor in older people. Despite that, the risk of infection, associated complications and mortality, are rather lower in those who are vaccinated than in those who are unvaccinated.

3.9 GLOSSARY

MDR organisms	Multi Drug Resistant organisms
FUO	Fever of Unknown Origin

Bacteremia	Presence of bacteria in the blood stream
Sepsis	Life threatening organ dysfunction caused by a dysregulated host response to infection

3.10 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

1.

Organ	Age related changes	Effect
Skin	Epidermal and dermal atrophy leading to breach in skin integrity	Skin and soft tissue infections
Pharynx	Impaired cough reflex Abnormal swallowing mechanism	Aspiration
Ureters	Inadequate peristalsis and incompetent vesicoureteral reflex	Reflux and ascending infection
Bladder	Impaired emptying capacity and defective surface mucin	Reflux and ascending infection
Hormonal	Loss of effect of estrogen on mucosa changes	Urinary tract infection in and change in colonising flora women

2. Malnutrition is associated with
   - Delayed wound healing
   - Formation of pressure ulcers
   - Increased risk of nosocomial infections
   - Increased length of hospital stay
   - Increased mortality
   - Poor response to vaccine

Check Your Progress 2

1. Frail older people have lower mean basal temperature than the accepted normal basal temperature. The accepted normal basal temperature is 98.6^{o}F(37^{O}C). Fever in frail older adults is defined as
   - A single oral temperature greater than 100^{o}F (>37.8^{o}C)or
   - Repeated oral temperatures greater than 99^{o}F (>37.2^{o} C) or
   - Repeated rectal temperatures greater than 99.5^{o}F (>37.5^{o}C) or
   - Increase in temperature of greater than 2^{o}F (>1.1^{o}C)over baseline temperature.
2. The atypical presentations of infections in elderly are
   - Weakness, easy fatigability
   - Anorexia, refusal of feeds and unexplained weight loss
   - Acute Confusional state

- Avoidance of social contact and social isolation
- Incontinence
- Immobility
- Falls and
- Exacerbation or worsening of underlying comorbidity such as diabetes, cardiac failure, etc

Check Your Progress 3

1.

Antimicrobial	Other drugs	Effect
Metronidazole	Oral anticoagulants	↑ risk of bleeding
Nitrofurantoin	Fluroquinolone	↓ effect of nitrofurantoin
Vancomycin	Aminoglycosides	↑ nephrotoxicity and ototoxicity
Sulphonamides	Anti-diabetics	↑ risk of hypoglycemia
Linezolid	Selective serotonin reuptake inhibitors	↑ risk of serotonin syndrome

2. No, I will not treat asymptomatic bacteriuria. Unnecessary antimicrobial use causes drug resistance

Check Your Progress 4

1. The most likely diagnosis is community acquired pneumonia with DM, CAD
   - The patient must be hospitalized

Investigations

- Do a complete hemogram (Hb, TLC, DLC, ESR)
- Blood chemistry(Blood Sugar, Blood Urea, Serum Creatinine, Serum Sodium, Serum Potassium, Liver function test)
- Blood culture
- Sputum Gram stain and culture
- Arterial blood gas analysis
- Chest x-ray PA view

Treatment

- Nasal O_2
- IV Fluids
- Ceftriaxone + Azithromycin as empiric antibiotics since we are suspecting community acquired pneumonia

- Consider insulin for diabetes management as the patient is sick
- Continue drugs for CAD
- Initially try nonpharmacological management for delirium
- Back care
- Bowel and Bladder care
- Close monitoring for complications

2. Ask about the vaccination status of the patient. The advice will be
    1. If she has not received Pneumococcal vaccine so far - PCV13 followed by PPSV23, 6 to12 months later
    2. If she has received PPSV23 first at the age of 65 and above – PCV13, 1 year later
    3. If she has received PPSV23 before the age of 65 - PCV13 and then PPSV23, 6 to 12 months later and a minimum interval of 5 years has to be maintained between the two doses of PPSV23.

3.11 REFERENCES AND FURTHER READINGS

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